Draft Background Assessment Report for the Central Sierra Zero Emission Vehicle Readiness Plan

December 21, 2018

Prepared for
Tuolumne County Transportation Council

Prepared by
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Executive Summary

The State of California is leading the nation in electric vehicle (EV) and EV infrastructure (EVI) goals. Governor Edmund G. Brown Jr.'s Executive Order B-16-2012 tasked the California Energy Commission (CEC) and other state agencies to support benchmarks to bring 1.5 million zero emission vehicles (ZEVs) to California's roads and in conjunction make sure that Californians have easy access to ZEV infrastructure to charge those vehicles by 2025. Expanding EV charging networks is critical to supporting these goals and reducing barriers to plug-in electric vehicle (PEV) adoption. To meet state and regional targets, Tuolumne County Transportation (TCTC) engaged the Center for Sustainable Energy (CSE) to develop the Central Sierra ZEV Readiness Plan (the Plan). The goal of the Plan is to improve opportunities for ZEV Readiness in the Central Sierra Region (Region) and resolve barriers to the widespread deployment of private and public ZEV infrastructure. In pursuit of this goal, the following critical project objectives were identified:

1. Evaluate the current state of the ZEV market;
2. Study and analyze site locations needed for ZEV infrastructure deployment;
3. Evaluate opportunities to streamline ZEV permitting, installation, and inspection to facilitate the timely approval and construction of ZEV infrastructure;
4. Study and analyze the feasibility of ZEV adoption in municipal fleets;
5. Create a venue for stakeholder coordination and gain input from key stakeholders on the ZEV Readiness Plan;
6. Identify funding sources for an implementation program.
7. This Background Assessment Report documents the current state of the ZEV market, details ZEV market growth, and identifies existing gaps; addressing project objective 1.

The Region is located along the western slope of the Sierra Nevada mountain range and includes a four-county area: Alpine County, Amador County, Calaveras County, and Tuolumne County. The Regional population is approximately 139,438 people, 45% whom are close to retirement and live locally year-round. The second largest segment of individuals within the Region (10.2%) are also close to retirement but reside in the area seasonally. Despite the relatively small permanent population, the Region is home to several historical state and national parks with beautiful scenery and recreational activities that attract year-round visitors.

The Region has existing EV drivers and EV infrastructure but has not achieved wide-adoption. There are currently 203 plug-in hybrid electric vehicles (PHEVs) and 196 battery electric vehicles (BEVs) in the Region according to 2018 vehicle registration data from the State of California. This accounts for just 0.16% of total vehicle registrations in the four-county region. EV vehicle growth projections identify 1,090 to 1,195 total PEVs by 2020 and 1,617 to 2,233 total PEVs in the Region by 2025.

Currently, there are 27 sites that offer EV charging with a total of 70 charging ports. While the current charging infrastructure is sufficient in terms of number of charging plugs per vehicle, analysis of geographical coverage of existing public charging stations shows that these charging stations are heavily concentrated in southern and western portions of the county and are mainly located in small cities in the foothills. This means there are opportunities for deployment along major travel routes that lead over the Sierra Nevada's or state/national parks located further east in the Region. Demand projections identify a minimum of 230 EV charging units will be required with a maximum estimate of 320 charging units in the Region by 2025. Charging station plug projections will require 191 to 249 destination

level 2 charging station plugs in the Region and 39 to 71 direct current (DC) fast charging plugs to support the expected growth in number of EVs by 2025. This means that the number of destination level 2 charging plugs will need to increase nearly 5-fold over the next 7 years and the number of DC fast charging plugs will need to increase nearly 7-fold over the same time.

Significant barriers exist that challenge continued wide-spread EV adoption in the Region. The mountainous terrain and cold weather climate requires vehicles to use more energy, resulting in a necessity to provide charging infrastructure that accounts for reduced efficiency. The permanent population of the Region is also small and sparsely dispersed, which requires appropriate EV infrastructure siting, however, with a booming tourism industry there is increased seasonal demand for EV infrastructure. Network connectivity issues and a lack of cellular coverage creates an obstacle for deploying networked EV chargers. Severe and inclement weather can accelerate normal wear and tear on stations and, coupled with the terrain, make it difficult to access and maintain stations. Lastly, while there is State-wide policy supporting EV integration into planning and development, regional/local policy does not exist that specifically supports EV and EVI expansion.

A survey of regional business owners and managers was completed as part of the project work. Most survey respondents expressed a positive perception of EVs and charging stations. All respondents identified knowledge gaps that needed to be overcome to encourage wide-spread EV adoption; Identified barriers included:

- Installation costs and available incentives;
- Electrical panel capacity requirements;
- Charging technology options;
- List of EV charging infrastructure installers; and
- Guidance on billing users

While there are significant barriers to overcome, the Regional also has existing conditions and opportunities that can be leveraged to bridge the gap to meet state goals. Looking ahead, several strategies can be employed to increase EV deployment and adoption. Employing mandatory and voluntary codes for EV infrastructure in buildings and parking lots will increase the availability of charging at new developments. Streamlining the permitting process for installing EV charging will make it quicker and less costly for equipment installers and property owners to pursue EV solutions. Implementing local ordinances that comply with accessibility and signage needs for EV charging is important for making sure EV charging stations are accessible to all EV drivers. Leveraging the Region's solar potential to extend charging infrastructure to remote locations can mitigate existing gaps in electrical service. Conducting Regional outreach to educate stakeholders about EVs, EV Infrastructure options, available financing vehicles, and connecting them with installation professionals is also needed. These and other deployment solutions, as well as recommended deployment locations, and an outreach strategy (including a Tool-Kit) are planned as part of the Plan; scheduled to be completed in August 2019.

Source: USDA Forest Service

INTRODUCTION & REGIONAL SETTING

Introduction

California's Zero Emission Vehicles (ZEV) Action Plan projects 1.5 million ZEVs will be on the road by 2025. With the transportation sector being the largest contributor to greenhouse gas (GHG) emissions in California, ZEVs are integral for meeting GHG emission reduction goals identified in AB 32, AB 197, and SB 32, and play a significant role in meeting regional targets identified in Tuolumne County Transportation Council's (TCTC) Rural Sustainable Strategies from the 2016 Tuolumne Regional Transportation Plan. To meet state and regional targets, TCTC engaged the Center for Sustainable Energy (CSE) to develop a Central Sierra ZEV Readiness Plan (the Plan) for the four-county area: Alpine County, Amador County, Calaveras County, and Tuolumne County.

The goal of the Plan is to improve opportunities for ZEV Readiness in the Central Sierra Region (Region) and resolve barriers to the widespread deployment of private and public ZEV infrastructure. In pursuit of this goal, the following critical project objectives were identified:

1. Evaluate the current state of the ZEV market;
2. Study and analyze site locations needed for ZEV infrastructure deployment;
3. Evaluate opportunities to streamline ZEV permitting, installation, and inspection to facilitate the timely approval and construction of ZEV infrastructure;
4. Study and analyze the feasibility of ZEV adoption in municipal fleets;
5. Create a venue for stakeholder coordination and gain input from key stakeholders on the ZEV Readiness Plan;
6. Identify funding sources for an implementation program.

This Background Assessment Report documents the current state of the ZEV market, details ZEV market growth, and identifies existing gaps; addressing project objective 1. Findings stated herein will inform and direct the development of the Plan; scheduled to be completed in August 2019.

Figure 1: Counties in the Region

Source: Center for Sustainable Energy, 2018

- Alpine County
- Amador County
- Calaveras County
- Tuolumne County

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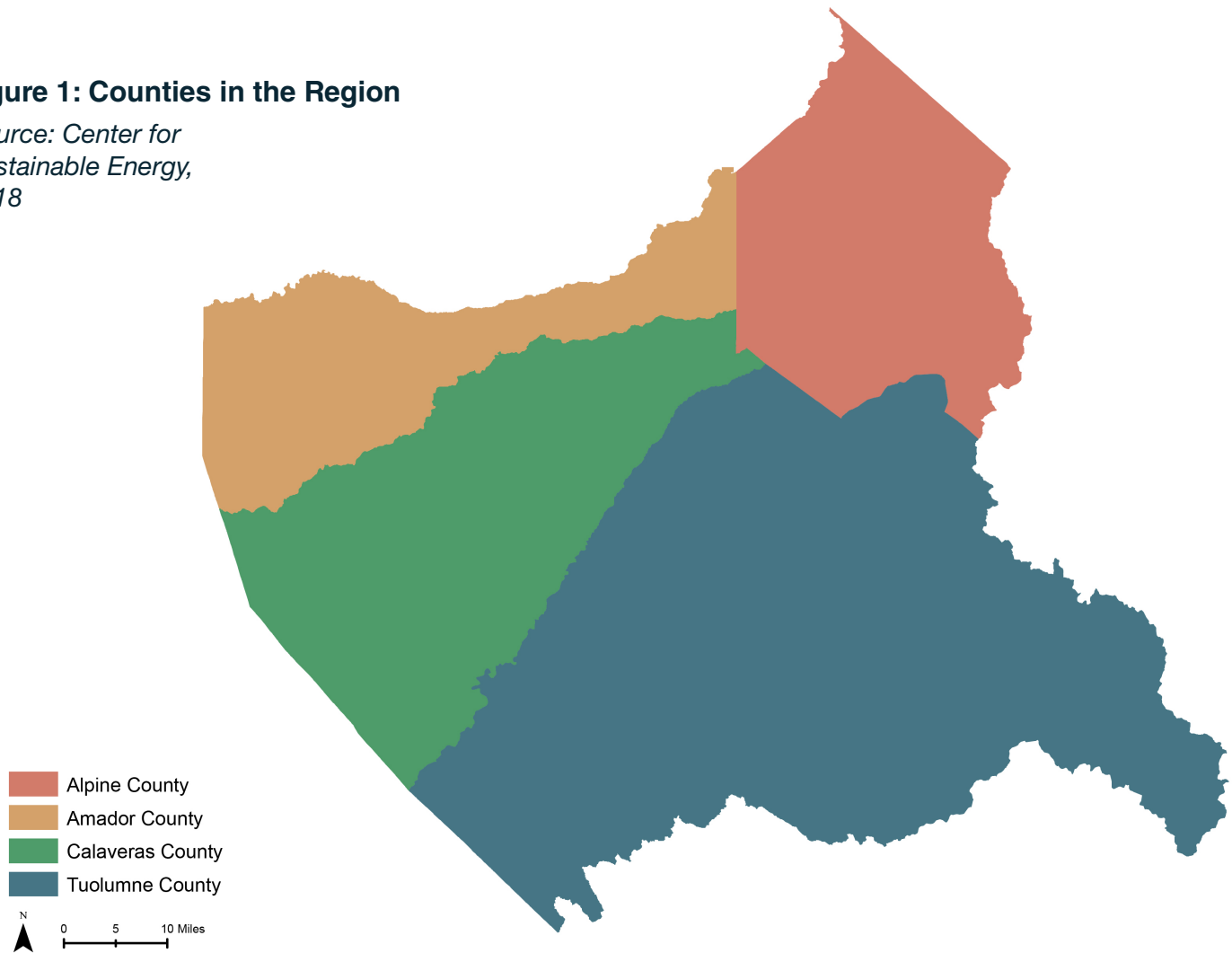
Geography

The Region is located along the western slope of the Sierra Nevada mountain range and includes Alpine County, Amador County, Calaveras County, and Tuolumne County (Figure 1). Communities within the Region trace their roots to California's gold rush era, and the current population lives along the same waterways and small valleys in the Sierra foothills that were once dominated by placer mining (CSEDD, 2017) The region features 4,500 square miles of rolling hills, forest lands, and high mountain peaks with a change in elevation ranging from near sea level to approximately 13,000 feet above mean sea level.

Figure 2: Aerial View of the Region
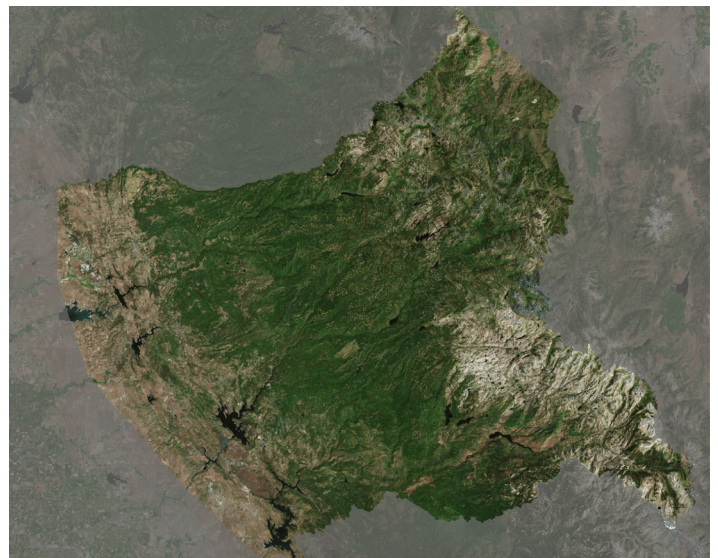
Source: Center for Sustainable Energy, 2018

Figure 3: Spring/Summer Solar Potential and Transmission Lines

Source: Center for Sustainable Energy, 2018
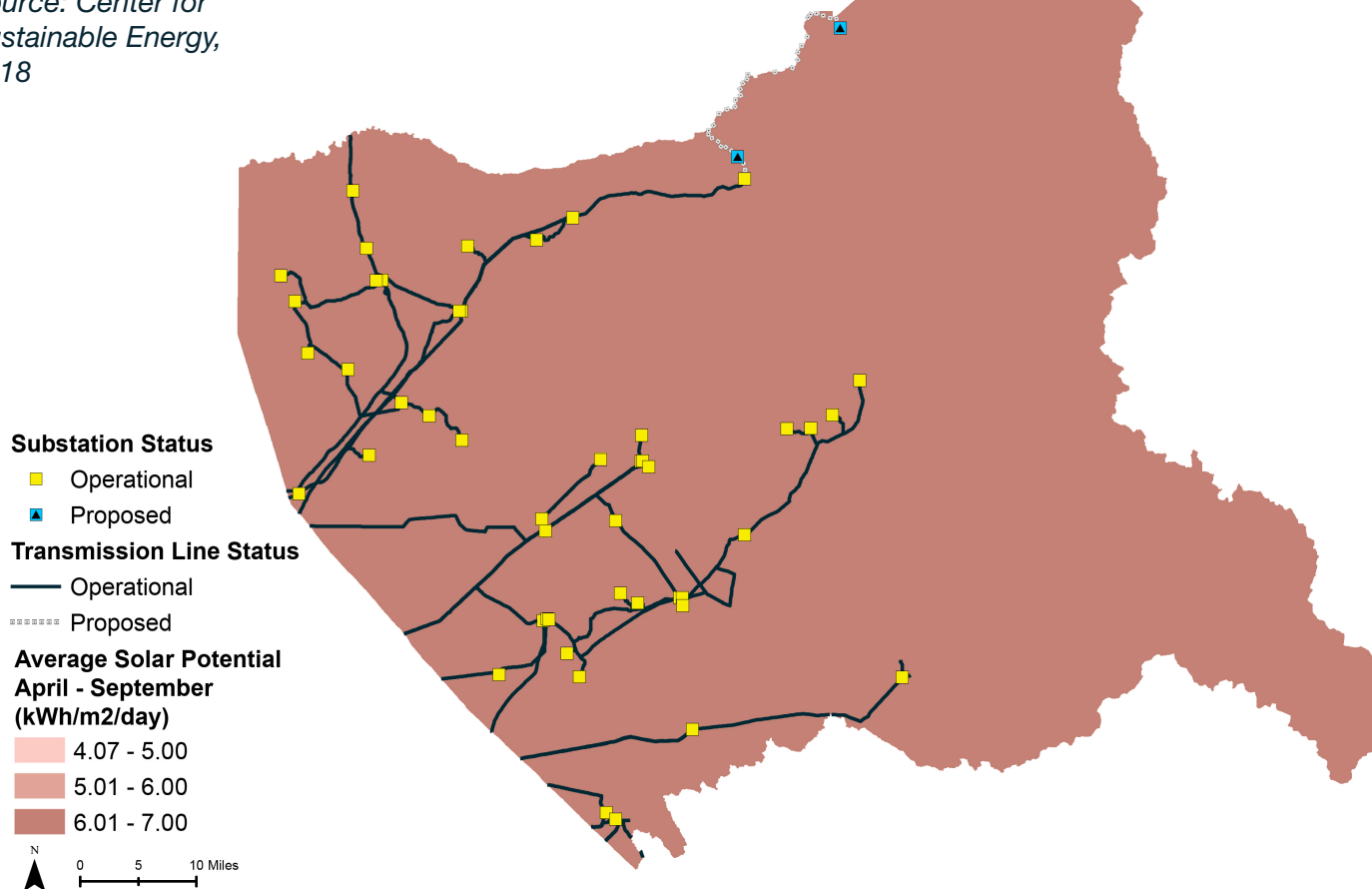
Electrical Infrastructure

According to the California Energy Commission, in 2014, 98 percent (%) of the electrical generation capacity in the region was from hydro power, 2% was from biomass, and less than 1% was from solar; the Region does not have natural gas electricity generation capacity (CSEDD, 2017). The Region is serviced by Pacific Gas & Electric, Liberty Utilities, Kirkwood Utilities Department, and the Tuolumne Public Power Agency. Figure 3 depicts the existing transmission infrastructure.

Although less than 1% of electricity is currently generated via photovoltaics, the Region has good year-round solar potential, as depicted in Figures 3 and 4.

Figure 4: Fall/Winter Solar Potential and Transmission Lines
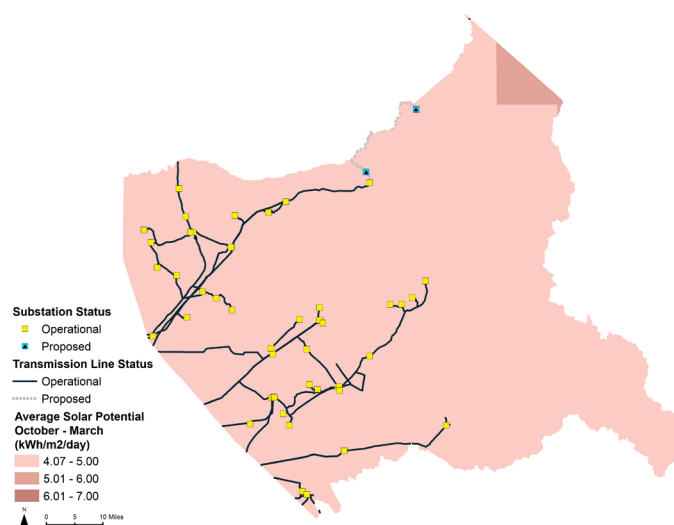
Source: Center for Sustainable Energy, 2018

Figure 5: State Highways in the Region

Source: Center for Sustainable Energy, 2018
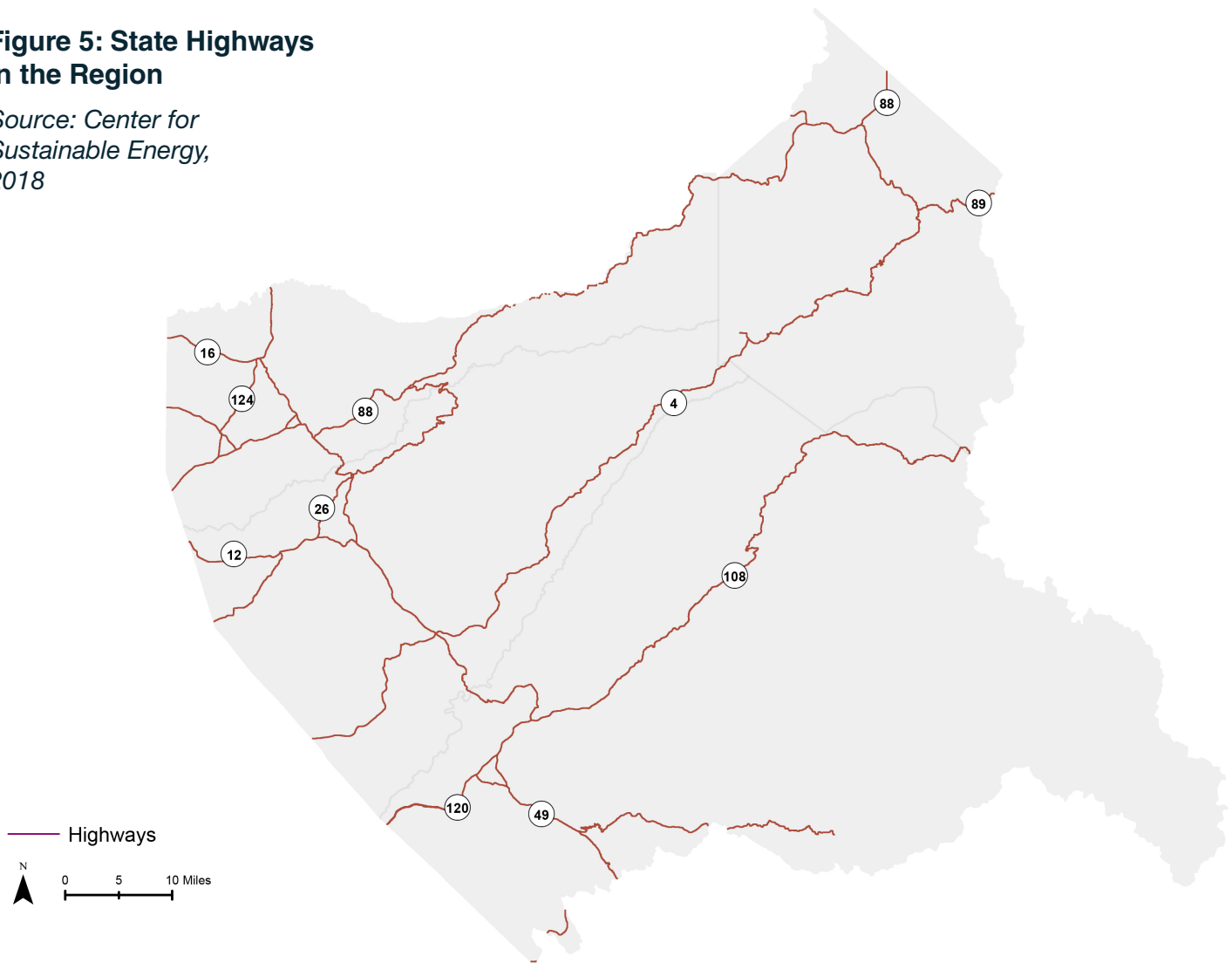
Highways

State and county highways are the backbone that connect communities and provides access to coveted destinations. California State Route 49 is a vital north-south artery for foothill communities. Three east-west gateways, Highway 4 (Ebbetts Pass), Highway 108 (Carson Pass), and Highway 120 (Tioga Pass) crest the Sierra Mountains. State Route 120 provides access to Yosemite National Park. Highways in the region include:

- State Route 49: North-South through, Amador, Calaveras, Tuolumne
- State Route 89: North- South through Alpine County
- State Route 88: East-West through Amador County

- State Route 4: East-West through Calaveras County
- State Route 108: East-West through Tuolumne County
- State Route 120: East-West through Tuolumne County

Based on California Department of Transportation (Caltrans) 2016 traffic data, State Route 49 through Tuolumne County has the highest average annual daily traffic volume (AADT) in the Region (255,500 vehicles). The lowest AADT traffic volume (24,000 vehicles) was recorded in Alpine County on State Route 88 (Caltrans, 2016). Figure 5 shows the locations of major highways in the county.

Population

The Region population of approximately 139,438 people accounted for less than 1% of the statewide population, according to State of California Department of Finance's January 1, 2017 population estimates. According to ESRI's Tapestry Segmentation Area Profiles, nearly 45 % of the Region is comprised of Rural Resort Dwellers who are residents close to retirement. These individuals are primarily older, married couples with no children at home; 81.8% of these individuals are homeowners. The second largest segment of individuals within the Region (10.2%) are also close to retirement but reside in the area seasonally (CSEDD, 2017).

The region has seven incorporated cities and 50 smaller, unincorporated census-designated places (CDP). The unincorporated population accounts for nearly 82% of the region's total population. Figure 6 and Table 2 provides an overview of population counts by county and location and Table 1 identifies the cities and communities within the Region.

Table 1: Cities and Communities in the Region by County

Alpine	Amador	Calaveras	Tuolumne
Bear Valley CDP	Amador City	Angels City	Sonora City
Mesa Vista CDP	Ione City	Dorrington CDP	Groveland CDP
Kirkwood CDP	Jackson City	Forest Meadows CDP	Phoenix Lake CDP
Alpine Village CDP	Plymouth City	West Point CDP	Cold Springs CDP
Markleeville CDP	Sutter Creek City	Copperopolis CDP	Soulsbyville CDP
	Fiddletown CDP	San Andreas CDP	Pine Mountain Lake CDP
	Drytown CDP	Mokelumne Hill CDP	Columbia CDP
	Camanche North Shore CDP	Vallecito CDP	Tuolumne City CDP
	Camanche Village CDP	Rail Road Flat CDP	Long Barn CDP
	Pine Grove CDP	Valley Springs CDP	Mi-Wuk Village CDP
	Pioneer CDP	Rancho Calaveras CDP	Tuttletown CDP
	Red Corral CDP	Arnold CDP	East Sonora CDP
	Buckhorn CDP	Mountain Ranch CDP	Twain Harte CDP
	Volcano CDP	Avery CDP	Mono Vista CDP
	Buena Vista CDP	Murphys CDP	Strawberry CDP
	Martell CDP	Wallace CDP	Cedar Ridge CDP
	River Pines CDP		Jamestown CDP
			Chinese Camp CDP
			Sierra Village CDP

Source: U.S. Census Bureau Places, 2017

Figure 6: Population by Census Tract, 2010

Source: Center for Sustainable Energy, 2018

Population 2010

	133 - 1175
	1176 - 1867
	1868 - 2995
	2996 - 3709
	3710 - 4046
	4047 - 4672
	4673 - 5073
	5074 - 5961
	5962 - 6969
	6970 - 9515

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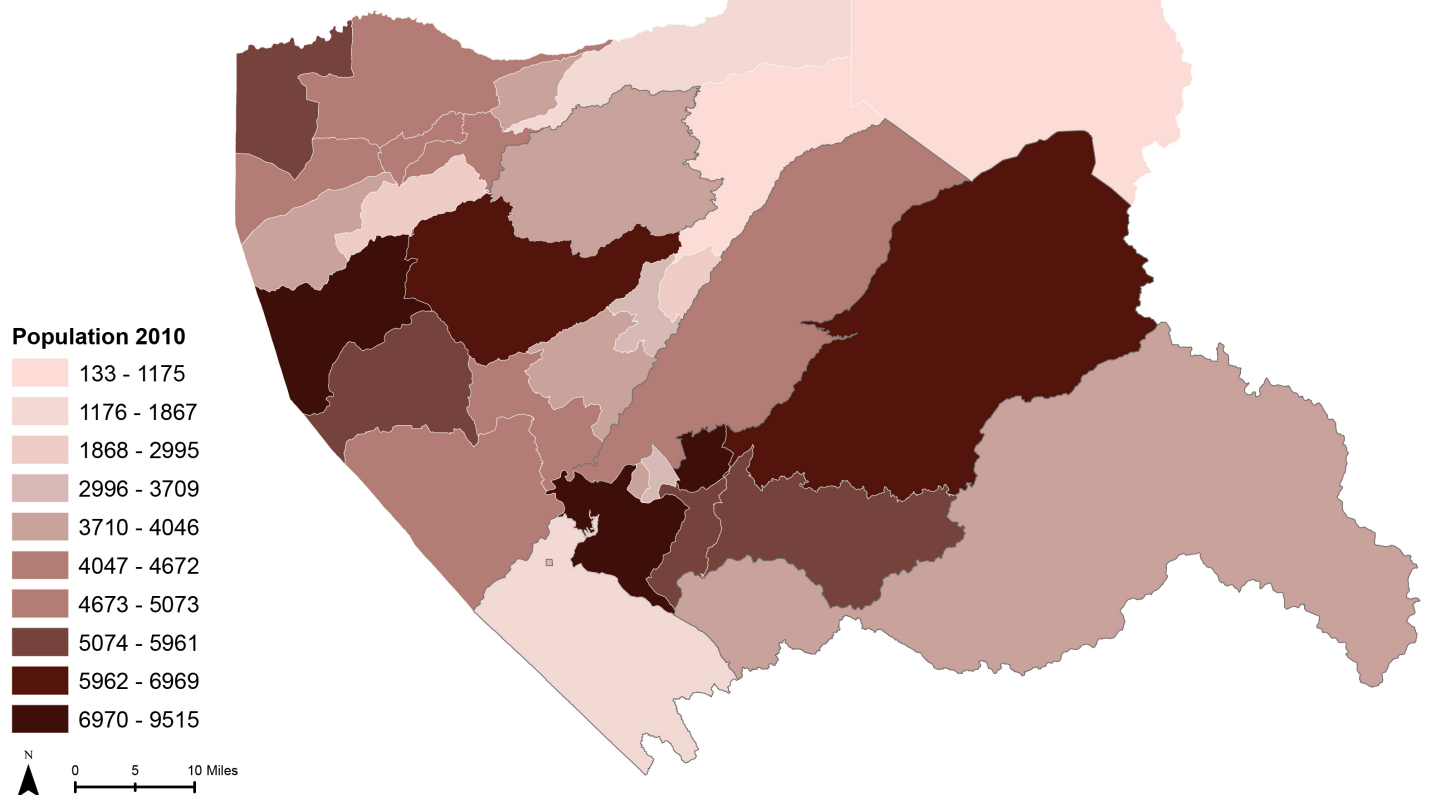
Table 2: Population Estimates by County as of January 1, 2017

County	Population Counts by Location		Total Population
Alpine	Unincorporated Area	1,156	1,156
Amador	Amador	190	38,382
	Ione	7,683	
	Jackson	4,761	
	Plymouth	1,010	
	Sutter Creek	2,505	
	Unincorporated Area	22,233	
Calaveras	Angels City	4,108	45,175
	Unincorporated Area	41,067	
Tuolumne	Sonora	4,876	54,725
	Unincorporated Area	49,849	
Total Population in the Region		**139,438**	

Source: State of California Department of Finance, 2018

Tourism & Destinations

Parks

Despite the relatively small permanent population, the Region is home to several historical state and national parks with beautiful scenery and recreational activities that attract visitors. Popular destinations include Yosemite National Park, Calaveras Big Trees, and the Columbus State Historical Park. According to the National Park Service, Yosemite National Park had over 4.3 million recreational visitors and nearly 1.9 million vehicles during 2017. Approximately three-quarters of 2017 visitors attended the park between May and October. Traffic volumes is greatest at the Arch Rock Entrance compared to the park's South Entrance (Badger Pass, Big Oak Flat, Hetch Hetchy) or Tioga Pass, which represented only about 30% of the total volume in 2017.

The Central Sierra has five major state parks: Calaveras Big Trees, Columbia State Historical Park, Railtown 1897, Indian Grinding Rock, and Grover Hot Springs. Table 4 lists those parks and their annual attendance and revenue.

Recreation

The Region has a rich historical past with remnants of gold mining, an old-west atmosphere, and historical landmarks. Calaveras County is home to the Mark Twain Cabin which is a California Historical Landmark and inspiration for Calaveras County's Fair and Jumping Frog Jubilee which has grown to over 45,000 attendees annually.

Figure 7: Parks, Lakes, and Forests in the Region

Source: Center for Sustainable Energy, 2018
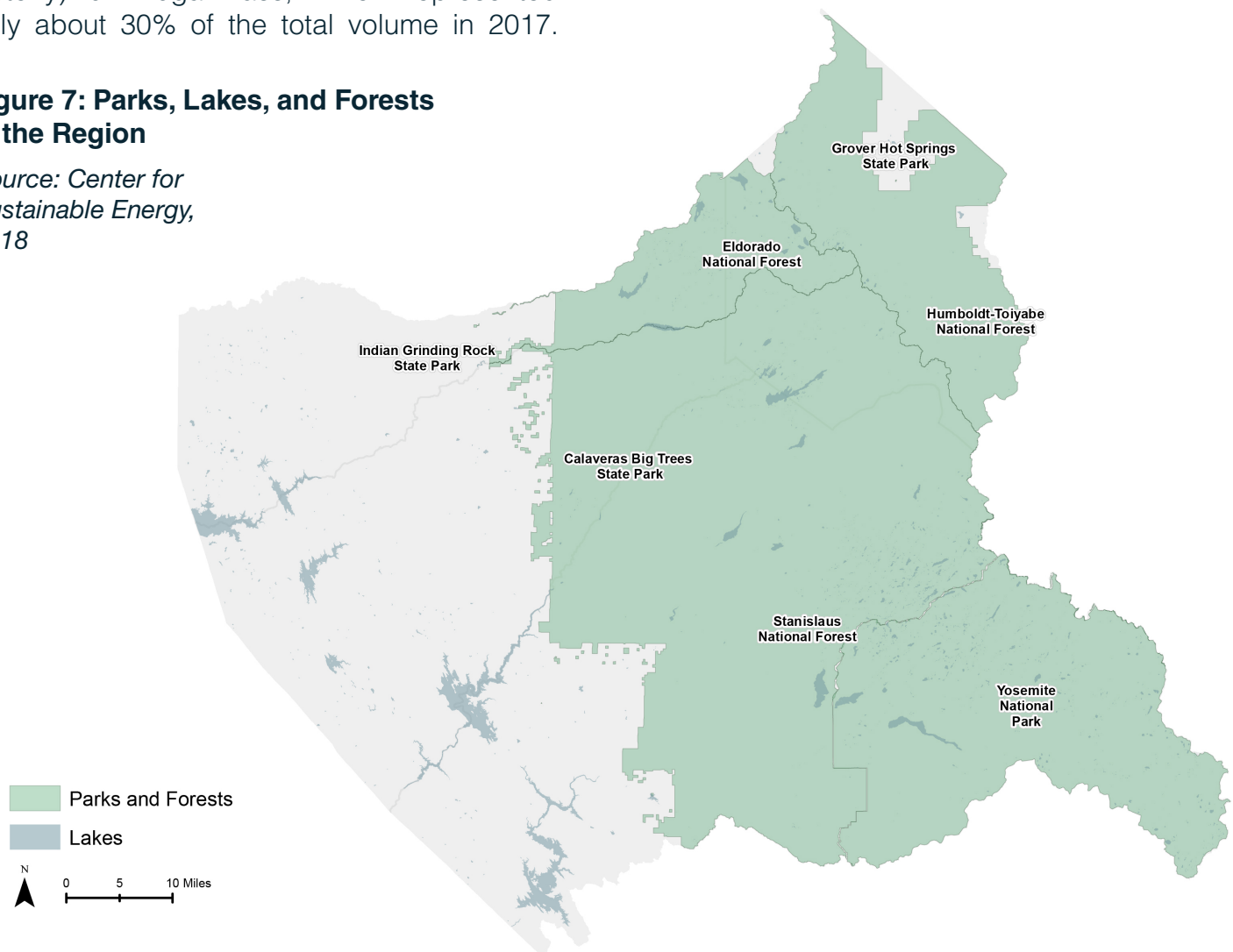
The Region's diverse natural landscape supports numerous recreational activities including camping, hunting, fishing, and skiing. Although most Alpine campgrounds close for the winter season visitor travel is sustained as ski resorts become recreational destinations. Kirkwood resort accessed by Highway 88 attracts visitors who are visiting resorts in the South Lake Tahoe area and the Bear Valley resort accessed by Highway 4 offers a quieter alternative to larger ski resorts. The Region is also home to Wineries and casinos; Amador and Calaveras counties have more than 50 wineries; casinos operated by Native American tribes are spread throughout the Region.

Table 3: 2017 Yosemite National Park Recreation Visitors per Month

Month	Visitors	Visitor %
January	120,025	3%
February	119,421	3%
March	166,793	4%
April	302,553	7%
May	471,844	11%
June	565,702	13%
July	633,351	15%
August	615,892	14%
September	566,279	13%
October	429,827	10%
November	217,927	5%
December	127,276	3%
2017 Totals	**4,336,890**	**100%**

Source: U.S. National Parks Service, 2017

Table 4: Central Sierra State Park Visitor for FY 2015-16

| Park Name | County | Visitor Attendance | | | | Revenue |
		Paid Use Day	Free Day Use	Camping	Total Visitor Attendance	Total Revenue
Calaveras Big Trees State Park	Tuolumne/ Calaveras	175,486	4,231	27,903	207,620	$1,095,305
Columbia State Historical Park	Tuolumne	0	451,701	0	451,701	$448,158
Railtown 1897 State Historical Park	Tuolumne	19,298	26,813	0	46,111	$99,819
Indian Grinding State Historical Park	Amador	9,990	2,414	1,811	14,215	$40,905
Grover Hot State Park	Alpine	51,446	8	32,378	83,832	$525,740

Source: California Department of Parks and Recreation, 2017

Transit

Public fleets operating in the Region include the four counties, incorporated cities, community services districts, and school districts. State and Federal fleets operate in the region; no local fleets were identified.

There are four primary transit operators in the Region: Tuolumne County Transit, Alpine County Local Transportation Commission, Calaveras Transit, and the Amador Regional Transit System.

The Yosemite Area Regional Transportation System (YARTS) also operates a seasonal route (from May to September) through the Region: Sonora – Hwy 120. At peak service (June through August), the Sonora route operates 7 days a week with six trips (YARTS, 2018). YARTS operates along four highway corridors including SR 140 and SR 41. Figure 7 shows the transit routes throughout the region.

Based on 2016 data from the Federal Transit Administration's (FTA) National Transit Database, Regional transit agencies operate a total of 56 transit vehicles that account for 1,338,669 annual vehicle revenue miles and 63,756 annual vehicle revenue hours (National Transit Database, 2016).

Bus vehicles make up 71% of regional transit vehicles; they operate on fixed routes and serve a large group of commuters. Demand response vehicles (25% of regional transit vehicles) generally operate within transit agency's fixed route boundaries and serve seniors and passengers with disabilities; limited demand response vehicles operate as a door-to-door service. Commuter bus vehicles only operate in Amador, providing service between business centers and outlying residential regions; They typically operate during traditional peak commute times with limited stops and account for only 4% of the regional transit vehicles.

Table 5: Central Sierra Region 2016 Annual Agency Profile

	Commuter Bus Vehicles	Demand Response Vehicles	Bus Vehicles	Annual Vehicle Revenue Miles	Annual Vehicle Revenue Hours
Tuolumne County Transit	1,656	1%	5,062	3%	6,718
Alpine County Local Transportation Commission	13,971	8%	5,160	3%	19,131
Calaveras Transit	17,512	10%	20,943	11%	38,455
Amador Transit	29,797	17%	28,749	16%	58,546
Yosemite Area Regional Transportation System (YARTS)	27,645	16%	33,945	19%	61,590
Total	**170,681**	**100%**	**182,485**	**100%**	**353,166**

Source: National Transit Database, 2016

Figure 7: Transit Routes in the Region

Source: Center for Sustainable Energy, 2018:

— Amador Transit
— CalaverasTransit
— Tuoloumne Transit
— YARTS Sonora Route

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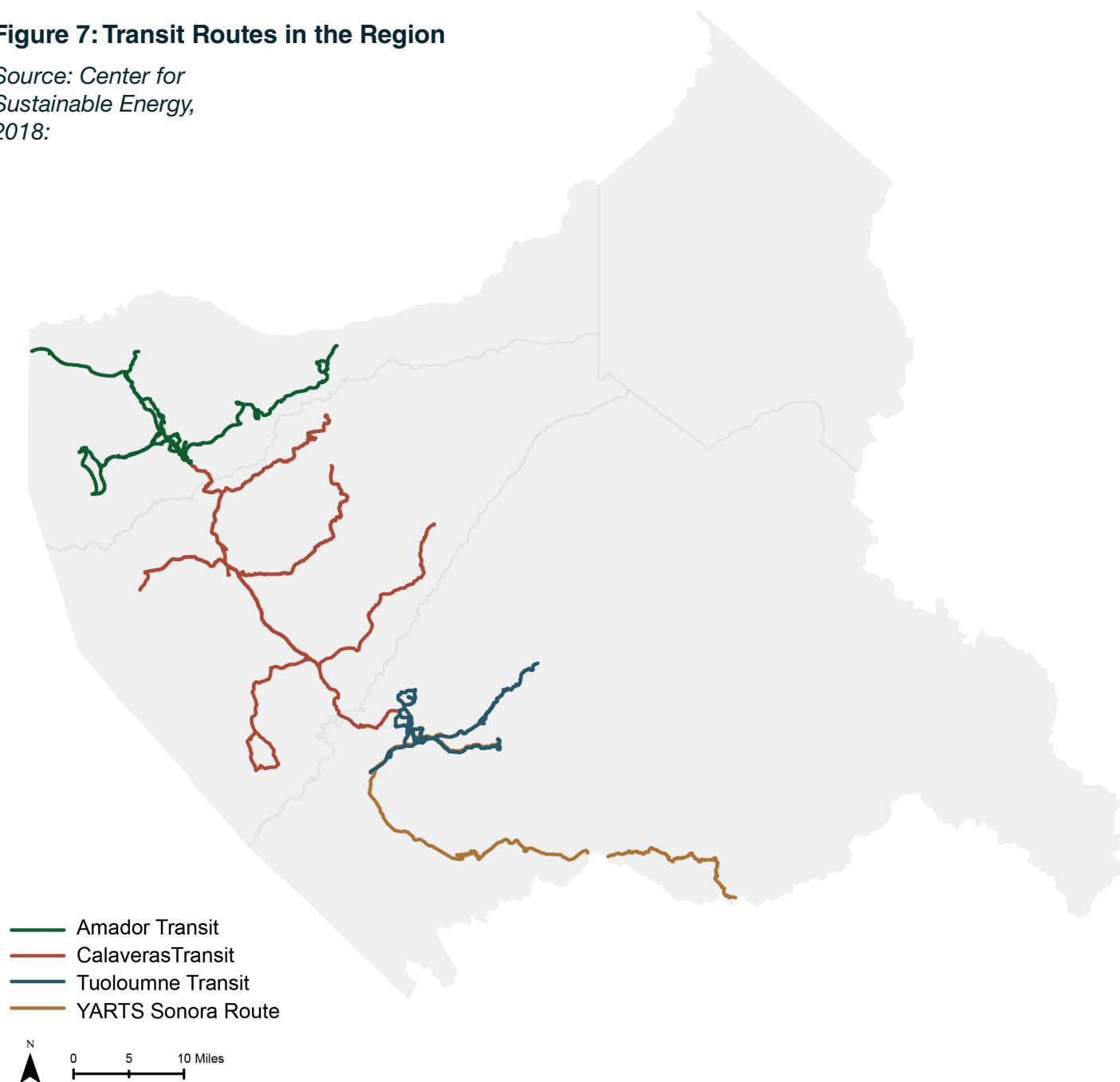
EXISTING CONDITIONS

PEV Registrations

The region has EV drivers, EV infrastructure and numerous existing conditions that support wider EV adoption. Vehicle registration statistics and charging station data are primary indicators of the existing EV market size. Department of Motor Vehicles (DMV) registration data identifies general PEV market attributes but does not readily provide information on the types of vehicles deployed.

There are currently 203 plug-in hybrid electric vehicles (PHEVs) and 196 battery electric vehicles (BEVs) in the Region according to 2018 vehicle registration data from the State of California. This accounts for just 0.16% of total vehicle registrations in the four-county region.

The Clean Vehicle Rebate Program (CVRP) was initiated in March 2010. CVRP offers incentives to purchasers of PEVs in California, however the program is elective and participation rates can be impacted by vehicle eligibility and applicant income caps.

Table 6: California PEV Registrations, 2018

Fuel Type	Number of Registrations	% of Total Registrations
PHEV	163,317	0.53%
BEV	178,348	0.58%
Total	**341,665**	**1.12%**

Source: California Department of Motor Vehicles

Table 7: Central Sierra Region PEV Registrations, 2018

Fuel Type	Number of Registrations	% of Total Registrations
PHEV	203	0.08%
BEV	196	0.08%
Total	**399**	**0.16%**

Source: California Department of Motor Vehicles

As of May 31, 2018, CVRP had issued 247,084 PEV rebates. Less than 1% (184) of those rebates were issued in the Region. PEV drivers in Calaveras and Amador counties have redeemed the most rebates in the Region, accounting for approximately 71% of rebates in the region. Table 8 shows the number of rebates by vehicle type.

Figure 8 shows that the monthly number of rebates issued in the Region has increased over time. Central Sierra PEV drivers redeemed an average of 3.2 rebates per month in 2017, an increase from 2.4 rebates in 2016. In the first five months of 2018, the region redeemed about 5.2 rebates per month. Table 9 shows how the annual number of rebates issued has increased since the beginning of the program. Furthermore, Figure 9 shows where issued rebates are concentrated throughout the Region and Figure 10 shows how the rebates are distributed when normalized by population.

Table 8: CVRP Rebates for the Region

County	PHEV	BEV	PHEV%	BEV%
Alpine	0	2	0%	100%
Amador	27	37	42%	58%
Calaveras	28	38	42%	58%
Tuolumne	31	21	60%	40%
Total	**86**	**98**	**47%**	**53%**

Source: Center for Sustainable Energy, 2018

Table 9: CVRP Rebates per Year by County

Year	Alpine	Amador	Calaveras	Tuolumne	Total Region	Total State
2011	0	2	2	1	5	4,424
2012	0	3	4	3	10	11,117
2013	1	5	13	3	22	29,004
2014	0	9	8	7	24	43,552
2015	1	11	9	9	30	46,383
2016	0	10	11	8	29	43,432
2017	0	13	10	15	38	45,575
2018	0	11	9	6	26	23,530
Total	**2**	**64**	**66**	**52**	**184**	**247,017**

Source: Center for Sustainable Energy, 2018

Figure 8: CVRP Rebates per Month for the Region
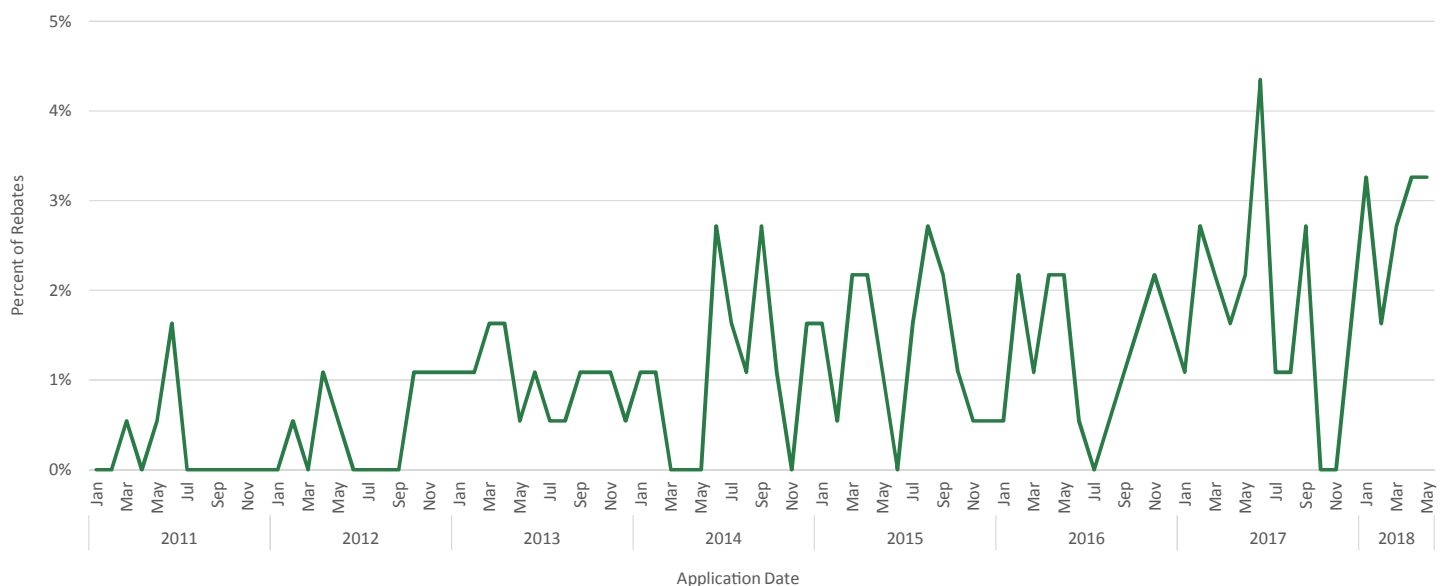
Source: Center for Sustainable Energy, 2018

Figure 9: CVRP Rebate Map Region

Source: Center for Sustainable Energy, 2018

Number of Rebates
- 0 - 3
- 4 - 5
- 6 - 7
- 8 - 10
- 11 - 13

N
0   5   10 Miles
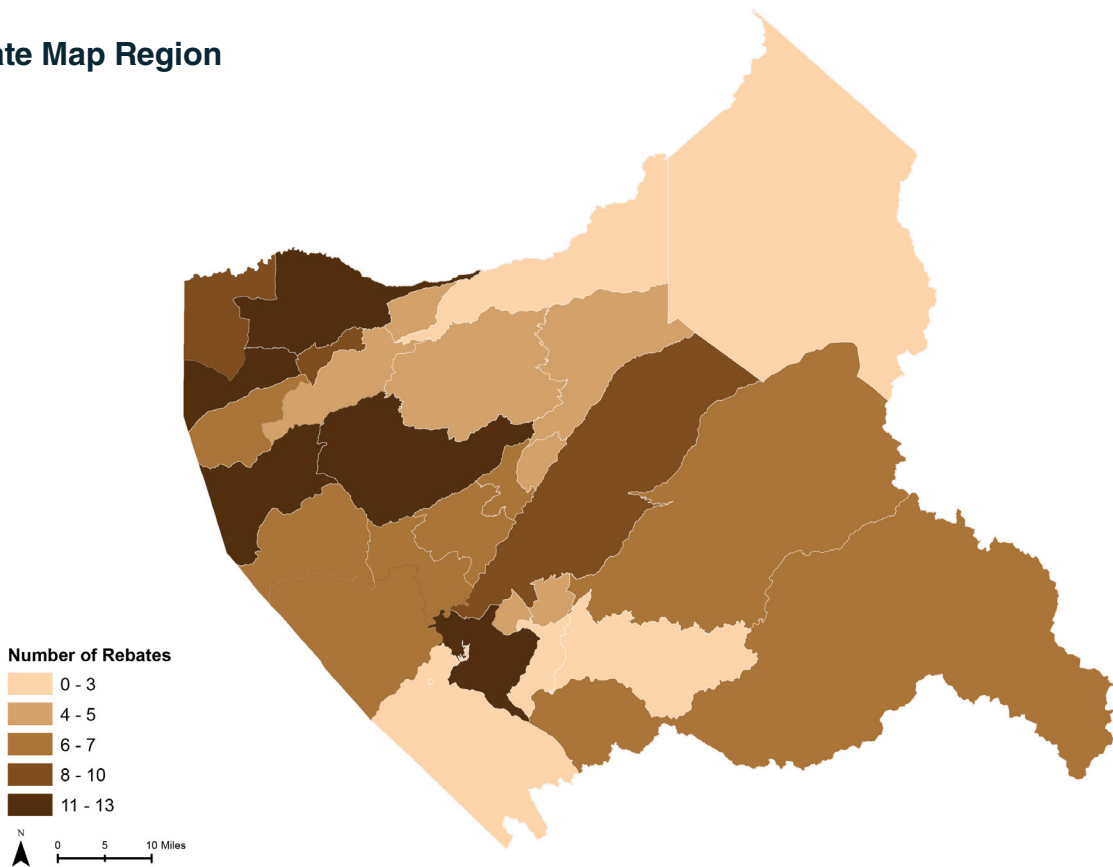
Figure 10: CVRP Rebate Map for the Region by Population

Source: Center for Sustainable Energy, 2018

Number of Rebates per 1,000 Residents
- 0
- 1
- 2
- 3
- 10

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0   5   10 Miles
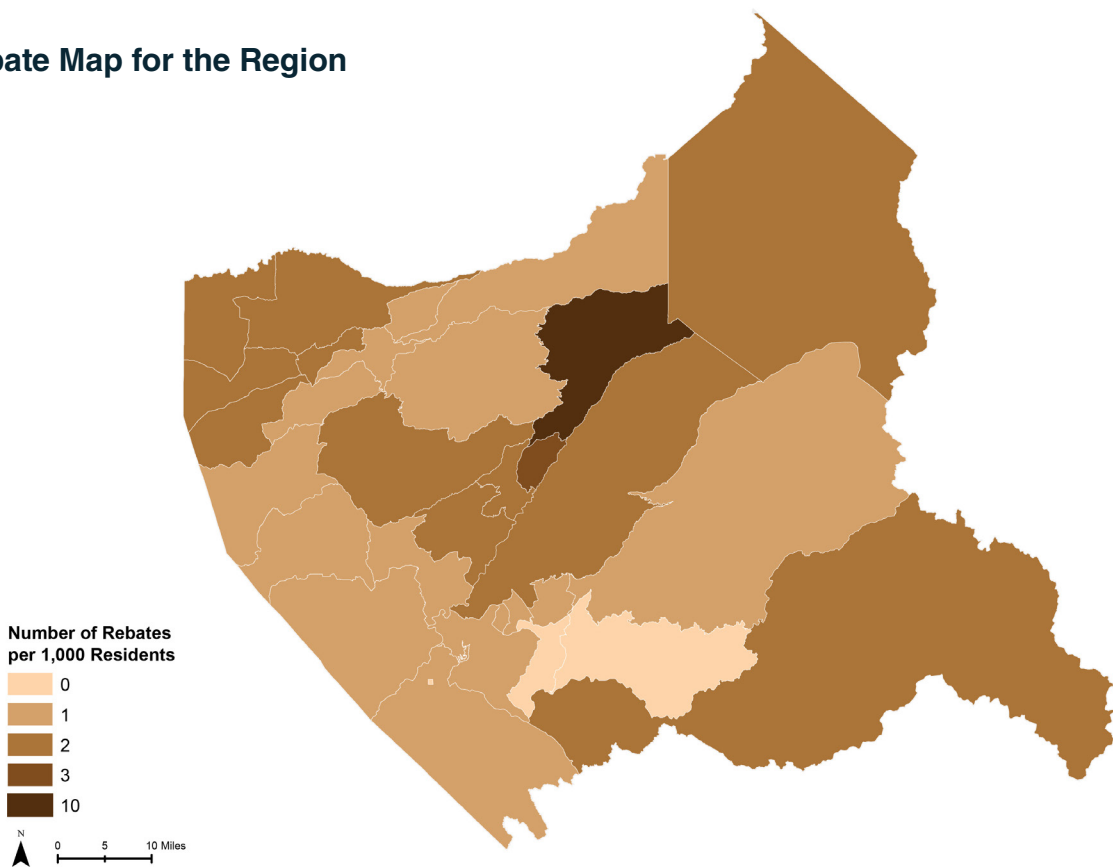
EV Infrastructure

Alternative Fuels Data Center (AFDC) Data

The U.S. Department of Energy's AFDC provides an alternative fueling station locater using data for existing and planned stations. Data is provided by trade media, Clean Cities coordinators, infrastructure equipment and fuel providers, original equipment manufacturers, and regular station users. The station locater provides details about the station location, power level, plug, connector, and network type for alternative fueling stations. Table 10 shows the locations of charging stations in the Region that are listed in the AFDC database.

As of September 30, 2018, there were at least 27 locations in the Region with public Level 2 and DC fast charging stations. Only three locations host DC fast charging - a public lot in Groveland, Yosemite Gateway Museum, and Rush Creek Lodge all in Tuolumne County. Most of the charging stations are sited at lodges, inns, wineries, and resorts.

Table 10: Department of Energy AFDC Station Counts

County	Location Name	City	Charger and Connector Type	Station Plugs	Nearest State Route
Alpine	Bear Valley Lodge	Bear Valley	Level 2, Tesla	2	4
	Sorensen's Resort	Hope Vally	Level 2, Tesla	1	88
	Kirkwood Mountain Resort	Kirkwood	Level 2, Tesla	6	88
Amador	REST Hotel	Plymouth	Level 2, Tesla	1	49
	Taste Restaurant and Wine Bar	Plymouth	Level 2, Tesla	1	49
	Shenandoah Vineyards Winery	Plymouth	Level 2, Tesla	1	49
	Andis Wines	Plymouth	Level 2, J-1772, and Tesla	3	49
	Karmere Vineyards	Plymouth	Level 2, Tesla	3	49
	Amador Regional Transit	Sutter Creek	Level 2, J-1772	2	49
	Gold Quartz Inn Senior Retirement Home	Sutter Creek	Level 2, J-1772	2	49
	Avio Vineyards	Sutter Creek	Level 2, Tesla	2	88
Calaveras	Courtwood Inn	Murphys	Level 2, J-1772, and Tesla	2	4
	Dunbar House 1880 Bed & Breakfast Inn	Murphys	Level 2, Tesla	1	4
	New Melones - Glory Hole Recreational Area	Angels Camp	Level 2	1	4
	Victoria Inn	Murphys	Level 2, Tesla	1	4

County	Location Name	City	Charger and Connector Type	Station Plugs	Nearest State Route
Tuolumne	Groveland Hotel	Groveland	Level 2, Tesla	1	120
	Groveland Supercharger	Groveland	DC Fast Charger, Tesla	7	120
	Evergreen Lodge	Groveland	Level 2, J-1772, and Tesla	2	120
	Jamestown Hotel	Jamestown	Level 2, Tesla	1	49
	Chicken Ranch Casino	Jamestown	Level 2, Tesla	3	49
	Adventist Health Hospital	Sonora	Level 2	10	49/108
	Black Oak Casino	Tuolumne	Level 2, Tesla	5	108
	McCaffrey House Bed & Breakfast Inn	Twain Harte	Level 2, J-1772, and Tesla	2	108
	Columbia College	Columbia	Level 2, J-1772	2	49
	Tuttletown Recreational Area	Tuttletown	Level 2, J-1772	1	49
	Groveland Yosemite Gateway Museum*	Groveland	DC Fast Charger, J1772	3	120
	Rush Creek Lodge*	Groveland	DC Fast Charger, J1772	3	120

Source: Alternative Fuels Data Center, 2018

under construction

PlugShare Data

The PlugShare database provides the location of over 90,000 stations in the U.S. and Canada and allows homeowners to register their charging stations, providing insight on the number of residential charging stations. PlugShare data is different than AFDC data therefore, utilizing both datasets results in an increased understanding of the public PEV charging station count. The AFDC station locater provides plug counts for Tesla chargers in the Region but does not provide plug counts for J-plugs (also known as J-1772) co-located with Tesla stations at five locations. As a free app and webtool, PlugShare allows users to find charging stations, leave reviews and photos, and connect with other PEV owners worldwide. The Central Sierra ZEV Readiness Plan Team verified AFDC station counts with manual queries in the PlugShare map to check the accuracy; the number of stations identified using PlugShare are mapped in Figure 11.

Level 1 Charging

It is important to note that this list does not include locations of level 1 charging, however, level 1 charging can play an important role in providing short-term and readily-available infrastructure. Specifically, level 1 charging at RV parks, campgrounds, and natural areas can be a cost-effective means of ensuring PEV drivers can access remote areas of the region while having ample state of charge to return home. Level 1 charging at these sites could be installed in various ways, but one short-term solution could be to provide gas-powered generators that power electrical outlets for level 1 charging. In the longer term, solar and battery storage could be installed to power level 1 charging outlets at these sites, and this would provide additional greenhouse-gas reduction benefits compared to the use of generators.

Figure 11: Existing Charging Infrastructure

Source: Center for Sustainable Energy, 2018

Highways
Existing DCFC
Existing L2

N

0   5   10 Miles
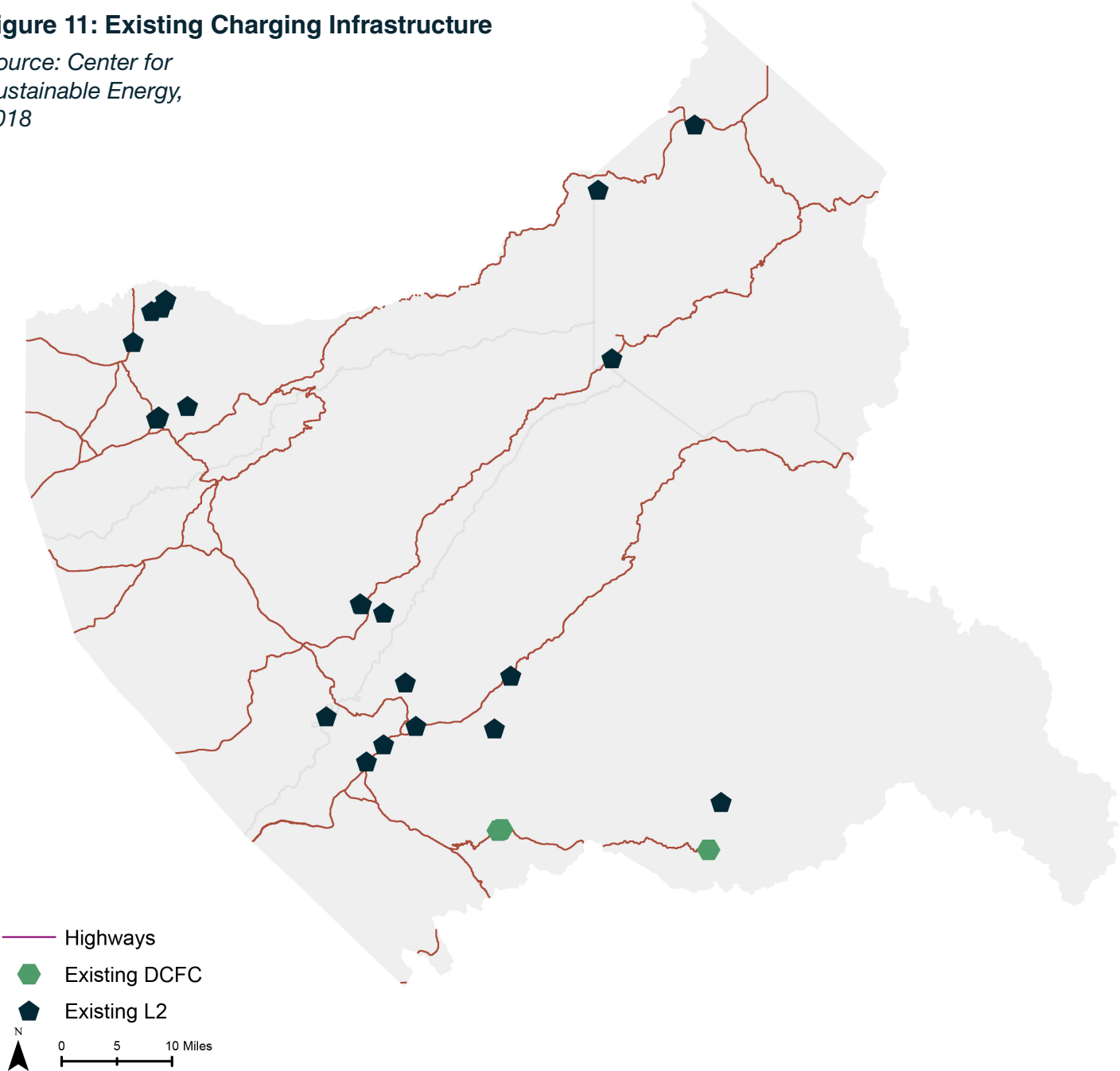
Policy & Planning

Statewide
Building & Development Codes

The 2016 California Green Building Standards Code (effective since January 1, 2017) identifies mandatory and voluntary codes for EV infrastructure in buildings and parking lots within California. These codes establish construction requirements for new residential and commercial buildings.

Section 4.106.4 of the CalGreen code describes EV charging guidelines for new residential construction, detailing parking space dimension designations, and electrical configurations in accordance with California Electrical Code, Article 625. New one-and two-family dwellings must have raceways installed that accommodate 208/240 volt circuits for every unit, while 3% of multi-unit dwellings (MUDs) with 17 or more units must accommodate 40 amp circuits (California Building Standards Commission, 2016). Service or subpanels with EV charging circuits must be marked as "EV CAPABLE" to support future EV charging.

Section 5.106.5.3 provides codes for new

construction at commercial locations, which provides electrical configuration and parking space requirements for EV charging spaces. Newly designated EV charging spaces are required to support 40-amp circuits and mark EV capable panels for future spaces.

Section 4.106.8 provides additional code tiers for residential locations that facilitate future EV charging installation. Under this mandate, new one and two-family dwellings and townhomes with attached private garages must meet mandatory requirements and be labeled as "EV READY" for future installations. For MUDs, 5% of total spaces for buildings with 17 or more units will be designated EV charging spaces. Section A5.106.5.3 introduces additional tiers for new commercial development, which is summarized in Table 11.

The local governments within the Region do not currently have building codes requiring EV-readiness beyond what is required by CalGreen.

Table 11: EVCS Parking Space Requirements for New Commercial Construction

Total Number of Parking Spaces	5.106.5.3 Mandatory Commercial Requirements	A5.106.5.3 Optional Tier 1 Requirements	A5.106.5.32 Optional Tier 2 Requirements
0-9	0	0	1
10-25	1	2	2
26-50	2	3	4
51-75	4	5	6
76-100	5	7	9
101-150	7	10	12
151-200	10	14	17
201 and over	6% of total spaces	8% of total spaces	10% of total spaces

Source: California Building Standards Commission, 2016

Regional
Plans

Table 12: Regional Transportation Planning Goals Supporting EV Infrastructure

County	Plan	Goal	Policy or Objective
Tuolumne	Transportation System Management	Goal: Develop a transportation system that maximizes the use of transportation facilities in the most efficient and cost-effective way.	Policy: Develop and support a regional Electric Vehicle Infrastructure Implementation Plan for Tuolumne County.
Tuolumne	2016 Final Regional Transportation Plan	Goal 3: Practice environmental stewardship by protecting air quality, natural resources, and historical and cultural assets. (Regional Goal 5)	Policy 6: Support the planning and construction of plug-in electric vehicle charging stations.
Alpine	Alpine County Regional Transportation Plan (2015)	Goal 10: Reduce Greenhouse Gas (GHG) Emissions.	Objective: Ensure that transportation projects contribute to the goal of lowering vehicle emissions. Policy: Promote projects that can be demonstrated to reduce air pollution, such as alternative fuel programs.
Amador	2015 Amador County Regional Transportation Plan	Goal 9A – Implement a comprehensive set of transportation improvements that will collectively result in regional air quality improvements	N/A
Calaveras.	Calaveras 2017 Regional Transportation Plan	Goal 3: Enhance sensitivity to the environment in all transportation decisions.	Objective 3B: Promote and design transportation projects that will reduce greenhouse gas emissions and thereby positively contribute to meeting statewide global warming emissions targets set in the Global Warming Solutions Act of 2006 (AB 32).

Funding & Incentives

EV charging stations face a variety of installation and operation costs that inhibit the development of a diverse EVCS network. Most single-family homes are equipped with the 110/120 volt outlets that can be used for Level 1 charging, but relying on Level 1 charging isn't feasible for most EV drivers. MUD, workplaces, and public spaces have the potential for electrical and physical barriers (e.g., lack of make-ready infrastructure, billing complexities, distance to/from building) that can increase the cost to install all types of charging (e.g., Level I, Level II, DCFC).

One method to reduce installation costs and burdens is to offer incentives and funding programs that help pay for the installation of EV charging. After determining suitable areas for potential EV charging investments, many PEV plans and assessments provide resources for stakeholders to begin targeting sites within these areas. These resources discuss solutions to EV charging barriers like installation and operation costs, station utilization strategies, and financial incentives that could minimize associated costs. The most common sources of EV infrastructure funding are listed in Figure 12.

Local Funding Opportunities

Pacific Gas & Electric (PG&E)

PG&E administers three funding programs for electric vehicle infrastructure. These programs include the FleetReady Program, Fast Charge Program, and EV Charge Network Program.

- **FleetReady Program** – Starting in 2018, PG&E received $236 million in eligible funds from the California Public Utilities Commission (CPUC) for infrastructure supporting fleet vehicle charging. PG&E is working with fleet managers that request funding across Northern and Central California to install EVCS at 700 sites (FleetReady program, 2018)

- **Fast Charge Program** – Starting in 2018, PG&E will fund and build infrastructure for public DCFCs, including 25% located within DACs. Furthermore, PG&E will offer rebates for customers in DACs who wish to purchase DCFCs (CPUC Approves New PG&E Projects to Help Accelerate Electric Vehicle Adoption in California, 2018).

- **EV Charge Network Program** - Starting in 2016, the CPUC approved the PG&E EV Charge Network Program to install 7,500 Level 2 EVCS at MUDs and workplaces. Within the service territory, PG&E will install the infrastructure at qualified locations with at least ten parking spaces available for charging (About the Program, 2018).

Figure 12: Major Funding Sources for Light-Duty Charging Infrastructure in California

ARFVTP $16.6	VW Settlement* $48.0	PG&E* $43.3	SCE^ $22.0	SDG&E* $15.0

Source: California Energy Commission. All funding amounts are estimated for FY 2017-2018 and measured in millions of dollars. *Funding from the VW Settlement, PG&E, and SDG&E will be disbursed over multiple years - reported amounts are annual averages of estimated total infrastructure funding. ^The SCE Charge Ready pilot program stopped accepting reservations on January 3, 2017, however, SCE is expected to seek authority from the CPUC to expand the program.

Original Source: Department of Energy, 2018-2019 Investment Plan Update for the Alternative and Renewable Fuel and Vehicle

Carl Moyer Program

The Carl Moyer Memorial Air Quality Standards Attainment Program (Moyer Program) was implemented in 1998. The current program is authorized under Senate Bill 513 (SB 513). SB 513 provides funding for infrastructure projects such as alternative fueling stations for on-road and off-road vehicles and equipment (California Air Resources Board, 2017). Moyer Program project types include:

- Replacement
- Repower
- Retrofit
- Vehicle Retirement
- Infrastructure

The Program applies to on-road and off-road heavy-duty vehicles including school buses, heavy-duty trucks and buses, transit fleet vehicles, drayage trucks, solid waste vehicles, public agency/utility vehicles, and emergency vehicles.

The Moyer Program is implemented through local air districts and funding amounts vary. For example, the cap for a School Bus Zero-Emission Replacement is $400,000 through the State Funding Caps for Moyer School Bus Projects.

State Funding Opportunities

Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP)

The California Legislature appropriated funds for the Low Carbon Transportation Program, which includes $125 million specifically allocated to the Hybrid and Zero-Emission Truck and Voucher Incentive Project (California Air Resources Board, 2018). HVIP provides clean truck and bus vouchers to help fleets reduce the initial costs of converting fleets to PHEVs and ZEVs and range from $8,000 to $45,000 per vehicle.

Federal Funding Opportunities

Alternative and Renewable Fuels and Vehicle Technology Program (ARFVTP)

The ARFVTP, a program of the U.S. Department of Energy, provides annual investments for advanced transportation and fuel technologies (ARFVTP Overview, 2018), including EVCS. Available funding for the 2018-2019 investment cycle reached a total of $134.5 million, more than the average annual investment of $100 million. According to the 2018-2019 Investment Plan Update for the Alternative and Renewable Fuel and Vehicle Technology Program, policy goals for the

Table 13: ARFVTP Funded Projects in the Region

Project	Address	Amount	Description	Status
ARV-10-001-271	86 Glory Hole Rd., Angels Camp, CA 95222 (Calaveras County)	$2,996.54	Update Existing EV infrastructure To SAE-J1772	Complete
ARV-10-001-11	33 Broadway, Jackson, CA 95642 (Amador County)	$2,996.54	Update Existing EV infrastructure To SAE-J1772	Complete
ARV-10-001-270	7591 Reynolds Ferry Rd., Sonora, CA 95370 (Tuolumne County)	$2,996.54	Update Existing EV infrastructure To SAE-J1772	Complete

Source: ARFVTP Project Map, 2018

investment include GHG Reduction, Petroleum Reduction, Low-Carbon Fuel Standard, Air Quality, and ZEV Regulations (2018). ARFVTP funded the three projects within the Region listed in Table 13. ClipperCreek, an EVCS manufacturer, was the recipient of these funds. *Congestion Mitigation and Air Quality Improvement (CMAQ) Program*

The FAST Act authorizes funding of $2.3-2.5 billion to the CMAQ program for apportionment to the states. States, local governments, and transit agencies can use these funds to invest in transportation projects that support the Clean Air Act. Projects eligible for the funds include "alternative fuel vehicles and infrastructure. A project supported with CMAQ funds must demonstrate that the project reduces emissions, is located in or benefits an EPA designated nonattainment or maintenance area and is a transportation project (23 U.S.C. 149)" (Department of Energy, 2016).

According to the Environmental Protection Agency's (EPA) Clean Air Act National Ambient Air Quality Standards, Tuolumne, Calaveras, and Amador Counties are all designated nonattainment for at least 1 NAAQS Pollutant (2018).

- Tuolumne County is Designated Nonattainment for 1 NAAQS Pollutant (8-Hour Ozone 2015) – Marginal

- Calaveras County is Designated Nonattainment for 2 NAAQS Pollutants (8-Hour Ozone 2008 & 8-Hour Ozone 2015) – Marginal

- Amador County is Designated Nonattainment for 1 NAAQS Pollutant (8-Hour Ozone 2015) – Marginal

Low or No Emission Vehicle Program – 5339(c)

The FAST Act authorizes $55 million in funding per year through FY 2020 for capital projects involving low or zero-emission public transportation vehicles. The program may fund up to 85% of the cost, but requires a 15% non-federal cost share. The funding is apportioned to the State of California through the 5307 Urbanized Area Formula. Public information is available on the FAST Act website and FAST Act Section 5339 fact sheet (Department of Energy, 2016).

Title XVII Clean Energy Loan Guarantees

Loan guarantees are available through the U.S. Department of Energy for investment in alternative fuel vehicles. Loan guarantees may cover up to 100% of the eligible project cost and may include infrastructure and networking projects. More information is available on the Loan Guarantee Program website and the Alternative Fuel Infrastructure fact sheet (Department of Energy, 2016).

Surface Transportation Block Grant Program (STBG)

The FAST Act authorizes funding for the STBG program. Funding "apportioned to a State for the STBG provide for the construction of electric vehicle charging stations associated with 1) construction of truck parking facilities (23 U.S.C. 133(b)(1)(E); and 2) fringe and corridor parking facilities (e.g. park and ride facilities) (23 U.S.C. 133 (b)(5)).

Incentives

General information on organizations that offer ZEV related funding is useful in both plans and toolkits. Understanding different incentives that can reduce the cost of EVCS installation will help reduce barriers to infrastructure deployment. BCAG developed a table of different incentive programs for EV charging and PEV purchase costs and sorted them by funder, these are shown, along with local funding opportunities, in Table 14.

Table 14: ARFVTP Funded Projects in the Region

Programs	Description	Amount	Eligibility
Federal Programs			
Plug-in Electric Vehicle Tax Credit	A tax credit for the purchase or lease of a new PEV, ZEV, PHEV, ZEM or NEV	$2,500 - $7,500 per vehicle	Individuals
Fuel Cell Vehicle Tax Credit	A tax credit for the purchase of a new light-duty FCEV; credits are based on vehicle weight	$4,000 - $40,000 per vehicle	Individuals
Low Speed, 2/3 Wheel PEVs Tax Credit	Tax credit for low speed and 2/3-wheel vehicles	10% of vehicle $2,500 limit	Individuals
Employee Corporate Incentives	Private companies and organizations offering employees assistance with purchasing new ZEVs	$1,000 - $5,000 per vehicle	Individuals
Alternative Fuel Vehicle Refueling Property Credit	A 30% tax credit is allowed for any qualified alternative fuel vehicle refueling property	$1,000 - $30,000 per vehicle	Individuals/Property Owners
State Incentive Programs			
Alternative and Renewable Fuel, Vehicle Technology, Clean Air, and Carbon Reduction Act			
Clean Vehicle Rebate Project (CVRP)	Available rebate for ZEVs, PHEVs, NEVs and ZEMs	$900 - $2,500 per vehicle, with a limit of two rebates for vehicles purchased or leased after 2015	Individuals/Private Fleets/Public Fleets/Nonprofit
California Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project	Vouchers to help fleets reduce the initial costs of converting fleets to PHEVs and ZEVs	$8,000 - $110,000 per vehicle, including buses	Fleets
Hybrid Off-Road Equipment Pilot Project	Vouchers to integrate hybrid off-road construction vehicles into California	$28,500 - $75,000 per vehicle	Public/Private Fleets
Air Resources Board Grant Programs			
Enhanced Fleet Modernization Program	Voluntary retirement of passenger or cargo trucks with a vehicle weight rating of 10,000 pounds or less	$500 - $1,500 per vehicle	Individuals/Private Fleets

| Programs	Description	Amount	Eligibility
Good Movements Emission Reduction Program	ARB working with Local Agencies to reduce air pollution and health risks associated with heavy freight movement	Up to $50 million	Local Agencies
PLACE Program	Loans for fleets that can be used for fleet modernization, e.g., retrofitting diesel engines with emission control systems	$1 million	Private Fleets Less Than 500
Local Programs			
Tuolumne County Air Pollution Control District	Carl Moyer Program - Limited funding opportunities for zero-emission on-road and off-road heavy-duty vehicles as well as infrastructure	$200,000 available each year; Grant amounts vary	Private Companies and Local Agencies
Calaveras County Air Pollution Control District	Carl Moyer Program - Limited funding opportunities for zero-emission on-road and off-road heavy-duty vehicles as well as infrastructure	Information not publicly available	Private Companies and Local Agencies
Amador Air District	Carl Moyer Program - Limited funding opportunities for zero-emission on-road and off-road heavy-duty vehicles as well as infrastructure	Information not publicly available	Private Companies and Local Agencies
Great Basin Unified Air Pollution Control District (Alpine)	Carl Moyer Program - Limited funding opportunities for zero-emission on-road and off-road heavy-duty vehicles as well as infrastructure	Information not publicly available	Private Companies and Local Agencies

Barriers

Network Connectivity

To collect data on usage and costs of utilizing EV charging stations, they must be "network-capable," meaning they are able to communicate with a backend network operations center which collects, stores, and manages data from the EV charging stations. To have this capability, EV charging stations communicate via Wi-Fi, 3G/4G cellular communication, or through a local area network (LAN) which utilizes a wide area network (WAN). As a result, networked EV chargers must be deployed in areas with adequate cellular network coverage and/or internet cable running to the station.

To better understand the type and strength of cellular coverage in certain regions, OpenSignal has developed an online mapping tool which shows the strengths of 2G, 3G, and 4G cellular coverage. OpenSignal data indicates that cellular coverage in the Region is a potential barrier for EV charging station connectivity (and potentially wider EV adoption), except along major travel corridors. Figure 13 shows the strength of cellular coverage in the Region and surrounding areas.

The cellular coverage in the Region limits the areas where networked charging stations can be deployed, especially in remote regions and along certain travel corridors. To accept payments for usage, the charging stations must either have a credit card reader that is connected to Wi-Fi or a cellular network or facilitate payment through an app, which also requires the charging station be connected to the internet via Wi-Fi or cellular connection. In remote locations, where cable service for internet does not exist, installing charging stations will require significant confidence in the cellular coverage. As a result, installing networked charging stations in remote locations and along remote travel corridors face significant challenges because the station operators will not have a reliable means to charge for their services and monitor their stations.

Figure 13: Cellular Coverage Map in the Region
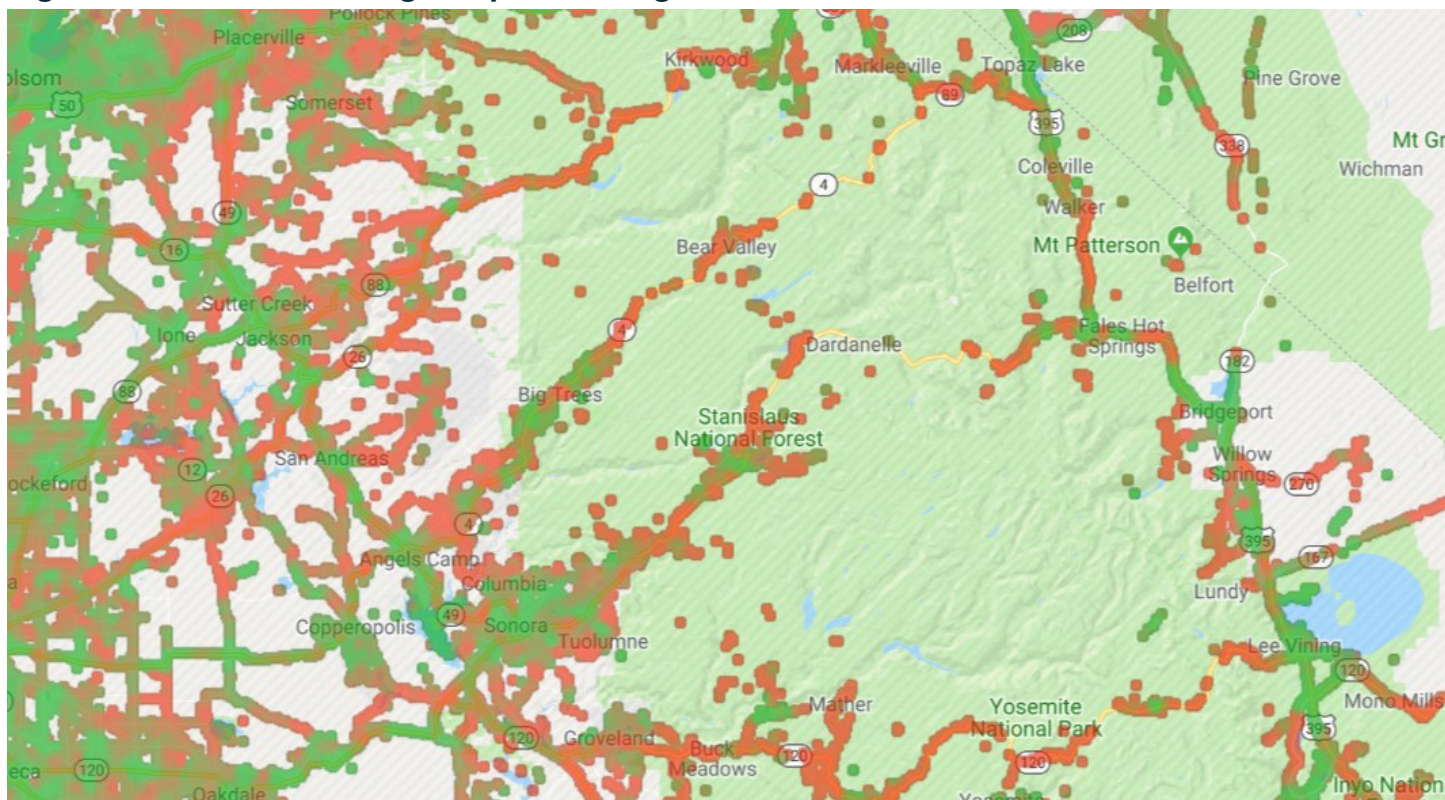
Source: Open Signal, 2018

Maintenance

The Region has seasonal climates with varied weather conditions including significant sunshine, wind, and precipitation events (e.g., rain, snow, and ice), which increases the risk of damage to EV charging stations from acute or prolonged exposure. This may require more frequent maintenance and an increased cost to maintain, especially for stations located in remote areas.

Elevation

The Region is largely rural, covers a large geographical area with low population density, requires large travel distances between communities, and features mountainous terrain, which are unique challenges to the successful deployment of Zero Emission Vehicles. Elevation affects zero-emission buses (ZEBs) and ZEVs because climbing requires more power than traveling the same distance without elevation change. When grade changes are significant, vehicle range diminishes which requires more charging infrastructure be installed to provide adequate coverage. As is shown in Figure 14, the Region's elevation changes from 500 ft. near the valley to almost 13,000 in the mountainous terrain.

In the YARTS Short Range Transit Plan, YARTS has committed to transitioning to an all-ZEB fleet. However, there are known regional barriers such as route grade and distance that make purchasing and operating ZEBs a challenge. The YARTS routes are longer with steeper grade compared to the surrounding transit agency territories that have purchased or are in the process of purchasing battery-electric buses (BEBs) (YARTS Short Range Transit Plan Draft, 2018). These agencies include:

• South Lake Tahoe: Received grant funding to purchase 3 vehicles

• Park City Transit: 5 BEBs

• San Joaquin RTD System: 17 BEBs

Yosemite National Park operates shuttle buses throughout the Yosemite Valley, covering more than 436,000 annual operating miles. The shuttle service helps to reduce congestion and the environmental impacts associated with automobiles in the Valley. The park has ordered two Proterra electric buses to add to the fleets, representing the first deployment in the region (Proterra, 2017).

Purchasing BEBs is a significant investment for transit agencies due to the high cost of the vehicles and necessary infrastructure. As YARTS notes, there are funding opportunities to offset the high cost of these vehicles, but significant charging investment along transit routes is necessary to enable the transition to BEBs on regional routes due to the length and elevation change (YARTS Short Range Transit Plan Draft, 2018) as noted in Figure 14.

The YARTS Short Range Transit Plan also identifies the local electrical system capacity as a limitation for switching to ZEBs and BEBs (YARTS Short Range Transit Plan Draft, 2018). As the National Park Service integrates the Proterra buses into their fleet, the agency continues evaluating existing charging infrastructure and grid capacity; NPS is currently conducting a capacity study for the electrical system in the region. Completion of the study will benefit the Region by increasing understanding of the electrical grid and identifying infrastructure alternatives.

Figures 15-18 show the elevation change along the Regional transit agency's routes. The longest route, the YARTS Sonora route, is 177 miles roundtrip.

Figure 14: Elevation in the Region
Source: Center for Sustainable Energy, 2018

Elevation in Feet

─── 500 - 1,499
─── 1,500 - 2,499
─── 2,500 - 3,499
─── 3,500 - 4,999
─── 5,000 - 6,499
─── 6,500 - 7,999
─── 8,000 - 8,999
─── 9,000- 9,999
─── 10,000 - 10,999
─── 11,000 - 13,000

N

0   5   10 Miles
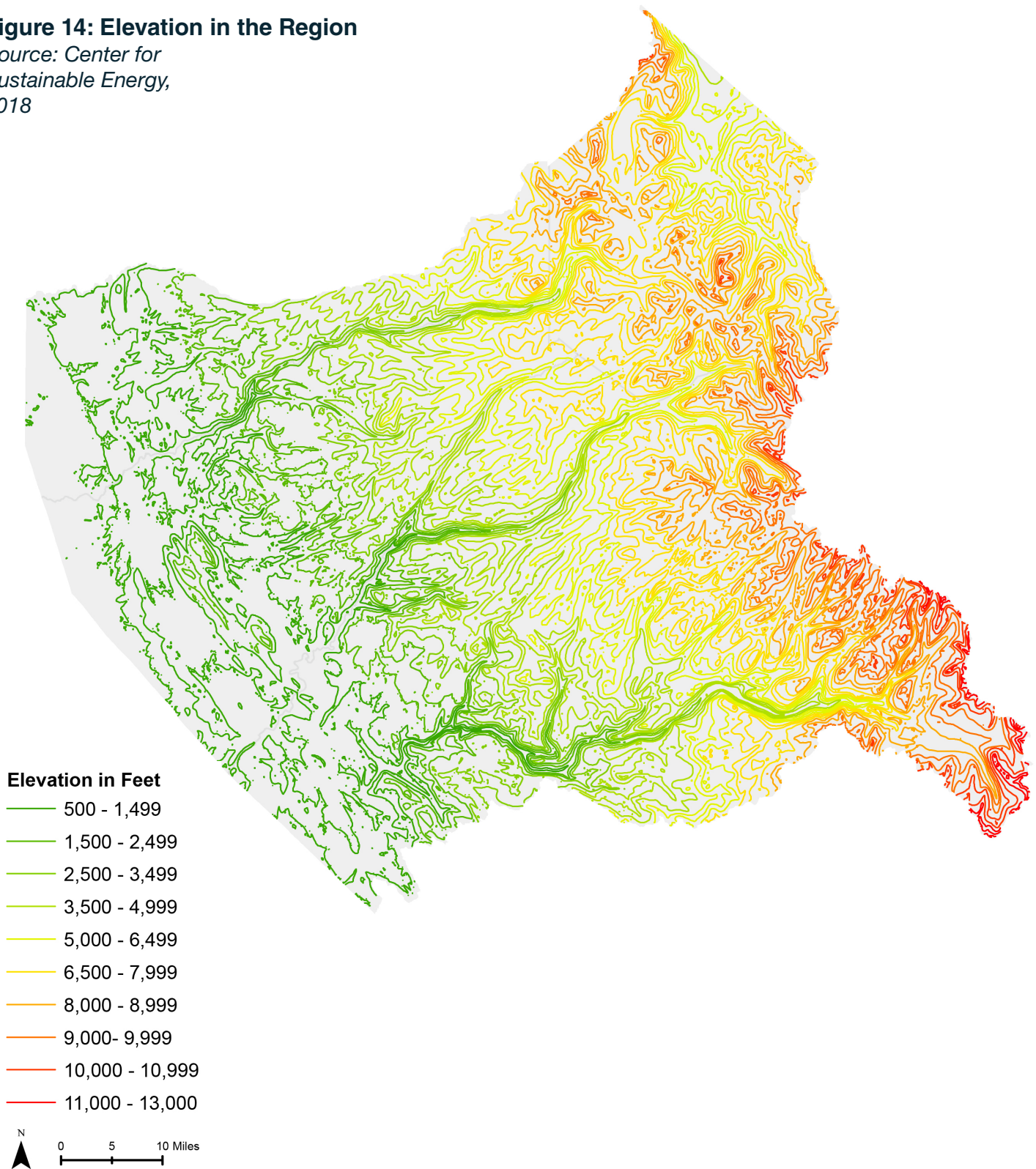
Figure 15: Amador Transit Route Elevation

Legend: Upcountry — Sacramento — Plymouth — Ione — Sutter Creek Shuttle*
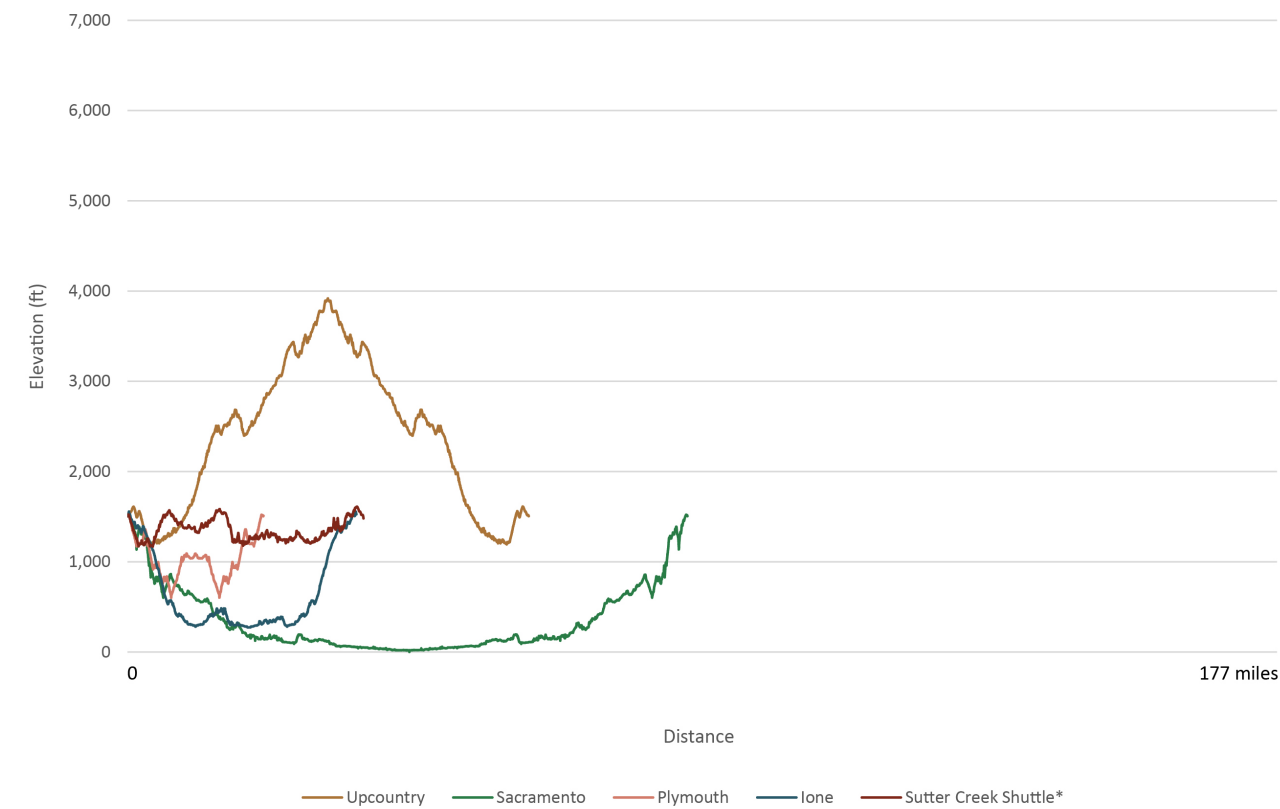
Source: Center for Sustainable Energy, 2018

Figure 16: Calaveras Transit Route Elevation

Legend: Blue Line — Green Line — Red Line — Purple Line — Copper Line

Source: Center for Sustainable Energy, 2018

Figure 17: Tuolumne Transit Route Elevation

Legend: Sonora Loop, Sierra Village - Sonora, Jamestown - Sonora - Columbia, Sonora - Columbia, Sonora - Tuolumne
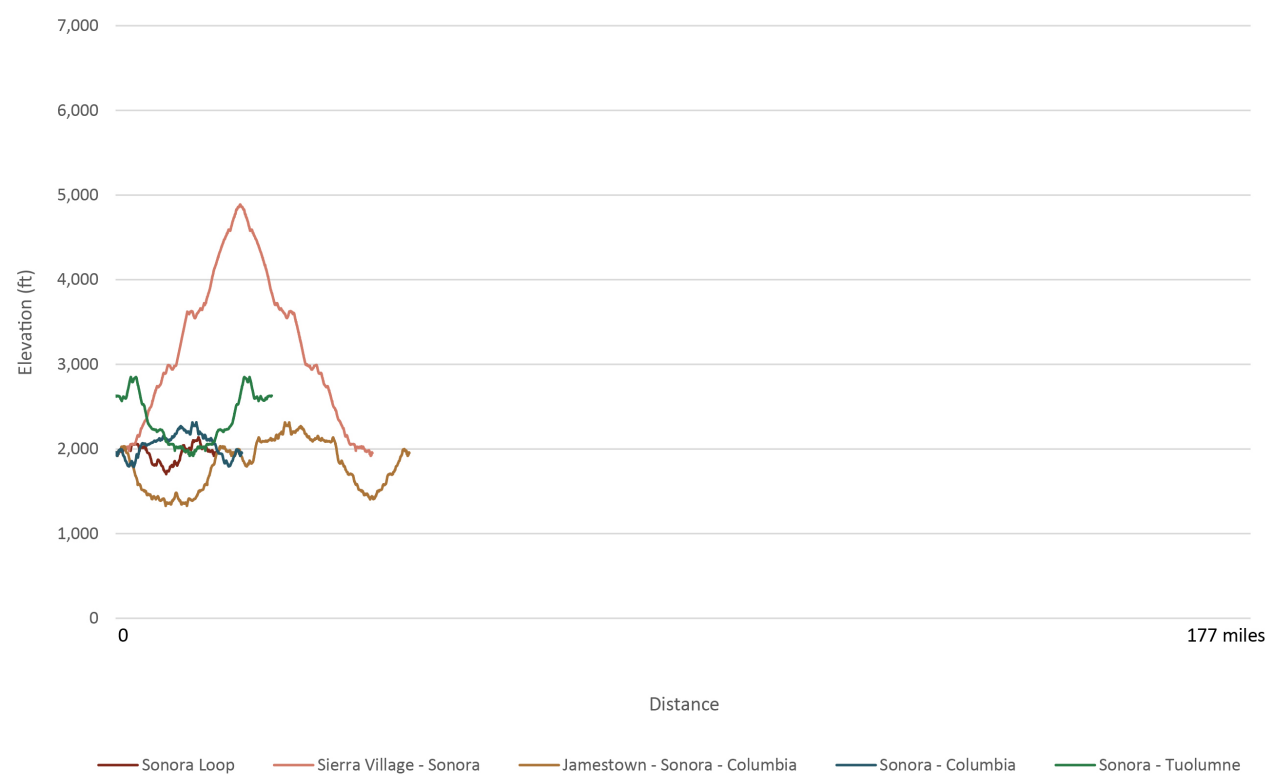
Source: Center for Sustainable Energy, 2018

Figure 18: YARTS Sonora Route Elevation
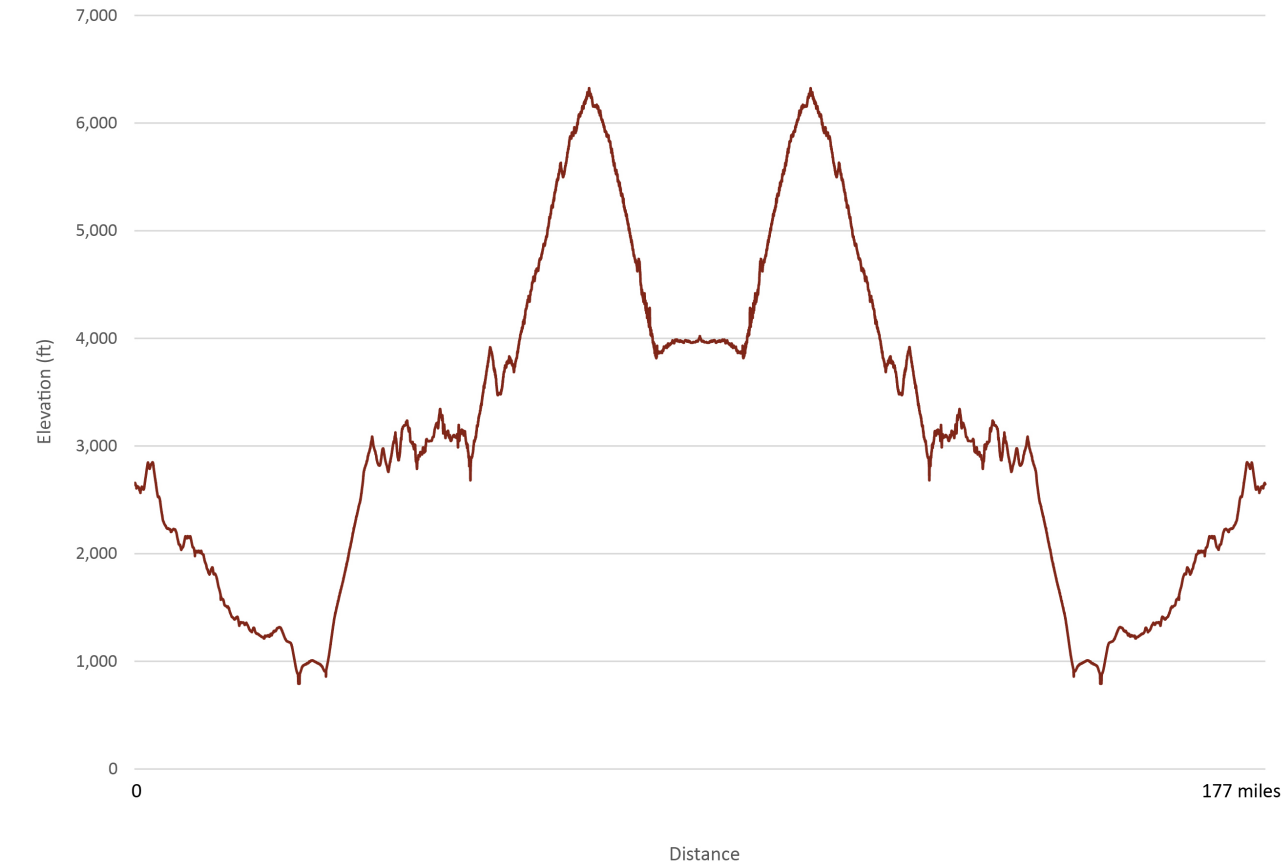
Source: Center for Sustainable Energy, 2018

GAPS ANALYSIS

PEV Growth Projections

Statewide Deployment

According to the Alliance of Automobile Manufacturers, there were 49,765 battery electric vehicles (BEV) and 45,107 plug-in hybrid electric vehicles (PHEV) sold in California in 2017, an increase from 38,861 and 34,933 in 2016, respectively. Overall, the deployment of PEVs in the State of California has steadily increased since 2011 and is expected to grow at an even faster rate from 2018 to 2025. As more models become available and as the deployment of charging infrastructure increases, California residents will have more incentive to purchase PEVs. These factors, along with others, heavily influenced the growth of the PEV market from 2011 to 2017. Table 16 shows the growth of the PEV market.

Similar to the rest of the state, the Region expects to see a substantial growth in PEVs over the next seven years leading into 2025 benchmarks. While the rate of EV rebate deployment has been stagnant over the last four years (see Table 16), the availability of all-wheel drive electric vehicles and EV charging infrastructure in the region is likely to increase over the next seven years.

Regional Deployment

There are currently 203 plug-in hybrid electric vehicles (PHEVs) and 196 battery electric vehicle (BEVs) in the Region according to 2018 State of California vehicle registration data (California DMV, 2018). PEVs account for 0.16% of total vehicle registrations in the Region. Table 16 shows the projected number of PEVs in the Region by 2025.

Utilizing CEC projections, the Region needs 1,834 more PEVs by 2025, to reach their goal of 2,233 PEV Vehicles (5.6 times the current count). CVRP rebate statistics, participation rates for 2010-2015, and new PEV adoption rates were then used to generate county-level projections for the number of PEVs by 2025. Figure 19 illustrates the existing and projected PEV count by county.

Table 15: California PEV Registrations, 2018

County	Projected Number of PEVs by 2025 (Input)
Alpine	27
Amador	647
Calaveras	801
Tuolumne	758
Total	**2,233**

Source: California Energy Commission, 2018

Table 16: Statewide PEV Deployment by Year

Year	PHEV	PHEV%	BEV	BEV%	Total Annual PEV Sales	PHEV:PEV ratio
2011	1,656	1%	5,062	3%	6,718	0.25
2012	13,971	8%	5,160	3%	19,131	0.73
2013	17,512	10%	20,943	11%	38,455	0.46
2014	29,797	17%	28,749	16%	58,546	0.51
2015	27,645	16%	33,945	19%	61,590	0.45
2016	34,993	21%	38,861	21%	73,854	0.47
2017	45,107	26%	49,765	27%	94,872	0.48
Total	170,681	100%	182,485	100%	353,166	0.48

Source: Alliance of Automobile Manufacturers, 2018

Figure 19: Existing and Projected PEVs by County, 2018 & 2025
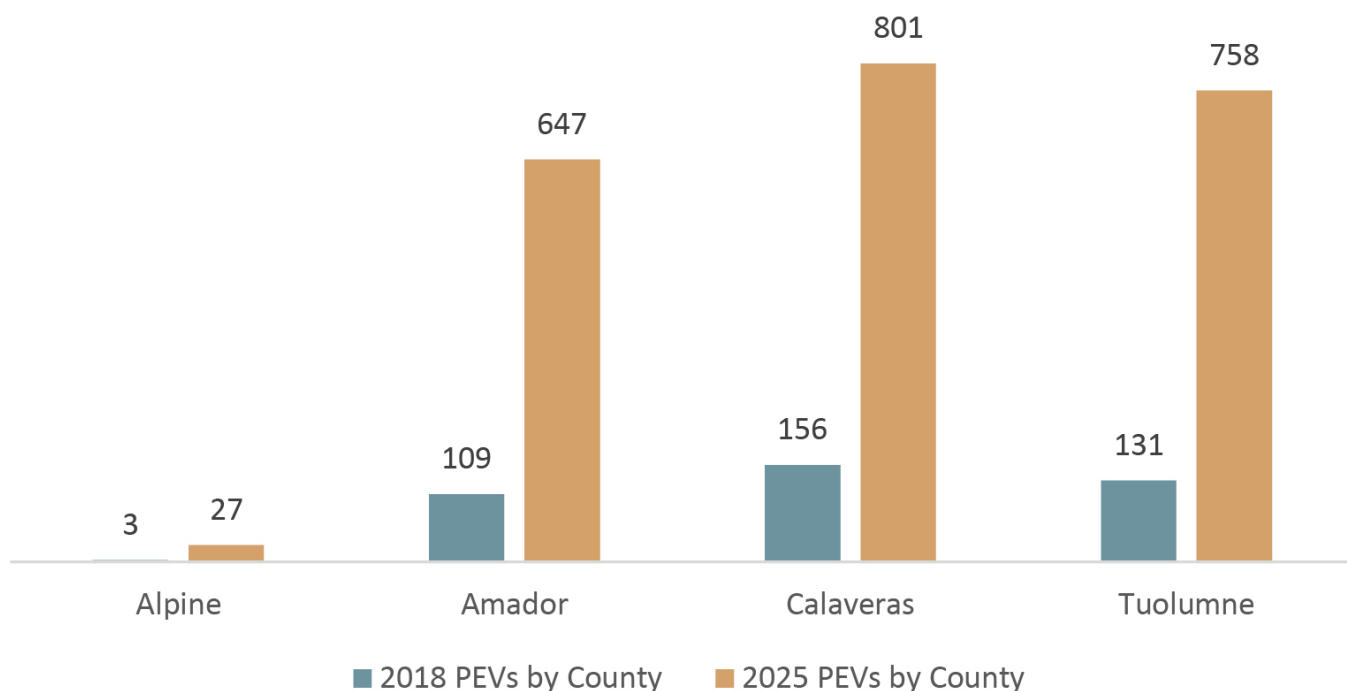
Source: California Energy Commission, 2018; California Motor Vehicle Fuel Types by County, 2018

In 2017, the CEC and NREL used projections from their Energy Demand Forecast, 2018-2030 report to estimate statewide ZEV needs. Results from this analysis show that the Region is expected to have 2,233 PEVs by 2025, which represents approximately 0.2% of the statewide EV fleet.

Another method for estimating the size of the Region's future ZEV fleet uses linear forecasting based on CVRP rebates and program participation rates (i.e., what percentage of the overall ZEV market participates in the CVRP). From April 2016 through June 2018, the authors calculated the proportion of CVRP rebates to DMV vehicle registrations for each fuel type and divided them by monthly rebate totals. Linear regression was then used to forecast the size of the market beyond May 2018. Regression results forecasted 2,233 ZEVs in the Region by December 2025. Table 17 summarize participation rates used for analysis and Figure 20 illustrates linear extrapolations through December 2025.

Table 17: CVRP Participation Rates Used for Linear Extrapolation

Participation Rate	Plug-in Hybrid	Battery-Electric	Total Plug-in Hybrid Vehicle
CVRP Participation Rates for Central Sierra Region (March 2010 - June 2018; analysis relative to DMV registration data)	36%	43%	40%

Source: California Department of Motor Vehicles; Center for Sustainable Energy, 2018

Figure 20: Forecasted Zero-Emission Vehicle Market for the Region
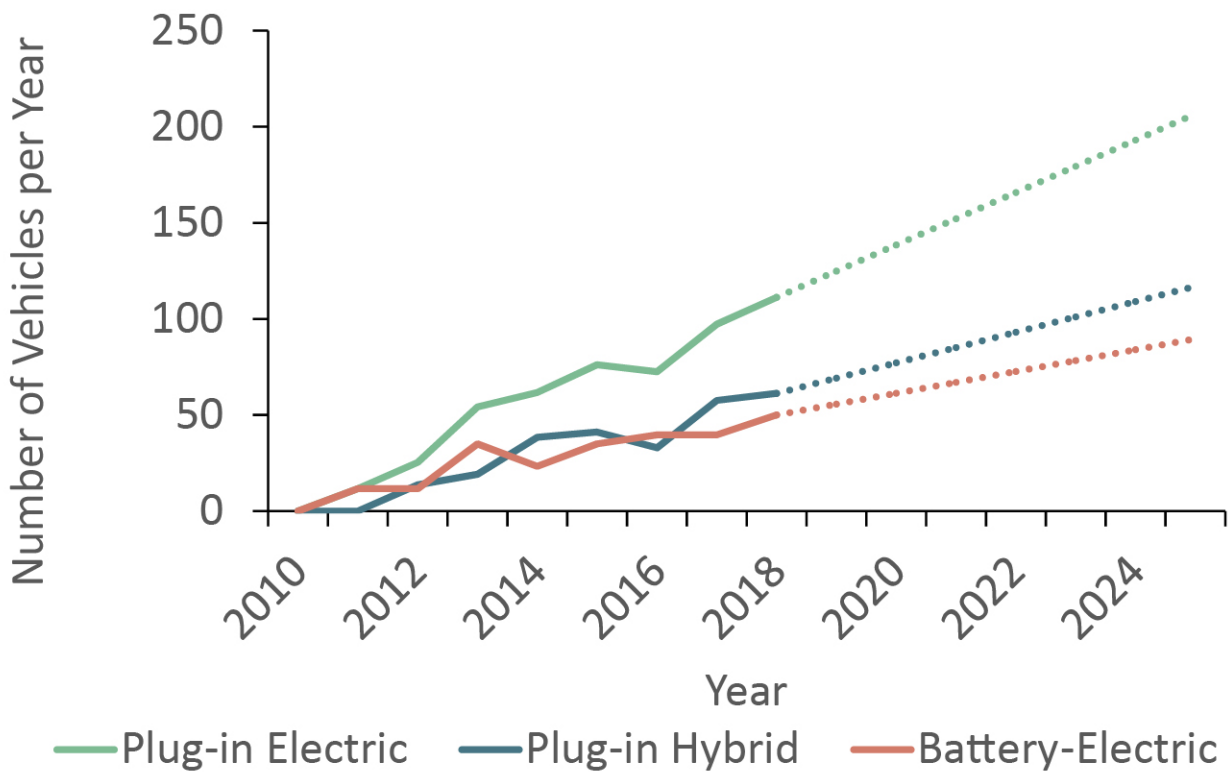
Source: California Department of Motor Vehicles; Center for Sustainable Energy, 2018

Scenario Analysis

To estimate EV charging needs for the Region by 2020 and 2025, the authors applied three different PEV scenarios. Fleet in this reference describes all electric vehicles on the road.

Scenario 1: Energy Commission Fleet Projections

Scenario 1 uses county and statewide PEV estimates calculated by the CEC in its 2017-2025 infrastructure projections report. By 2025, the CEC estimated that there would be 2,233 PEVs in the Region, representing 0.17% of the statewide PEV fleet. The authors calculated the 2025 BEV fleet by multiplying the statewide proportion of BEVs by the county's 2025 PEV fleet estimate. The CEC did not provide county-level estimates for the 2020 fleet, so the following formulas were used to calculate these fleets.

Central Sierra Region 2020 PEV Fleet

2020 Region Plug-in Electric Fleet Projection = 2020 Statewide PEV Fleet Projection × 0.02%

Central Sierra 2020 BEV Fleet

2020 Region BEV Fleet Projection = 2020 Region PEV Fleet Projection × 2020 Statewide BEV Fleet Projection ÷ 2020 Statewide PEV Fleet Projection

Scenario 1: CVRP-Based Fleet Projections

Scenario 2 uses the CVRP-based projections for PHEVs and BEVs to December 2020 and December 2025, described earlier in the report. Regression results forecasted 1,617 ZEVs in the Region by December 2025. Table 17 summarizes participation rates used for analysis and Figure 20 illustrates linear extrapolations through December 2025.

Scenario 3: Market-Share Fleet Projections

Finally, the authors created Scenario 3 based on the Region's percentage of Governor Brown's Executive Order requiring 1 million vehicles by 2020 and 1.5 million by 2025, also mentioned in NREL's 2014 California Statewide Plug-in Electric Vehicle Infrastructure Assessment. The 2020 and 2025 ZEV vehicle targets were calculated by multiplying the 1 million and 1.5 million ZEV goals by the Region's statewide EV market share, which amounts to 0.12%. The ZEV goals were then multiplied by BEV and PEV proportions calculated from DMV registration data.

Table 18 summarizes the different 2020 and 2025 fleet scenarios used to estimate EV infrastructure needs.

Table 18: PEV Fleet Scenarios for the Region

Fleet Scenarios	2020		2025	
	Total PEVs	Total BEVs*	Total PEVs	Total BEVs*
Scenario 1: Energy Commission	1,090	603	2,233	1,232
Scenario 2: CVRP	1,041	468	1,617	728
Scenario 3: Market-Share	1,195	587	1,793	880

Source: National Renewable Energy Laboratory; California Energy Commission, California Department of Motor Vehicles, Center for Sustainability, 2018

EVI Growth Projections

EV infrastructure projections help transportation planners anticipate future EV charging demand and deploy adequate infrastructure. The CEC and National Renewable Energy Laboratory (NREL) developed the Electric Vehicle Infrastructure Projection tool (EVI-Pro) to quantify the types of PEV charging infrastructure required to meet PEV drivers' needs. In 2017, the CEC and NREL used the EVI-Pro tool to project infrastructure needs to meet California's 1.5 million ZEV goal by 2025. To generate projections, the EVI-Pro model utilizes four primary inputs: PEV attributes such as electric range and efficiency; infrastructure attributes for residential, workplace, and public charging; travel data from regional models or transportation surveys; and county-level sales projections by technology type. The EVI-Pro model generates low and high estimates. The low estimate is based on peak vehicle quantity calculations and reflects the minimum quantity of chargers that must be available to meet drivers' simultaneous need to charge. The high estimate utilizes the total number of vehicle charging events over a 24-hour period assuming chargers are shared with at least one other vehicle. The Regional EVI-Pro analysis estimates between 230 and 320 total charging stations are needed by 2025(California Energy Commission, 2018).

Table 19 identifies the total low-end estimate of PEV charging stations needed in 2025 to serve the projected future demand.

Table 20 identifies the total high-end estimate of PEV charging stations needed in 2025 to serve the projected future demand.

Table 21 identifies the total average estimate of PEV charging stations needed in 2025 to serve the projected future demand.

Table 19: Low Estimate PEV Charging Stations in 2025, by County, According to CEC/NREL

County	Workplace L2 Chargers	Public L2 Chargers	DC Fast Chargers	Total
Alpine	0	1	1	2
Amador	20	39	14	73
Calaveras	21	45	16	82
Tuolumne	32	33	8	73
Total	73	118	39	230

Source: California Energy Commission, 2018

Table 20: High Estimate PEV Charging Stations in 2025, by County, According to CEC/NREL

County	Workplace L2 Chargers	Public L2 Chargers	DC Fast Chargers	Total
Alpine	0	4	3	7
Amador	30	52	29	111
Calaveras	25	45	20	90
Tuolumne	35	58	19	112
Total	90	159	71	320

Source: California Energy Commission, 2018

Table 21: Mid-Range Estimate PEV Charging Stations in 2025, by County, According to CEC/NREL

County	Workplace L2 Chargers	Public L2 Chargers	DC Fast Chargers	Total
Alpine	0	3	2	5
Amador	25	46	22	93
Calaveras	23	45	18	86
Tuolumne	34	46	14	94
Total	82	140	56	278

Source: California Energy Commission, 2018

Table 22: Low-High-Mid Estimate Totals of PEV Charging Stations in 2025, by County, According to CEC/NREL

County EVI Estimates		
Alpine Totals Low: 2 High: 7 Average: 5	**Calaveras Totals** Low: 82 High: 90 Average: 86	**Region Totals** **Low: 230** **High: 320** **Average: 278**
Amador Totals Low: 73 High: 111 Average: 93	**Tuolumne Totals** Low: 73 High: 112 Average: 94	

Source: California Energy Commission, 2018

Visitor Travel

EVO-Pro projections paint a partial picture but do not account for EV infrastructure demand generated by visitor travel. The California Statewide Regional Travel Model estimates that 23,299 daily trips originated outside and ended within Central Sierra in 2010; that count is projected to increase by 89% to 44,068 daily trips in 2040 (California Department of Transportation, 2014). Utilizing State PEV registration rates (1.12%) as a proxy for determining PEV share of total visitor travel, approximately 223 PEVs made daily trips in 2010 and 441 PEVs are expected by 2040. The resulting annual number of visitor PEVs in 2010 is estimated to have been 81,395 with 160,848 annual visitor PEVs expected in 2040.

Table 23: California PEV Registrations, 2018

Fuel Type	Number of Registrations	% of Total Registrations
PHEV	163,317	0.53%
BEV	178,348	0.58%
Total	**341,665**	**1.12%**

Source: California Department of Motor Vehicles

Charging Port Projections

There are currently 27 sites that offer EV charging with a total of 70 charging ports. Using the EVI-Pro tool, there will need to be 191-249 destination level 2 charging station plugs in the region and at least 39-71 DC fast charging plugs to support the expected growth in number of EVs by 2025. Average numbers are shown in Figure 21.

Charging Location Demand

After identifying the number of charging ports needed in the region, charging station locations can be sited to serve these vehicles. State parks and Yosemite National Park are some of the key destinations in the region, but there are many other types of destinations where charging infrastructure could be sited to help meet demand, including lakes and national forest recreation areas, schools, and historic main streets areas.

Table 24 provides average charging duration and dwell time by location type. Utilizing regional points of interest, institutions, and tourist destinations, the Planning Team was able to identify recreational areas: campgrounds and picnic areas, wineries, vineyards, tasting rooms, ski resorts; public destinations: public airports, public schools and colleges, parks, forests, and lakes; and historic destinations as viable charging location opportunities.

Figure 21: Average Projected Charger Demand 2017-2025
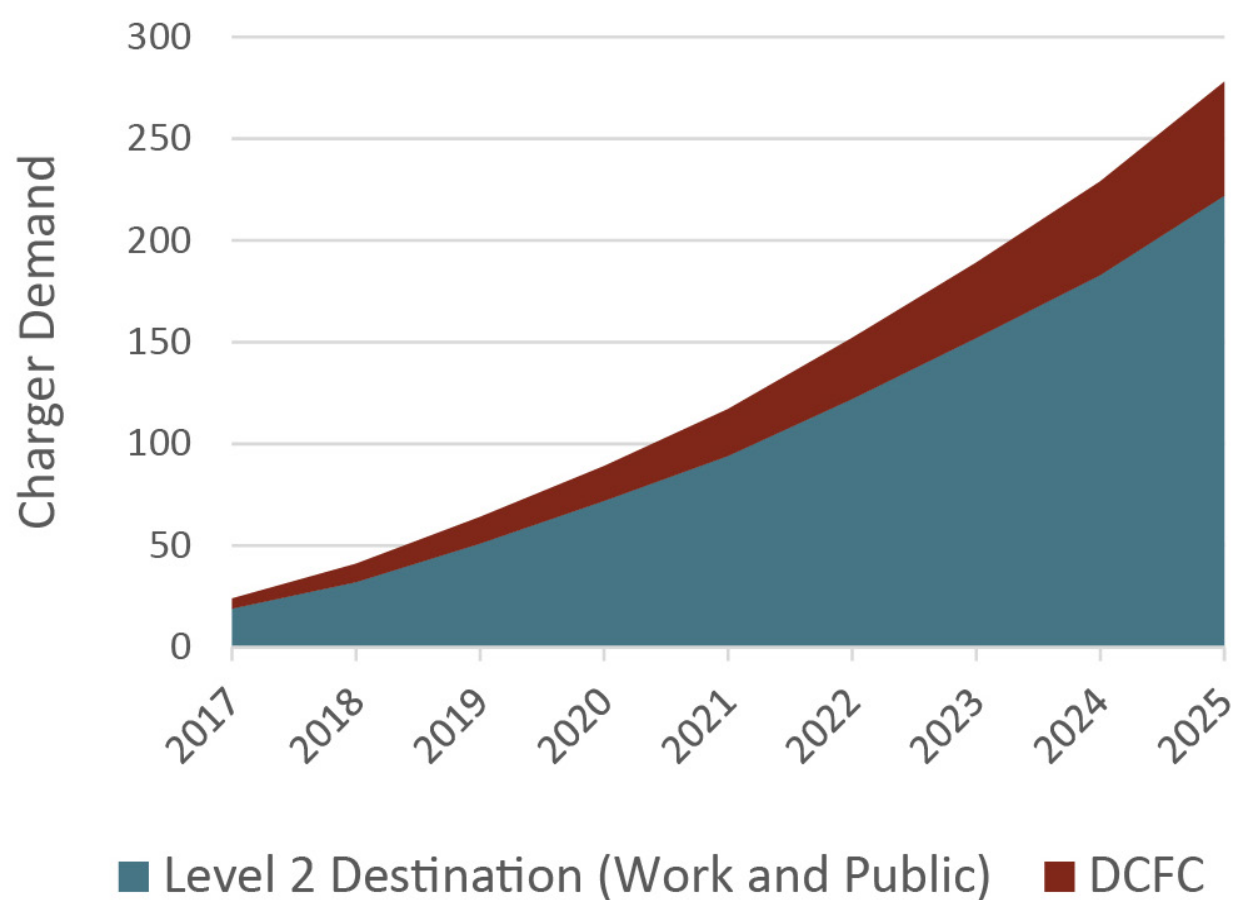
Source: NREL and CEC, 2018

Table 24: ChargePoint Electric Vehicle Duration and Dwell Time Analysis

Location type	Level	kWh/charging event	Charging duration (min)	Dwell time plugged in (min)
Education	L2	8.6	133	175
Healthcare	L2	9.6	137	217
Hospitality	L2	10.7	164	367
Multifamily	L2	14.2	177	532
Municipal	L2	10.1	135	378
Parking	L2	7.9	120	260
Parks and Rec	L2	11.1	147	338
Retail	L2	5.3	84	189
Workplace	L2	7.4	112	240
Retail	DCFC	11.8	34	37
Workplace	DCFC	11.8	57	116

Source: Charging Electric Vehicles in Smart Cities: An EVI-Pro Analysis of Columbus, Ohio (NREL, February 2018)

Regional Destinations

Districts

The Angels Camp Main Street is a good example of implementing charging infrastructure in a historic district. The Angels Camp Main Street Plan identifies electric vehicle charging as a future trend and an essential component of transportation planning in the region. The plan recommends that charging be included in commercial and residential planning through parking lots, garages, and on-street parking. As a regional tourist destination that attracts PEV drivers from across the state, historic districts are well positioned to provide charging infrastructure to visitors and residents alike.

The planning team identified the following regions as districts for further analysis. These include the following areas in each county:

- Alpine: Markleeville
- Amador: Amador City, Ione, Jackson, Sutter Creek
- Calaveras: Angels Camp
- Tuolumne: Sonora

These areas are significant in the Region for implementing EV infrastructure for one or more of the following factors: size, Regional historic district, proximity to major travel corridors, Main Street designation, and parking infrastructure. The planning team will conduct further in-person site analysis for several of these locations, and surrounding commercial districts.

Figure 22: Regional Districts of Interest, EV Infrastructure

Source: Center for Sustainable Energy, 2018
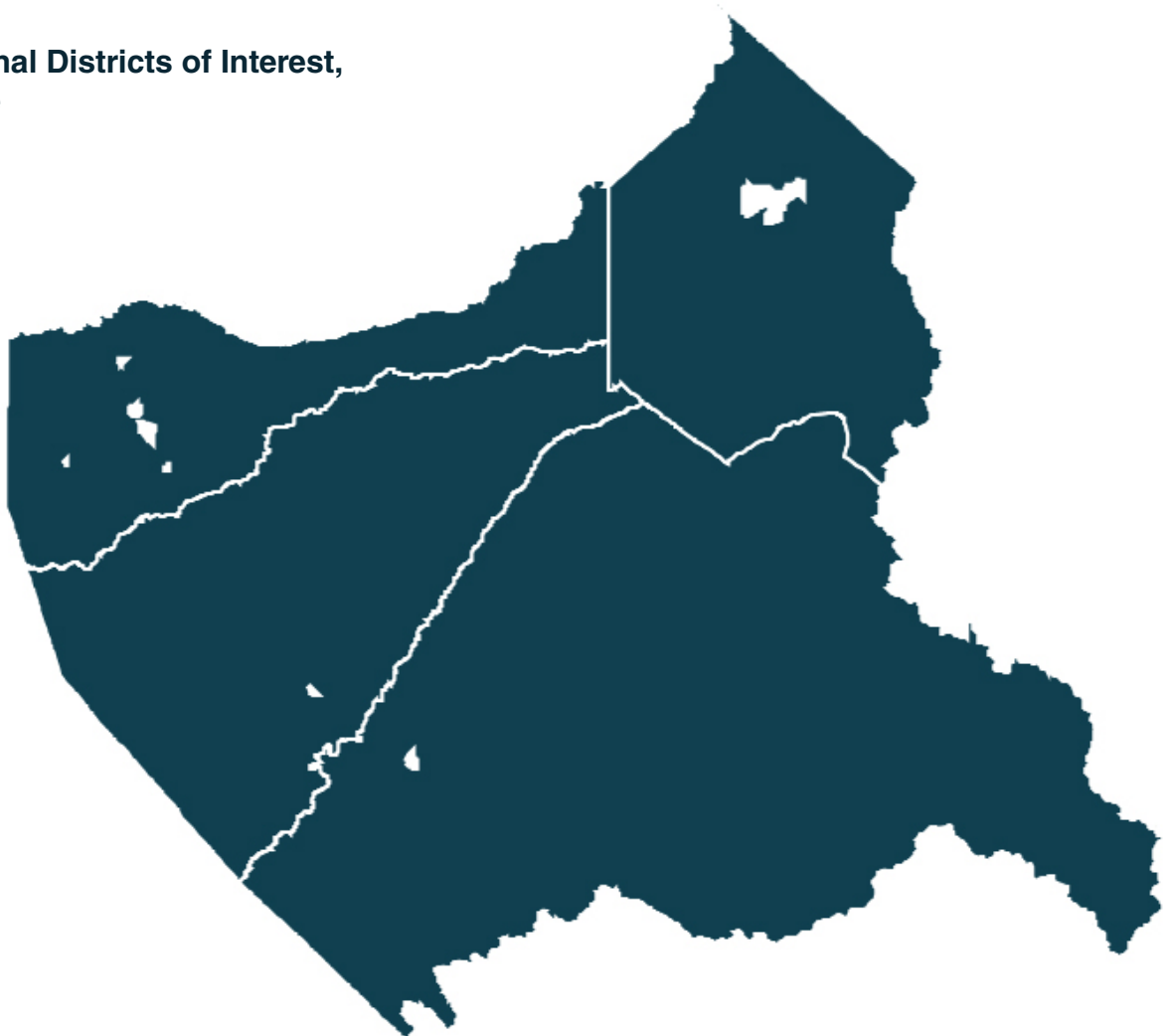
Figure 23: Markleeville District, Alpine
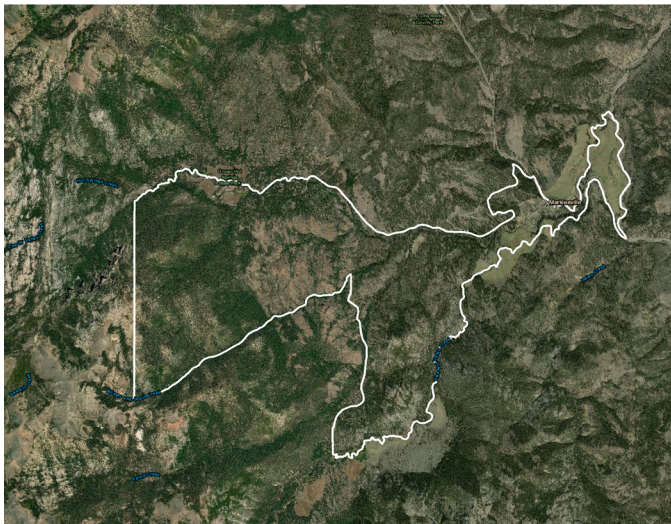
Source: Center for Sustainable Energy, 2018

Figure 24: Ione District, Amador

Source: Center for Sustainable Energy, 2018

Figure 25: Jackson District, Amador

Source: Center for Sustainable Energy, 2018

Figure 26: Sutter Creek District, Amador
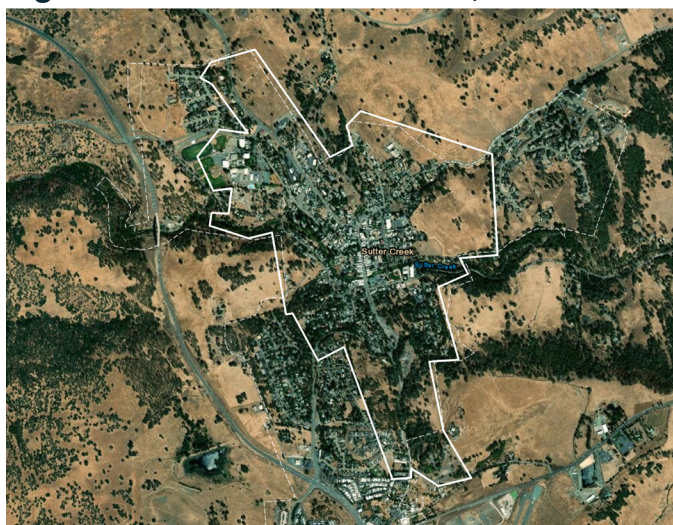
Source: Center for Sustainable Energy, 2018

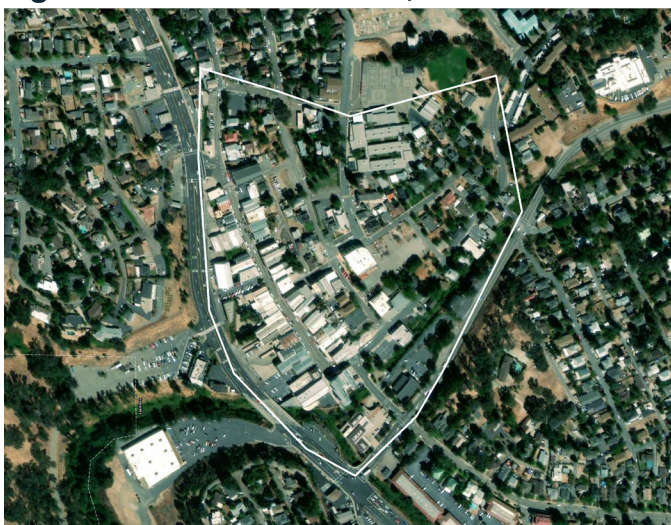**Figure 27: Angels Camp District, Calaveras**
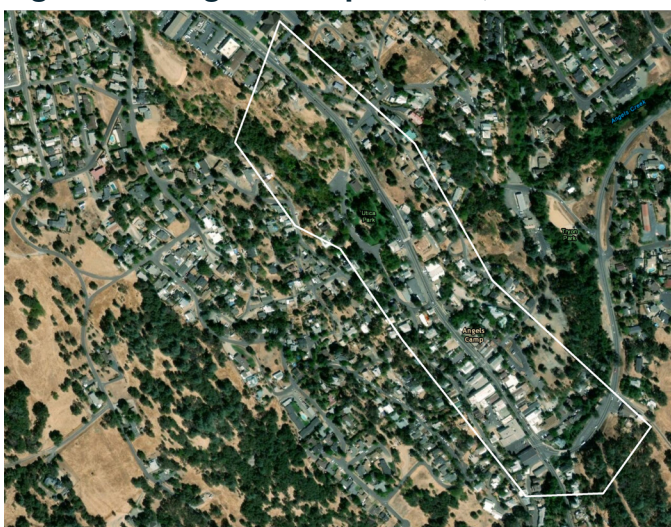
Source: Center for Sustainable Energy, 2018

Figure 28: Sonora District, Tuolumne
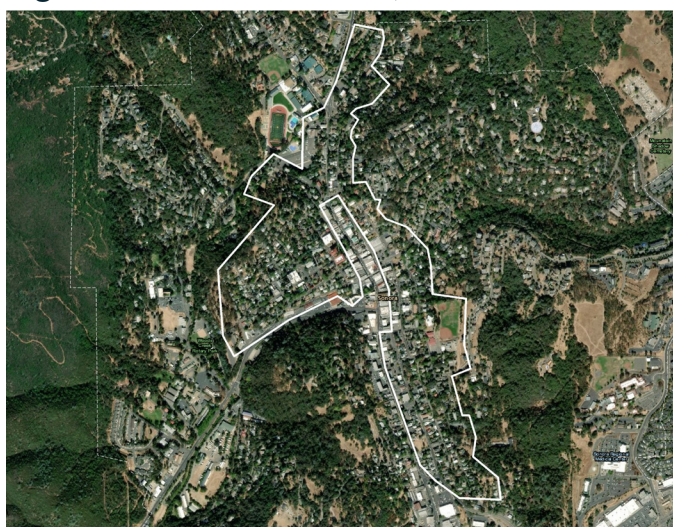
Source: Center for Sustainable Energy, 2018

Tourism & Recreation

Tourist and recreation destinations within the region are also prime examples of charging infrastructure opportunities since they draw large numbers of regional visitors who generally stay at the destination for extended periods of time.

Schools

Schools are good locations for charging infrastructure for both public charging and workplace charging and include fleet transition opportunities for school bus fleets.

Airports

Airports in the Region may provide opportunities for longer dwell times and are destinations for visitors and residents alike.

Figure 29: Tourism & Recreation in the Region

Source: Center for Sustainable Energy, 2018

Ski Resorts

Wineries, Tasting Rooms, & Vineyards

Campgrounds and Picnic Areas

N

0   5   10 Miles
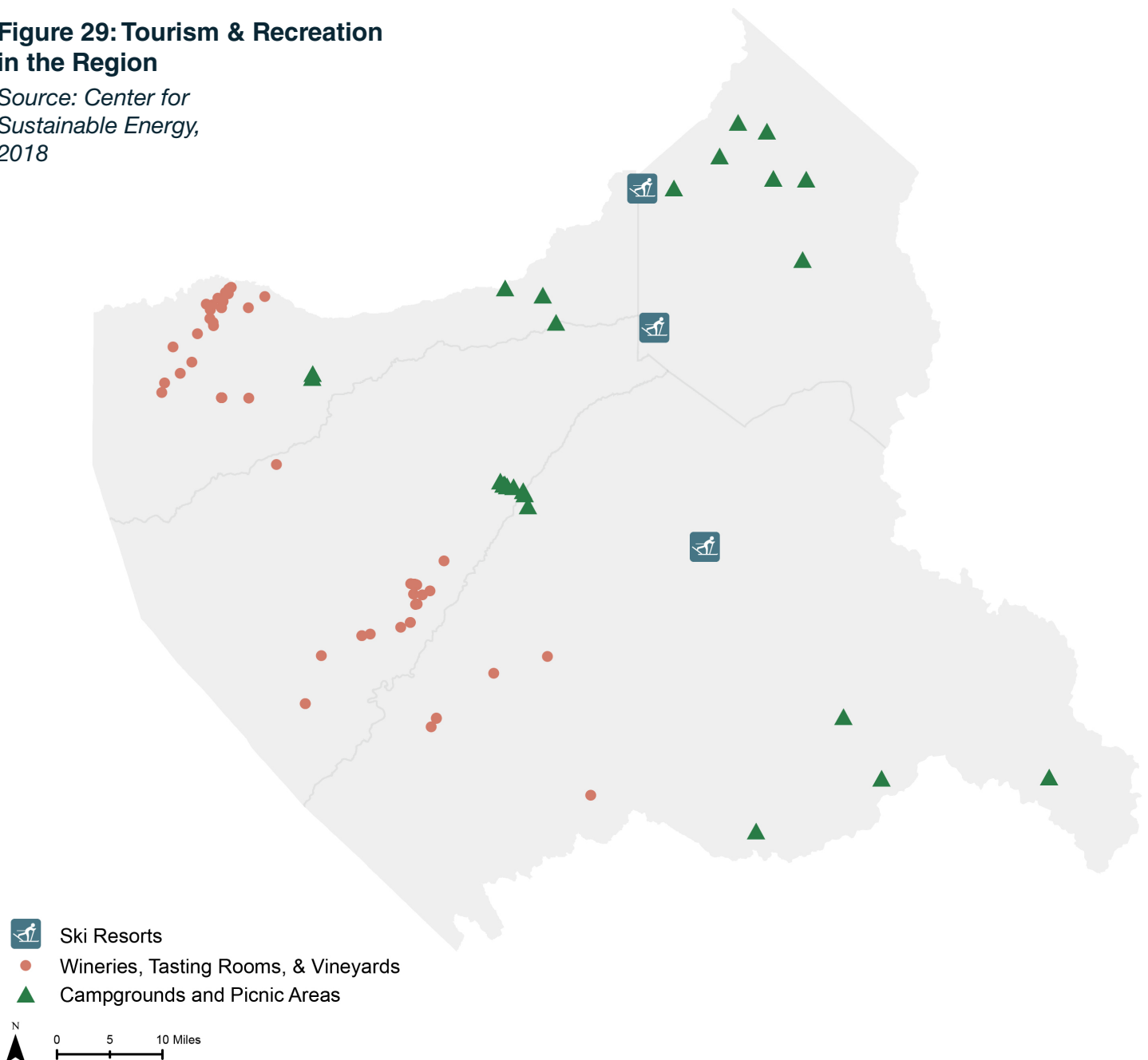
Figure 30: Schools in the Region

Source: Center for Sustainable Energy, 2018

Public Schools
Colleges

0 5 10 Miles
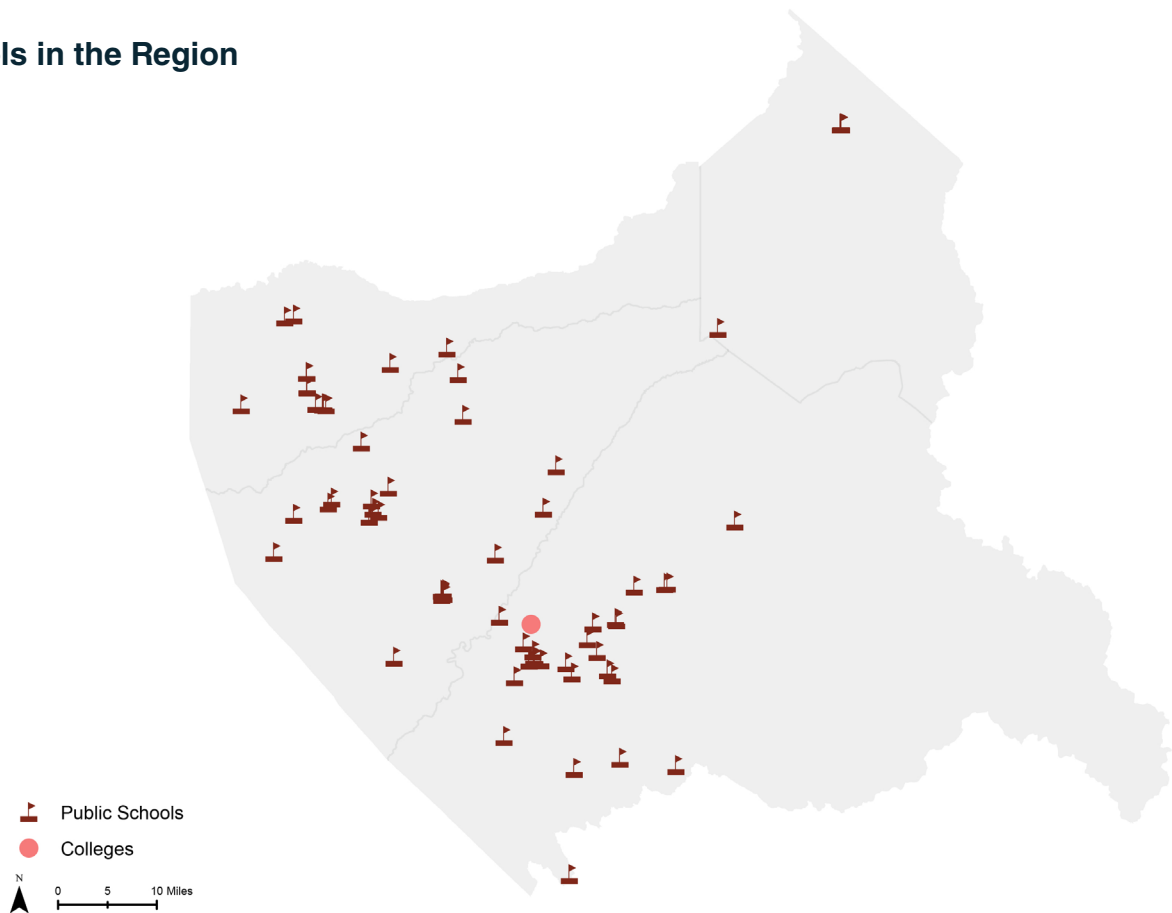
Figure 31: Airports in the Region

Source: Center for Sustainable Energy, 2018

Public Airports

0 5 10 Miles
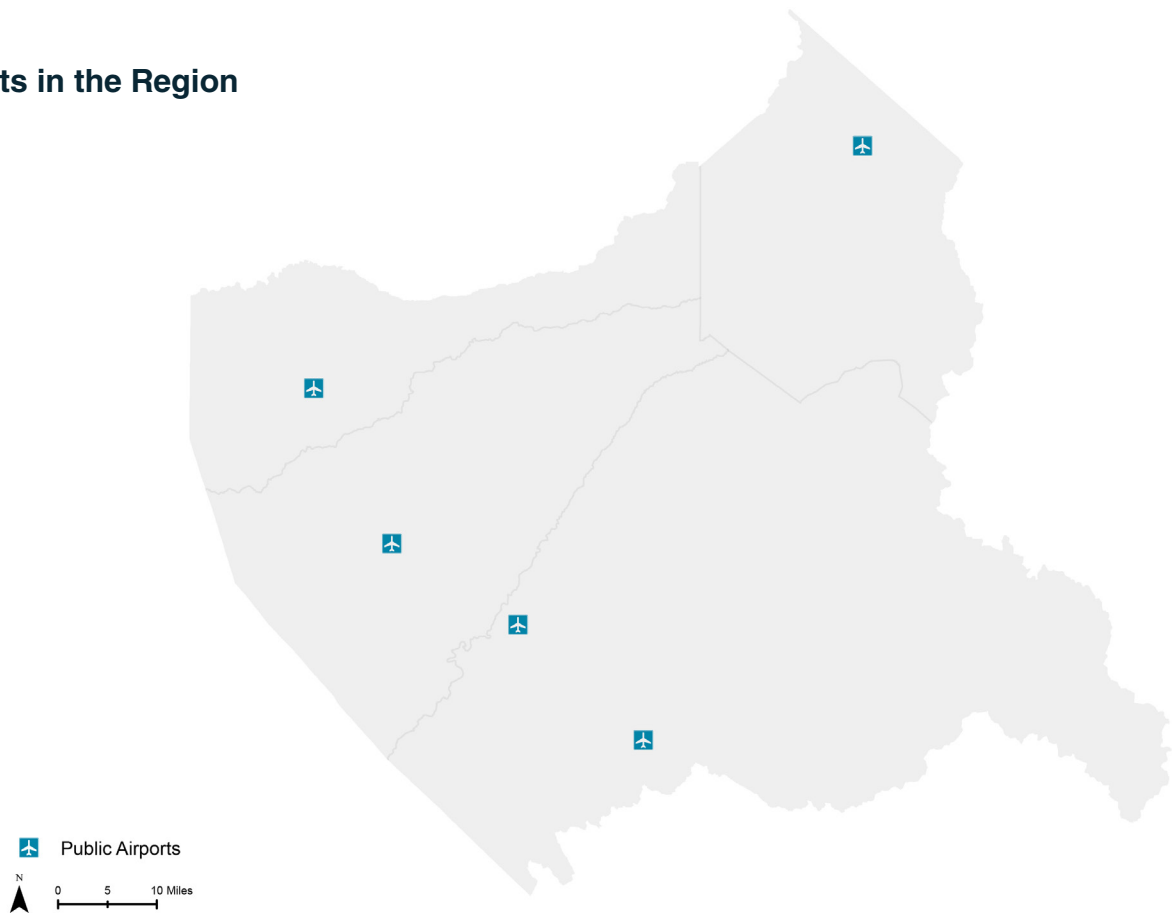
YARTS Stops & State Park Entrances

Opportunities for charging infrastructure also exist along YARTS stops and at State Park entrances. Visitors to the region utilize the YARTS system to visit Yosemite and surrounding destinations and provide opportunities for EVCS at park and ride locations.

Stops along the Sonora – Highway 120 YARTS route are also potential opportunities for EVCS in the region. These include the following 12 stops listed in Table 25.

Figure 31: YARTS Stops and State Park Entrances

Source: Center for Sustainable Energy, 2018

Grover Hot Springs State Park

Eldorado National Forest

Humboldt-Toiyabe National Forest

Indian Grinding Rock State Park

Calaveras Big Trees State Park

Stanislaus National Forest

Yosemite National Park

Potential Charging Areas for State and National Parks

🅿 YART Stops and State Park Entrances within 1/2 mile of EV Charging

🅿 YART Stops and State Park Entrances

0   5   10 Miles
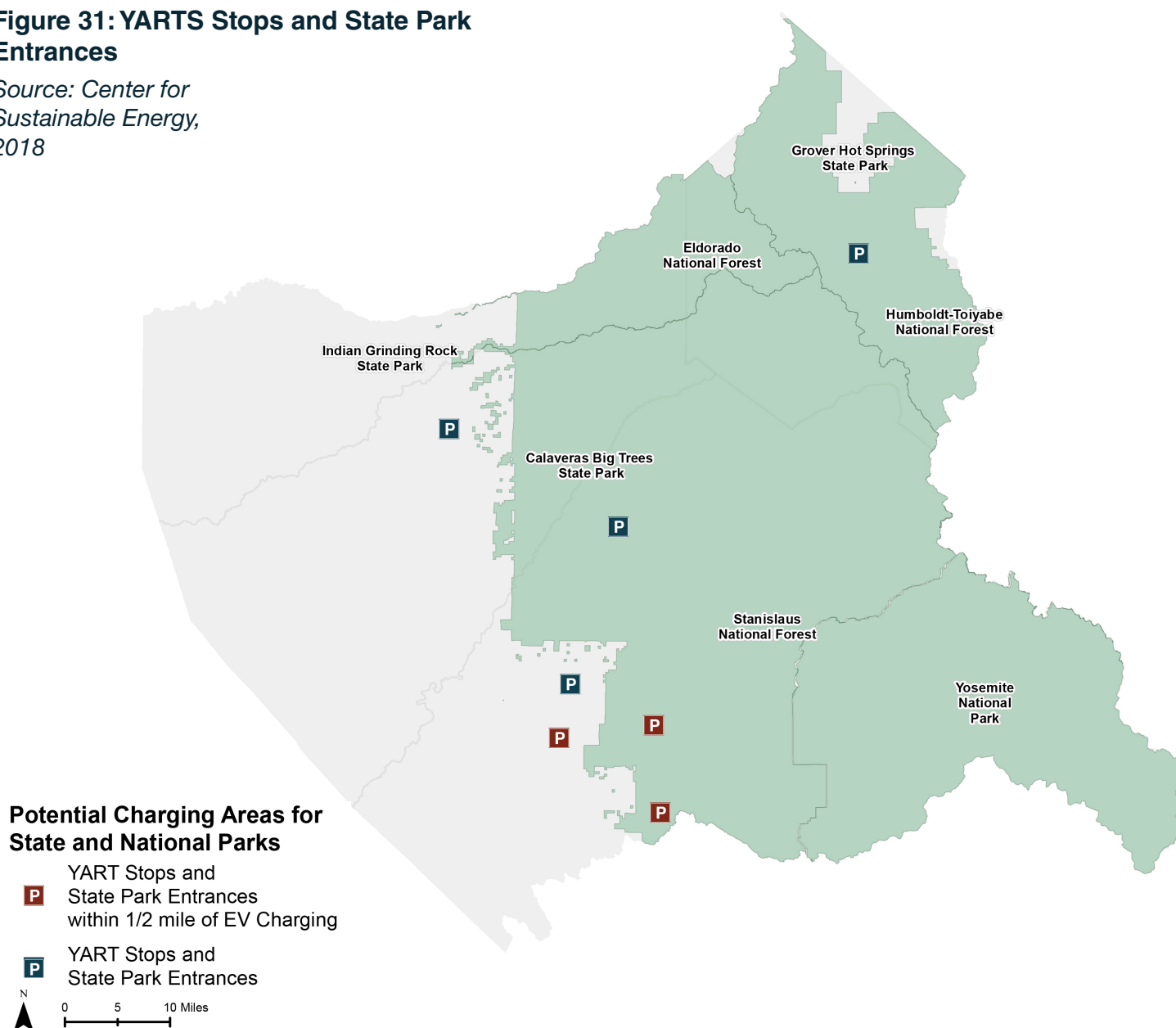
Table 25: Stops on The Sonora – Highway 120 Route

Stop	Sonora to Yosemite National Park Stops
1	Black Oak Hotel and Resort
2	Sonora Best Western
3	Inns of California/Downtown Sonora
4	Rocca Park/ Jamestown Main Street
5	Mary Laveroni Park
6	Yosemite Pines RV Park
7	Buck Meadows Restaurant
8	Yosemite Lakes Campgrounds
9	Rush Creek Lodge
10	Big Oak Flat/ Park Entrance Gate
11	Crane Flat Gas Station
12	Yosemite Valley Visitor Center

Source: Yosemite Area Regional Transportation System, 2018

Source: The Fresno Bee, 2018

Workplace Charging Locations

The Region is comprised largely of retired residents with a smaller but active workforce. CVRP survey data indicates that 73% of respondents feel that workplace charging is an important decision metric for acquiring a PEV. Therefore, identifying the top employers with the largest workforce in each county is beneficial to identifying opportunities for charging infrastructure. The following tables identify the top 25 employers in each county. These locations are then shown on the subsequent map, which also evaluates the current infrastructure available in proximity to these locations.

Figure 32: Top Employers & Existing Charging, All Counties

Source: Center for Sustainable Energy, 2018

Legend:
- Top Employers
- Existing DCFC
- Existing L2

Figure 33: Top Employers & Existing Charging, Alpine County
Source: Center for Sustainable Energy, 2018
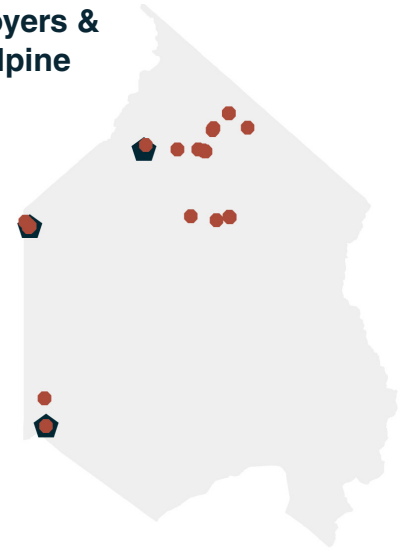
Table 26: Major Employers in Alpine County, 2018

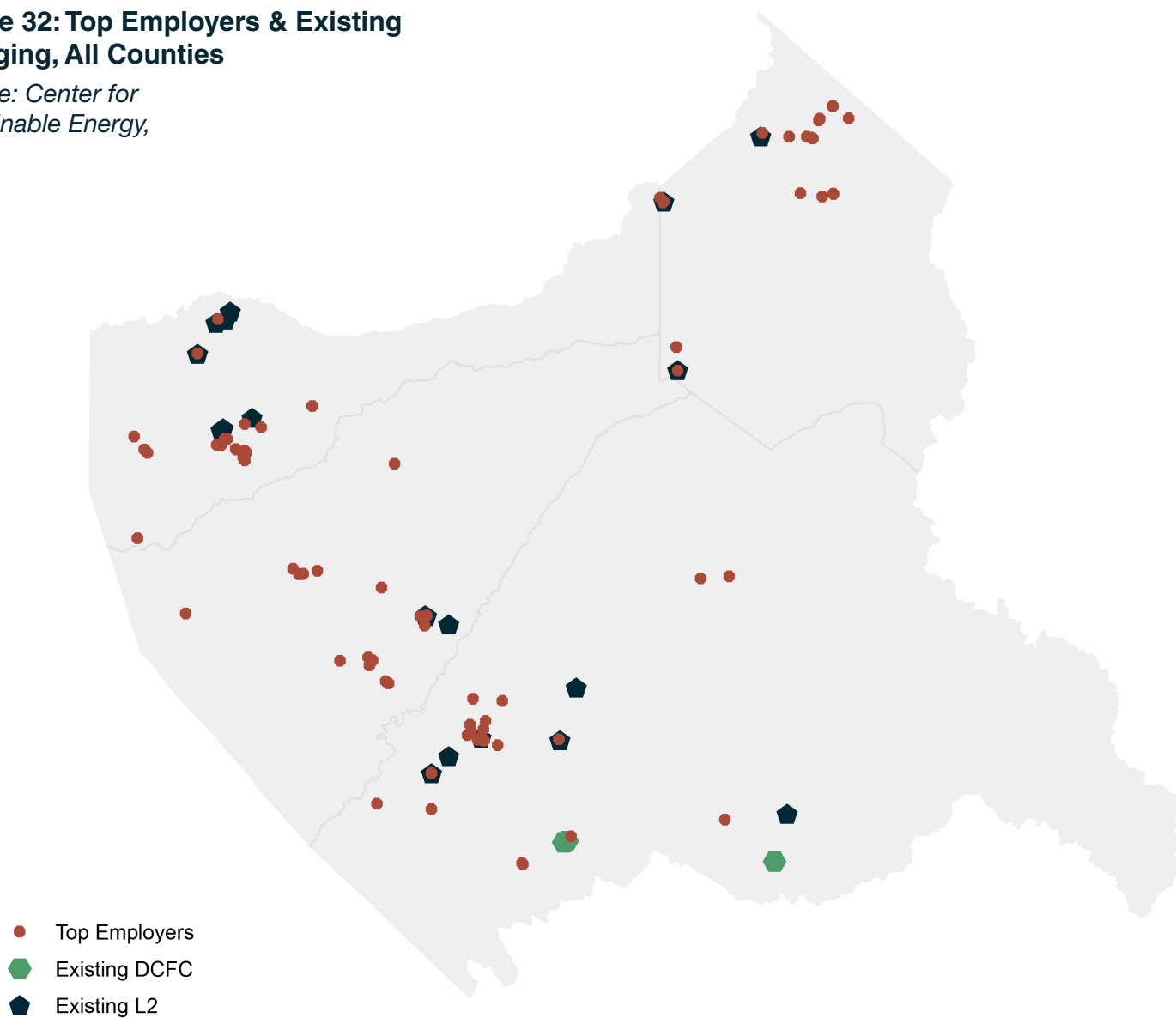| Employer Name	City	Industry	Employees
Alpine County Fire Station	Markleeville	Government Offices-County	10-19
Alpine County Health Dept	Markleeville	Government Offices-County	10-19
Alpine County Public Works	Markleeville	Government Offices-County	10-19
Alpine County School	Markleeville	Schools	20-49
Alpine County Sheriff	Markleeville	Government Offices-County	10-19
Alpine County Social Svc Dept	Markleeville	Government Offices-County	10-19
Alpine County Superior Court	Markleeville	County Government-Courts	5-9
Alpine Learning Center	Markleeville	Schools	10-19
Child Protective Services	Markleeville	Social Service & Welfare Organizations	10-19
Diamond Valley Elementary School	Markleeville	Schools	20-49
Grover Hot Springs State Park	Markleeville	Parks	10-19
Intero Real Estate Svc	Markleeville	Real Estate	20-49
Kirkwood Meadows Utility	Kirkwood	Water & Sewage Companies-Utility	20-49
Kirkwood Mountain Resort	Kirkwood	Resorts	20-49
Kirkwood Real Estate	Kirkwood	Real Estate	5-9
Kirkwood Ski Education	Kirkwood	Skiing Instruction	10-19
Live Violence Free	Markleeville	Marriage & Family Counselors	10-19
Pacific Utility	Markleeville	Utility Contractors	5-9
Pacific Utility Audit Inc	Markleeville	Utility Contractors	5-9
Sorensen's Resort	Markleeville	Resorts	20-49
Tahoe Youth & Family Svc	Markleeville	Home Health Service	10-19
Transportation Department	Markleeville	Government Offices-State	10-19
Womens Center	Markleeville	Sexual Counseling & Therapy	10-19
Woodfords Community	Markleeville	Social Service & Welfare Organizations	5-9
Woodfords Maintenance Station	Markleeville	Government Offices-State	10-19

Source: America's Labor Market Information System (ALMIS) Employer Database, 2019; State of California Employment Development Department

Figure 34: Top Employers & Existing Charging, Amador County
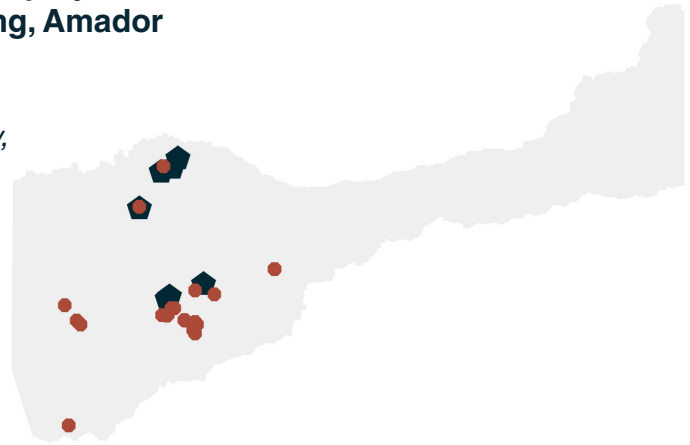
Source: Center for Sustainable Energy, 2018

Table 27: Major Employers in Amador County, 2018

Employer Name	City	Industry	Employees
Amador County Sheriff	Jackson	Government Offices-County	100-249
Ampine	Sutter Creek	Plywood & Veneers-Manufacturers	100-249
Argonaut Care Home	Jackson	Nursing & Convalescent Homes	50-99
Beth Sogaard Catering	Plymouth	Caterers	50-99
Borjon Vineyard & Labor Svc	Plymouth	Farm Management Service	100-249
County Coroner	Jackson	Government Offices-County	100-249
Ione Elementary School	Ione	Schools	50-99
Jackson Casino & Resort	Jackson	Casinos	1000-4999
Jackson Junior High School	Jackson	Schools	50-99
Kit Carson Nursing & Rehab	Jackson	Hospitals	100-249
Lake Camanche Marina & Grill	Ione	Marinas	50-99
Lake Camanche Recreation	Ione	Recreation Centers	50-99
Lodi Memorial Hospital Assn	Ione	Hospitals	50-99
Lowe's Home Improvement	Jackson	Home Centers	100-249
Mariah Resources Incorporated	Jackson	Labor Contractors	50-99
Mule Creek State Prison	Ione	Government Offices-State	500-999
Raley's	Jackson	Grocers-Retail	100-249
Raley's	Jackson	Grocers-Retail	50-99
Save Mart	Jackson	Grocers-Retail	50-99
Sierra Pacific Industries	Martell	Lumber-Manufacturers	100-249
Sutter Amador Hospital	Jackson	Hospitals	250-499
Volcano Public Telephones	Pine Grove	Radio/Tv Broadcasting/Comm Equip (mfrs)	100-249
Volcano Vision Inc	Pine Grove	Internet Service	100-249
Volcano Vision-Kirkwood Repair	Pine Grove	Television-Cable & CATV	100-249
Walmart	Jackson	Department Stores	100-249

Source: America's Labor Market Information System (ALMIS) Employer Database, 2019; State of California Employment Development Department

Figure 35: Top Employers & Existing Charging, Calaveras County
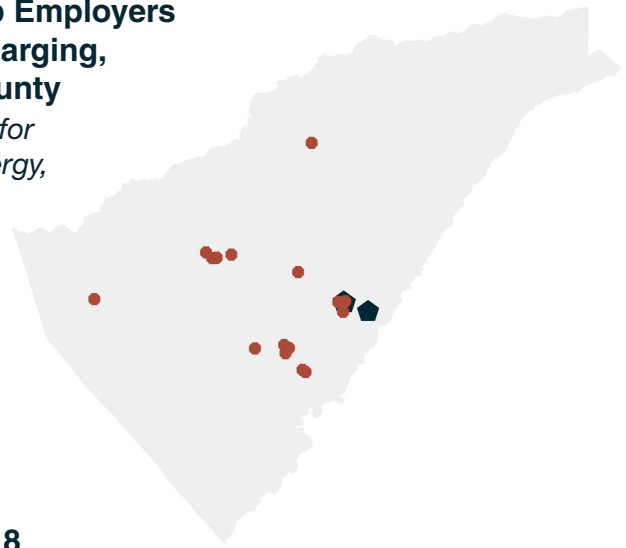
Source: Center for Sustainable Energy, 2018

Table 28: Major Employers in Calaveras County, 2018

Employer Name	City	Industry	Employees
Avalon Training Ctr	San Andreas	Nursing & Convalescent Homes	100-249
Bear Valley Mountain Resort	Bear Valley	Hotels & Motels	250-499
Big Trees Market	Arnold	Grocers-Retail	50-99
Bret Harte High School	Angels Camp	Schools	100-249
Calaveras County Human Svc	San Andreas	Government Offices-County	50-99
Calaveras County Sheriff	San Andreas	Government Offices-County	50-99
Calaveras County Surveyor	San Andreas	Government Offices-County	50-99
Calaveras High School	San Andreas	Schools	50-99
Calaveras Lumber	Angels Camp	Gift Shops	50-99
Calaveras Public Works Dept	San Andreas	Government Offices-County	50-99
Foothill Village Senior Living	Angels Camp	Retirement Communities & Homes	50-99
Forestry & Fire Protection	San Andreas	Government Offices-State	250-499
Global Payments Inc	Bear Valley	Bill Paying Service	50-99
Hotcakesinc	Copperopolis	Restaurants-Family Dining	50-99
Ironstone Vineyards	Murphys	Wineries (mfrs)	100-249
Jerry Lind Elementary School	Valley Springs	Schools	50-99
Mact Health Board Inc	Angels Camp	Clinics	50-99
Mark Twain Medical Center	San Andreas	Hospitals	250-499
Native Daughters-Golden West	Murphys	Fraternal Organizations	100-249
Rail Road Flat Elementary School	San Andreas	Schools	50-99
Rite-Passage-Sierra Ridge Academy	San Andreas	Residential Care Homes	100-249
Smith Timber Co	Wilseyville	Sawmills (mfrs)	50-99
Sonora Regional Med Ctr	Angels Camp	Health Services	50-99
UPS Customer Center	Angels Camp	Mailing & Shipping Services	50-99
Worldmark Angels Camp	Angels Camp	Hotels & Motels	50-99

Source: America's Labor Market Information System (ALMIS) Employer Database, 2019; State of California Employment Development Department

**Figure 36: Top Employers
& Existing Charging,
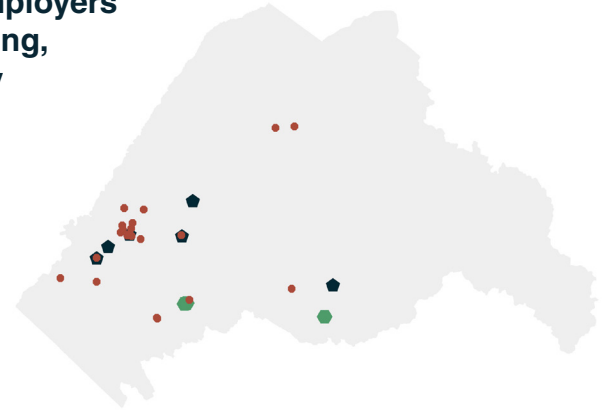Tuolumne County**

*Source: Center for
Sustainable Energy,
2018*

Table 29: Major Employers in Tuolumne County, 2018

Employer Name	City	Industry	Employees
Adventist Health Sonora	Sonora	Hospitals	1000-4999
Black Oak Casino	Tuolumne	Casinos	500-999
Black Oak Casino	Tuolumne	Casinos	100-249
Chicken Ranch Bingo & Casino	Jamestown	Casinos	100-249
Columbia College	Sonora	Schools-Universities & Colleges Academic	100-249
Corrections Dept	Jamestown	Government Offices-State	1000-4999
Diestel Family Turkey Ranch	Sonora	Ranches	100-249
Dodge Ridge Ski Resort	Pinecrest	Skiing Centers & Resorts	500-999
Hetch Hetchy Project	Groveland	Government Offices-City, Village & Twp	250-499
Hetch Hetchy Water & Power	Moccasin	Government Offices-County	100-249
Kohl's	Sonora	Department Stores	100-249
Lair of the Golden Bear	Pinecrest	Camps	100-249
Lowe's Home Improvement	Sonora	Home Centers	100-249
Moccasin Low Head Hydro Prjct	Moccasin	Power Plants	250-499
Pine Mountain Lake Assn	Groveland	Associations	100-249
Ranch House Restaurant	Jamestown	Restaurants	100-249
Safeway	Sonora	Grocers-Retail	100-249
Sierra Pacific Industries	Chinese Camp	Lumber-Manufacturers	100-249
Sonora High School	Sonora	School Districts	100-249
Tuolumne County Human Svc Agency	Sonora	Government Offices-County	100-249
Tuolumne County Sheriff	Sonora	Government Offices-County	100-249
Tuolumne County Special Education	Sonora	Schools	100-249
Tuolumne General Hospital	Sonora	Emergency Medical & Surgical Service	250-499
Tuolumne Mewuk Tribal Council	Sonora	Casinos	100-249
Walmart	Sonora	Department Stores	250-499

*Source: America's Labor Market Information System (ALMIS) Employer Database, 2019; State of California
Employment Development Department*

Transportation Demand

Highway corridors represent the primary conduit for interregional charging and past CEC funding opportunities through the state have funded fast charging along highway corridors with locations every 20 miles. This provides range assurance for drivers traveling along these highway routes since the spacing ensures that electric vehicle drivers with different range capabilities will have multiple chances to stop to charge. The Figure 37 displays a hypothetical DC fast charger location placed every 20 miles along the primary state routes in the Region.

The identified points give a general idea of where charging stations could go to provide this coverage. Additional work would be needed to see where suitable sites for DCFC exist. Traffic counts and other information can also inform which routes are higher priorities. For example, State Route 88 over Carson pass has the highest average traffic of any of the transalpine passes, and offers year-round connections to the Lake Tahoe region, which has some EV infrastructure in place. By contrast, the Sonora Pass has lower traffic, challenging terrain, and closes in the winter making it less suitable and a lower priority for EV charging.

Figure 37: YARTS Stops and State Park Entrances

Source: Center for Sustainable Energy, 2018
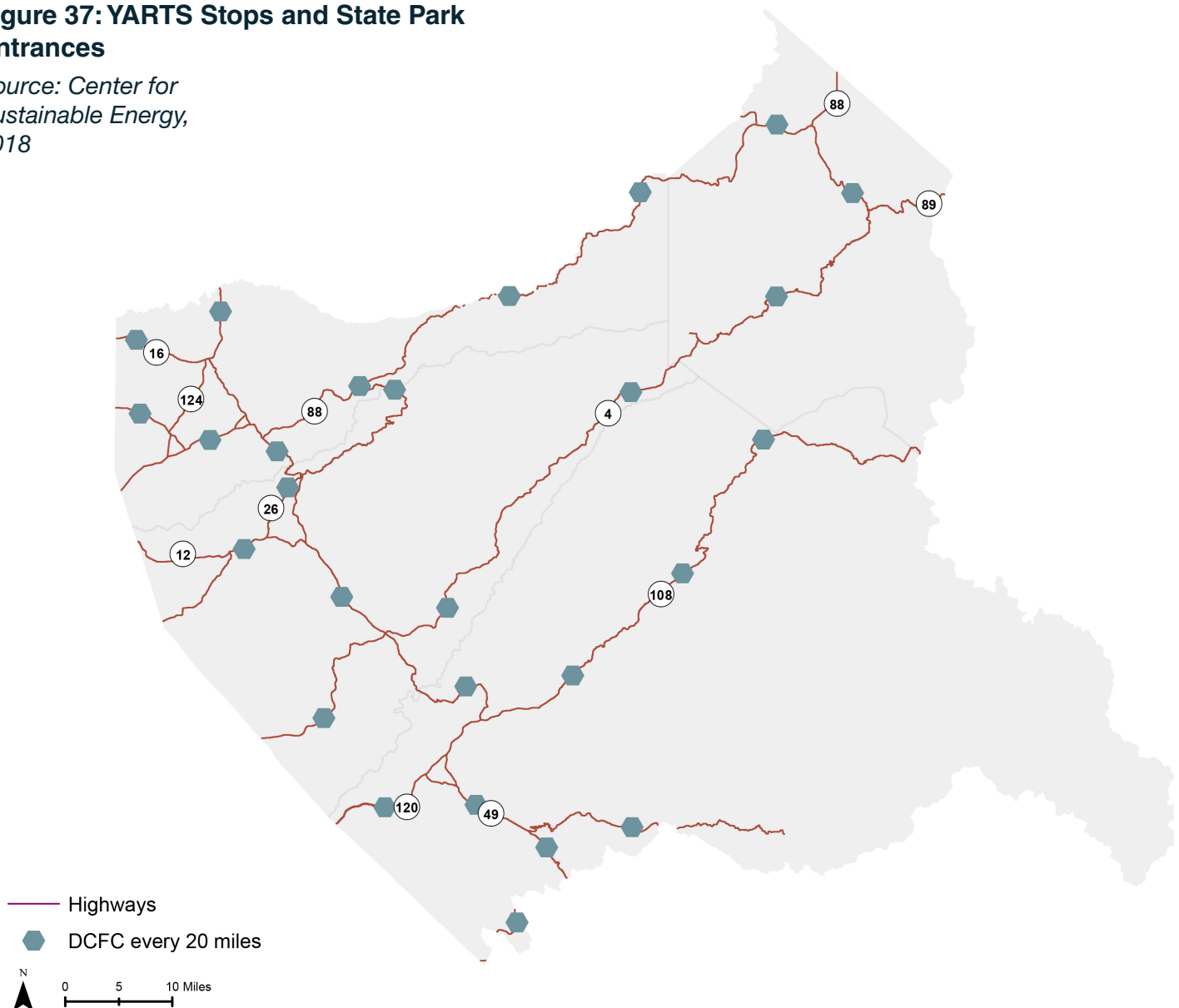
Local Business Survey

To help understand the level of knowledge and attitudes about EVs, the Central Sierra Zero-Emission Vehicle Readiness Planning Team conducted a survey of business owners and managers in the region. The survey was designed to:

- Understand business owners'/managers' interest in providing EV charging for customers/employees

- Understand business owners'/managers' barriers and needs related to installing EV charging

- Provide direction regarding resources that can be included in toolkits to help business owners with installation of EV charging

- Offer opt-in for additional information and/or participation in planning efforts.
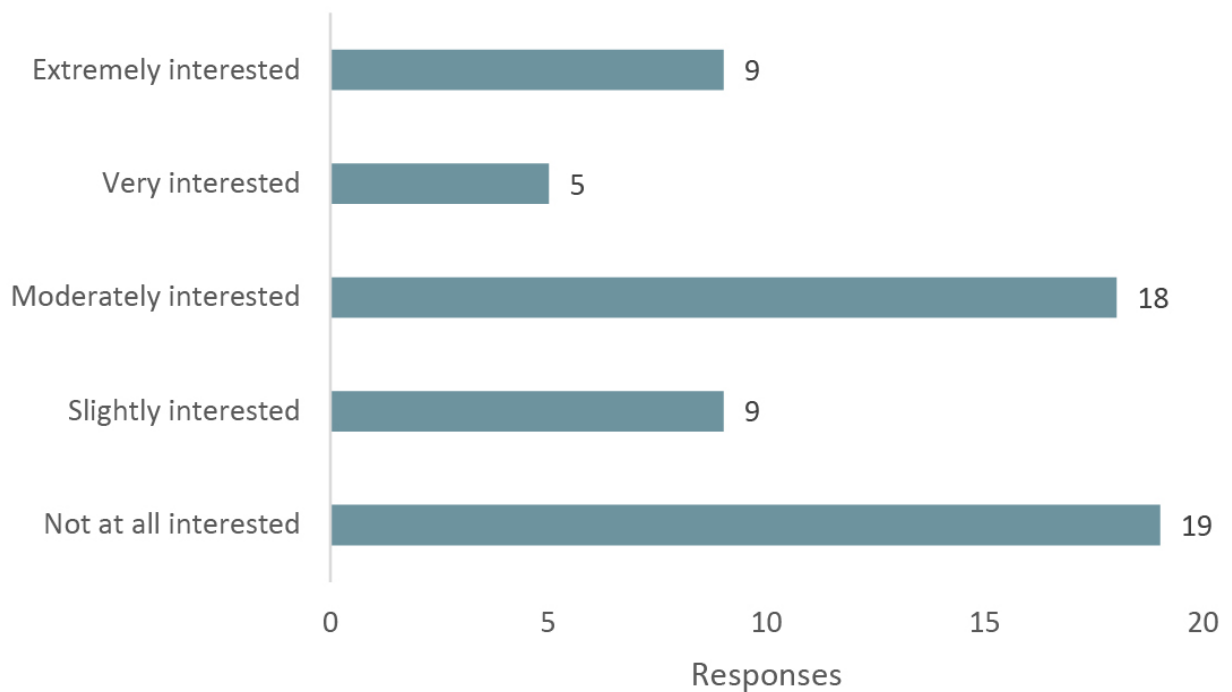
The survey was distributed to local businesses through local Chambers of Commerce, Business Associations, and other similar professional organizations. Though the sample is not representative of all Central Sierra business owners/managers, the responses provided valuable insights about what areas businesses find challenging with regards to installing EV charging, and which resources might be useful to helping them overcome those challenges. Question topics included questions about the business location and type, customer characteristics, existing EV charging, customer and employee inquiries, respondent interest in installing EV charging, information that would be useful to informing that process, and any barriers to installation the business might be facing.

A total of 65 complete responses were collected; responses were received from business owners in all four Central Sierra counties. Business types varied, though the most common types were hotels, resorts, and casinos, and other business in tourism and recreation. There were also eight responses from restaurants or wineries. Most respondents reported their primary customers are out-of-towners.

Most survey respondents had some level of interest in learning more about installing EV charging stations and expressed a positive perception of EVs or charging stations (Figure 38). Respondents also provided insights on the barriers (Figure 39) they faced when researching EV charging as well as the types of information that would be useful to them when contemplating installing EV charging at their businesses. Based on this data, a significant gap exists and requires education and outreach efforts on the following topics:
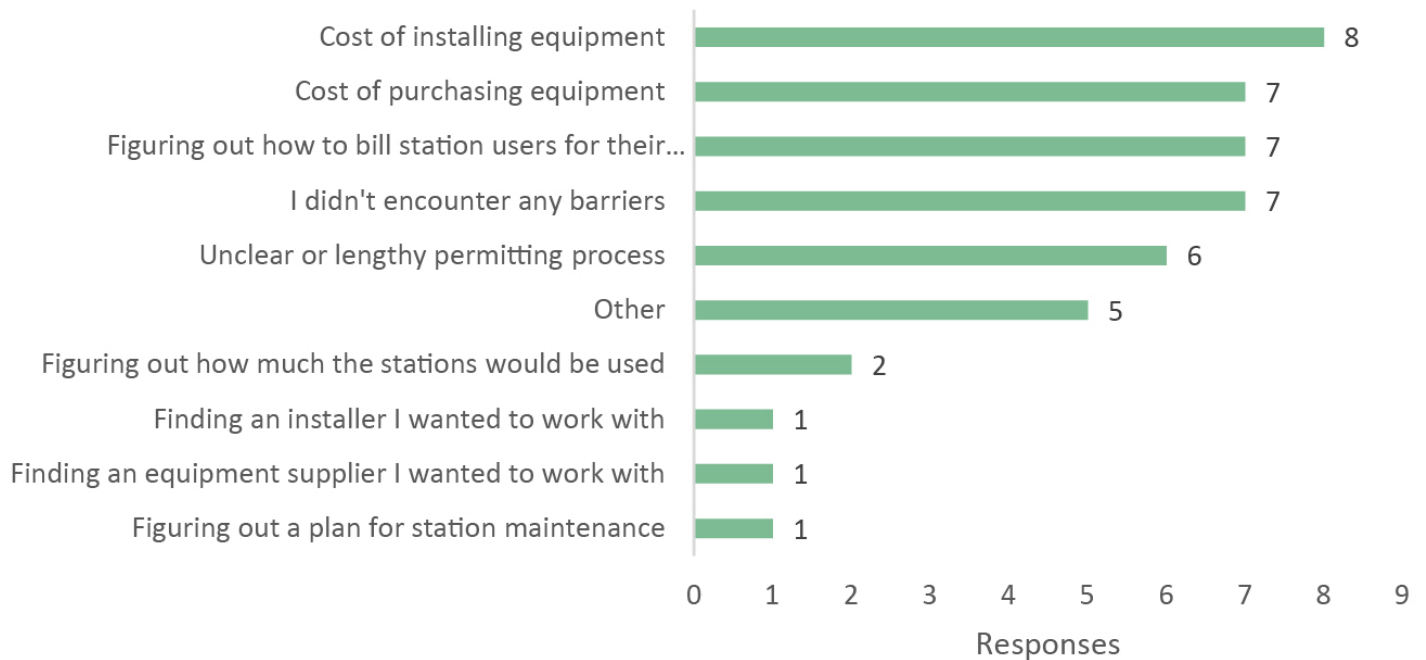
- Installation costs and available incentives

- Electrical panel capacity requirements

- Charging technology options

- List of EV charging infrastructure installers

- Guidance on billing users

Figure 38: How interested are you in learning more about installing EV charging station(s) at your business? (n=60)

Interest Level	Responses
Extremely interested	9
Very interested	5
Moderately interested	18
Slightly interested	9
Not at all interested	19

Responses

Source: Business Survey, Center for Sustainable Energy, 2018

Figure 39: What barriers, if any, did you encounter when researching the idea of installing EV charging stations at your business? Select all that apply. (n=23)

Barrier	Responses
Cost of installing equipment	8
Cost of purchasing equipment	7
Figuring out how to bill station users for their...	7
I didn't encounter any barriers	7
Unclear or lengthy permitting process	6
Other	5
Figuring out how much the stations would be used	2
Finding an installer I wanted to work with	1
Finding an equipment supplier I wanted to work with	1
Figuring out a plan for station maintenance	1

Responses

Source: Business Survey, Center for Sustainable Energy, 2018

Conclusion

The Region has existing EV drivers and EV infrastructure but has not achieved wide-adoption. There are currently 203 PHEVs and 196 BEVs in the Region according to 2018 vehicle registration data from the State of California. This accounts for just 0.16% of total vehicle registrations in the four-county region. EV vehicle growth projections identify 1,090 to 1,195 total PEVs by 2020 and 1,617 to 2,233 total PEVs in the Region by 2025.

Currently, there are 27 sites that offer EV charging with a total of 70 charging ports. While the current charging infrastructure is sufficient in terms of number of charging plugs per vehicle, analysis of geographical coverage of existing public charging stations shows that these charging stations are heavily concentrated in southern and western portions of the county and are mainly located in small cities in the foothills. This means there are opportunities for deployment along major travel routes that lead over the Sierra Nevada's or state/national parks located further east in the Region.

Demand projections identify a minimum of 230 EV charging units will be required with a maximum estimate of 320 charging units in the Region by 2025. Charging station plug projections will require 191 to 249 destination level 2 charging station plugs in the Region and 39 to 71 direct current (DC) fast charging plugs to support the expected growth in number of EVs by 2025. This means that the number of destination level 2 charging plugs will need to increase nearly 5-fold over the next 7 years and the number of DC fast charging plugs will need to increase nearly 7-fold over the same time.

Significant barriers exist that challenge continued wide-spread EV adoption in the Region. The mountainous terrain and cold weather climate requires vehicles to use more energy, resulting in a necessity to provide charging infrastructure that accounts for reduced efficiency. The permanent population of the Region is also small and sparsely dispersed, which requires appropriate EV infrastructure siting, however, with a booming tourism industry there is increased seasonal demand for EV infrastructure. Network connectivity issues and a lack of cellular coverage creates an obstacle for deploying networked EV chargers. Severe and inclement weather can accelerate normal wear and tear on stations and, coupled with the terrain, make it difficult to access and maintain stations. Lastly, while there is State-wide policy supporting EV integration into planning and development, regional/local policy does not exist that specifically supports EV and EVI expansion.

A survey of regional business owners and managers was completed as part of the project work. Most survey respondents expressed a positive perception of EVs and charging stations. All respondents identified knowledge gaps that needed to be overcome to encourage wide-spread EV adoption; Identified barriers included:

- Installation costs and available incentives;
- Electrical panel capacity requirements;
- Charging technology options;
- List of EV charging infrastructure installers; and
- Guidance on billing users

While there are significant barriers to overcome, the Region also has existing conditions and opportunities that can be leveraged to bridge the gap to meet state goals. Looking ahead, several strategies can be employed to increase EV deployment and adoption. Employing mandatory and voluntary codes for EV infrastructure in buildings and parking lots will increase the availability of charging at new developments. Streamlining the permitting process for installing EV charging will make it quicker and less costly for equipment installers and property owners to pursue EV solutions. Implementing local ordinances

that comply with accessibility and signage needs for EV charging is important for making sure EV charging stations are accessible to all EV drivers. Leveraging the Region's solar potential to extend charging infrastructure to remote locations can mitigate existing gaps in electrical service. Conducting Regional outreach to educate stakeholders about EVs, EV Infrastructure options, available financing vehicles, and connecting them with installation professionals is also needed. These and other deployment solutions, as well as recommended deployment locations, and an outreach strategy (including Toolkits) are planned as part of the Plan; scheduled to be completed in August 2019.

Source: USDA Forest Service

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Map Data Sources

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CVRP
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ABBREVIATIONS

Air Resources Board	ARB
Alternative Fuels Data Center	AFDC
Battery Electric Bus	BEB
Battery Electric Vehicle	BEV
Butte County Association of Governments	BCAG
California Air Resources Board	CARB
California Energy Commission	CEC
Census Designated Place	CDP
Center for Sustainable Energy	CSE
Clean Vehicle Rebate Program	CVRP
Direct Current Fast Charging	DCFC
Direct Current	DC
Electric Vehicle	EV
Electric Vehicle Charging Stations	EVCS
Electric Vehicle Infrastructure	EVI
Electric Vehicle Infrastructure Projection Tool	EVI-Pro
Electric Vehicle Service Provider	EVSP
Electric Vehicle Supply Equipment	EVSE
Federal Transit Administration	FTA
Level 1	L1
Level 2	L2
Local Area Network	LAN
Multi-Unit Dwellings	MUD
National Renewable Energy Laboratory	NREL
Original Equipment Manufacturer	OEM
Pacific Gas & Electric	PG&E
Plug-in Electric Vehicle	PEV
Plug-in Hybrid Electric Vehicle	PHEV
Wide Area Network	WAN
Yosemite Area Regional Transit	YARTS
Zero Emission Bus	ZEB
Zero Emission Vehicle	ZEV