



**CALIFORNIA  
ENERGY COMMISSION**



Clean Transportation Program

## **FINAL PROJECT REPORT**

# **Takecharge II**

## **Infrastructure Roadmap**

**Prepared for: California Energy Commission**

**Prepared by: Sacramento Area Council of Governments**

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# California Energy Commission

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- Sacramento Municipal Utility District
- Sacramento Metropolitan Air Quality Management District
- Valley Vision
- Greenwise Joint Venture
- SacEV
- Sacramento Clean Cities
- University of California, Davis, Plug-In Hybrid and Electric Vehicle Research Center

# PREFACE

Assembly Bill 118 (Núñez, Chapter 750, Statutes of 2007) created the Clean Transportation Program. The statute authorizes the California Energy Commission (CEC) to develop and deploy alternative and renewable fuels and advanced transportation technologies to help attain the state's climate change policies. Assembly Bill 8 (Perea, Chapter 401, Statutes of 2013) reauthorizes the Clean Transportation Program through January 1, 2024, and specifies that the CEC 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 about \$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 nonroad 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 CEC's annual Clean Transportation Program Investment Plan Update. The CEC issued PON-10-602 to provide funding opportunities under the Clean Transportation Program to help regions develop plug-in electric vehicle strategic plans for electric vehicle supply equipment, establish best practices for "PEV-ready" building and public works guidelines, and to help streamline electric vehicle supply equipment permitting, installation, and inspection processes. In response to PON-10-602, the recipient submitted an application which was proposed for funding in the CEC's notice of proposed awards September 26, 2011 and the agreement was executed as ARV-11-009 on March 16, 2012.

# ABSTRACT

The purpose of this report is to bring together Capital Area stakeholders to address the roll out of plug-in electric vehicles in a coherent, cohesive manner that promotes wise planning with a consumer-friendly focus. To achieve this, the Capital Area plug-in electric vehicles Coordinating Council – a gathering of industry leaders and interested parties from around the region – will:

- Establish tailored guidelines that civic planners can use to establish consistent plug-in electric vehicle readiness building codes, permitting requirements and inspection processes to expedite charging infrastructure installations in the Sacramento Region;
- Develop guidelines for consistent outreach, message, and education to consumers;
- Plan for public infrastructure deployment that benefits individual motorists and promotes fleet adoption of plug-in electric vehicles; and
- Identify training opportunities that meet basic emergency responder needs.

This report, the end product of this collaborative effort, details the recommended actions for the Capital Area’s preparation for the growth of plug-in electric vehicles. This was accomplished by: working closely with the Capital Area Plug-in Electric Vehicle Coordinating Council on informing the region on plug-in electric vehicles infrastructure and readiness elements; working one-on-one with planners on creating and implementing various aspects of plug-in electric vehicles readiness at the local level; and creating a regional electric vehicle charging infrastructure plan to serve existing and future plug-in electric vehicles most efficiently.

The report outlines how the approximately 75,000 plug-in electric vehicles forecasted for our region by 2025 will travel, and how best to provide charging opportunities for those vehicles, and vehicles passing through the region to outside destinations. Several key actions are recommended at the local and regional level, to better prepare our region for plug-in electric vehicles. This includes: streamlining the residential and commercial electric vehicle charging station permit process, conducting consistent outreach and education at every level around the Capital Area, providing training opportunities for first responders and local building officials, pricing policies, and interoperability between plug-in electric vehicles and other modes of transportation.

**Keywords:** Sacramento Area Council of Governments, plug-in electric vehicle readiness, PEV readiness plan, plug-in electric vehicles infrastructure

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# TABLE OF CONTENTS

	Page
Acknowledgements .....	i
Preface.....	ii
Abstract .....	iii
Table of Contents.....	v
List of Figures .....	vii
List of Tables .....	vii
Executive Summary.....	1
Plug-in Electric Vehicle Market Forecasts.....	2
Regional Travel Behavior .....	2
Charging Demand .....	2
Land Use Analysis .....	3
Plug-in Electric Vehicle Readiness.....	3
CHAPTER 1: Introduction .....	5
Why is a PEV Plan Needed in the Sacramento Region? .....	5
Emerging Market.....	5
Federal and State Goals.....	5
Regional PEV Planning.....	6
Why SACOG.....	7
SACOG’s Approach to Regional PEV Planning .....	7
California’s Executive Order.....	7
Assembly Bill 32 .....	8
Senate Bill 375 .....	9
PEV 101.....	9
The Sacramento Region.....	11
El Dorado County .....	11
Placer County.....	11
Sacramento County .....	11
Sutter County.....	12
Yolo County .....	12
Yuba County .....	12
CHAPTER 2: Infrastructure Plan .....	14
Map of Existing EVSE.....	14
Summary of Plug-In Electric Vehicle Survey: Choosing Among PEV, Conventional Automobile and Transit .....	15
Introduction .....	15
Results .....	15
Analysis .....	17
Getting to One Million: Electric Vehicles in the Marketplace.....	17
Introduction .....	17

Are 1 Million PEVs Possible? .....	18
Conclusions.....	19
Site Analyses .....	19
Destination Analysis.....	20
Results .....	20
Summary .....	21
Sites by Jurisdiction .....	22
Scenario Process .....	22
Metrics .....	25
Why Metrics Are Needed.....	25
Measuring the Scenarios .....	25
What, Why, and How.....	25
Greenhouse Gas Emissions Reductions .....	28
Funding Sources for Electric Vehicle Supply Equipment.....	29
Current, Real Programs.....	29
Feasible, Speculative Programs .....	30
CHAPTER 3: Readiness Plan .....	32
PEV Readiness .....	32
Residential Charging.....	32
Single-Family Residential EVSE Permit Streamlining .....	33
Public Charging .....	34
TakeCharge Jurisdiction Meetings, December 2012 – January 2013.....	35
Findings.....	35
Questions Remain .....	35
Plug-in Electric Vehicle Emergency and First Responder FAQ.....	35
CHAPTER 4: Action Plan .....	39
Residential Integration .....	39
Single Family Home EVSE Deployment.....	39
Policies .....	41
Workplace Integration .....	42
Workplace Charging Policies.....	46
Workplace Charging Surveys.....	47
Fleet Integration .....	48
On-Peak Charging Mitigation .....	49
Outreach .....	52
Snapshot of Public Awareness of PEVs.....	52
Changes Between 2012 and 2013.....	52
SacEV’s Goals for Increasing Public Awareness.....	53
Building Public Awareness Through Events.....	53
Building Awareness Through Social Media.....	55
Building Public Awareness at the Workplace.....	55
TakeCharge Web Resources and Meetings .....	56
Continued Outreach.....	57
Glossary .....	59



# LIST OF FIGURES

	Page
Figure 1: Calculation Used in Efficiency Analysis.....	28
Figure 2: Typical Plug-In Day Event .....	54
Figure 3: YouTube Interview – Electric Vehicles in the Sacramento Region .....	55
Figure 4: Post-drive Testimonials .....	56

# LIST OF TABLES

	Page
Table 1: Scoping Plan Emission Reductions.....	8
Table 2: Clean Vehicle Rebates in Sacramento Region.....	14
Table 3: Outline of Two Avenues of Analysis.....	22
Table 4: Scenarios Showing Percentage of Charging Instances by Setting in 2025 .....	22
Table 5: Scenarios Showing Quantities of Charging Instances by Setting in 2025 .....	24
Table 6: Preferred Scenarios Showing Numbers of Charging Instances by Setting in 2025.....	25
Table 7: Assumptions of Electricity Consumption and Range Rates.....	26
Table 8: Charging Times and Kilowatt-Hours Consumed .....	26
Table 9: EVSE Public Costs Forecast.....	27
Table 10: 2025 Light Duty Automobile Fleet Projection.....	29
Table 11: Electricity Time of Use Rates in SACOG Region .....	30
Table 12: Single-Family Residential Recommendations .....	39
Table 13: Multi-Family Residential Recommendations .....	41
Table 14: Workplace Charging Recommendations .....	46
Table 15: On-Peak Charging Recommendations .....	50
Table 16: PEV Use Recommendations .....	51
Table 17: PEV Support Recommendations .....	58



# EXECUTIVE SUMMARY

Increasingly, residents of the six-county Sacramento region (the counties of El Dorado, Placer, Sacramento, Sutter, Yolo, Yuba) rely on plug-in electric vehicles to travel around the region to commute, run errands, and visit family and friends. With over 1,200 PEVs in the region as of 2013, these vehicles are becoming a more common sight as they join the ranks of Sacramento's regional transportation network. Improved battery technology, increased vehicle make and model choices, state incentives, expensive gasoline costs, and concerns over climate change and energy security continue to stimulate this growing market.

PEVs are paramount to California's long term sustainable transportation and air quality strategies. They have the potential to reduce petroleum consumption, increase energy independence, and minimize greenhouse gas emissions. However, successful electrification of California's automobile fleet will depend on a widespread network of charging stations as well as supportive policies, zoning, and codes. Across the state, communities are beginning to take important actions to plan and accommodate the growing fleet of plug-in electric vehicles.

The TakeCharge Coordinating Council is assisting this transition. The TakeCharge Coordinating Council is a coalition of the region's agencies leading the charge for plug-in electric vehicles and their charging infrastructure. Partners include:

- Sacramento Area Council of Governments
- Valley Vision
- Greenwise Joint Venture
- Sacramento Metropolitan Air Quality Management District
- Sacramento Municipal Utilities District (SMUD)

In addition to the partners, a variety of stakeholders from the automobile, local government, plug-in electric vehicle driver association, public health, workforce development and training agencies, and environmental industries participate in the Coordinating Council. Together, the TakeCharge Coordinating Council is providing guidance to regional cities and counties in becoming plug in electric vehicle-ready in an ever changing legal, regulatory, and economic environment. With funding from the California Energy Commission and SMUD, TakeCharge is releasing a series of reports that relate to PEV readiness, infrastructure, and implementation.

In 2012, TakeCharge partners released *TakeCharge I: A First Step to PEV Readiness in the Sacramento Region* to begin preparing the Sacramento region for broad PEV adoption. The first plan outlined five core elements of plug-in electric vehicle readiness including: streamlined permitting and inspection processes, training and education programs, updated building codes, updated zoning and parking policies, and outreach to various audiences.

This document, *TakeCharge II: Infrastructure Roadmap (The Plan)*, represents the results of rigorous research, planning and analysis conducted to help the Sacramento region reduce miles driven and convert the remaining miles to electric. It begins to set a plan for the physical infrastructure that local governments will need to install to support widespread adoption of PEVs. The purpose of *The Plan* is to develop an efficient charging network that meets the current and future demands for electric vehicle adoption by suggesting charging in locations

that minimize the need to drive and monitor the placement of charging opportunities over time. This approach to deploying plug in electric vehicle infrastructure complements Sacramento Area Council of Governments' 2035 Metropolitan Transportation Plan/ Sustainable Communities Strategy.

The Plan considers five main components related to plug-in electric vehicle charging:

1. **PEV Market Forecasts:** The estimated number of plug-in electric vehicles in the region now and in the future.
2. **Regional Travel Behavior:** Current and forecasted regional driving patterns.
3. **Charging Demand:** Generated demand for charging throughout the region.
4. **Land Use Analysis:** Land uses suitable for hosting electric vehicle supply equipment.
5. **PEV-Readiness:** The region's jurisdictions and partner agencies that are plug-in electric vehicle-ready.

## **Plug-in Electric Vehicle Market Forecasts**

The Plan works to support Governor Brown's order on zero-emission vehicles, and therefore forecasts plug-in electric vehicle market growth for the region to be approximately 75,000 new vehicles by the year 2025. This is based on the region's share of California's forecasted population in 2025. This growth is similar to hybrid car sales today, which are roughly 3.4 percent of all automobile sales.

To support this forecast, Sacramento Area Council of Governments conducted an analysis of different variables and determined it was indeed feasible to have 75,000 electric vehicles in the region by 2025. This is discussed in more detail in a later section of The Plan.

All figures discussed within this summary are available within the document *TakeCharge II: Infrastructure Roadmap* (The Plan). The Plan shows the percentage of PEV sales is estimated to surpass 3 percent of the market.

## **Regional Travel Behavior**

To understand current and future demands for electric vehicle charging, Sacramento Area Council of Governments needed to understand the existing and forecasted travel in the region. For this, the PEV plan uses 2008 travel behavior and forecasted 2020 and 2035 travel from the adopted MTP/ Sustainable Communities Strategy. These data show distance, mode of transportation, and final destinations for regional travel. Results show that plug-in electric vehicles can meet the driving demand for the average trip in the region. The Plan shows average daily miles will continue to drop below the range provided from a one-hour charge from a Level 2 charger.

## **Charging Demand**

The travel behavior data are used to determine how much charging is required and to help pinpoint the best locations for chargers. Combined with demographic data describing populations most likely to be early adopters of electric vehicles, the data show the landscape for current and future charging demand. The report finds that forecasted travel behavior through the year 2025 in the region has most charging taking place at home with some workplace and public charging needed to meet excess demand. The Plan shows most charging will take place at home in 2025.

## **Land Use Analysis**

To best utilize the capital needed to implement a regional electric vehicle charging plan, Sacramento Area Council of Governments conducted an analysis looking at the best locations to place chargers. This analysis, described in detail in a later section, looked at where those who were more likely to drive an electric vehicle would drive. Based on the land use of the destination, different levels of charging were applied. For example, slower Level 1 and Level 2 chargers were modeled in locations where potential plug-in electric vehicle drivers were spending more time (work), and direct current Fast Chargers were modeled in the places where they would be for only 60 minutes or less (coffee shops). In addition, direct current Fast chargers were placed in areas with higher traffic, as well as in locations that could serve multiple purposes (work, public, multi-family, etc.).

This analysis creates an efficient infrastructure plan that balances providing sufficient infrastructure such that electric vehicle drivers would not wait for chargers, and a network of chargers would not be left underutilized. *TakeCharge II* attempts to do this while finding ways to shorten the vehicle trips that might be needed to find available charging.

## **Plug-in Electric Vehicle Readiness**

In order for the pieces of the electric vehicle charging plan to be implemented, the region needs to look at becoming more ready for an increase in electric vehicles. *The Plan* outlines several PEV readiness elements that are key to help facilitate the transition to more electric vehicle drivers. These include:

- Making the process for getting a permit to install a charger easy.
- Planning to include charging infrastructure in future development.
- Conducting outreach and education to consumers.
- Providing training for local officials and emergency responders.
- Considering ways to provide charging opportunities for people who live in multi-family dwelling units.
- Looking at ways to efficiently provide workplace charging.
- Including electric vehicles in local fleets.

Addressing these elements will help our region be ready for an increase in electric vehicles. *TakeCharge III*, the next installment of the TakeCharge report series, will lay out a plan to build off local jurisdiction's plug-in electric vehicle readiness to implement the physical infrastructure plan.



# CHAPTER 1:

## Introduction

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### Why is a PEV Plan Needed in the Sacramento Region?

#### Emerging Market

The Sacramento region is an emerging market for plug-in electric vehicles (PEVs). Recent estimates indicate that more than 1,100 rebates for electric vehicles have been issued by the California Clean Vehicle Rebate Program (CVRP) to residents in the region as of November 2013, and more than 300 chargers exist along the region's transportation networks to fuel these vehicles with more chargers being planned. National trends show an increase in month-over-month PEV sales, with an average increase of 3 percent over the past 12 months<sup>1</sup>. The region over the same time frame has seen on average a 4 percent increase in month-over-month PEV sales<sup>2</sup>, which indicates that more and more PEVs will be on the region's roads in coming years.

This increase is happening for several reasons. The conditions for driving an electric vehicle in the Sacramento region are ideal. Relatively flat roads, warm weather, and short commutes mean drivers can attain high mileage on a single charge. At the same time, more information is available to the public on the reduced costs to operate a PEV, and Sacramento region residents are taking advantage of the federal and state financial incentives to lower the cost of owning or leasing a PEV. Furthermore, there is a wide variety of electric vehicle model choices with more makes and models being announced almost every quarter.

#### Federal and State Goals

These federal and state financial incentives are part of larger policies to reduce greenhouse gas emissions (GHG) and our nation's reliance on foreign oil. Both President Obama and California Governor Brown have issued orders calling for increased adoption of PEVs.

The President issued an order in the 2011 State of the Union address calling for 1 million electric vehicles on the nation's roads by 2015. Through tax incentives, research and development, and competitive grants to support implementation of necessary PEV infrastructure, the President created policies to help attain this goal. Prior to setting this goal, auto manufacturers were already investing in researching and developing electric vehicles<sup>3</sup>. In the years since the State of the Union address, more PEVs have entered the marketplace, and

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<sup>1</sup> National sales information was taken from the [Hybrid Cars Market Dashboard](https://www.hybridcars.com/market-dashboard/) that outlines monthly sales of alternative fuel vehicles (<https://www.hybridcars.com/market-dashboard/>)

<sup>2</sup> California rebate information was taken from the [California Clean Vehicle Rebate Program](https://cleanvehiclerebate.org/eng/rebate-statistics) (<https://cleanvehiclerebate.org/eng/rebate-statistics>)

<sup>3</sup> The U.S. Department of Energy conducted an analysis of the current state of PEVs and how the nation can reach the goal of [1 million electric vehicles by 2015](https://www1.eere.energy.gov/vehiclesandfuels/pdfs/1_million_electric_vehicles_rpt.pdf) ([https://www1.eere.energy.gov/vehiclesandfuels/pdfs/1\\_million\\_electric\\_vehicles\\_rpt.pdf](https://www1.eere.energy.gov/vehiclesandfuels/pdfs/1_million_electric_vehicles_rpt.pdf))

sales continue to climb. The PEV Readiness Plan in the Sacramento region will help further the nation's goals.

In 2012, California Governor Jerry Brown issued Executive Order B-16-2012 calling for 1.5 million zero-emission vehicles (ZEVs) in the state by 2015. PEVs will play a large role in helping to achieve that goal, which is an implementation measure of the state's 2006 Global Warming Solutions Act, Assembly Bill 32 (Nunez, Chapter 488, Statutes of 2006). The bill aims to reduce GHG emissions to 1990 levels by the year 2020. While many factors influence GHG emissions in the transportation sector (including vehicle miles of travel, fuel efficiency, congestion, and carbon levels in the fuel, to name a few), emissions from the tailpipes of cars is one of the biggest contributors. An increased number of PEVs on the region's roads would go a long way to reduce GHG emissions.

To help achieve the federal and state goals related to PEVs, SACOG began the PEV Readiness Plan (PEV Plan) to prepare the six-county Sacramento region for an increased number of PEVs. The goal of the PEV Plan is to create a regional approach to PEV readiness, through a coordinated effort between all interested parties. The PEV Plan will move the region toward the goals set by the President and Governor and the region's own goals.

## Regional PEV Planning

In 2012, TakeCharge partners released *TakeCharge I: A First Step to PEV Readiness in the Sacramento Region* to begin preparing the Sacramento region for broad PEV adoption. The first plan outlined five core elements of PEV readiness including: streamlined permitting and inspection processes, training and education programs, updated building codes, updated zoning and parking policies, and outreach to various audiences.

This document, *TakeCharge II: Infrastructure Roadmap (The Plan)*<sup>4</sup>, represents the results of rigorous research, planning and analysis conducted to help the Sacramento region reduce miles driven and convert the remaining miles to electric. It begins to set a plan for the physical infrastructure that local governments will need to install to support widespread adoption of PEVs. The purpose of *The Plan* is to develop an efficient charging network that meets the current and future demands for electric vehicle adoption by suggesting charging in locations that minimize the need to drive and monitor the placement of charging opportunities over time. This approach to deploying PEV infrastructure complements Sacramento Area Council of Governments' 2035 Metropolitan Transportation Plan/ Sustainable Communities Strategy.

The Plan considers five main components related to PEV charging:

1. **PEV Market Forecasts:** The estimated number of PEVs in the region now and in the future.
2. **Regional Travel Behavior:** Current and forecasted regional driving patterns.
3. **Charging Demand:** Generated demand for charging throughout the region.
4. **Land Use Analysis:** Land uses suitable for hosting electric vehicle supply equipment.
5. **PEV-Readiness:** The region's jurisdictions and partner agencies that are PEV-ready.

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<sup>4</sup> [TakeCharge II: Infrastructure Roadmap](https://www.sacog.org/sites/main/files/file-attachments/master_takecharge_ii_12-21-16.pdf?1487177689). Sacramento Area Council of Governments  
[https://www.sacog.org/sites/main/files/file-attachments/master\\_takecharge\\_ii\\_12-21-16.pdf?1487177689](https://www.sacog.org/sites/main/files/file-attachments/master_takecharge_ii_12-21-16.pdf?1487177689)



The PEV Plan will be the most efficient way to create a robust PEV charging network that all residents can utilize. Currently, some daily travel initiated within a city or county boundary ends within that same boundary. However, a majority of travel extend beyond jurisdictional boundaries<sup>5</sup>. The Plan shows travel patterns require a regional approach to planning.

This necessitates the need for a charging network that goes beyond city and county lines and takes a holistic approach to infrastructure planning. A plan where staff from local jurisdictions, utilities, partner agencies, and other interested parties come together to discuss how to best serve a large area with a growing population of PEVs. A regional approach will make for a more resourceful and efficient charging network.

## **Why SACOG**

A regional PEV Plan requires a centralized body to oversee the effort. SACOG – the Metropolitan Planning Organization and Council of Governments for the twenty-two cities within El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba counties, and the counties themselves – has a proven track record of regional collaboration. Recently recognized for its work producing the Blueprint project, a 50-year vision for the Sacramento region<sup>6</sup>, SACOG has worked with its member jurisdictions on similar planning efforts. SACOG hosts the Capital Area PEV Coordinating Council, the stakeholder group working with the TakeCharge partners on regional PEV readiness planning. In addition, SACOG convenes a monthly Planners Committee – a 28-member committee consisting of the planning directors or their designees of each of SACOG’s member jurisdictions. The committee was originally formed to advise SACOG on the development of the Blueprint Project and now advises on all items relating to land use. These groups work with SACOG staff to lay the framework for local level implementation of regional planning efforts, including those related to PEVs.

## **SACOG’s Approach to Regional PEV Planning**

SACOG and the TakeCharge partners have three main goals for the creation of the regional PEV Plan:

1. Support California’s goals related to zero-emission vehicles and GHG emission reductions.
2. Be consistent with the region’s adopted Metropolitan Transportation Plan/Sustainable Communities Strategy.
3. Create opportunities for existing and future PEV drivers to fuel their vehicles in as efficient a manner as possible.

## **California’s Executive Order**

Governor Brown’s Executive Order sets the following targets related to PEVs:

- By 2015, all major cities in California will have adequate infrastructure and be “zero-emission vehicle ready”;

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<sup>5</sup> [Growth Projections for 2035 - Sacramento Area Council of Governments](https://www.sacog.org/growth-projections-2035) <https://www.sacog.org/growth-projections-2035>

<sup>6</sup> More information on the [SACOG Blueprint](http://www.sacregionblueprint.org/) is available online (<http://www.sacregionblueprint.org/>)

- By 2020, the state will have established adequate infrastructure to support 1 million zero-emission vehicles in California;
- By 2025, there will be 1.5 million zero-emission vehicles on the road in California; and
- By 2050, virtually all personal transportation in the State will be based on zero-emission vehicles, and greenhouse gas emissions from the transportation sector will be reduced by 80 percent below 1990 levels.

### **Assembly Bill 32**

Prior to Governor Brown’s executive order on ZEVs, in September 2006, Governor Schwarzenegger signed into law AB 32, which set a statewide goal of reducing GHG emissions to 20 percent below 1990 levels by 2020. In order to be effective, measures to reduce GHG will have to occur in connection with similar reductions by other states and countries. Through AB 32, California is attempting to assume a leadership role in the abatement of climate change and to offer a model for other states and countries to reduce GHG emissions.

AB 32 also takes into account the relative contribution of each source, or source category, to protect adverse impacts on small businesses and others by requiring the California Air Resources Board (ARB) to recommend a minimum threshold of GHG emissions below which emissions reduction requirements would not apply. AB 32 also allows the Governor to adjust the deadlines mentioned above for individual regulations or the entire state to the earliest feasible date in the event of extraordinary circumstances, catastrophic events, or threat of significant economic harm.

As part of AB 32, in 2008 ARB created the Scoping Plan, which contains strategies to reduce GHG emissions. The Scoping Plan uses various actions including regulations, incentives, and market mechanisms to achieve reduction targets. In 2011, ARB approved an update of the expected GHG emissions reductions from each of the measures outlined in the Scoping Plan document. Table 1 shows the expected measures and statewide reductions.

The sector SACOG is most concerned with is transportation, which represents half of the total reductions outlined in the Scoping Plan. SACOG is responsible for helping the state achieve all of these goals, but specifically T-3, Regional Targets (Senate Bill 375).

**Table 1: Scoping Plan Emission Reductions**

<b>GHG Reductions from Scoping Plan</b>	
<b>Measures in Capped Sectors</b>	<b>49</b>
<i>Transportation</i>	<i>24.4</i>
T-1 Advanced Clean Cars	3.8
T-2 Low Carbon Fuel Standards	15
T-3 Regional Targets (Senate Bill 375)	3
T-4 Tire Pressure Program	0.2
T-5 Ship Electrification	0.6
T-7 Heavy Duty Aerodynamics	0.9
T-8 Medium/Heavy Hybridization	0
T-9 High Speed Rail	1
<i>Electricity and Natural Gas</i>	<i>24.6</i>

<b>GHG Reductions from Scoping Plan</b>	
E-1 Energy Efficiency and Conservation	7.8
CR-1 Energy Efficiency and Conservation	4.1
CR-2 Solar Hot Water	0.1
E-3 Renewable Energy Standards	11.4
E-4 Million Solar Roofs	1.1

**The transportation sector is tasked with meeting half of the GHG reductions. Table 1 shows GHG reductions from the Scoping Plan in million tons of CO<sub>2</sub> equivalents.**

Source: ARB AB 32 Scoping Plan, 2010

### **Senate Bill 375**

Senate Bill 375 (Steinberg, Chapter 728, Statutes of 2008), signed into law in 2008, built upon AB 32. The new law's core provision is a requirement for regional transportation planning agencies such as SACOG to develop a "Sustainable Communities Strategy" to reduce GHG emissions from passenger vehicles. The Sustainable Communities Strategy will outline the region's plan for combining transportation resources, such as roads and mass transit, with a realistic land use pattern, in order to meet a state target for reducing greenhouse gas emissions. The strategy must take into account the region's housing needs, transportation demands, and protection of resources and farmlands.

As the designated Metropolitan Planning Organization, SACOG is responsible for developing a regional transportation plan every four years. For the region to be eligible to receive federal transportation funds, the transportation system must be able to show a steady decrease in pollution emissions until the area's air is clean enough to meet federal air quality standards. Like a PEV plan, transportation systems are best planned at a regional level, because trips are not confined to a single administrative boundary.

The most recently adopted transportation plan, the Metropolitan Transportation Plan/Sustainable Communities Strategy for 2035 provides the regional vision for surface transportation with considerations for land use and funding constraints the region can reasonably expect to see through 2035. The Plan takes an integrated approach to transportation and land use as well as their impacts on air quality and climate change.

Because SACOG has additional state and federal regulations which it must adhere to through the Metropolitan Transportation Plan/ Sustainable Communities Strategy, the regional PEV readiness plan must be consistent with those goals, and therefore must address goals beyond providing a robust charging network. The Metropolitan Transportation Plan/ Sustainable Communities Strategy achieves federal air quality standards and statewide GHG emission targets by reducing the overall amount of driving that takes place in the region. This is accomplished through an integrated land use and transportation plan that minimizes the need for vehicular travel and focuses on providing opportunities for people to take alternative modes of transportation for their trips. This reduces the amount of miles driven and, more importantly, reduces growth in traffic congestion, which exacerbates tailpipe emissions for internal combustion engine cars.

### **PEV 101**

PEV is a general term used to describe any automobile that plugs into an electrical source in order to charge a set of batteries that are used to, at least partially, power the motor. PEVs

are indistinguishable from other cars on the road in most ways except for their reliance on outside electricity to charge batteries. There are different styles of vehicles, from small cars to compact cars, to full size trucks. A PEV can be driven on any road, can carry multiple passengers, and, in some cases, can be driven as fast and as far—if not farther—than most internal combustion engines.

One way to distinguish the different types of PEVs is based on how they use batteries. There are two types of PEVs: full battery electric vehicles and plug-in hybrid vehicles (PHEVs).

A car that fully relies on batteries, does not have an internal combustion engine, nor rely on a fuel source in the motor is known as a battery electric vehicle. This ranges from neighborhood electric vehicles all the way to full-size electric trucks. Most battery electric vehicles can travel between 70 and 100 miles on a full charge, typically powered by lithium ion batteries that are around 30 kWh in capacity.

A plug-in hybrid electric vehicle or PHEV car still plugs into a power source, but also has an internal combustion engine. This differs from a regular hybrid, which has both an internal combustion engine and an electric motor and battery that helps increase gas mileage and reduce tailpipe emissions. Typically, PHEVs travel fewer miles in full electric mode because they can travel many more miles in hybrid mode. One type of PHEV, the extended range electric vehicle can travel 300+ miles in hybrid mode.

No matter the type of electric vehicle, it will likely meet the typical driving patterns of consumers in the region. SACOG estimates that, on average, people today in the six-county region drive 25.8 miles per day.<sup>5</sup> Daily driving is estimated to decrease as seen in the Plan. These estimates are less than half of the estimated low end mileage provided by a fully charged PEV.

Whether driving an all battery plug-in electric or a plug-in hybrid electric, periodically the batteries need to be charged using some type of electric vehicle supply equipment (EVSE). Generally, there are three types of EVSE that are based on the level or speed of charging desired. These are Level 1, Level 2, and DC Fast Charge. All new plug-in electric vehicles can use the standard connector (J1772) for charging and come equipped with cords for charging with 120 volt outlets.

Level 1 charging uses a standard 120 volt outlet found in most buildings. PEVs sold today come with a portable Level 1 charger, making it easy to charge anywhere a 120 volt outlet is available. This level of charging takes longer to fully charge a drained battery, up to 17 hours in some PEVs. Often, Level 1 chargers are used in the residential setting so vehicles can be charged overnight. Level 2 charging requires a 240 volt outlet, like a dryer or other large appliance in the home. While most homes are equipped with these outlets, adding a Level 2 charger often requires an upgrade to the electrical panel. Level 2 charging is relatively quick, taking less than 8 hours to fully charge most PEVs. They are often installed in residential or workplace settings.

As the name implies, DC Fast Charging is much quicker, supplying an 80 percent charge in less than an hour. The DC, or direct current, is much higher voltage as it is connected directly to the power supply via the charger. Due to high costs, this level of charging is less applicable at home, and may be more appropriate for public, commercial, interstate, and other convenient locations that provide an opportunity to charge when limited time is a major factor.

## **The Sacramento Region**

The SACOG regions spans a diverse geography, including a rapidly growing urban core, highly productive agricultural lands, small foothill communities, and sparsely populated forest lands around the western slope of Sierra Nevada Mountains. These conditions and how they relate to PEV infrastructure are described in more detail by county.

### **El Dorado County**

El Dorado County extends from the line of Sacramento County on the west to the Sierra Nevada on the east. From west to east, the geography of El Dorado County progresses from foothill to mountainous terrain. Existing land uses include residential, commercial, and industrial urban development, rural and agricultural lands used for agricultural production, resource extraction, open space and recreation.

While communities such as El Dorado Hills and Cameron Park are recently urbanized areas in the county, Placerville is the only incorporated city. Both commercial and residential development has been clustered along U.S. Highway 50 and State Routes 49 and 193. Elevation increases while traveling east through the foothills, putting additional strain on the car and draining the battery more quickly. This topography, plus the high traffic counts of drivers traveling to the popular recreational areas around Lake Tahoe present an opportunity for PEV charging.

### **Placer County**

With a similar geography to El Dorado County, Placer County is predominantly rural. The six incorporated cities within Placer County are Auburn, Colfax, Lincoln, Loomis, Rocklin and Roseville; however, the majority of the population lives in the suburban southwest portion of the county where residential development has occurred in and around the fast-growing cities of Roseville and Rocklin. Placer County's housing stock ranges from rural residential areas to medium and high-density dwelling units in urbanized areas. Most residential development within the county consists of single-family dwellings, suggesting a large need for jurisdictions to have a quick and efficient permitting process in place for residential EVSE installations.

In recent years, Roseville and Rocklin have emerged as a regional employment centers. Many of the county's employment centers feature large campuses with ample parking that could be easily equipped with EVSE workplace charging. The City of Auburn also has a large concentration of employment due to its role as the county seat of government. It also is home to the company Clipper Creek, one of the pioneers in the electric vehicle supply equipment industry.

### **Sacramento County**

Sacramento County lies at the geographic center of the SACOG region and the middle of the Central Valley, California's prime agricultural land. The county's land ranges from agricultural to heavily urbanized uses. Sacramento County extends from the low delta lands between the Sacramento and San Joaquin rivers in the north to about ten miles beyond the State Capitol and east to the foothills of the Sierra Nevada Mountain Range. The southernmost portion of Sacramento County has direct access to the San Francisco Bay Area, another region that is aggressively pursuing widespread adoption of supportive PEV policies and technology.

The geographic boundaries of the County of Sacramento include seven incorporated cities, which include Citrus Heights, Elk Grove, Folsom, Galt, Isleton, Rancho Cordova, and Sacramento.

The high density of jobs, commercial business, amenities and services provide many ideal locations for public charging. The county's prioritization of infill projects has led to a trend in new mixed use developments with commercial, office, light industrial, and multifamily housing (i.e. condos, townhomes, apartment complexes). This development trend presents an opportunity for citywide ordinances that require new buildings to be equipped with conduits and wiring to support EVSE.

Outside of the county's urban core, land uses are predominantly low-density suburban on flat terrain that is conducive to maximizing a PEV's battery. The Cosumnes River flood plain and existing agricultural operations geographically separate the suburban City of Elk Grove from the more rural cities of Galt and Isleton in the southern part of the County. This may present "range anxiety", or the fear of running out of battery for drivers. Connectivity between the southern parts of Sacramento County to the rest of the region will be a priority when considering siting locations for EVSE.

### **Sutter County**

Sutter County is predominantly agricultural and has only two incorporated cities – Yuba City and Live Oak. Several unincorporated rural communities include Meridian, Nicolaus, East Nicolaus, Rio Oso, Robbins, Sutter and Trowbridge. Often, rural communities are served by smaller municipal utilities, which may not offer the same range of PEV-related rates, policies, and incentives offered by larger utilities. Solar panels and electrical storage may be able to help solve this, but can increase installation cost, which presents added financial burden on small city budgets.

Additionally, cellular or broadband coverage may be limited in these rural communities. A lack of access to digital communications may require a different billing system for electric vehicle charging than the current practice in the urban parts of the region. Highway emergency call boxes could potentially provide access to digital cellular connectivity for the county's small rural communities. Ultimately, it is unlikely that the region's smaller populations and more rural counties like Sutter and Yuba will generate high demand for PEVs and EVSE.

### **Yolo County**

Most of eastern Yolo County's land is flat plains and basins, while the western land is largely composed of rolling terraces and steep uplands used for dry-farmed grain and range. The majority of this land is preserved or used in some capacity (production, crop rotation, processing) for agriculture, the county's economic driver. Yolo County has strict agriculture preservation policies that direct urban development into existing urban areas.

Nearly 85 percent of the population lives in the County's four cities (Davis, West Sacramento, Winters, and Woodland). Land uses in these cities are relatively compact compared to other cities in the region, which is conducive to the smaller batteries of neighborhood electric vehicles and battery electric vehicles such as the Nissan Leaf. Additionally, Yolo County is home to the University of California, Davis and its Plug-in Hybrid Electric Vehicle Research Center, a research division of the nationally acclaimed Institute of Transportation Studies.

### **Yuba County**

Yuba County is located in the Northern Sacramento Valley, approximately 40 miles north of the state capitol, Sacramento. Its boundaries stretch from the farms and orchards of the valley to the timberlands of the Sierra. Like Sutter County, Yuba County is also primarily rural and agricultural, presenting similar challenges for PEVs. The Highway 70 corridor in unincorporated

Yuba County has recently experienced suburban residential growth in the Plumas Lakes community. Plumas Lakes' remote area may pose difficulty in securing sufficient electrical distribution infrastructure to support Level 2 or DC charging options.

Significant flood constraints keep Marysville a relatively compact city, which is conducive to driving a PEV. It is also the County seat and thus a major employment center. The city of Wheatland has also had modest growth. These areas will most likely candidates for PEVs and EVSE in Yuba County.

# CHAPTER 2:

## Infrastructure Plan

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### Map of Existing EVSE

Using July 2013 data from the Department of Energy's Alternative Fuel Data Center<sup>7</sup>, it was determined that the Sacramento region has over 300 publicly accessible charging stations. At that time there are currently 51 Level 1 charging stations and 257 Level 2 charging stations at over 115 different locations. While the Folsom Outlets boast a proprietary (Tesla exclusive) fast charger, to date, there are no publicly available DC fast chargers in the region. However, the EVSE landscape is rapidly growing and expanding. By 2014, SMUD plans to have installed eight DC fast chargers in Sacramento County. A map of the available charging stations can be viewed at the Alternative Fuel Data Center website.

These statistics only capture publicly available charging infrastructure. It is more challenging to assess how many residential charging units are in the Sacramento region. If a PEV owner decides to charge their vehicle with existing outlets in their home (i.e. 110 V or 220 V), generally no permitting and documentation is needed. Additionally, depending on the jurisdiction, the purpose of an electrical panel upgrade is not necessarily documented. These gaps in information make it difficult to assess how many residential EVSE are in the region.

Estimates for the number of residential EVSE come from the CVRP, funded by the ARB and administered by the California Center for Sustainable Energy (CCSE). In 2009, \$63.7 million was appropriated for FY 2009-2013 to promote the production and use of ZEVs, including electric plug-in hybrid electric and fuel cell vehicles through a rebate program. Rebates are available for individuals, nonprofits, government entities and business owners. In many respects, the number of rebates on PHEVs acts as the best proxy for an estimate of residential charging stations. One caveat, however, is that the Chevy Volt was not eligible for the CVRP until February 2012. Approximately 2,300 Chevy Volt's were sold in California before the Volt became eligible for the CVRP and, therefore, these vehicles are not reflected in the CVRP's database. Current estimates suggest that there are over 1,000 residential EVSE units in the Sacramento area. Table 2 shows California has issued 1,238 rebates in the SACOG region.

**Table 2: Clean Vehicle Rebates in Sacramento Region**

<b>County</b>	<b>ZEV &amp; PHEV Rebates Issued to Date</b>
El Dorado	143
Placer	259
Sacramento	654
Sutter	4
Yolo	168
Yuba	10
<b>Total SACOG region</b>	<b>1,238</b>

Source: CVRP Database, 9 September 2013

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<sup>7</sup> [Alternative Fuel Data Center](https://afdc.energy.gov/stations/#/find/nearest) (https://afdc.energy.gov/stations/#/find/nearest)



# Summary of Plug-In Electric Vehicle Survey: Choosing Among PEV, Conventional Automobile and Transit

## Introduction

### *Background*

SACOG conducted a non-scientific survey to examine the mode of travel that commuters use to get to work, and what circumstances might change those behaviors. The survey focused on how PEVs might fit the needs of respondents in consideration of other transportation options that are available to them.

### *Methodology*

The survey was distributed by email in July and August 2013. It was distributed to SACOG staff, plus the 400 members of the SACOG Planners Committee (comprised mostly of local government planners and consultants) and the PEV TakeCharge Council (comprised of parties who are interested in promoting PEVs in the Sacramento region). There were 57 respondents to the survey. These survey populations are not intended to be a representative sample of the general population per se, but collectively they provide insight into what transportation choices people make and where thresholds are for making those choices. **Error! Bookmark not defined.**

The survey was designed to find:

- How many miles and how many minutes does the respondent commute each day;
- By what mode of transportation does the respondent travel to work/school;
- If they drive, does the respondent drive conventional, hybrid, or PEVs;
- How much is the driver willing to pay for gasoline and parking before he/she would change mode of transportation;
- What is the maximum amount of time the respondent is willing to spend on transit;
- Whether the respondent thinks he/she would buy or lease a PEV within 5 years.

## Results

### *The Breakdown of Commute Trips by Mode*

- 51 percent drive to work or school
- 27 percent take transit
- 20 percent walk or bike
- the average commute distance is 13.8 miles one-way

### *Of Those Who Drive*

- 55 percent drive conventional internal combustion engine vehicles;
- 10 percent drive hybrid (e.g. Toyota Prius) vehicles
- 35 percent drive plug-in electric vehicles (PEVs)
- 32 percent paid for parking and the remaining 68 percent had free parking
- The average commute time is 24 minutes in one direction

- The average estimated time that a respondent believes it would take for transit is 53 minutes, more than twice the time than driving
- When noted that the price of gasoline is approximately \$3.75 a gallon, and a typical PEV gets about 20 miles per dollar on a level 1 charger and about 100 miles per dollar on a level 2 charger, the average driver indicated that he/she would consider switching to a PEV when the cost of gasoline reaches \$6.50 a gallon.
- The average maximum amount of time that respondents were willing to spend on transit was 37 minutes, if they were to switch.
- If the amount of time that transit takes was within an acceptable range and the price of gasoline was higher than respondents' maximum threshold, 43 percent of respondents said they would switch to a PEV, 29 percent would take transit, 10 percent would walk or bike, and 19 percent would still drive. Of those who choose a PEV, the reasons that they wrote why they would choose this over taking transit is mostly for convenience, time savings, ability to go to places that transit doesn't serve, or need for flexibility.

#### *For Current PEV Users*

- None of the 11 respondents pay for parking.
- The PEV user pays just under \$14 a month to charge their car at home (this does not account for the cost of charging elsewhere, such as at work or in public).
- The average amount of time that it takes a PEV driver to commute in one direction is just under 31 minutes.
- The average PEV user believes that the comparable commute trip taken by transit would be 79 minutes.
- When asked what the maximum number of minutes would be it would take for PEV users to switch to transit, 55 percent said it would have to be less than 15 minutes, 27 percent said less than 30 minutes, and 19 percent said less than 45 minutes.
- The reasons that PEV users decided to purchase/lease a PEV: 89 percent cited economic factors, 67 percent stated environmental factors, and 44 percent mentioned design and technological factors.

#### *For Current Transit Riders*

- The average amount of time that current transit riders take to commute in one direction is almost 44 minutes.
- The average amount of time that transit riders believe it would take to commute in one direction if they drove a car is 29 minutes.
- If transit riders could no longer take transit to work/school, then 69 percent of them would drive a conventional car, 23 percent of them would drive a PEV, and 8 percent would walk or bike.
- Exactly half, 50 percent, of transit users walk or bike to the transit stop/station, and the other 50 percent drive a car.

- If the transit users' transit stop/station had a PEV charger, 57 percent of those that drive said they would use it if they had a PEV. 57 percent said they would consider purchasing a PEV.

### *Of All Respondents*

- When asked "How likely do you think you are to buy or lease a PEV in the next 5 years": 30 percent said they were very likely or somewhat likely to do so, 26 percent said they were not sure, and 43 percent said they were somewhat unlikely or very unlikely to do so.
- When asked what factors would affect whether or not respondents would buy or lease a PEV in the next five years, 70 percent said it would be economic factors, 49 percent stated technical or design factors, 23 percent said environmental factors and 28 percent said other reasons.

## **Analysis**

Although this is not a scientific survey, the results provide some insight on the thoughts of many professionals who work in planning related fields in the Sacramento area. The overall picture is that cost, time, and convenience significantly affect the choice of transportation mode. Concern for environmental sustainability is also a factor when respondents considered how they would commute to work and school. This is evidenced by almost half of respondents (47 percent) take transit or walk/bike to work, and of the half that drive, 35 percent drive a PEV and another 10 percent drive a hybrid.

For those who drive, commute time was the biggest factor in their behavior. Their average commute time is 24 minutes, and they believe that the comparable average commute time by public transit would be 53 minutes.

Drivers said their average maximum threshold if they were to take transit is 37 minutes. In order for them to switch modes of travel to transit for their commute, the price of gasoline would have to increase substantially to \$6.50 a gallon.

As with many drivers, convenience is critical for current PEV users. Their average commute time is 31 minutes but believe on average a comparable commute by transit is 79 minutes. Most (79 percent) said transit would have to take less than 30 minutes (less than the time it takes to drive) before they would consider taking transit. Also, the cost savings for driving a PEV is presumably substantial compared to using a gasoline powered automobile. The average PEV driver who commutes only pays \$14 a month, and all PEV respondents say they do not pay for parking.

For current transit riders, the key issue is: How do they get to the transit station or stop? Half drive and the other half walk or bike. Fifty-seven percent (57 percent) said they would consider a PEV if charging were available near their transit stop.

## **Getting to One Million: Electric Vehicles in the Marketplace**

### **Introduction**

In 2011 President Obama called for 1 million PEVs<sup>3</sup> on the road by 2015. This goal was aimed at reducing tailpipe emissions, U.S. dependence on foreign oil, and also to increase American manufacturing of alternative fuel sources. This goal came shortly after the bail-out of American auto manufacturers and was followed by large federal subsidies given to alternative fuel

vehicle manufacturers. There has been some criticism of this federal assistance, especially since PEVs have not sold in the numbers some experts had predicted.

Following the President, Governor Brown issued an executive order calling for 1.5 million zero-emission vehicles on California's roads by 2025. For this plan, it is assumed that 80 percent of that goal will be achieved with PEVs.

The estimates the federal government used to assess the reality of 1 million PEVs on American roads included high sales volumes for a limited number of vehicles, including 80 percent of the 1 million PEV met by the Chevy Volt and the Nissan Leaf. According to industry data compiled by hybridcars.com, there was an estimated 7,671 Chevy Volts and 9,674 Nissan Leafs sold in 2011<sup>Error! Bookmark not defined.</sup>, well below the projections provided by the DOE.

A February 2011 status report conducted by the Department of Energy (DOE) states that many PEVs planned by various manufacturers were not included in their estimates. Today consumers can purchase at least 15 different makes and models of PEVs. While the Volt and Leaf account for a large amount of the more than 43,000 PEVs that hybridcars.com estimates have been sold through September 2013, these other models are helping to increase overall sales. Having additional vehicles in the market has a big impact on the total sales of EVs.

### *Market Fluctuation*

Much work has been done to characterize the typical PEV consumer. Household income, age, educational attainment, home tenure and other social-demographic variables have been used to identify early adopters of PEV technology and potential new markets. While these variables are helpful in identifying likely consumers today, they are not predictive of who may purchase PEVs in the future. They constrain PEV consumers to a niche market. However, like any commodity, PEVs and the market for them seem to be susceptible to external forces. The forces that impact PEV sales are not too different from those that affect car sales overall, and it appears that, when sales of cars increase or decrease from one month to the next, PEV and hybrid sales respond in a similar manner. The Plan shows the percent change in sales changes from one month to the next for regular and electric vehicles beginning in December 2010. The PEV sales, shown by the red line, appear to generally follow the trends of the other car types. This would suggest that PEVs are not isolated to one particular group, that instead, like any car, increase and decrease depending on general market conditions.

### **Are 1 Million PEVs Possible?**

There are roughly 24,500 PEVs on California's roads today, in order to get to 1.2 million by 2025 there would need to be roughly 14,300 PEVs sold in 2013 with an increasing amount sold each year with just over 160,000 sold in 2025 as indicated within The Plan. Despite this large number, it equals only an estimated 4.3 percent of all vehicles sold that year, more than 12 years after being on the market. According to hybridcars.com, today hybrid cars represent over 3 percent of all automobile sales<sup>8</sup>, and they have been on the market for just over 10 years. Additionally, research conducted by University of California, Davis shows that in their first two years on the market, PEVs have sold more than hybrids their first two years on the

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<sup>8</sup> [Hybrid Cars Website](https://afdc.energy.gov/stations/#/find/nearest) (https://afdc.energy.gov/stations/#/find/nearest)

market, as seen in The Plan. These facts seem to suggest a 4.3 percent market share for PEVs is achievable by 2025.

Further analysis on the ability for the nation, state, and Sacramento region to reach its targets for PEV adoption is included in TakeCharge II report.[Error! Bookmark not defined.](#)

## Conclusions

The goals set by the President and Governor are lofty, however it is not necessary to make a giant shift away from traditional internal combustion engines to electric vehicles in order to achieve these goals. A 4 percent market share for electric vehicles does not seem unrealistic. The only question is about timing: How soon can this shift happen? Getting electric vehicles to the same share as hybrids within the next 10 years sounds reasonable, but, as with hybrids, PEVs will likely need assistance from federal, state, and local agencies. Efforts from these agencies should include:

- Education to consumers on the benefits of driving an electric car.
- Outreach to car dealerships to work with potential customers on how an electric vehicle can meet their driving needs.
- Work with utilities on finding ways to reduce charging rates while reducing the impacts on the grid.
- Local jurisdictions to find ways to make the permit process to install a charger easier.
- A plan to create an efficient network of chargers so that existing and future electric vehicle drivers can fuel their vehicles.

The Plan works to address these concerns by setting a regional framework from which local jurisdictions and partner agencies can work to prepare themselves for increased demand for electric vehicles and electric vehicle charging infrastructure.

## Site Analyses

SACOG conducted three primary analyses to estimate the most efficient locations for future public charging infrastructure.

- One analysis evaluates future destination demand, which identifies the characteristics of PEV drivers and uses Census data and SACOG's 2035 travel model data to predict common destinations of that population.
- The second analysis is a travel corridor analysis for siting public DC Fast Chargers. This analysis also employed 2035 travel model data to estimate EVSE demand based on the range of a vehicle, the miles driven per tour, and route. This analysis was performed by the Plug-In & Hybrid Electric Vehicle Research Center at the University of California, Davis and is shown in Technical Appendix T3 of the TakeCharge II.[Error! Bookmark not defined.](#)
- The third analysis inventories parcel-level land use to optimize public EVSE with its surrounding context building on the travel corridor analysis mentioned above. This creates an infrastructure plan that enhances district and neighborhood characteristics and is sensitive to travel behavior, land use activities, and public space, while aligning with the metrics of the PEV plan and SACOG's Metropolitan Transportation Plan/Sustainable Communities Strategy.

## Destination Analysis

This study intends to identify the best areas to target installation of public electric vehicle charging infrastructure in the region based on who currently drives PEVs. Generally, these areas are common destinations such as downtowns, business districts, office complexes, campuses, and transit stations.

Ideal locations for EVSE are conceptualized at the macro level for this study. The intent is to indicate corridors or areas rather than exact businesses that would serve PEV drivers. Using clusters of parcels to create corridors allows TakeCharge partners to approach individual businesses in areas of likely EVSE demand without the risk of any particular business' disinterest.

This analysis used a multistep approach to identify destination areas by answering the following questions: Who currently drives PEVs? Where do these drivers go? What is located at these destinations? What is located nearby? Who will likely drive PEVs in the future? Using data to answer these questions allowed this study to estimate which areas in the SACOG region are most likely to be accessed by a PEV, and therefore where there may be a demand for PEV charging stations.

The results of this analysis are drawn on the map on the following pages, where the areas highlighted in green show zones that attract at least 100 trips per day with the darker shaded areas attracting more trips, upwards of 17,000 trips per day. The full methodology and analysis of this study can be found in the Technical Appendix T2 of TakeCharge II. **Error! Bookmark not defined.**

### *Fast Charger Placement Analysis*

This analysis showed where there would likely be demand for DC Fast Chargers using three methods:

- 1) Destination-based charging demand, which used the SACOG travel demand model to find trip destinations that are part of a tour longer than 65 miles but shorter than 110 miles, made by a light duty automobile.
- 2) "Aspirational" fast charging based on survey responses from Nissan Leaf owners; and
- 3) Corridor fast charging using routes created with SACOG's travel model data and the regional road network (SACOG's "centerline" network). With these data, trips were modeled to follow a certain route and would drop virtual pins when vehicles reached 80 percent of the mileage range of common PEVs. By aggregating these pins into clusters, the model shows geographic corridors where there would be demand for a "charging incident." This assumes the ideal occurrence of a charge to be when the battery reaches 20 percent of full capacity. By this metric, a driver of a Nissan Leaf with a 75-mile range would ideally charge after driving approximately 60 miles. (As battery technology advances, this range could increase.)

## Results

The destination fast charging analysis resulted in concentration of demand near work centers and some other areas such as the airport. The results are shown graphically in *TakeCharge II: Infrastructure Roadmap*.

The Plan clearly shows the demand potential downtown, but also in Rancho Cordova near employment centers.

The survey results of fast chargers show a similar picture of fast charging needs .

The results within the Plan shows a strong preference for downtown as well as the airport. Other city centers also match the destination fast charge locations.

Lastly the initial 16 locations identified in the destination model and the survey were treated as initial locations for the corridor modeling. In other words, which of the locations were also useful for pass-through travelers? The results of the corridor analysis are illustrated in The Plan.

The first number in the sub-group ranking indicates the rank of the charging area while the second number shows which charger in the group was superior. A rank of 5-2 would indicate that the area was the 5<sup>th</sup> best and the charger was the second choice in the 5<sup>th</sup> best group.

## **Summary**

By combining factors and aggregating geography, a ranking system incorporates the main use cases for fast charging. One factor not considered in this analysis was the role fast charging could play in a neighborhood setting as an alternative to level 2, which is potentially important for apartment dwellers. The final scoring ranks downtown Sacramento and the Sacramento International Airport highest, followed by the Highway 50 and Interstate 80 corridors. The State Route 99 and Interstate 5 corridors in southern Sacramento County rank the next highest.

A description of the analyses and methodology are available in the Technical Appendix T3 of TakeCharge II. **Error! Bookmark not defined.**

## *Land Use Analysis*

The land use analysis evaluated potential locations of public EVSE with the intent of maximizing the co-benefits that PEV charging infrastructure can provide. It looked to redefine the perception and implication of a “fueling station” since PEV technology has evolved to allow vehicles to fuel in virtually any parking space, without strict zoning requirements or hazardous material risks posed by gas stations.

This analysis builds on the travel corridor analysis discussed above. Within these corridors, SACOG looked at parcel level land uses to find the best fine-grain locations for charging infrastructure. “Best” locations were construed as places where PEV drivers would receive maximum co-benefits from using particular EVSE. These co-benefits were local economic development, public space use and enhancement, and activities associated with certain land uses (i.e. grocery shopping, coffee shops, ATMs, parks, or play structures). These amenities were mapped and overlaid on a 0.5-mile walking network to reflect a 10-minute walk time, allowing a round-trip within the 20 minutes of a typical DC fast charge. Multi-family housing was also overlaid with these amenities, as public charging can act as a proxy for residential charging for those who live in multi-family dwellings and are unable to install EVSE at their home.

Locations became apparent by the area and number of destinations one could reach within a 10-minute walk. Downtown Sacramento is an example of a site that performed well in the land

use analysis because of the walkable grid pattern of the streets and the compact mix of amenities. An outline of the two avenues of analysis is represented in Table 3 below.

**Table 3: Outline of Two Avenues of Analysis**

<ol style="list-style-type: none"> <li>1. Use of infrastructure             <ol style="list-style-type: none"> <li>a. Destinations &amp; Routes</li> <li>b. Travel Corridors (within 3 miles of highways and interstates)</li> </ol> </li> </ol>	<ol style="list-style-type: none"> <li>2. Surrounding Land Use Amenities (within 10 minute/0.5-mile radius)             <ol style="list-style-type: none"> <li>a. Local Economic Development</li> <li>b. Public Space Use &amp; Enhancement</li> <li>c. Activity with Associated Land Use (i.e. grocery shopping, post office)</li> </ol> </li> </ol>
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Source: SACOG staff analysis

Data used in this analysis included SACOG travel model data, SACOG’s centerline network, SACOG’s 4-way intersection spatial data, and SACOG’s 2035 land use data (multifamily housing, open space, parks, and civil services). It also used North American Industry Classification System employment data to find business categories for the land use amenities, such as coffee shops and banks.

**Sites by Jurisdiction**

Incorporating the Preferred charging landscape scenario with the site analyses gives an idea of how much charging infrastructure should go where. To do this, demographic profiles and driving patterns were used to estimate the amount of charging needed within each jurisdiction in the region. These numbers are provided to guide how much planning is needed at the local level to accommodate estimated demand. SACOG, with help from the TakeCharge partners, will help local jurisdictions find the best sites for precise EVSE locations.

**Scenario Process**

With the understanding that electric vehicle charging can take place in three primary settings—home, work, and public locations—SACOG created a scenario-based process to assign numbers of charging units in each of these categories to the region and to individual jurisdictions. Four charging scenarios were created: Residential Focused, Workplace Focused, Public Focused, and Balanced. Each scenario assumed that charging would happen in all three settings, but at varying distributions. The balanced scenario assumed an equal distribution of charging instances among the three settings. The four scenarios are summarized in the table below. The majority of charging instances occurs at home and assumes that most multi-unit dwellings are wired for EVSE installations. It assumes mostly Level 1 at home and work and mostly DC in public. Most charging takes place at work at Level 1 during the hours of 8 am and 5 pm. Residential charging is mostly Level 1 while public charging is split evenly between Level 2 and DC. Most charging is still at home, but there is a large increase in public charging and away from residential and workplace. Public charging is mostly DC while residential and workplace charging is primarily Level 1 (Table 4).

**Table 4: Scenarios Showing Percentage of Charging Instances by Setting in 2025**

<b>Residential Focus</b>				
	<b>L1</b>	<b>L2</b>	<b>DC</b>	<b>Total</b>
<b>Residential</b>	80%	10%	< 1%	90%
<b>Workplace</b>	2%	1%	< 1%	3%
<b>Public</b>	1%	2%	3%	6%



<b>Workplace Focus</b>				
	<b>L1</b>	<b>L2</b>	<b>DC</b>	<b>Total</b>
<b>Residential</b>	27%	3%	< 1%	30%
<b>Workplace</b>	30%	20%	< 1%	50%
<b>Public</b>	< 1%	10%	10%	20%
<b>Public Focus</b>				
	<b>L1</b>	<b>L2</b>	<b>DC</b>	<b>Total</b>
<b>Residential</b>	40%	10%	< 1%	50%
<b>Workplace</b>	7%	3%	< 1%	10%
<b>Public</b>	2%	13%	25%	40%
<b>Balanced</b>				
	<b>L1</b>	<b>L2</b>	<b>DC</b>	<b>Total</b>
<b>Residential</b>	27%	6%	< 1%	33%
<b>Workplace</b>	20%	13%	< 1%	33%
<b>Public</b>	1%	12%	20%	33%

**Charging instances are evenly distributed between residential, workplace and public charging. There is a Level 1 focus at home and work; there is a DC focus with public charging.**

Source: SACOG staff analysis

These scenarios used the California electric vehicle targets set by Governor Brown in the California Zero-Emission Vehicle Action Plan, which assumes 1.2 million electric vehicles on the road by 2025. Currently, the Sacramento region represents 6.2 percent of the California’s population—about 75,000. By this calculation, SACOG set the regional EV target at 6.2 percent of 1.2 million, or 74,633 electric vehicles by the year 2025.

Using this target fleet of 74,633 electric vehicles, SACOG performed an analysis to identify the number of chargers needed to fuel this fleet. A full description of this analysis can be found in TakeCharge II. **Error! Bookmark not defined.** The analysis resulted in the following numbers of charging units projected for each general location shown in Table 5.

**Table 5: Scenarios Showing Quantities of Charging Instances by Setting in 2025**

<b>Residential Focus</b>				
	<b>L1</b>	<b>L2</b>	<b>DC</b>	<b>Total</b>
<b>Residential</b>	59,706	7,463	7	67,177
<b>Workplace</b>	746	187	3	936
<b>Public</b>	21	41	56	118
<b>Total</b>	60,473	7,691	67	68,231
<b>Workplace Focus</b>				
	<b>L1</b>	<b>L2</b>	<b>DC</b>	<b>Total</b>
<b>Residential</b>	20,151	2,239	7	22,397
<b>Workplace</b>	11,195	3,732	3	14,930
<b>Public</b>	10	207	104	321
<b>Total</b>	31,356	6,178	114	37,648
<b>Public Focus</b>				
	<b>L1</b>	<b>L2</b>	<b>DC</b>	<b>Total</b>
<b>Residential</b>	29,853	7,463	7	37,324
<b>Workplace</b>	2,612	560	3	3,175
<b>Public</b>	41	539	466	1,047
<b>Total</b>	32,507	8,562	477	41,546
<b>Balanced Focus</b>				
	<b>L1</b>	<b>L2</b>	<b>DC</b>	<b>Total</b>
<b>Residential</b>	20,151	4,478	7	24,636
<b>Workplace</b>	7,463	2,426	3	9,892
<b>Public</b>	21	249	207	477
<b>Total</b>	27,635	7,152	218	35,005

Source: SACOG staff analysis

When reading these numbers, it should be noted that these represent the regional numbers of EVSE proposed in each general location. The electric vehicles they will charge will be a mixture of personal automobiles and fleet vehicles, some households may have multiple EVs, some households—such as multi-family units—will not have EVSE installed in the residence. This helps set context for why even the Residential Focus scenario does not assign a charger for every vehicle in the region, and why the Workplace Focus scenario does not assign a charger for every two vehicles in the forecasted electric fleet.

To inform a decision of which scenario would perform best, these scenarios were evaluated using a series of metrics including grid impacts, public costs, and infrastructure throughput. These metrics are discussed in the next section.

These scenarios and their metric performance were released for public comment to the TakeCharge Coordinating Council, planners, an EV drivers’ advocacy group, and air quality and transportation professionals. They were asked to give feedback on the practicality and quality of these scenarios—primarily the percent breakdown of charging instances by location. With the feedback received from stakeholders, SACOG created a “Preferred Scenario” shown in Table 6. The Preferred Scenario looked much like the Residential Focus scenario, but with some charging instances shifting from the home to the workplace and public locations. The preferred percent breakdown of charging and numbers of EVSE by location is shown below and was also evaluated for performance with the metrics described later.

**Table 6: Preferred Scenarios Showing Numbers of Charging Instances by Setting in 2025**

<b>Preferred Scenario (Percentages)</b>				
	<b>L1</b>	<b>L2</b>	<b>DC</b>	<b>Total</b>
<b>Residential</b>	70%	4%	1%	75%
<b>Workplace</b>	7%	2%	1%	10%
<b>Public</b>	1%	9%	5%	15%
<b>Preferred Scenario (Quantities)</b>				
	<b>L1</b>	<b>L2</b>	<b>DC</b>	<b>Total</b>
<b>Residential</b>	52,243	2,985	7	55,235
<b>Workplace</b>	2,612	187	3	2,802
<b>Public</b>	21	187	93	301
<b>Total</b>	54,876	3,358	104	58,338

Source: SACOG staff analysis

## **Metrics**

### **Why Metrics Are Needed**

The goal for the Plan is to create an efficient electric vehicle charging network that serves the needs of existing and future PEV drivers. This goal, and the Plan in general, carry out larger regional and statewide goals related to air emissions, fiscal responsibility, and energy use. In order to know if the Plan is addressing this goal, a set of metrics were generated. These metrics are used to determine how the proposed charging infrastructure performs in relation to the goal of the Plan, and the larger context in which it is applied. The metrics are a way to measure, discuss, and enhance the Plan for an ever-changing electric vehicle environment.

### **Measuring the Scenarios**

As described in an earlier section, a series of charging infrastructure scenarios were generated to address the different needs and behaviors of current and future PEV drivers. These scenarios were then measured using a set of metrics related to electricity consumption, costs, and intensity of use. From these measures a preferred scenario was generated that best met the goals of the Plan. The following sections discuss the metrics in terms of this preferred scenario.

### **What, Why, and How**

Metrics used in the Plan speak to the previously mentioned goals, but do not cover every aspect of electric vehicles. Instead, they are a cross-section of issues surrounding electric vehicles, and in some cases, a good proxy for many issues. The metrics used are:

- Impacts on the electrical grid from electric vehicle charging,
- The cost to the public for providing charging,
- The wait time for a charger versus the amount of stranded infrastructure, and

The analysis to measure these impacts included estimating the amount of charging needed in a given day, the time at which charging was likely to occur, and the level of charging. A description of these elements can be found in the Charging Scenarios section. Additional assumptions for each metric were made and are described below.

## Grid Impacts

How much and when electricity is consumed for electric vehicle charging has a big impact on the electrical grid. This impact is most notable in power distribution, which may include power degradation and reduced transformer life.

In order to measure grid impacts, the rate of electricity consumed by charging level, the range per charge, and the amount of charge needed had to be known.

Different levels of charging consume different amounts of electricity. Table 7 outlines the average rates that were used for this analysis and Table 8 shows the charging times for each level.

Depending on the vehicle and the level of charging, different driving distance ranges are possible. The Plan shows the typical ranges by level of charging used for this analysis. These numbers were then applied to the amount of charging that would be necessary to drive 25.8 miles per day, which was the regional average of vehicular travel in the adopted Metropolitan Transportation Plan/ Sustainable Communities Strategy for 2008.

**Table 7: Assumptions of Electricity Consumption and Range Rates**

<b>Level of Charging</b>	<b>Range per Time of Charge (assuming a Nissan Leaf)</b>	<b>Electricity Consumption Rate</b>
L1	4.5 miles per 1 hour	1.5 kilowatt-hours per hour
L2	26 miles per 1 hour	6.6 kilowatt-hours per hour
DC Fast	40 miles per 10 minutes	90 kilowatt-hours per hour

**DC Fast Chargers provide the fastest charge.**

Source: SACOG

**Table 8: Charging Times and Kilowatt-Hours Consumed<sup>9</sup>**

<b>Charging Needed per Day (Assumes 25.8 average daily miles driven)</b>			
	Level 1 hours	Level 2 hours	DC Fast hours
Hours	5.73	0.99	0.11
Kilowatt-hours	8.6	6.5	9.9

**Level 2 Chargers provide the least energy-consumptive charge for daily use.**

Source: Plug-in America

Once all of the necessary charging times by level of charger were estimated, the total number of chargers and vehicles from the scenario were used to estimate the amount of electricity consumed throughout the day. This was then compared to the existing amount of electricity consumed during a typical day in July.

The Plan shows that, during the peak electricity use times represented by the red line, from 2 pm to 8 pm, the amount of electricity estimated to be consumed in the preferred charging scenario is relatively low. Although a later section of the Plan suggests policies to further reduce this impact by distributing more charging to off-peak times, the preferred charging scenario already has a relatively low impact on the grid.

<sup>9</sup> [Understanding Electric Vehicle Charging](https://pluginamerica.org/understanding-electric-vehicle-charging/) https://pluginamerica.org/understanding-electric-vehicle-charging/

### *Public Costs*

A study by the EV Project<sup>10</sup> stated that widespread adoption of PEVs would largely depend on private investment in infrastructure, but some public investment, especially in the early stages of deployment, would be necessary.

Not all costs estimated for infrastructure in the Plan would be burdened by the public, therefore a factor to scale down the costs to just those for the public was applied. This factor estimates how much of the total costs within each charging setting (residential, workplace, and public) will be subsidized by the public. Subsidies could include but are not limited to: public chargers provided by local jurisdictions; local incentives for providing workplace, public, or residential charging; reduced electricity costs.

Table 9 shows the total estimated cost of infrastructure assumed in the Plan, and the proposed public subsidy.

**Table 9: EVSE Public Costs Forecast**

<b>Total Costs*</b>	<b>Public Subsidy</b>	<b>Public Costs</b>
\$49,863,075	9.00%	\$4,505,446
*Note: Includes purchase and install		

Source: SACOG

The total amount of infrastructure purchase and installation costs was estimated using the number of chargers estimated in the preferred scenario by charging level and sector and multiplied by an average cost per charger taken from a compilation of studies conducted by CALSTART<sup>11</sup>. The electricity costs were estimated using the total hours of charging by time of day, level of charger, and sector from the analysis conducted above on grid impacts and multiplied by the average electricity cost in kilowatt hours. These costs can fluctuate by time of day if time-of use rates are used. For this analysis a reduced rate was assumed between the hours of 10 pm and 6 am.

### *Infrastructure Efficiency*

There are many studies looking at the barriers to PEV deployment, and many that identify the amount of time necessary to charge a vehicle. However, there are few studies that look at the amount of queue time, or time spent waiting for an available charger, as a barrier to broader adoption. Anecdotally, through the Coordinating Council, SACOG has heard that the fear of having to wait for charging can be a barrier to the use of an electric vehicle.

On the side of the charging infrastructure provider, purchasing and installing costly infrastructure that is not being used, often called stranded assets or stranded infrastructure, is considered a poor investment.

To create an efficient regional network of PEV chargers, an analysis must be conducted that looks at the balance between the time a PEV driver might wait to charge an electric vehicle

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<sup>10</sup> [AVTA: ARRA EV Project Overview | Department of Energy](https://www.energy.gov/eere/vehicles/downloads/avta-arr-ev-project-overview)  
<https://www.energy.gov/eere/vehicles/downloads/avta-arr-ev-project-overview>

<sup>11</sup> [CALSTART Best Practices for Workplace Charging September 2013.pdf](http://evchargingpros.com/wp-content/uploads/2015/05/Calstart-Best-Practices-for-Workplace-Charging.pdf) <http://evchargingpros.com/wp-content/uploads/2015/05/Calstart-Best-Practices-for-Workplace-Charging.pdf>

against the amount of infrastructure in the region that is underutilized. To do this, a ratio of net charging time availability to charger demand was estimated. The ratio is used as a proxy to determine if infrastructure has a long wait time, which could mean additional chargers are needed, or if infrastructure has no wait time, which could indicate it is stranded infrastructure. The calculations used to calculate infrastructure efficiency are shown in Figure 1.

**Figure 1: Calculation Used in Efficiency Analysis**

$(A * B) - (C * D * E * F)$ ; where:

- A = number of chargers available in the region
- B = hours in a day a charger is available
- C = total number of electric vehicles in the region
- D= percent share of all charging instances in the region in one day
- E = capacity of electric vehicles charged per day at a single charger
- F = hours of charging needed per electric vehicle

This number is then divided by the demand for charging, estimated using the following formula:

$(C * D)$ ; where

- C = total number of electric vehicles in the region
- D= percent share of all charging instances in the region in one day

Source: SACOG

The more efficient charging scenarios have a balance of wait time for chargers, which means they are being used, and a high number of vehicles charged, or throughput, which means the chargers are not stranded assets. The preferred scenario generates a high score on the efficiency spectrum as shown in The Plan, but due to the high number of residential chargers that efficiency drops slightly from a perfect score as residential chargers are typically used for vehicles in that household only.

### **Greenhouse Gas Emissions Reductions**

A driving force for PEV adoption is the impact on greenhouse gas emissions reductions by PEV's zero tailpipe emissions. While a "zero-emission vehicle" designation is still somewhat generous given the emissions produced from electricity generation, PEVs have the potential to play a key part in meeting the air quality targets set at the federal and state levels. Furthermore, as utility companies continue to add renewable sources in their energy portfolios per AB 32 requirements, actual emissions generated by PEVs will continue to get cleaner.

Based on California's ZEV targets, SACOG analyzed regional light duty automobile fleet projections for 2020 and their associated vehicle miles traveled (VMT) and GHG emissions. A full adoption of Governor Brown's Executive Order B-16-2012 would electrify 75,000 of the light duty automobiles in the SACOG region by 2025. Given the fleet projected by the California Air Resources Board by about that year, the resulting breakdown of light duty automobiles in 2020 is shown in Table 10 below.

**Table 10: 2025 Light Duty Automobile Fleet Projection**

	<b>El Dorado</b>	<b>Placer</b>	<b>Sacramento</b>	<b>Sutter</b>	<b>Yolo</b>	<b>Yuba</b>	<b>Region</b>
Electric Light Duty Automobiles	4,482	11,617	47,905	2,291	6,788	1,917	75,000
Gasoline Light Duty Automobiles	50,620	131,204	541,054	25,879	76,671	21,646	847,074
All Light Duty Autos	55,102	142,821	588,959	28,170	83,459	23,563	922,074
Electric vehicles miles traveled/day	129,328	369,358	1,492,885	72,310	245,561	67,511	2,376,951
gVMT/day	1,460,672	4,171,642	16,861,115	816,690	2,773,439	762,489	26,846,049
Daily GHGs emitted without fleet electrification (tons)	2.96	8.00	37.09	1.91	5.7	1.9	57.56
Daily GHGs emitted with fleet electrification (tons)	2.72	7.35	34.07	1.75	5.24	1.75	52.88
GHG reductions from fleet electrification (tons/day)	0.24	0.65	3.02	0.16	0.46	0.15	4.68

Source: ARB EMFAC 2020 fleet data

Using daily VMT projections (above) and the greenhouse gas emissions produced from the light duty automobile sector, transportation greenhouse gas emissions scenarios could easily be calculated. By meeting the Governor’s target for ZEVs, in the Sacramento region would see a reduction in greenhouse gas emissions of 4.68 tons per day. The full calculations can be found TakeCharge II. **Error! Bookmark not defined.**

## **Funding Sources for Electric Vehicle Supply Equipment**

Currently, there are few sources of funding and incentives for electric vehicle charging infrastructure. There are other programs that are feasible, but speculative. They are listed below because these sources may become real in the near future.

### **Current, Real Programs**

*Alternative Fuel Vehicle Tax Credit*

The IRS will credit 30 percent of the cost of refueling infrastructure. A cap is in place of \$30,000 for business-use property and \$1,000 for personal-use property and can be seen in the business’s IRS Form 8911.

**PEV Charging Rate Reduction**

SMUD offers a reduced time-of-use rate option to residential customers who own a licensed passenger PEV. The electricity time of use rates in SACOG region are explained in Table 11.

**Table 11: Electricity Time of Use Rates in SACOG Region**

WINTER SEASON - OCTOBER 1 through MAY 31				PEV Time of Use Rates	
	On-Peak ¢/kWh			SMUD	0.11
	Off-Peak ¢/kWh			SMUD	0.08
	On-Peak ¢/kWh			PG&E	0.26
	Off-Peak ¢/kWh			PG&E	0.1
SUMMER SEASON - JUNE 1 through SEPTEMBER 30					
	On-Peak ¢/kWh			SMUD	0.24
	Off-Peak ¢/kWh			SMUD	0.09
	On-Peak ¢/kWh			PG&E	0.38
	Off-Peak ¢/kWh			PG&E	0.1

Source: SMUD and PG&E PEV Rates as of November 2013

*Clean Vehicle Electricity and Natural Gas Rate Reduction*

New in 2013, Pacific Gas & Electric (PG&E) offers simplified time of use rate plans for electricity used for plug-in electric vehicle charging and natural gas vehicle home fueling appliances. **Error! Bookmark not defined.**

*California Clean Vehicle Rebate Project*

The Clean Vehicle Rebate Project (CVRP) is funded by the Air Resources Board and administered by the California Center for Sustainable Energy. The project began in 2009, when \$63.7 million was appropriated for FY 2009-2013 to promote the production and use of ZEVs, including electric, plug-in hybrid electric and fuel cell vehicles through a rebate program. Individuals, nonprofits, government entities and business owners are all eligible for a rebate. For the 2013-2014 fiscal year, \$69.5 million is available in rebates for purchasing 30 eligible vehicle models.<sup>12</sup>

**Feasible, Speculative Programs**

Congestion Mitigation Air Quality Program

This federal funding is administered jointly by three agencies, the Sacramento Area Council of Governments (SACOG), El Dorado County Transportation Commission and Placer County Transportation Planning Agency for the Sacramento region, which includes El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba Counties. Each agency does a call for projects about every two years but on different schedules.

<sup>12</sup> [CVRP Home | Clean Vehicle Rebate Project](https://cleanvehiclerebate.org/en) https://cleanvehiclerebate.org/en



For this program to graduate from speculative to real, the agencies would have to specifically invite EVSE applications for funding. There is no explicit eligibility for EVSE, but EVSE is an eligible use of funding.<sup>13</sup>

#### *Motor Vehicle Registration Fee Program*

This program provides funding for projects that reduce air pollution from on- and off-road vehicles. Although EVSE is eligible for this funding, air districts in the Sacramento region do not currently use these funds for EVSE programs. Instead, the focus is on strategies to reduce the emissions of diesel trucks. In contrast, San Joaquin, Bay Area, and South Coast Air Districts fund EVSE programs, but these air districts differ from the Sacramento region in the size of funding, the size of population, and the severity of their air quality status.

For this to graduate from speculative to real, air districts in the Sacramento region, such as the Sacramento Metropolitan Air Quality Management District, would have to redirect funding from reduction of diesel emissions to promotion of plug-in electric vehicles (PEVs) and EVSE.

#### *Alternative and Renewable Fuel and Vehicle Technology Program*

The California Energy Commission puts out Requests for Projects for EVSE projects. According to the 2012-2013 Investment Plan for the Alternative and Renewable Fuel and Vehicle Technology Program, Commission Final Report, \$6.75m is available for projects/programs in 2012/13 for electric vehicle charging.

#### *Energy.gov Tax Credits Rebates and Savings*

The Department of Energy maintains this site to provide links to tax credits, rebates, and other savings for energy savings. It is filterable by state, eligibility type, provider, and expiration date. (Tip: Sort for "Alternative Fuel Vehicles.")

#### *Alternative Fuels Data Center*

The Department of Energy maintains this site to provide links to federal and state laws and incentives. (Tip: look for "Alternative Fuel.")

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<sup>13</sup> [Funding - Sacramento Area Council of Governments \(sacog.org\)](https://www.sacog.org/funding) https://www.sacog.org/funding

# CHAPTER 3:

## Readiness Plan

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### PEV Readiness

Making the region's jurisdictions PEV ready is one of the objectives of the Plan. Being PEV ready consists of several of the core elements outlined earlier, including permit streamlining, updated building codes, and local policies for parking. The Plan offers the framework for being PEV ready by providing resources to begin addressing the core elements related to local governments.

### Residential Charging

Many PEV owners want to charge their PEV at home for convenience. In most residences, EVSE can be either a standard 120 volt or 240 volt electrical outlet. The standard 120 volt electrical outlets most homes have in their garage today provide Level 1 charging for a PEV. Generally, no permitting is required as PEVs can be plugged into any 120 volt outlet for charging. However, a permit may be required if a resident wants to take advantage of a reduced electric rate that may be offered by the local utility company, as this may require a sub-meter to be installed. Level 2 charging requires a 240 volt power supply and the charging station (i.e. the EVSE), which generally requires a permit. A Level 2 EVSE installation generally requires a modification or upgrade to a home's existing electrical panel, which triggers the need to obtain a building permit and involvement of the electric utility company.

If Level 2 charging and/or a reduced or residential time of use rate is desired, the process for obtaining a permit for either item should generally be started by contacting the local utility provider. The local utility company can review RTEV rate options with the customer and can also assess the adequacy of the infrastructure in the area, both of which are useful to know prior to contacting an electrician or the local permitting department. After a decision has been made about wanting Level 2 charging, a RTEV rate, or both, a qualified electrical contractor should be contacted to do an electricity panel capacity and load calculation. Generally, after this, the contractor or the homeowner can submit an application for a building permit.

In general, EVSE permits and installations in multi-unit dwellings present more challenges than for single family homes, including ownership issues and physical challenges. Permitting and installing EVSE in multi-unit dwellings will require permission of the property owner or manager for rental units. However, even if the unit is owner occupied, most condominium and townhome properties have a Homeowners Association with elected boards and contracts that can govern the use of private and common spaces; therefore EVSE installation may require approval from such a board.

EVSE installation requires an electrical connection between the chargers (located near the parking space) and the tenant, or owners, electrical panel. In MDU residences, this may be physically impossible or financially impractical. Recent California legislation, Senate Bill 880 (Corbett), protects the rights of multi-unit dwelling residents to install home charging; however, these types of challenges still remain. TakeCharge I offers more information and tips on permitting for residential EVSE.

## Single-Family Residential EVSE Permit Streamlining

As the PEV market increases and more PEVs are purchased, there will likely be an increase in EVSE permitting. This is especially true in single-family residences as many PEV owners today are likely to live in detached single-family homes. Generally, more new cars are purchased by drivers who live in detached single-family homes than are purchased by drivers living in apartments or MDUs. Because of their purchase prices and the fact that PEVs are new to the market and will not likely have a large used car base for some time, it is likely PEV owners will largely follow this same trend. Currently, EVSE permitting, and installations occur much less often in multi-family homes than in single-family homes, largely due to the challenges outlined above and the lower PEV ownership rate in MDUs.

All jurisdictions in the Sacramento region have a process for residential electric panel repairs or upgrades and this is the same permit used for issuing residential EVSE permits. The cost and requirements for obtaining this type of permit varies from jurisdiction to jurisdiction. This section describes opportunities for streamlining this process for residential EVSE permits specifically.

Because PEVs are new and EVSE permitting is not a frequent or common occurrence for either the PEV owner or the local planning and building departments, education is key to a successful process. A great example of this in the region is the City of Sacramento's "Guide to Electrical Vehicle Supply Equipment (EVSE) Permits for Residential". This guide is specifically designed for PEV owners and offers information when a permit is required, as well as the process, fees and the submittal requirements needed to obtain a permit. The guide is published on the City's website and is also available at the city permit counter. A template of this guide, provided in of TakeCharge II<sup>Error! Bookmark not defined.</sup>, is to be used by local governments in their PEV permit s streamlining process.

Most customers needing EVSE will work with a certified electrical contractor, and it is typically the contractor who will obtain the permit from the city or county building department on behalf of the customer. A permitting process that requires more than one trip to the building department to obtain the permit results in project delays and increased costs to the customer. Additionally, EVSE permitting for residential single-family homes is generally uncomplicated so customers should be able to get a permit within one day of application.

There are many ways to facilitate a same day permitting process, including over-the-counter service at the time of application or online or faxing permitting options. A survey of local permitting processes in the Sacramento region indicates that most jurisdictions process basic EVSE permitting within one day and/or one visit to the permit counter.

For an electrical repair or upgrade permit, including EVSE permits, most jurisdictions at a minimum require single line diagrams, an electrical load calculation worksheet, EVSE specifications, and a site plan. Some have additional requirements including wiring methods or electrician certification, for example. Because EVSE permits fall within an established process that each jurisdiction has set up for electrical repair or upgrade permits, it is not likely every jurisdiction could standardize their requirements to a regional standard, nor is it necessary. The customer education guide provides a template submission checklist and load calculation worksheet that jurisdictions can implement.

Most jurisdictions charge a permit fee for EVSE installations that is based on the value of the project so permit fees can vary widely within a region and even within a single jurisdiction.

Implementing a flat fee for EVSE installations could provide some predictability to customers, but similar to the discussion above on standardizing requirements, it is likely more important to educate the customer upfront with an average or range of cost to be expected.

However, if individual jurisdictions want to implement a flat fee program for EVSE permits, some considerations should include: the variation of equipment among EVSE and PEVs, the range of the age of homes in the community and whether or not many small projects would end up subsidizing larger projects, and also staff recovery costs for permit counter staff, plan review, and inspectors.

## **Public Charging**

Range anxiety, or the fear of being stranded with an uncharged PEV, is a barrier to a more widespread adoption of PEVs. While many PEV owners charge at home, public charging options— including the workplace— are becoming increasingly popular. Public charging offers an alternative to home-based charging and also provides range anxiety relief for existing and potential PEV owners.

There are several models of public charging available, both at public off-street parking facilities and on-street opportunities. Charger siting strategies for commercial installations typically involve trade-offs between highly visible locations which can showcase the host site's commitment to the environment versus lower-visibility locations that may be less costly and less prone to preemptive occupancy by ICEs (also known as "ICE-ing"). As a rule of thumb, distance equals cost, so the longer the conduit run, whether horizontal or vertical, the higher the cost. In general, indoor locations tend to have better access to power than outdoor sites, but outdoor sites may have better cellular reception for units that are wirelessly networked. The wide array of options presents both the opportunities for innovation and complexity for implementation.

Since public charging stations offer a service to the general public, the ADA prohibits discrimination of individuals on the basis of disabilities. However, the only accessibility guidelines that currently exist in California for public chargers are of those called out in Chapter 11B of the California Building Code for fueling devices for automobiles and the State of California Internal Policy 97-03. Chapter 11B of the CBC—Standards for Card Readers at Gasoline Fuel-dispensing facilities applies not only to card reader of liquid fuel dispensers but also to EVSE equipment as electricity is specifically identified as a motor fuel. State of California Internal Policy 97-03—Interim Disabled Access Guidelines for Electric Vehicle Charging Stations was developed to provide guidance for the installation of charging equipment on state-owned parking lots, including public schools. It states that local agencies are granted latitude to adopt similar methods of administering code requirements. While the Policy references the California Building Standards Code, it does not reference the California Electrical Code, Fire Code, Vehicle Code, or Manual on Uniform Traffic Control Devices; all of which must be considered when providing safe, accessible and enforceable public charging infrastructure.

The inconsistencies and incompleteness of the standard for card-reading devices on fuel dispensers and the State's internal policy on accessible chargers has resulted in local agencies developing broad interpretations of the documents. The result has been inconsistent applications of policy across the State, as well as across the nation. Key challenges facing property owners, engineers, architects, contractors and others are how to place charging equipment near a convenient and sufficient power source, protect the equipment from

possible vehicle damage, and still ensure that the equipment is accessible for persons with disabilities.

## **TakeCharge Jurisdiction Meetings, December 2012 – January 2013**

Between December 2012 and January 2013, SACOG staff met with 21 jurisdictions in the region to discuss PEV readiness. The meeting participants consisted of building officials and planners, and, on occasion, sustainability managers, public health and economic development staff.

### **Findings**

Overall, the jurisdictions were receptive to SACOG's approach to PEV readiness with regards to outreach, permits, ordinances, and workforce training. Many jurisdictions acknowledged the need to revisit previous efforts to achieve PEV readiness such as replacing older outdated charging stations and replacing older EV fleet cars; however, the majority of staff were optimistic about new efforts to plan for electric vehicles. Taking a regional stance to PEV readiness was a positive selling point of these meetings. Planning and Building Departments appreciated the importance of an interconnected and seamless charging network in the region. Many jurisdictions are motivated to add PEV charging stations to spur economic development and meet the GHG emission reduction goals in their Climate Action Plans. They expressed an interest in working with SACOG staff to become competitive applicants for upcoming EVSE funding opportunities. The agenda and action notes from each meeting are included in TakeCharge II. **Error! Bookmark not defined.**

Building officials were valuable participants at these meetings. They are well-versed in the logistics of installing charging stations at home and in public areas. Many are already involved in training sessions through the Sacramento Valley Association of Building Officials. Some jurisdictions have already begun requiring conduits and outlets for charging stations or set parking ratios in new residential and commercial parking. All jurisdictions are interested in more information about PEV readiness steps and best practices in other areas. Building officials would like to see more emergency response classes. This will be incorporated in the grant deliverable SACOG PEV Model Ordinance Toolkit.

### **Questions Remain**

There are still many unanswered questions about charging stations in multifamily developments, such as who will pay for electricity and zoning or building code requirements. Many jurisdictions seem to be in favor of standardizing the permitting process to install home charging stations, although the opposite was found in a survey that SACOG sent out last year to building officials.

For PEV adoption to increase, education opportunities need to be provided for all participants in the PEV value chain, including first responders. The following section outlines questions and answers for emergency response built from training providers.

## **Plug-in Electric Vehicle Emergency and First Responder FAQ**

### **How can you tell whether or not a vehicle is electric?**

For identification purposes, many vehicles have a formal badge that is usually on front fenders, doors or the rear. Badging often involves a manufacturer's trade name. Some EVs have badging that indicates they are "Electric" or "Zero Emission" vehicles. Some model names are specific and are only made as PHEVs or PEVs. Some vehicles have engine compartment

emblems. Manufacturers may use different names, including hybrid, hybrid synergy drive, or Integrated Motor Assist. Some may have an instrument cluster, or a hybrid logo on the vehicle's interior instruments (i.e. odometer, etc.). This logo may not be visible when a vehicle is shut down. There are also informal identification methods to indicate whether a vehicle is a hybrid PEV. These include high voltage labels, battery vents, electric cables, and panels.

### **Do electric vehicles have different emergency response protocols than a conventional vehicle?**

Emergency response protocols for electric vehicles are not significantly different than those for conventional vehicles. Usually, electric drive vehicles are designed with cutoff switches to isolate the battery and disable the electric system, and all high-voltage power lines are colored orange.

### **What are some common hazards at incident scenes?**

The following are common hazards: traffic, downed power lines, fuel spills or other HAZMAT, environmental hazards, fire, and unstable vehicles.

### **Can you get shocked from a PEV?**

Like the inherent dangers of driving an internal combustion car, there are dangers of operating a PEV; however, PEVs have safety features built in. One feature is called a "floating" system, where the energy path is isolated from the chassis and does not pass through the body of the car and to the driver. Some components (such as the speed controller and charger) will not function if they detect a current path to the chassis, even in milliamps.

EVs also have safety disconnects built in, including a main contactor, a circuit breaker, and fusible links that can manually disarm the battery pack circuit. These disconnects can also operate automatically in instances when tools are dropped across battery terminals, collision damage occurs, or some currents surges arise.

### **Do batteries leak significant amounts of electrolytes if damaged or breached?**

Batteries are in protective cases. If the case is breached, batteries will not leak a significant amount of electrolyte. NiMH and Li-Ion are dry cell batteries and may produce a few drops per cell if crushed. Some models may leak coolant. However, this should not be confused with electrolyte.

### **Do PEV batteries explode or catch fire or spew acid during an accident?**

EVs have a circuit breaker and fusible links that will break open the electrical circuit if an accident causes a short.

Similar to gasoline being spilled on skin, battery acid will cause irritation if not washed off. If it splashes on skin, it should be washed off as soon as possible, but it is not an instant emergency.

Additionally, the battery pack is not one compartment full of acid. Each battery has three separate cells with a small amount of acid in each one. One would have to split open all the cells of many batteries at once to get any sizable amount of acid exposure.

## **Do EV batteries release hydrogen gas?**

EV batteries can release hydrogen if the battery pack is being worked very hard, especially when it is low on charge. Hydrogen is also released as a normal occurrence at the end of the charging cycle, as the batteries equalize their charges.

Hydrogen quickly rises and dissipates. Most garages have enough air leaks and ventilation to avoid any problems with hydrogen. It would take a very strong concentration of hydrogen in the air to reach explosive levels. If this were to happen, there would be an overwhelming smell of battery acid long before an explosion happened.

## **How do I immobilize a vehicle?**

Immobilizing a vehicle typically requires using chocks, or wedges of sturdy material that can be placed behind the vehicle's wheels to prevent accidental movement. Place the vehicle in park. Engage the emergency brake. You may need to use the joystick shifter. Electronic parking brakes will not engage after battery power is cut. Secure the vehicle's wheels with chocks.

## **How do I disable a vehicle?**

You will need to shut off the vehicle ignition by disconnecting the 12 VDC battery. You can also disable the vehicle by pulling the high voltage system control fuse.

## **Are there different extrication methods for electric vehicles?**

Standard cribbing methods are acceptable to extricate a person from a vehicle. One should always place cribbing at the vehicle's structural points and be sure to avoid fuel lines, high voltage cabling, etc. Typically, high voltage components are not in the "cut points". Before one conducts extrication operations, they should determine the locations of occupant protection systems and high voltage components.

## **Are EVs safe when submerged in water?**

Electric vehicle charging cords and stations are designed to be safe in the rain or in water. Charging apparatus is designed so that the current doesn't flow until the plug is fully engaged in the receptor and it is protected from the elements by the structure of the plug and charging station.

## **What should first responders know about submersion when working with an electric vehicle?**

One should follow standard shutdown procedures. If access is a problem, remove the vehicle from water and then shut it down. Micro-bubbling may occur, but this is not a shock hazard, but a natural result of electrolysis. Damaged high voltage components, however, may be a shock hazard. Electric vehicles' shells and ground fault circuit interrupters provide protections from shock hazard.

## **What should a first responder know when an electric vehicle is on fire?**

For the most part, one should follow normal emergency shutdown procedures. First responders should use respiratory protection and utilize standard extinguishing equipment. It is important to not use this equipment to pierce the hood of an electric vehicle, due to HV

components and cabling near the surface. Putting out an EV fire typically requires a lot of water. An EV's electrical system is designed to not energize water (including fire streams).

If the fire is burning internally (battery involvement), try to allow the battery to burn itself out. Try to cool the outside of the battery—enclosure will impede direct extinguishment. External cooling can slow down and prevent the fire from spreading to adjacent cells in the battery.

If a charging station has caught on fire, treat the fire like any other energized electrical fire in a structure. First shut down power to the charging station before performing extinguishment operations. If a vehicle is struck while using the charging station, first turn off the power at the charging station. Then begin immobilizing and disabling operations.

### **Where can public safety responders go to learn how to address PEV related emergencies?**

- Sacramento Regional Public Safety Training Center, operated by American River College.
- The National Fire Protection Association's Electric Vehicle Safety Training project.
- National Alternative Fuels Training Consortium
- Underwriter's Laboratory safety training
- CalFire's Alternative Fuel Vehicle's Training Manual.

### **Sources:**

- Electro Automotive
- Portland General Electric
- Pocket Tools Training



# CHAPTER 4:

## Action Plan

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### Residential Integration

When planning for PEV charging in the residential realm, there is an important distinction between single family and multifamily homes. SACOG made twenty-one recommendations and presents regional guidelines for EVSE deployment in both contexts as illustrated in Tables 12-15.

#### Single Family Home EVSE Deployment

To date, single family homeowners are the largest market segment of plug-in electric vehicle owners. One explanation for this is the relative ease in charging: most single family detached houses include a garage and electric outlets for a charging station. A garage provides a convenient way to charge a vehicle overnight without having to buy special equipment, lengthy conduits or trenching. While a panel upgrade may be needed to support the EVSE, it is a relatively easy process for a certified electrician to install a home charger.

To continue supporting EVSE installation in single family homes, SACOG recommends the policies shown in Table 12.

**Table 12: Single-Family Residential Recommendations**

Recommendation	Explanation
1. Support a streamlined inspection and installation process for EVSE in SACOG jurisdictions.	Electrical work such as the addition of a 120V or 220V outlet often requires a permit from a local planning department and an inspection. Permits usually consist of an application that defines the project as well as a fee. Streamlining the permitting process could include making permit requests available online and creating a universal application process between jurisdictions, such as adopting the sample permit included in TakeCharge II.
2. Support education and training opportunities for local building inspectors to learn about EVSE installations.	Keeping local building inspectors informed of new technology and best practices regarding plug-in electric vehicles and EVSE is crucial to creating a more streamlined permitting process. Better informed building officials facilitate more efficient inspections and reduce bottlenecks.
3. Work with local utility providers to streamline the installation process of dedicated Time-of-Use meters	One of the advantages to driving a PEV is being able to take advantage of differential electricity rates available for EVSE; however, installing a second meter is another layer of complexity in the overall PEV adoption process. SACOG will coordinate with the region's utility providers (SMUD, PG&E and Roseville Electric) to make materials about time of use meter installations easily available.

Recommendation	Explanation
4. Make information about EVSE rebates accessible via the TakeCharge website.	Reducing the overhead costs of a PEV charging station supports widespread PEV adoption among single-family homeowners. Using the region's "one-stop shop" website. TakeChargeSac.org, SACOG will maintain an up to date list of rebate opportunities for homeowners looking to install a home charger.

Source: SACOG

### *Multi-Unit Dwelling EVSE Deployment*

Multi-unit dwellings, including apartment complexes, townhomes, studios, and condos, represent a large share of the housing supply in the Sacramento region. However, charging a PEV in multi-unit dwellings is more difficult than in a single family home. The major barriers of installing charging stations in multi-unit dwellings are politically and technically difficult to overcome. They can be categorized as stakeholder-related, site-related, and cost-related:

- Stakeholder-related
  - Homeowner association codes, covenants and restrictions and landlords may restrict installation of charging stations in multi-unit dwellings.
  - Building managers may see conversion of parking spaces as a hassle.
  - Renters may fear repercussions of lobbying too hard for EVSE.
  - Landlords and property managers may not want to assume responsibility for managing equipment.
  - Turnover of tenants in multi-unit dwellings may mean that at a given time, no residents will have electric vehicles and charging stations will go unused.
  - There is lost value if renters leave their MUD and paid for EVSE installation.
- Site-related
  - Physical limitations of buildings, such as number of parking spaces for residents, inadequate electrical capacity, configuration of carports and parking areas, distance between parking sites and electrical outlets, lack of access to Wi-Fi in underground parking, etc.
- Cost-related
  - Uncertainties about who will assume responsibility for paying for electrical upgrades, installation, maintenance, electricity usage, etc.
  - Homeowner Associations are not eligible to receive many of the major subsidies and rebate programs that can offset the costs of installing EVSE.

Overcoming these challenges will be critical to supporting widespread adoption of PEVs among MUD residents. Many of the governance-related challenges of working with property managers and homeowner's associations are being alleviated through legislation such as Senate Bill 880 (Corbett, Chapter 6, Statutes of 2012). Essentially, this act protects PEV drivers from

unreasonable barriers of installing charging equipment in deeded areas or common parking areas. A homeowner’s association (HOA) must allow the EVSE installation unless it is unreasonably expensive or impossible to install. Under SB 880, HOAs must enter a license agreement with the PEV driver, who must meet the following conditions:

- The charging station meets all applicable health and safety standards as well as all other applicable zoning, land use or other ordinances or land use permits. The applicable safety standard for AC Level 1 or Level 2 charging is UL 2594, Standard for Safety of Electric Vehicle Supply Equipment. For DC fast charging, the standard is UL 2202, Standard for Safety of Electric Vehicle Charging System Equipment.
- The charging station meets all applicable measurement standards pursuant to the Business and Professions Code, Division 5.
- The charging station complies with the HOA’s architectural standards for the installation of the charging station.
- A licensed contractor is engaged to install the charging station. Within 14 days of approval, provide a certificate of insurance that names the association as an additional insured party under the owner’s homeowner liability coverage policy for \$1,000,000 (except when existing wall outlets are used). Pays for the electricity usage associated with the charging station.
- The HOA can also compel current and future owners of the charging station to pay for maintenance, repair or removal of the charging station and for any resulting damage to the station, common area or exclusive-use common area. Importantly, the law allows, without a full HOA member vote, a portion of the common area to be used for utility lines or meters to support charging in a deeded or designated parking space. The provisions of this law are in Sections 1353.9 and 1363.07 of the Civil Code.

However, it is important to note that Senate Bill 880 does not apply to apartment buildings, meaning that there is still much to be done to ease the barriers surrounding PEV charging in multi-unit dwellings. SACOG can play a role in reducing these barriers in a variety of ways, such as supporting an adjustment of local regulations and zoning and sharing information.

**Policies**

SACOG recommends the policies in Table 13 for multi-family.

**Table 13: Multi-Family Residential Recommendations**

Recommendation	Explanation
5. Offer incentives for new MUD development projects that include EVSE.	Because home charging plays a crucial role in the overall PEV charging landscape, it is important to support EVSE in all types of housing. Offering incentives (i.e. expedited approval process, reduced overall parking requirements, etc.) will help bolster support from the development community to include PEV infrastructure in new housing projects.
6. Support increased access to night time charging and charging stations.	Creating more opportunities for overnight charging is a strategy that provides a variety of benefits. Night time charging is outside of peak hours, which creates lower energy costs for the vehicle owner and reduces grid impact. An example to increasing access to night time charging is: private properties (i.e. businesses with

Recommendation	Explanation
	EVSE) allowing patrons, non-patrons or non-employees to use their charging stations after hours.
7. Support the expansion of EVSE installation rebates to multifamily housing units.	Expanding access to residential charging will encourage purchase of PEVs and alleviate range anxiety. To date, the California Clean Vehicle Rebate Project, funded by the California Energy Commission, only allows individuals to apply for PEV and EVSE rebates. Subsidizing the purchase of EVSE by landlords will increase charging access for renters while decreasing the cost burden to landlords.
8. Create convenient and accessible charging station opportunities that can act as a proxy for multifamily residential charging (i.e. grocery stores).	<p>SACOG’s land use and transportation analysis reasoned that destinations routinely accessed by car could become charging opportunities for multi-family housing residents. Grocery stores emerged as a strong land use for the following reasons:</p> <ol style="list-style-type: none"> <li>1. Vehicles offer storage space for bulky grocery items. As a result, grocery shopping trips are less likely to be replaced with another mode of transportation.</li> <li>2. Driving behaviors reflect a likely incidence of shopping at a local grocery store, as opposed to driving across town. As a result, people tend to live a short distance from the grocery store where they shop.</li> </ol> <p>More information about SACOG’s grocery store EVSE analysis can be found in TakeCharge II.</p>

Source: SACOG

## Workplace Integration

### *Benefits*

Offering workplace charging has a variety of benefits for employers, employees, and building owners:

- Range Security – Workplace charging can alleviate “range anxiety,” the fear of getting stranded with an empty battery. Charging during the day can reduce stress and make for more productive workdays.
- Workforce Satisfaction – Workplace charging is an amenity that many employees will appreciate. Easing the work commute will ensure happier and eager employees.
- Employee Attention and Retention – Employees and prospective employees like to see their organization on the cusp of technological innovation and sustainability. Workplace charging is a great service to attract and maintain talent.
- Corporate Sustainability – Adding workplace charging stations helps reduce the carbon footprint of your organization. Supporting clean transportation is crucial to sustainability

efforts – over 30 percent of the United States’ greenhouse gas emissions come from the transportation sector alone.

- **Publicity** – The public pays attention to employers that are championing electric vehicles. These organizations get press for being eco-conscious and for offering a desired service to employees. Many of the most sought after companies are praised for their progressive workplace charging programs.
- **Cost Savings** – Should an employer buy electric vehicles for their fleet; a business can realize long-term fuel savings from EVs and workplace charging.

### *Planning and Implementation Process*

The steps to install workplace charging vary case-by-case. Depending on building and parking ownership, the process can be fairly straightforward or complicated. The easiest situation to install workplace charging would be if a company owns the building and parking lot and can easily access electricity. It is more complicated when a company leases space. Often, parking is independently owned, and electricity is inaccessible. Maintaining honest and frequent communication with these stakeholders will be crucial in securing workplace charging. Sharing the benefits of electric vehicle charging stations will also help speed up the process and make the entire process run more smoothly.

### *Identify Employee Interest in Workplace EV Charging*

To get the ball rolling, it is important to estimate the demand for PEV charging. A survey could be administered to employees to gauge interest in this service. Potential survey questions could include whether an employee currently owns a PEV or has plans to buy a PEV, how far their work commute is, willingness to pay for the service, and whether workplace charging would make them more likely to buy a PEV. Survey questions should focus on both short and long term interest in PEV ownership and workplace charging.

### *Identify Key Stakeholders in Workplace Charging*

Starting a workplace charging program requires coordination between different stakeholders. Likely stakeholders include employees, workplace management (Human Resources, Legal Counsel), workplace property owners, parking lot operators, and electricians, though this is not an exhaustive list.

### *Identify EVSE Needs*

Be sure to estimate how much electricity will be used by PEV drivers, EVSE system costs, electric panel upgrades, and associated installation and maintenance costs. These costs will determine the appropriate EVSE quantity and type (Level 1, Level 2, and DC Fast Charge) for an office.

### *Establish EVSE Installation Budget*

According to the Department of Energy, Level 1 charging EVSE ranges from \$10 to \$1,000. Level 2 chargers have an equally large price range, ranging between \$500 and \$6,000. These price ranges reflect the case-by-case basis of EVSE installation costs. The type of EVSE unit, physical layout of the parking area, as well as current and anticipated electricity needs will determine the installation costs. DC Fast Chargers cost over \$15,000 per unit, though improved technology continues to bring the price down. Some of the most common line items in an EVSE installation budget include:

- EVSE units
- Equipment rental (trencher, etc.)
- Sidewalk demolition/repair
- Labor (both physical installation and in-house workplace charging program development)
- Incentives (if available)
- Optional EVSE equipment (RFID credit card/smartcard readers, etc.)
- Signage and paint

### *Identify Financial Incentives*

Currently, there is a federal EV infrastructure tax credit of 30 percent up to \$30,000 for businesses looking to install EV charging stations. Plug-in America tracks EV charging equipment incentives.<sup>14</sup>

### *Determine Electricity Usage*

To date, many EV workplace charging programs are free for employees to use. The cost of electricity used to charge an EV is minimal, so businesses consider EV charging a comparable line item for other business perks such as kitchen amenities.

However, as there is greater market penetration for EVs, free charging may have to be revised. The California Center for Sustainable Energy (CCSE) and the California Air Resources Board (ARB) found that California EV owners are willing to pay 40-70 percent more for public and workplace charging compared to standard residential electricity rates.

### *Workplace Charging Policy*

An employer will want to draft clear company policies on workplace charging. Clear policies will address the following issues:

- *Who gets access to EVSE parking area?*  
It's important to communicate internally and externally who can access the EVSE. Signage and paint can help demarcate where dedicated EV parking is. The usage policies should be shared not just with staff, but also visitors who may be visiting the site for a meeting.
- *What time of day can EVSE be used?*  
EVSE charging has many temporal ramifications. The charging policy should lay out whether the EVSE can be used outside of the business' operating hours. It should also address any potential time limits for a car to use the EVSE.
- *What are the security measures surrounding the EVSE?*  
Although rare, theft and vandalism can happen with EVSE. Policies should be written that address what to do in the event that connectors and cables are damaged.
- *How will usage be determined if numerous people want to charge at the same unit at the same time?*

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<sup>14</sup> [State & Federal Incentives - \(pluginamerica.org\)](https://pluginamerica.org/why-go-plug-in/state-federal-incentives/) https://pluginamerica.org/why-go-plug-in/state-federal-incentives/

Policies should be designed that address when people want to charge simultaneously. One of the best solutions is to create specific and consistent charging time slots, rather than allowing a first-come-first-serve policy. To make sure the charging station is being used efficiently (i.e. a car that has been fully charged doesn't continue to use the space), there are many types of smartphone applications that can alert drivers when their charge is done. Smartphone apps may play a large role in planning, monitoring and scheduling PEV charges.

- *What costs are associated with the workplace charging program?*

Employers should be upfront about all costs, including EVSE unit purchase and installation. The policy should concisely lay out how much users will pay for the service as well as the payment methods available (credit card, prepaid cards, paycheck deduction, etc.)

### *Installation*

When siting a location for EVSE, it may be helpful to work with a contractor and evaluate the workplace's parking configuration. Safety considerations include shelter from weather, proper lighting, barriers to prevent collision with other cars, signage with emergency contacts, and placement of cords in a way that minimizes tripping.

Another important consideration when siting a charging station surrounds compliance with the Americans with Disabilities Act (ADA). Accessible EVSE spots often have wider stalls to accommodate vans and they place cables and infrastructure at an accessible height. You can learn more about accessibility issues in the U.S. Department of Justice's Standards for Accessible Design<sup>15</sup>.

Determine who will complete the EVSE installation—most likely, you will have to coordinate with the property managers in finding a certified electrician. The electrician will play a key role in performing necessary inspections, utility upgrades and installation, and determining what, if any, permits are needed. Most jurisdictions in the SACOG region require local permits when performing a panel upgrade.

It is recommended that you notify your utility provider when installing a Level 2 charging station at your workplace. Most likely, the EVSE will not make a big difference on the electrical load of the building, but it helps to keep them up to date so they can maintain their distribution and network capacity.

The workplace charging site will need signage to help enforce usage. Signage can include but is not limited to directional wayfinding signs to charging stations or regulatory signs. Permissive signs are usually green and white and provide motorists with information about when/where they can park. Prohibitive ones are typically red/black/white, and warn a motorist not to take a particular action. Signage should clearly delineate who can access the EVSE and when. Painted pavement markings can also help.

### *SACOG Region-Specific Case Studies of Electric Vehicle Workplace Charging Programs*

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<sup>15</sup> [2010 ADA Standards for Accessible Design](https://www.ada.gov/regs2010/2010ADASTandards/2010ADASTandards.htm)

<https://www.ada.gov/regs2010/2010ADASTandards/2010ADASTandards.htm>

In the Sacramento region, many key environmental employers, including the California Air Resources Board, CalPERS, Sacramento Metropolitan Air Quality Management District and, West Sacramento’s California Fuel Cell Partnership have begun offering workplace charging for their employees.

City of Sacramento

April 2013, the City of Sacramento accomplished an incredible milestone of installing more than 100 electric vehicle charging stations around the State Capitol. Much of this funding came from a State and Federal grant funded by the American Recovery and Reinvestment Act through the Transportation Electrification Initiative administered by the Department of Energy and the CEC<sup>16</sup>. Businesses are also beginning to offer public charging for their customers, including:

- Walgreens offers electric vehicle charging stations at 800 locations across the country. The charging stations are typically Level 2 chargers that can add up to 25 miles of range per hour of charge. A charge typically costs between \$3-4 a charge session. Walgreen’s EV initiative makes it the nation’s largest retail EV charging station host. In the Sacramento region alone, Walgreens has 22 stations.
- Whole Foods unveiled its first electric vehicle charging station at its flagship store in Austin, Texas in 2010. The company’s stations offer both 110 volt and 220 volt charging options. The Whole Foods grocery store in Folsom currently has EVSE for public use.

**Workplace Charging Policies**

To help support adoption of workplace charging, SACOG recommends the policies shown in Table 14.

**Table 14: Workplace Charging Recommendations**

Recommendation	Explanation
<p>9. Coordinate with businesses and Transit Management Associations to provide workplace charging for employees.</p>	<p>Transit Management Associations are non-profit, member-controlled organizations that provide transportation services in a particular area, such as a geographic region, business district, medical center, etc. Most often, these associations are public-private partnerships made up of local government and businesses in the defined area. Every Transit Management Association has Transportation Management Coordinators.</p> <p>Transit Management Associations provide an overarching framework for transportation demand management programs and services. Such programs are usually more cost effective when operated in conjunction with an association than as independent businesses. For example, a Transit Management Association may be able to have a larger purchasing power</p>

<sup>16</sup> [City of Sacramento Celebrates 100th EV Charging Station - Green Fleet - Government Fleet \(government-fleet.com\)](https://www.government-fleet.com/111143/city-of-sacramento-celebrates-100th-ev-charging-station?prestitial=1) https://www.government-fleet.com/111143/city-of-sacramento-celebrates-100th-ev-charging-station?prestitial=1



Recommendation	Explanation
	when buying charging stations from an EVSE provider and receive a discount. Additionally, these associations could work together and receive a discounted and expedited permitting process from a local government to install workplace charging station.
10. Prioritize workplace charging in areas where EVSE can be used outside of typical operating business hours.	Targeting workplace charging initiatives in densely populated areas with mixed land uses will ensure that workplace EVSE do not become “stranded” or underutilized. Choosing to install workplace charging at businesses that are located near major shopping centers or multifamily housing complexes will ensure that the infrastructure will be used beyond traditional 9 am - 5 pm working hours.

Source: SACOG

### Workplace Charging Surveys

In April 2013, the TakeCharge Coordinating Council, SacEV, and the Sacramento Clean Cities Coalition organized three PEV “Ride & Drive” events at two major workplaces in the region: the University of California campus in Davis and the Vision Service Plan campus in Rancho Cordova. A third Ride & Drive event was also held at a major environmental conference in downtown Sacramento that many green employers and fleet managers were attending. Promotional materials for the events included flyers, email listservs, and invitational videos created by the Clean Cities Sac channel on YouTube. Each Ride & Drive event was four hours long and scheduled during the lunchtime hours to give employees time to check out the PEVs on display, get questions answered by on-site PEV experts, and participate in the test drive event.

The goal of these test drive events was to gauge workplace and fleet managers’ interest in installing PEV charging stations as well as provide general information about PEVs. To do this, a survey was created for Ride & Drive participants, shown in TakeCharge II. **Error! Bookmark not defined.**

For the UC Davis event, invitations were widely distributed on campus and in the community as flyers, as articles in campus papers and in emails distributed to faculty and staff. In order to also attract foot traffic, the event was staged near one of the most popular dining locations on the campus and Scooter, the Spare the Air mascot was on hand to greet visitors. One of the major highlights of the UC Davis event was the Tesla Model S. While the vehicle was not available for the test drive portion of the event, it drew a lot of attention to the event.

The Vision Service Plan event was a private event for the company’s 2,000 employees. The partners worked with Vision Service Plan Facilities and HR staff to notify employees in advance

about the Ride & Drive opportunity. Again, to have a high level of visibility and generate considerable foot traffic, a popular on-site restaurant was picked for the location.

The third Ride & Drive was held in conjunction with the Green California Summit at the Sacramento Convention Center to support Earth Day. Working in partnership with the Downtown Transit Management Associations, the event was broadly noticed in advance through the Employee Trip Coordinators (who are members of the Downtown Transit Management Association) at all the major employment centers in Downtown Sacramento. Attendees at the Green California Summit were also encouraged to participate.

All three Ride & Drive events were successful in engaging businesses and individuals with the different types of electric vehicles available on the market. The events were designed to be both fun and informational. Participants could talk to EV owners/experts on site to learn more about what it's like to own and operate an electric vehicle. Additionally, they had the opportunity to physically get behind the wheel of an electric vehicle.

Throughout the course of the Ride & Drives, several hundred individuals were able to get personal orientation to electric vehicles and get their questions answered. This direct engagement with the vehicles plays an important role in demystifying some of the doubts people have about PEVS—largely the misconception that electric vehicles are under-developed and more closely resemble golf carts than actual automobiles. Overwhelmingly, Ride & Drive participants were impressed by the technological efficiency and design of the various EV models and walked away with a more positive attitude towards EVs. As the TakeCharge collaborative continues to spread PEV awareness in the Sacramento region, Ride & Drive events will be an important outreach strategy.

Most of the participants did not fill out the survey about workplace charging. However, their lack of responses is likely not attributed to a lack of interest in buying a PEV, but rather, the time constraints of their lunch breaks and wanting to optimize their time. For future Ride & Drive events, it may be best to require participants to take the survey before they can test drive the car. While this will ensure more survey responses, it will not gauge whether or not the physical experience of getting behind the wheel of a PEV changes their attitude about wanting to own one.

## **Fleet Integration**

In March 2012, Governor Brown signed Executive Order B-16-12, which mandates that State entities work to support the rapid commercialization of zero-emission vehicles. Part of the order stipulates that state agencies purchase zero-emission vehicles as part of their light-duty vehicle fleet replacement with targets of 10 percent replacement by 2015, and 25 percent by 2020.

In Sacramento, the Department of General Services is leading the efforts to comply with the Governor's 2015 directive. Part of the department's work is to develop an efficient procurement method for agencies to purchase charging equipment and deploy pilots. To date, Department of General Services has installed 24 electric vehicle charging stations at five state parking facilities in the Sacramento area and has added 10 PEVs to the state's rental pool. These "pilot PEVs" allow agencies and staff to gain first-hand experience using PEVs and will hopefully encourage agencies to convert their fleets to PEVs. The stations that Department of General Services installed were from Coulomb Technologies' State and Federal grants to

expand electric charging infrastructure and helped the department offset an estimated \$150,000.

Once the current fleet purchasing moratorium has concluded, State agencies are expected to begin replacing their existing older fleet vehicles. However, State fleets have been under a purchasing moratorium since 2009, creating backlogged demand to replace as many vehicles as possible. The additional per vehicle cost of ZEVs will be a financial barrier for agencies looking to replace their vehicles.

### *Creating a PEV Fleet*

Government vehicles aren't the only fleets going green and becoming electric. From small cars to large-scale delivery trucks, PEVs come in all shapes and sizes, making them a perfect addition to any type of vehicle fleet.

The cost of PEVs is expected to go down as production volume increases, making the payback period for a PEV reasonably competitive with other vehicles. The California Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project is funded and managed by the California Air Resources Board. The goal of this voucher program is to offset some of the initial costs of ZEVs to help speed up the market penetration of clean, low-carbon hybrid and electric trucks and buses.

Currently, all fleets (small, large, private, public) are available to receive a voucher. Vouchers range from \$8,000 to \$45,000 and are on a first-come, first-serve basis for the purchase of trucks and buses. There is also additional funding for the first three vehicles in the fleet to receive vouchers up to \$65,000 per vehicle. Each qualifying vehicle has a pre-set voucher amount.

From buses to delivery utility and waste collection, the eligible vehicles in the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project range greatly in size and purpose.

### *PEV Fleets – Regional Industry Clusters of Opportunity*

As part of a grant received from the California Workforce Investment Board, TakeCharge partners are working to increase the demand for, and deployment of, electric vehicles in the Sacramento region.

Due to its potential to reduce both fleet operating costs and transportation related emissions, increasing the use of electric vehicles in government and business fleets has been identified as an important opportunity area for the region. The Regional Industry Clusters of Opportunity grant engages regional employers and other key stakeholders to identify strategies that will increase the deployment of EVs in local fleets. By working with local businesses and stakeholders, the project team will hear firsthand how best to appeal to business owners and fleet operators to bring more EVs into fleets of all sizes around the region. A portion of the Regional Industry Clusters of Opportunity II grant funds will also be used to create a targeted outreach campaign that will provide information about the financial incentives relating to integrating PEVs into public and private fleets.

This project began in the summer of 2013 and will continue through 2014.

### **On-Peak Charging Mitigation**

To realize maximum environmental benefit from electric vehicles, charging activity must be focused on off-peak times of the day. Off-peak charging has the smallest impact on the

electric grid because it allows utility companies to use their existing power facilities without dipping into their “dirtier” power generators or building greater capacity. In other words, off-peak charging distributes electricity demand in a similar way that a driver will schedule a recreational trip to avoid congested commute traffic.

To create an infrastructure plan that minimizes grid impacts, SACOG carried out research to define “on-peak” and “off-peak” and to find which types of infrastructure have the biggest impacts on the grid. TakeCharge partners at SMUD assisted with this research and considers peak times as between 12 noon and 10 pm, with the Sacramento area’s hot summer season being particularly stressful to the grid. Furthermore, higher voltage charging infrastructure has the largest pull on the grid: higher voltage DC fast chargers create a larger load than lower voltage Level 1 and Level 2 chargers.

With these impacts in mind, SACOG focused its efforts on low voltage charging that could take place at night and in the early morning in order to best mitigate the effect of necessary on-peak charging. In addition to the Infrastructure Plan that emphasizes low-voltage residential charging, SACOG created the following policies to further incentivize off-peak charging. SACOG conducted economic and quantitative analyses of these policies, illustrated in TakeCharge II. **Error! Bookmark not defined.**

To alleviate on-peak charging, SACOG recommends the policies in Table 15.

**Table 15: On-Peak Charging Recommendations**

<b>Recommendation</b>	<b>Explanation</b>
<b>Pricing</b>	
11. Price the cost to charge and park an EV in a downtown business district higher than riding transit, but lower than fueling and parking an internal combustion vehicle.	This policy intends to incentivize conversion of current commute Vehicle Miles Traveled (VMT) to electric VMT while still incentivizing transit use, per the VMT reduction targets set by SB 375 and the Metropolitan Transportation Plan/ Sustainable Communities Strategy 2035.
12. Create "congestion" pricing for on-peak charging.	Congestion pricing is an economic strategy for pricing congestible public goods with higher peak charges during busy times. This strategy incentivizes use during non-peak times or utilizing alternative modes during peak times.

Source: SACOG

Additional steps can be taken to further encourage the purchase and use of PEVs.

To facilitate the use of PEVs, SACOG recommends the policies in Table 16.

**Table 16: PEV Use Recommendations**

<b>Recommendation</b>	<b>Explanation</b>
<b>Parking Ratios</b>	
13. Establish minimum parking ratios for PEVs	This policy would increase the parking available for electric vehicles and therefore decrease the available parking for internal combustion vehicles, assuming total parking supply is constant in the short run. This availability and reduction in parking availability act as incentives and disincentives, respectively. These should be minimum ratios, not a minimum number of spaces.
14. In-lieu parking fees used to build parking garages can be applied to purchase EVSE for that parking garage	Businesses and developments in downtown areas often contribute to the building or maintenance of central parking garages, in-lieu of providing on-site parking spaces. This policy allows those in-lieu fees to be used for EVSE in those garages.
<b>Spare the Air Integration</b>	
15. Provide free on-street parking for PEVs on Spare the Air days.	Free on street parking on Spare the Air days incentivizes driving PEVs on days with poor air quality.
16. Do not provide public charging on Spare the Air days.	The Spare the Air program calls for decreased emissions as well as decreased electricity consumption. While PEV driving should be encouraged on Spare the Air days, charging them during peak hours—particularly at high voltages common with public EVSE—is contrary to the mission of Spare the Air.
<b>PEV/Transit Interoperability</b>	
17. Provide EVSE and designated PEV parking at transit stations and hubs.	Tying EVs to transit has multifaceted benefits. It is an ideal way to reduce VMT, meet regional GHG reduction targets, extend the range of travel, and take advantage of lower voltage charging while drivers are at work. It allows PEVs to be fully integrated into a multi-modal transportation network.
18. Create interoperability with the Connect Card, the universal transit card for the Sacramento region, and allow charging to be purchased and loaded on the Connect Card.	This policy bolsters the tie between transit and EVs by allowing charging to be purchased online or at commercial outlets and loaded to a universal transit card—the Connect Card. This makes for a seamless multi-modal commute for PEV drivers.

<b>Recommendation</b>	<b>Explanation</b>
19. Bundle transit and PEV charging for Connect Card users. By purchasing charging, PEV users would qualify for a reduced fare monthly transit pass.	This policy incentivizes PEV, and transit use even further in order to realize the full benefits of Policy 17. Providing PEV users with reduced fare monthly transit passes incentivizes transit use, a mode that helps the region meet its VMT reduction targets. This aims to encourage a multi-modal commute where one might otherwise choose to commute exclusively by vehicle.
<b>Other Possible Policies</b>	
20. Eliminate the fuel tax and create a tiered VMT tax where the fee for electric vehicle miles traveled (Battery Electric Vehicles) < electric vehicle miles traveled (PHEV) < VMT (ICE).	As a larger percentage of the vehicle fleet is electrified and fuel economy improves, the current fuel tax will be insufficient to provide the necessary funding for the road and highways system. A tiered VMT tax aims to capture the costs to society associated with operating each type of vehicle.
21. Provide a tax incentive for businesses that provide workplace charging.	Charging at workplaces is a key step to reducing drivers' "range anxiety" while the range of EVs is still relatively low. Workplace charging will be less crucial as battery capacity increases with technology improvements.

Source: SACOG

## Outreach

### Snapshot of Public Awareness of PEVs

The mission of the Sacramento Electric Vehicle Association (SacEV) is to accelerate the regional adoption of plug-in electric vehicles and supporting infrastructure. SacEV is a volunteer, regional chapter of the non-profit, national Electric Auto Association ([www.electrcauto.org](http://www.electrcauto.org)). Public awareness is increasing in the Sacramento Region, and SacEV has played a central role in that development.

SacEV members have directly engaged over 10,000 members of the public in a variety of venues, including formal classes and presentations, environmental events, farmer's markets, Neighborhood Night out, and other public ceremonies. SacEV's experienced members continually provide information and insight to counter public misconceptions such as:

- EVs are too expensive to own for most.
- EVs are basically golf carts and do not perform well.
- EVs have pollution from electric generators that make them less environmentally friendly than many gas cars.

### Changes Between 2012 and 2013

SacEV has seen a significant shift in public perception in just the last year. The shift was evident in the flow of media coverage and information sharing. In 2012, public information and media questions generally revolved around TV and radio sound bites. In 2013, there has been far more interest and desire for details on range, costs, and real driver experience.

SacEV observed another sign of this shift among regional fleet managers in. The September 2012 Ride & Drive event, with talks, displays and panels on alternative fuels, was held for fleet managers, and was well attended. A similar event was held a year later in September 2013, and SacEV noticed that the areas of interest evolved. Also well attended, the 2013 event was distinguished by a decline in the fleet managers' interest in taking test drives. SacEV attributes this changes to the increased knowledge base of fleet managers, resulting in a decreased interest among fleet managers for the exploratory and introductory nature of the test drive portion of the event.

In 2012, most public charging stations were very lightly used by PEV drivers. EVSE at the Sacramento International Airport, Roseville Galleria shopping mall, SMUD Customer Service office, and City of Sacramento public garages were only lightly used, if used at all. Consequently, SacEV received frequent comments that these stations were a waste of taxpayer and business funds.

In contrast SacEV observed a new phenomenon in 2013: charger congestion. It appears that the EV adoption rate has exceeded the growth rate of public EVSE. Despite an increase in the number of EVSE in the region, PEV drivers have noted the difficulty in finding an open charger. EV drivers travelling to the Sacramento International Airport, a location with chargers usually vacant, now report that all 12 chargers are often full. The Roseville Galleria shopping mall chargers rarely have open positions. All the Sacramento City parking garages rarely have EVSE parking space available after 9 AM on weekdays. And even though the Sacramento City Hall parking garage tripled its number of chargers, over 80 vehicles are competing for 23 spaces.

SacEV, in conjunction with TakeCharge partners, has succeeded in moving the regional interest and adoption of PEVs forward. Advancement in public awareness and PEV adoption is also attributed to PEV friendly policies, growing public knowledge, and improving public perception.

## **SacEV's Goals for Increasing Public Awareness**

Consistent with its mission, SacEV adopted the following purpose statements:

- For members: To act as a source of information on the current state of electric vehicle technology and be an advocate for infrastructure in the region.
- For the public: To promote and educate the public on the current and future state, availability, uses, and purchase options of electric vehicles along with their infrastructure, technology, benefits, and value.
- For youth: To encourage experimentation with, use of, and knowledge building of electric vehicle technology through exposure, training, and education.

## **Building Public Awareness Through Events**

SacEV provided EV related assets to 40 events in 2011 and 2012. These assets included:

- Range of available PEVs
- EV owners sharing their personal experience driving electric
- Technology presentations to youth and adults including solar charging, fuel cells, electric motors.

An example of one of the larger SacEV events was September's Plug-In Day event (Figure 2). SacEV worked with SACOG, local auto dealers, utilities, and EVSE and Solar providers, drew and engaged more than 4,500 people from all over Sacramento county with the following:

- Test drives: > 250
- Test drive miles: > 700
- Display cars: > 50
- Faces painted: > 65
- Glitter tattoos: > 75

**Figure 2: Typical Plug-In Day Event**



Source: Plug-in Day

Three charging stations were awarded to the first three event test drivers that purchased PEVs. The winners were identified the following day having purchased Nissan LEAF, Toyota RAV 4 Electric, and a Chevy Volt. Folsom Lake Ford loaned a Ford Fusion to Aerojet General's Director of Corporate Responsibility to try out for a few days to get his impression of the electric vehicle. This can be seen in Figure 3

Knowledge and insight gained by the community were illustrated by some of statements from dealers:

- Nissan Dealer: "Plug In Day was a great event. A great chance for people to come out, with no pressure, to see the cars, drive the cars and learn about the cars without being a buying event. Over the next few days following the event, we had a lot of people from the event show up and sold quite a few vehicles due to the event, at least 15 to 20 LEAFs."
- Nissan Dealer: "I lost count of how many after 30 or 40 test drives. Originally we were just doing two cars. Before we knew it, I had to call up the dealership to send more people out. We ended up with four cars and reps."
- Chevy Dealer: "We had 3 salesmen with 3 different Volts. Going to the event, I knew a little bit about the Volt, speaking with Volt owners there I learned a lot more then and



there. I personally provided over 50 test drives at the event and I spoke with all those test drivers who didn't know anything about the Volt. The next day I sold 3 of them due to the event."

- Nissan Dealer: "The turnout was great. It really was. Whatever SacEV did for the turnout, it was spot on. A turn out with the right kind of people came. People that were truly interested in the car. They wanted the pressure-free time to learn about the car. And it showed by the people that came into the dealership afterwards to get the other half of the story – pricing, what it takes to own the vehicle. Most had already found out from the event whether the car would fit their lifestyle.

### **Building Awareness Through Social Media**

SacEV uses social media, web pages and email distribution to provide information to the public on topics such as:

- Regional PEV related news updates
- Tips for New PEV owners
- Summary listings of available PEVs and their attributes
- Key website for more information
- Updates on regional PEV sales activity
- Calendar of PEV related events

### **Figure 3: YouTube Interview – Electric Vehicles in the Sacramento Region**



Source: [Electric Vehicles in the Sacramento Region -Tim Murphy - YouTube](#)

### **Building Public Awareness at the Workplace**

In conjunction with partners such as the Sacramento Metropolitan Air Quality Management District and dealers, SacEV launched a program in 2012 to provide regional executives with three-day loaner PEVs and captured their post drive testimonials (Figure 4).

Future activities include workplace test drives and workplace charging consultation.

**Figure 4: Post-drive Testimonials**

Fair Oaks resident Tod Strain commuted to his job at Arden Fair Mall for a week in an Electric Ford Focus from Downtown Ford as part of TakeCharge Sacramento's Executive Loaner Program

Tod Strain  
Senior Property Manager  
Macerich / Arden Fair Mall

**PERFORMANCE:** LOVED THE SMOOTH POWER OF THE ELECTRIC MOTOR  
**CHARGING AT HOME:** EASY  
**CHARGING AT WORK:** EASY (ARDEN FAIR HAS THREE CHARGING STATIONS)  
**GALLONS OF GAS SAVED:** 10

Contact your local car dealers to talk about new PEV models and figure out which one is right for you!

**TAKECHARGE**  
www.takechargesac.org

Source: SACOG

### **TakeCharge Web Resources and Meetings**

SACOG will continue to maintain its TakeCharge Resources webpage, which offers both region-specific and general information about PEV related projects. This will remain an important portal to keep local planners and decision makers up to date. Additionally, SACOG will continue to bring in PEV experts and practitioners to report updates at the TakeCharge Coordinating Council meetings, which are designed to be a regional forum for convening on PEV related issues. PEV experts that have presented at the Coordinating Council include:

- Joshua Cunningham, PEV Collaborative on PEV Readiness
- Erik deKok, City of Sacramento on City Efforts toward PEV Readiness
- Bill Boyce, SMUD on Utility Roles in PEVs
- Patty Youngdale, Coda on Coda EVs

- Thomas Miller, Mitsubishi on Mitsubishi EVs
- Lisa Chiladakis, ARB on Statewide Incentives
- Tobias Barr, UC Davis on EV Forecasts
- Frank Jenkins, EVI on Heavy Duty EVs
- Eric Cahill, Adaptive Consulting on EV Carshare
- John Sheers, CEERT on NRG Settlement
- Gabriel Hern, ViaMotors
- Don Howe, Caltrans on EV Signage
- Will Barrett, Clipper Creek Regional EVSE
- Becky Haupt, Phil Haupt Electric
- Joel Pointon SDG&E on MUD Charging
- Gil Tal, UC Davis on EVSE modeling

### **Continued Outreach**

While federal and state level agencies will help offer incentives for vehicles and charging stations (i.e. tax credits and rebates), it will be important for the regional and local levels to provide extensive and meaningful outreach to inform people about the environmental, economic, and public health benefits of PEVs. Additionally, many of the common features, technologies and practices surrounding vehicles and vehicle ownership (including car prices, re-fueling infrastructure, and vehicle range) are different with plug-in electric vehicles and will require basic "PEV 101" consumer education.

Already, the Sacramento region has started outreach campaigns to educate consumers on the basic mechanics of PEVs and their benefits. In 2011, the Capitol Area PEV Coordinating Council (TakeCharge Coordinating Council) was created to promote plug-in electric vehicle readiness in the Sacramento region. The Coordinating Council identified three major aspects of PEV readiness in the region:

1. Outreach to consumers, businesses and local governments;
2. Working with local governments to streamline the permit process for electric vehicle supply equipment (EVSE) installations, and creating building ordinances that standardize EVSE inclusion; and
3. Identifying workforce development and training opportunities for building inspectors, planners, emergency first responders, and auto dealers.

The following is a list of partner agencies of the TakeCharge Coordinating Council involved with PEV outreach and education:

- SACOG manages the Coordinating Council and the organization's consumer outreach website, TakeChargeSac.org. The website's focus is to provide region-specific information (when applicable) and direct readers to top quality sources of PEV information. Much of the website's current content is aimed at addressing current cost, rebate and charging concerns. One of the more popular tools developed by SACOG and

hosted on the TakeChargeSac.org website is the “regional range finder tool” that is designed to reduce range anxiety for drivers. Users can input a location to the map and see where charging stations are available within their driving range.

- Valley Vision provides strategic guidance around workforce development activities, stakeholder outreach and overall project execution. During the process of the PEV Infrastructure Plan development, Valley Vision was responsible for coordinating specialized workshops for different types of users (i.e. building owners and property managers) to increase public awareness of PEVs and their benefits.
- Sacramento Metropolitan Air Quality Management district acts as a project member and oversees many of the outreach initiatives for the TakeCharge Coordinating Council.
- Greenwise Joint Venture supports the TakeCharge Coordinating Council’s PEV readiness goals and outreach efforts. Greenwise is a non-profit focused on transforming the region into the greenest in the country. Supporting the deployment of clean transportation technologies, such as PEVs, is key to the Greenwise initiative.
- SMUD is a member of the project team, providing knowledge and leadership gained from many years of providing energy to power PEVs.
- SacEV is a non-profit organization made up of PEV owners and advocates. SacEV plays an important role in the TakeCharge Coordinating Council's outreach initiatives by coordinating test drive opportunities and providing first-hand driver experience of owning a PEV in the Sacramento region.

As the Sacramento region continues to support plug-in electric vehicles, SACOG recommends the policies shown in Table 17.

**Table 17: PEV Support Recommendations**

<b>Recommendation</b>	<b>Explanation</b>
<b>Outreach &amp; Information Sharing</b>	
22. Continue to develop and maintain the TakeChargeSac.org website as a comprehensive information source of purchasing, owning and driving a PEV in the Sacramento area.	SACOG will continue to act as an informational clearinghouse and provide the web resources to improve and maintain PEV information sharing.
23. Continue to support and assist TakeCharge Coordinating Council members’ outreach efforts to increase public awareness about the benefits of PEVs.	SACOG is able to provide planning and data resources to the TakeCharge effort to support information-based decision making.

Source: SACOG

# GLOSSARY

**CALIFORNIA ENERGY COMMISSION (CEC)**—The state agency established by the Warren-Alquist State Energy Resources Conservation and Development Act in 1974 (Public Resources Code, Sections 25000 et seq.) responsible for energy policy. The CEC's five major areas of responsibilities are:

- Forecasting future statewide energy needs.
- Licensing power plants sufficient to meet those needs.
- Promoting energy conservation and efficiency measures.
- Developing renewable and alternative energy resources, including providing assistance to develop clean transportation fuels.
- Planning for and directing state response to energy emergencies.

Funding for the CEC's activities comes from the Energy Resources Program Account, Federal Petroleum Violation Escrow Account, and other sources.

**CLEAN VEHICLE REBATE PROGRAM (CVRP)**— promotes clean vehicle adoption in California by offering rebates from \$1,000 to \$7,000 for the purchase or lease of new, eligible zero-emission vehicles, including electric, plug-in hybrid electric and fuel cell vehicles.<sup>17</sup>

**DIRECT CURRENT (DC)**—A charge of electricity that flows in one direction and is the type of power that comes from a battery.

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

**ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE)**—Infrastructure designed to supply power to EVs. EVSE can charge a wide variety of EVs, including BEVs and PHEVs.

**GREENHOUSE GAS (GHG)**—Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include water vapor, carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (NO<sub>x</sub>), halogenated fluorocarbons (HCFCs), ozone (O<sub>3</sub>), per fluorinated carbons (PFCs), and hydrofluorocarbons (HFCs).

**PACIFIC GAS AND ELECTRIC COMPANY (PG&E)**—An electric and natural gas utility serving the central and northern California region. **PLUG-IN ELECTRIC VEHICLE (PEV)**—A general term for any car that runs at least partially on battery power and is recharged from the electricity grid. There are two different types of PEVs to choose from—pure battery electric and plug-in hybrid vehicles.

**PLUG-IN HYBRID ELECTRIC VEHICLE (PHEV)**—PHEVs are powered by an internal combustion engine and an electric motor that uses energy stored in a battery. The vehicle can be plugged in to an electric power source to charge the battery. Some can travel nearly 100 miles on electricity alone, and all can operate solely on gasoline (similar to a conventional hybrid).

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<sup>17</sup> [CVRP Overview | Clean Vehicle Rebate Project](https://cleanvehiclerebate.org/en/cvrp-info) <https://cleanvehiclerebate.org/en/cvrp-info>

SACRAMENTO AREA COUNCIL OF GOVERNMENTS (SACOG)—An association of local governments in the six-county Sacramento region.

SACRAMENTO MUNICIPAL UTILITY DISTRICT (SMUD)—The acronym for the Sacramento Municipal Utility District, an electric utility serving the greater Sacramento, California, region.

ZERO EMISSION VEHICLE (ZEV)—Vehicles that produce no emissions from the on-board source of power (e.g., an electric vehicle).