CALAVERAS COUNCIL OF GOVERNMENTS

ELECTRIC VEHICLE CHARGING INFRASTRUCTURE IMPLEMENTATION PLAN

NOVEMBER 2024

PREPARED FOR:

CALAVERAS COUNCIL of GOVERNMENTS

DOCUMENT DESCRIPTION

CLIENT	Calaveras Council of Governments
Project Name	EV Charging Infrastructure Implementation Plan
Document Name	Final Plan
Date Document Issued	November 22, 2024

VERSION CONTROL

DATE	DESCRIPTION
2/9/24	Initial Document Template and write-ups to date
7/19/24	Draft final version (with 4 priority sites)
11/22/24	Final version (with 8 priority sites)

PREPARED FOR THE CALAVERAS COUNCIL OF GOVERNMENTS

CALAVERAS COUNCIL of GOVERNMENTS

Project partners:

PREPARED BY DKS ASSOCIATES

Gurbir Antaal, Project Manager

Steffen Coenen, Electromobility Engineer

Mike Usen, Principal-in-Charge

AS SUPPORTED BY FRONTIER ENERGY

Thomas Paddon

Soria Adibi

Mary Cvetan

Ari Sanjar

TABLE OF CONTENTS

1. INTRODUCTION 1

EXECUTIVE SUMMARY 1
PURPOSE 5
HOW TO USE THIS DOCUMENT 5

2. RELEVANT ELECTRIC VEHICLE REGULATIONS 6

FEDERAL REGULATION 6
STATE-SPECIFIC CALIFORNIA REGULATION 7
LOCAL REGULATIONS, POLICIES, AND PLANS 14

3. VEHICLE FLEET ELECTRIFICATION ANALYSIS 16

BACKGROUND 16
METHODOLOGY 16
FLEET REPLACEMENT 18

4. FLEET CHARGING RECOMMENDATIONS 27

INTRODUCTION 27
CHARGING STATION TYPES 27
SELECTION OF MOST SUITABLE CHARGING STRATEGY 29
OVERVIEW OF CHARGER RECOMMENDATIONS 32
FLEET CHARGER RECOMMENDATIONS FOR CALAVERAS COUNTY 33
FLEET CHARGER RECOMMENDATIONS FOR CITY OF ANGELS CAMP 37

5. CHARGING INFRASTRUCTURE PRIORITIZATION 39

PRIORITIZATION PROCESS 39
FACILITY-LEVEL ANALYSIS AND RECOMMENDATIONS 44

APPENDICES 59

APPENDIX A. DATA COLLECTION PLAN 61

OVERVIEW 62
PROCESS 62
VEHICLE AND FACILITY DATA 62
TIMELINE 62

APPENDIX B. STAKEHOLDER COLLABORATION AND ENGAGEMENT PLAN 63

OVERVIEW 64
STAKEHOLDER ENGAGMENT 64

APPENDIX C. OVERVIEW OF FLEET EV CHARGING STRATEGIES 66

INTRODUCTION 67
SMART CHARGERS AND LOAD MANAGEMENT 67
STRATEGY WITH DEDICATED LEVEL 2 CHARGERS 68
STRATEGY WITH SHARED LEVEL 2 CHARGERS 69
TYPICAL CAPITAL COST DIFFERENCES BETWEEN DEDICATED AND SHARED CHARGERS 70
SUPPLEMENTAL DC FAST CHARGERS 72

APPENDIX D. FUNDING OPPORTUNITIES 73

INTRODUCTION 74
FEDERAL FUNDING 74
STATE-SPECIFIC CALIFORNIA PROGRAMS 77
LOCAL AND REGIONAL PROGRAMS 85

APPENDIX E. STRATEGIES AND RECOMMENDATIONS RELATED TO EVS AND EV CHARGERS 87

FLEET ELECTRIFICATION 88
CHARGING EQUIPMENT BEST PRACTICES 91
INNOVATIVE APPROACHES TO FLEET CHARGING 98

APPENDIX F. BACK-UP POWER AND RESILIENCY 104

BACKUP GENERATORS 105
HYDROGEN FUEL CELLS 107
BATTERY ENERGY STORAGE 107
SOLAR 109
MICROWIND 110
MOBILE MICROGRIDS 110
BIDIRECTIONAL CHARGING 111
CONCLUSION 113

APPENDIX G. COST ESTIMATES ASSUMPTIONS 115

CAPITAL EXPENDITURE (CAPEX) ESTIMATES 116
OPERATIONS & MAINTENANCE EXPENDITURE (OPEX) ESTIMATES 117

APPENDIX H. CONCEPTUAL CHARGER INSTALLATION LAYOUT PLANS 121

CALAVERAS COUNTY
- GOVERNMENT CENTER: WEST LOT
- GOVERNMENT CENTER: EAST LOT
- SHERIFF'S OFFICE
- COLOMBO
- HUMAN SERVICES BUILDING

CITY OF ANGELS CAMP
- CITY HALL/POLICE DEPARTMENT
- UTICA PARK

LIST OF FIGURES

FIGURE 1: ADVANCED CLEAN TRUCKS ZEV SALES REQUIREMENTS 10

FIGURE 2: EVCS PERMIT PROCESS AND TIMELINE IN CALIFORNIA, ACCORDING TO AB 1236 AND AB 970 SOURCE: PERMIT STREAMLINING 13

FIGURE 3: CHARGING SPEEDS FOR COMMON FLEET VEHICLES DEPENDING ON CHARGER TYPE . 29

FIGURE 4: EXEMPLARY CHARGING TIMES FOR TYPICAL FLEET EVS ON LEVEL 2 AND DC FAST CHARGING STATIONS OF DIFFERENT POWER OUTPUTS. 31

FIGURE 5: POTENTIAL CHARGING SCHEDULE ROTATING DIFFERENT FLEET EVS ON THE SAME CHARGER ACROSS MULTIPLE DAYS OR NIGHTS. 31

FIGURE 6: CALAVERAS COUNTY GOVERNMENT CENTER 43

FIGURE 7: DANNAR MOBILE POWER STATION. SOURCE: DANNAR 99

FIGURE 8: XOS HUB MOBILE CHARGING SOLUTION. SOURCE: XOS 99

FIGURE 9: SPARKCHARGE'S ROADIE PORTABLE DC FAST CHARGER. SOURCE: SPARKCHARGE ..100

FIGURE 10: JOULE CASE BATTERY MODULES WITH CHARGING PEDESTAL. SOURCE: JOULE CASE 100

FIGURE 11: SHOALS FUEL EV CHARGING SOLUTION. SOURCE: SHOALS 101

FIGURE 12: PUBLIC EV CHARGERS IN CALAVERAS COUNTY. SOURCE: AFDC, PLUGSHARE, CALAVERAS COG 102

FIGURE 13: TRAILER-MOUNTED 625-680 KVA MOBILE GENERATOR. SOURCE: HIPOWER 106

FIGURE 14: MAINSPRING LINEAR GENERATOR 106

FIGURE 15: SCHEMATIC OF HYDROGEN FUEL CELL POWERED CHARGERS (SOURCE: KAIZEN CLEAN ENERGY) 107

FIGURE 16: JOULE'S MODULAR, STACKABLE, CHAINABLE BATTERY SYSTEM (LEFT), DANNAR MOBILE POWER STATION (RIGHT).....108

FIGURE 17: BEAM EV ARC SOLAR-POWERED EV CHARGER WITH BUILT-IN BACKUP ENERGY STORAGE. SOURCE: BEAM 109

FIGURE 18: 10-KW MICROWIND TURBINES WITH SOLAR AND BUILT-IN BACKUP ENERGY STORAGE. SOURCE: FLOWGEN 110

FIGURE 19: BIDIRECTIONAL CHARGING. SOURCE: FLEETCARMA 112

LIST OF TABLES

TABLE 1: CALAVERAS COUNTY FLEET VEHICLE REPLACEMENT AND CHARGER INSTALLATION PHASING AT SELECTED PRIORITY SITES 1

TABLE 2: CITY OF ANGELS FLEET VEHICLE REPLACEMENT AND CHARGER INSTALLATION PHASING AT SELECTED PRIORITY SITES 3

TABLE 3: ADVANCED CLEAN FLEETS ZEV FLEET MILESTONES BY MILESTONE GROUP AND YEAR ..8

TABLE 4: BASELINE ASSUMPTIONS FOR FLEET ANALYSIS 16

TABLE 5: DUTY CYCLE PARAMETERS FOR ELECTRIFICATION 17

TABLE 6: CLASS SIZES AND CATEGORIES OF VEHICLES 18

TABLE 7: CALAVERAS COUNTY FLEET VEHICLES BY FACILITY DOMICILE 19

TABLE 8: COUNTY VEHICLE FLEET BY DUTY CYCLE 20

TABLE 9: CALAVERAS COUNTY FLEET BREAKDOWN BY DEPARTMENT 22

TABLE 10: CALAVERAS COUNTY FLEET REPLACEMENT BY PHASES 23

TABLE 11: ANGELS CAMP FLEET VEHICLES BY FACILITY DOMICILE 24

TABLE 12: ANGELS CAMP FLEET REPLACEMENT DUTY CYCLES 24

TABLE 13: ANGELS CAMP FLEET VEHICLES BY DEPARTMENT 25

TABLE 14: ANGELS CAMP FLEET ELECTRIFICATION BY PHASE 26

TABLE 15: RECOMMENDED CHARGING STATIONS FOR CALAVERAS COUNTY 35

TABLE 16: RECOMMENDED CHARGING STATIONS FOR THE CITY OF ANGELS CAMP 38

TABLE 17: PRIORITIZATION CRITERIA APPLIED TO COUNTY AND CITY FACILITIES FOR FLEET EV CHARGING INFRASTRUCTURE ASSESSMENTS 41

TABLE 18: CHARGER CAPITAL AND OPERATIONAL EXPENSE ESTIMATES AT CALAVERAS COUNTY'S GOVERNMENT CENTER 47

TABLE 19: CHARGER CAPITAL AND OPERATIONAL EXPENSE ESTIMATES AT CALAVERAS COUNTY'S SHERIFF'S OFFICE 49

TABLE 20: CHARGER CAPITAL AND OPERATIONAL EXPENSE ESTIMATES AT CALAVERAS COUNTY'S COLOMBO FACILITY 50

TABLE 21: CHARGER CAPITAL AND OPERATIONAL EXPENSE ESTIMATES AT CALAVERAS COUNTY'S HUMAN SERVICES BUILDING 52

TABLE 22: CHARGER CAPITAL AND OPERATIONAL EXPENSE ESTIMATES AT THE CITY OF ANGELS CAMP'S CITY HALL 54

TABLE 23: CHARGER CAPITAL AND OPERATIONAL EXPENSE ESTIMATES AT THE CITY OF ANGELS CAMP'S OLD NAPA BUILDING PROPERTY 56

TABLE 24: CHARGER CAPITAL AND OPERATIONAL EXPENSE ESTIMATES AT THE CITY OF ANGELS CAMP'S UTICA PARK 57

TABLE 25: SUMMARY TABLE: OVERVIEW OF GENERAL CHARGING STRATEGIES SUITABLE FOR EV FLEETS 71

TABLE 26: SUMMARY OF FEDERAL FUNDING SOURCES 76

TABLE 27: SUMMARY OF COMMUNITIES IN CHARGE INCENTIVES 78

TABLE 28: SUMMARY OF ELIGIBLE AND INELIGIBLE COSTS 79

TABLE 29: CORE VOUCHER FUNDING AMOUNTS 82

TABLE 30: SUMMARY OF CALIFORNIA FUNDING SOURCES 84

TABLE 31: SUMMARY OF LOCAL AND REGIONAL FUNDING SOURCES 86

TABLE 32: RECOMMENDED EV CHARGER ATTRIBUTES 94

TABLE 33: ELECTRICAL DEMANDS OF MISSION-CRITICAL FLEET FACILITIES 105

TABLE 34: COMPARISON OF BACKUP POWER OPTIONS 113

1. INTRODUCTION

EXECUTIVE SUMMARY

This plan is a strategic roadmap to guide electrification of Calaveras County's 395 and Angels Camp's 32 fleet vehicles between 2025 and 2040. This will require installation of a total of 81 Level 2 chargers and 12 DC Fast Chargers of differing outputs to be shared between the fleet electric vehicles (EVs). The ratio of EVs per charger is determined by daily energy demands and nightly dwell time. The total capital expenditure for charger deployment including electrical service upgrades at selected priority sites is estimated to cost about $3.9 million for Calaveras County and about $1.6 million for Angels Camp. Additionally, the total operating expenditure, which includes charger maintenance, licensing and networking fees, as well as electricity expenses (which can be thought of as the future fuel costs of the County's and City's fleets), is estimated at about $6.9 million for Calaveras County and about $1.6 million for Angels Camp over the period from 2025 to 2040.

CALAVERAS COUNTY

Calaveras County has 395 fleet vehicles to replace with EVs. Under the recommended shared charging strategy, this will require installation of a total of 83 charging stations. Since most of these will be dual-port stations (two charging ports), a total of 152 fleet EVs will be able to charge simultaneously. These will consist of a total of 73 AC and DC Level 2 charging stations, 3 50kW DC charging stations and 7 high-power (150kW) DC Fast Chargers. Calaveras County prioritized two parking areas at the Government Center and three other facilities for installation of chargers in three phases concurrent with fleet vehicle replacement, as summarized in **Table 1**. In addition to the fleet chargers, one dual-port Level 2 charging station is to be added at the Human Services Building for use by the public.

TABLE 1: CALAVERAS COUNTY FLEET VEHICLE REPLACEMENT AND CHARGER INSTALLATION PHASING AT SELECTED PRIORITY SITES

LOCATION	PHASE 1: 2025-2028	PHASE 2: 2029-2034	PHASE 3: 2035-2040
GOVERNMENT CENTER			
VEHICLE REPLACEMENT	3	58	59
CHARGER INSTALLATION	**West lot:** • 7 dual-head low-output Level 2 stations	**East lot:** • 6 dual-head medium-output Level 2 stations • 2 single-head 22.5 kW DC chargers • 1 dual-head 50 kW DCFC station • 1 dual-head 150 kW DCFC station	**East lot:** • 5 dual-head medium-output Level 2 stations • 3 single-head 22.5 kW DC chargers • 2 dual-head 150 kW DCFC station
TOTAL CAPEX PER PHASE	$290,500	$958,400	$367,800

LOCATION	PHASE 1: 2025-2028	PHASE 2: 2029-2034	PHASE 3: 2035-2040
TOTAL CAPEX		**$1,616,700**	
TOTAL OPEX PER PHASE	$153,120	$1,078,800	$2,191,740
TOTAL OPEX		**$3,423,660**	
SHERIFF'S OFFICE			
VEHICLE REPLACEMENT	2	58	59
CHARGER INSTALLATION	• 1 dual-port medium-output Level 2 station • 1 single-port 22.5 kW slow DC charger • 1 dual-port 150 KW DCFC station	• 6 dual-port medium-output Level 2 stations • 1 dual-port 150 kW DCFC station	• 13 dual-port medium-output Level 2 stations • 2 dual-port 150 kW DCFC station
TOTAL CAPEX PER PHASE	$488,500	$776,000	$750,900
TOTAL CAPEX		**$2,015,400**	
TOTAL OPEX PER PHASE	$146,760	$806,640	$2,020,980
TOTAL OPEX		**$2,974,380**	
COLOMBO			
VEHICLE REPLACEMENT	-	9	12
CHARGER INSTALLATION	-	• 2 dual-port low-output Level 2 stations	• 1 single-port 11.5 kW DC charger
TOTAL CAPEX PER PHASE	-	$100,200	$18,400
TOTAL CAPEX		**$118,600**	
TOTAL OPEX PER PHASE	-	$69,720	$123,840
TOTAL OPEX		**$193,560**	
HUMAN SERVICES BUILDING			
VEHICLE REPLACEMENT	-	6	16
CHARGER INSTALLATION	-	• 2 dual-port low-output Level 2 stations (1 for fleet, 1 for public)	• 2 dual-port low-output Level 2 stations (both for fleet)
TOTAL CAPEX PER PHASE	-	$67,600	$51,600
TOTAL CAPEX		**$119,200**	
TOTAL OPEX PER PHASE	-	$90,780	$219,900
TOTAL OPEX		**$310,680**	
TOTAL			
TOTAL CAPEX PER PHASE	$779,000	$1,902,200	$1,188,700
TOTAL CAPEX		**$3,869,900**	
TOTAL OPEX PER PHASE	$299,880	$2,045,940	$4,556,460
TOTAL OPEX		**$6,902,280**	

ANGELS CAMP

The City of Angels Camp has 32 fleet vehicles to electrify. By using the recommended shared charging strategy, the City will need to install a total of 10 EV charging stations with 19 ports to support fleet charging needs. Of these, 8 should be AC and DC Level 2 chargers supplemented by 2 high-power (150kW) DC Fast Chargers. The City's prioritized sites for these installations are prioritizing the City Hall/Police Department property at 200 Monte Verda St., the old NAPA building property at 1056 S Main St., and the new Utica Park site development. Charger installation should occur concurrent with fleet vehicle replacement in three phases summarized in **Table 2** below. In addition to the fleet chargers, one dual-port Level 2 charging station is to be installed at the new Utica Park site development for use by the public.

TABLE 2: CITY OF ANGELS FLEET VEHICLE REPLACEMENT AND CHARGER INSTALLATION PHASING AT SELECTED PRIORITY SITES

LOCATION	PHASE 1: 2025-2028	PHASE 2: 2029-2034	PHASE 3: 2035-2040
CITY HALL/POLICE DEPARTMENT			
VEHICLE REPLACEMENT	To be determined, due to relocation of PD vehicles to a different location and repurposing this site for Public Works vehicles.		
CHARGER INSTALLATION	• 1 single-head 22.5 kW DC charger • 1 dual-head 150 kW DCFC station	• 3 dual-head medium-output Level 2 stations • 1 dual-head 150 kW DCFC station	• 2 dual-head low-output Level 2 stations
TOTAL CAPEX PER PHASE	$567,500	$264,100	$47,800
TOTAL CAPEX		**$879,400**	
TOTAL OPEX PER PHASE	$128,160	$440,340	$511,260
TOTAL OPEX		**$1,079,760**	
OLD NAPA BUILDING PROPERTY			
VEHICLE REPLACEMENT	-	-	-
CHARGER INSTALLATION	• 2 dual-port low-output Level 2 stations • 1 dual-port medium-output Level 2 station	-	-
TOTAL CAPEX PER PHASE	$212,900	-	-
TOTAL CAPEX		**$212,900**	
TOTAL OPEX PER PHASE	$54,600	$146,880	$211,860
TOTAL OPEX		**$413,340**	

LOCATION	PHASE 1: 2025-2028	PHASE 2: 2029-2034	PHASE 3: 2035-2040
UTICA PARK			
VEHICLE REPLACEMENT	-	-	-
CHARGER INSTALLATION	• 1 dual-port low-output Level 2 station	-	-
TOTAL CAPEX PER PHASE	$32,100	-	-
TOTAL CAPEX		**$32,100**	
TOTAL OPEX PER PHASE	$23,920	$53,220	$67,920
TOTAL OPEX		**$145,060**	
TOTAL			
TOTAL CAPEX PER PHASE	$812,500	$264,100	$47,800
TOTAL CAPEX		**$1,124,400**	
TOTAL OPEX PER PHASE	$206,680	$640,440	$791,040
TOTAL OPEX		**$1,638,160**	

KEY RECOMMENDATIONS

- **Charging Strategy:** Fleet EV charging should occur overnight while fleet EVs are parked. Due to resource efficiency and cost savings, a shared charging strategy is recommended for both jurisdictions using Level 2 chargers shared between multiple fleet EVs to cover the fleets' baseload charging needs, supplemented by a small number 150kW DCFC installed at strategic locations.
- **Charger Selection**: Shared Level 2 chargers are recommended at sites where the majority of domiciled vehicles are light-duty.
- **Charger to EV Ratios**: Use Level 2 and DC chargers shared between fleet EVs, with ratios of EVs per charger determined by daily energy demands and nightly dwell time.
- **Charging MHD EVs**: Sites that have majority medium and heavy-duty vehicles require shared low to high output DC Chargers to supplement the fleet's Level 2 chargers.
- **Supplemental DCFCs:** 150kW High-power DC Fast Chargers should be installed at Calaveras County's Arnold Maintenance Yard, Government Center and Sheriff's Office and at Angels Camp's Corp Yard and Police Department to provide quick charging, supplementing overnight charging for convenience and redundancy.
- **Implementation Phasing:** Charger installations should be installed concurrently with EV fleet replacement in three Phases: **Phase 1** being near-term from 2025 to 2028, and **Phase 2** being 2029 to 2034, and **Phase 3** from 2035 to 2040
- **Utility Upgrades:** Install utility electrical upgrades ASAP to ensure adequate electrical infrastructure for Phase 1 charger installations (charging for Light Duty Vehicles).

PURPOSE

This Electric Vehicle Charging Infrastructure Implementation Plan is intended to guide charger deployment and recommendations for replacement of existing Internal Combustion Engine (ICE)-powered fleet vehicles with electric vehicles for Calaveras County's and the City of Angels Camp's municipal fleets. This plan evaluates opportunities to incorporate EV purchases into the vehicle replacement plan over the next 15 years. The development of this document involved multiple stakeholders from Calaveras Council of Governments, Calaveras County, and the City of Angels Camp who provided input on the departmental operations of fleet vehicles.

HOW TO USE THIS DOCUMENT

Chapter 1 is the introduction. It includes the executive summary and explains the purpose of planning fleet electrification.

Chapter 2 is a summary of federal, state and local regulations and policies relevant to transportation electrification.

Chapter 3 is the fleet electrification analysis. It analyzes the existing fleet based on vehicle utilization.

Chapter 4 focuses on fleet charging recommendations, providing an overview of charging types, charging strategy alternatives evaluation, and specific recommendations for both Calaveras County and Angels Camp.

Chapter 5 documents Calaveras County and Angels Camp's prioritization of charging facilities for fleet EVs.

Appendices A-G provide supplementation information addressing data collection, stakeholder collaboration and engagement, charging strategy alternatives, funding opportunities, recommended best practices for fleet electrification and charging, back-up power and resiliency and the assumptions used in the cost estimates.

2. RELEVANT ELECTRIC VEHICLE REGULATIONS

The purpose of this chapter is to provide the regulatory and policy context for fleet electrification by both Calaveras County and the City of Angel's Camp's vehicle fleet. Not all of these may be directly applicable to these fleets but understanding them provides general context for future decision making by both fleets. The most relevant of these are summarized below with federal regulations first followed by state-specific regulations and then relevant local mandates or regulations for Calaveras County. The described laws and rules include both direct regulations on the County and City as well as policies that indirectly impact their fleet operations in the future.

FEDERAL REGULATION

LIGHT-DUTY AND MEDIUM-DUTY VEHICLES

In March of 2024, the Environmental Protection Agency (EPA) finalized the strongest-ever emission standards[1] for light-duty cars and trucks and medium-duty vehicles up to a 14,000 lbs. gross vehicle weight rating. For light-duty vehicles, the standards are ultimately projected to result in an industry-average 50% reduction in greenhouse gas (GHG) emissions[2] by 2032 compared to 2026. For medium-duty vehicles, the reduction in per-mile emissions in that timeframe equates to 44%. The standards will apply to new vehicle sales with model years 2027 through 2032 and beyond.

The means by which each automaker must comply with these provisions is not prescribed, meaning that different vehicle technologies can be used to meet the standards. However, all projections show that the majority of these emission reductions will only be achievable with battery-electric and, to a lesser extent, with plug-in hybrid electric vehicles. This means that automakers are required to sell an increasing number of electric vehicles, changing vehicle supply for private customers as well as for fleets in the coming years.

As result, Calaveras County and the City of Angels Camp can expect more EV product availability and variety as well as purchase price decreases given expected economies of scale in the EV supply chain, including production and distribution.

HEAVY-DUTY VEHICLES

In March of 2024, the EPA announced the final greenhouse gas emissions standards[3] for heavy-duty vehicles. This regulation builds on previous iterations by both expanding the scope to model years 2027-2032 and imposing stricter standards heavy-duty vehicles as sold by manufacturers. It applies to vocational vehicles (such as delivery trucks, refuse haulers, public utility trucks, transit, shuttle, school buses, etc.) and tractors (such as day cabs and sleeper cabs on tractor-trailer

[1] Multi Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles: https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-multi-pollutant-emissions-standards-model

[2] As measured in grams of CO_2 per mile

[3] https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-greenhouse-gas-emissions-standards-heavy-duty

trucks). The rule is expected to result in significant benefits for public health and welfare through lowered GHG emissions from heavy-duty vehicles.

Like the EPA rule for light-duty vehicles, these standards are technology-neutral and performance-based. They apply to each manufacturer's total fleet of vehicles sold in each model year. The provisions are expected to lead to an increase in zero-emission vehicle availability on the market and cost decreases for new heavy-duty vehicles.

Both Calaveras County and the City of Angels Camp operate vehicles of the types covered in this EPA rule, meaning that more zero-emission models suitable to replace existing diesel fleet vehicles will be available in coming years.

STATE-SPECIFIC CALIFORNIA REGULATION

California is the leading state in terms of promoting, funding, and increasingly requiring the sale and use of zero-emission vehicles. The most important state regulation applicable to Calaveras County and the City of Angels Camp is the Advanced Clean Fleets rule enabled in 2023, as described below. Additionally, there are other pieces of regulation that affect vehicle manufacturers, aimed at increasing the supply and product variety of zero-emission light, medium, and heavy-duty vehicles and off-road equipment, as described in this section as well.

ADVANCED CLEAN FLEET (ACF) REGULATION

The most significant regulation impacting the transition to zero emissions medium and heavy-duty vehicle operations is California's Advanced Clean Fleets (ACF) regulation[4], approved in April 2023. ACF applies to all but the smallest operators of medium and heavy-duty vehicle fleets operating on California's roads including both private companies and public agencies. Beginning in 2024, ACF mandates the transition away from internal combustion to zero-emissions fleets—either battery electric or fuel cell electric for vehicles exceeding a Gross Vehicle Weight Rating (GVWR) of 8,500 lbs. by 2042. This also includes on-road and off-road yard tractors and light-duty package delivery vehicles. The timeframe for implementation will depend on the fleet type and selected compliance pathway as explained in the following section.

High Priority and Federal Fleets

ACF prioritizes any entity with $50 million or more in annual revenue or that owns or controls 50 or more vehicles with at least one vehicle in California.[5] ACF also applies to any federal agency that operates at least one vehicle in California. Such low thresholds mean that even many relatively small companies or agencies will need to comply, many of which may not even be large enough to operate their own charging infrastructure.

[4] https://ww2.arb.ca.gov/our-work/programs/advanced-clean-fleets

[5] https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/acf22/ac/acffro21.pdf

Compliance Pathway Alternatives

ACF offers two alternative pathways for high-priority and federal fleets to comply with the regulation: a Model Year Schedule and a ZEV Milestones Option, both of which seek to achieve 100% zero-emission fleet by specific deadlines for different classes of medium and heavy-duty vehicles.

Model Year Schedule: Under this pathway alternative, all medium and heavy-duty vehicles beyond their useful life must be removed from the fleet and all new vehicles must be EV or FCEV beginning January 1, 2024.

ZEV Milestones Option: Under this pathway alternative, ZEV replacement schedules will be determined by specific vehicle groups, see **Table 3**. This begins with vans, box trucks, two-axle buses, and yard tractors, which must be fully electrified by 2035 starting with a 10% fleet electrification requirement in 2025. Electrification of the next vehicle group consisting of work trucks, day cab tractors, and three-axle buses begins in 2027 with full electrification mandated by 2039. Finally, sleeper cabs tractors, and specialty vehicles begin electrification in 2030 with full electrification mandated by 2042.

TABLE 3: ADVANCED CLEAN FLEETS ZEV FLEET MILESTONES BY MILESTONE GROUP AND YEAR

PERCENTAGE OF VEHICLES IN FLEET THAT MUST BE ZEVS	10%	25%	50%	75%	100%
MILESTONE GROUP 1: Box trucks, vans, 2-axle buses, yard tractor, LD package delivery vehicles	2025	2028	2031	2033	2035 (and beyond)
MILESTONE GROUP 2: Work trucks, day cab tractors, pickup trucks, 3-axle buses	2027	2030	2033	2036	2039 (and beyond)
MILESTONE GROUP 3: Sleeper cab tractors	2030	2033	2036	2039	2042 (and beyond)

Public Fleets

Along with designated "High Priority and Federal Fleets", ACF also applies to medium and heavy-duty vehicles operated by cities, counties, special districts, and state agencies (i.e., entities with exempt plates from the DMV).[6] Under the Model Year Schedule pathway alternative, 50% of medium and heavy-duty vehicle purchases from 2024 – 2026 must be ZEVs, and 100% of medium and heavy-duty vehicle purchases from 2027 and beyond must be ZEVs. Public agencies may instead opt for the ZEV Milestone Option until January 1, 2030, which may provide greater flexibility for compliance.

Local governments within designated low-population counties, including Calaveras County and the City of Angels Camp, are permitted to delay implementation of ACF requirements until 2027 when 100% of new MHD fleet purchases must be ZEVs. Alternatively, agencies may adhere to a fleet

[6] https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/acf22/ac/acffro11.pdf

transition milestone schedule, seen in **Table 3**. Public agencies must opt into the milestone option by January 1, 2030.

Reporting

For state and local government agency fleets, annual compliance reporting must be submitted no later than April 1, 2024. This reporting includes:

- State or local government agency information
- Vehicle information:
  - VIN, make, model, model year, license plate number
  - GVWR, body type
  - Fuel and powertrain type
  - Date of purchase, date vehicle was added to or removed from fleet
  - Vehicle designation under an exemption or extension
  - Odometer or hubodometer readings for backup vehicles
  - Engine family and engine model year for any vehicle added to the fleet after January 1, 2024
- Funding contract start and end date for vehicles purchased with California State funding if the vehicle is to be excluded from ACF during the funding contract
- Vehicles being replaced that fall under the ZEV Purchase Exemption must identify which vehicle is being replaced

HVIP ineligibility

According to the California Air Resources Board, vehicles purchased using an HVIP voucher will not count as a ZEV purchase. Generally speaking, ZEV purchases before 2024 or in excess of the amounts required starting in 2024, count towards future ZEV purchase requirements as long as the ZEV is still active in the fleet. However, this decision also means that excess vehicles purchased using an HVIP voucher will also not count towards future purchase requirements.

ADVANCED CLEAN CARS II (ACC II) REGULATION

In August 2022, the California Air Resources Board (CARB) voted on the Advanced Clean Cars II plan to scale down light-duty passenger car, truck, and SUV emissions beginning with the 2026 model year through 2035. Under this regulation, all new passenger cars, trucks, and SUVs sold in California will be zero-emission vehicles by 2035, putting Governor Newsom's 2020 Executive Order N-79-20 into law. This sets a clear timeline for the transition of California's vehicle fleet toward electrification, a transformation expected to be replicated across the nation.

ADVANCED CLEAN TRUCK (ACT) REGULATION

The Advanced Clean Trucks (ACT) regulation is a zero-emission vehicle sales requirement imposed on the manufacturers and a one-time reporting requirement for large entities and fleets. The ACT requires manufacturers who sell medium and heavy-duty vehicles to sell zero-emissions vehicles as an increasing percentage of their annual sales from 2024 to 2035. The ACT regulation covers

vehicles of weight Classes 2B through 8. This essentially impacts all vehicles heavier than 8,500 pounds. By 2035, the ACT requirements will include:

- 55% of Class 2B-3 truck sales must be zero-emission
- 75% of Class 4-8 straight truck sales must be zero-emission
- 40% of truck tractor sales must be zero-emission

ACT was adopted by CARB before ACF, and ACF's 2036 ZEV sales mandate on the manufacturers goes beyond the requirements laid out in the ACT rule. Yet, ACT is slated to impact near- and mid-term MHD electric vehicle supply given the rising ZEV sales share requirements.

Figure 1 shows the increasing percentages of ZEV sales required under the ACT regulation.

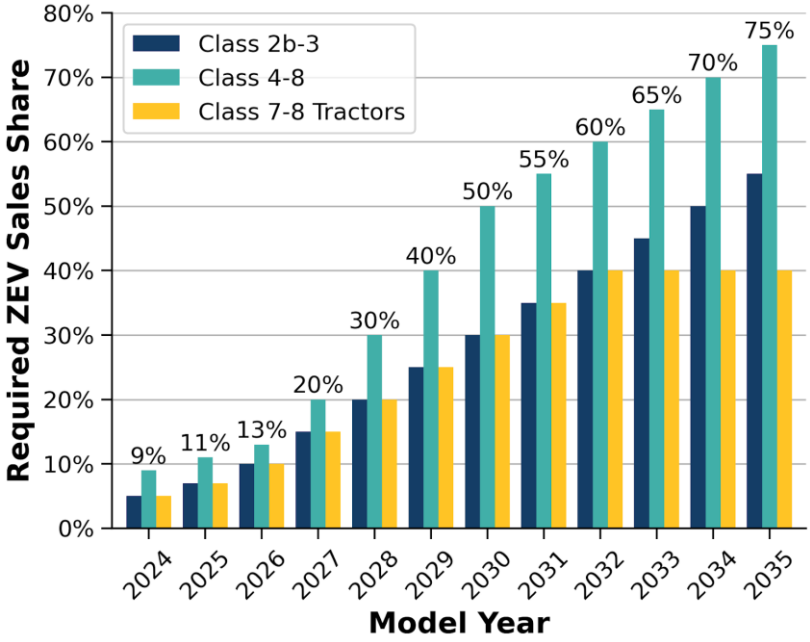


FIGURE 1: ADVANCED CLEAN TRUCKS ZEV SALES REQUIREMENTS

ZERO-EMISSION FORKLIFTS

In June 2024, the California Air Resources Board (CARB) finalized and passed a regulatory measure[7] designed to promote the use of zero-emission forklifts across various fleet operations throughout the state of California. The regulation applies to Class IV and Class V forklifts (beginning in 2026), large fleets (operating 26 units or more, starting in 2028), and small fleets (starting in 2029). It applies to forklift and engine manufacturers, as well as private and public entities, including public utilities, special districts, and government agencies.

Aside from specific exemptions, starting in the aforementioned years, fleet operators will be required to gradually retire old internal combustion engine forklifts. The regulation is not expected

[7] https://ww2.arb.ca.gov/our-work/programs/zero-emission-forklifts

to drastically impact the County or City given that no or almost no large internal combustion engine forklifts operate in their fleets.

IN-USE OFF-ROAD DIESEL-FUELED FLEETS REGULATION

The California Air Resources Board (CARB) is amending its existing regulation of In-Use Off-Road Diesel-Fueled Fleets due to the increasing importance of reducing oxides of nitrogen (NOx) emissions from off-road heavy-duty diesel vehicles. The amendment will phase out the oldest, highest-emitting off-road vehicles, will restrict the addition of Tier 3 and 4i engines, mandate the use of renewable R99 or R100 Renewable Diesel, and provide compliance flexibility for low-use vehicles and requirements to increase enforceability.[8]

INNOVATIVE CLEAN TRANSIT (ICT) REGULATION

The California Air Resources Board (CARB) adopted the Innovative Clean Transit (ICT) regulation in December 2018. This regulation requires all public bus transit agencies in the state to gradually transition to a complete ZEB (Zero Emission Bus) fleet by 2040. ICT states that all transit agencies are required to produce ZEB rollout plans that describe how each agency is planning to achieve a full transition to ZE fleets by 2040 as well as outlining reporting and record-keeping requirements. Specific elements required in the rollout plan include:

- A full explanation of how each transit agency will transition to ZEBs by 2040 without early retirement of conventional internal combustion engine buses.
- Identification of the ZEB technology each transit agency intends to deploy.
- How each transit agency will deploy ZEBs in disadvantaged communities.
- Identification of potential funding sources.
- A training plan and schedule for ZEB operators and maintenance staff.
- Schedules for bus purchase and lease options (including fuel type, number of buses, and bus type).
- Construction of associated facilities and infrastructure (including location, type of infrastructure, and timeline)

CARB defines large transit agencies as operating in "an urbanized area with a population of at least 200,000 as last published by the Bureau of Census before December 31, 2017, and has at least 100 buses in annual maximum service." Agencies that do not meet this definition are categorized as small transit agencies.

The ICT regulation requires transit agencies to submit annual compliance reports from 2021 to 2050. The reports must include information on the agency's fleet, each bus owned or leased, ZEB mobility options, and renewable fuel usage. The first report must include data from December 31, 2017.

The total new ZEB purchase requirement for heavy-duty transit vehicles (traditional 35-ft. or 40-ft. buses unless otherwise stated) of small transit agencies is 25% for 2026-2027 and then moves to 100% for 2029 and beyond. Specific vehicle types, such as motor coaches, cutaways, double-

[8] https://ww2.arb.ca.gov/resources/fact-sheets/overview-amendments-use-road-diesel-fueled-fleets-regulation

deckers, and 60-ft. vehicles, are exempt from this purchase schedule until 2026 or later (dependent on Altoona testing being completed). Whereas large agencies are required to start purchasing ZEBs in 2023, small agencies are exempt until 2026, when 25% of new bus purchases must be zero emission.

EV CHARGING STATION PERMIT STREAMLINING

In California, the state bills AB 1236 (2015) and AB 970 (2021) set the standards for EV charging station development in the state and what processes cities and counties need to put in place to support the efficient expansion of EV charging infrastructure across California.[9] AB 1236 was passed in 2015 and is in effect since 2017. It requires all cities and counties to provide an expedited permitting process for EV charging stations (including a streamlining ordinance and checklist).

AB 970 builds on these bills and was passed in September 2021. It has been in effect since January 2022 for large cities/counties (>200,000 population) and since January 2023 for small (<200,000) cities/counties. The bill requires cities and counties in California to limit project review for EV charging stations to health and safety requirements. It also sets specific timelines to the review period based on the size of the project, differentiating between 1-25 stations and 26 or more stations per project site. For a 1-25-station project, EV charging station applications will be deemed complete 5 business days upon receipt, unless the city or county issues a written deficiency notice detailing all changes to be made to make the application consistent with the permitting checklist. This process is visualized below in Figure 2.

[9] An overview of AB 1236 and AB 970 can be found at this link: https://static.business.ca.gov/wp-content/uploads/2021/11/EV-Charger-Permit-Streamlining-AB-1236-Fact-Sheet-Version-1.pdf

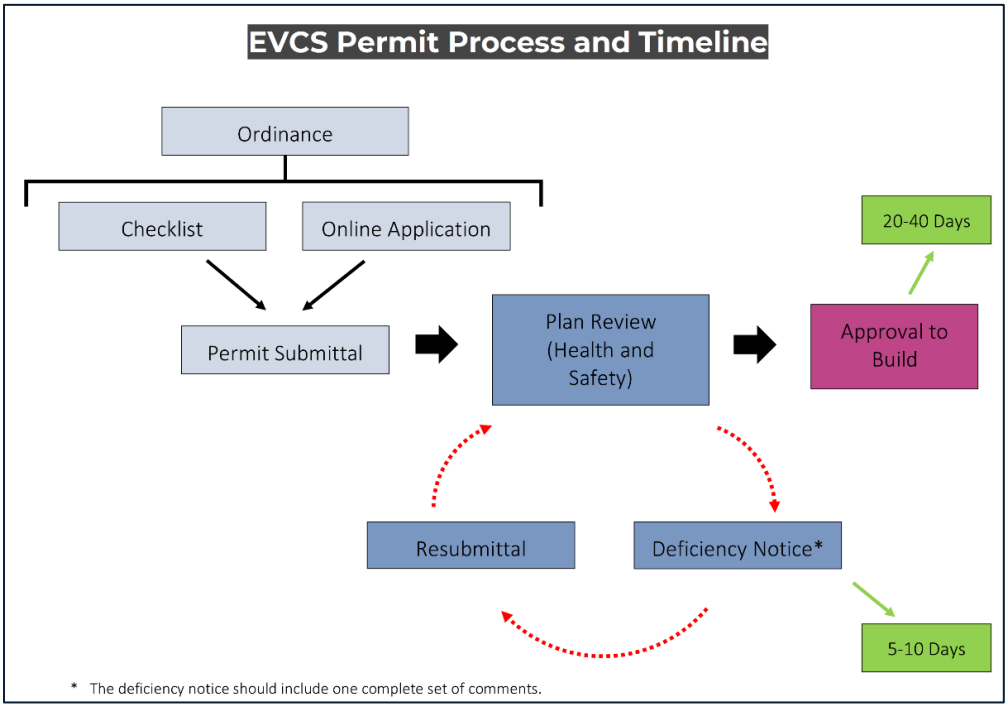


FIGURE 2: EVCS PERMIT PROCESS AND TIMELINE IN CALIFORNIA, ACCORDING TO AB 1236 AND AB 970 SOURCE: PERMIT STREAMLINING

The California Governor's Office of Business and Economic Development (GO-Biz) developed the Permitting Electric Vehicle Charging Stations Scorecard, based on AB 1236 and AB 970, to help California jurisdictions streamline EVCS permitting. The criteria to be considered streamlined "EVCS Permit Ready" are listed below.

- Streamlining Ordinance for Expedited EVCS Permit Process
- Permitting Checklists Online for L2 & DCFC
- Administrative Approval of EVCS
- Approval Limited to Health & Safety Review
- Electronic Signatures Accepted
- EVCS Not Subject to Association Approval
- One Complete Deficiency Notice if the Application is Incomplete

Calaveras County has completed the permit streamlining process. However, the City of Angels Camp has not completed any of the permit streamlining steps listed above. The GO-Biz ZEV Program provides a map of the permit streamlining progress in all jurisdictions in California.[10]

[10] https://business.ca.gov/industries/zero-emission-vehicles/plug-in-readiness/

LOCAL REGULATIONS, POLICIES, AND PLANS

CALAVERAS COUNTY CODE OF ORDINANCES

Electric vehicle charging infrastructure in Calaveras County is regulated by Title 15, Section 11 of the Calaveras County Code of Ordinances. This Chapter specifies the permitting, scope, fee, and inspection regulations for EV charging stations anywhere in the County. As of the writing of this plan, chapter 15.11 of the County Code of Ordinances was last updated in February of 2017[11], long before electric vehicles became common.

CALAVERAS COUNTY GENERAL PLAN

The policy most relevant to fleet electrification in the County's General Plan[12] can be found in the Public Facilities & Services Element. Policy PF 3.1 states *Support the development of new energy generating technologies and facilitate the incorporation of these technologies into new development while retaining community character*. Though this policy does not specifically reference transportation decarbonization or fleets, it is subsequently referenced by Energy and Solid Waste measure PF 3B Alternative Fuel Vehicles Infrastructure and Incentives which states *Amend the zoning code to recognize and permit infrastructure necessary to support alternative fuel vehicles (e.g., charging stations) and encourage their use through the provision of incentives provided in the zoning code*. Other measures which could potentially have ramifications for charging infrastructure installation for fleets are the Siting Guidelines (PF-3E): *Adopt siting policies or guidelines addressing land use compatibility for energy and solid waste facilities*.

CENTRAL SIERRA ZERO EMISSION VEHICLE READINESS PLAN

The Central Sierra Zero Emission Vehicle Readiness Plan[13] completed in 2019 assessed the Central Sierra Region's existing conditions with respect to EVs and charging stations, recommended siting procedures for additional charging infrastructure, and included other actions to support EV adoption. Calaveras County is one of four counties analyzed as part of this plan. Objective 4 in the plan's introduction recommends to "[s]tudy and analyze the feasibility of ZEV adoption in municipal fleets", a goal realized for the County and the City of Angels Camp through this EV Charging Infrastructure Implementation Plan.

The Central Sierra Zero Emission Vehicle Readiness Plan also recommends electrification of school buses, transit fleets, and commercial vehicles as technology increasingly allows. Lastly, the plan provided general tools for assessing fleets for EV adoption, such as evaluating the market availability of suitable EV replacement models and understanding charging times for fleet EVs.

---

[11] https://library.municode.com/ca/calaveras_county/codes/code_of_ordinances?nodeId=COOR_TIT15BUCO_CH15.11ELVECHST

[12] https://planning.calaverasgov.us/General-Plan

[13] https://www.tuolumnecountytransportationcouncil.org/_files/ugd/fe950e_19a8561ed2f848b0b3332499504ae862.pdf

CALAVERAS CONNECT SHORT-RANGE TRANSIT PLAN (2020-2025)

Calaveras Connect's most recent Short-Range Transit Plan[14] outlines public transportation services and improvements in the county for the next five years. The plan also addresses the required transition of the transit fleet to zero emissions. It highlights the importance of charging infrastructure and the need to assess the charging site and make recommendations for appropriate chargers, while considering the range and other operational needs of electric buses and available funding sources.

The plan, however, is limited to the County's transit fleet, and does thus not comment on other municipal fleet vehicles, which are addressed as part of this implementation plan.

[14] https://calacog.org/wp-content/uploads/2021/01/Calaveras_SRTP_-Final-Report-1-28-21-reduced-file-size.pdf

3. VEHICLE FLEET ELECTRIFICATION ANALYSIS

BACKGROUND

This chapter documents which of Calaveras County's and Angels Camp's existing ICE-powered fleet vehicles can be replaced by battery electric vehicles (EVs) and evaluate the anticipated electrical energy needs.

METHODOLOGY

Frontier's fleet transition analysis used existing fuel and mileage data to project energy demand for a replacement ZEV for fleet vehicles. **Table 4** below outlines standard assumptions used in the fleet transition analysis.

TABLE 4: BASELINE ASSUMPTIONS FOR FLEET ANALYSIS

BEGINNING YEAR	2027	
ENDING YEAR	2040	City and County staff
ANNUAL OPERATING DAYS	250	City and County staff
SALES TAX RATE %	7.75%	CDTFA
REPLACEMENT PRIORITIZATION POLICY	Useful life, ACF	County staff
GHG EMISSIONS - GAL OF GASOLINE	8,887	grams CO2e/gal (EPA)
GHG EMISSIONS - GAL OF DIESEL	10,180	grams CO2e/gal (EPA)
NON-RENEWABLE PG&E MIX GHG EMISSIONS - GRAMSCO2E/KWH	0.45359	grams CO2e/kWh (EPA)
PG&E RENEWABLE MIX	100%	PG&E
COST PER GALLON OF GASOLINE	$5.31	EIA; 2022 Annual
COST PER GALLON OF DIESEL	$6.25	EIA; 2022 Annual
PG&E AVERAGE COST OF ELECTRICITY PER KWH	$0.20	BEV-2-S (Secondary), Off Peak rate
LCFS CREDIT PRICE	$64.91	CARB
EV MSRP PRICE INCREASE PER YEAR	4%	City and County staff

LICENSE/REGISTRATION	$65reg+$29CHP+$102TIF+VLF.65%	CA DMV
INSURANCE	Self-insured	City and County staff
OPERATING EXPENSES	Fuel	
EV PARITY YEAR	2035	
TIMELINE	Beginning year-ending year	
DEPRECIATION METHOD	Not included	
SALVAGE VALUE	Not included	
VEHICLE DWELL TIME(NON-WORKING HOURS)	14 hours	City and County staff

The ZEV replacement year and daily energy demand were estimated for each vehicle using existing data from both the fleet and Frontier Energy's catalog of market ready EVs. Replaced vehicles are assumed to maintain the same activity level as the existing vehicle based on established parameters shown in **Table 4** and **Table 5**.

TABLE 5: DUTY CYCLE PARAMETERS FOR ELECTRIFICATION

VEHICLE CATEGORY	Light duty, medium duty, heavy duty
CONFIGURATION	Car, Pickup, SUV, Cargo Van, Work Trucks, Flatbed, Transit Van, Box Truck, 3 Axle Truck
MINIMUM RANGE	Miles per day
RANGE DEGRADATION ALLOWANCE (%)	Additional energy required for HVAC, PTO, etc. as a percentage of maximum range
DWELL TIME/CHARGING WINDOW	Hours per day available for charging
NUMBER OF SEATS	
CARGO CARRYING CAPACITY	Lbs.
TOWING CAPACITY	Lbs.

The team analyzed vehicles and replacements based on existing vehicle size. **Table 6** illustrates the class sizes and categories of vehicles.

TABLE 6: CLASS SIZES AND CATEGORIES OF VEHICLES

GVWR (IN LBS.)	VEHICLE CLASS	CATEGORY	DESCRIPTION	SUBJECT TO ACF?
<6,000	Class 1	Light duty	Sedan, SUV, minivan	No
6001-8,500	Class 2a, e, f	Light duty	Full-size and mini pick-up	No
8,501-10,000	Class 2b, g, h	Medium duty	Crew size pick up, utility	Yes
14,000	Class 3	Medium duty[15]	Service body, Cargo van	Yes
16,000	Class 4	Medium duty	Step van, Crane	Yes
19,500	Class 5	Medium duty	Bucket truck, Snowplow	Yes
26,000	Class 6	Medium duty	Transit bus, Flatbed	Yes
33,000	Class 7	Heavy duty	Sweeper, Water truck	Yes
>33,000	Class 8	Heavy duty	Tanker truck, Dump	Yes

Each vehicle's ZEV Pathway was based on regulatory requirements to electrify. Vehicles exempt from regulations, surplus or offroad vehicles were excluded from this analysis. These included four fire emergency vehicles and one ATV for Angels Camp. For Calaveras County's fleet, 10 light duty vehicles were marked as surplus and 12 ATVs and four emergency vehicles.

The consultant team worked with the County and City to define "Phases" based on regulatory deadlines, expected EV cost parity, and vehicle useful life. The timeline for the replacement phases are:

- Phase 1: 2025-2028
- Phase 2: 2029-2034
- Phase 3: 2035-2040

FLEET REPLACEMENT

CALAVERAS COUNTY

The fleet transition plan calls for the replacement of 395 ICE vehicles, including sedans, vans, pickups, sport utility vehicles and heavy-duty tracks with EVs. Frontier modeled suitable

[15] CARB considers this class as "medium-duty." EPA considers this class as "heavy-duty."

replacement vehicles for each vehicle type or "duty cycle" for the purposes of estimating energy demand and capital expenditures.

A critical part of this project is to determine charging recommendations which includes projecting electrical loads at each facility where fleet EVs need to charge. Fuel consumption data from existing ICE fleet vehicles provides a starting point for modeling these electrical loads for EV charging which also includes factors to account for the significantly higher energy efficiency of EVs relative to ICE vehicles, and to address real-world factors affecting range degradation. In this analysis we estimated a total fleet-wide electrical demand of 9,564 kWh.

Based on the County's fleet replacement policies (e.g., expected lifespan) and existing and anticipated commercial EV availability, we assume that Calaveras County will need approximately 12 years to cycle through the existing vehicle fleet, gradually replacing each vehicle with an electric equivalent model that meets the City's needs for each asset. **Table 7** illustrates the vehicle breakdown by size and facility domicile location for the county.

TABLE 7: CALAVERAS COUNTY FLEET VEHICLES BY FACILITY DOMICILE

FACILITY	ADDRESS	LD VEHICLES	MD VEHICLES	HD VEHICLES
AIRPORT	3600 Carol Kennedy Dr., San Andreas	1	0	0
ANIMAL SERVICES	901 Jeff Tuttle Drive, San Andreas	4	1	0
ARNOLD MAINTENANCE YARD	1191 Linebaugh Rd, Arnold	14	4	4
COLOMBO	23 E St Charles, San Andreas	20	0	1
GLENCOE	16151 Hwy 26, Glencoe	6	2	1
HUMAN SERVICES BUILDING	509 E St Charles St, San Andreas	22	0	0
JENNY LIND MAINTENANCE YARD	11558 Milton Rd, Valley Springs'	6	2	1
PUBLIC HEALTH	700 Mountain Ranch Rd	7	1	0
ROCK CREEK LANDFILL	12021 Hunt Rd, Milton	9	4	4
GOVERNMENT CENTER	891 Mountain Ranch Rd	92	22	6
SHERIFF'S OFFICE	1045 Jeff Tuttle Dr, San Andreas	134	3	1
(ROTATING)		19	2	2
TOTAL		**334**	**41**	**20**

Table 8 below summarizes the County's existing internal combustion engine (ICE) vehicle fleet by duty cycle categories listed in the first column for the purpose of identification of EV equivalents for evaluating energy demands. The second column lists examples of existing ICE vehicles comprising

the fleet that will need to be replaced by comparable EVs for each duty cycle category. The "EV range" is the modeled maximum range of these vehicles after accounting for factors that impact driving range such as the use of heating or air conditioning, hills, parasitic loads like light bars, lifts, on-board computers, cargo weight, battery degradation, etc. Reducing the expected maximum range to account for these real-world conditions will ensure that sufficient charging capacity is planned.

TABLE 8: COUNTY VEHICLE FLEET BY DUTY CYCLE

	EXISTING LIGHT DUTY FLEET ICE FLEET VEHICLES	EV RANGE (MILES)	EXISTING VEHICLE QUANTITY	MODELED REPLACEMENT EV
LIGHT DUTY SEDAN	Ford Crown Victoria Ford Taurus Mercury Grand Marquis Pontiac Vibe Pontiac Sunfire Ford Fusion Dodge Avenger Chevrolet Impala Chevrolet Cruze	270	44	Hyundai Ioniq 6
LIGHT DUTY SUV	Chevrolet Suburban Ford Explorer Jeep Cherokee Ford Excursion Ford Windstar Ford Expedition Chevrolet Traverse Chevrolet Equinox Chevrolet Tahoe Chevrolet Suburban Dodge Durango Subaru Outback Toyota Land Cruiser Subaru Forester Ford Bronco Sport	225	115	Ford Mustang Mach-E
LIGHT DUTY MINIVAN	Chevrolet Astro GMC Safari Ford Windstar Chrysler Voyager Chevrolet Uplander Dodge Grand Caravan Toyota Sienna Honda Odyssey	250	14	VW ID Buzz
LIGHT DUTY PICKUP	Ford F150 Ford Ranger Chevrolet Colorado Chevrolet Silverado GMC Sierra Ram 1500 Dodge Dakota	240	97	Ford F-150 Lightning

	EXISTING LIGHT DUTY FLEET ICE FLEET VEHICLES	EV RANGE (MILES)	EXISTING VEHICLE QUANTITY	MODELED REPLACEMENT EV
MEDIUM DUTY PICKUP (CLASS 2G, 2H, AND 3)	Ford F-250 Ford F-350 Ford E-350 Chevrolet K30 Chevrolet Military Truck GMC Sierra Dodge Ram Chevrolet Silverado Ford Transit	350	77	Ram 1500 REV
HEAVY DUTY TRUCK (CLASS 4 AND 5)	Ford F-450 Ford F-550	120	9	Lightning FE4-86/129
HEAVY TRUCK (CLASS 6)	Ford F-600 Ford F-650 Ford F-700 Ford F-750 International MR065	240	12	Mack MD Electric
HEAVY DUTY TRUCK (CLASS 7 AND 8)	International 1854 International SR525 International 9940i International Sf667 International L9227 Western Star 4900 Kenworth L700 Ford LNT8000 Mack Granite Kenworth W900 Kenworth T880	275	20	Volvo VNRe
CARGO VAN	Ford E-350	250	1	Ford eTransit
MEDIUM DUTY PASSENGER VAN	Ford E-150 Ford E-350 Dodge Ram Wagon Ford Econoline Ford Transit	120	6	Lightning FE4-86/129
Total Fleet Vehicles		**395**		

Lastly, it is important to note that the vehicles shown in the "Modeled Replacement EV" column have been designated as a model for replacement of a specific duty cycle because these are EVs for which key data such as battery size, MPGe, and charging acceptance rate (maximum charging speed) are available. We are not necessarily recommending that the City procure any of these specific models—we are simply using them to model projected energy use.

As shown in **Table 9**, vehicles are distributed across a variety of departments, with the majority assigned to the Public Works and Police departments.

TABLE 9: CALAVERAS COUNTY FLEET BREAKDOWN BY DEPARTMENT

DEPARTMENT	TOTAL EXISTING FLEET VEHICLES
ADMINISTRATION	28
AGRICULTURE	9
AIRPORT	1
ANIMAL SERVICES	5
ASSESSOR	2
BUILDING	10
CALMET	1
CALWORKS	24
CNEU	2
DAY REPORTING CENTER	4
DISTRICT ATTORNEY	7
ENVIRONMENTAL HEALTH	9
FACILITIES	12
HEALTH SERVICES	7
INTEGRATED WASTE MANAGEMENT	14
JAIL	5
LIBRARY SAN ANDREAS	1
MARINE SAFETY	1
MENTAL HEALTH	23
NARCOTICS SEIZURE ACCOUNT	1
OES	3
PLANNING	1
PROBATION	8
PUBLIC WORKS	81
SHERIFF OFFICE	129
SUBSTANCE ABUSE	2
TECHNOLOGY SERVICES	3
VETERAN SERVICES	1
VICTIM WITNESS	1

Based on the existing fleet composition and age, each vehicle was assigned a replacement date within each phase for electrification, shown in **Table 10**.

TABLE 10: CALAVERAS COUNTY FLEET REPLACEMENT BY PHASES

PHASE	LD VEHICLES	MD VEHICLES	HD VEHICLES	TOTAL
PHASE 1: 2025-2028	14	4	4	22
PHASE 2: 2029-2034	163	11	10	184
PHASE 3: 2035-2040	157	26	6	189
TOTAL	**334**	**41**	**20**	**395**

An interactive version of the data visualizations can be accessed at:
https://fleet.frontierenergy.com/calaveras-county/

Password: Calaveras County

CITY OF ANGELS CAMP

The fleet transition plan calls for the replacement of 32 ICE vehicles, including sedans, vans, pickups, sport utility vehicles and heavy-duty trucks with EV. We have modeled suitable replacement vehicles for each vehicle type or "duty cycle" for the purposes of estimating energy demand and capital expenditures.

A critical part of this project is to determine charging recommendations which includes projecting electrical loads at each facility where fleet EVs need to charge. Fuel consumption data from existing ICE fleet vehicles provides a starting point for modeling these electrical loads for EV charging which also includes factors to account for the significantly higher energy efficiency of EVs relative to ICE vehicles, and to address real-world factors affecting range degradation. In this analysis we estimated Angels Camp's total fleet-wide electrical demand of 578 kWh per day. Angels Camp's fleet did not provide data on useful lives or replacement years for vehicles. Frontier estimated that vehicles over 10 years old would begin replacement in 2027 when ACF will take effect and Angels Camp will be required to electrify MHD vehicles. To reduce the number of vehicles needing to be replaced in 2027, the earliest model year's useful life was applied to the same model vehicles in the fleet. Based on the City's fleet replacement policies (e.g., expected lifespan) and existing and anticipated commercial EV availability, we assume that Angels Camp will need approximately 12 years to cycle through the existing vehicle fleet, gradually replacing each vehicle with an electric equivalent model that meets the City's needs for each asset. **Table 11** illustrates the vehicle breakdown by size and facility domicile location.

TABLE 11: ANGELS CAMP FLEET VEHICLES BY FACILITY DOMICILE

FACILITY	ADDRESS	LD VEHICLES	MD VEHICLES	HD VEHICLES
Corp Yard	200 MONTE VERDA ST.	11	3	3
Wastewater Treatment Plant	3000 Centennial Ln.	1	0	0
Police Department	200 Monte Verda St. A	10	0	0
Fire Department	1404 Vallecito Rd	3	1	0
TOTAL		**25**	**4**	**3**

Table 12 below summarizes Angel Camp's existing internal combustion engine (ICE) vehicle fleet by duty cycle categories listed in the first column for the purpose of identification of EV equivalents for evaluating energy demands. The second column lists examples of existing ICE vehicles comprising the fleet that will need to be replaced by comparable EVs for each duty cycle category. The "EV range" is the modeled maximum range of these vehicles after accounting for factors that impact driving range such as the use of heating or air conditioning, hills, parasitic loads like light bars, lifts, on-board computers, cargo weight, battery degradation, etc. Reducing the expected maximum range to account for these real-world conditions will ensure that sufficient charging capacity is planned.

Lastly, it is important to note that the vehicles shown in the "Modeled Replacement EV" column have been designated as a model for replacement of a specific duty cycle because these are EVs for which key data such as battery size, MPGe, and charging acceptance rate (maximum charging speed) are available. We are not necessarily recommending that the City procure any of these specific models—we are simply using them to model projected energy use.

TABLE 12: ANGELS CAMP FLEET REPLACEMENT DUTY CYCLES

DUTY CYCLE	EXISTING LIGHT DUTY FLEET ICE FLEET VEHICLES	EV RANGE (MILES)	EXISTING VEHICLE QUANTITY	MODELED REPLACEMENT EV
LIGHT DUTY SEDAN	Dodge Charger	270	2	Hyundai Ioniq 6
LIGHT DUTY SUV	Ford Explorer Chevrolet Tahoe Ford Interceptor	225	5	Ford Mustang Mach-E

LIGHT DUTY PICKUP	Ford Ranger	240	15	Ford F-150 Lightning
	Dodge Ram			
	Chevrolet Silverado			
	Isuzu Hombre			
	GMC Canton			
	GMC Sierra			
MEDIUM DUTY PICKUP (CLASS 2G, 2H, AND 3)	Ford F-250	350	6	Ram 1500 REV
	Ford F-350			
	Chevrolet Silverado			
HEAVY DUTY TRUCK (CLASS 5)	GMC C5	120	1	Ford Chassis Cab
HEAVY DUTY TRUCK (CLASS 7 AND 8)	International 4900	275	3	Volvo VNRe
	International Ma015			
	Ford F-700			
TOTAL FLEET VEHICLES			32	

As shown in **Table 13**, vehicles are comprised of four departments, including Public Works, Water/Wastewater, Police, and Fire.

TABLE 13: ANGELS CAMP FLEET VEHICLES BY DEPARTMENT

DEPARTMENT	TOTAL EXISTING FLEET VEHICLES
PUBLIC WORKS	7
WATER/WASTEWATER	11
POLICE	10
FIRE	4

Based on the existing fleet composition and age, each vehicle was assigned a replacement date within in each phase for electrification, shown in **Table 14**.

TABLE 14: ANGELS CAMP FLEET ELECTRIFICATION BY PHASE

PHASE	LD VEHICLES	MD VEHICLES	HD VEHICLES	TOTAL
PHASE 1: 2025-2028	1	2	1	4
PHASE 2: 2029-2034	13	2	2	17
PHASE 3: 2035-2040	11	0	0	11
TOTAL	**25**	**4**	**3**	**32**

An interactive version of the data visualizations can be accessed at: https://fleet.frontierenergy.com/angels-camp/

Password: Angels Camp

4. FLEET CHARGING RECOMMENDATIONS

The purpose of this chapter is to provide high-level recommendations on the suitable quantity and types of fleet chargers at each of Calaveras County's and the City of Angels Camp's fleet facilities. These recommendations are based on careful evaluation of the two jurisdictions' current vehicle fleets and their utilization, and the potential to gradually replace existing assets with electric vehicles (EVs), as described in Chapter 3.

INTRODUCTION

To determine an optimal charging strategy for both Calaveras County's and the City of Angels Camp's future electric fleets, the project team assessed the projected vehicle energy needs and typical daily dwell times available for charging.

This included a vehicle-by-vehicle analysis for each County and City facility where fleet vehicles domicile to ensure that the energy demand of each fleet EV can be met by providing sufficient charging capacity. Chargers with different power output types (AC/DC) and power levels (kW) were considered. An overview of different types of EV charging stations and their typical use cases is provided in the following section.

CHARGING STATION TYPES

LEVEL 1 CHARGING

Level 1 EVSE provides charging through a standard three-pronged 120-volt (V) AC house plug with a J1772[16] standard vehicle connector and requires a dedicated branch circuit. Most, if not all, EVs come with a Level 1 EVSE cord set. Level 1 is usually used for charging when there is only a 120V outlet available, typically seen in most single-family residential homes.

The main advantage of Level 1 EVSE is that it requires no additional infrastructure or investment, while the main disadvantage is that it is slow compared to other options.

Level 1 charging is a relatively low-cost way to provide low-speed charging for small numbers of underutilized vehicles with longer parking times. However, due to slow charging speeds, lack of load management flexibility, and no data collection, it is not recommended for charging either fleet

LEVEL 2 CHARGING

Level 2 EVSE offers charging through 240V (typical in residential applications) or 208V (typical in commercial applications) AC plugs with a dedicated electrical circuit and use the same vehicle connector as Level 1 equipment. Depending on the vehicle's battery type, acceptance rate[17], and

[16] J1772, also known as a J plug, is the North American standard for electrical connectors for electric vehicles maintained by SAE International

[17] EVs have on-board chargers that convert alternating current delivered by a charger to direct current to recharge the vehicle's battery pack. These on-board chargers have a maximum acceptance rate that determines how fast a battery can accept electricity while recharging. Higher acceptance rate indicates faster battery charging capabilities.

the charger's circuit capacity and configuration, Level 2 charging typically adds about 10-25 miles of range per hour of charge time.

Because a Level 2 EVSE can easily charge a typical EV battery within only a few hours, it is the typical installation for fleet and workplace chargers and other commercial applications. Most fleet vehicles travel fewer than 30 miles a day, so Level 2 EVSE could re-charge a typical LD fleet vehicle's battery in approximately 1-2 hours. For fleet domicile locations with multiple electric vehicles, these chargers could potentially be shared by more than one vehicle to optimize charger utilization.

Level 2 EVSE is available at a range of price points, from the relatively low speed (3.8-7.7kW) entry-level AmazingE "dumb" chargers from ClipperCreek, to relatively fast (19.2 kW) hard-wired connected or "smart chargers", such as Blink's IQ 200. High-end smart chargers typically use WiFi or cellular connections to transmit and track charging and financial data. The advantages of "dumb chargers" (earliest model of vehicle chargers that do not have advanced capabilities) are their low cost, simplicity, and reliability. The advantages of higher cost smart chargers include faster charging and the ability to manage and share power loads, schedule charging at certain times-of-use for lower electric rates and monitor charging data through online dashboards and smartphone apps.

Level 2 charging is typically the most appropriate way to provide medium-speed charging for fleet vehicles or workplace charging with moderate parking dwell times.

DC FAST CHARGING

DCFC (480V input to the EVSE) enables rapid charging. A 50 kW DCFC, until recently, the most common public fast chargers, adds 60-80 miles of range to a light duty vehicle in as little as 20 minutes.

High-powered chargers are high amperage DCFC (150-350 kW or more) that are the fastest and most expensive type of EVSE. Tesla, EVgo and Electrify America all deploy these in their public charging networks; they can provide 75 miles of charge in about 10 minutes. However, actual charging speeds are limited by each vehicle's acceptance rate.

As shown below in Figure 3, lower cost EVs such as the older Nissan Leaf and Chevrolet Bolts can charge no faster than 50kW. Newer and higher end EVs can charge more quickly with 800V charging becoming more common, allowing mid-priced EVs like the Hyundai IONIQ 5 and Kia EV6 to charge at 240kW.

Acceptance rates will likely improve in the future as more high-power chargers are deployed and more EVs enter the market[18]. Also, now that Tesla is allowing most other EV manufacturers access to its Supercharger network, the North American Charging Standard (aka NACS or SAE J3400) provides an incentive for faster acceptance rates.

[18] https://insideevs.com/news/348233/electric-car-dc-fast-charging-comparison/

EV Battery Charging Times

EV Vehicles	Battery Capacity (kW-h)	Acceptance Rate in kW		Time Required for Optimum (80%) Battery Charged Based on Charger Loads (h)												
				Level 1 Chargers		Level 2 Chargers						DCFC Chargers				
		AC	DC	1.4[1]	1.9[1]	3.6	6.6	7.2	9.6	12	19.2	50	100	150	175	250
Nissan Leaf	62	6.6	150	35.4	26.1	13.8	7.5	7.5	7.5	7.5	7.5	1.0	0.5	0.3	N/A	N/A
Chevrolet Bolt	66	7.2	50	37.8	27.8	14.7	10.9	7.4	7.4	7.4	7.4	1.1	N/A	N/A	N/A	N/A
Lordstown Endurance	109	11	150	62.3	45.9	24.2	13.2	12.1	9.1	9.1	9.1	1.8	0.9	0.6	N/A	N/A
Tesla Model X/S	100	11.5-17.5	250	57.1	42.1	22.2	12.1	11.1	8.3	4.7	4.7	1.6	0.8	0.5	0.5	0.3
Tesla Model Y	75	11.5	250	42.9	31.6	16.7	9.1	8.3	6.3	5.2	5.2	1.2	0.6	0.4	0.3	0.2
Ford Mach-E	98.8	10.5	150	56.5	41.6	22.0	12.0	11.0	8.2	7.5	7.5	1.6	0.8	0.5[2]	N/A	N/A
Ford E-Transit	67	11.3	100	38.3	28.3	14.9	8.2	7.5	5.6	4.7	4.7	1.1	0.6	N/A	N/A	N/A
Nissan Ariya	65	7.2	130	37.2	27.4	14.4	7.9	7.2	7.2	7.2	7.2	1.0	0.5	0.4	N/A	N/A
Volkswagen ID4	62	11	150	35.4	26.1	13.8	7.5	6.9	5.2	4.5	4.5	1.0	0.5	0.3	N/A	N/A
Ford F-150 Lightning	115	11.3	150	66.0	48.4	25.6	13.9	12.8	9.6	8.1	8.1	1.8	0.9	0.6	N/A	N/A
Hyundai Ioniq 5	58	10.9	350	33.0	24.4	12.9	7.0	6.4	4.8	4.3	4.3	0.9	0.5	0.3	0.3	0.2

1: Level 1 chargers include 16A (1.4kW) and 20A (1.9kW) breaker ampacity.

2: The base Select Ford Mustang Mach-E modal is capable of up to 115 kW of fast-charging capability, while all other Mustang Mach-E models will go to 150 kW.

00.0 = kW

FIGURE 3: CHARGING SPEEDS FOR COMMON FLEET VEHICLES DEPENDING ON CHARGER TYPE

SELECTION OF MOST SUITABLE CHARGING STRATEGY

OVERVIEW OF ALTERNATIVES

In principle, two alternative approaches of charging fleet EVs were considered:

1. *Dedicated* strategy with one Level 2 charging port assigned to each fleet EV combined with central load management
2. *Shared* strategy with Level 2 chargers shared between multiple fleet EVs with smart charging software

Conceptually, the simplest way to charge an EV fleet is with a dedicated charger assigned to each EV, so that every EV can charge overnight in an assigned parking stall equipped with its own port. This strategy made sense for early EV models with limited driving range due to small batteries driven during the day and parked overnight, providing ample parking time (also known as *dwell*) time for battery charging using low speed chargers. However, since most public agency fleet vehicles drive relatively few miles per day compared to their existing or anticipated battery capacity, dedicated chargers are not typically necessary. The County's fleet vehicles drive an average of 33 miles per day, while the City's fleet vehicles only average about 21 miles per day. Depending on the site and vehicle type, the average daily required energy for each EV is projected to be only 5-45 kWh per day. These energy needs could be comfortably met by recharging each EV every few nights or using other available time windows for opportunity charging (i.e., charging at a time and place that is convenient rather than a fixed time and place).

More details (operational workings, benefits, and disadvantages) on the potential charging strategies are provided in **Appendix C.** Both strategies were evaluated, resulting in the quantities of chargers recommended by type and charging speed. The results were assessed by the project team with regard to the suitability to support the jurisdiction's fleet transition to EVs.

SHARED LEVEL 2 BASELOAD CHARGING

Based on a detailed assessment of the County's and City's fleets, a shared charging strategy is recommended for both jurisdictions using Level 2 chargers shared between multiple fleet EVs to cover the fleets' baseload charging needs. Reasons including resource efficiency and cost savings for this recommendation are explained below.

In a charging strategy with chargers dedicated to individual fleet EVs, each fleet EV has its own charging plug, which is neither the most cost-effective nor resource-efficient approach. Additionally, installing numerous extra chargers would result in construction impacts at all parking stalls used by fleet vehicles. Lastly, the two fleet's energy needs, as modeled in a previous project phase, are relatively small, allowing for the use of a fewer number of chargers shared between multiple fleet EVs.

Additionally, DKS has learned through multiple fleet electrification planning and design projects that dedicated chargers are typically 50-250%[19] more expensive to deploy than shared chargers, given the common need for electrical service upgrades. In the long run, the fleet charging demand in some locations will necessitate the installation of multiple Level 2 chargers which are likely to exceed the existing electrical capacity at the panel level. The more chargers installed at each location, the larger the electrical service resulting in more expensive electrical upgrades comprised of new panels, switchboards, and/or transformers. Additionally, larger upgrades substantially delay the process of providing charging near-term infrastructure for new fleet EVs given frequent delays e.g. in the provision of utility-side transformers and other long-lead equipment.

Figure 4 below shows typical charging durations for example EV models (Nissan Leaf and Ford F-150 Lightning). The charging times refer to charging sessions during which the EV's battery gets replenished from 10% to 90% SOC. Few EVs in the County and City fleets will require such a session on a typical day. Hence, each Level 2 charger to be installed County and City facilities could be shared among multiple fleet EVs, each of which would get a full recharge every few nights as shown in Figure 5.

Furthermore, Figure 4 demonstrates that for some EV models, a limited AC charging power acceptance rate may not justify the need for a charging station with higher power outputs. For example, a Nissan Leaf's acceptance rate is limited to only 6.6 kW, hence the charging time on a 11.5-kW charger is the same as on a 6.6-kW charger. For the two jurisdictions' fleets, given the typical daily mileage and common EV models' AC acceptance rates, low and medium-output

[19] The lower end of that range would apply for facilities at which no major electrical system upgrades would be needed for fleet charging. The higher end of that range applies when upgrades such as larger transformers, switchboards, or electrical panels are necessary. Electrical upgrades can be substantially more expensive to support dedicated chargers for each fleet EV than when sharing chargers between EVs, as recommended in this plan.

chargers (6.6-11.5 kW provided at each port) will be sufficient to meet these fleets' charging needs[20]. Such chargers can recharge a light-duty EV battery from 10% to 90% state-of-charge within 5-12 hours.

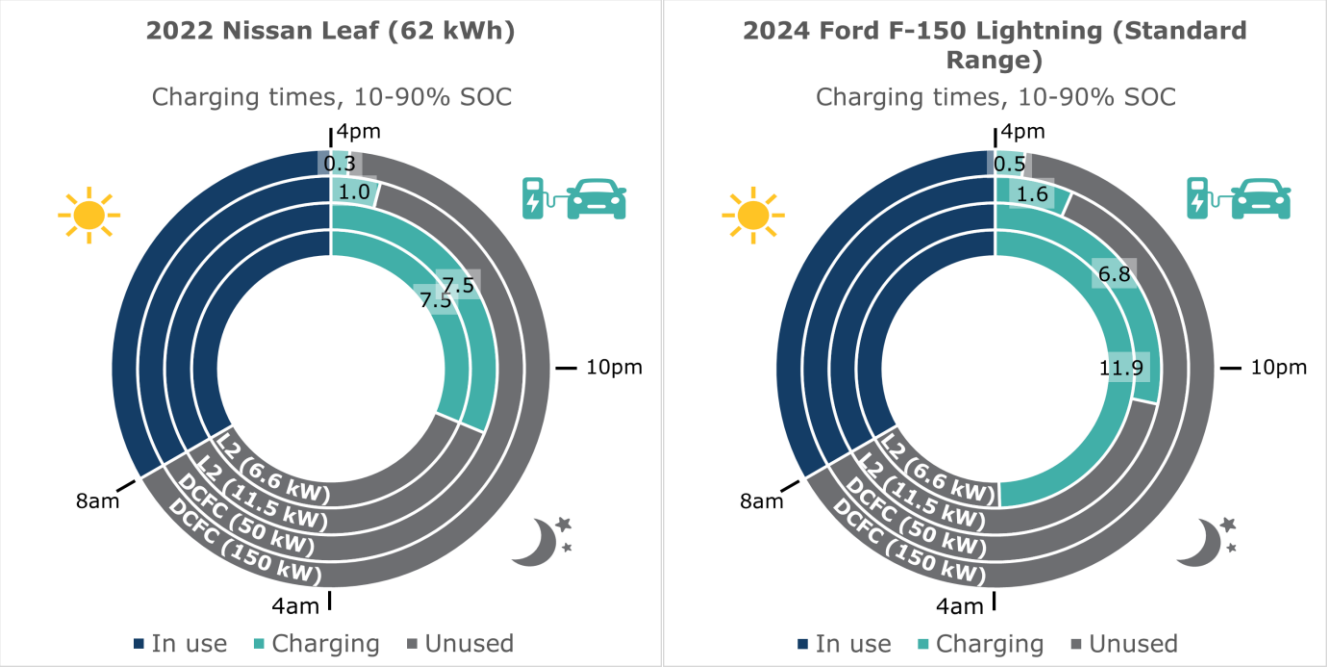


FIGURE 4: EXEMPLARY CHARGING TIMES FOR TYPICAL FLEET EVS ON LEVEL 2 AND DC FAST CHARGING STATIONS OF DIFFERENT POWER OUTPUTS.

Week	Vehicles...	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	...charging (at night)							
	...in operation							
2	...charging (at night)							
	...in operation							
3	...charging (at night)							
	...in operation							
4	...charging (at night)							
	...in operation							
5	...charging (at night)							
	...in operation							

FIGURE 5: POTENTIAL CHARGING SCHEDULE ROTATING DIFFERENT FLEET EVS ON THE SAME CHARGER ACROSS MULTIPLE DAYS OR NIGHTS.

[20] Of the currently available surrogate EVs used to model the two fleets' energy needs, only the Ford F-150 Lightning accepts AC power higher than 11.5 kW. The existing Ford F-150 pickup trucks (and similar pickups, such as the Chevy Silverado) in Calaveras County's fleet drive an average of about 30 miles per day, which would require a 2-hour charging session on an 11.5-kW charger per day or about 10 hours of overnight charging once per week. Hence, high-output Level 2 chargers (19.2 kW) are not warranted and would represent an overbuild for the two fleets.

Lastly, the utilization of shared chargers also facilitates the use of fleet chargers by employees to charge their personal EVs, providing "workplace charging". If desired, managed "smart" chargers and their associated software could distinguish between fleet EVs and personally-owned EVs in charging sessions, e.g. through the use of RFID cards in each fleet EV and issued to employees for use with their personal EVs. This way, employees are not bound to specific, dedicated charging stations and parking stalls.

For these reasons, it is not recommended for Calaveras County or the City of Angels Camp to provide one charging port for every fleet EV and instead share chargers among multiple EVs.

SUPPLEMENTAL DC FAST CHARGERS

In addition to shared Level 2 chargers to cover typical daily energy needs, the project team recommends installation of a few direct current fast charging (DCFC) stations at various County and City facilities to provide operational convenience, flexibility, and redundancy to in addition to AC Level 2 chargers. The concept, typical use cases, benefits, and disadvantages of supplemental DCFCs are further explained in **Appendix C**.

OVERVIEW OF CHARGER RECOMMENDATIONS

Based on careful analysis of the fleet utilization data and projected daily energy demands, a number of dual-port AC Level 2 charging stations are recommended for shared use by both fleets' EVs for overnight charging. Each dual-port station may be either one charger unit with two ports or two units with one port each; the latter would be mounted on a dual-mount pedestal and require the same amount of space as the former. While a single unit may be ideal, not all manufacturers offer this configuration. As previously discussed, low-output (6.6-7.7 kW provided at each port) and medium-output (9.6-11.5 kW at each port) charging stations would be sufficient to meet the charging needs. As previously discussed, such chargers can recharge an empty light-duty EV battery from 10% to 90% state-of-charge within 5-12 hours and far more quickly for a typical partly charged battery meaning these are well-suited for overnight charging when the fleet EV is typically parked at a County or City-owned fleet facility. Dual-port chargers should be placed between two parking stalls so that two EVs can access both cords and charge simultaneously.

For the heavy-duty (Class 7 and 8) components in the County's and City's fleet, some EV models currently on the market lack an onboard AC-to-DC converter and thus cannot be charged on a traditional AC Level 2 charging station. Hence, for these vehicles, low/moderate-output DC chargers (also known as Level 2 DC or DC Slow Chargers) with a power rating of up to 22.5 kW are recommended for overnight charging of a heavy-duty EV's battery. This is the most cost-effective way to charge heavy-duty EVs lacking an onboard AC-to-DC converter when the daily mileage is moderate, and the nighttime is available as a reliable charging window. This is due to the low procurement and installation costs of these chargers and supporting electrical infrastructure compared to DCFC stations and the potential to avoid or mitigate utility demand or subscription

charges that are based on the peak power demand. Examples of suitable products meeting these needs include ABB's Terra DC Wallbox[21] or Wallbox's Quasar II[22].

These "baseload" chargers should be supplemented by one or two dual-port 150 kW[23] high-speed DCFC stations installed at select, large fleet facilities as detailed in the following sections. It should be noted that these DCFC stations are not necessary to cover the County's or City's fleet's typical charging demand. Instead, they are intended to supplement AC Level 2 chargers and should be used in the following situations:

- When drivers or fleet operators forgot to plug-in an EV for overnight charging when it needed to be recharged.
- When unexpectedly high driving demand warrants the need for a quick recharge to reinstate an EV's availability for duties.

Not using the supplemental fleet DCFC stations should be the norm for typical daily charging operations, ensuring availability of these expensive assets when they are needed the most. To reduce capital expenditure, the County and City could also consider omitting installing a DCFC station at one or the other location. The geographic distance between facilities and the current lack of public DCFC stations in the vicinity of these locations should be considered for this decision.

FLEET CHARGER RECOMMENDATIONS FOR CALAVERAS COUNTY

The recommended charging station quantities by type for Calaveras County's fleet are shown in **Table 15** below. A total of 83 charging stations of varying types providing access to 152 charging ports are recommended across the County's facilities. Of these, 59 dual-port AC Level 2 charging stations are recommended for shared use by the fleet for overnight charging across the County's facilities, providing access to 118 EVs charging simultaneously. Of these AC Level 2 stations, 20 charging stations (40 charging ports) should be capable of providing 6.6 kW (low-output) and 39 charging stations (78 charging ports) should be rated at up to 11.5 kW (medium-output). The distinction allows for an optimization of public investment by avoiding additional electrical service upgrade costs that would be necessary if all Level 2 stations were medium-output. Additionally, five 11.5-kW single-port and nine 22.5-kW single-port DC chargers are recommended for overnight charging of heavy-duty EVs lacking onboard AC-to-DC converters.

The Government Center (San Andreas Road Yard & Equipment Service Center) and Sheriff's Office would install the most chargers of all the facilities where the County fleet vehicles domicile. These are also the two facilities at which dual-port high-powered DC fast charging stations with a power output of 150 kW at each port are recommended for occasionally achieving a full state-of-charge quickly when needed. Of the three dual-port DCFC stations recommended at the Government Center, one should be reserved for or assigned to heavy-duty dump trucks to cover any urgent charging needs these heavy-duty EVs may have due to their unique operational requirements. At

[21] https://new.abb.com/ev-charging/terra-dc-wallbox

[22] https://wallbox.com/en_us/quasar2-dc-charger

[23] One dispenser capable of delivering 150 kW through each plug simultaneously. This may require a separate standalone 300 kW DC power cabinet, either near the dispenser or the power source.

the Sheriff's Office, four dual-port DCFC stations are recommended to ensure the charging needs of mission-critical EVs based there are met.

At three locations – the Arnold Maintenance Yard, Rock Creek Landfill, and the Government Center – dual-port DCFC stations rated at 50 kW per port are recommended due to the assignment of multiple heavy-duty dump trucks with substantial utilization. These 50-kW chargers can be used to recharge future electric dump trucks overnight after days on when their battery depleted entirely. For typical operations, the low/moderate-output DC chargers (at 11.5 or 22.5 kW) are sufficient to recharge a partially depleted battery every one or two nights by rotating different trucks through the same charger. No high-powered 150-kW DC fast chargers are recommended at Rock Creek Landfill and Arnold Maintenance Yard as dump trucks have at least a couple of hours of dwell time every day for charging.

Most vehicles in the County's Administration Department are marked as "rotating". Three low-output Level 2 charging stations and one 11.5-kW DC charger are recommended to address these EVs charging needs. These chargers should be installed at these EVs' respective parking locations or in the parking stalls closer to the electrical room.

Table 15 also shows how many fleet EVs will, on average, share access to one charging port at each facility. This number ranges from 1 up to 4.2 EVs per port. The smaller the per-EV projected energy demand is, the greater the number of EVs generally sharing a charging port by charging in subsequent nights on the same port. For Calaveras County's fleet as a whole, about 2-3 EVs should share access to each charging port on average. This is also the case at the two facilities with the greatest number of fleet vehicles, the Government Center and Sheriff's Office.

Lastly, **Table 15** also lists the total connected electrical load that would result from the recommended chargers. The greater the number of chargers, the higher the proposed connected load and the more system upgrades needed to meet that demand. The proposed connected load refers to the total power output of all recommended charging stations. It is provided both in kW (referring to the raw sum of all chargers' power outputs) and kVA (kW/0.8, accounting for a power factor of 80% providing a margin of safety, and referring to the capacity needed to be provided by the electrical service). The main electrical infrastructure to be sized per the National Electrical Code (NEC) is the proposed connected loads listed in the rightmost column.

TABLE 15: RECOMMENDED CHARGING STATIONS FOR CALAVERAS COUNTY

SITE	ADDRESS	NO. OF FLEET VEHICLES				RECOMMENDED CHARGING STATIONS							EVs PER CHARGING PLUG	PROPOSED CONNECTED LOAD	
		LD	MD	HD	TOTAL	DUAL-PLUG L2 (2x6.6 KW)	DUAL-PLUG L2 (2x11.5 KW)	SINGLE-PLUG DC (11.5 KW)	SINGLE-PLUG DC (22.5 KW)	DUAL-PLUG DCFC (2x50 KW)	DUAL-PLUG DCFC (2x150 KW)	TOTAL CHARGING PLUGS		[KW]	[KVA]
AIRPORT	3600 Carol Kennedy Dr., San Andreas	1	-	-	**1**	1	-	-	-	-	-	**2**	1.0	13.2	16.5
ANIMAL SERVICES	901 Jeff Tuttle Drive, San Andreas	4	1	-	**5**	-	2	-	-	-	-	**4**	1.3	46.0	57.5
ARNOLD MAINTENANCE YARD	1191 Linebaugh Rd, Arnold	14	4	4	**22**	-	3	2	-	1	-	**10**	2.2	192.0	240.0
COLOMBO	23 E St Charles, San Andreas	20	-	1	**21**	2	-	1	-	-	-	**5**	4.2	37.9	47.4
GLENCOE	16151 Hwy 26, Glencoe	6	2	1	**9**	2	-	1	-	-	-	**5**	1.8	37.9	47.4
HUMAN SERVICES BUILDING	509 E St Charles St, San Andreas	22	-	-	**22**	3	-	-	-	-	-	**6**	3.7	39.6	49.5
JENNY LIND MAINTENANCE YARD	11558 Milton Rd, Valley Springs	6	2	1	**9**	-	2	-	1	-	-	**5**	1.8	68.5	85.6
PUBLIC HEALTH	700 Mountain Ranch Rd	7	1	-	**8**	1	-	-	-	-	-	**2**	4.0	13.2	16.5
ROCK CREEK LANDFILL	12021 Hunt Rd, Milton	9	4	4	**17**	1	1	-	2	1	-	**8**	2.1	181.2	226.5

SITE	ADDRESS	NO. OF FLEET VEHICLES				RECOMMENDED CHARGING STATIONS							EVs PER CHARGING PLUG	PROPOSED CONNECTED LOAD	
		LD	MD	HD	TOTAL	DUAL-PLUG L2 (2x6.6 KW)	DUAL-PLUG L2 (2x11.5 KW)	SINGLE-PLUG DC (11.5 KW)	SINGLE-PLUG DC (22.5 KW)	DUAL-PLUG DCFC (2x50 KW)	DUAL-PLUG DCFC (2x150 KW)	TOTAL CHARGING PLUGS		[KW]	[KVA]
GOVERNMENT CENTER	891 Mountain Ranch Road, San Andreas	92	22	6	**120**	7	11	-	5	1	3	**49**	2.4	1457.9	1822.4
SHERIFF'S OFFICE	1045 Jeff Tuttle Dr, San Andreas	134	3	1	**138**	-	20	-	1	-	4	**49**	2.8	1682.5	2103.1
(ROTATING)		19	2	2	**23**	3	-	1	-	-	-	**7**	3.3	51.1	63.9
TOTAL (STATIONS)		**334**	**41**	**20**	**395**	**20**	**39**	**5**	**9**	**3**	**7**	**83**	**2.6**	**3,821**	**4,776**
TOTAL (CHARGING PLUGS)						**40**	**78**	**5**	**9**	**6**	**14**	**152**			

FLEET CHARGER RECOMMENDATIONS FOR CITY OF ANGELS CAMP

The recommended charging station quantities by type for the City of Angels Camp's fleet are shown in **Table 16** below. A total of 10 charging stations of varying types providing access to 19 charging ports are recommended across the City's facilities. Of these, 7 dual-port AC Level 2 charging stations are recommended for shared use by the fleet across the City's facilities for overnight charging, providing charging for up to 14 EVs simultaneously. Of these, 3 charging stations (6 charging ports) should be providing 6.6 kW (low-output) and 4 charging stations (8 ports) should be rated at up to 11.5 kW (medium-output). The distinction allows for an optimization of public investment by avoiding additional electrical service upgrade costs that would be necessary if all Level 2 stations were medium-output. Additionally, at the Corp Yard, one 11.5-kW single-port DC charger is recommended for overnight charging of heavy-duty bucket and dump trucks.

Most chargers will be installed at 200 Monte Verda St. (Police Department, City Hall, and Corp Yard). There, two dual-port high-powered DC fast charging stations with a power output of 150 kW at each port are recommended for occasional topping off EVs when needed.

Table 16 also shows how many EVs will, on average, share access to a charging port at each facility. This number ranges from 1 up to 4.3 EVs per port. The smaller the per-vehicle projected energy demand is, the more EVs can generally share a charging port by charging during subsequent nights on the same port. For the City's fleet as a whole, about 1-2 EVs should share access to each charging port on average.

Lastly, **Table 16** also lists the total connected load resulting from the recommended chargers. The greater the quantity of chargers, the higher the proposed connected load and the more challenging it would be to meet that demand. The proposed connected load refers to the total power output of all recommended charging stations. It is provided both in kW (referring to the raw sum of all chargers' power outputs) and kVA (kW/0.8, accounting for a power factor of 80% providing a margin of safety, and referring to the capacity needed to be provided by the electrical service).

TABLE 16: RECOMMENDED CHARGING STATIONS FOR THE CITY OF ANGELS CAMP

SITE	ADDRESS	NO. OF FLEET VEHICLES				RECOMMENDED CHARGING STATIONS							EVs PER CHARGING PLUG	PROPOSED CONNECTED LOAD	
		LD	MD	HD	TOTAL	DUAL-PLUG L2 (2x6.6 KW)	DUAL-PLUG L2 (2x11 KW)	SINGLE-PLUG DC (11.5 KW)	SINGLE-PLUG DC (22.5 KW)	DUAL-PLUG DCFC (2x50 KW)	DUAL-PLUG DCFC (2x150 KW)	TOTAL CHARGING PLUGS		[KW]	[KVA]
CORP YARD	200 Monte Verda St.	11	3	3	**7**	2	-	1	-	-	1	**7**	2.4	337.9	422.4
POLICE DEPARTMENT		10	-	-	**10**	-	3	-	-	-	1	**8**	1.3	369.0	461.3
WASTEWATER TREATMENT PLANT	300 Centennial Ln.	1	-	-	**1**	2	-	-	-	-	-	**2**	1.0	13.2	16.5
FIRE DEPARTMENT	1404 Vallecito Rd.	3	1	-	**4**	-	1	-	-	-	-	**2**	2.0	23.0	28.8
TOTAL (STATIONS)		**25**	**4**	**3**	**32**	**3**	**4**	**1**	**-**	**-**	**2**	**10**	**1.7**	**743.1**	**928.9**
TOTAL (CHARGING PLUGS)						**6**	**8**	**1**	**-**	**-**	**4**	**19**			

5. CHARGING INFRASTRUCTURE PRIORITIZATION

In its first section, this chapter addresses the considerations made to prioritize a limited number of County and City sites for in-depth assessments of electrical infrastructure to provide detailed recommendations on suitable fleet (and public[24]) EV charging infrastructure. The findings of these site assessments, including conceptual layout plans of future EV chargers at these locations and estimates of both capital and operational costs, will be provided in a subsequent section of this chapter.

PRIORITIZATION PROCESS

OVERVIEW

Table 17 below lists criteria considered in the selection of County and City fleet domicile sites for prioritized assessment for fleet EV charging infrastructure. The project team identified the relevant criteria that the County and City should apply to narrow down possible choices to a total of four sites for in-depth assessments for fleet EV charging infrastructure. Representatives of both the County and City provided a relative weighting (high/medium/low) for each of the selection criteria. For 4 of the 12 listed criteria, County and City staff assigned the same importance[25]. For 5 criteria, the City assigned a higher importance than the County[26]. For another 2 criteria, the County assigned a higher importance than the City[27]. For one criterion, the project team did not receive an assigned importance by the City (CO_2 emission reduction potential).

Overall, County and City staff agree that facility ownership status, i.e. the question whether a particular facility is leased or owned, is an important determinant of their ability to exert control over the site and facilitate the installation of fleet charging infrastructure. Both County and City staff also put a high emphasis on equity (environmental and social) and hence would like to prioritize EV charging infrastructure installation in disadvantaged and historically underserved areas.

A difference in the County's and City's assessment of the relative importance of different criteria could be seen in the extent to which they would like the number of vehicles covered by ACF (Class 2B and higher) versus not covered by ACF (Class 2A and lower) to inform which sites to prioritize. The County assigns "medium" importance to using the number of vehicles not covered by ACF as a

[24] In the case of the City of Angels Camp's Utica Park

[25] Criteria with the same importance assigned: Facility ownership status (high), Number of non-fleet parking spaces (low), Criteria air pollutant reduction potential (low), Equity (social and environmental) (high)

[26] Criteria with higher importance assigned by the City than by the County: Electricity demand for future EVs, EV replacement model availability, Proximity to public charging stations, Number of vehicles of Class 2B and higher (affected by ACF), Vehicle age

[27] Criteria with higher importance assigned by the County than by the City: Number of fleet parking spaces, Number of vehicles of Class 2A and under (not affected by ACF)

site selection determinant and a "low" importance to vehicles covered by ACF. The opposite weighting was done by the City. Relatively speaking, the County and City have the same share of Class 2B and higher vehicles in their respective fleets[28]. Some level of subjectivity in the assignment of these relative importance cannot be avoided and hence it should **not** be inferred that the City is more concerned with compliance with the ACF regulation than the County. Ultimately, as explained further below, the County selected parts of its San Andreas Road Yard & Equipment Service Center (Government Center) as a prioritized site, which domiciles about half of the County's medium- and heavy-duty fleet vehicles.

[28] County: 124 of 395 (31%). City: 10 of 32 (also 31%).

TABLE 17: PRIORITIZATION CRITERIA APPLIED TO COUNTY AND CITY FACILITIES FOR FLEET EV CHARGING INFRASTRUCTURE ASSESSMENTS

	Criterion	Data needs	Comment	Priority (low/medium/high)	
				Calaveras County (Marcos Munoz)	City of Angels Camp (Rebecca Callen)
Ease or speed of implementation	**Facility ownership status**	Leased/owned	Prioritize sites owned by the County/City	High	High
	Electricity demand for future EVs	Class, make, model for each fleet vehicle	Prioritize sites with lower projected electricity demand (easier and faster deployment)	Medium	High
	EV replacement model availability	Class, make, model for each fleet vehicle	Prioritize sites with vehicles that have suitable EV replacement models on the market	Low	Medium
	Number of fleet parking spaces	Fleet parking spaces by facility	Probably not very important unless any existing facility has too few parking spaces	High	Low
	Number of non-fleet parking spaces	Fleet parking spaces by facility	Probably not very important unless any existing facility has too few parking spaces	Low	Low
	Proximity to public charging stations	AFDC	Prioritize sites close to public charging stations (which can serve as backup for fleet chargers)	Low	High
Related to vehicle counts	**Number of vehicles of Class 2A and under (not affected by ACF)**	Vehicle class for each fleet vehicle	Prioritize sites with more vehicles	Medium	Low
	Number of vehicles of Class 2B and higher (affected by ACF)	Vehicle class for each fleet vehicle	Prioritize sites with more vehicles (to be compliant)	Low	Medium
CO_2 emissions	**CO_2 emission reduction potential**	Annual fuel consumption for each vehicle	Prioritize sites where vehicles induce a lot of CO_2 emissions	Low	*(not received)*
Environmental justice	**Criteria air pollutant reduction potential**	Fuel type for each fleet vehicle	Prioritize sites with more diesel vehicles	Low	Low
	Equity (social and environmental)	Based on EJScreen, CalEnviroScreen, or CEJST	Prioritize sites in disadvantaged and underserved areas	High	High
Other	**Vehicle age**	Model year for each fleet vehicle	Prioritize facilities with older vehicles	Low	Medium

CALAVERAS COUNTY

After consideration of the prioritization criteria described above, Calaveras County chose the following facilities for an in-depth site assessment:

- Government Center:
  - Parking area marked as "West lot" (see **Figure 6**), i.e. west/north of buildings A (Administration) and J (Facilities Management)
  - Parking area marked "East lot" (see **Figure 6**), i.e. north of buildings K (Grand Jury), L (Substance Use Services), M (Behavioral Health Administration), and N (Mental Health Programs)
- Sheriff's Office (1045 Jeff Tuttle Dr, San Andreas)
- Colombo (23 E St Charles, San Andreas)
- Human Services Building (509 E St Charles St, San Andreas)

One focus thus lies on the Government Center and the required charging infrastructure at this location. It appears that most of the 120 fleet vehicles assigned to the Government Center regularly park in these two locations. The majority of charging infrastructure recommended for this site should be installed at these two described parking areas.

The other large site serving more than 100 fleet vehicles is the County's Sheriff's Office, located directly north of the Government Center. In terms of fleet operations, emergency-response and other mission-critical vehicles operate out of this facility, including patrol cars, investigations and detective units, as well as administrative vehicles.

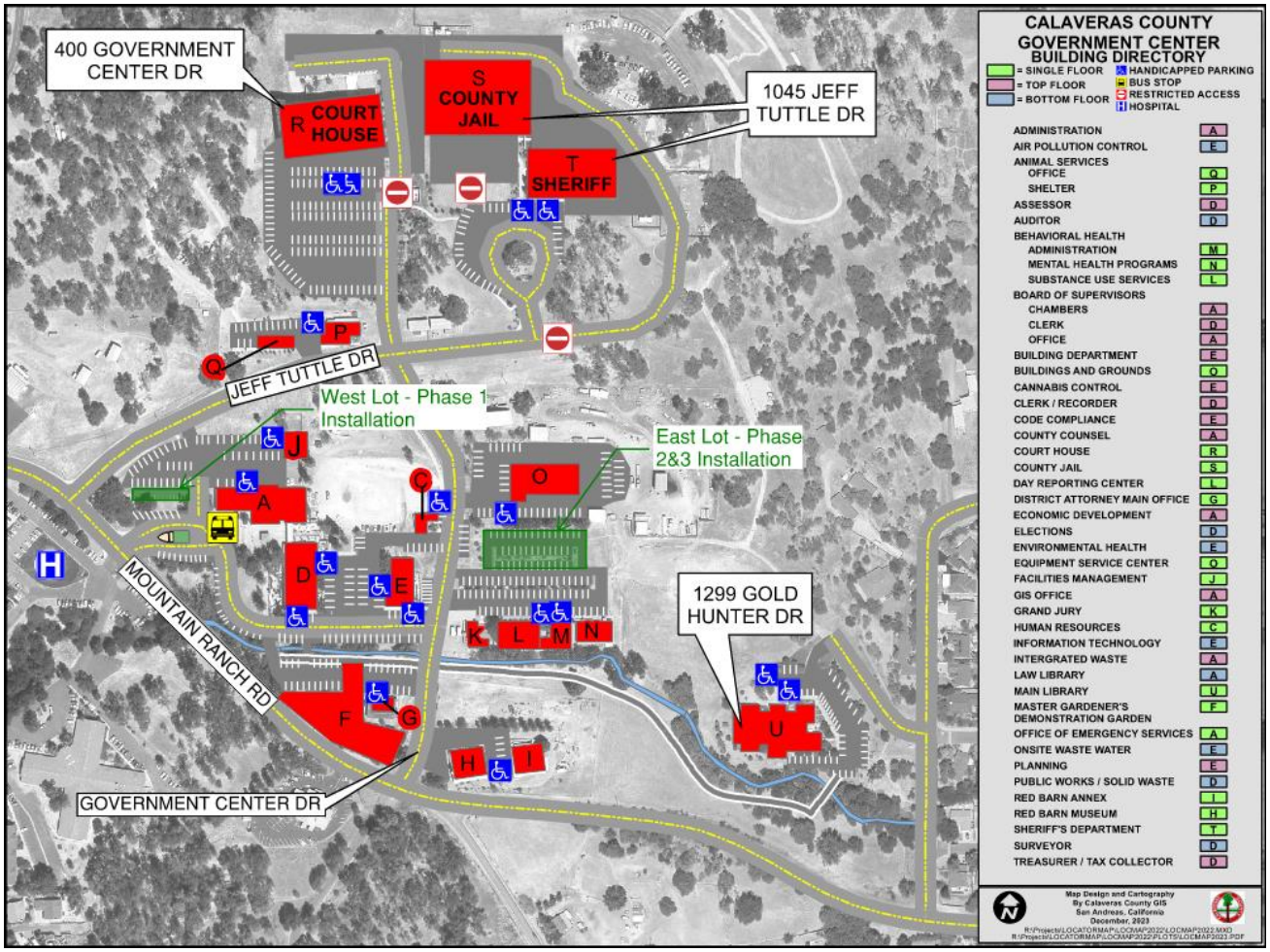


FIGURE 6: CALAVERAS COUNTY GOVERNMENT CENTER

CITY OF ANGELS CAMP

After consideration of the prioritization criteria previously described, the City of Angels Camp selected the following locations for an in-depth site assessment:

- City Hall/Police Department property (200 Monte Verda St, Angels Camp)
- The old NAPA building property (1056 S Main St, Angels Camp)
- Utica Park (1055-933 S Main St, Angels Camp, CA 95222)

The Monte Verda property would be a central location for all or almost all City vehicles (Police Department, Fire, Public Works) and hence is of special interest for fleet EV charging infrastructure to the City.

The old NAPA building was recently acquired by the City and is in a central location in the south end of the town. It has adequate electrical capacity, with the option to upsize the electrical infrastructure as needed for fleet EV chargers. More details on the electrical infrastructure at the NAPA building are provided in the following section.

Utica Park is a City-owned recreational retreat for the public featuring a playground. Currently (as of late 2024), the Utica Park Site Improvement Project (Project #23-07.06) is in the construction phase. As part of this project, it is recommended to incorporate an EV charging station to serve park visitors that wish to charge at this location.

CONCLUSION

In-depth site assessments, including site visits, reviews of existing electrical infrastructure and electricity usage, cost estimates for each charging infrastructure installation phase, and conceptual layout plans of proposed charger locations will be conducted for the four listed locations.

It should be noted that neither the County nor the City intends to build out charging infrastructure only at these locations, but rather will focus their near-term budgeting and planning efforts here.

FACILITY-LEVEL ANALYSIS AND RECOMMENDATIONS

For the County and City facilities identified as near-term priorities (see the previous section), this section presents in-depth site assessment findings. These are based on site visits, reviews of existing electrical infrastructure and electricity usage, and the charger quantities recommended for each respective site. Recommendations include an implementation plan of these charging stations over time, along with estimates of both capital and operations & maintenance costs for each installation phase as well as conceptual layout plans of proposed charger locations.

The methodology and considered cost categories behind all cost estimates included in the following are described in **Appendix G**.

CALAVERAS COUNTY

Overview

Summaries of fleet vehicle assignments, proposed EV chargers, information on existing electrical infrastructure and capacity, and recommendations to accommodate the electrical power needs of the proposed chargers are provided in the following sections for each site.

In addition, the following should be noted:

- All recommended Level 2 (L2) and DC fast chargers (DCFC) are dual-port unless otherwise specified because dual-port chargers are generally more cost efficient than single-port chargers.
- All low-output DC chargers are single-port because no dual-port DC Level 2 chargers are commercially available.
- Low-output Level 2 chargers are rated up to 6.6 kW
- Medium-output Level 2 chargers are rated up to 12 kW
- High-output Level 2 chargers are rated at 19.6 kW
- Low-output single-port DC chargers recommended for charging HD fleet EVs are rated at 11.5 kW
- Medium-output dual-port DC Fast chargers are rated at 50 kW

- High-output DC Fast chargers are rated at 150 kW
- Phases refer to the following time periods:
  - Phase 1: 2025-2028
  - Phase 2: 2029-2034
  - Phase 3: 2035 onwards (all fleet vehicles electrified)

Government Center

Based on priority and scope of work, Calaveras County staff has selected two parking locations at the Government Center, referred to as West Lot and East Lot (as marked in **Figure 6**), for the installation of electric vehicle chargers. There are a total of 120 fleet vehicles domiciled at the Government Center. Of these fleet assets, 92 are light-duty vehicles, 22 are medium-duty vehicles, and 6 are heavy-duty vehicles, all of which will be replaced with comparable class electric vehicles (EVs).

The projected combined (total) electrical demand for charging these 120 EVs would be approximately 3,720 kWh per day. Given the average of only 32 miles driven daily by each fleet vehicle assigned to these locations and the battery size of likely replacement EVs, overnight charging every two or three days using a Level 2 charger should be sufficient.

A total of 7 low-output dual port, 11 medium-output dual port, 5 low-output single-port DC slow, 1 medium-output dual-port 50kW DC Charger and 3 high-output dual-port 150 kW DC Fast Chargers are recommended to be installed in three consecutive phases.

West Lot

A total of seven (7) low-output (up to 7.2 kW) dual-port Level 2 chargers are recommended to be installed on the south side of the parking lot. Fourteen existing parking stalls will need to be restriped and clearly marked with signage indicating "EV Charging Only," designated for exclusive use by County fleet vehicles. These chargers should be installed during Phase 1 of project implementation.

Major renovations are currently underway to install new electrical infrastructure for a new District Attorney Office Building, which will be constructed on the east side of buildings A and J. As part of these electrical infrastructure improvements, Calaveras County has taken the initiative to install conduit stub-outs from the main electrical panel to the west lot parking area for future EV charger installation. This proactive step will reduce the overall construction cost of the project since the conduits and pull boxes have already been installed from the electrical panel to the parking area.

The existing main electrical panel, installed as part of the electrical infrastructure, has a main breaker rated at 1000 Amps at 480V, 3-phase power. This panel will provide power to the new District Attorney Office Building as well as some minor power needs in building A. Additionally, there is a 150 Amp, 480V, 3-phase spare breaker installed for future EV charging use, with 2-inch conduit stub-outs to the west lot, as shown on the record drawings[29]. The maximum power that

[29] As shown on the construction plans "Electrical Service Replacement for The Calaveras Government Center, County of Calaveras" sheet numbers E-001 to E-202.

can be delivered on a 150 Amp breaker is 99.7 kVA, which will be sufficient to power seven dual-port low-output Level 2 chargers using load management. However, new sub-panels (480V and 208V) and a step-down transformer will need to be installed to convert power from 480V to 208V, 3-phase, to power the Level 2 chargers. These sub-panels and the step-down transformer should be installed near the chargers to minimize new conduit trenching.

Appendix H shows the conceptual layout plans for the location, quantity, and electrical infrastructure.

East Lot

A total of eleven (11) medium-output dual-port Level 2 chargers, five (5) single-port DC slow, one (1) dual-port 50 kW DC, and three (3) dual-port 150 kW DC Fast Chargers are recommended at this parking lot. These should be installed in Phases 2 and 3 of project implementation per the following guidance:

Phase 2 will require the installation of six (6) medium-output dual-port Level 2 chargers, two (2) single-port DC slow, one (1) dual-port 50 kW DC, and a dual-port 150 kW DC Fast charger along with electrical infrastructure that will provide power to Phase 2 and 3 charger installations. Conduit stub-outs are recommended to be installed in Phase 2 for chargers to be installed in Phase 3.

Phase 3 will require the installation of five (5) medium-output dual-port Level 2 chargers, three (3) single-port DC slow, and two (2) dual-port 150 kW DC Fast chargers.

There will be a total of 35 existing parking stalls that will need to undergo restriping, clearly marked with signage indicating "EV Charging Only" and designated for exclusive use by County fleet vehicles, out of which eighteen (18) parking stalls to be restriped in Phase 2 and the remaining seventeen (17) to be restriped Phase 3 of project implementation.

There are major renovations that are being planned at the Government Center that include demolition of buildings L, M and N on the southern edge of the East Lot. A new office building will be constructed during the same time frame as Phase 2. To optimize cost efficiency, DKS recommends installing electrical infrastructure and trench to the parking area where EV chargers are to be installed during the electrical design of the building. The County will need to provide an additional 1500 kVA of electrical capacity to power EV chargers as part of the design of the new building.

However, during Phase 2 construction, new 480 V and 208 V sub-panels and a step-down transformer will need to be installed to convert power from 480 V to 208 V 3 phase to power the Level 2 chargers. The sub-panels and step-down transformer should be installed in close proximity to the chargers to minimize conduit trenching.

Appendix H shows the recommended location and quantity and electrical and charging infrastructure.

TABLE 18: CHARGER CAPITAL AND OPERATIONAL EXPENSE ESTIMATES AT CALAVERAS COUNTY'S GOVERNMENT CENTER

		PHASE 1: 2025-2028	**PHASE 2:** 2029-2034	**PHASE 3:** 2035-2040
CHARGER INSTALLATIONS		**West lot:** • 7 dual-head low-output Level 2 stations	**East lot:** • 6 dual-head medium-output Level 2 stations • 2 single-head 22.5 kW DC chargers • 1 dual-head 50 kW DCFC station • 1 dual-head 150 kW DCFC station	**East lot:** • 5 dual-head medium-output Level 2 stations • 3 single-head 22.5 kW DC chargers • 2 dual-head 150 kW DCFC station
CAPEX	**CHARGERS**	$79,500	$331,900	$263,500
	MATERIALS	$142,500	$418,700	$74,000
	CIVIL/LANDSCAPING	$18,800	$75,000	$9,400
	PERMITS	$7,500	$7,500	-
	UTILITY UPGRADES	-	-	-
	CONTRACTING/DESIGN	$42,200	$125,300	$20,900
	TOTAL CAPEX PER PHASE	**$290,500**	**$958,400**	**$367,800**
	TOTAL CAPEX		**$1,616,700**	
ANNUAL OPEX	**DEPRECIATION**	$6,440	$35,130	$84,700
	ROUTINE MAINTENANCE	$1,790	$3,990	$4,810
	CORRECTIVE MAINTENANCE	$600	$1,200	$1,500
	SOFTWARE LICENSING	$1,560	$3,120	$3,600
	NETWORKING FEES	$1,020	$2,040	$2,040
	POTENTIAL KWH FEE	$970	$4,860	$9,710
	ELECTRICITY EXPENSES	$38,840	$194,200	$388,400
	LCFS REVENUE	-$12,950	-$64,730	-$129,470
	TOTAL ANNUAL OPEX	$38,280	$170,800	$365,290
	TOTAL OPEX PER PHASE	**$153,120**	**$1,078,800**	**$2,191,740**
	TOTAL OPEX		**$3,423,660**	

Sheriff's Office

There are a total of 138 fleet vehicles domiciled at the Sheriff's Office. Of these fleet assets, 124 are light-duty vehicles, including many emergency-response and other mission-critical vehicles, including patrol cars, investigations and detective units, as well as administrative vehicles. Additionally, there are three medium-duty and one heavy-duty vehicles domiciled at this location.

The projected combined (total) electrical demand for charging these 120 vehicles once they become electric would be approximately 3,130 kWh per day. Given the average of about 45 miles driven daily per fleet vehicles, the battery size of likely available replacement EVs, and the nature of the Sheriff's Office's emergency-response operations, a combination of quick charging on high-power DC fast chargers as well as overnight charging on medium-output Level 2 chargers is recommended. Overnight Level 2 charging every one to three nights is particularly recommended for non-patrol vehicles, maximizing DC fast charger availability for patrol cars.

A total of twenty (20) dual-port medium-output Level 2 chargers, one (1) single-port 22.5 kW slow DC charger, and four (4) dual-port 150 kW DC fast chargers are recommended for this facility (see **Table 15**). The DC fast chargers should provide 150 kW available at each of the total of eight (8) ports simultaneously, to optimize the ability for patrol vehicles to obtain a quick recharge. The chargers will be installed in three phases as outlined below:

Phase 1 will involve the installation of chargers utilizing the existing electrical capacity. One (1) dual-port medium-output Level 2 charger, one (1) single-port 22.5 kW slow DC charger, and one (1) dual-port 150 kW DC Fast Charger are recommended for Phase 1 installation. The site's main switchboard is a 3200A, 480V, 3-phase system with 600A of available spare capacity. To support the chargers in Phase 1, a 600A breaker should be installed in the main switchboard with a new 600 A, 480V electrical panel, 75 kVA step-down transformer and a 150 A, 208 V sub-panel should be installed in the landscaped island located in the center of the parking lot.

New electrical infrastructure is required to power chargers in Phases 2 and 3. A new 1600A 480V electrical switchboard, 300 kVA step-down transformer, and a 600A sub-panel to power Level chargers installed in Phases 2 & 3. These should be installed in the landscaped area in the northeast end of the parking lot. Phase 2 will require the installation of six (6) dual-port medium-output Level 2 chargers and one (1) dual-port 150 kW DC Fast Charger. Conduit stub-outs are recommended to be installed in Phase 2 for chargers to be installed in Phase 3.

Phase 3 will require the installation of thirteen (13) dual-port medium-output Level 2 chargers and two (2) dual-port 150 kW DC Fast Chargers.

There will be a total of 49 existing parking stalls that will need to undergo restriping, clearly marked with signage indicating "EV Charging Only" and designated for exclusive use by County fleet vehicles. Of these five (5) parking stalls should be restriped in Phase 1, fourteen (14) restriped in Phase 2, and the remaining thirty (30) should be restriped in Phase 3 of project implementation.

Appendix H shows the conceptual layout plans, quantity, and electrical infrastructure for the location.

TABLE 19: CHARGER CAPITAL AND OPERATIONAL EXPENSE ESTIMATES AT CALAVERAS COUNTY'S SHERIFF'S OFFICE

		PHASE 1: 2025-2028	**PHASE 2:** 2029-2034	**PHASE 3:** 2035-2040
CHARGER INSTALLATIONS		• 1 dual-port medium-output Level 2 station • 1 single-port 22.5 kW slow DC charger • 1 dual-port 150 KW DCFC station	• 6 dual-port medium-output Level 2 stations • 1 dual-port 150 kW DCFC station	• 13 dual-port medium-output Level 2 stations • 2 dual-port 150 kW DCFC station
CAPEX	**CHARGERS**	$197,000	$243,100	$497,500
	MATERIALS	$188,200	$252,300	$156,200
	CIVIL/LANDSCAPING	$35,700	$37,500	$37,500
	PERMITS	$7,500	$7,500	-
	UTILITY UPGRADES	-	$129,000	-
	CONTRACTING/DESIGN	$58,300	$106,600	$50,700
	TOTAL CAPEX PER PHASE	**$488,500**	**$776,000**	**$750,900**
	TOTAL CAPEX		**$2,015,400**	
ANNUAL OPEX	**DEPRECIATION**	$23,070	$49,330	$102,730
	ROUTINE MAINTENANCE	$970	$2,230	$3,230
	CORRECTIVE MAINTENANCE	$300	$900	$1,200
	SOFTWARE LICENSING	$1,200	$2,040	$2,400
	NETWORKING FEES	$1,020	$1,020	$1,020
	POTENTIAL KWH FEE	$370	$2,850	$8,180
	ELECTRICITY EXPENSES	$14,650	$114,090	$327,120
	LCFS REVENUE	-$4,880	-$38,030	-109,040
	TOTAL ANNUAL OPEX	$36,690	$134,440	$336,830
	TOTAL OPEX PER PHASE	**$146,760**	**$806,640**	**$2,020,980**
	TOTAL OPEX		**$2,974,380**	

Colombo

A total of two (2) dual-port low-output Level 2 chargers and one (1) single-port 11.5 kW DC slow charger are recommended at this site. These should be installed in Phases 2 and 3 of project implementation as outlined below:

A new 200A, 208V electrical service should be installed during Phase 2 to provide power for all planned charger installations. The new service panel should be installed along the northwest corner of the main building to minimize the distance to the potential PG&E tie-in point.

Phase 2 will require the installation of two (2) dual-port low-output Level 2 chargers along with electrical infrastructure to provide power for Phase 2 and 3 charger installations. Conduit stub-outs are recommended to be installed in Phase 2 for chargers to be installed in Phase 3.

Phase 3 will require the installation of one (1) single-port 11.5 kW slow DC charger.

A total of 5 existing parking stalls will need to undergo restriping, clearly marked with signage indicating "EV Charging Only" and designated for exclusive use by County fleet vehicles, out of which four (4) parking stalls should be restriped in Phase 2 and the remaining one (1) restriped in Phase 3 of project implementation.

The existing parking lot at this location prohibits vehicles over 5,000 lbs. This would exclude heavy vehicles such as the Ford F-150 Lightning and over. Additionally, this site is a leased facility.

Appendix H shows the conceptual layout plans, quantity, and electrical infrastructure for the location.

TABLE 20: CHARGER CAPITAL AND OPERATIONAL EXPENSE ESTIMATES AT CALAVERAS COUNTY'S COLOMBO FACILITY

		PHASE 1: 2025-2028	**PHASE 2:** 2029-2034	**PHASE 3:** 2035-2040
CHARGER INSTALLATIONS		-	• 2 dual-port low-output Level 2 stations	• 1 single-port 11.5 kW DC charger
CAPEX	**CHARGERS**	-	$17,700	$10,600
	MATERIALS	-	$24,600	$2,400
	CIVIL/LANDSCAPING	-	$18,800	$3,800
	PERMITS	-	$7,500	-
	UTILITY UPGRADES	-	$15,100	-
	CONTRACTING/DESIGN	-	$16,500	$1,600
	TOTAL CAPEX PER PHASE	-	**$100,200**	**$18,400**
	TOTAL CAPEX		**$118,600**	

		PHASE 1: 2025-2028	PHASE 2: 2029-2034	PHASE 3: 2035-2040
ANNUAL OPEX	DEPRECIATION	-	$2,060	$2,940
	ROUTINE MAINTENANCE	-	$680	$970
	CORRECTIVE MAINTENANCE	-	$300	$300
	SOFTWARE LICENSING	-	$1,200	$1,200
	NETWORKING FEES	-	$1,020	$1,020
	POTENTIAL KWH FEE	-	$230	$510
	ELECTRICITY EXPENSES	-	$9,200	$20,550
	LCFS REVENUE	-	-$3,070	-$6,850
	TOTAL ANNUAL OPEX	-	$11,620	$20,640
	TOTAL OPEX PER PHASE	**-**	**$69,720**	**$123,840**
	TOTAL OPEX		**$193,560**	

Human Services Building

A total of four (4) dual-port low-output Level 2 chargers are recommended at this facility. These should be installed in Phases 2 and 3 of project implementation, as outlined below:

The main switchboard at this site is a 1600A, 208V, 3-phase system with two (2) available 200A spare breakers that can support the installation of Level 2 chargers. A new 200A sub-panel should be connected to one (1) of the 200A spare breakers on the main switchboard, with 3-inch wall-mounted conduit extending to the planned charger installation locations.

Phase 2 will require the installation of one (1) dual-port low-output Level 2 charger for fleet use and one (1) dual-port low-output Level 2 charger for public use along with electrical infrastructure that will provide power for Phases 2 and 3 charger installations. Conduit stub-outs are recommended to be installed in Phase 2 for chargers to be installed in Phase 3. Phase 3 will require the installation of two (2) dual-port low-output Level 2 chargers.

A total of eight (8) existing parking stalls need to undergo restriping, clearly marked with signage indicating "EV Charging Only" and designated for exclusive use by County fleet vehicles, out of which two (2) parking stalls should be restriped in Phase 2 and the remaining four (4) parking stalls restriped in Phase 3 of project implementation.

Appendix H shows the conceptual layout plans, quantity, and electrical infrastructure for the location.

TABLE 21: CHARGER CAPITAL AND OPERATIONAL EXPENSE ESTIMATES AT CALAVERAS COUNTY'S HUMAN SERVICES BUILDING

		PHASE 1: 2025-2028	PHASE 2: 2029-2034	PHASE 3: 2035-2040
CHARGER INSTALLATIONS		-	• 2 dual-port low-output Level 2 stations (1 for fleet, 1 for public)	• 2 dual-port low-output Level 2 stations (both for fleet)
CAPEX	CHARGERS	-	$17,700	$17,700
	MATERIALS	-	$28,600	$19,600
	CIVIL/LANDSCAPING	-	$3,800	$7,500
	PERMITS	-	$7,500	$0
	UTILITY UPGRADES	-	$0	$0
	CONTRACTING/DESIGN	-	$10,000	$6,800
	TOTAL CAPEX PER PHASE	-	**$67,600**	**$51,600**
	TOTAL CAPEX		**$119,200**	
ANNUAL OPEX	DEPRECIATION	-	$2,060	$3,810
	ROUTINE MAINTENANCE	-	$680	$1,260
	CORRECTIVE MAINTENANCE	-	$300	$300
	SOFTWARE LICENSING	-	$1,200	$1,200
	NETWORKING FEES	-	$1,020	$1,020
	POTENTIAL KWH FEE	-	$360	$1,050
	ELECTRICITY EXPENSES	-	$14,260	$42,010
	LCFS REVENUE	-	-$4,750	-$14,000
	TOTAL ANNUAL OPEX	-	**$15,130**	**$36,650**
	TOTAL OPEX PER PHASE	-	**$90,780**	**$219,900**
	TOTAL OPEX		**$310,680**	

* For the one public Level 2 charging station proposed at this site, an increase in charger utilization over time is assumed: 5 hours per day during Phase 2, 8 hours per day during Phase 3. If the County makes this charger available to the public, electricity expenses from that charger could be fully, partially, or over-recouped by charging users an appropriate per-kWh fee. As documented in the assumptions in **Appendix G**, the provided estimates are based on an average effective electricity rate of $0.40 per kWh charged by the Calaveras Public Power Agency.

CITY OF ANGELS CAMP

Overview

City of Angels staff has selected two City-owned parking locations for the installation of electric vehicle chargers. These two locations are:

1. City Hall/Police Department
2. Napa Building
3. Utica Park

Summaries of fleet vehicle assignments, proposed EV chargers, information on existing electrical infrastructure and capacity, and recommendations to accommodate the electrical power needs of the proposed chargers are provided in the following sections for each site.

In addition, the following should be noted:

- All recommended Level 2 (L2) and DC fast chargers (DCFC) are dual-port unless otherwise specified because dual-port chargers are generally more cost efficient than single port chargers.
- All low-output DC chargers are single-port because no dual-port DC Level 2 chargers are commercially available.
- Low-output Level 2 chargers are rated up to 6.6 kW
- Medium-output Level 2 chargers are rated up to 12 kW
- High-output Level 2 chargers are rated at 19.6 kW
- Low-output single-port DC chargers recommended for charging HD fleet EVs are rated at 11.5 kW
- Medium-output dual-port DC Fast chargers are rated at 50 kW
- High-output DC Fast chargers are rated at 150 kW
- Phases refer to the following time periods:
  - Phase 1: 2025-2028
  - Phase 2: 2029-2034
  - Phase 3: 2035 onwards (all fleet vehicles electrified)

City Hall/Police Department (200 Monte Verda St, Angels Camp)

The City Hall and Police Department are located adjacent to each other, allowing them to share a common fleet parking and charging area. Currently, no fleet vehicles are assigned to City Hall. The Police Department has ten (10) light-duty vehicles that will be replaced with their equivalent electric vehicles. The electrical demand for charging these 10 vehicles is approximately 354.8 kWh per day. Given the average of only 39 miles driven daily by all fleet vehicles at this location and the battery size of the likely replacement EVs, charging every second or third day on a Level 2 charger should be sufficient.

The City plans to relocate the current Police Department to a newer location and repurpose this site for the Public Works Department. An existing fueling station, which services the entire City fleet, is located behind a secured fence on the south side of the site near the City Hall building. City Hall is powered by a 400 Amp electrical panel located outside on the west side of the building. A 50 kVA

pole-mounted utility transformer in close proximity to the electrical panel feeds this 400 Amp panel. There is no available electrical capacity from the existing panels at City Hall to power EV chargers.

Due to the lack of available electrical as-built drawings, the age of the Police Department building, and the total quantity of EV chargers to be installed, new electrical infrastructure is recommended at this site. A new infrastructure will be required in the parking lot near the existing pole-mounted utility transformer. Further engineering analysis by PG&E is needed to evaluate the exact location of power available to accommodate the EV charging loads from a new transformer. The new transformer needs to be rated at 1000 kVA or greater to accommodate the projected fleet EV charging loads.

It is recommended to install a total of two (2) low-output, three (3) medium-output dual-port Level 2 chargers, one (1) single-port DC slow charger, and two (2) dual-port 150 kW DC Fast chargers at this site, in three (3) consecutive phases. The EV chargers should be installed on the west side of the parking area, except for a dual-port 150 kW DC Fast Charger, which should be installed near the existing fueling station to serve the charging needs of future fleet EVs similar to how the existing fueling station provides for the City's existing gas-powered fleet vehicles.

In Phase 1, the City should install a single-port DC slow charger and a single dual-port 150 kW DC Fast charger, along with the necessary electrical infrastructure to support all needed charging infrastructure. Conduit stub-outs for Phases 2 and 3 constructions are also recommended as part of the initial phase to provide cost-effective flexibility. Phase 2 should include installation of three (3) medium-output dual-port Level 2 chargers and a dual-port 150 kW DC Fast charger. Phase 3 should be limited to installation of two (2) low-output dual-port Level 2 chargers connected to conduit installed in the initial implementation phase.

A total of 13 existing parking stalls will need to be restriped and clearly marked with signage indicating "EV Charging Only," designated for exclusive use by County fleet EVs. This includes restriping one stall in Phase 1, eight (8) stalls in Phase 2, and the remaining four (4) stalls in Phase 3.

Appendix H shows the conceptual layout plans, quantity, and electrical infrastructure for each location.

TABLE 22: CHARGER CAPITAL AND OPERATIONAL EXPENSE ESTIMATES AT THE CITY OF ANGELS CAMP'S CITY HALL

		PHASE 1: 2025-2028	**PHASE 2:** 2029-2034	**PHASE 3:** 2035-2040
CHARGER INSTALLATIONS		• 1 single-head 22.5 kW DC charger • 1 dual-head 150 kW DCFC station	• 3 dual-head medium-output Level 2 stations • 1 dual-head 150 kW DCFC station	• 2 dual-head low-output Level 2 stations
CAPEX	**CHARGERS**	$185,600	$209,100	$22,700
	MATERIALS	$144,400	$38,300	$14,400

		PHASE 1: 2025-2028	PHASE 2: 2029-2034	PHASE 3: 2035-2040
	CIVIL/LANDSCAPING	$37,500	$5,700	$5,700
	PERMITS	$7,500	-	-
	UTILITY UPGRADES	$116,100	-	-
	CONTRACTING/DESIGN	$76,400	$11,000	$5,000
	TOTAL CAPEX PER PHASE	**$567,500**	**$264,100**	**$47,800**
	TOTAL CAPEX		**$879,400**	
ANNUAL OPEX	DEPRECIATION	$22,380	$46,020	$47,770
	ROUTINE MAINTENANCE	$680	$1,600	$1,990
	CORRECTIVE MAINTENANCE	$300	$600	$600
	SOFTWARE LICENSING	$1,200	$1,560	$1,560
	NETWORKING FEES	$1,020	$1,020	$1,020
	POTENTIAL KWH FEE	$230	$820	$1,170
	ELECTRICITY EXPENSES	$9,330	$32,670	$46,670
	LCFS REVENUE	$3,110	$10,890	$15,560
	TOTAL ANNUAL OPEX	$32,040	$73,390	$85,210
	TOTAL OPEX PER PHASE	**$128,160**	**$440,340**	**$511,260**
	TOTAL OPEX		**$1,079,760**	

Napa Building (1056 S Main St, Angels Camp)

Currently, no fleet vehicles are assigned to this site. The building that occupied site was demolished to build a new two-story parking structure that will serve the local community, visitors to Utica Park, as well as to provide EV charging for the City's fleet.

A total of two low-output dual-port and one medium-output dual-port Level 2 chargers are recommended at this site. These chargers should be installed during implementation Phase 1 as part of the two-story parking structure's construction.

It is recommended to install at least a 200 Amp, single-phase service to provide power to these EV chargers. The chargers should be installed in close proximity to the electrical service to reduce overall construction costs.

Because this will be a new facility, no drawings of these chargers are included as part of this plan but will instead need to be included in the facility's design process.

TABLE 23: CHARGER CAPITAL AND OPERATIONAL EXPENSE ESTIMATES AT THE CITY OF ANGELS CAMP'S OLD NAPA BUILDING PROPERTY

		PHASE 1: 2025-2028	PHASE 2: 2029-2034	PHASE 3: 2035-2040
CHARGER INSTALLATIONS		• 2 dual-port low-output Level 2 stations • 1 dual-port medium-output Level 2 station	-	-
CAPEX	CHARGERS	$34,100	-	-
	MATERIALS	$58,200	-	-
	CIVIL/LANDSCAPING	$9,400	-	-
	PERMITS	$,7500	-	-
	UTILITY UPGRADES	$67,900	-	-
	CONTRACTING/DESIGN	$35,800	-	-
	TOTAL CAPEX PER PHASE	**$212,900**	**-**	**-**
	TOTAL CAPEX		**$212,900**	
ANNUAL OPEX	DEPRECIATION	$2,938	$2,938	$2,938
	ROUTINE MAINTENANCE	$969	$969	$969
	CORRECTIVE MAINTENANCE	$300	$300	$300
	SOFTWARE LICENSING	$1,200	$1,200	$1,200
	NETWORKING FEES	$1,020	$1,020	$1,020
	POTENTIAL KWH FEE	$260	$650	$1,040
	ELECTRICITY EXPENSES *	$10,440	$26,100	$41,760
	LCFS REVENUE	-$3,480	-$8,700	-$13,920
	TOTAL ANNUAL OPEX	$13,650	$24,480	$35,310
	TOTAL OPEX PER PHASE	**$54,600**	**$146,880**	**$211,860**
	TOTAL OPEX		**$413,340**	

* Assuming an increase in charger utilization over time: 2 hours per day during Phase 1, 5 hours per day during Phase 2, 8 hours per day during Phase 3. If the City makes these chargers available to the public, electricity expenses could be fully, partially, or over-recouped by charging users an appropriate per-kWh fee. As documented in the assumptions in **Appendix G**, the provided estimates are based on an average effective electricity rate of $0.40 per kWh charged by the Calaveras Public Power Agency.

Utica Park

One (1) dual-port low-output Level 2 charger is recommended for installation at this park. The site is currently undergoing significant renovations as part of the **Utica Park Site Improvement Project (Project #23-07.06)**. As part of this construction, a new 3-inch conduit will be installed from the existing 200A electrical panel to the parking spaces designated for EV charger installation. Dedicated wiring to power the dual-port low-output Level 2 charger will be routed through this conduit from the electrical panel.

A total of two (2) existing parking stalls will be designated for EV charging:

1. Non-ADA Stall: One (1) stall will be restriped and clearly marked with signage indicating "EV Charging Only."
2. ADA Van-Accessible Stall: The other stall will be configured as an ADA-compliant van-accessible space with EV charging capability.

This plan integrates EV charging infrastructure into the park's renovation project while meeting accessibility requirements and ensuring efficient use of parking spaces.

Appendix H shows the conceptual layout plans, quantity, and electrical infrastructure for the location.

TABLE 24: CHARGER CAPITAL AND OPERATIONAL EXPENSE ESTIMATES AT THE CITY OF ANGELS CAMP'S UTICA PARK

		PHASE 1: 2025-2028	PHASE 2: 2029-2034	PHASE 3: 2035-2040
CHARGER INSTALLATIONS		• 1 dual-port low-output Level 2 station	-	-
CAPEX	CHARGERS	$8,900	-	-
	MATERIALS	$9,100	-	-
	CIVIL/LANDSCAPING	$1,900	-	-
	PERMITS	$7,500	-	-
	UTILITY UPGRADES	-	-	-
	CONTRACTING/DESIGN	$4,700	-	-
	TOTAL CAPEX PER PHASE	**$32,100**	**-**	**-**
	TOTAL CAPEX		**$32,100**	
ANNUAL OPEX	DEPRECIATION	$1,120	$1,120	$1,120
	ROUTINE MAINTENANCE	$390	$390	$390
	CORRECTIVE MAINTENANCE	$300	$300	$300
	SOFTWARE LICENSING	$1,200	$1,200	$1,200

	PHASE 1: 2025-2028	PHASE 2: 2029-2034	PHASE 3: 2035-2040
NETWORKING FEES	$1,020	$1,020	$1,020
POTENTIAL KWH FEE	$260	$260	$260
ELECTRICITY EXPENSES	$2,710	$6,890	$10,440
LCFS REVENUE	-$910	-$2,300	-$3,480
TOTAL ANNUAL OPEX	$5,980	$8,870	$11,320
TOTAL OPEX PER PHASE	**$23,920**	**$53,220**	**$67,920**
TOTAL OPEX		**$145,060**	

* Assuming an increase in charger utilization over time: 2 hours per day during Phase 1, 5 hours per day during Phase 2, 8 hours per day during Phase 3. If the City makes this charger available to the public, electricity expenses could be fully, partially, or over-recouped by charging users an appropriate per-kWh fee. As documented in the assumptions in **Appendix G**, the provided estimates are based on an average effective electricity rate of $0.40 per kWh charged by the Calaveras Public Power Agency.

APPENDICES

DKS

428 J STREET, SUITE 340 • SACRAMENTO, CA 95814 • 916.368.2000 • DKSASSOCIATES.COM

CONTENTS

APPENDIX A. DATA COLLECTION PLAN

APPENDIX B. STAKEHOLDER COLLABORATION AND ENGAGEMENT PLAN

APPENDIX C. OVERVIEW OF FLEET EV CHARGING STRATEGIES

APPENDIX D. FUNDING OPPORTUNITIES

APPENDIX E. STRATEGIES AND RECOMMENDATIONS RELATED TO EVS AND EV CHARGERS

APPENDIX F. BACK-UP POWER AND RESILIENCY

APPENDIX G. COST ESTIMATES ASSUMPTIONS

APPENDIX H. CONCEPTUAL CHARGER INSTALLATION LAYOUT PLANS

APPENDIX A. DATA COLLECTION PLAN

OVERVIEW

Data collection is a crucial step in any electric vehicle (EV) transition process. This information is used to directly inform planning and engineering assumptions, goals, and facilitate an ongoing dialogue about next steps.

PROCESS

The approach is based on best practices and lessons learned from similar projects. The DKS and Frontier teams have over time created a more streamlined process to make the best use of time and to minimize the requirements and resources from Calaveras County staff.

The steps for the data collection plan include:

1. Provide a vehicle and facilities data collection template to the client to complete
2. Validate and clean the data provided in the filled-out template, working with the client on any gaps
3. Consider which internal combustion engine (ICE) vehicles are candidates for transitioning to EVs considering aspects such as duty cycles, mileage, and cost versus utility
4. Identify suitable EV surrogates for estimating electrical loads of future replacement vehicles for charging planning purposes
5. Develop a phased transition plan around client goals and needs
6. Assess and identify facilities for suitable EV charging
7. Consider other aspects of fleet transition process such as total cost of ownership analysis and/or rightsizing, if requested
8. Continue ongoing discussions throughout the process to best align expectations

VEHICLE AND FACILITY DATA

Ideal vehicle information included within the template include variables such as VIN, make, model, year, daily or yearly mileage, maintenance and/or vehicle purchase costs, fuel usage, as well as duty cycle. Other data points such as where the vehicle is parked, if it is owned or leased, what department it is operated and managed by, and notes about configuration go a long way to providing a more robust and accurate transition plan.

Additionally, facility information is an important aspect of the data collection plan. This includes the last year (or more) of electrical meter readings from the electric utility to determine baseline energy use per facility, any planned building changes and/or vehicle charging stations, and as-built engineering drawings.

TIMELINE

The expected timeline for data collection can vary greatly depending upon the size of the fleet, number of facilities (and number of departments/managers), and client goals.

At the time of this writing, the schedule for this project is being updated to accommodate scope refinements. Data collection will be included in the updated schedule.

APPENDIX B. STAKEHOLDER COLLABORATION AND ENGAGEMENT PLAN

OVERVIEW

Transitioning to a new transportation technology is both exhilarating and overwhelming, therefore the DKS and Frontier team take a human-centered approach to all of our ZEV projects. We expect and encourage interaction with employees, community-based organizations, business associations, residents, and businesses throughout the project.

Stakeholder collaboration and engagement is important because the people who will use and interact with the EVs and their new stations need to be involved in the decisions, not informed about them later.

STAKEHOLDER ENGAGMENT

To facilitate stakeholder involvement, the DKS team will support the County project manager to establish a Project Advisory Committee (PAC). These typically include agency departments such as fleet and facility managers, department leads, executive offices, a sustainability office, and sometimes a procurement and/or a board representative.

We highly encourage participation from people or agencies that focus on equity and economic development, although they may not attend all PAC meetings.

PROCESS

Frontier Energy will schedule and facilitate at least three (3) meetings with County staff and the PAC, with a portion of the first meeting set aside to establish public stakeholders and an advisory list. The Stakeholders will have an opportunity to provide their initial ideas and recommendations through two (2) meetings, including input on the draft report.

The goals in each meeting will be to ensure that everyone understands the fleet transition planning process and can raise any questions or concerns. The project team will provide toolkits and resources that Calaveras County can offer to its residents, businesses, and nonprofit organizations. These will include information to help make sense of the transition such as grant, incentive, voucher, or pilot projects as they become available.

At the end of the project, the team will create a PowerPoint presentation with narrative about the plan, and this will be presented at the second public stakeholder meeting.

TASK BREAKDOWN

This breakdown includes the overall list of subtasks associated with Task 2, Stakeholder Collaboration and Engagement, as written in the scope of work.

- 2.1 PAC Meeting 1: Formation of Project Advisory Committee and Kickoff Meeting
    - 2.1.1 Gather information from Fleet and Facility staff for information on vehicle usage, needs and plans for fleet and facility changes

    - 2.1.2 Gather information from departmental managers regarding charging operations, especially for mission-critical vehicles
    - 2.1.3 Identify training needs for the County's mechanic staff
    - 2.1.4 Gather information on number and type of facilities to be evaluated
- 2.2 Stakeholder Group Meeting 1: Gather initial ideas and recommendations
- 2.3 PAC meeting 2: Discuss initial DKS recommendations
- 2.4 PAC Meeting 3: to discuss draft plan
- 2.5 Stakeholder Group Meeting 2: Gather input on draft report
- 2.6 Public workshop/presentation of final report
-
- **Deliverable 1: Stakeholder Advisory list**
- **Deliverable 2: Stakeholder Advisory Group agendas, minutes, presentations, and action items**
- **Deliverable 3: 6 meetings total; 3 PAC, 2 Stakeholder and 1 Public**

APPENDIX C. OVERVIEW OF FLEET EV CHARGING STRATEGIES

INTRODUCTION

The purpose of this appendix is to provide an overview of possible charging strategies for future electric vehicles (EVs) in the City and County's fleets. The project team assessed these alternative charging strategies, given fleet operational needs. The following provides an overview of the operational workings, benefits, and disadvantages of both a dedicated and a shared charging strategy.

This appendix evaluates two primary charging strategies:

1. *Dedicated* strategy with dedicated Level 2 charging ports with load management
2. *Shared* strategy with shared Level 2 chargers with smart charging software

SMART CHARGERS AND LOAD MANAGEMENT

Load management is software used by so-called "smart" or "managed" chargers that are connected to the internet via WiFi, cell or ethernet with the ability to communicate, collect data and be remotely managed.

Smart chargers can reduce the maximum power draw to avoid or mitigate needed electrical service upgrades or utility demand charges by splitting or balancing the power between chargers (load splitting or balancing), or load management systems. These systems allow fleet operators to control when and how each fleet EV is charged by distributing power between chargers.

By utilizing a load management system, certain facilities may be able to avoid the need for electrical service upgrades. Additionally, since load management can integrate with a building's electrical system, facility upgrades that conserve electricity, such as replacing windows, installing air barriers, or upgrading lighting to multi-level LED can significantly increase capacity for vehicle charging at fleet parking garages that share their electrical systems with buildings.

An additional benefit of smart chargers is their ability to collect data on charging, which is useful for informing future planning, for monetizing Low Carbon Fuel Standard (LCFS) credits, and other needs. Many smart chargers also typically have the ability to collect and track payments from charging sessions, useful for accounting and revenue collection.

The disadvantages of networked smart chargers required for load management are higher purchase costs for the chargers themselves and the ongoing monthly data and service costs that can vary depending on the individual system architecture and quantity of chargers.

By comparison, so-called "dumb" chargers lack data collection and connectivity and thus do not feature any advanced capabilities such as load management or sharing, demand response, or comprehensive user and data interfaces. While dumb chargers may be used under a dedicated charging strategy, we typically recommend fleets deploy so-called "smart" chargers to facilitate managed charging. Such chargers, which feature the aforementioned capabilities, have become the quasi-standard in the industry and allow the fleet operator to track charging data and manage charger power outputs based on desired parameters including each EV's state-of-charge, shift start times, and power constraints.

For these reasons, we recommend use of smart chargers for both dedicated or shared charging as explained below.

STRATEGY WITH DEDICATED LEVEL 2 CHARGERS

The basic way to charge a fleet is with individual chargers dedicated to each vehicle in the fleet. This approach to charging typically requires each fleet EV to be assigned a parking stall and that each parking stall be equipped with its own Level 2 charger.

OPERATIONS

From the driver's perspective, vehicle users pick up the fleet EV at the assigned stall, manually disconnect the charger before driving, and later return the EV to the same assigned stall and reconnect the charging cord.

Fleet or facility managers would be able to monitor EV charging in real-time and have the ability to prioritize charging of certain EVs or adjust the power distribution between EV charging and the building or other loads.

BENEFITS

Of the different charging strategies considered, dedicated smart charging provides the most operational simplicity while also providing data and the ability to manage electrical loads. The primary benefits of dedicated Level 2 charging include:

- Enhanced ability to charge medium- and heavy-duty fleet vehicles with light or variable duty cycles and provides charging flexibility.
- A charger to EV ratio of 1:1 will optimize the benefits of bidirectional charging for fleet vehicles with bidirectional charging capability for providing backup power to facilities, fleet EVs and generating grid services revenue through vehicle-to-grid-integration.

DISADVANTAGES

The main disadvantages of dedicated chargers include cost inefficiency and construction impacts. A ratio of one charger per parking stall or per EV requires installation of numerous electrical outlets or chargers which is generally inefficient because each charger would typically be in use for charging only a relatively small fraction of the time. Compared to sharing chargers, this can potentially be a costly approach due to the expense of procuring and installing more chargers. In addition, Chapter 6 of Section 625 of the National Electrical Code (NEC) requires a dedicated single pole circuit breaker for each 110 V outlet (used by Level 1 chargers) or 220 V Level 2 charger. Depending on the number of EVs to charge, this can easily exceed the capacity of each facility's main electrical panel, requiring installation of subpanels. As a result, many medium-sized and most large fleet facilities will typically require costly electrical service upgrades including a new electrical panel or subpanel to comply with this requirement.

Of the two charging strategies considered, dedicated smart chargers can be the most costly strategy due to the higher cost of purchasing and installing more chargers coupled with the expense of larger electrical service upgrades, conduit and wire installation as well as site restoration.

GENERAL RECOMMENDATIONS

Dedicated chargers generally make the most sense in fleet depot facilities with ample power supply where relatively large numbers of heavily utilized light duty EVs with long dwell times will be domiciled in assigned parking stalls.

STRATEGY WITH SHARED LEVEL 2 CHARGERS

At facilities with shared chargers, a reduced number of Level 2 chargers are installed to serve all the fleet EVs domiciled by rotating vehicles between chargers, in other words taking turns charging. Based on relatively low use/mileage (miles/day) and parking durations (12-16 hours), this should be generally feasible for most EV fleets operated by public agencies.

OPERATIONS

This can be accomplished by rotating parking assignments, or by installing the chargers centrally between parking stalls so that each charger can access multiple EVs simply by moving the charge cord from vehicle to vehicle. Not needing to charge their batteries every night means fleet EVs could passively share chargers by taking turns based on a schedule or through active management depending on each vehicle's state of charge.

Additionally, one or more shared DC fast chargers could potentially supplement shared Level 2 chargers[30] at fleet facilities with multiple light-, medium-, and heavy-duty EVs in the future as EV fleets diversify with the addition of heavier vehicle classes. In cases where dwell times are limited to less than eight hours, the anticipated duration of charging may still be sufficient to charge the fleet if there is a relatively small number of EVs, the EVs are light or medium-duty with small batteries, or their typical daily mileage is relatively low.

BENEFITS

The primary benefits of sharing chargers include mitigating potential electric service upgrade costs and reducing initial investment costs associated with the procurement and installation of chargers since a reduced number of individual chargers is required. This approach is also useful to leverage the constrained electrical capacity of certain sites to install more chargers that would share the limited electrical service by managing (or balancing) the load.

In cases where fleet chargers are also used for workplace or public charging, the utilization of shared chargers also simplifies the operational workings of a potential charger sharing with personal EVs. Chargers and their associated software could distinguish between fleet EVs and personally-owned vehicles in charging sessions, for example by equipping fleet vehicle drivers with suitable RFID cards that ensure the respective department or group pays for the right charging sessions. Employees who would like to charge their personal EVs on the same charging stations would instead need to pay via credit card or by using the respective charger vendor's app, unless Calaveras County or the City of Angels Camp would allow its employees or other users to charge

[30] See section on "Supplemental DC Fast Chargers" for more detail.

their personal vehicles for free. This way, employees are not bound to specific, dedicated charging stations and parking stalls.

DISADVANTAGES

Operational logistics: Sharing chargers requires careful management of fleet EVs to ensure that all vehicles maintain a sufficient state of charge for their intended daily use. If the vehicles or the charge cords would need to be moved, behavioral adjustment by fleet vehicle drivers or by dedicated fleet or parking management staff or contractors would be needed which increases operation costs. However, in many fleets, most vehicles only need to be charged every few days, and this can be done overnight, as visualized in **Figure 4** of this report. In this case, there are no costs for dedicated fleet or parking management staff. Still, charging sessions need to be planned or scheduled to ensure each fleet EV maintains sufficient charge for its mission.

GENERAL RECOMMENDATIONS

Sharing chargers makes the most sense under the following circumstances:

- Fleet facilities that serve fleet EVs that typically drive less than 40 miles per day and have dwell times longer than eight hours.
- Fleet facilities with limited available electrical capacity to avoid the expense of electrical service upgrades.
- Fleet facilities at which a schedule could be introduced according to which typical daily vehicle charging needs can be met (with extraordinary charging needs to be met by supplemental DC fast chargers)
- Fleet facilities lacking assigned parking

TYPICAL CAPITAL COST DIFFERENCES BETWEEN DEDICATED AND SHARED CHARGERS

Based on DKS' extensive fleet electrification planning and design experience, *dedicated* chargers are typically 50-250% more expensive to deploy than *shared* chargers, given the common need for electrical service upgrades. The lower end of that range would apply for facilities at which no major electrical system upgrades are needed. The higher end of that range applies when upgrades such as on the transformer, switchboard, or panel level are necessary. Electrical upgrades can be substantially more expensive when attempting to provide dedicated chargers for each fleet EV than when sharing a smaller number of chargers between EVs.

While at many fleet facilities the existing electrical panels may support a limited number of Level 2 charging stations (say, 2-3 low-output dual-port stations), deploying more chargers (as required by the dedicated strategy) would incur expensive electrical upgrades involving new panels, switchboards, and/or transformers. Additionally, such upgrades substantially delay the process of providing charging infrastructure for new fleet EVs given frequent delays in the provision of utility-side upgrades and the procurement of the mentioned electrical hardware.

TABLE 25: SUMMARY TABLE: OVERVIEW OF GENERAL CHARGING STRATEGIES SUITABLE FOR EV FLEETS

	DEDICATED LEVEL 2 CHARGERS	SHARED LEVEL 2 CHARGERS
OPERATIONS	• Drivers manually connect and disconnect the vehicle to and from the charger upon returning to the vehicle and before using it, respectively • For fleet and facility managers: ability to monitor EV charging in real-time, ability to prioritize certain vehicles or adjust or limit power output	• Rotate parking assignments or install chargers between parking stalls so that they can be accessed by multiple vehicles • Take turns or follow schedule for charging vehicles (not charging every day or night) • A shared DC fast charger could supplement depot charging at large facilities that house a diverse vehicle fleet
BENEFITS	• Most operational simplicity • Enhanced ability to charge medium- and heavy-duty vehicles • Optimal utilization of capabilities of bidirectional charging	• Mitigated potential electric service upgrades • Reduced initial investments costs for procurement and installation of chargers • Leverage constrained electrical service at certain sites
DISADVANTAGES	• Resource inefficiency • Large infrastructure investments • Large construction impacts	• Requires careful management of fleet EVs and their SOC • Requires behavioral adjustment by fleet vehicle drivers (as vehicles and/or charge cords need to be moved) or dedicated fleet staff or contractors which increase operation costs • Requires more planning around when and where which numbers of chargers need to be in place
GENERAL RECOMMENDATIONS AND SUITABLE USE CASES	• Fleet depot facilities with limited power supply and a relatively large number of heavily-utilized light-duty EVs with long dwell times	• Facilities that serve fleet EVs that typically drive less than 40 miles per day and have dwell times longer than eight hours • Facilities with limited available electrical capacity to avoid the expense of electrical service upgrades • Facilities at which a schedule could be introduced according to which typical daily vehicle charging needs can be met

SUPPLEMENTAL DC FAST CHARGERS

In addition to a recommended set of Level 2 charging stations for regular baseload charging operations (whether in a dedicated or shared strategy), high-power DC fast charging infrastructure may be used to supplement Level 2 charging in order to provide additional resilience in the form of charging capacity and speed. Specifically, supplemental DCFCs are recommended at larger fleet facilities where larger concentrations of fleet EVs are domiciled, especially for medium- and heavy-duty fleet EVs and/or mission critical assets, such as at Public Works corp yards and police departments.

In addition to DC Fast Chargers installed at fleet facilities, there may be publicly available DC Fast Chargers operated by commercial charging networks such as EVGo, Electrify America, Tesla, and others convenient to fleet operations. Thanks to recent federal and state funding, more chargers are being installed, especially NEVI-funded clusters of four 150 kW DC Fast Chargers located within one mile of freeway interchanges on designated Alternative Fuel Corridors.

Potential **benefits** of supplemental DCFCs include:

- **Resiliency:** If an overnight power outage or a malfunction of individual Level 2 chargers prevents fleet EVs from obtaining a full state of charge.
- **Charging capacity contingency:** Supplemental DCFCs can help meet each fleet EV's charging needs even in events of unexpected, high demand. This may be the case on days or weeks where fleet EVs are assigned additional duties beyond "average" duty cycles, such as when vehicles would need to embark on a longer trip or tow a trailer.
- **Fool proofing:** Supplemental DCFCs can mitigate the impacts of human error. If drivers forget to plug their EVs into the L2 charger overnight, they can quickly charge up at the DCFC.
- **Opportunity charging:** Staff with fleet EVs parked at one site can use the supplemental DCFC at another if needed, since these chargers are not assigned to any specific vehicles and can charge in a short time.
- **Address range anxiety:** DC fast charging infrastructure can also help mitigate fleet EV drivers' concerns regarding the driving range of their EV and occasional need to quickly top off the battery state-of-charge.
- **Public benefit and revenue:** When not in use by fleet EV drivers, DCFCs could be made available to other EV drivers depending on the charger's location for employees, other agencies and the general public. Charging revenues collected from these other users can offset program costs.

Disadvantages of supplemental DCFCs may include:

- **Additional costs:** Compared to L2 chargers, DCFCs are significantly more expensive to purchase and maintain.

Potential redundancy: If the recommended charger strategies work as intended, supplemental DCFCs may not be used as much as anticipated, which could undermine the justification of the significant investment in the first place. If such a situation were to occur, it could possibly be addressed by repurposing the chargers for other uses, such as employee or public charging.

APPENDIX D. FUNDING OPPORTUNITIES

INTRODUCTION

In the state of California, funding opportunities for EVs and EV chargers continue to grow rapidly. Covered expenses typically include the purchase or lease of EVs, the purchase and installation of charging infrastructure, and expenses for hydrogen fuel cell electric vehicles (FCEVs) and their refueling infrastructure. Multiple funding opportunities exist federally as well as in several states, with eligible applicants ranging from private customers, state and local government agencies, tribal governments, school districts, transit agencies, utilities, fleet owners and operators, ports, and in some cases vehicle dealers and charging infrastructure vendors. Funding programs typically have a fixed term and a limited allocation of funds. However, the range of funding options has vastly expanded over the past couple of years and especially in the past few months. Information on specific programs can change quickly and we encourage CCOG to monitor and identify funding sources timely and carefully.

Incentive programs have very specific requirements for applications, including specific requirements for eligible vehicles and charging equipment, data reporting, and special considerations for public fleets. Some programs are very competitive and "sell out" quickly and others take time and persistence.

This appendix serves as an overview of the most relevant programs with substantial funding resources. Numerous other funding opportunities related to electric vehicles and their charging infrastructure exist in addition to those mentioned.

FEDERAL FUNDING

ALTERNATIVE FUEL INFRASTRUCTURE TAX CREDIT

The Alternative Fuel Infrastructure Tax Credit offers tax incentives for the installation of fueling equipment for various alternative fuels. Starting January 1, 2023, eligible fueling equipment qualifies for a tax credit of 30% of the cost or 6% in the case the property is subject to depreciation with a maximum limit of $100,000. Projects meeting wage and apprenticeship requirements can get the full 30% credit, regardless of depreciation status. Certain census tract requirements must also be met for installation locations. This credit does not include permitting and inspection fees and can be used at multiple locations by station owners. Unused credits can be carried back one year or forward for up to 20 years.[31]

COMMERCIAL ELECTRIC VEHICLE (EV) AND FUEL CELL ELECTRIC VEHICLE (FCEV) FEDERAL TAX CREDIT

Starting January 1, 2023, businesses and tax-exempt organizations can qualify for a tax credit when purchasing new Electric Vehicles (EVs) and Fuel Cell Electric Vehicles (FCEVs). The eligibility criteria depend on the vehicle's Gross Vehicle Weight Rating (GVWR): EVs and FCEVs with a GVWR

[31] https://afdc.energy.gov/laws/10513

below 14,000 lbs. need a battery capacity of at least 7 kWh, while those above 14,000 lbs. require a minimum of 15 kWh. The tax credit amount is determined as the lesser of three options:

- 15% of the vehicle's purchase price for plug-in hybrid electric vehicles
- 30% of the purchase price for EVs and FCEVs,
- The incremental cost compared to a similar internal combustion engine vehicle

The maximum credit is capped at $7,500 for qualified vehicles under a GVWRs of 14,000 pounds and $40,000 for those over a GVWR of 14,000 pounds. This tax credit cannot be combined with the Clean Vehicle Tax Credit.[32]

ENERGY EFFICIENCY AND CONSERVATION BLOCK GRANT (EECBG)

The U.S. Department of Energy (DOE) provides grants through the Energy Efficiency and Conservation Block Grant (EECBG) Program to support initiatives aimed at reducing energy consumption and fossil fuel emissions in the transportation sector. Eligible projects include conservation programs, financing for energy-efficient and environmentally friendly transportation infrastructure, and incentive programs for the purchase and installation of energy-efficient, renewable energy, and zero-emission transportation infrastructure. The grants are available to U.S. territories, and state, local, and tribal governments.[33] The EECBG program currently has $550 million in available funding until expended. Awarded funds are determined through formula and competitive grant applications.

REBUILDING AMERICAN INFRASTRUCTURE WITH SUSTAINABILITY AND EQUITY (RAISE) GRANT

The USDOT's Rebuilding American Infrastructure with Sustainability and Equity (RAISE) grant program offers federal financial assistance for surface transportation infrastructure projects. The program operates annually and has $1.5 billion in funding available for the 2024 cycle. Eligible projects encompass various areas such as supporting connected, electric, and autonomous vehicles, facilitating modal shifts for freight and passengers, and installing zero-emission vehicle infrastructure. Eligible applicants include U.S. territories, states, local, and tribal governments, as well as transit agencies, port authorities, metropolitan planning agencies, and other government subdivisions. The funds will be split equally between urban and rural areas with a minimum of $15 million reserved for areas of persistent poverty of historically disadvantaged communities. Projects will be eligible for up to a 100% federal cost share.[34]

[32] https://www.irs.gov/credits-deductions/commercial-clean-vehicle-credit

[33] https://www.energy.gov/scep/energy-efficiency-and-conservation-block-grant-program

[34] https://www.transportation.gov/RAISEgrants

SUMMARY OF FEDERAL FUNDING

Table 26 summarizes federal funding sources.

TABLE 26: SUMMARY OF FEDERAL FUNDING SOURCES

SOURCE	PROGRAM/AWARD NAME	ELIGIBLE APPLICANTS	CATEGORY	APPLICATION TYPE	BENEFITING DISADVANTAGED OR LOW-INCOME COMMUNITIES	FUNDING AMOUNT
THE U.S. DEPARTMENT OF ENERGY	Commercial Electric Vehicle (EV) & Fuel Cell Electric Vehicle (FCEV) Federal Tax Credit	Businesses & Tax-Exempt Organizations	Purchase of new Electric Vehicles (EVs) & Fuel Cell Electric Vehicles (FCEVs).	N/A – Tax Credit	N/A	$7,500
THE U.S. DEPARTMENT OF ENERGY	Energy Efficiency and Conservation Block Grant (EECBG)	U.S. territories, and state, local, and tribal governments	ZEV Infrastructure	Competitive Grant	N/A	$550 Mil until expended
REBUILDING AMERICAN INFRASTRUCTURE WITH SUSTAINABILITY AND EQUITY (RAISE) GRANT	RAISE Grant	U.S. territories, and state, local, and tribal governments, transit agencies, port authorities MPAs and other gov. subdivisions	ZEV Infrastructure	Competitive Grant	Minimum of $15 million reserved for areas of persistent poverty of historically disadvantaged communities.	Projects will be eligible for up to a 100% federal cost share

STATE-SPECIFIC CALIFORNIA PROGRAMS

The following incentive programs and projects are specific to California, administered and/or funded by state agencies, such as the California Air Resources Board (CARB)[35] or the California Energy Commission (CEC).[36] Some of the funding available in California-specific programs derives from revenue continually generated in the state's greenhouse gas emissions cap-and-trade program[37] or the Low Carbon Fuel Standard (LCFS), other funding comes from federal grants and is distributed by state agencies.[38]

As with all funding opportunities, programs can change quickly and it is therefore recommended they be checked often. Resources include:

- California Governor's Office of Business and Economic Development (GO-Biz) ZEV Funding Resources library: https://business.ca.gov/industries/zero-emission-vehicles/zev-funding-resources/
- CalStart: https://fundingfindertool.org/planning-grants/
- Drive Clean: https://driveclean.ca.gov/search-incentives

At the state level, three primary agencies provide funding for transportation electrification:

- The California Energy Commission (CEC): https://www.energy.ca.gov/funding-opportunities
- The California Department of Transportation (CalTrans): https://dot.ca.gov/programs/budgets/state-transportation-grants
- The California Air Resources Board: https://ww2.arb.ca.gov/our-work/topics/incentives

COMMUNITIES IN CHARGE (FUNDING WAVE 3)

Overview

Communities in Charge is a state-funded initiative under the Clean Transportation Program of the California Energy Commission, administered by CALSTART. Its goal is to expand electric vehicle (EV) accessibility, stimulate emerging markets, and accelerate the deployment of Level 2 EV charging stations across California. Aligned with California Climate Investments, the program prioritizes equitable deployment of charging infrastructure in underrepresented communities,

[35] California Air Resources Board: https://ww2.arb.ca.gov/

[36] California Energy Commission: https://www.energy.ca.gov/

[37] California Air Resources Board: Cap-and-Trade Program: https://ww2.arb.ca.gov/our-work/programs/cap-and-trade-program

[38] California Air Resources Board: Low Carbon Fuel Standard: https://ww2.arb.ca.gov/our-work/programs/low-carbon-fuel-standard

including disadvantaged communities (DACs), low-income communities (LICs), and Tribal Nations. At least 50% of funding is allocated to benefit these populations[39].

Funding Wave 3 provides $30 million in incentives, with allocations distributed across Northern, Southern, Central, and Eastern regions to foster geographic equity. These allocations are based on population, DAC/LIC representation, and historical funding trends. The program emphasizes swift deployment while offering technical assistance and targeted outreach to help applicants navigate the process. Applicants have from **November 14, 2024, to January 31, 2025,** to submit their applications through the online Incentive Processing Center (IPC).

Eligible applicants include property owners, authorized lessees, and representatives who have incurred costs for installing Level 2 EV charging stations at qualified sites. Publicly accessible chargers must operate for a minimum of 18 hours per day, seven days a week. Single-family homes, duplexes, triplexes, individual townhomes, mobile homes, school bus charging sites, and already completed projects are not eligible for incentives.

A summary of incentives can be found in **Table 27**. The program offers a tiered incentive structure, with a base incentive of up to $6,500 or 100% of eligible costs per charging port, whichever is less. Additional incentives are available for specific projects, including $2,000 per port for multi-family housing and $3,500 per port for Tribal projects. However, no single entity may receive more than 25% of the total funding. Participants may not combine ("stack") these incentives with other state or local EV funding programs but may still benefit from federal tax credits and California's Low Carbon Fuel Standard (LCFS) program.

Applications are evaluated based on project readiness, categorized into tiers:

- **Tier 1**: Projects with completed site design, permits, and equipment (highest readiness).
- **Tier 2** and **Tier 3**: Projects at progressively earlier stages of development.

Funding is awarded on a first-come, first-served basis, with ties resolved by lottery. At least 50% of funding is reserved for projects located in disadvantaged or low-income communities.

TABLE 27: SUMMARY OF COMMUNITIES IN CHARGE INCENTIVES

ELIGIBLE INCENTIVES FOR LEVEL 2 EVSE	AMOUNT PER ELIGIBLE CHARGING PORT
BASE INCENTIVE	Up to $6,500, or 100% of eligible costs, whichever is less
MULTI-FAMILY HOUSING PROJECT SITE	Additional $2,000 towards eligible costs

[39] Communities in Charge. (2024). *Communities in Charge Implementation Manual: Funding Wave 3* [PDF]. Retrieved from https://thecommunitiesincharge.org/wp-content/uploads/2024/11/Communities-in-Charge-Implementation-Manual-Funding-Wave-3-ADA.pdf

PROJECT SITE FOR TRIBAL GOVERNMENT, TRIBAL ENTITY, OR NON-GOVERNMENTAL ORGANIZATIONS SERVING TRIBAL COMMUNITIES	Additional $3,500 towards eligible costs

EligIble Costs

A summary of eligible and ineligible costs is provided in **Table 28** below.

TABLE 28: SUMMARY OF ELIGIBLE AND INELIGIBLE COSTS

CATEGORY	ELIGIBLE COSTS	INELIGIBLE COSTS
EQUIPMENT COSTS	• EV supply equipment (EVSE) • Electrical panels • Transformers • Demand management equipment • Lighting for EV ports • On-site signage related to EV chargers • Security cameras for EV ports	• Administrative costs associated with completing application paperwork, phone calls, and tasks relating to the submission of program required materials to the Incentive Processing Center (IPC) • Upgrades to utility-owned electrical infrastructure (the percentage of total costs covered by the utilities) • Permitting fees paid to Authorities Having Jurisdiction (AHJs) • Costs to fund stand-alone energy generation, such as Battery Energy Storage Systems (BESS) or Photovoltaic (PV) solar. • Profit to the Applicant organization • Costs associated with ensuring compliance with state or federal building codes, including provisions of the California Green Building Standards Code requiring the installation of a minimum amount of electric vehicle supply equipment, EV Capable, or EV Ready parking spaces
MATERIALS & MISCELLANEOUS	• Wire and conduit • Bollards • Concrete and asphalt • Paint • Construction fencing (around installation site)	
SERVICE COSTS	• Warranties from OEM (up to $400/year per port) • Service Level Agreements (SLAs) for maintenance/repair (up to $400/year per port) • Networking agreements (up to $250/year per port) • Cellular/internet service for operation months covered under networking agreement • Security camera monitoring services • Demand management software	
UTILITY COSTS	• Utility upgrades necessary for EVSE installation with documentation and	

	compliance with utility program requirements	• Costs associated with Design, Engineering and Planning Labor
PLANNING & ENGINEERING COSTS	• ADA Site upgrades due to EV deployment • Architectural studies, site surveys, and engineering design • California sales tax • Shipping and handling	• Stub-outs/make ready • Direct Labor, fringe benefits, and indirect (overhead and general/administrative costs) • Travel costs • Lease payments for EV charging spaces • Land valuations for EV charging spaces • Self-Invoicing

Source: *Communities in Charge. (2024). Communities in Charge Implementation Manual: Funding Wave 3 [PDF]. Retrieved from* https://thecommunitiesincharge.org/wp-content/uploads/2024/11/Communities-in-Charge-Implementation-Manual-Funding-Wave-3-ADA.pdf

Recommendation to Calaveras COG, Calaveras COunty, and the City of Angels Camp

As local governments and with project sites assessed as part of the Calaveras COG Electric Vehicle Charging Infrastructure Implementation Plan, Calaveras COG, Calaveras County, and the City of Angels Camp are eligible for the base incentive amount of up to $6,500 or 100% of eligible costs, whichever is less, per installed Level 2 charging port. Each dual-port Level 2 station, many of which are recommended to the County and City fleet for installation as part of the plan, counts as two ports and would thus qualify for an incentive amount of up to $13,000.

Based on the program requirements, sites may be for private, public, or mixed use to allow flexibility for the site hosts. As such, the County or City could choose to focus on fleet-only charging infrastructure or provide shared access to the charging stations for public passenger vehicles (for sites with public access). For municipal fleets, Level 2 charging stations must only be deployed for the charging of light-duty fleet vehicles. For more details, see section 2.3.7. of the Implementation Manual linked further above.

CHARGING INFRASTRUCTURE FOR GOVERNMENT FLEETS

The Clean Transportation Program of the California Energy Commission has announced a grant solicitation that offers up to $30 million for projects that focus on electric vehicle charging infrastructure for light-duty government fleets. The program aims to support the electrification of these fleets in California by providing accessible and dedicated EV charging infrastructure. The ultimate goal of this initiative is to reduce vehicle emissions, particularly in disadvantaged and low-income communities, and it aligns with local government sustainability and climate action plans.

Projects must install a minimum of 100 charging ports at fleet home bases or depots. Both Level 2 and DCFC stations are eligible. The application deadline is April 5th, 2024.[40]

HYBRID AND ZERO-EMISSION TRUCK AND BUS VOUCHER INCENTIVE PROJECT (HVIP)

The California Air Resources Board also runs the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) and administers funds through a 3rd party.[41] The program features two annual funding rounds and provides a point-of-sale rebate for medium- and heavy-duty vehicles, incl. buses, school buses, refuse trucks, step vans, straight trucks, and tractors. The program website includes a list of all eligible vehicle models, including most of the market-ready medium- and heavy-duty EVs and incentive amounts ranging from e.g. $120,000 for many Class 7 or 8 trucks and up to $395, for school buses.[42] After the Board's review in November 2023 of the changes proposed in the FY 2023-24 Funding Plan for Clean Transportation Incentives, staff will announce the public work group(s) to implement the approved program modifications. These work group(s) will be held in the first half of 2024.

ENERGY INFRASTRUCTURE INCENTIVES FOR ZERO-EMISSION (ENERGIIZE) COMMERCIAL VEHICLES

The EnergIIZE program for commercial vehicles is funded by the California Energy Commission and provides incentives for zero-emission vehicle infrastructure equipment for medium- and heavy-duty EVs and FCEVs in California. The project defines four separate funding lanes: EV Fast Track Lane, EV Jump Start Funding Lane, EV Public Charging Station Funding Lane (now closed), Hydrogen Funding Lane. The EV Jump Start Funding Lane is intended for commercial fleet operators in disadvantaged or low-income communities. Funding amounts for EnergIIZE projects range from up to a $750,000 cap per EV Jump Start project up to $3 million cap per hydrogen project. The whole program is worth $69 million, this funding lane has $13.9 million in incentives available. Eligible applicants for the EnergIIZE program include public fleets, car-sharing and rental car fleets, businesses, transit agencies, school districts, and EV-charging infrastructure vendors. Costs for the charging equipment, required electrical service upgrades and demand management equipment can be covered.[43]

Source: https://afdc.energy.gov/laws/12513

[40] https://www.energy.ca.gov/solicitations/2023-12/gfo-23-606-charging-infrastructure-government-fleets

[41] https://ww2.arb.ca.gov/our-work/programs/clean-truck-bus-vouchers-hvip/about

[42] California HVIP: https://californiahvip.org/

[43] EnergIIZE Commercial Vehicles: https://www.energiize.org/

CLEAN OFF-ROAD EQUIPMENT (CORE) VOUCHER INCENTIVE PROJECT

This incentive program focuses on off-road equipment, i.e. zero-emission vehicles and related equipment in use outside of public streets. This includes forklifts, mobile and ground power units, railcar movers, terminal tractors (e.g. at ports), transport refrigeration units, agricultural vehicles and equipment, construction vehicles, and more. CORE provides vouchers to buyers and lessees in California for eligible equipment on a first-come, first-served basis. The program also provides enhanced incentives for fleet purchases of zero-emission equipment in disadvantaged communities, with a target of allocating at least 50% of CORE funds to such communities.

CORE reopened on July 18, 2023 with $185 million available. Manufacturers, dealers, and equipment users are eligible to apply for the CORE Voucher Incentive Project. CARB also administers this project.[44] Per-vehicle voucher amounts can be seen in **Table 29** below.

TABLE 29: CORE VOUCHER FUNDING AMOUNTS

EQUIPMENT TYPE	POTENTIAL VOUCHER	POTENTIAL INFRASTRUCTURE ENHANCEMENT
ON- AND OFF-ROAD TERMINAL TRACTORS	Up to $200,000	Up to $30,000
TRUCK AND TRAILER-MOUNTED TRUS	Up to $65,000	Up to $9,000
LARGE FORKLIFTS	Up to $500,000	Up to $30,000
CARGO HANDLING EQUIPMENT	Up to $1,000,000	Up to $30,000
AIRPORT CARGO LOADERS	Up to $100,000	Up to $30,000
WIDE-BODY AIRCRAFT TUGS	Up to $200,000	Up to $30,000
RAILCAR MOVERS AND FREIGHT LOCOMOTIVES	Up to $1,000,000	Up to $30,000
MOBILE POWER UNITS AND AIRCRAFT GROUND POWER UNITS	Up to $300,000	Up to $30,000
MOBILE SHORE POWER CABLE MANAGEMENT SYSTEMS	Up to $500,000	N/A

[44] California CORE: https://californiacore.org/

COMMERCIAL HARBOR CRAFT SHORE-SIDE ELECTRIC AND HYDROGEN FUELING VESSEL SUPPLY EQUIPMENT	Up to $100,000	N/A
CONSTRUCTION EQUIPMENT	Up to $500,000	Up to $30,000
AGRICULTURAL EQUIPMENT	Up to $500,000	Up to $30,000
COMMERCIAL HARBOR CRAFT	Up to $1,000,000	N/A

Source: https://ww2.arb.ca.gov/our-work/programs/clean-off-road-equipment-voucher-incentive-project/about

SUMMARY OF CALIFORNIA FUNDING

Table 30 summarizes California funding sources.

TABLE 30: SUMMARY OF CALIFORNIA FUNDING SOURCES

SOURCE	PROGRAM/AWARD NAME	ELIGIBLE APPLICANTS	CATEGORY	APPLICATION TYPE	BENEFITING DISADVANTAGED OR LOW-INCOME COMMUNITIES	FUNDING AMOUNT
CALIFORNIA AIR RESOURCES BOARD	Charging Infrastructure for Government Fleets	Government Fleets	ZEV charging infrastructure	Application based on Eligibility	Disadvantaged Communities preference	Up to $30 million in total funding
CALIFORNIA AIR RESOURCES BOARD	Hybrid & Zero-Emission Truck & Bus Voucher Incentive Project (HVIP)	Individual owner-operators, small businesses, corporate leaders, school districts, and municipal fleets	Purchase & Sale of ZEV. Transit, Buses, Public School Buses, Drayage Trucks, Small E-Fleet	First-Come/First-Served	N/A	Vouchers Range Depending on Vehicle Class from $7,500-$400,000
CALIFORNIA ENERGY COMMISSION	Energy Infrastructure Incentives For Zero-Emission (energIIZE) Commercial Vehicles	Businesses, Organizations, Nonprofits, Or Public Transit Agencies Entities Based In California	ZEV Infrastructure	Grant Application	50%	Up to $10 Million (last round)
CALIFORNIA AIR RESOURCES BOARD	Clean Off-Road Equipment (CORE) Voucher Incentive Project	Manufacturers, dealers, and equipment users	Off Road Equipment	First come, first served	50% of funds allocated and enhanced incentives	$185 Million available in total

LOCAL AND REGIONAL PROGRAMS

PG&E EV FLEET PROGRAM

PG&E's EV Fleet program is tailored to fleet owners and operators in the process of electrifying their medium- and heavy-duty vehicle fleets. This includes school buses, transit buses, tractors, refuse trucks, agricultural equipment, and other vehicle types, and their related charging infrastructure. Up to $9,000 per vehicle and 50% of the cost of the EV chargers can be covered by PG&E under the program. Applicants must be existing PG&E customers, own or lease the relevant property on which the necessary charging infrastructure is to be installed and acquire at least two medium- or heavy-duty electric vehicles.[45]

CARL MOYER PROGRAM

The Carl Moyer Memorial Air Quality Standards Attainment Program is a partnership program between CARB and California Air Quality districts, such as the Calaveras County Air Pollution Control District. This program is voluntary and seeks to reduce emissions by funding diesel, alternative-fueled, and zero-emission replacement engines, vehicles, and equipment. Applications are evaluated on a first come-first served basis until funds are exhausted. Eligible project types include:

- Equipment & vehicle replacement
- Engine replacement (repower)
- Power system conversion
- Engine Retrofit
- Battery charging & alternative fueling infrastructure.

Eligible Project Categories include:

- Agricultural equipment
- Off-road equipment
- Locomotives
- Marine vessels and equipment
- Public school buses
- Heavy-duty trucks and transit buses
- Infrastructure

[45] PG&E: EV Fleet Program: https://www.pge.com/evfleet

SUMMARY OF LOCAL AND REGIONAL FUNDING

Table 31 summarizes local and regional funding sources.

TABLE 31: SUMMARY OF LOCAL AND REGIONAL FUNDING SOURCES

SOURCE	PROGRAM/AWARD NAME	ELIGIBLE APPLICANTS	CATEGORY	APPLICATION TYPE	BENEFITING DISADVANTAGED OR LOW-INCOME COMMUNITIES	FUNDING AMOUNT
PACFRIC GAS & ELECTRIC	EV Fleet Program	Fleet Owners & Operates, PG&E Customers	ZEV Purchase & Charging Infrastructure	N/A. Incentives & Rebates	N/A	$9,000 per vehicle, 50% of Charger Cost
CALIFORNIA AIR RESOURCES BOARD & CALAVERAS COUNTY AIR POLLUTION CONTROL DISTRICT	Carl Moyer Program	Public & Private Entities	Heavy-Duty Truck & Buses, School Buses, Transit Vehicles, Drayage Trucks, Public Agency & Utility Vehicles, Emergency Vehicles, & Solid Waste Collection Vehicles	First-Come/First-Served	N/A	Varies based on Air District

APPENDIX E. STRATEGIES AND RECOMMENDATIONS RELATED TO EVS AND EV CHARGERS

This appendix summarizes best practices for electrification of municipal fleets based on experience with numerous public agency fleet electrification projects.

FLEET ELECTRIFICATION

INTERNAL COORDINATION

- **Institute a Facility EV Charging Infrastructure Advisory Committee:** Transitioning the County and City to all-electric fleets will require significant capital investments in terms of electrical system upgrades and EV charging infrastructure purchase and installation. This will require close coordination between departmental stakeholders for capital budgeting and prioritization of capital projects by an advisory committee whose members are (or are committed to becoming) knowledgeable about these issues.

INTERIM ACTIONS

- **Take actions to reduce emissions even before electrification:** Transitioning to an all-electric fleet takes many years. Fleets can take interim actions even before replacing existing ICE vehicles to reduce the emissions of their operations. Examples of such actions include improved driving through driver training and monitoring to reduce rapid acceleration, hard braking and excessive steering, idling reduction, use of telematics and software to improve routing and fuel economy.
- **Fleet Rightsizing:** Most fleets have more vehicles than they need. Underutilized vehicle assets should not be replaced with EVs since their emissions savings is unlikely to offset the embedded carbon of the EV's production. Therefore, fleets should evaluate which fleet assets can be surplused prior to planning electrification.

FLEET VEHICLE REPLACEMENT

- **Build sufficient contingencies into fleet electrification budgets and schedules:** The County and City should develop plans to replace each existing fleet vehicle with suitable EV alternatives by the planned replacement year, but they should be aware that OEMs have been months or years behind in development of new EV models and delivery of current models, resulting in chronic and severe EV supply shortages. As a result, many fleets have been unable to comply with planned replacement schedules and EV prices have escalated far above budget estimates. Therefore, the County and City should expect to be able to adjust plans and budgets to address these constraints.
- **Use surcharges on existing fleet fuel purchases to fund fleet electrification:** One way to fund purchases of charging infrastructure and the incremental cost of EVs relative to ICE vehicles is by adding a modest surcharge to existing fuel sales, a practice the City of Spokane (WA) has pioneered. Over time, this has generated a sustainable funding stream independent of third-party funding sources.
- **Strategically adjust vehicle replacement schedules to accommodate automotive industry delays:** Consider delaying replacement of existing fleet vehicles lacking suitable, available fleet EV models by extending the service life of existing ICE vehicles by an extra year or two if possible if doing so would allow replacement by an EV then. If a suitable EV is not available in the near future, fleets may need to delay the replacement opportunity to the next

replacement cycle to allow the industry to provide more available products, and use the extra time to plan, permit, purchase and install charging infrastructure.

- **Focus on highest emitters first:** Prioritize replacement of existing fleet vehicles with higher GHG emissions with EVs as soon as suitable EV models exist, to maximize emissions reduction. Since emissions are largely determined by duty cycle, high-use vehicles should be the County's and City's highest priority for electrification, especially for light-duty trucks and vans for which electric models like the Ford F-150 Lighting and e-Transit are now available. Although usage is typically measured in miles, many fleet vehicles are used as mobile offices or run auxiliary equipment like HVAC systems, computers, lights, lifts, blowers, etc. powered by their batteries or hydraulic systems while idling. Thus, engine time and fuel consumption may be a more appropriate metric of vehicle use for measuring emissions and reductions thereof from those vehicles.
- **Only electrify fleet vehicles when environmentally beneficial to do so:** Some vehicles are used so infrequently or are operated so lightly that the emissions reduction benefits of electrification do not offset their lifecycle emissions due to the significant embodied carbon in current production processes of EVs and their batteries. For such vehicles, it makes more sense – both environmentally and economically – to forgo replacement until regulations mandate the adoption of zero-emission vehicles. Note that ACF may mandate electrification of underutilized MHD vehicles.
- **Replace vehicles opportunistically:** Because the cost differential between light-duty EV and equivalent ICE models is far lower than for medium- and heavy-duty EVs, fleet managers should generally focus on replacing light-duty vehicles in the near- and mid-terms and medium and heavy-duty vehicles in the medium and long terms when battery technology and economies of scale make these vehicles more cost-competitive. However, there may be opportunities for replacing certain medium and heavy-duty vehicles that fleet managers should consider. Examples include vehicle-specific incentives, grants, and rebates available for certain vehicles. In addition, electric alternatives to certain specialty vehicles offer co-benefits in addition to emissions reduction. For example, electric street sweepers generate far less noise, allowing them to comply with local noise ordinances, unlike diesel equivalents. Note that CARB's ACF rule mandates electrification of medium and heavy-duty vehicles regardless of their economics.
- **Plan for special-use vehicles:** While most fleet vehicles have similar uses and duty cycles and can therefore share EV chargers and charging strategies, certain fleet vehicles have unique design and operational characteristics that require special considerations when planning. Examples include fire engines and aid cars which need to operate for extended periods of time in emergency operations with little or no opportunity to recharge their batteries. In addition, the odometer data may not provide an accurate measurement of energy consumption because much of the fuel consumed is used to power special equipment such as pumps, lights, radios, etc. To address the emissions reduction needs of such vehicles, detailed planning is typically required for both vehicle replacement and charging infrastructure installation.
- **Collect and use data to inform planning decisions:** Vehicle replacement plans should be informed by quality data. Therefore, fleet managers should employ GPS and fleet management software to track vehicle usage actively and accurately (e.g., daily VMT, time of day use, O&M costs, etc.) to better understand the usage of the fleet to inform future planning decisions.
- **Purchase EVs to meet realistic range:** The majority of fleet vehicles drive relatively few miles per day, therefore EV driving range is unlikely to be a concern. For most fleet vehicles, the County and City should purchase EVs with smaller batteries (if a choice is available for any given

model) to reduce expenditure. Of course, for mission-critical vehicles (such as police pursuit vehicles, fire department vehicles, snow plows, etc.), where maximum range is essential, both fleets should consider buying EVs with larger batteries.

CHARGING INFRASTRUCTURE

With respect to choosing the right charging infrastructure to fit the fleet's needs, there are many important decisions to be made by municipal fleet and facilities managers. A few crucial ones are listed here, with more details on best practices for charging equipment explained in the section on "Charging Equipment Best Practices".

- **Utility collaboration:** Electrical upgrades are often required to power the electrical loads at fleet charging facilities for sites lacking sufficient power. These typically require significant investment in electrical infrastructure such as new large transformers, switchgear, mounting pads or vaults and conduit which combined with installation, can result in the largest single cost factor or a fleet electrification project.
- **Size electrical infrastructure upgrades to meet future charging needs:** Typically, the largest single cost component of charger installation is electrical "make-ready" infrastructure including electrical transformers, switchgear, panels, conduit, trenching, site restoration etc. Therefore, Calaveras County and the City of Angels Camp should size infrastructure to provide extra electrical capacity to meet the fleet's future needs in anticipation of electrification of heavy-duty vehicles once they become more available and cost-competitive.

PROJECT IMPLEMENTATION

- **Budget sufficient resources for projects:** Fleet electrification typically requires major capital investments. Along with the hard cost of purchasing EVs and chargers, additional investments include purchase of makeready electrical infrastructure and charger installation consisting of associated materials and equipment for installation along with site restoration when trenching is required. Soft costs such as project design, permitting, utility fees and contingencies must also be budgeted for. Collectively, these costs greatly exceed the purchase price of the chargers themselves.
- **Engage your local utility early:** One of the longest lead items that most fleets have little control over is for the provision of electrical capacity to power chargers. It can take months just to engage a typical utility in the planning process plus many more months to procure critical electrical hardware such as transformers, making utility engagement the critical path on many projects. Calaveras County and the City of Angels Camp will benefit from engaging with the Calaveras Power Agency as early as possible.
- **Implement project phasing strategically:** Recognizing that replacing the entire fleet with EVs will take over a decade, the County and City will need to be strategic in its fleet electrification investments. As previously noted, the most cost-effective fleet components to electrify first are light-duty vehicles for which suitable and cost-effective EV models can be acquired in the short term, especially for high-use vehicles. Implementation of charging infrastructure installation plans should be phased to utilize existing electrical capacity at each facility to power early phase EV purchases while funding and design for future phases is sought.
- **Leverage California's Low Carbon Fuel Standard as revenue source:** California's LCFS program empowers EV charging infrastructure owners to register credits from delivered electricity which upon monetization produce ongoing revenue through the transportation

electrification transformation. The monetization of these environmental credits is through a commodity market for producers of carbon intensive transportation fossil fuels. While carbon pricing will fluctuate depending on the market supply and demand, the revenue from the sale of clean fuel credits can generate revenue for the City that will offset a portion of the costs of fleet electrification including electricity and EVSE operation and maintenance. As a fuel user, the County's and City's fleets are eligible to register as an obligated party to generate and sell clean fuel credits for fuels they purchase and use that have a lower carbon intensity than the state standard. This includes electricity dispensed through both public and fleet EV chargers. The revenue from those credits gets reinvested back into clean fuels and clean fleet vehicles by County and City departments.

FUTURE PROOFING

- **Keep fleet electrification plans up-to-date:** The electromobility industry is and will likely continue to be in a rapid state of change. Therefore, the implementation actions emerging from Calaveras COG's fleet electrification planning for Calaveras County and the City of Angels Camp should be reviewed and updated every two to three years. This will ensure the County and City stay abreast of rapid developments in the EV market, battery and charging technology, changes, and is able to leverage new grants, rebates, and other financial incentive opportunities.
- **Adapt to new technology:** Being open to exploring new ideas and technologies will allow fleets to capitalize on future opportunities that could revolutionize transportation. Examples of promising new technologies to adapt include Plug and Charge protocols, bidirectional charging, and automated charging. Plug and Charge protocols standardized under ISO 15118 simplify charger payments for EV drivers by creating a standardized way for EVs to electronically communicate with charging stations via a secure, encrypted digital language. Bidirectional charging will allow fleets to leverage the energy storage capacity of their combined batteries to provide charging resiliency to mission-critical fleet EVs, reduce demand charges, power buildings during power outages, mitigate power demand spikes and generate grid services revenues by selling power back to the grid. Inductive and robotic charging will make charging easier for drivers and eventually power autonomous vehicles. Dynamic inductive charging will eliminate the need for EVs to be parked while charging, allowing autonomous EV fleets to maintain state of charge while driving.

While some of such technologies are years out to reach full product maturity and adoption on a larger scale, the section on "Innovative Approaches to Fleet Charging" presents two new approaches to charging that are particularly useful for municipal fleets: battery-based mobile charging and public charging.

CHARGING EQUIPMENT BEST PRACTICES

The following best practices and decision criteria are included to provide guidance in the sizing, selection, and placement of chargers. The issue of addressing resiliency by providing alternative sources of temporary power during utility outages is also included.

CHARGER SIZING

The critical factors in evaluating the "size" (or power, as measured in kW) of EV chargers are the intended vehicle's battery capacity, charging acceptance rate, energy consumption, dwell time, and the quantity of EVs to be charged.

BATTERY CAPACITY

The capacity of the battery is measured in kilowatt hours (kWh). EVs commonly purchased by fleets and the general public typically have batteries ranging in size from 40-100 kWh. Larger battery sizes can typically require longer charging durations, but greater storage capacity means reduced charging frequency.

CHARGING ACCEPTANCE RATE

Each EV has a maximum acceptance rate for both AC and DC charging. Since this rate is the vehicles' maximum charging speed, it should be used to calculate the charging duration. While there is no current benefit for fleets and public charging station hosts to purchase higher-speed chargers, future EVs may become available with higher acceptance rates that may require installation of high-power chargers. This may especially become the case with more and more automakers adopting 800-Volt battery architecture, which support higher speeds of charging.

EV QUANTITY

In general, if a site is planned to be used by multiple EVs, charger quantities and speed should be calculated to ensure reasonable charging times, especially if chargers are shared between multiple EVs. Fleet managers should consider the frequency with which they plan to rotate EVs though shared chargers.

ELECTRICAL CAPACITY

The critical factor to determine charger sizing is the available electrical capacity. The electrical panel rating and the available electrical capacity at the charging facility will determine the number of chargers that can be installed and their maximum power ratings. Since many existing facilities were built without anticipating the need to charge EVs, unused capacity to accommodate significant charging infrastructure is typically not available. Here, portable charging stations such as the ones described in the section on mobile charging can be of help to reduce the peak demand imposed on the grid and thus mitigate the need for electrical service upgrades for new charging infrastructure.

ENERGY CONSUMPTION

Vehicle energy consumption consists of its average "daily duty cycle" (average miles traveled). For fleet managers the daily duty cycle for each vehicle type can be useful to calibrate the total charging needs for a particular site.

DWELL TIME

For municipal agencies like Calaveras County and the City of Angels Camp, assuming most fleet vehicles will charge overnight while not in use, the duration of "dwell", or stationary charging time,

determines the maximum charge duration per night. Longer dwell times mean slower chargers (chargers with smaller kW rating) can be used, which are often less expensive in terms of both purchase costs and electrical service upgrades.

CHARGER SELECTION

Key considerations to help guide charger selection are listed below. **Table 34** summarizes recommended features and capabilities relevant to these attributes.

- **Charge plugs:** For most applications, dual-port charging stations are more cost-effective and versatile. Level 2 uses J1772 standard plugs while DCFC uses CCS standard plugs. However, these may transition to NACS/J3400 (already in use by Tesla). The ability to replace a cord or charging plug on each charger should be provided.
- **Usability:** The charger should be easy to use by drivers and the charge cord length should reach multiple stalls. The charger face plate should be easy to read in any lighting condition; color-coded lights that indicate charging status increase readability.
- **Uptime:** A warranty or service level agreement (SLA) for the chargers that also includes uptime and corrective maintenance requirements can be useful to ensure that chargers are available.
- **Ruggedness:** Outdoor charging equipment requires robust hardware as it is exposed to the elements, repeated use, and possibly abuse or vandalism. Chargers installed in garage interiors or with less public use may require less robust and costly hardware. Most charger vendors include at least a one-year warranty; some vendors include or offer optional extended warranties.
- **Connectivity:** Charging data needs to be conveyed between the chargers, controllers, and management system. Multiple connectivity options are available depending on the charger or site where the chargers are located. These include wired connections using Wi-Fi, Cellular (4G and above), and/or Ethernet.
- **Payment/data collection:** Collecting payment for charging or tracking energy usage by EVs (or for fleet managers, by departments) can occur through a variety of mechanisms. Not all chargers offer payment functionality. Publicly available EV chargers in California must have a credit card reader and mobile payment device physically located on each charger dispenser or on a kiosk serving the charger dispenser. They must also display a toll-free number for payment processing. No membership for payment may be required.
- **Data security:** Appropriate data privacy and security requirements and standards should be supported by selected chargers.
- **Efficiency:** Chargers with power load management capability are the most energy efficient; ENERGY STAR-rated chargers use 40% less energy in stand-by mode.
- **Certification:** Commercially available chargers that are certified ensures product integrity, energy efficiency, and chargers that conform with the highest safety standards. **Table 34** lists some current certifications available for EV chargers.
- **Interoperability:** Open charge point standards are critical to making EV charging hardware compatible with multiple charging software platforms, providing greater flexibility, accessibility, and affordability for the charging system operator relative to charging hardware using proprietary software. Most chargers are currently OCPP 1.6 compatible, but OCPP 2.0 is becoming increasingly available with superior functionalities explained below.

- **Future-proofing:** Charging technology changes rapidly. To maximize the lifespan of charger investments, consider the following adaptable features:
  - Open Charge Point Protocol (OCPP 2.0) compliance expands functionality beyond OCPP 1.6 by improving device management, transaction handling, security features, smart charging functionalities, bidirectional communication, and ISO 15118 support.
  - Modular architecture consists of a singular centralized controller that supports multiple charging heads that can be added over time to provide scalability to meet growing future needs.
  - Demand Response (DR) capability avoids charging during periods of peak power demand and prioritizes charging when the grid has ample electrical capacity). OpenADR 2.0 is a DR protocol that would allow chargers to be included as part of a larger DR and/or distributed energy resources (DER, such as solar or wind) project.
  - ISO 15118 Plug-and-Charge technology-ready simplifies the payment process so that the charger recognizes each fleet vehicle and automatically bills the correct account.
  - Bidirectional (V2G) charging based on ISO/IEC 15118 standards and UL 1741-SA and UL 9741 Certification.
  - The North American Charging Standard (NACS) is currently being standardized as SAE J3400 and is expected to replace the SAE J1772 by 2025. Originally developed by Tesla in 2012, it was opened up to other EV manufacturers in 2023. During the transition from J1772 to NACS, non-Tesla EV manufacturers will initially provide adaptors to allow EVs equipped with J1773 plugs to use Tesla chargers in 2024 and will add NACS plugs to their EV products the following year. Therefore chargers equipped with NACS plugs or that can be upgraded to NACS and J1772 to NACS adaptors will need to be included in future charger purchases by fleets.
- **Data collection:** Fleet or facility managers may desire data from chargers to inform future decision-making and require dependable, accessible, secure, and frequently updated systems.

TABLE 32: RECOMMENDED EV CHARGER ATTRIBUTES

ATTRIBUTE	RECOMMENDED CAPABILITY OR FEATURES
CHARGE PLUGS	• Level 2: Dual-head SAE J1772 (and when available NACS) CHAdeMO for fleets with older Nissan Leaf models • DCFC: Dual-head 150 kW (or faster) with CCS and NACS plugs • Ability to replace cord or charger plugs to a different standard in the future if needed
POWER	• Capable of at least a 7.2-kW power output.
USABILITY	• Cable management capability with 25-foot cable length • Visible charging status lights
UPTIME	• A warranty or service level agreement (SLA) that includes charger uptime and corrective maintenance requirements
RUGGEDNESS	• NEMA-4 rated to operate outdoors and in extreme weather conditions. • Minimum warranty of three years

	• Field-swappable modular components
CONNECTIVITY	• Ethernet • 4G or if possible, 5G wireless communication • Wi-Fi • Bluetooth (optional)
PAYMENT/DATA COLLECTION	• Payment collection options to include RFID or QR code, Credit/debit card tap or swipe, Apple Pay, Google Wallet, or with smartphone app • Compliance with electric metering requirements in the CCR 4002.11 Electrical Vehicle Fueling Systems • Provide a mobile payment device physically located on each charger dispenser or on a kiosk serving the charger dispenser. • Support remote start capabilities for, at minimum, payment via a toll-free phone number. • Mandatory subscription, membership, or account for payment prohibited.
DATA SECURITY	• SOC2 compliance ensures that driver and customer data is secure.
EFFICIENCY	• Load management/power sharing capability • ENERGY STAR[46] rated
CERTIFICATION	• Certified by the UNDERWRITERS' Laboratories, Inc.[47] (UL), to UL 2594. • Compliant with Society of Automotive Engineers (SAE) J1772 standard for charging plug connector and operational requirements[48] (Pending transition to NACS). • Appropriate IEEE[49] & NEC[50] Ratings • AC chargers: Energy Star certification 1.0 in compliance with WAC 194-24-200. The rule went into effect on Jan. 1, 2024, and is enforced based on the manufacturing date and not the installation date • DC chargers: Certified by a NRTL to UL 2202 or UL 9741.
INTEROPERABILITY	• OCPP 1.6 Compliance and Certification • Ability to meet California's Low Carbon Fuel Standard's reporting requirements

[46] EPA's ENERGY STAR certified EV chargers provide the same functionality as standard products but use 40% less energy in standby mode: https://www.energystar.gov/productfinder/product/certified-evse/results

[47] UL is an OSHA-accredited Nationally Recognized Testing Laboratory (NRTL) that tests products, including EV charging stations, to applicable UL standards for safety. UL has multiple EV safety standards including: 2202 – Electric Vehicle (EV) Charging System Equipment; 2594 – Electric Vehicle Supply Equipment (EVSE); 2251 – Plugs, Receptacles and Couplers for Electric Vehicles; 62 – Flexible Cords and Cables; 2231-1 & -2 - Personnel Protection for EVSEs and 9741 – Bidirectional EV Charging System Equipment: https://www.ul.com/resources/apps/product-iq

[48] Society of Automotive Engineers (SAE) J1772 covers the general physical, electrical, functional and performance requirements to facilitate conductive charging of EV/PHEV vehicles in North America. https://www.sae.org/standards/content/j1772_201710/

[49] IEEE 1547: Interconnecting Distributed Resources with Electric Power Systems and IEEE 1547.1: Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems. https://standards.ieee.org/standard/1547-2018.html

[50] Section 625 of The National Electrical Code regulates electrical conductors and equipment supporting EV charging. https://www.ecmweb.com/national-electrical-code/article/20899765/article-625-electric-vehicle-charging-systems

FUTURE PROOFING	• OCPP 2.0 compliance and certification • Modular architecture and scalability • Demand Response capable, such as through OpenADR 2.0 compliance • ISO 15118 Plug and Charge technology-ready • Bidirectional (V2G) charging[51] based on ISO/IEC 15118 standards and UL 1741-SA and UL 9741 Certification. • Energy Star 1.2
DATA COLLECTION	• Capacity to accurately record and produce the number of unique charging events, average duration of each charging event, kilowatt hours delivered by each charger and downtime at each charger by month • Cloud-based dashboard portal

CHARGER PLACEMEMENT AND INSTALLATION

To optimize operational efficiency and reduce installation costs, when planning to place or install EV chargers, consider the four factors below:

1. Electrical service

- Providing power for chargers is typically the most complex and expensive part of EV charger projects, especially for large-scale charger installations like fleet depots that typically lack sufficient existing electrical capacity for deployment of large numbers of chargers and therefore will require electrical service upgrades from the local utility. Depending on the site, providing power to the chargers can be simple or complex. Where appropriate, multiple options for providing power such as from the utility-owned transformer or from the site host facility's electrical room should be considered.
- Evaluate capacity of electrical infrastructure (utility service and electrical panel) to support immediate and long-term vehicle charging needs. Identify costs for necessary electrical service upgrades in collaboration with local utilities and/or a qualified electrician.
- To help minimize costs, choose charging locations that are as close as possible to existing or proposed electrical service infrastructure and other EV charging stalls.
- Plan electrical raceway or conduit runs for electrical wiring and data cables from the electrical panel serving the chargers and consider a layout that minimizes linear conduit distances to all proposed EV charger-equipped parking spaces.
- If possible, install chargers during construction, remodels, or other facility upgrades planned to reduce costs and minimize construction impacts.
- Charger hosts should consider different strategies to separate meters for building and electric vehicle charging uses to manage peak load impact on the grid and minimize demand charges for electric vehicles.

2. Charger location and layout

[51] https://www.charinev.org/news/news-detail-2018/news/the-five-levels-of-grid-integration-charin-ev-grid-integration-roadmap-published/

- Key considerations for siting fleet chargers include proximity to available power, user convenience, and parking facility operations.
- To reduce the cost of conduit and conductor installation and minimize voltage drop, chargers should be located as close to the power source as possible. To maximize convenience, chargers should be placed in accessible locations as close as possible to charger-equipped parking stalls. Chargers should also be clustered together to help fleet managers, especially if chargers are to be shared.
- If possible, surface-mount conduit along wall surfaces to avoid more costly trenching under paved surfaces. If wall or column mounting is not feasible, trench beneath planting strips to reduce cutting and re-paving costs and to minimize disruptions during construction.
- Identify suitable locations with smooth, plumb surfaces for wall mounted charging stations if possible or suitable floor surfaces for pedestal mount stations. If possible, use wall-mounted chargers to avoid the need for pedestals which are more costly and complex to install.
- To maximize charging capacity, consider installing dual-port pedestal mount stations with long charge cords (up to 25'). Many chargers include optional cord management systems such as retracting reels to minimize trip hazards. Depending on parking configuration, a single charger or dual head charger pair can serve up to eight parking stalls.
- To comply with the Americans with Disabilities Act (ADA), the charging station must not block ramps or pathways, and cables should not extend across ramps or pathways when connected to a vehicle.
- Where feasible, avoid locating chargers under trees where sap, pollen, or leaves would fall on the charging station.
- To better accommodate the varied charge port locations on different EVs, use perpendicular (90 degree) parking stalls that allow a vehicle to enter either front-first or rear-first instead of parallel or diagonal stall parking.
- Check local requirements for accessibility and pathway width, sometimes called "path of travel" to ensure charger placement does not restrict sidewalk use.
- Plan locations for easy and cost-effective future charger installation, typically adjacent to other EV charging stalls.

3. Operational considerations

- Provide adequate lighting activated by motion sensors for safe night-time access and consider weather protection.
- Consider siting chargers in areas with good visibility and securely affixed to the ground or wall.
- Closed-circuit television (CCTV) surveillance is an additional option, especially in low visibility public areas, to prevent theft and vandalism.
- Ensure chargers are easily identified and install signage or wayfinding as needed.
- Provide protective bollards and wheel blocks where appropriate, especially on sloped sites.

4. Data connectivity

- Chargers recommended for public use or fleet vehicles should be smart or at least enhanced with smart charging capability with add-on technology like Cyber Switching, or PowerFlex. This is to provide data on charging and energy use to fleet and facilities managers as well as

to provide the benefits of load management. To be smart, chargers must be able to transmit data which requires cellular connectivity, WiFi, or ethernet.

- In general, smart chargers use cellular signals to communicate with the cloud. Stand-alone chargers have their own integral modems while modular chargers communicate to a central control hub using ethernet or WiFi that communicates to the cloud via a cellular modem or through the facility's internet. To ensure dependable coverage, communication systems need to be stand-alone and not be dependent on the building's WiFi system.
- Measure cellular signal levels to ensure adequate coverage where smart chargers will be installed. Underground or enclosed parking structures may require cellular repeaters to ensure adequate signal strength to chargers.

INNOVATIVE APPROACHES TO FLEET CHARGING

For fleet facilities not owned by Calaveras County or the City of Angels Camp, a variety of charging options are available, including portable charging, mobile charging-as-a-service, and the use of public charging infrastructure. Different approaches and available product offerings for these newer, innovative approaches to charging public fleets are presented in the following.

MOBILE FLEET CHARGING

Mobile charging options could be among those to consider to provide additional operational flexibility, avoid unnecessary load draws when feasible, or provide charging at locations not owned and controlled by the County or City. Most mobile charging solutions on the market today are chargers that are part of a vehicle carrying a battery designed to serve multiple light-duty vehicles' charging needs or at least a few medium or heavy-duty vehicles at a time. Such products would be able to serve fleet vehicles that are based at facilities not owned or controlled by the County or County, as well as facilities that do not have sufficient electrical capacity to serve the changing needs of the vehicles based at that site.

Examples of such mobile systems are presented below. For the last couple of years, there have been various products entering the mobile charging market, often from innovative start-ups aiming to provide new charging solutions particularly for municipal or commercial electric vehicle fleets.

The list of discussed vendors does not represent a holistic market representation, but is an overview of exemplary systems with features suitable for fleets such as Calaveras County's and the City of Angel Camp's:

- The Dannar Mobile Power Station (**Figure 7**) is a full-sized vehicle consisting of a motorized chassis supporting a large storage battery. The DANNAR 4.00 base configuration comes with a 250-kWh Li-Ion battery pack and can be upgraded with additional packs for a total of either 375 or 50 kWh of on-board electricity. In addition, such a mobile station can be configured with a large selection of optional attachments such as scissor lifts, forklift masts, dump beds, water tanks, electric water pumps, or portable light units.

- The XOS Hub™[52] (**Figure 8**) is a trailer-mounted mobile charging solution capable of charging up to 5 vehicles at one time using CCS plugs. This standard-sized trailer can be hauled to various fleet at facilities that don't have chargers to deploy fleet EVs without the need for capital investments in the facility as well as to store energy to avoid peak-time demand charges. Powered by a 390-kWh battery, it is sized for relatively small fleet facilities with limited available space for fleet EVs with light to moderate duty cycles. It can be charged with a 3-phase, 480-V charge rate and can deliver its stored electricity to the connected vehicles with up to 40 kW each. The hub is networked with LTE and Wi-Fi interfaces.

FIGURE 7: DANNAR MOBILE POWER STATION. SOURCE: DANNAR

FIGURE 8: XOS HUB MOBILE CHARGING SOLUTION. SOURCE: XOS

MOBILE CHARGING-AS-A-SERVICE

Some providers offer mobile charging options as a service ("charging-as-a-service"). Such companies can take on the role of providing charging for electrified fleets at leased facilities, during temporary on-site fleet operations (such as at a construction site), or whenever there is an unexpected outage or a power demand that cannot be met with existing utility infrastructure. Such firms provide on-demand backup solutions, especially useful in early phases of the fleet transition towards electric vehicles. These solutions can also help provide sufficient electrical power on a temporary basis before utility-side electrical infrastructure upgrades are completed.

This is a scalable way to expand electrical supply to meet load growth far quicker and potentially more cost-effectively than adding new switchgear, transformers and conductors or even substations. This could be quickly provided as an interim solution for facilities awaiting electrical service upgrades from electrical utilities but could prove to be more cost-effective in the long-term depending on the local utility situation. For leased facilities or other fleet domiciles that are not

[52] https://www.xostrucks.com/xes/#mobilecharging

owned by the fleet operator, it provides a way to power charging without the need to make major infrastructure investments at each site.

Because battery-powered charging is also independent of the power grid, resiliency from power outages is an important co-benefit. And being mobile, batteries can quickly be replaced by freshly recharged batteries trucked to the site whenever needed.

Mobile Charging-as-a-service is a rapidly evolving industry. The SparkCharge charging-as-a-service for fleets[53] promises to be operational within 14 days, avoiding the need for any installation or construction. Another promising company that has been in the battery business since 2007 and is making a lot of traction with grid-scale portable power is Joule Case. Such options can be an excellent fit for fleet facilities of all sizes due to their stackable, scalable nature. Joule Case offers turnkey commercial power solutions to fit any level of energy consumption from EV Fleet charging needs. Their modular, stackable, exchangeable systems are self-contained energy storage and charging infrastructure. As a result, no major additional infrastructure or permitting is typically required for installation. Joule Case also offers leasing options providing flexibility for different applications. These include Charging-as-a-Service, long-term leases, or for multiple charging events.

FIGURE 9: SPARKCHARGE'S ROADIE PORTABLE DC FAST CHARGER. SOURCE: SPARKCHARGE

FIGURE 10: JOULE CASE BATTERY MODULES WITH CHARGING PEDESTAL. SOURCE: JOULE CASE

Shoals offers a modular charging solution called Fuel that can be deployed at an existing fleet site or depot in about 1-3 days, while drastically reducing the need for construction work as well as material and cable costs. The system provides a "power center" that comprises a built-in transformer capable of stepping down a 480-V input voltage. The unit connects to charging stations from any vendor via above-ground cable guards that eliminate the need for trenching and can withstand vehicles of up to 10,000 lbs. driving across them.

[53] https://www.sparkcharge.io/pages/sparkcharge-fleet

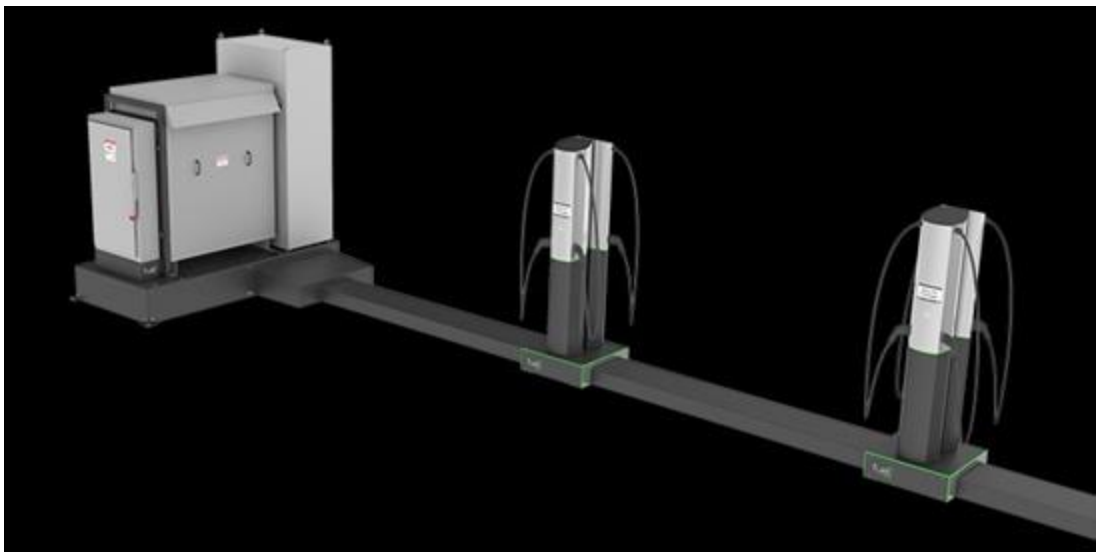


FIGURE 11: SHOALS FUEL EV CHARGING SOLUTION. SOURCE: SHOALS

USE OF PUBLIC CHARGING

Fleets generally charge their EVs overnight at fleet domicile facilities. However, fleet EVs can also use public chargers, especially for opportunity charging when driving long distances. Opportunity charging using publicly available high-output DC fast chargers can provide a convenient and cost-effective way for municipal fleets to supplement their own charging infrastructure to maintain uninterrupted vehicle availability in times of high usage or as a backup option for emergency response vehicles. While not as ubiquitous as in larger urban areas of California, public charging networks like EVgo and Electrify America have deployed charging stations in Calaveras County and more will be constructed with the help of NEVI and other public funding and increasing private investment.

Figure 12 below shows currently available public EV chargers in Calaveras County in relation to existing County and City facilities.

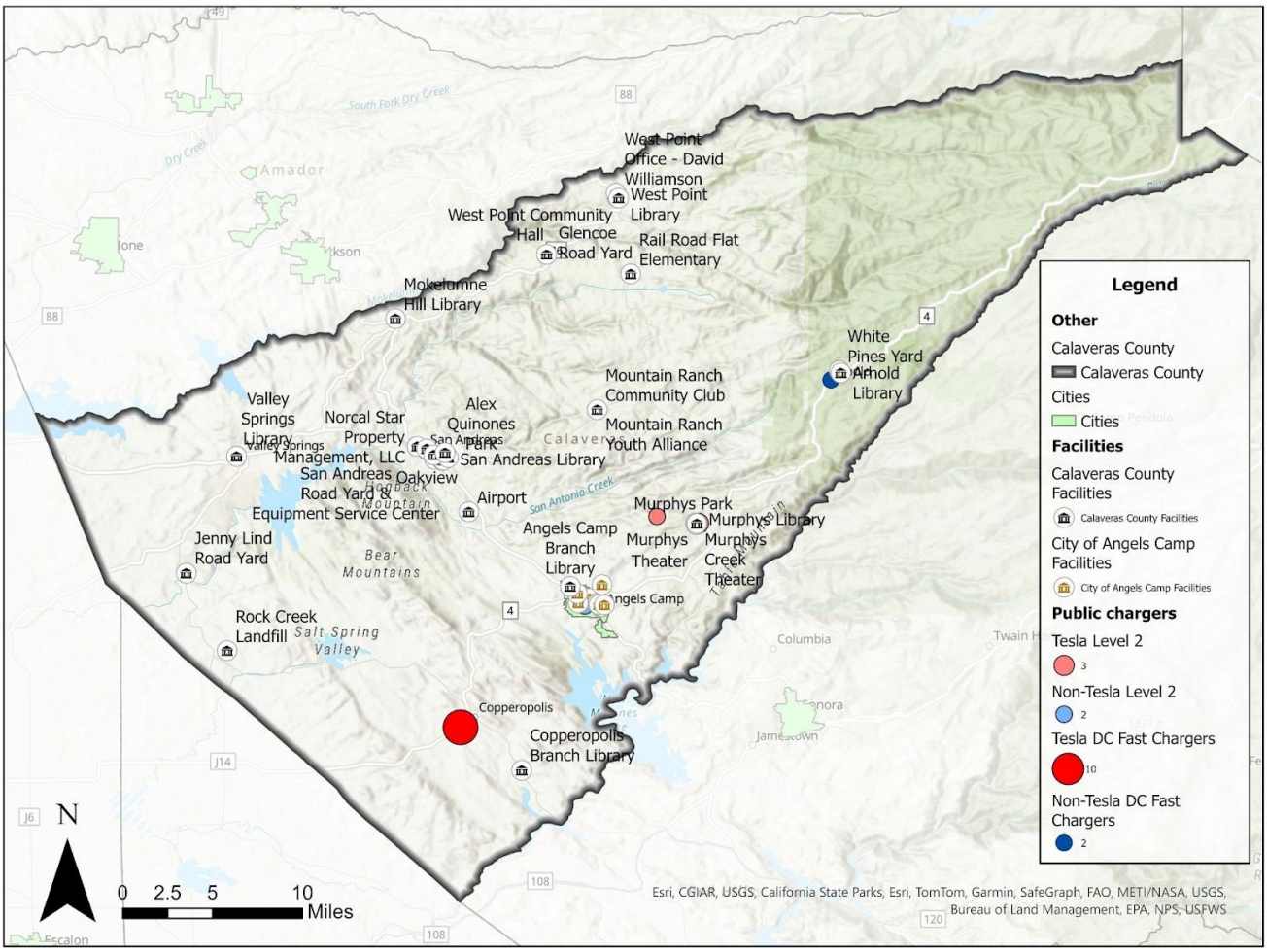


FIGURE 12: PUBLIC EV CHARGERS IN CALAVERAS COUNTY. SOURCE: AFDC, PLUGSHARE, CALAVERAS COG

The largest public charging network as discussed, was developed, and continues to be operated by Tesla for the exclusive use of Tesla EVs. However, in May of 2023, Ford and Tesla announced that Ford would have access to 12,000 chargers in Tesla's Supercharger network. Several weeks later in early June, GM and Rivian followed suit with a similar deal with Tesla and since then, the majority of other OEMs have made similar announcements.

Tesla's charging network has long been the envy of all EV drivers as Tesla Superchargers are strategically sited and more abundant than other high-speed chargers available to the public. They are also generally easier for EV drivers to use thanks to their plug-and-charge functionality and more reliable than other networks.

By gaining access to the nation's most accessible, reliable, and fastest charging network, fleets and other Ford and GM drivers will be able to avoid capital expenditures by not having to invest in their own supplemental DC fast chargers, or at least may need fewer of them since fast, abundant, and reliable chargers will soon be available at Tesla's charging stations.

The rapid adoption of EVs by the public and the relatively long charging times (by comparison to liquid fuels) presents a business opportunity for a new industry of commercial charging destinations with amenities for drivers while charging their EVs. For example, Electrify America is planning a handful of "showcase stations" with up to 20 DC fast chargers, plus amenities like customer lounges and solar canopies to shield customers from sun and foul weather, vehicle showcases, and security cameras plus additional lighting for increased safety. Mercedes-Benz will also be developing its own EV fast-charging network with more than 400 North American charging sites, with a total of 2,500 350-kw DC fast-charging connectors in place by 2027. Charging sites will be spaced at regular intervals along highways, close to major intersections and metropolitan areas, with an emphasis on sites near shopping or restaurants, as well as Mercedes dealerships. Amenities like restrooms and some form of shelter from the weather, as well as video surveillance, will also be included. Startups like Rove include 40 publicly accessible DC fast chargers some of which will offer up to 350 kW, plus a 24/7 indoor lounge, outdoor seating with Wi-Fi, restrooms, car wash, and a Recharge by Gelson’s market. There will also be nighttime security guards and a fenced-in pet area.

APPENDIX F. BACK-UP POWER AND RESILIENCY

Fleets operating mission-critical EVs need to be able to charge independently of the power supply. Most of the County's mission-critical vehicles are domiciled at the Government Center and the Sheriff's Office, which are in close proximity to each other. The City of Angels Camp's mission-critical vehicles are domiciled at 200 Monte Verda St. (Police Department, City Hall, Corp Yard) and Fire Department. Therefore, each of these will need to provide backup power for fleet EV charging as summarized below in **Table 33** during extended power outages.

TABLE 33: ELECTRICAL DEMANDS OF MISSION-CRITICAL FLEET FACILITIES

SITE	DAILY DEMAND [KWH]	AVERAGE LOAD (IF CHARGING OVERNIGHT OVER 12 HOURS) [KW]	PEAK LOAD (BASED ON RECOMMENDED CHARGERS) [KW]
CALAVERAS COUNTY			
GOVERNMENT CENTER	3,720	310	1,822
SHERIFF'S OFFICE	3,133	261	2,103
CITY OF ANGELS CAMP			
200 MONTE VERDA ST. (POLICE DEPARTMENT, CITY HALL, CORP YARD)	447	37	884
FIRE DEPARTMENT	127	11	29

The conventional approach would be to install an additional pad-mounted generator, replace an existing generator with a larger unit, or install a plug for quick connection to a portable trailer-mounted generator. Alternative approaches that respect zero-emission targets and mandates include deploying a microgrid to utilize a solar array, preferably with battery energy storage, and/or the use of bidirectional chargers using fleet EVs to charge one another. For example, the Ford F-150 Lightning has integral charging ports that could be used to charge other fleet EVs. Some of the currently available zero-emission resiliency and backup options are explained below.

BACKUP GENERATORS

Conventional fuel back-up generators are available in sizes up to 2,000 kW. These generators can be permanently installed at facilities for dependability and ease of operations or can be mounted on trailers to provide greater flexibility for fleet operators. If any County or City-owned generators have spare capacity, existing generators could be used to power chargers. However, backup generators are typically sized for existing building loads. If additional generation capacity is limited, the County and City could install a generator at one or more of their primary fleet facilities where emergency-response vehicles are domiciled or at least provide quick connect couplings and an adjacent space to park a trailer-mounted portable generator. Portable generators offer flexibility but typically cost up to 30% more to purchase.

Backup generators can be powered by diesel fuel or other liquid fuel sources like natural gas or propane. To help achieve the carbon reduction goals, renewable diesel—a hydrocarbon diesel fuel produced by hydro-processing of fats, vegetable oils, and waste cooking oils—could be substituted

for standard petroleum diesel. According to industry sources like Neste[54], which is available from two distributors in Stockton, such a substitution reduces lifecycle emissions by up to 80% compared to petroleum diesel.

FIGURE 13: TRAILER-MOUNTED 625-680 KVA MOBILE GENERATOR. SOURCE: HIPOWER

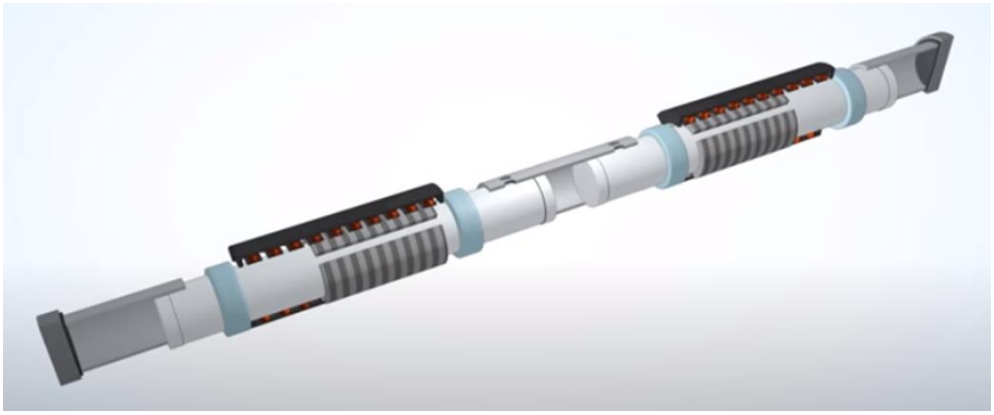


FIGURE 14: MAINSPRING LINEAR GENERATOR

An alternative to traditional internal combustion powered generators are linear generators, which follow a more fuel-agnostic approach. Linear generators can typically run on a range of fuels including natural gas, biogas, hydrogen, ammonia, and syngas. They are functionally different to conventional generators in that they utilize a flameless compression reaction of the fuel gas in use. The expansion of the gas upon reaction drives the generation of electricity in the linear generator. Mainspring[55] offers a scalable product that can provide 480-V output voltage starting at an output power of 230 kW which could easily power a dual-port DC Fast Charger at any of the County's or City's facilities. In an existing configuration, the linear generator runs on natural gas or biogas with a hydrogen blend of up to 30%, but the system is capable of running 100% on either hydrogen or

[54] https://www.neste.us/neste-my-renewable-diesel/find-fuel

[55] https://www.mainspringenergy.com/solutions/

ammonia. An example of linear generators deployed in California include a new installation to power charging for Prologis's drayage fleet.

HYDROGEN FUEL CELLS

Fuel cells are a rapidly growing form of grid-independent generation that can, depending on the energy feedstock and conversion process, be environmentally sustainable. Fuel cells combine the fuel (typically hydrogen) with oxygen to shed electrons and generate an electric current. In the case of hydrogen fuel cells, the only byproducts of this process are: electrical current, water (H_2O), and heat. There are several major companies that can provide this type of generation, including Bloom Energy and Kaizen Clean Energy. Their technology is stackable, scalable, and requires only limited physical space.

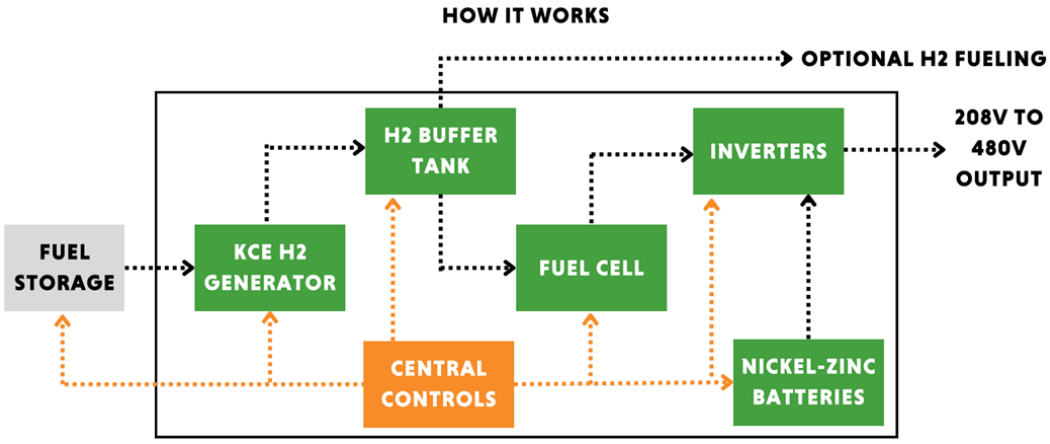


FIGURE 15: SCHEMATIC OF HYDROGEN FUEL CELL POWERED CHARGERS (SOURCE: KAIZEN CLEAN ENERGY)

The capital investment required for a fuel cell's initial infrastructure and the cost of hydrogen can be expensive; however, compared to the footprint and efficiency of other forms of power generation such as generators, solar PV or wind turbines, they can be a useful alternative or complementary technology.

Since generators and fuel cells are costly and fuel consuming, several alternative approaches to provide resiliency for fleet fueling during power outages are based on the use of distributed energy resources (DER) and battery storage as explained below.

BATTERY ENERGY STORAGE

Battery storage is a technology that enables electrical energy to be stored for later use. A battery energy storage system (BESS) is an electrochemical device that charges (or collects energy) from the grid and then discharges that energy when needed such as during a power outage or to reduce demand on the grid. Like generators, a BESS can be permanently installed or be portable. Examples range from chargers with integrated batteries like Freewire Technology's Boost chargers, to small portable units, like the Dannar Mobile Power Station, to on- and off-site grid-scale storage battery facilities, like Joule's modular battery system.

Improvements in energy storage technology have improved space efficiency too. For example, Joule's battery modules are only 4' wide, 4' high and 8' long and available with up to 300kWh of storage capacity. Therefore, a single standard parking stall would provide sufficient space for up to four adjacent modules with 1,200kWh of storage capacity. Since these are stackable, a second row of battery modules would double this capacity to 2,400kWh which would be sufficient to fully charge 40 typical light duty EVs. As battery technologies continue to improve in terms of energy density and lower cost, the use of BESS will become increasingly viable.

FIGURE 16: JOULE'S MODULAR, STACKABLE, CHAINABLE BATTERY SYSTEM (LEFT), DANNAR MOBILE POWER STATION (RIGHT)

One of the main distinctions of types of BESS is whether it is designed to be installed permanently or whether it is a portable or temporary solution. Permanently installed BESS can provide backup power for spontaneous grid outages (blackouts and brownouts, or partial outages) as well as mitigate the daily peak charging demand by replacing all or parts of the power draw from the existing utility service with its own electricity. Mobile or temporary BESS, on the other hand, provide a flexible solution for fleet applications in which less certainty exists around where and when additional or backup power will be needed. Mobile battery systems can be deployed at specific sites on short notice and moved to a different location when needed.

Some third-party charging-as-a-service providers offer large mobile batteries delivered by truck that can power onsite chargers. One startup is StorEdgeAI[56] which will offer a mobile battery-based charging supply solution at less than half the cost of gasoline fueling. StorEdgeAI hopes to deliver bulk electricity daily, independent of the utility grid, directly from large renewable plants to EV charging locations such as fleet depots. StorEdgeAI's technology enables one mobile battery unit (with several MWh onboard on a 30' shipping container) to fulfill the daily energy needs for over 100 light-duty EVs. Mobile battery fleet size scales incrementally with demand (as fleet

[56] https://storedge-ai.com/

electrification grows), removing upfront investment risk. Such solutions require no utility grid upgrades or onsite utility distribution infrastructure.

SOLAR

Instead of or in addition to back-up generators or batteries, EV charging operations can be protected from power supply interruptions by on-site renewable generation like photovoltaic solar panels coupled with on-site energy storage batteries.

Solar power is becoming an increasingly viable source of power for EV charging because of improvements in energy collection and storage technology. Solar technologies provide environmental benefits due to a lack of carbon emissions and resiliency benefits from an ability to operate with independence from the electrical grid during disruptions or emergencies. One example of this is a transportable turnkey vehicle charging station called EV ARC powered by a tracking solar canopy and lithium-ion battery storage developed by Beam, formerly Envision Solar International, that may be very appropriate for multiple fleet applications. This modular solar charging platform is designed to be operated independently from the grid or it can be grid-buffered. They require no construction nor ground disturbance and therefore can be installed and set up quickly at the charging site without permitting and essentially no operating cost. The company has recently developed an upgraded version of the company's existing standard EV ARC shown in **Figure 17**, the High Powered EV ARC, which can be equipped with 38-51kWh of battery storage, 40 Amp power supply, and an 8.4-kW Level 2 charger or a 12.5kW DC charger. The charger can split dynamically among as many as six J1772 charging ports. The high-powered EV ARC is able to be daisy chained or stacked with surface cabling to support 50kW DC fast charging, which is able to produce 1,000 miles of EV driving range per day on average, depending on site location and amount of sunlight.

FIGURE 17: BEAM EV ARC SOLAR-POWERED EV CHARGER WITH BUILT-IN BACKUP ENERGY STORAGE. SOURCE: BEAM

Another solar powered charger option is Paired Power's Pair Tree, consisting of a 5kW solar canopy with bi-facial modules coupled with a 43kWh storage battery for charging when the sun isn't

shining. Each Pair Tree contains dual 5kW Level 2 charging ports, LED lighting and parking bollards, a software app for full charging control including reservations via smartphone.

Solar powered EV chargers such as Beam's EV ARC or Paired Power's Pair Tree can be islanded (no grid connection) to simplify installation. However, they can also be connected to the grid.

MICROWIND

Another potential source of distributed renewable energy for powering EV chargers is wind. Due to technological advances, small wind turbines that spin in as little as 5-mph wind can provide up to 10 kW of power, enough to supply a medium output Level 2 charger. Flowgen Technology, a Swiss cleantech company, designs, manufactures, and constructs these turbines as well as "smart microgrids" combined with battery energy storage and smart controls to optimize microgrid performance. These smart microgrids can operate autonomously (in "island mode"), daisy-chained to create to scale (kW-MW) with interoperability control and communication and can also be connected to the larger utility grid, making it more adaptable and resilient and reduces stress on the utility grid.

FIGURE 18: 10-KW MICROWIND TURBINES WITH SOLAR AND BUILT-IN BACKUP ENERGY STORAGE. SOURCE: FLOWGEN

MOBILE MICROGRIDS

At least one company, CE+T America, has combined multiple distributed energy components (DER) into a stand-alone pre-wired mobile microgrid mounted on an 8'x20' skid that can fit in a single standard parking stall. The Watt2Go mobile microgrid (W2G) power system supports EV charging with an option to mount Level 2 or DCFC stations on a W2G single skid. The system architecture can be configured in a controlled environment using CE+T's "DEPGreen" design configurator in real-time to meet specific energy requirements. The W2G can operate in grid connected or autonomously in island mode using combinations of conventional and new generation and storage technologies, such as generators, solar PV, MicroWind, LFP batteries and fuel cells. Because they are skid-mounted modular microgrids, they can be deployed in less than a day and be relocated via

truck from one fleet facility to another if needed. Like other recommended EV charging technologies, the single skid W2G is modular and scalable up to 240 kW of power and 515 kWh capacity and capable of being stacked to MW size with full interoperability to meet the needs of larger fleets.

BIDIRECTIONAL CHARGING

A promising emerging technology is bidirectional charging. Bidirectional charging refers to being able to charge EVs and draw power back from an EV's battery as a power supply. Bidirectional charging combines the use of a bidirectional charger, a bidirectionally enabled battery-electric vehicle and a software management program. This combination of assets enables EVs to deliver two-way (bidirectional) power flow by drawing power from the grid or a building and discharging energy back into a building or the grid. Each component of bidirectional charging is explained below. Collectively, these technologies are commonly known as "vehicle-to-everything" or simply "V2X". Bidirectional chargers are available in the US by international charging vendors like Borg Warner, Wallbox and Nuvve as well as domestic startups like Fermata Energy.

Vehicle-to-Grid (V2G): Enables surplus EV battery capacity to be exported back to the grid to provide a variety of grid services for grid operators and utilities, including system-wide load management, frequency regulation, renewables integration, power-outage resiliency, etc. Such services are also referred to as vehicle-grid-integration (VGI).

Vehicle-to-Building (V2B): Vehicle-to-Building services, which are behind the meter, non-export-to-grid activities, refer to the dispatch of power from a bidirectional EV to a commercial or residential building. The main application of V2B is demand charge management on facilities with high to moderate demand charges. SMUD currently has demand charges especially during weekdays in the summer, and this could change in the future as electrical demand grows while hydro capacity dips during system-wide summer peaks and the grid becomes increasingly dependent on renewable, intermittent energy sources like wind and solar.

V2B can also provide disaster resiliency/back-up power for buildings through sharing of power between the buildings co-located with the fleet parking facility and the vehicles that charge there, allowing buildings to borrow stored electricity from the EV batteries. This way, EVs could provide emergency dispatchable mobile backup power capacity during power outages.

Vehicle-to-Vehicle (V2V): Allows EVs to transfer power to and from each other's batteries. Since utilization by most fleet vehicles is well within the battery range of currently available EVs, a substantial surplus power is typically available. As battery capacity expands far beyond the daily range needs of most fleets, this surplus capacity will likely expand even more. This power could be shuffled between vehicles via a microgrid or backup generator on an as-needed basis, reducing demands on fleet charging infrastructure as well as on the grid. During power outages, mission critical vehicles, like police cruisers and fire department apparatus, could draw power from non-mission critical vehicles, allowing their batteries to function as backup power storage reducing the need for investments in backup energy storage and emergency generators. A practical application would be to use an EV, e.g., Ford F-150 Lightning with onboard power outlets, to charge other utility vehicles. Other solutions include other EVs capable of bidirectional charging such as a Nissan, Hyundai, or Kia connected to charging stations that are each capable of bidirectional

charging. The charging station, or the underlying charge management software, could then request the charging of a specific vehicle using the energy stored in a different vehicles' batteries.

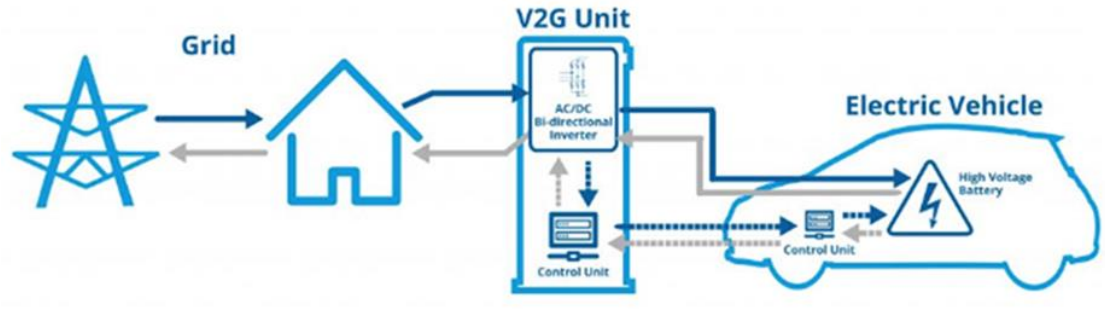


FIGURE 19: BIDIRECTIONAL CHARGING. SOURCE: FLEETCARMA

Benefits: Bidirectional charging will provide a variety of benefits to fleets, facilities, and utilities, including potential revenue from grid services, cost reduction through avoided demand charges and resiliency for buildings and vehicles using EV batteries providing backup energy storage. This technology unlocks the significant energy storage potential of EVs and enables EV batteries to provide valuable energy services to buildings and the electric grid. Most privately-owned EVs are parked 95% of the time (as are privately-owned combustion engine vehicles), and even fleet EVs are typically parked more than 60-70% of the time. This offers abundant sources of mobile, distributed, and dispatchable capacity.

Disadvantages: Unfortunately, universal bidirectional EV chargers are not yet available. Every OEM (like Ford) tends to have proprietary software or communication protocols to allow their EVs to talk to other equipment. Most of it is due to liability concerns so all equipment requires compatibility certification. The current lack of bidirectional charging standards are expected to remain until standards are approved through CharIN by 2025. Bidirectional charging should be considered by fleets to be an emerging technology that will change quickly and should be tracked on an on-going basis as it will likely revolutionize the industry. Another challenge is the lack of current standards for V2G and V2B and open architecture, potentially resulting in compatibility limitations.

Some vehicle OEMs, including Ford, GM, Rivian, and Hyundai, are embracing bidirectional charging technology by aiming to include this capability in their current or future EV model offerings. Additionally, commercially available bidirectional chargers are limited to a few options including the Fermata Energy FE-15 and the Ford Charge Station Pro[57], Wallbox Quasar II and a pair of DCFC from Borg Warner. In addition, more such charging products are under development by many different companies so it is reasonable to assume that bidirectional charging will be part of future EV and charger models and that it will be increasingly deployed given its unique resiliency benefits, potential to mitigate partial or full grid power outages and other benefits.

[57] https://www.solarpowerworldonline.com/2023/02/what-is-bidirectional-ev-charging/

CONCLUSION

The need for back-up power is growing rapidly as both vehicles and facilities transition from fossil fuels like gasoline, diesel, and natural gas to electricity. This is increasing strain on the electrical grid and the risk of brownouts and public safety power shutoffs events is a critical concern for fleet operators, especially for mission critical EV fleets. Industry has only recently begun to react to this demand with a variety of innovative resiliency solutions, many of which are novel and unproven. For fleets like Calaveras County's or Angels Camp's domiciled at multiple locations, each with unique site conditions, different vehicle types and power demands, the fleets will likely need to deploy a variety of approaches, rather than selecting specific technologies. For example, solar combined with BESS makes sense where space is sufficient and mobile battery powered chargers could be used at multiple sites to supplement and distribute power produced by backup generators. In the future, once accepted by more automotive and EV charger OEMs and standardized, V2V will likely be the most cost-effective approach since the City will be acquiring significant battery capacity integral to its growing EV fleet and the incremental cost of bidirectional chargers is negligible. For now, the fleets should continue to monitor improvements to resiliency technology as it improves and standardizes and make purchases as needed during implementation of this plan.

Table 34 below summarizes the advantages and disadvantages of these backup power alternatives.

TABLE 34: COMPARISON OF BACKUP POWER OPTIONS

TECHNOLOGY	ADVANTAGES	DISADVANTAGES
GENERATORS	• Flexibility • Can be mobile • Availability through purchase or lease	• Noisy when running • Fuel consumption • Potential emissions • Occupies physical space
FUEL CELLS	• Zero emissions • Silent operations • Flexibility	• Fuel consumption • Occupies physical space
BATTERY ENERGY STORAGE	• Zero emissions • Silent operations • Flexibility • Can be mobile • Availability through purchase or lease	• Needs power supply • Occupies physical space
SOLAR	• Zero emissions • Silent operations • Can be independent of power grid	• Daylight only, or requires battery energy storage • Needs solar access • Requires large open area
MICROWIND	• Zero emissions • Can be independent of power grid	• Wind-dependent and requires battery energy storage

TECHNOLOGY	ADVANTAGES	DISADVANTAGES
BIDIRECTIONAL CHARGING (V2X)	• Zero emissions • Silent operations • Flexibility • Can be mobile • Can be independent of power grid • Utilizes existing assets (EV batteries) • Requires no additional space	• Requires bidirectional EVs and chargers • Lack of industry standards (CharIN)

APPENDIX G. COST ESTIMATES ASSUMPTIONS

This appendix describes the assumptions made to develop planning-level cost estimates for the fleet EV charging infrastructure as recommended to be phased in over time at the four County and City facilities.

CAPITAL EXPENDITURE (CAPEX) ESTIMATES

Each of these categories of project capital costs are listed and explained below.

HARD COSTS

EV Chargers

This includes:

- Level 2 EV chargers
  - Low-output (~6.7 kW), ChargePoint CT4000 or equivalent
  - Medium-output (~11.5 kW), ChargePoint CPF50 or equivalent
  - High-output (~19.2 kW), Chargepoint CP6000 or equivalent
- Power cords and cable management for Level 2 chargers
- DC fast chargers (150 kW Chargepoint/Blink/ABB or equivalent)
- Gateway module/load Management Devices

Note: This excludes costs for warranties because the standard warranty that the vendor offers is part of the cost estimate tool.

Materials/Equipment

This includes costs of purchasing and installing materials typically required for fleet EV charging projects (other than the EV chargers themselves) including the following items:

- Wiring
- Conduit Systems (underground and/or surface-mounted)
- Trenching and/or directional drilling
- Pull Boxes (installed in the ground and/or surface-mounted)
- Aerial wire spans
- Footings for installation of EV charger pedestals and electrical service panels
- Bollards
- Wheel stops
- Step-down transformers
- Electrical service panels including sub panels
- Circuit breakers
- Signage
- Striping for parking stalls

Site Restoration

Site restoration covers the costs to install civil/landscaping improvements to restore the site following excavation and other construction activities including:

- Minor restoration for civil infrastructure such as roadway and/or sidewalk repaving
- Minor curb and gutter restoration
- Minor surface water (drainage infrastructure) restoration
- Minor landscaping restoration such as replanting

SOFT COSTS

Contracting/Design

An estimated 25% mark-up has been applied to the project costs excluding charger purchase costs to include:

- Engineering design fees
- Contractor profits

Permitting

Each local authority with jurisdiction mandates electrical permits for installation of EV chargers:

- Electrical permit fees charged by local jurisdictions, typically $5k per site plus $1k for labor and contingency.

Utility Fees

This consists of fees charged by the electrical utility (Calaveras Public Power Agency) to bring additional power to the fleet charging depot to power the EV chargers, including:

- Electrical upgrade design
- Transformer replacement

CONTINGENCIES

A 25% mark-up has been applied to the project costs for each cost category consistent with public agency capital project budgeting.

OPERATIONS & MAINTENANCE EXPENDITURE (OPEX) ESTIMATES

To estimate the operating and maintenance expenses (OPEX) the County and City will have to cover, various cost categories were considered as described in the following.

DEPRECIATION

- Assuming a depreciation of the charging hardware (charging stations) over their lifecycle, implying the need to budget for a replacement of that hardware through an OPEX budget (annual depreciation)
- Assuming an 8-year lifespan for Level 2 chargers, DCFCs, and load management devices (12.5% annual depreciation).
- Include one load management device (~$2,500) per site

MAINTENANCE

Routine maintenance

- Simple, small-scale activities (usually requiring only minimal skills or training) associated with regular (weekly or monthly) and general upkeep of charging stations against normal wear and tear. For example:
  - Resetting the Wi-Fi router or cellular gateway (if needed)
  - Resetting a breaker (if needed)
  - Cleaning the station, incl. checking the connector for any debris lodged in between the pins
  - Potential snow and trash removal
  - Labor involved from on-site staff
- % of depreciation, scaling down with higher numbers of chargers, as a decreasing marginal cost to service each additional charger onsite can be expected
  - Sites with less than 5 charging stations: 33% of annual depreciation*
  - Sites with 5-9 charging stations: 25% of annual depreciation*
  - Sites with 10-19 charging stations: 15% of annual depreciation*

  **assuming DCFCs have the annual depreciation of Level 2s (a DCFC's routine maintenance needs do not differ from those of Level 2 stations to the same extent as the hardware cost difference would suggest)*

Preventative maintenance

This would include remote monitoring, detection, correction, and prevention of incipient failures on the charging stations, before they become actual or major failures. Since this is not typically provided as a separate service by charging providers, it is assumed that such expenses are covered under the "Corrective maintenance" category.

Corrective maintenance

- Extended warranty for potentially necessary repair work, truck rolls, etc., estimated at $300 per instance
- Sites with less than 5 charging stations: ~1 instance/year → 1x$300/year = $300/year
- Sites with 5-9 charging stations: ~2 instances/year → 2x$300/year = $600/year
- Sites with 10-19 charging stations: ~3 instances/year → 3x$300/year = $900/year

EXPENSES INCURRED AT THE COUNTY AND CITY ITSELF

Vandalism and insurance

It was assumed that potential vandalism is covered by the municipal insurance policy.

Staffing

It was assumed that potential staffing needs include general management of chargers, training, maintenance coordination, billings, as well as vehicle rotation if applicable. Any related costs are assumed to be covered under "Routine maintenance".

Parking revenue loss

Parking revenue loss may be incurred when charging equipment occupies revenue generating parking space(s), but was not assumed in the provided estimates given that fleet chargers will be placed at fleet parking spaces.

EXPENSES OWED TO THE CHARGING PROVIDER

Licensing fees (for software/load management)

- To use charging software, typically includes a load management setup
- Estimated at roughly $100-$200 per site per month, based on scope and complexity (based on information from charging providers)
- Sites with less than 5 charging stations: $100/month
- Sites with 5-9 charging stations: $130/month
- Sites with 10-19 charging stations: $170/month

Networking fees

- For internet connection (WiFi/Ethernet or cellular gateway), assumed to be ~$85/month per site

Potential kWh fee

- Revenue sharing is required by some charging station providers. It can e.g. be used as a way for the provider to hide potential credit card processing fees.
- Assumed to be 1 ct/kWh dispensed by the chargers, with the total annual kWh dispensed by chargers at each site determined by the projected fleet energy demand.

ELECTRICITY EXPENSES

- Given a lack of detailed information on electricity rate plans by the Calaveras Public Power Agency, an average effective electricity rate of $0.40 per kWh was assumed to estimate future electricity expenses incurred from fleet EV charging. This effective rate is in line with average electric rates in Calaveras County, see e.g. https://www.energysage.com/local-data/electricity-cost/ca/calaveras-county/.

POTENTIAL CLEAN FUEL STANDARD REVENUE

- County and City could leverage California's Low Carbon Fuel Standard (LCFS) to generate credits from their charging stations and thus revenue.
- Based on DKS' previous project experience, this revenue can amount to up to a third of the annual electricity expenses.

CONTINGENCY

It is recommended to the County and City to include an additional 20% contingency in OPEX estimates to cover market and price fluctuations for budgeting purposes. This contingency was not included in the shown estimates.

ADDITIONAL ASSUMPTIONS

The annual OPEX estimates referenced in this document refer to annually incurred costs within each phase and at each specific location, considering all installed charging stations and electrified vehicles by that phase.

It is implicitly assumed that chargers to be added in each phase are installed at the beginning of each phase, i.e. they start incurring the listed OPEX during the entirety of the phase. If the County or City choose to only install some chargers e.g. halfway through a phase, such as in 2032, then the total shown annual OPEX in that location will only be reached then. Hence, the listed values are generally an estimate of the *maximum* to be expected OPEX over time.

APPENDIX H. CONCEPTUAL CHARGER INSTALLATION LAYOUT PLANS

CALAVERAS COUNTY - GOVERNMENT CENTER WEST LOT

# OF VEHICLES THAT CAN BE CHARGED SIMULTANEOUSLY	14

	LOW OUTPUT
# OF CHARGERS	7

Phase 1 Construction

CONSTRUCTION PHASES:
Phase 1: 2025-2028
Phase 2: 2029-2034
Phase 3: 2035 Onwards

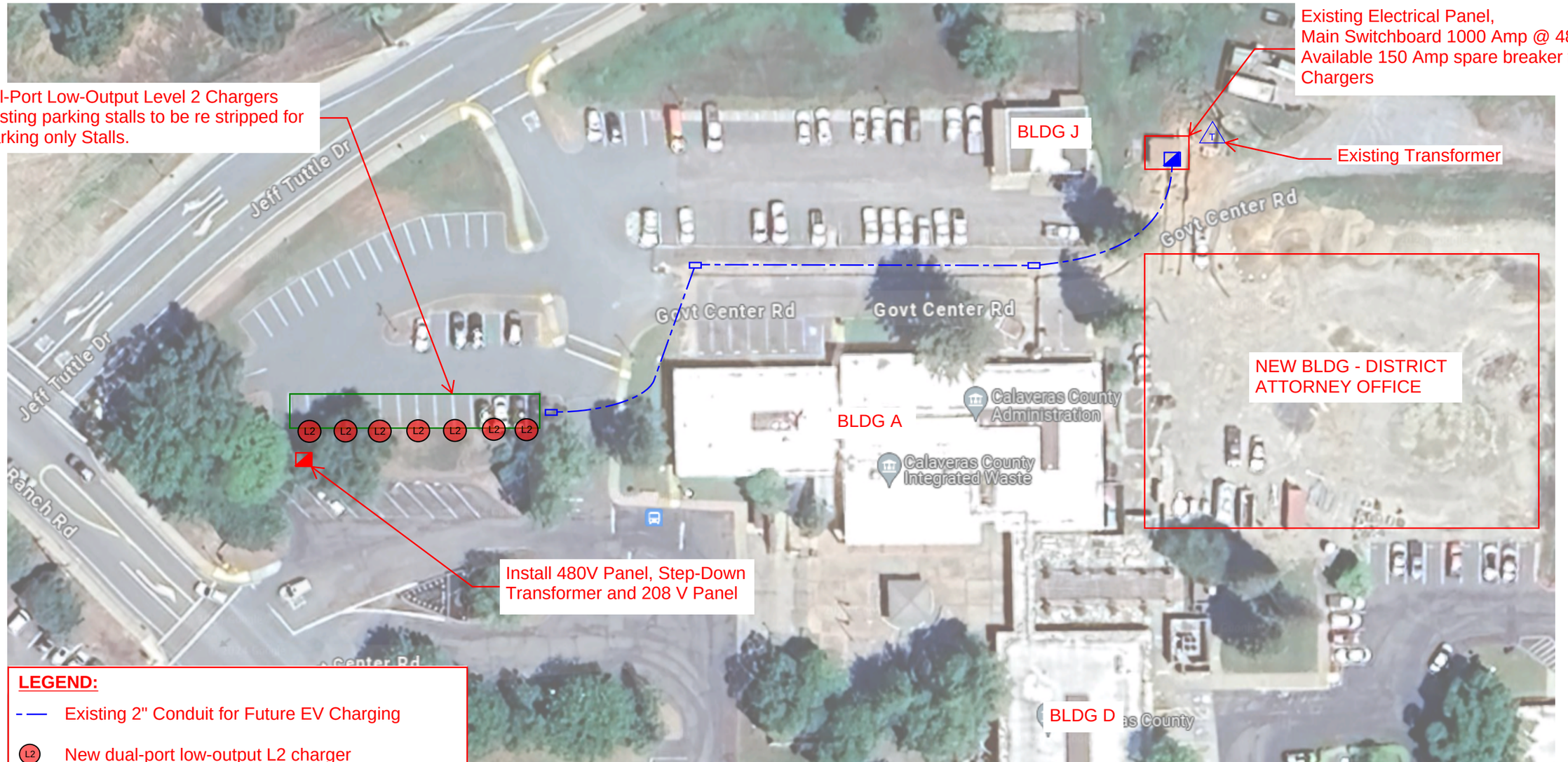
7 Dual-Port Low-Output Level 2 Chargers
14 existing parking stalls to be re stripped for EV parking only Stalls.

Existing Electrical Panel,
Main Switchboard 1000 Amp @ 480V, 3 phase
Available 150 Amp spare breaker to power EV Chargers

Existing Transformer

NEW BLDG - DISTRICT ATTORNEY OFFICE

Install 480V Panel, Step-Down Transformer and 208 V Panel



LEGEND:

- Existing 2" Conduit for Future EV Charging
- New dual-port low-output L2 charger
- Existing electrical switchboard/panel
- New electrical switchboard/panel/sub-panel
- Existing transformer
- Existing Pull Box

N

CALAVERAS COUNTY - GOVERNMENT CENTER EAST LOT

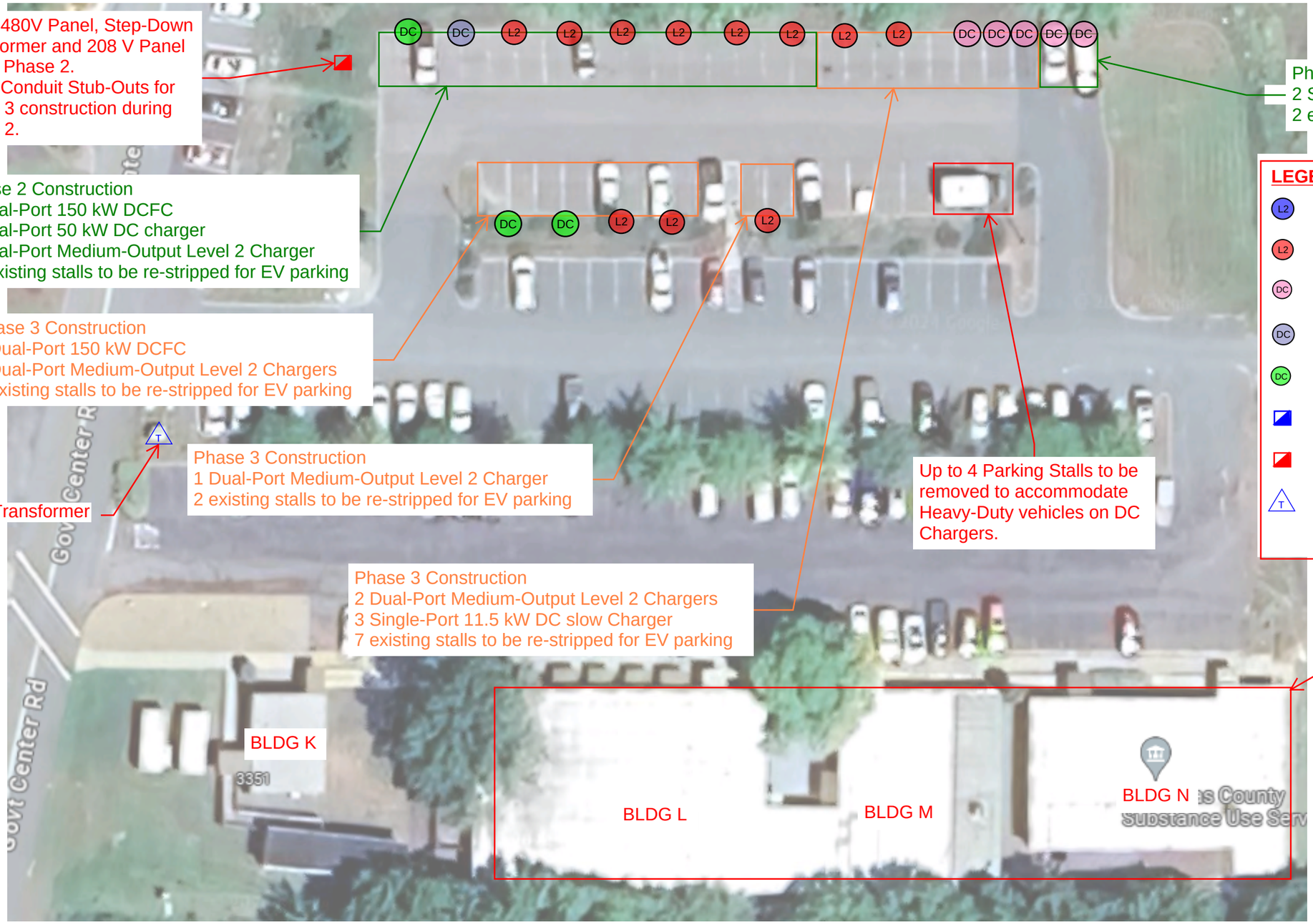
# OF VEHICLES THAT CAN BE CHARGED SIMULTANEOUSLY	35

Existing 35 Parking Stalls to be re stripped to EV Charging Only Stalls and up to 4 Parking Stalls to be removed to accommodate Heavy-Duty vehicles on DC Chargers.

	MEDIUM OUTPUT	11.5 kW DC SLOW	50 kW DC	150 kW DCFC
# OF CHARGERS	11	5	1	3

CONSTRUCTION PHASES:
Phase 1: 2025-2028
Phase 2: 2029-2034
Phase 3: 2035 Onwards

Phase 2: 6 medium-output dual-port L2 chargers, 2 DC-slow single-port chargers, 1 dual-port 50 kW DC medium charger and 1 dual-port 150 kW DC fast charger.
Phase 3: 5 medium-output dual-port L2 chargers, 3 DC-slow single-port chargers, and 2 dual-port 150 kW DC fast chargers.



Install 480V Panel, Step-Down Transformer and 208 V Panel during Phase 2.
Install Conduit Stub-Outs for Phase 3 construction during Phase 2.

Phase 2 Construction
1 Dual-Port 150 kW DCFC
1 Dual-Port 50 kW DC charger
6 Dual-Port Medium-Output Level 2 Charger
16 existing stalls to be re-stripped for EV parking

Phase 3 Construction
2 Dual-Port 150 kW DCFC
2 Dual-Port Medium-Output Level 2 Chargers
8 existing stalls to be re-stripped for EV parking

Phase 3 Construction
1 Dual-Port Medium-Output Level 2 Charger
2 existing stalls to be re-stripped for EV parking

Existing Transformer

Phase 3 Construction
2 Dual-Port Medium-Output Level 2 Chargers
3 Single-Port 11.5 kW DC slow Charger
7 existing stalls to be re-stripped for EV parking

Up to 4 Parking Stalls to be removed to accommodate Heavy-Duty vehicles on DC Chargers.

Phase 2 Construction
2 Single-Port 11.5 kW DC slow Chargers
2 existing stalls to be re-stripped for EV parking

LEGEND:

- Existing single/dual-port L2 charger
- New dual-port low/medium/high-output L2 charger
- New single-port DC slow charger (11.5 kW)
- New dual-port DC fast charger (50 kW)
- New dual-port DC fast charger (150 kW)
- Existing electrical switchboard/panel
- New electrical switchboard/panel/sub-panel
- Existing transformer

Green Text = Implementation Phase 2
Orange Text = Implementation Phase 3

Major Renovations planned for phase 2, Electrical Service to be sized based on the building loads and EV Charging Loads. Add an additional 1500 kVA of Electrical Loads from EV Chagring.

N

CALAVERAS COUNTY - SHERIFF'S OFFICE

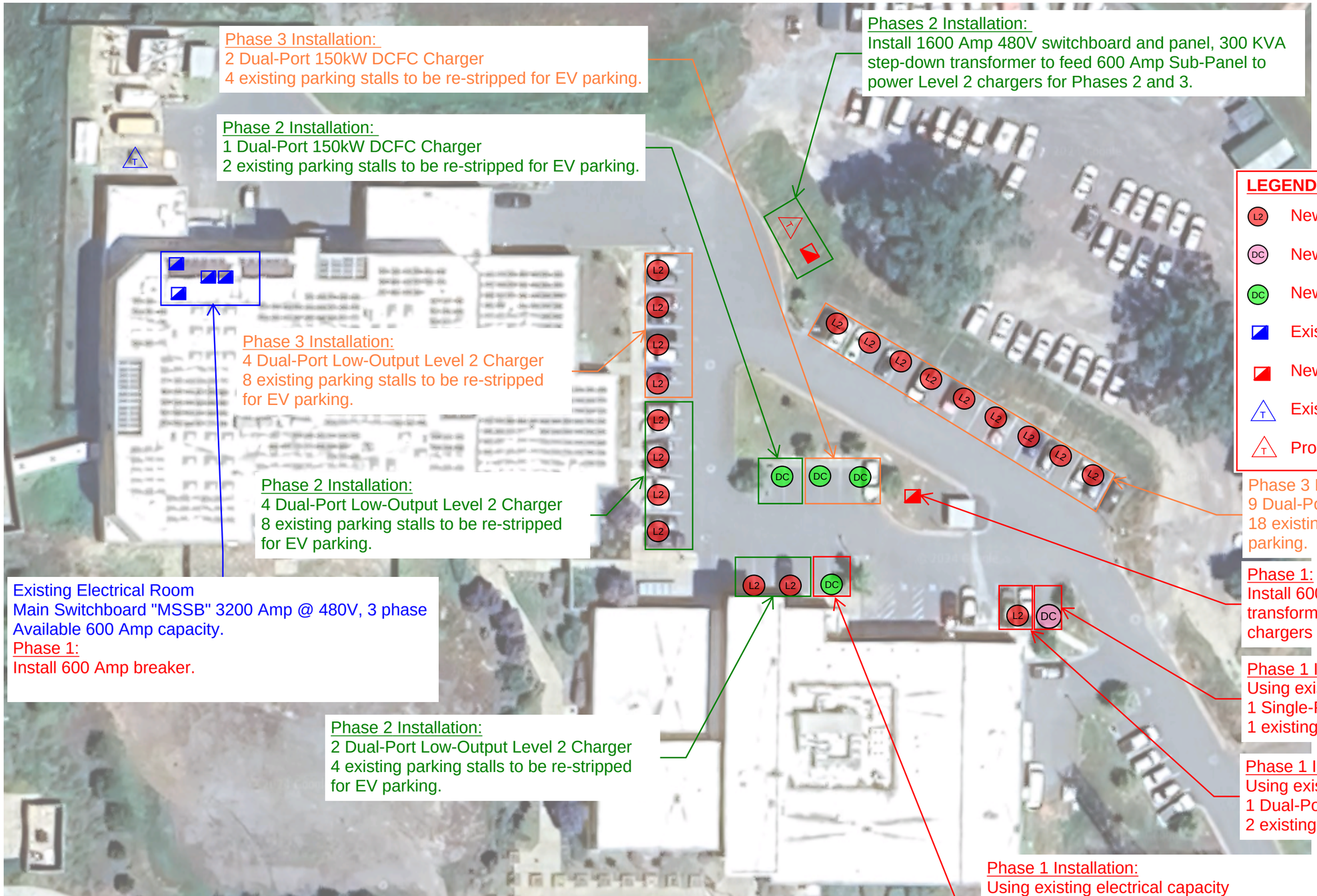
Red Text = Implementation Phase 1
Green Text = Implementation Phase 2
Orange Text = Implementation Phase 3

# OF VEHICLES THAT CAN BE CHARGED SIMULTANEOUSLY	49

	MEDIUM OUTPUT	22.5 kW DC SLOW	150 kW DCFC
# OF CHARGERS	20	1	4

Phase 1: 1 medium-output dual-port L2 charger,
1 DC single-port charger, and
1 dual-port 150 kW DC fast charger.
Phase 2: 6 medium-output dual-port L2 chargers and
1 dual-port 150 kW DC fast charger.
Phase 3: 13 medium-output dual-port L2 chargers and
2 dual-port 150 kW DC fast chargers.

CONSTRUCTION PHASES:
Phase 1: 2025-2028
Phase 2: 2029-2034
Phase 3: 2035 Onwards



LEGEND:

- New dual-port low/medium/high-output L2 charger
- New single-port DC slow charger (22.5 kW)
- New dual-port DC fast charger (150 kW)
- Existing electrical switchboard/panel
- New electrical switchboard/panel/sub-panel
- Existing transformer
- Proposed Transformer

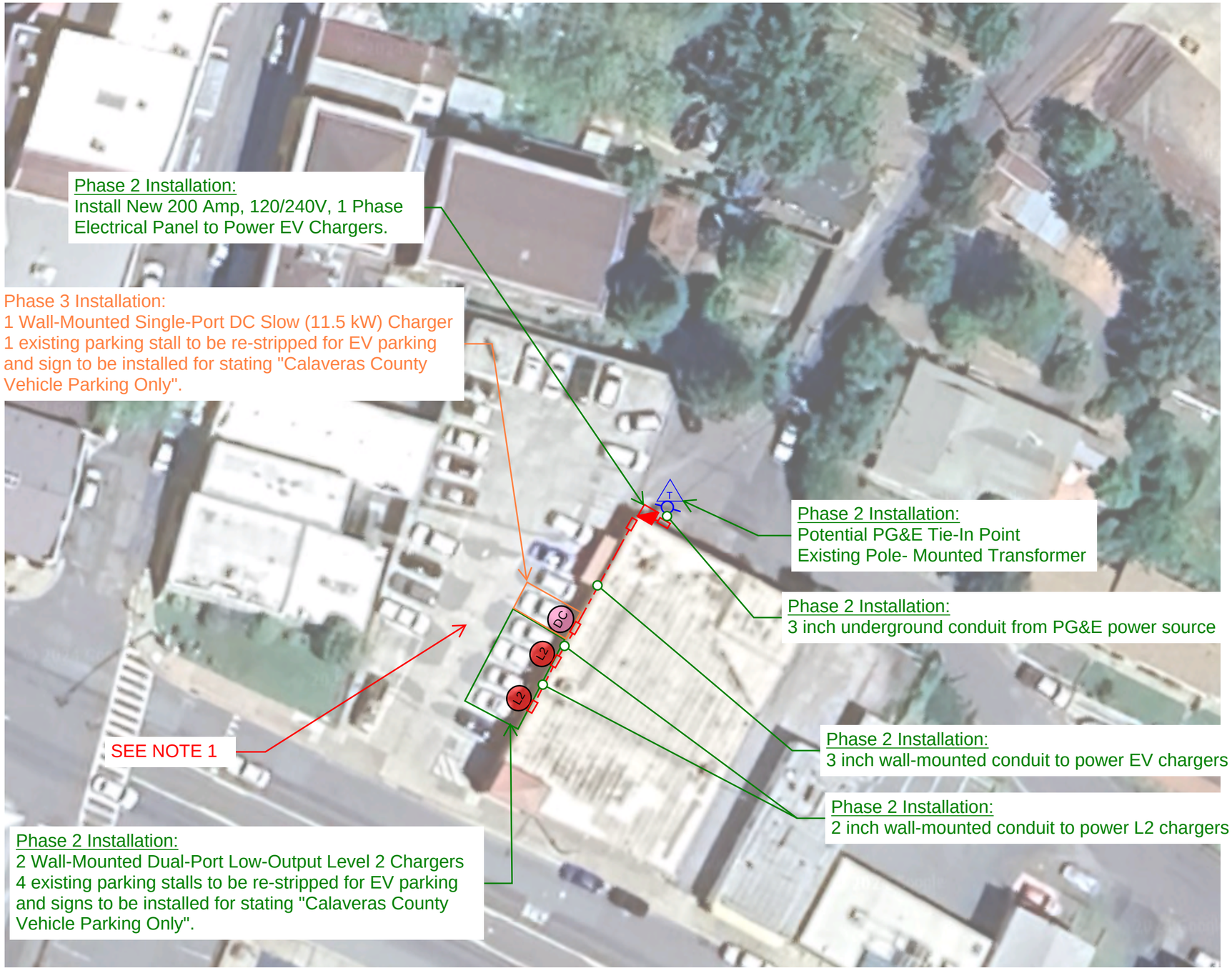
CALAVERAS COUNTY - PROBATION (COLOMBO) BUILDING

# OF VEHICLES THAT CAN BE CHARGED SIMULTANEOUSLY	5

	LOW OUTPUT	11.5 kW DC SLOW
# OF CHARGERS	2	1

Phase 2: 2 low-output dual-port L2 charger.
Phase 3: 1 DC-slow single-port charger.

CONSTRUCTION PHASES:
Phase 1: 2025-2028
Phase 2: 2029-2034
Phase 3: 2035 Onwards



LEGEND:

- Proposed Conduit for EV Charging
- New dual-port low-output L2 charger
- New single-port DC slow charger (11.5 kW)
- New electrical switchboard/panel
- Pull Box (Wall-Mounted/In-Ground)
- Existing PG&E Pole and Transformer

Green Text = Implementation Phase 2
Orange Text = Implementation Phase 3

NOTE 1: THE EXISTING PARKING LOT PROHIBITS VEHICLES OVER 5000 LBS. THIS WOULD EXCLUDE HEAVY VEHICLES LIKE FORD F-150 LIGHTNING AND OVER.

N

CALAVERAS COUNTY - HEALTH AND HUMAN SERVICES

# OF VEHICLES THAT CAN BE CHARGED SIMULTANEOUSLY	8

	LOW OUTPUT
# OF CHARGERS	4

Phase 2: 2 low-output dual-port L2 charger.
Phase 3: 2 low-output dual-port L2 chargers.

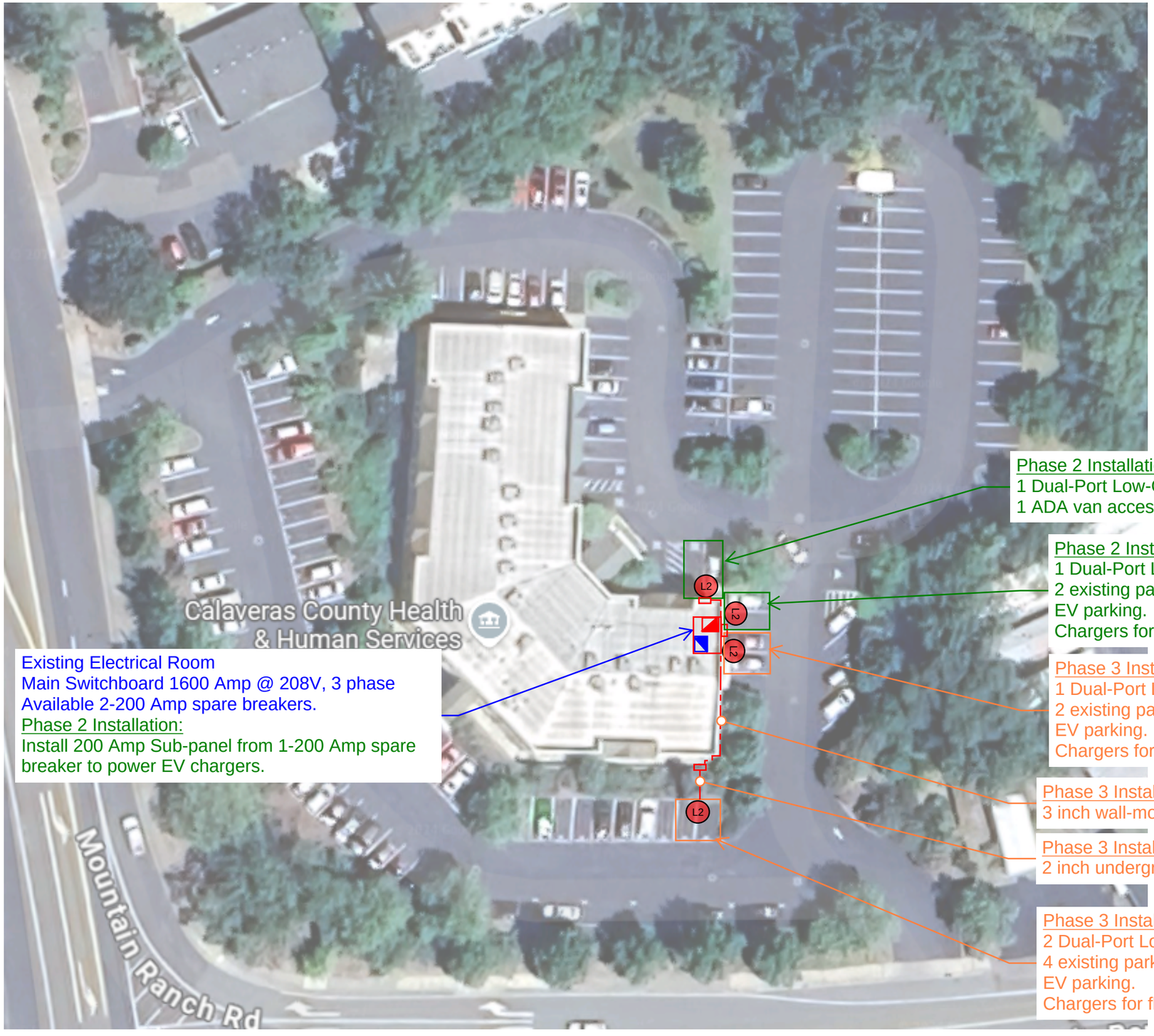
1 Charger for Public Charging in Phase 2.

CONSTRUCTION PHASES:
Phase 1: 2025-2028
Phase 2: 2029-2034
Phase 3: 2035 Onwards

LEGEND:

- Proposed Conduit for EV Charging
- L2 — New dual-port low-output L2 charger
- Existing electrical switchboard/panel
- New electrical switchboard/panel/sub-panel
- Pull Box

Green Text = Implementation Phase 2
Orange Text = Implementation Phase 3



Existing Electrical Room
Main Switchboard 1600 Amp @ 208V, 3 phase
Available 2-200 Amp spare breakers.
Phase 2 Installation:
Install 200 Amp Sub-panel from 1-200 Amp spare breaker to power EV chargers.

Phase 2 Installation:
1 Dual-Port Low-Output Level 2 Charger for public use.
1 ADA van accessible and 1 Non-ADA parking stall.

Phase 2 Installation:
1 Dual-Port Low-Output Level 2 Charger
2 existing parking stalls to be re-stripped for EV parking.
Chargers for fleet use.

Phase 3 Installation:
1 Dual-Port Low-Output Level 2 Charger
2 existing parking stalls to be re-stripped for EV parking.
Chargers for fleet use.

Phase 3 Installation:
3 inch wall-mounted conduit to power L2 charger (Typ.)

Phase 3 Installation:
2 inch underground conduit to power L2 charger (Typ.)

Phase 3 Installation:
2 Dual-Port Low-Output Level 2 Chargers
4 existing parking stalls to be re-stripped for EV parking.
Chargers for fleet use.

N

CITY OF ANGELS CAMP - CITY HALL/POLICE DEPARTMENT

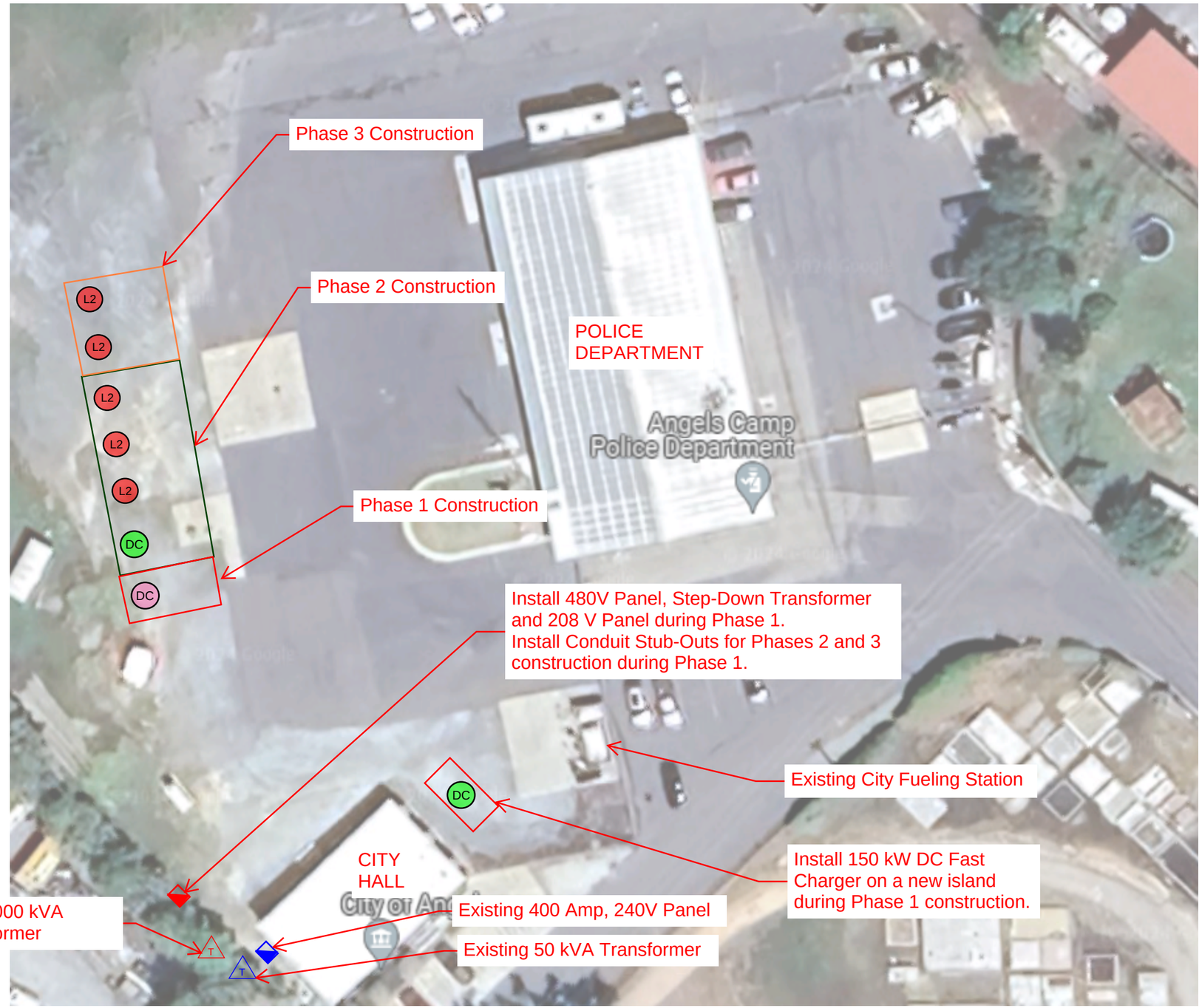
# OF VEHICLES THAT CAN BE CHARGED SIMULTANEOUSLY	10

Existing 13 Parking Stalls to be re stripped to EV Charging Only Stalls and one centralized DC Fast Charging station to be installed.

	LOW OUTPUT	MEDIUM OUTPUT	11.5 kW DC SLOW	150 kW DCFC
# OF CHARGERS	2	3	1	2

Phase 1: 1 DC-slow single-port and 1 dual-port 150 kW DC fast charger.
Phase 2: 3 medium-output dual-port L2 chargers, and 1 dual-port 150 kW DC fast charger.
Phase 3: 2 low-output dual-port L2 chargers

CONSTRUCTION PHASES:
Phase 1: 2025-2028
Phase 2: 2029-2034
Phase 3: 2035 Onwards

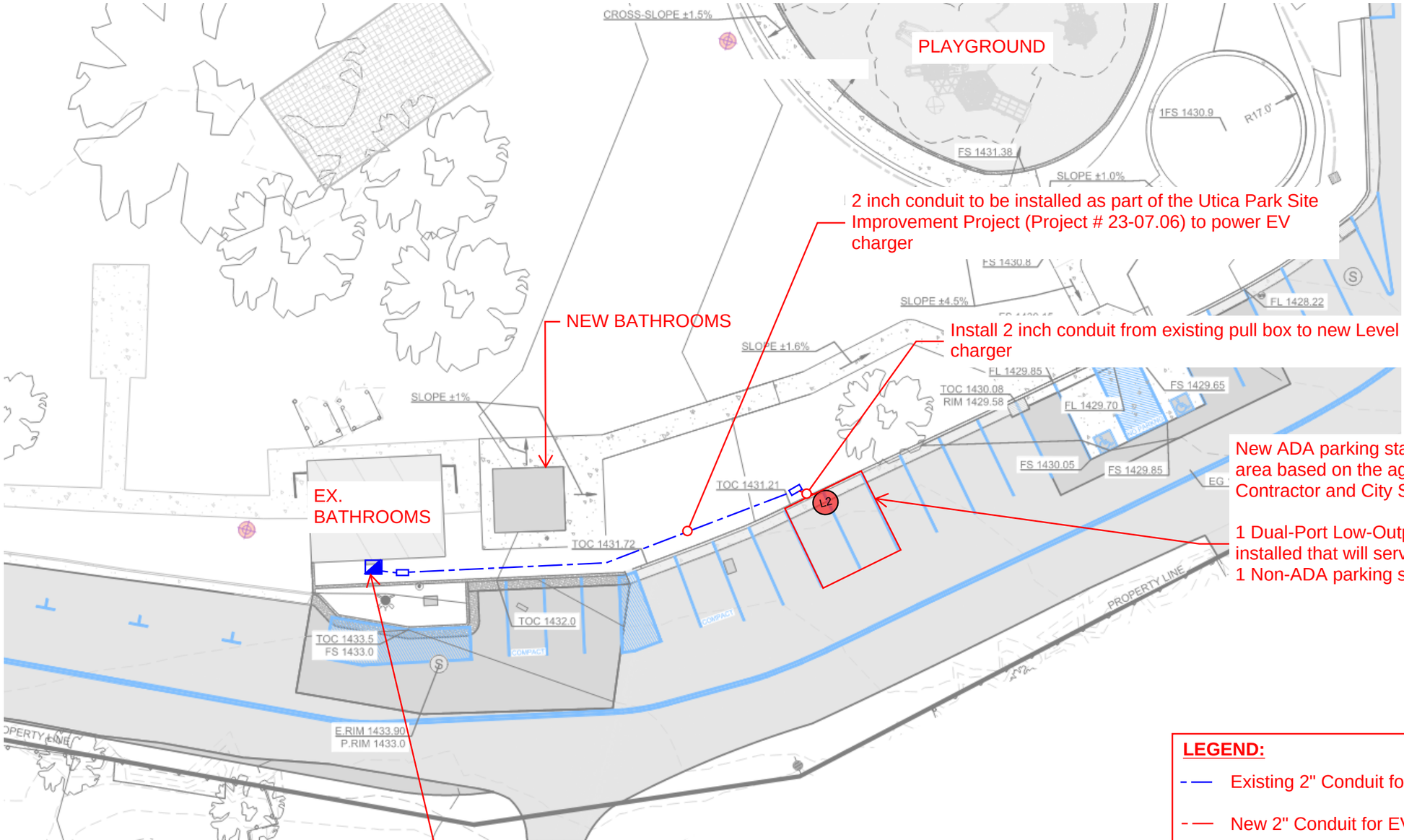


LEGEND:

- L2 — New dual-port low/medium/high-output L2 charger
- DC — New single-port DC slow charger (11.5 kW)
- DC — New dual-port DC fast charger (150 kW)
- Existing electrical switchboard/panel
- New electrical switchboard/panel/sub-panel
- T — Existing Transformer
- T — New Transformer

N

CITY OF ANGELS CAMP - UTICA PARK



2 inch conduit to be installed as part of the Utica Park Site Improvement Project (Project # 23-07.06) to power EV charger

Install 2 inch conduit from existing pull box to new Level 2 charger

New ADA parking stalls to be relocated in this area based on the agreement between the Contractor and City Staff.

1 Dual-Port Low-Output Level 2 charger to be installed that will serve 1 ADA van accessible and 1 Non-ADA parking stall.

Existing 200 Amp, 240 V Service. Install 2-40 Amp breakers to power new Level 2 charger.

# OF VEHICLES THAT CAN BE CHARGED SIMULTANEOUSLY	2

LEGEND:

- Existing 2" Conduit for Future EV Charging
- New 2" Conduit for EV Charging
- L2 — New dual-port low-output L2 charger
- Existing electrical switchboard/panel
- Existing Pull Box