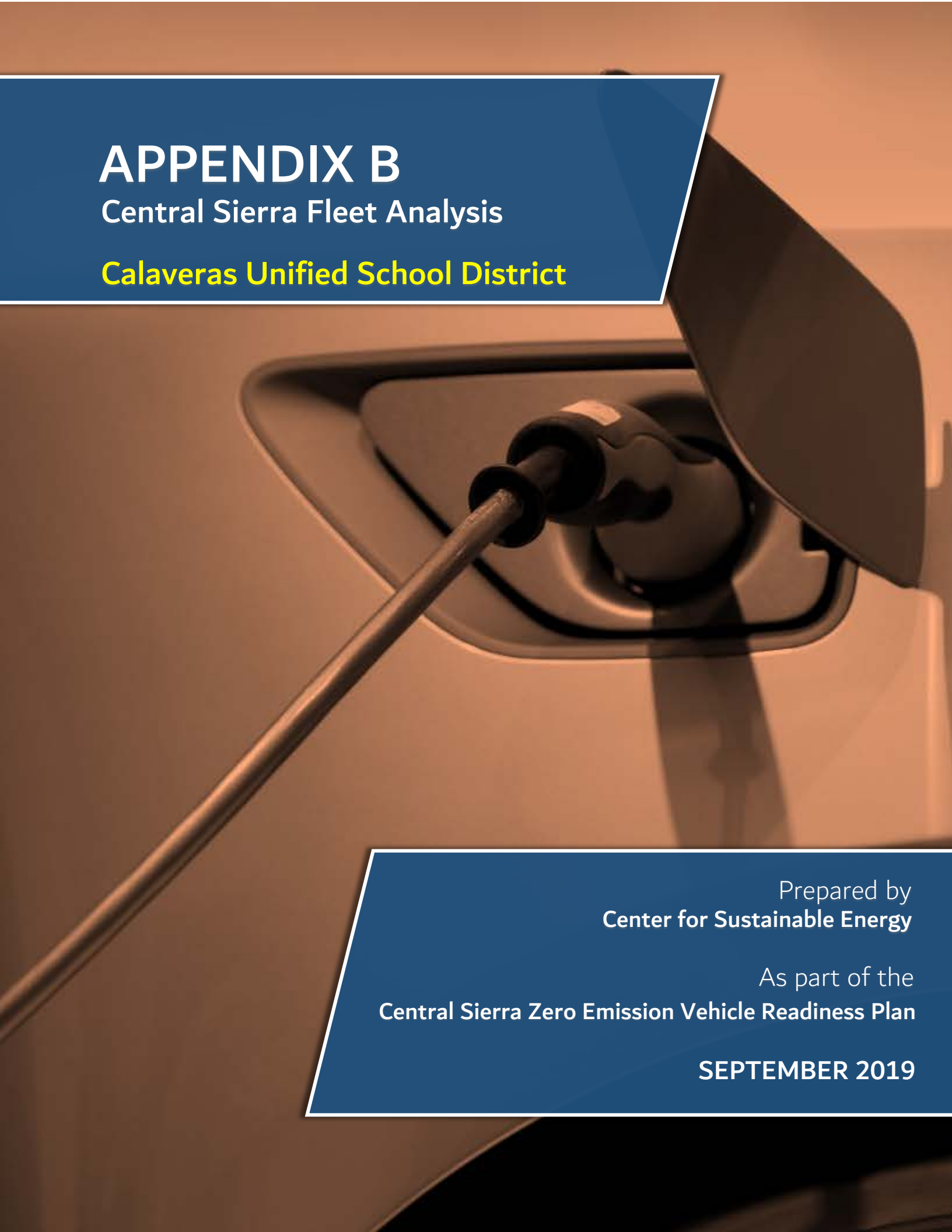

APPENDIX B

Central Sierra Fleet Analysis

Calaveras Unified School District

Prepared by

Center for Sustainable Energy

As part of the

Central Sierra Zero Emission Vehicle Readiness Plan

SEPTEMBER 2019

I. Introduction

Governor Edmund G. Brown Jr.'s Executive Order B-48-18 committed to a target of 5 million zero-emission vehicles (ZEVs) registered and operating on California roads by 2030. As part of the Central Sierra region's efforts to comply with the mandates of the Executive Order, the Tuolumne County Transportation Council (TCTC) engaged the Center for Sustainable Energy (CSE) to develop a ZEV Readiness Plan (the Plan) for the four-county Central Sierra region, consisting of the counties of Alpine, Amador, Calaveras, and Tuolumne.

The goal of the Plan is to improve opportunities for ZEV Readiness in the Region and resolve barriers to the widespread deployment of private and public ZEV infrastructure. In pursuit of this goal, the Tuolumne County Transit (TCT) fleet was analyzed to identify opportunities for electrification. The analysis focused on the following:

- Analyzing the current fleet and identifying inventory that can be replaced with electric or plug-in hybrid alternatives.
- Estimating the capital cost to replace current/future vehicles with electric or plug-in hybrid alternatives. Identify incentives and other cost savings associated with fleet transition.
- Discussing benefits of replacing internal combustion vehicles with ZEVs.

Findings

- Currently, Calaveras Unified School District has **37 vehicles** that have electric replacement options, either available currently or in the very near-term (next 2-4 years).
- The estimated total cost of replacing 37 vehicles with similar, 2019 model-year internal combustion vehicles is approximately $3.61 million. Of these 37 vehicles, all have appropriate BEV replacements and none have appropriate PHEV replacements.
- The following replacement scenario (a full-BEV scenario) was identified:
    - **BEV-Only Scenario**: Replace all eligible vehicles with fully electric alternatives. This will cost approximately $4.04 million (an incremental cost of $432,122), save up to $1.8 million in fuel costs and abate 11,295 tonnes of GHGs over the vehicles' assumed lifetime of ten years.
- Payback periods on both vehicles are favorable – an estimated 2 years with the eLion Type C school bus, and approximately 9 years with the Motiv EPIC 4 chassis.
- BEVs/PHEVs typically have lower maintence requirements/costs, compared to internal combustion engine vehicles, but specific savings are difficult to predict given the nascent state of the market.
- Benefits of converting to ZEVs include reduced environmental impact, reduced maintenance costs, and achieving/maintaining regulatory compliance.

II. Current Fleet Replacement Analysis

CSE examined the School District's current fleet inventory to determine which vehicles may have suitable electric replacement options. This analysis found that there are **37 total vehicles (5 unique models)** that can be replaced with electric vehicles. Table 1 shows the current vehicles identified as candidates for electric replacement:

Table 1: Existing fleet vehicles with suitable replacement options (PHEV and/or BEV)

Count of Vehicles	Model Year	Make	Model	Classification	Suitability of Available Replacement (BEV/PHEV)
5	1980-1987	Crown	Coach Bus	Heavy-Duty Diesel	High/None
1	1989	Collins	Bantam	Medium-Duty Diesel	High/None
2	1997	Collins	Bantam	Medium-Duty Diesel	High/None
8	1994	Thomas	West Coaster	Heavy-Duty Diesel	High/None
5	2001-2013	International	CE	Heavy-Duty Diesel	High/None
16	2002-2015	International	RE	Heavy-Duty Diesel	High/None

Note: "Suitability of Available Replacement" reflects the likelihood that the currently available BEV/PHEV models can serve as a direct replacement for the existing vehicles, considering duty cycle, passenger capacity, and other variables.

Please note that the recommendations outlined in section 3 are general recommendations based on vehicle size and weight and may not be direct replacements due to variations in requirements for duty cycle, passenger capacity, and/or other specific considerations. For more information and additional alternatives, please see the Internal Combustion Vehicle Replacement Guide (enclosed as an attachment to the original email). Please assess your fleet's unique needs as thoroughly as possible through data and use monitoring and carefully considering each vehicle's unique service requirements.

III. Replacement Options

While these vehicles have replacement options for each, some are more cost-effective than others. For example, recommendations for replacement of light-duty trucks are less cost-effective and offer fewer options than recommendations for replacing sedans. Electric light-duty truck options are rapidly being released to the market and we expect that there will be more options available within ten years.

Due to their fleet's composition of heavy- and medium-duty buses with no PHEV options, Calaveras Unified School District has only an all BEV replacement option. This scenario is depicted in Table 2. Table 3 shows the existing vehicles, their associated BEV replacement vehicles, the estimated vehicle-life and entire-class fuel cost savings, and abated GHG emissions resulting from converting the entire vehicle class.

Table 2: BEV-only fleet replacement scenario (cost)

Count	Class	BEV/ PHEV	Proposed Make and Model	ICE MSRP (unit)	ZEV MSRP (unit)	Incremental Cost (unit)	Cost of ZEV Replacements	Potential Incentives
34	Heavy Duty Diesel	BEV	eLion School Bus, Type D	$101,520	$330,108	$228,588	$11,223,672	$220,000 x34 = $7,480,000
3	Medium Diesel Bus	BEV	Motiv EPIC 4 Dearborn on Ford E450 Platform - School Bus	$51,860	$188,570	$136,710	$565,710	$90,000 x3 = $270,000
					Subtotal	**$8,182,122**	**$11,789,382**	**$7,750,000**
						TOTAL INCREMENTAL COST (Incremental Cost – Incentives)		**$432,122**

*Costs are for chassis only. Representative models have not been tested by Altoona.

Table 3: Battery-electric vehicle replacement table.

Fully Electric Options								
Car Class	**Representative Model Being Replaced**	**Replacement Vehicle**	**Quantity of Eligible Vehicles in Class**	**Estimated Per-Vehicle Annual Fuel Savings**	**Vehicle Lifetime Savings**	**Estimated Payback Period (Years)**	**Total Class Lifetime Fuel Savings**	**Total Class Lifetime GHG Savings (tonnes)**
Heavy Duty	Thomas West Coaster	Lion Electric Type D (without Lift)	34	$4,470	$48,945	2	$1,664,139	10,414.20
Medium Duty	Collins Bantam	Motiv EPIC 4 Dearborn on Ford E450 Platform - School Bus	3	$4,187	$45,844	9	$137,532	880.61
		Subtotal	**37**	**$8,657**	**$94,789**	**--**	**$1,801,670**	**11,294.81**

Calaveras Unified School District has an option for low-cost, zero-carbon electricity from the New Melones Dam. As such, the Estimated Per-Vehicle Annual Fuel Savings; Vehicle Lifetime Savings; Estimated Payback Period; Total Class Lifetime Fuel Savings; and Total Class Lifetime GHG Savings reflects operating the vehicles using Tuolumne Public Power Agency energy. The following assumptions (Table 4) were incorporated in the above tables:

Table 4: Assumptions underpinning tables 3a and 3b (above).

Assumption	Value
Vehicle Service Life*	10 years
Gasoline Price ($/gallon)	$2.95
Gasoline GHG Intensity (kg CO2e/gallon)	8.78 kg
Diesel Price ($/gallon)	$2.70
Diesel GHG Intensity (kg CO2e/gallon)	10.21 kg
Electricity Price † ($/kWh)	$0.110
Electricity GHG Intensity † (kg CO2e/kWh)	0 kg (optional)
*Vehicles are frequently kept longer than this value, providing further savings on fuel and GHG abatement	

In general, heavy-duty vehicles are relatively well represented within the battery-electric vehicle market, although range, cargo volumes, and other specifications may not exactly match existing vehicles. Certain niches are difficult to replace. For example, cutaway bus models are now on the market, but tend to be rare. Specific suitability depends on several variables, including terrain, use intensity, and passenger capacity requirements. Plug-in hybrid heavy-duty vehicles, such as school buses, are even rarer, and thus are typically excluded from the analysis.

Furthermore, plug-in vehicle costs are significantly higher than gas-powered comparisons. Table 2 outlines the estimated incremental costs associated with each vehicle. A vehicle with an incremental cost value of $0 means that after incentives are factored in, the cost of procuring that vehicle is not more than simply purchasing a direct replacement vehicle.

The vehicle replacement analysis used average fuel prices as reported by the Tuolumne County Transportation Council, and divided the fleet's vehicles into classes shown above, using a representative

vehicle's mileage and fuel consumption to reflect the "typical" vehicle within each class. The representative vehicle was then compared to the replacement plug-in vehicle**.**

Calaveras Unified School District's fleet is composed of heavier-duty, full-size school buses. These large buses qualify for excellent incentives under the California Air Resource Board's Hybrid Truck and Bus Voucher Incentive Project (HVIP) and offer opportunities for significant fuel savings and greenhouse gas reduction.

In general, vehicles with payback periods longer than 15 years may not offer a good economic return, but can still offer fuel savings, reduce greenhouse gas emissions, and position the fleet as a forward-thinking, environmentally conscious entity.

Other Considerations

The procurement of plug-in vehicles should be straightforward, and in many cases does not differ significantly from the procurement process for internal-combustion vehicles. More specialized applications may require direct communication with a manufacturer or an authorized retailer. Authorized retailers are typically listed on manufacturer websites. Some EVs are available and eligible for reduced cooperative purchase through organizations such as Sourcewell. Incentives outlined below as section 4 offer the ability to lower the upfront cost of procurement but may be subject to additional stipulations and conditions.

Calaveras Unified School District should carefully evaluate all fuel types and available incentives when vehicle replacement decisions are made. California offers rebates and incentives for alternative fuel vehicles and infrastructure: currently available incentives are outlined later in this chapter.

Accessible charging and fueling infrastructure are crucial for successfully incorporating ZEVs into fleets. It is a best practice to evaluate, site, and construct enough infrastructure prior to adding ZEV vehicles. Ideally, electricity demand evaluations are completed, and the appropriate number of charging/fueling stations are installed before vehicles are ordered. While charging at lower power levels (2kW - 7 kW) is adequate for the small batteries found in passenger cars, vehicles with high gross vehicle weights typically require larger batteries. In order to charge these larger batteries fully in a similar amount of time, both buses above require larger power draws. The eLion Type C buses recommended above draw 19.2kW of power, while the Motiv EPIC 4 chasses charge at 15kW.

IV. Incentives

Vehicle Incentives

The California Energy Commission (CEC) and ARB offer alternative transportation grants and rebates through under the Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP) and other low carbon transportation funding. Funding is allocated annually and the 2019-2020 budget for the CEC ARFVTP Program (www.energy.ca.gov/altfuels/) is approximately $95.2 million. ARB managed about $400 million in rebates and projects in FY 2017-18 and 2018-19 through the Air Quality Improvement Program/ Low Carbon Transportation funding plan (www.arb.ca.gov/msprog/aqip/aqip.htm).

The calculations that underpin Tables 3a and 3b use the California Hybrid Truck and Bus Voucher Incentive Project (HVIP) program to offset the incremental cost of electrified buses and trucks.

Clean Vehicle Rebate Project (CVRP)

CSE manages ARB's Clean Vehicle Rebate Project (CVRP) (https://cleanvehiclerebate.org/), which provides rebates of up to $2,500 for light- duty battery electric and plug-in hybrid vehicle purchases. CSE received $120 million in funding for FY 2018-2019. Table 5, *CVRP Rebate Amounts for Light-Duty Vehicles,* summarizes the rebates available.

Table 5: CVRP rebate amounts for light-duty vehicles

Vehicle Class	Maximum Incentive
Light duty zero emission vehicles (ZEV)	$2,500
Plug-in hybrid electric vehicles (PHEV)	$1,500
Zero emission motorcycles (ZEM)	$ 900
Neighborhood electric vehicles (NEV)	$ 900
Note: Eligible vehicles and associated rebate amounts are subject to change. Visit the CVRP program site for eligible vehicle models and associated rebates.	

Hybrid Truck and Bus Voucher Incentive Project (HVIP)

Rebates for commercial vehicles including trucks and buses are available through ARB's Hybrid Truck and Bus Voucher Incentive Project (HVIP) (www.californiahvip.org). As of September 2019, the HVIP estimated fund balance has been exhausted and a waitlist is in effect, but additional funding is expected in January 2020. A summary of the incentives available is provided in the ARB HVIP Voucher Amounts for Trucks and Buses tables below. Additional incentives are available for transit buses, vehicle conversions, and in disadvantaged communities.

Table 6: HVIP Voucher Amounts for *Zero-Emissions* Trucks & Buses

Gross Vehicle Weight (in pounds)	HVIP Maximum Voucher
5,001 – 8,500 lbs	$20,000
8,501 – 10,000 lbs	$25,000
10,001 – 14,000 lbs	$50,000
14,001 – 19,500 lbs	$80,000
19,501 – 26,000 lbs	$90,000
26,001 – 33,000 lbs	$95,000
> 33,001 lbs	$150,000

Table 7. Maximum HVIP Voucher Amounts for *Hybrid* Trucks & Buses

Gross Vehicle Weight (in pounds)	HVIP Maximum Voucher
6,001 – 8,500 lbs (plug-in hybrids only)	$2,000
8,500 – 10,000 lbs (plug-in hybrids only)	$6,000
10,001 – 19,500 lbs	$9,000
19,501 – 26,000 lbs	$12,000
26,001 – 33,000 lbs	$15,000
> 33,000 lbs	$18,000

Note that HVIP additionally provides incentives for electric vehicle charging infrastructure, as outlined in the following Infrastructure section.

Additional Funding Avenues (Vehicles)

Volkswagen Settlement Funding

The Volkswagen Environmental Mitigation trust provides $130 million to the state of California to "replace eligible Class 4-8 school, transit, and shuttle buses with new, commercially available, zero-emission technologies" (Air Resources Board, 2018). A school bus is eligible for a maximum incentive of $400,000; a transit bus is eligible for a maximum incentive of $180,000 (battery electric) or $400,000 (fuel cell); and a shuttle bus is eligible for a maximum incentive of $160,000. All of these awards additionally cover supportive infrastructure. For more information, please visit https://ww2.arb.ca.gov/resources/documents/californias-beneficiary-mitigation-plan

NOTE: VW Mitigation Funds are not stackable with HVIP funds; it is an either/or rebate.

Infrastructure

This analysis only covers the costs and fuel savings associated with the ownership and operation of fleet vehicles themselves. Another crucial component of electrification is the presence of reliable onsite charging infrastructure to ensure that vehicles are present and fueled when they are needed. Table 8, below, outlines the range of costs for the first EVCS port (plug) installed at a given site. Table 9 outlines specific installation variables that are incorporated into the "installation" cost element shown in Table 8. Note that many buses use DC Fast Charging as their default charging method.

Table 8: Approximate costs for non-residential, single-port electric vehicle charging stations (EVCS)
Cost data from Dept. of Energy (2015)

Cost Element	Level 1		Level 2		DC Fast Charge	
	Low	High	Low	High	Low	High
Hardware	$300	$1,500	$400	$6,500	$10,000	$40,000
Permitting	$100	$500	$100	$1,000	$500	$1,000
Installation	$0*	$3,000	$600	$12,700	$8,500	$51,000
Total	$400	$5,000	$1,100	$20,200	$19,000	$92,200

Table 9: Installation component cost ranges
Cost data from SANDAG (2016)

Cost Element	Cost
Conduit	$1.50-$2.50/ft
Trenching	$25-$100/ft
Concrete Patch	$14-$15/sq.ft
Asphalt Patch	$10-$11/sq.ft

Several funding programs exist to reduce the overall cost of installing EVCS at sites.

California Hybrid Truck and Bus Voucher Incentive Program (HVIP)

The HVIP program offers a voucher enhancement of up to $30,000 per vehicle voucher received to reduce the cost of installing EV infrastructure intended to support the ordered vehicles. The enhancements require a separate application, are approved on a case-by-case basis, and can be combined with other funding sources to cover up to 100% of the total capital cost of installation.

Pacific Gas and Electric (PG&E)

PG&E administers two open funding programs for electric vehicle infrastructure. These programs include the FleetReady Program and Fast Charge Program.

- **EV Fleet** – Starting in May 2019. PG&E received $236 million in eligible funds from the California Public Utilities Commission (CPUC) for infrastructure supporting fleet vehicle charging. PG&E is working with fleet managers that request funding across Northern and Central California to install EVCS at 700 sites (pge.com/fleetready).
- **Fast Charge Program** – Starting in summer 2019. PG&E will fund and build infrastructure for public DCFCs, including 25% located within DACs. Furthermore, PG&E will offer rebates for customers in disadvantaged communities (DACs) who wish to purchase DCFCs (CPUC Approves New PG&E Projects to Help Accelerate Electric Vehicle Adoption in California, 2018).

California Electric Vehicle Infrastructure Program (CALeVIP)

CALeVIP offers financial incentives for eligible EVCS infrastructure installations, and works with local governments and community partners to develop regional EV charging projects statewide. CSE manages each regional project, distributes rebates, and provides outreach and informational materials to assist property owners and service providers. Though funding is not available in the current 2019-2020 funding cycle for the Central Sierra region, new projects are added periodically and the region may be included in future funding. For more information, please see the CALeVIP website and browse the currently available projects.

Congestion Mitigation and Air Quality Improvement (CMAQ) Program

The FAST Act authorizes funding of $2.3 billion to $2.5 billion to the CMAQ program for apportionment to the states. States, local governments and transit agencies can use these funds to invest in transportation projects that support the Clean Air Act. Projects eligible for the funds include alternative fuel vehicles and infrastructure. A project supported with CMAQ funds must demonstrate that the project reduces emissions, is located in, or benefits an EPA designated nonattainment or maintenance area and is a transportation project (23 U.S.C. 149) (Federal Highway Administration, 2017). Projects located on FAST-designated corridors (including US 395 and SR 120) receive funding priority over those not located on these corridors.

Note: under the current Buy America requirements that apply to projects funded through this avenue, CMAQ funds may prove prohibitively difficult to utilize.

Volkswagen Settlement

- *Electrify America*

  The Electrify America program is a subsidiary of Volkswagen with the goal of investing $800 million into zero-emission vehicle projects between 2017 and 2027. This investment has typically been into Level 2 and DC Fast Charge infrastructure. Communities can suggest locations, but final siting decisions are ultimately up to Volkswagen/Electrify America.
- *California Volkswagen Mitigation*

The Volkswagen Environmental Mitigation Trust provides approximately $423 million for California to mitigate the additional NOx emissions from diesel Volkswagen vehicles equipped with defeat devices. As part of this, $5 million will be allocated in a competitive solicitation for EV infrastructure buildout. The funding cycle will begin inviting solicitations in Q3/Q4 2019 with the goal of filling physical and funding gaps in installed EVCS.

Center for Sustainable Energy™

One simple mission — DECARBONIZE.

The Center for Sustainable Energy® (CSE) is a nonprofit offering clean energy program administration and technical advisory services. With the experience and streamlined efficiency of a for-profit operation, CSE leads with the passion and heart of a nonprofit. We work nationwide with energy policymakers, regulators, public agencies, businesses and others as an expert implementation partner and trusted resource.

EnergyCenter.org