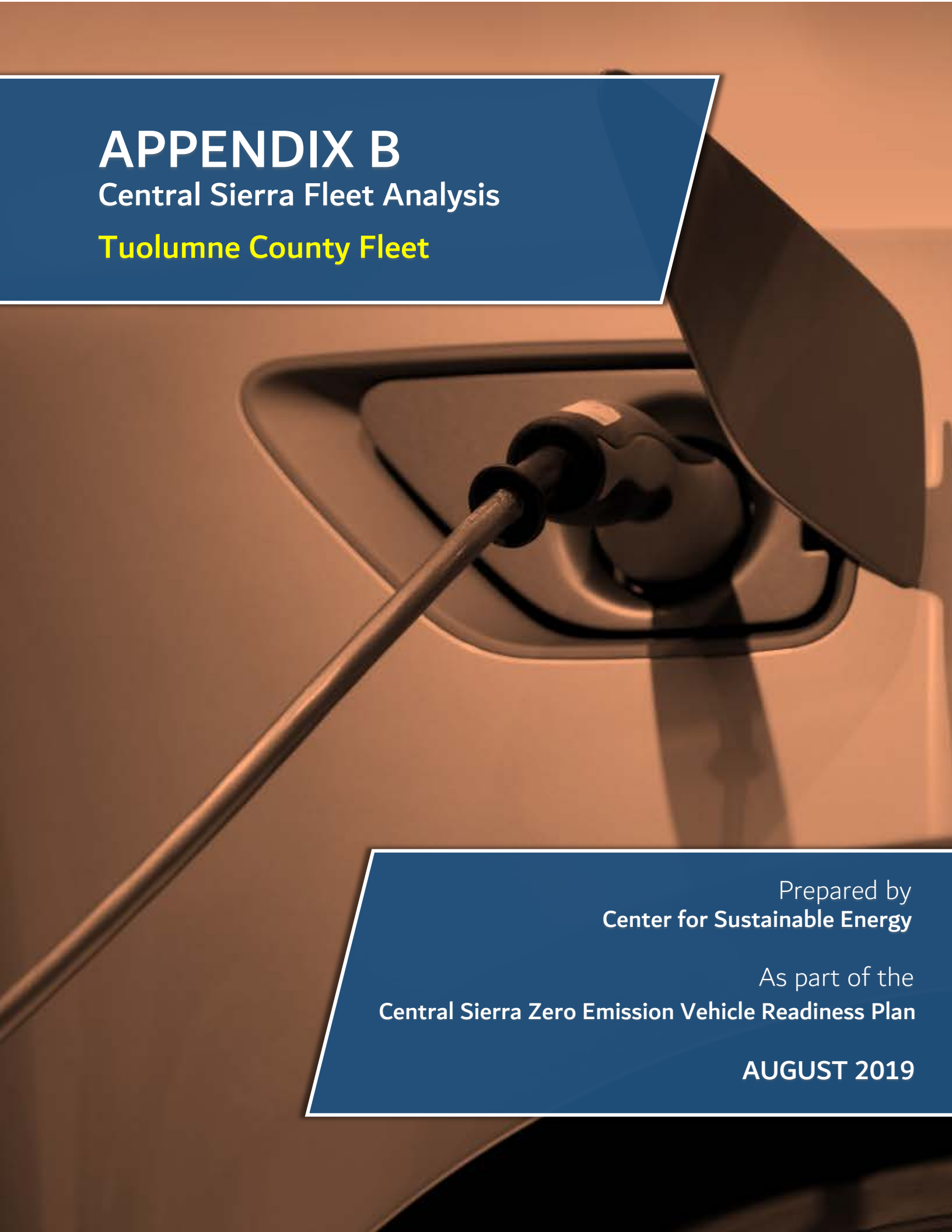

APPENDIX B

Central Sierra Fleet Analysis

Tuolumne County Fleet

Prepared by
Center for Sustainable Energy

As part of the
Central Sierra Zero Emission Vehicle Readiness Plan

AUGUST 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 Central Sierra Region (Region) and resolve barriers to the widespread deployment of private and public ZEV infrastructure. In pursuit of this goal, your fleet's composition and characteristics were examined to provide an assessment of electric replacement options for your vehicles. This analysis seeks to answer the following questions:

- Based on your current fleet, which vehicles can be replaced with electric or plug-in hybrid alternatives?
- How much will these vehicles cost to purchase, and which incentives are available?
- What are the quantitative benefits of replacing these vehicles with their electric alternatives?

II. Findings

- There are **260 vehicles** that have been identified as having electric replacement options, either available currently or in the very near-term (next 2-4 years).
- The incremental costs (the additional expense over a conventionally-powered replacement vehicle) of replacing all of the 260 identified vehicles with BEVs would be approximately $15 million. Replacing all eligible fleet vehicles with PHEVs will cost approximately $1.6 million.
- Replacing all eligible vehicles with electric alternatives would save an approximate total of $154,840 in fuel costs annually with BEVs, and $177,700 with PHEVs, assuming power is sourced from TPPA (New Melones Dam) at a rate of $0.11/kWh.

Vehicles Suitable for Replacement

CSE examined the County's current fleet inventory to determine which vehicles may have suitable electric replacement options. This analysis found that there are **260 total vehicles** that can be replaced with electric vehicles. The table below shows the vehicles which were identified as having a suitable electric replacement option:

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

Count of Vehicles	Model Year	Make	Model	Class	Replacement Model Suitability (BEV/PHEV)
51	1998-2018	Ford Taurus, Subaru Legacy, Toyota Prius	Light Sedan	High/High	High/High
1	2005	Ford E-350 Club Wagon	Light Duty Bus	Moderate/ None	Moderate/None
104	1994-2017	Chevrolet Silverado, Toyota Tacoma, Ford F-150	Light Duty Pickup	Moderate/ High	Moderate/High
4	1993-2012	Ford Altec Boom Lift	Medium Duty Pickup	Moderate/ Moderate	Moderate/ Moderate
73	1970-2018	Dodge Durango, Chevrolet Traverse, Subaru Forester	Light Duty SUV	Low/Low	Low/Low
27	1996-2017	Chevrolet Express, Ford Econoline, Dodge Caravan	Light Duty Van	High/ Moderate	High/Moderate

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. Specifically, recommendations for replacement of light-duty trucks are less cost-effective and offer fewer options than recommendations for replacing sedans. However, electric light-duty truck options are rapidly being introduced to the mass market and we expect that there will be many more options available within the next ten years. The vehicles identified as having suitable electrified and plug-in hybrid (if applicable) replacements are listed in Tables 2a and 2b on the next page.

Table 2a: 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)**
Light Gas Pickup	Chevrolet Silverado 1500	Motiv EPIC 4 Dearborn – Truck Body	104	$492.63	$31,528	19.09	$409,867	3,124.90
Light Gas SUV	Ford Explorer 4x4	Motiv EPIC 4 Dearborn – Truck Body	73	$511.82	$32,757	18.38	$298,904	2,278.90
Light Gas Car	Pontiac Grand Prix	Chevrolet Bolt	51	$856.92	$54,843	0.73	$349,625	950.67
Light Gas Passenger Van	Chevrolet Astro	Lightning Systems Transit 350HD Passenger Van	27	$625.98	$40,062	7.79	$135,211	576.85
Medium Gas Pickup	Chevrolet K3500	Motiv EPIC 4 Dearborn – Truck Body	4	$1,127.68	$72,172	7.23	$36,086	164.25
Light Duty Gas Bus	Ford E-350 Club Wagon	Motiv EPIC 4 Dearborn Chassis	1	$1,127.68	$72,172	7.23	$9,021	41.06

Table 2b: Plug-in hybrid vehicle replacement table.

Plug-in Hybrid 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)**
Light Gas Pickup	Chevrolet Silverado 1500	XL Hybrids Ford F-150 with XLP Plug-In Hybrid Upfit	104	$675.89	$5,407.11	1.57	$562,339.56	1,249.96
Light Gas SUV	Ford Explorer 4x4	XL Hybrids Ford F-150 with XLP Plug-In Hybrid Upfit	73	$702.22	$5,617.78	1.51	$410,097.78	911.56
Light Gas Car	Pontiac Grand Prix	Toyota Prius Prime (PHEV)	51	$843.34	$6,746.76	0.07	$344,084.52	764.83
Light Gas Passenger Van	Chevrolet Astro	Chrysler Pacifica PHEV	27	$327.67	$2,621.36	0.57	$70,776.82	157.32
Medium Gas Pickup	Chevrolet K3500	XL Hybrids F-250	4	$729.23	$5,833.85	0.77	$23,335.38	51.87

Tables 2a and 2b (above) show existing vehicles, their associated BEV replacement vehicles, the estimated vehicle-life and entire-class fuel cost savings, and abated greenhouse gas emissions resulting from converting the entire vehicle class. Tuolumne County 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 3) were incorporated in the above tables:

Table 3: Assumptions underpinning tables 2a and 2b (above).

Assumption	Value
Vehicle Service Life*	8 years
Gasoline Price ($/gallon)	$3.95
Gasoline GHG Intensity (kg CO2e/gallon)	8.78 kg
Diesel Price ($/gallon)	$4.02
Diesel GHG Intensity (kg CO2e/gallon)	10.21 kg
Electricity Price † ($/kWh)	$0.167 / $0.110
Electricity GHG Intensity † (kg CO2e/kWh)	0.215 kg / 0 kg
*Vehicles are frequently kept longer than this value, providing further savings on fuel and GHG abatement † Second number reflects electricity from the New Melones Dam, as applicable	

In general, electric light-duty truck and SUV options are currently limited in the market, and therefore towing capacities, cargo volumes, and other specifications are not an exact match. 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. It should be noted that costs outlined within these tables are incremental costs, i.e. 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 for the state of California on the date of analysis (March 29, 2019), 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.

While Tuolumne County's fleet is extremely large and diverse, vehicle mileages were not supplied with the dataset. The data was approximated by averaging mileages of similar vehicles from other fleets. Regardless, the County has significant opportunity to reduce operating costs and GHG emissions by pursuing BEV replacements for their gasoline passenger cars, and by replacing its pickup trucks and vans with BEV/PHEV alternatives. The current absence of an appropriate BEV replacement for SUVs makes a direct replacement less likely. Newer model years and normal should be lower priority than older vehicles, but do represent similar opportunity for savings.

In the absence of the HVIP incentive program, most of vehicles above would face payback periods that far exceed the vehicle's expected usable lifetime.

The procurement of vehicles should be straightforward, and does not differ significantly from the procurement process for internal-combustion vehicles. The Vehicle Replacement Guide enclosed in the email notes several vendors that sell both the CSE-recommended vehicles and alternative options. These are typically secondary vendors, though there are several manufacturers that are able to sell directly to fleets. 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.

Tuolumne County 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. These large vehicles may require higher-powered charging (30kW – 500kW) in applications that require minimal downtime.

IV. Incentives

a. Low Carbon Transportation Funding

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 2a and 2b use the California Hybrid Truck and Bus Voucher Incentive Project (HVIP) program to offset the incremental cost of electrified buses and trucks. Similarly, the federal $7,500 tax credit is combined with incentives from the Clean Vehicle Rebate Program to offset the incremental cost of electrified or PHEV light-duty vehicles.

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 4, *CVRP Rebate Amounts for Light-Duty Vehicles,* summarizes the rebates available.

Table 4: 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 May 2019, the HVIP estimated fund balance was over $57 million. 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 5: 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 6. 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)	½ incremental cost, up to $8,000
8,500 – 10,000 lbs (plug-in hybrids only)	½ incremental cost, up to $10,000
10,001 – 19,500 lbs	½ incremental cost, up to $15,000
19,501 – 26,000 lbs	½ incremental cost, up to $20,000
26,001 – 33,000 lbs	½ incremental cost, up to $25,000
> 33,000 lbs	½ incremental cost, up to $30,000

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.

b. 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 7, below, outlines the range of costs for the first EVCS port (plug) installed at a given site. Table 8 outlines

specific installation variables that are incorporated into the "installation" cost element shown in Table 7. Note that many buses and other heavy-duty vehicles use DC Fast Charging as their default charging method.

Table 7: 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 8: 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 three funding programs for electric vehicle infrastructure. These programs include the FleetReady Program, Fast Charge Program and EV Charge Network 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).
- **EV Charge Network Program** - Started in 2016. The CPUC approved the PG&E EV Charge Network Program to install 7,500 L2 EVCS at MUDs and workplaces. Within the service territory, PG&E will install the infrastructure at qualified locations with at least 10 parking spaces available for charging (pge.com/evcharge).

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.

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