Midpeninsula Regional Open Space District

R-24-103
Meeting 24-21
August 14, 2024

AGENDA ITEM 7

AGENDA ITEM

Midpeninsula Regional Open Space District Fleet Electrification Transition Plan

GENERAL MANAGER'S RECOMMENDATION

Review and accept the Midpeninsula Regional Open Space District Fleet Electrification Transition Plan.

SUMMARY

The Midpeninsula Regional Open Space District's (District's) Climate Action Plan (CAP) adopted by the Board of Directors (Board) in 2018 set goals for reducing the District's greenhouse gas emissions a total of 20% by 2022, 40 % by 2030, 80% by 2050. One of the four general strategies recommended in the CAP for reducing greenhouse emissions was increasing electric and alternative fuel equipment and vehicles. District staff developed a scope of work and issued a competitive request for proposals (RFP) in April of 2022 for a consultant to prepare a Fleet Transition Plan, which the Board awarded to ICF, Inc. in February 2023. ICF has provided similar services to other municipalities both locally and nationally. The final Fleet Electrification Transition Plan is now ready for Board review and acceptance.

DISCUSSION

<u>Background</u>

Over the past year and a half, District staff has worked with ICF to gather the data necessary to develop the District's Fleet Electrification Transition Plan (Plan), which provides a high-level blueprint and budget for transitioning the District's existing fleet to electric vehicles (EVs). The Plan also includes an analysis of infrastructure needs to support this transition at all four field offices and the administrative office. Furthermore, the Fleet Electrification Transition Plan includes analysis on Total Cost of Ownership for EVs, the environmental benefits, the District's current fleet management process, and staffing recommendations for managing the Districts' fleet. The Plan provides recommendations on potential funding sources, including grant opportunities.

The transition to EVs is an opportunity for the District to reduce its greenhouse gas emissions and demonstrate the Districts commitment to clean transportation and to abide by state law mandating regional and state fleets shift to zero emission technology. The two primary drivers for transition to electric vehicles are the District CAP targets and the state of California implementing measures for fleet electrification. There are number of policy mandates at the regional and state level that require the shift of fleet vehicles to zero emission technologies that are outlined in the Fleet Electrification Transition Plan. For example, the California Air Resources Board (CARB) issued the Advanced Clean Fleets Regulation which requires public fleets in California to begin transition to zero emission technology. The regulation requires that 50 percent of total number of new vehicle purchases must be zero emission vehicles beginning in 2024, increasing to 100 percent beginning in 2027. The regulation allows municipalities to operate existing vehicles through their useful life.

In February 2023, when the development of the Fleet Transition Plan began, ICF worked with District staff to gather all the District's vehicle and equipment information. The District has 102 Active, On-Road Vehicles, 5 of which are EVs. The data collection process was a time intensive process as the project team had to review numerous paper documents to submit required data to ICF.

Fleet Electrification Analysis

To determine the most suitable EV replacement for the District's existing Fleet, ICF utilized their EV Library that contains information about each EV available in the market and researched soon to be released EV models. ICF utilized its Fleet Assessment Model to evaluate the type of operations, daily mileage, fuel consumption, the District's Fleet Replacement Guidelines for each asset, to identify the existing vehicle requirements. The process ensures that the recommended EV replacements are the most suitable option for each vehicle, considering operational requirements, while also considering factors such as performance, availability, and cost effectiveness. ICF's assessment shows that out of the 97 on road vehicles that are currently (internal combustion engine) ICE vehicles, 96 could potentially be transitioned to battery-electric and plug -in hybrid EVs (PHEVs). The one vehicle not recommended for replacement is the 1974 VW Thing, which is the District's first patrol vehicle and is not currently used in daily operations. This vehicle highlights the District's history and is driven at both internal and community events. ICF established a proposed timeline for EV replacement based on the District's Fleet Replacement Guidelines and predicted availability of recommended replacement EV models.

For the District's on-road fleet, the transition to EVs will require the installation of a robust charging infrastructure at all four field offices and the administrative office, consisting of 38 dual-port chargers with power levels as high as 50 Kw, this charging infrastructure will be critical to ensure that the District's EV fleet can be efficiently charged and operated without disruption. Transitioning the District's fleet to EVs will require a capital investment of up to $5.7 million for vehicle procurement and approximately $772,754 for charging infrastructure. In addition to the charging infrastructure, $408,000 is required for electrical upgrades (e.g. transformers, panels, conduit) to accommodate the need for the proposed fleet electrification master plan. The total cost of ownership considers not only the capital and fueling infrastructure costs, but also the operations and maintenance expenses for the fleet, based on each vehicle's useful life. The transition to EVs is expected to significantly reduce fuel costs by approximately 80 percent, and maintenance cost by approximately 36 percent. EVs have fewer moving parts, which result in lower maintenance and repair costs. ICF's analysis shows the total cost of ownership for the District's EV fleet would be approximately $1.2 million higher than if the fleet were to continue operating with internal combustion engine vehicles.

Environmental Benefits of Fleet Electrification

Overall, the Fleet Electrification Transition Plan projects that replacing the 96 fossil fuel vehicles with battery-electric and plug-in hybrid EVs, the District could reduce more than 7,000 metric tons of GHG emissions and eliminate more than 49,000 pounds of nitrogen oxide emissions over the useful life of the replace EV fleet. This would be equivalent to removing more than 1,600 passenger vehicles from the road for a year.

Fleet Staffing Recommendations
To identify staffing recommendations for fleet management efficiency, ICF analyzed District's current structure for managing fleet operations. ICF identified that that there are currently 10 staff from 2 separate departments involved in managing and maintaining the District's fleet. To explore the best practices for fleet management, the project team met with fleet management teams in three municipalities that have a similar fleet size. Based on the research and interviews with the City of Laguna Beach, the City of Pittsburg, and Iowa City and reviewing the recent recommendations made by Baker Tilly in the Financial and Operational Sustainability Model Refresh (FOSM Refresh), ICF recommends appointment of a Fleet Manger/Supervisor and Fleet Maintenance Specialist to support this position.

The Fleet Manager/Supervisor will act as the central point of contact for all matters pertaining to fleet maintenance, repairs, and the acquisition of new vehicles. The position will collaborate with the Area Superintendents and Area Managers. This collaboration is critical for maintaining and overseeing the fleet's evolving needs. This position was also recommended in the FOSM Refresh.

The Fleet Maintenance Specialist will manage the regular maintenance of the fleet, as well as coordinating with other departments, repair shops, and dealerships for necessary repairs and recalls. Especially as the District transitions to EVs, there is an anticipated reliance on dealerships for conducting repairs in the near term. The inclusion of this specialized role is pivotal for ensuring operation efficiency and that vehicles remain functional as we implement EVs into the District's fleet. This position is in addition to the specific positions recommended in the FOSM Refresh but is consistent with the growth anticipated in the FOSM Refresh after initial hiring of specified positions.

ICF recommends that an EV charging Facilities Maintenance Specialist have oversight of EV charging infrastructure. The role would be dedicated to the regular maintenance, repair, and in-house troubleshooting of charging stations to ensure their optimal operation. Although this is a recommendation of ICF, the District is currently reviewing additional alternatives to maintaining its current EV infrastructure.

Fleet Management Software Solutions
As the District plans to transition to EVs, there is a need for a suitable fleet and data management system. ICF conducted interviews with members for District fleet team, IT, and sustainability staff. ICF was able to develop functional, user, and technical requirements that the District can use in a future solicitation for a fleet management system that not only bridges current operational gaps, but fully supports the fleets future direction into EVs.

Funding
The District's transition to an EV fleet will require additional funding. There is grant funding available to offset the District's costs. ICF developed financing and funding recommendations, which could significantly reduce the District's costs in transitioning the fleet to EVs. These options are detailed in Appendix E (Attachment 1). In addition, the District will need to coordinate with PG&E to see if it is feasible to offset the capital cost of EV transition and

identify funding necessary for electrical system upgrades to provide sufficient EV charging capacity at District field offices and the Administrative Office.

District's Current EV Fleet and Infrastructure
The District has already begun adding PHEVs and EVs to the existing Fleet. The District currently has 5 EVs/PHEVs in the fleet.

Year	Make	Model	Fuel Type
2015	Toyota	Prius	PHEV
2020	Chevrolet	Bolt	EV
2023	Ford	F150 Lightning	EV
2023	Ford	F150 Lightning	EV
2024	Chevrolet	Silverado	EV

The District is also replacing retiring vehicles with EVs as recommended in the Fleet Electrification Transition Plan. The District currently has 8 EVs and 3 PHEVs on order.

Amount	Make	Model	Fuel Type
8	Ford	F150 Lightning	EV
3	Jeep	Wrangler	PHEV

The District has 16 Level 2 charging ports throughout the four field offices and the Administrative Office.

Amount	Office
10	Administrative Office
4	South Area Field Office
2	Skyline Field Office

FISCAL IMPACT

There is no financial impact as a result of this report. The FY 2024-25 budget includes sufficient funds to begin implementing the Fleet Transition Plan. Budget for implementing the plan in future years will be requested through the budget and action plan process.

BOARD AND COMMITTEE REVIEW

October 10, 2018: Board adopt the Climate Action Plan (R-18-114, meeting minutes)

February 22, 2023: Board approved a contract for the Fleet Transition Plan to ICF (R-23-24, meeting minutes)

PUBLIC NOTICE

Public notice was provided as required by the Brown Act.

CEQA COMPLIANCE

This item is not a project subject to the California Environmental Quality Act.

NEXT STEPS

The District has several upcoming projects that support the Fleet Electrification Transition Plan. The Land and Facilities Department will bring The FY 25 Capital Vehicle and Equipment Purchase item to the Board in September 2024. In FY 25, the Information Systems and Technology Department will lead a project to implement a fleet management system that will plan, program, and track the management (including replacements and maintenance) of the vehicle and equipment fleet. Engineering and Construction Department will lead a project in FY26 to install FFO Solar Panels and EV chargers at the Foothills Field Office. In FY 26, the District will recruit a Fleet Manager position, which was recommended in the FOSM Refresh.

Project	Department	Timeline
Capital Purchase FY 25	Land & Facilities	Board item September2024
Fleet Management System	Information Systems and Technology	FY25
FFO Solar Panels/ EV Chargers	Engineering and Construction	FY26
Fleet Manager Recruitment	Human Resources	FY 26

Staff recommends utilizing a consultant to develop a staged implementation plan for the transition to an EV fleet, including charger procurement and infrastructure and facility improvements, with the goal of converting the District's fleet to electric by 2039. This plan will outline specific actions that need to be taken, timelines for each action, and the budget needed.

Attachment(s)

1. Midpeninsula Regional Open Space Fleet Electrification Transition Plan

Responsible Department Head:
Brandon Stewart, Manager, Land and Facilities Department

Prepared by/Contact person:
Benjamin Talavera, Management Analyst II, Land and Facilities Department

ATTACHMENT 1

Midpeninsula Regional Open Space District

Fleet Electrification Transition Plan

August 2024

Prepared by: ICF Incorporated L.L.C

Table of Contents

Executive Summary

Transportation is a significant contributor to air pollution and climate change. Vehicles, especially those powered by traditional fossil fuels, emit substantial amounts of greenhouse gases (GHGs) and pollutants into the atmosphere. To address this environmental challenge, vehicle fleets nationwide, including the 199 vehicles and equipment owned by the Midpeninsula Regional Open Space District (District, Midpen), are considering transitioning to electric vehicles (EVs). This shift offers numerous benefits: EVs produce zero tailpipe emissions, significantly reducing air pollution. They are more energy-efficient than internal combustion engine vehicles (ICEVs), leading to lower operational costs over time. Additionally, EVs contribute to reduced noise pollution, providing a quieter and smoother driving experience for fleet drivers.

Although transitioning to EVs may yield long-term cost savings for Midpen due to demonstrably lower operating expenses, it is crucial to acknowledge the considerable upfront costs as well as operational and logistical challenges that must be addressed. Moreover, lack of technology availability, especially for specialty vehicles and certain vehicles type (e.g., medium duty pickups) could pose significant challenges to Midpen as it strives to electrify vehicles that operate in remote and disconnected environments. Aside from the challenges related to cost and technology readiness of EVs, the deployment of appropriate and resilient charging infrastructure is also crucial for a successful transition. These potential challenges require careful planning and strategic investment to successfully achieve a full EV fleet.

To this end, Midpen initiated an RFP in April of 2022 seeking support in improving the management of its fleet, reduce fleet vehicle GHG emissions by transitioning to low- and zero-emissions, and assistance with the selection of a fleet management system.

This Fleet Electrification Transition Plan aims to assess Midpen's current fleet and provide recommendations for cost effective transition to clean transportation alternatives, along with installing EV charging stations for fleet vehicles in response to both the State policies such as Advanced Clean Fleet (ACF) regulation as well as Midpen's commitment to curb its GHG emissions significantly in the next 25 years. Furthermore, the plan offers guidance on the potential funding and financing sources available to facilitate the transition to an all-electric fleet.

Currently, out of the 199 vehicles and equipment owned by Midpen, 102 of them are active on-road vehicles. Of those on-road vehicles: 68 are gasoline-powered, 29 are diesel-powered, 4 are battery-electric, and 1 is plug-in hybrid.

The assessment carried out during this project revealed that out of the 102 active, on-road vehicles currently in Midpen's fleet, a total of 96 could potentially be transitioned to battery-electric vehicles. Note that not all vehicles have viable EV replacements at this time. For example, Midpen currently owns 16 medium-duty pickups, for which no viable EV replacements are available on the market. At the time of the assessment, ZEVx offered retrofit packages to convert existing F350 and F450 models to zero-emission technology. However, ZEVx has since discontinued production of these conversion packages. Some major OEMs, such as General Motors, are actively working on introducing models in this category, but currently, there are no EV medium-duty pickups available on the market. Given that one of the main objectives of this report is to advise on the required charging infrastructure over the next 10 to 15 years, it assumes that EV models for medium-duty pickups will become available on the market. This assumption enabled us to develop a comprehensive charging infrastructure solution that can accommodate the potential demand from all vehicles, if and when they transition to EVs.

With this assumption in mind, this assessment illustrates that transitioning Midpen's fleet to EVs would require the installation of 52 Level 2 dual-port chargers (DPCs) with power levels ranging from 6.6 kW to 15.4 kW.

The project team also determined that such transition will require a capital investment of $5.7 million for vehicle procurement and $550,000 for charging infrastructure (in net present value). In addition to the charging infrastructure cost, the project team also estimated that Midpen will require approximately $408,000 for electrical infrastructure upgrades (e.g., transformers, panels, conduit) to accommodate the need for the proposed fleet electrification transition plan.

Transitioning to an EV Fleet Requires Detailed Planning, Substantial Investment, and Collaboration among Stakeholders, and Experts

There are several challenges to consider when transitioning to an EV fleet: upfront costs, limited EV models, supply chain issues, charging infrastructure, uncertainty in charging time, dependence on power grid, workforce training, and take home vehicles

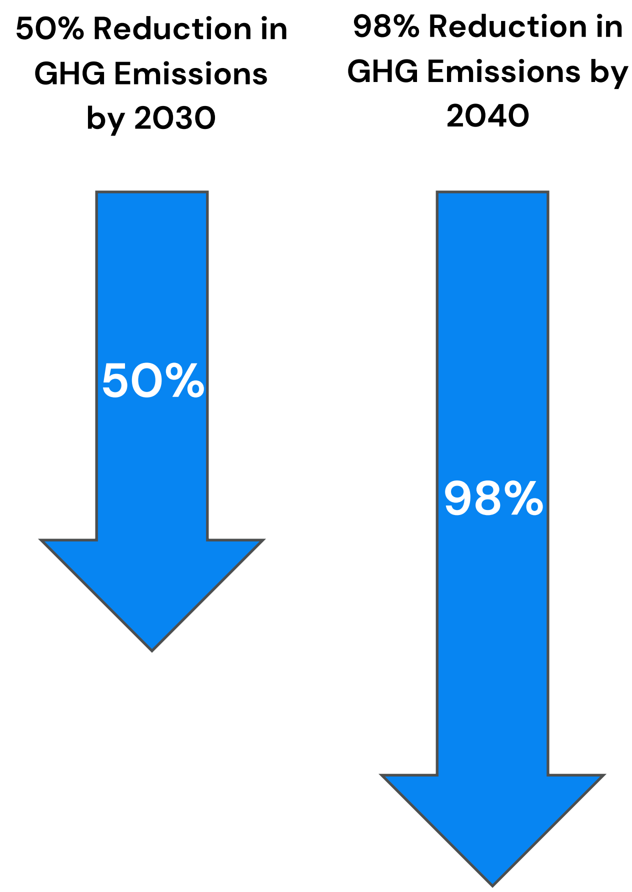
Moreover, based on the project team's estimates, the total cost of ownership for an EV fleet over its lifetime would be approximately $1.2 million (17 percent) higher than operating a fleet with ICEVs. Several factors contribute to this higher total cost of ownership: the initial cost of EVs is higher than that of conventional vehicles, electricity prices in the area of Midpen's operations are relatively high, and significant capital investment is required to establish the charging infrastructure and make necessary electrical infrastructure upgrades. However, the cost differential can be reduced by pursuing and obtaining various vehicle incentives and tax credits provided by state and federal governments. Midpen can apply to non-competitive rebates and incentives to reduce the cost difference to approximately $400,000 (6.3 percent). Midpen could further improve the cost-effectiveness of the transition by leveraging all available grants and credits. Of course, the total amount of funding made available to Midpen is contingent on successful application processes, which can take considerable time and resources.

The project analysis also revealed that transitioning to an EV fleet will provide substantial environmental benefits for Midpen. By replacing fossil fuel vehicles with EVs, Midpen could reduce over 7,000 metric tons of GHG emissions over the lifetime of the vehicles. This environmentally responsible outcome would be equivalent to removing over 1,500 passenger vehicles from the road for one year. Under the proposed fleet electrification schedule, Midpen can anticipate achieving a 50% reduction in fleet carbon emissions by 2030 and a reduction of over 98% by 2040, relative to the 2024 baseline.

Despite all these benefits, transitioning to an EV fleet is a complex and multi-faceted process that Midpen must carefully consider. Some of the challenges that the District might face during this transition include:

Upfront Costs: While generally EVs have a lower operational and maintenance costs, the initial cost of purchasing an EV can be higher than a traditional ICE vehicle. This can be a significant financial hurdle for fleets with limited budgets.

Figure ES1. GHG Emissions Reduction from Electrification of Midpen's Fleets



Limited Availability of EV Models: While there is an increasing number of EV models available on the market, the selection of vehicles is still limited compared to traditional ICE vehicles. This could make it difficult for Midpen to replace all 96 of their on-road vehicles as of this time. Currently, there are technology limitations for certain vehicle categories within Midpen's fleet. As described earlier, currently there is no viable F-350 or F-450 electric model available. However, the industry is expected to increase electric alternatives in the medium-duty space following CARB's ACF and Advanced Clean Trucks (ACT) regulations.

Supply Chain Issues: EV manufacturers may have limited production capacity, which can result in longer delivery times for Midpen when purchasing EVs for its fleet. The production of EVs is heavily reliant on specific components, such as lithium-ion batteries and rare earth elements, which are subject to global supply constraints and geopolitical influences. Additionally, the sudden surge in demand for EVs has outpaced the current production capacities of many manufacturers, leading to longer wait times for consumers and limited model availability.

Limited Dealership Networks: The distribution network for EVs is still evolving, and there may be limited dealership networks available in some regions. This can make it more difficult to access and purchase EVs for its fleet and to make sure all parts are available when Midpen needs to maintain them.

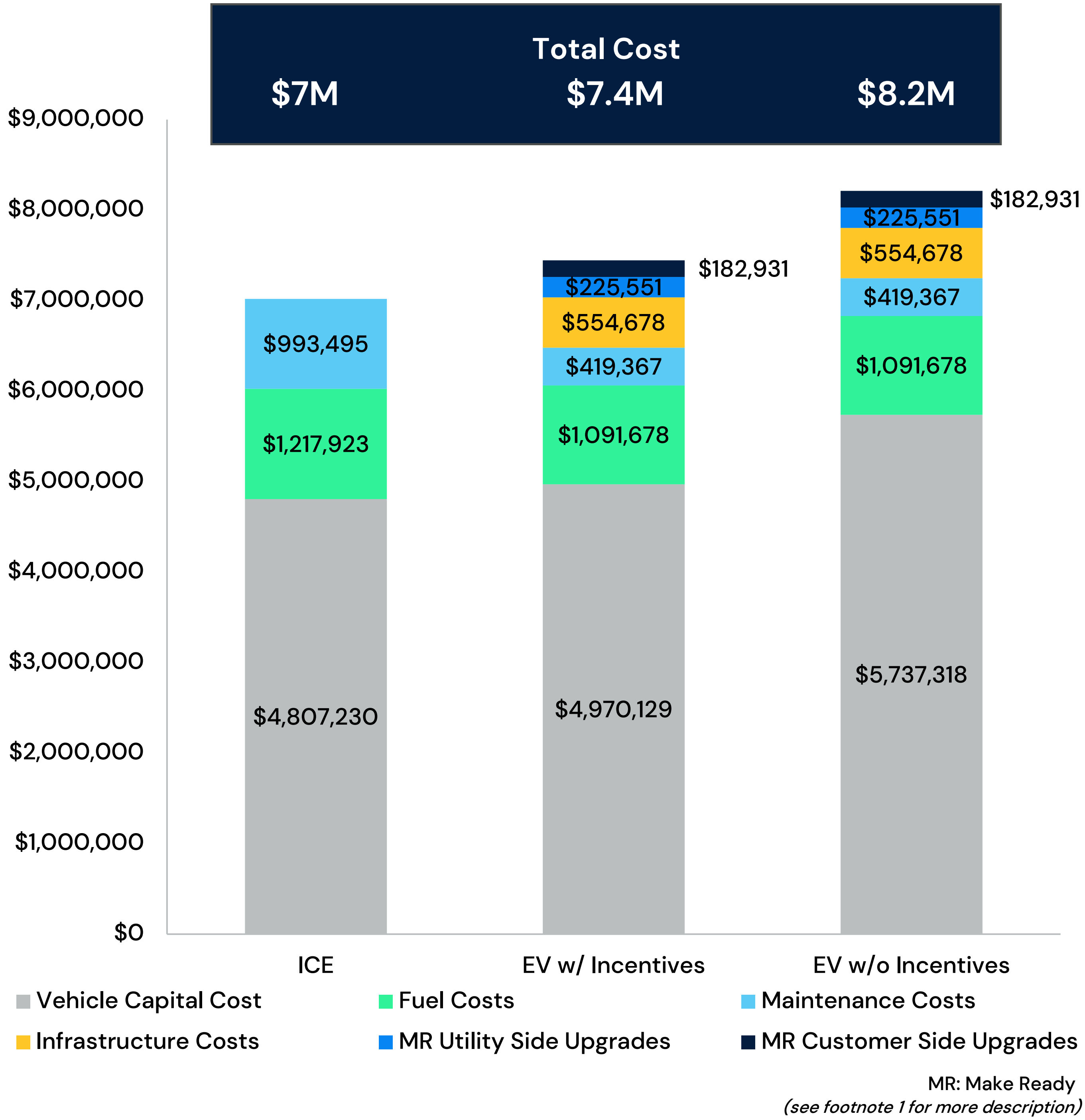
Charging Infrastructure: Midpen will need to install a network of charging stations to support its EV fleet, which can be a costly and time-consuming process. They also need to ensure that the charging stations are strategically located and able to handle the increased demand for electricity.

Uncertainty in Charging Time: In this assessment, the project team assumed that patrol vehicles in Midpen's fleet would have 8 hours of charging time and all other vehicles in the fleet would have 14 hours of charging time. However, there may be situations where emergency response and other fleet vehicles need faster charging times to maintain their availability on the road. To accommodate such scenarios, Midpen would need to invest in building a more powerful charging infrastructure, which could be significantly more expensive and place a much higher burden on the electrical infrastructure.

Dependence on the Power Grid: EVs require electricity to operate, and any disruption to the power grid can impact the ability of Midpen to charge its vehicles. This can be particularly challenging during extreme weather events, such as high winds, wildfires, or flooding, which can cause widespread power outages. Most EV charging stations do not have backup power sources, which means that they will not be operational during power outages. This can impact the ability to keep an EV fleet charged and operational. Additionally, during emergencies, such as natural disasters or other crises, the power grid may need to prioritize power to critical infrastructure, such as hospitals and emergency services. This may result in less power being available for charging EVs. Midpen can add backup power using distributed energy resources (DERs) to help mitigate this risk.

Workforce Training: Although the majority of Midpen's vehicle maintenance is handled by a third-party vendor, it is important to consider the staff training requirements in order to properly maintain and operate a fully electric fleet. EVs have a different set of maintenance requirements than ICE vehicles. The technology used in EVs is different from traditional ICE vehicles, and there may be a limited number of skilled technicians available to service and maintain EVs. This can impact the ability of Midpen to keep its EV fleet running smoothly.

Figure ES2. Total Cost of Ownership – EV vs. ICE vehicles without Incentives[1]

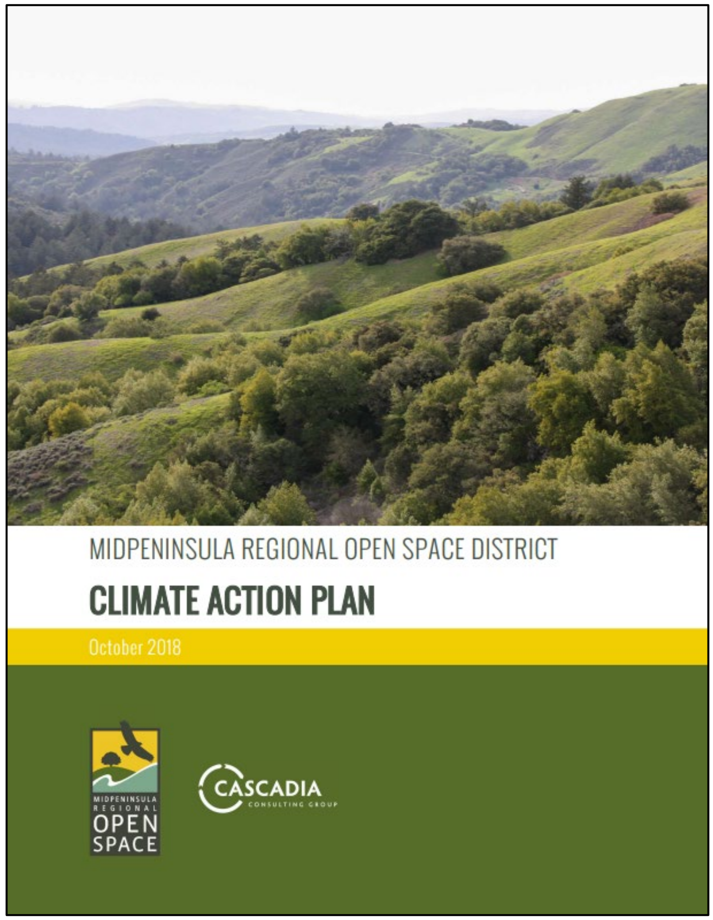


[1] Utility side Make-Ready (MR) infrastructure accounts for the upgraded the transformer, whereas MR customer side upgrades include new electric panel, electric meter, conduit and cable, trenching, and installation costs.

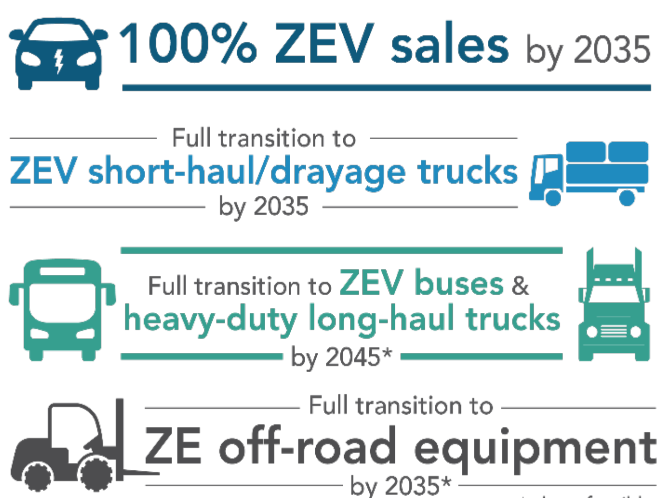
The Need to Transition to EVs and Baseline Inventory

Drivers for Transition

The Midpeninsula Regional Open Space District's (Midpen) fleet is a major contributor to its greenhouse gas (GHG) emissions, with transportation (vehicles, equipment, and business travel) accounting for nearly 50 percent of its carbon footprint as of 2022. Given Midpen's ambitious targets to reduce GHG emissions by 40 percent by 2030 and 80 percent by 2050[2], transitioning to electric vehicles (EVs) offers a crucial pathway to meet these goals. Electrifying the fleet can drastically reduce carbon emissions, enhance air quality, and align with Midpen's environmental commitments. Furthermore, the economic advantages of EVs, including lower operational and maintenance costs compared to internal combustion engines, provide a strong financial incentive for this shift.



In additional to Midpen's ambitious climate targets, the state of California has also implemented a range of measures, including mandates requiring automakers to produce a certain percentage of zero-emission vehicles (ZEV), financial incentives for consumers, and investments in charging and fueling infrastructure. In September 2020, Governor Newsom signed Executive Order N-79-20, which sets ambitious goals of transitioning to 100 percent light-duty ZEVs by 2035 and all medium- and heavy-duty vehicles to ZEVs by 2045. The order also includes directives for accelerating the deployment of charging infrastructure, increasing the number of ZEVs in public fleets, and promoting consumer awareness and adoption of EVs. This executive order lays the foundation for implementing policies to achieve these targets. To date,



Source: CARB

[2] https://www.openspace.org/sites/default/files/20181015%20Climate%20Action%20Plan_0.pdf

California has implemented several regulations that address all vehicle modes, including light-, medium-, and heavy-duty vehicles, and transit vehicles. Table 1 provides a summary of the most significant regulations currently in effect pertaining to the zero-emission transition of on-road vehicles.

Table 1. California Regulations Supporting ZEV Deployment

Regulation	Description
Advanced Clean Cars II	The Advanced Clean Cars II regulation will reduce light-duty passenger car, pickup truck, and SUV emissions from the 2026 model year through 2035. The regulations amend the Zero-Emission Vehicle Regulation to require an increasing number of ZEVs, including battery-electric, hydrogen fuel cell electric, and plug-in hybrid EVs. By 2035, the regulation requires 100% of new passenger vehicles sold in the state to be ZEVs.
Advanced Clean Trucks Regulation	The ACT regulation requires manufacturers of medium- and heavy-duty vehicles to sell increasing percentages of ZEVs in California. By 2035 it requires manufacturer to sell 55% of their Class 2b-3 and 75% of Class 4 -8 and 40% of Class 7-8 vehicles as zero emission.
Innovative Clean Transit Regulation	The ICT regulation, adopted in December 2018, requires public transit agencies to transition to a 100% zero-emission bus (ZEB) fleet by 2040. All transit agencies that own, operate, or lease buses with a gross vehicle weight rating (GVWR) greater than 14,000 lbs. must comply with the regulation. The ZEB purchase requirements vary depending on the transit agency's size.
Advanced Clean Fleets (ACF) Regulation	Starting in 2024, the regulation requires fleets operating in California to transition to zero emission technology with the goal of transitioning all drayage trucks to zero emission by 2035 and the rest of the medium- and heavy-duty (MD-HD) vehicles to zero emission by 2045. Specific to municipality fleets, 50% of the total number of vehicle additions must be ZEVs beginning January 1, 2024, increasing to 100% beginning January 1, 2027.

Upcoming fleet requirements under Alternative Clean Fleet (ACF) regulation are influencing the Midpen's short-term compliance priorities and long-term strategies for fleet procurement, maintenance, and operation. Despite the requirements starting in 2024, the regulation also allows fleet owners to request specific exemptions or extensions, provided they comply with all applicable requirements and meet reporting and recordkeeping obligations. A summary of these exemptions are provided below:

- **Backup Vehicle Exemption:** Fleet owners can designate vehicles as backup vehicles if they are operated less than 1,000 miles per year (excluding emergency operation miles) and meet reporting requirements. If these criteria are no longer met, the vehicle cannot operate in California and must be removed from the fleet if non-compliant with the regulations.
- **Daily Usage Exemption**: This exemption allows fleet owners to purchase a new ICE vehicle if no suitable battery electric vehicle (BEV) is available for their specific needs. To qualify, at least ten percent of the fleet must comprise ZEV or Plug-in Hybrid Electric Vehicle (PHEV). The application process requires detailed information about the vehicle to be replaced and potential BEV replacements, including make, model, weight class, and energy capacity. Fleet owners must also provide a daily usage report and explain why available BEVs cannot meet their needs.

- **ZEV Infrastructure Delay Extension:** Fleet owners experiencing delays in ZEV fueling infrastructure installation due to uncontrollable circumstances can request extensions. This is applicable only for vehicles being replaced at the affected site. The application requires documentation of the construction contract, reasons for the delay, and an executed ZEV purchase agreement. CARB will review these submissions to determine eligibility for the extension.
- **ZEV Infrastructure Site Electrification Delays**: Fleet owners can request an extension until January 1, 2030, if their electric utility provider cannot supply the required power for ZEV charging or refueling by the next compliance deadline. The initial extension can be up to three years, with a potential two-year renewal if necessary. Fleet owners must provide detailed documentation to the CARB, including utility responses, capacity estimates, and information about the charging infrastructure. The number of extensions depends on the utility's capacity to supply power, and fleet owners must deploy the maximum number of ZEVs that the existing infrastructure can support.
- **ZEV Purchase Exemptions**: Fleet owners may request exemptions to purchase new ICE vehicles if the required ZEV or NZEV configurations are unavailable. CARB will maintain a list of unavailable vehicle configurations, and fleet owners can apply for an exemption if their required configuration is not on this list. The application process involves submitting detailed information about the ICE vehicle being replaced and confirmation from manufacturers that the needed ZEV or NZEV configuration is not available. CARB will use this information, along with other resources, to determine whether the configuration is available for purchase as a ZEV or NZEV.
- **Mutual Aid Assistance Exemption**: Fleet owners with mutual aid agreements can apply for exemptions to purchase new ICE vehicles. The total number of new ICE vehicles allowed under this exemption cannot exceed 25% of the total number of vehicles in the California fleet, minus the number of ICE vehicles already purchased under granted exemptions. To be eligible, the fleet must comprise a minimum percentage of ZEVs, increasing over time. The application process requires detailed information about the needed ICE vehicle, charging or fueling capabilities, and documentation from mobile ZEV fueling providers. CARB will review the submissions to determine if the exemption criteria are met.

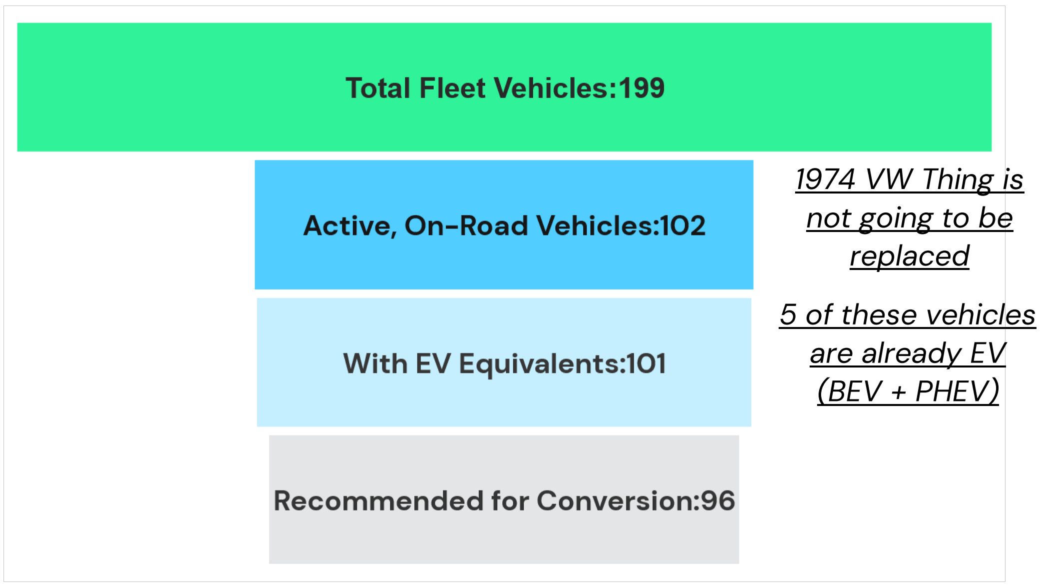
CARB's ACF staff can be contacted at zevfleet@arb.ca.gov or (866) 634-3735.

In light of the ACF regulation and Midpen's commitment to lowering its carbon footprint, a transition plan has been formulated. This plan involves a thorough inventory of the Midpen's fleet to pinpoint potential areas for integrating EVs, formulating a strategy to establish EV charging infrastructure at district facilities, and partnering with local and regional entities to obtain necessary funding and support for the shift towards EVs.

Overview of Midpen's Existing Fleet

Currently there are a total of 199 vehicles in Midpen's fleet, 102 on-road vehicles and 97 pieces of non-road equipment[3]. Of the 102 on-road vehicles, 5 of them are already electric (battery and plug-in hybrid), and 96 are recommended to convert to EVs at this time (Figure 1). Note that non-road vehicles are included in the total vehicle counts but are excluded from the Electric Vehicle Acquisition Recommendations and Fleet Environmental Impact Analysis sections of this report. Non-road vehicles are discussed separately in the Non-Road Equipment section.

Figure 1. Fleet Assessment Vehicle Breakdown



With the exception of 4 BEVs and 1 plug-in hybrid electric vehicle (PHEV)[4], all other vehicles are ICEVs utilizing either gasoline or diesel, as shown in Table 2. About half of the fleet is made up of medium- and heavy-duty vehicles which is illustrated in Figure 2 below. The estimated retirement schedule for the existing fleet is represented in Figure 3. This schedule informs the recommended EV replacement schedule, which is shown later in Figure 6.[5]

[3] Midpen has recently also acquired four additional Ford F150 Lightning SSV that are in addition to the 102 existing on-road vehicles. Given that those vehicles are already EV, they are not included in this fleet assessment report. However, their charging infrastructure needs will be evaluated in future tasks.

[4] PHEVs are considered alternative or near-zero emission vehicles.

[5] Vehicle type definitions are presented in Appendix D.

Table 2. Existing Fleet Fuel Type Distribution

Vehicle Type	Gasoline	Diesel[6]	BEV	PHEV
Sedan	1	-	1	1
SUV	12	-	-	-
Light-Duty Pickup	30	4	3	-
Medium-Duty Pickup	13	3	-	-
Van	1	-	-	-
Medium-Duty Vocational Truck[7]	10	16	-	-
Heavy Truck	-	6	-	-
Other	1	-	-	-
TOTAL	**68**	**29**	**4**	**1**

Figure 2. Existing Fleet – Vehicle Types

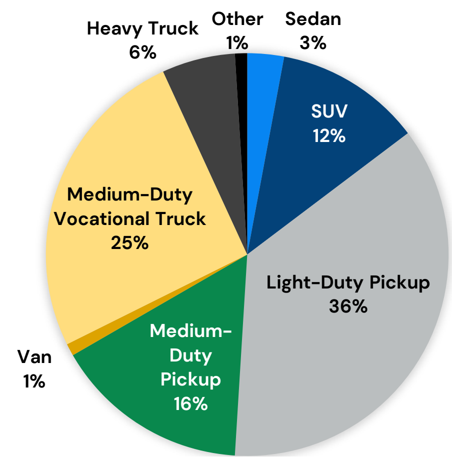
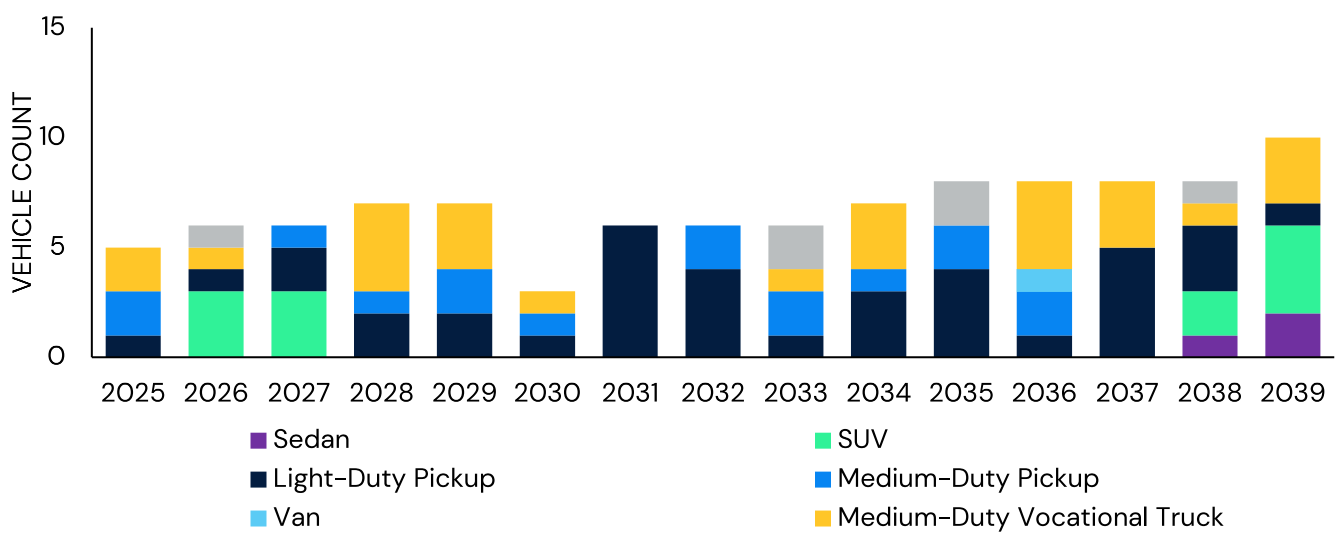


Figure 3. Existing Fleet – Retirement Schedule



Vehicles excluded from the on-road EV analysis include the 5 vehicles that are already electric, and a 1974 VW Thing, and non-road equipment (Table 3).

Table 3. Vehicle Types Excluded from Analysis

Vehicle Type	Quantity	Reason for Exclusion
Non-Road Equipment	99	Non-road equipment (See Non-Road Equipment Section)
Existing BEVs and PHEVs	5	Already electric or hybrid
VW Thing	1	Fleet identified as an inactive vehicle
TOTAL	**105**	

[6] For emissions calculations, renewable diesel (R99) was assumed for existing diesel vehicles.
[7] Medium-duty vocational trucks are Class 3 to Class 6 vehicles that are upfit to the specifications of their daily operations.

Fleet Transition Plan

Process for Determining the EV Replacement Recommendations

To determine the most suitable EV replacements for Midpen's existing fleet, ICF leverages its extensive EV Library, which contains up-to-date information about currently available and soon-to-be-released EV models. ICF also utilizes its Fleet Assessment Model to evaluate the type of operations, daily mileage, fuel consumption, and retirement year for each vehicle in Midpen's fleet. This information provides a comprehensive understanding of the operational requirements of Midpen's current vehicles. The process ensures that the recommended EV replacements are the most suitable option for each vehicle, considering their unique operational requirements, while also considering factors such as performance, availability, and cost-effectiveness. The process for determining the EV replacement recommendations is summarized in the following steps:

- **Data Collection**: ICF, in partnership with Midpen staff gather detailed information on each vehicle in the fleet. This comprehensive effort focused on collecting key metrics for each vehicle, including its make, model, fuel type, and vehicle type. Additionally, data regarding the dwelling location, annual and lifetime mileage, dwelling time, and specific capabilities such as power-take-off and towing capacity were recorded. The purpose of this thorough data collection was to provide a solid foundation of information to guide and inform decisions related to vehicle replacement.

- **EV Library**: ICF maintains a comprehensive database known as the "EV Library" that contains all the essential information about each EV available in the market, such as vehicle type, sub-type, application, expected availability, all-electric range, battery size, drivetrain, gross vehicle weight rating (GVWR), and vehicle price. Table 4 below shows the number of available BEV models by year and vehicle type.

Table 4. EV Availability by Vehicle Type from ICF's Proprietary EV Library

Vehicle Type	BEV Overall Models	BEV Trim Level Models	Currently Available Overall Models	Currently Available Trim Level Models	Next Year Available Models
Sedan	15	57	13	55	2
SUV	33	127	25	99	8
Light-Duty Pickup	5	19	4	16	1
Medium-Duty Pickup	2	2	2	2	N/A
Van	11	32	11	32	N/A
Medium-Duty Vocational	24	33	23	32	1
Heavy Truck	12	24	12	24	N/A

- **Fleet Assessment**: To identify appropriate replacement options that meet the existing vehicle requirements, ICF utilizes its Fleet Assessment Model, which assesses the operations, daily mileage, fuel consumption, and scheduled retirement year of each vehicle in Midpen's fleet. The project team leveraged the Midpen's vehicle retirement policy in determining the vehicle replacement schedules.

- **Identifying Potential EV Replacements**: ICF utilizes the Fleet Assessment outcomes to determine the EVs from the EV Library that meet Midpen's operational and financial criteria. ICF's fleet assessment model makes the best effort to select EV counterparts with operational specifications consistent with standard vehicles, however, it is possible that manufacturers may not be building EVs with identical specifications.
- **Evaluation of EV Replacements**: ICF evaluates the potential EV replacements by considering factors such as their performance, reliability, availability, and cost-effectiveness.

Key Assumptions

Key assumptions and data sources that were used in this analysis include the following. The EV Acquisition Recommendations section below provides additional detail on the financial assumptions in the model.

- **Vehicle Replacement Schedule:** The project team utilized the Midpen's Fleet Replacement Policy as a framework for deciding on the replacement year of each vehicle in the fleet. By taking into account both the age and the lifetime mileage of the vehicles, the team established a well-informed replacement schedule as illustrated Figure 3.
- **The Midpen's fleet replacement policy** sets forth general guidelines based on vehicle type, stipulating a range of years or mileage after which vehicles should be replaced. For example, Patrol (Code 3) vehicles are scheduled for replacement after 7-10 years or 90-100,000 miles, whichever comes first. Maintenance trucks have a span of 10-15 years or 95-110,000 miles, and administrative vehicles are replaced after 20 years or 110-130,000 miles. The policy allows for adjustments based on operating costs, conditions, and downtime, ensuring flexibility and responsiveness to the actual service life and performance of each vehicle.
- **Recommendation Threshold**: To align with Midpen's emission reduction goals as well as full compliance with the ACF regulation, EVs are recommended when there exists a suitable EV replacement regardless of cost effectiveness.
- **Vehicle Pricing**: The model uses the manufacturer suggested retail prices (MSRPs) for EVs where available. Please note that Midpen has a practice of utilizing state contracts for procurement whenever feasible. As a result, we incorporated pricing from California State contracts where available, which are presented in Appendix C. When MSRP pricing is unavailable, the model uses average pricing based on vehicle and fuel type based on Argonne National Laboratory's Alternative Fuel Life Cycle Environmental and Economic Transportation (AFLEET) Tool and ICF's *Comparison of Medium- and Heavy-Duty Technologies in California* report for the California Electric

Transportation Coalition (CalETC report). Vehicle pricing was escalated annually using the U.S. Energy Information Administration's (EIA) 2022 Annual Energy Outlook (AEO) and ICF's CalETC report for the California Electric Transportation Coalition. The model assumed all vehicles are owned and not leased.[8]

- **Fuel and Maintenance**: The model uses the U.S. EIA's average gasoline and diesel prices in the WECC region for the past three years, which is $4.19 per gallon of diesel and $3.93 per gallon of gasoline as of 2022. We acknowledge that Midpen currently employs renewable diesel (R-99) for its fleet operations. According to the most recent Clean Cities Alternative Fuel Price Report, it is noteworthy that the prices of diesel and R-99 in California closely align. This convergence in pricing can be attributed to the subsidies extended through the Low Carbon Fuel Standard (LCFS) program, which effectively levels the cost playing field between these fuel options. Therefore, the project assumed the same price for R-99 as it is estimated for conventional diesel. The model determines the average annual fuel use for each vehicle based on its average annual mileage (as provided by Midpen) and average fuel economy (miles per gallon), and then multiplies the fuel use value by the price per gallon of fuel. ICF uses fuel efficiency assumptions by vehicle and fuel type from the AFLEET Tool and ICF's CalETC report. The model also uses these sources to estimate average per mile maintenance costs based on vehicle and fuel type. Maintenance costs were escalated 2.20% annually.[9]
- **Electricity Pricing**: The model uses $0.35/kWh base rate (as provided by Midpen), escalated annually using projections from the U.S. EIA's 2022 AEO Reference Case for Transportation: Electricity.
- **Timeframe**: This analysis focuses on vehicle replacements for 2025 through 2039, with Total Cost of Ownership (TCO) calculations extending out across the vehicle lifespans. For vehicles purchased in 2039, the TCO is calculated out to 2053.
- **Vehicle Replacements**: The model uses vehicle retirement years provided by Midpen staff.
- **Discount Rate**: 5% was used for NPV calculations.
- **Vehicle Ranges**: The EV mileage ranges per charge were accounted for when recommending vehicle replacements. The analysis used an average temperature range of 33 to 88°F to assess the potential impact temperatures can have on EV ranges; this reduced EV model ranges to 88% of their maximum mileage range.[10]

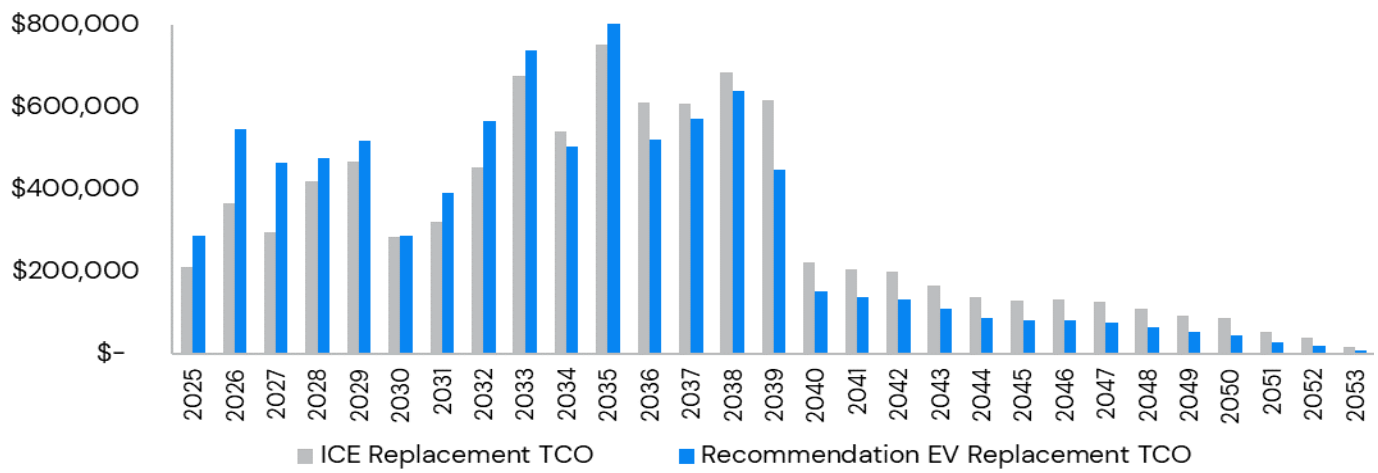
[8] The model assumes the cost of the Ford F-150 Lightning Pro SSV LR to be $70,853.80, based on Downtown Sacramento dealership Quote.
[9] A national average cost escalation rate of 2.2% to project maintenance costs over time is used.
[10] Note that the average temperature range does not account for potential future deviations due to climate change impacts.

- **Electric Vehicle Supply Equipment (EVSE) Pricing and Incentives**: The EVSE pricing assumptions utilized in this analysis are detailed further under "EV Charging Infrastructure Assumptions Applied" section.
- **Towing**: Per the project team's research, vehicles that tow loads on a daily basis were assumed to lose energy at a 60% higher rate than non-tow vehicles, and vehicles with a high amount of Idling (e.g., rangers) were assumed to lose energy at a 5% higher rate than non-Idling vehicles. The team included these coefficients for each of Midpen's applicable vehicles to ultimately determine daily energy demand.

Electric Vehicle Acquisition and Timeline Recommendations

There are 102 on-road vehicles scheduled for retirement between 2025 and 2039, 5 of them are already EVs, and 96 of them are recommended to be converted to battery electric vehicles (BEVs). Note that the 1974 VW Thing is not recommended for EV replacement. The charts below show the TCO for the 96 recommended vehicles each year if they were replaced with conventional ICE vehicles versus with the recommended EVs. This timeline is based on the existing fleet retirement schedule outlined in Figure 3 earlier. While the initial annual EV costs are higher than ICE costs, the lower operational cost of EVs significantly narrow the incremental TCO of EVs versus ICE vehicles. Figure 4 and Figure 5 provide a breakdown of the TCO for each EV replacement make and model. Note that these charts only provide the TCO for the ICE vehicles being replaced and does not include the replacement of currently owned EVs at the end of their lifetime.

Figure 4. Fleet Recommended Replacements TCO Comparison – Annual[11]



[11] For the purpose of this assessment, the project team assumed that the lifespan of EVs is generally comparable to ICE vehicles. However, it is noteworthy to mention that the battery pack typically lasts 7 to 10 years, with most manufacturers offering warranties that cover battery replacements for up to 10 years.

Figure 5. Fleet Recommended Replacements TCO Comparison - Cumulative

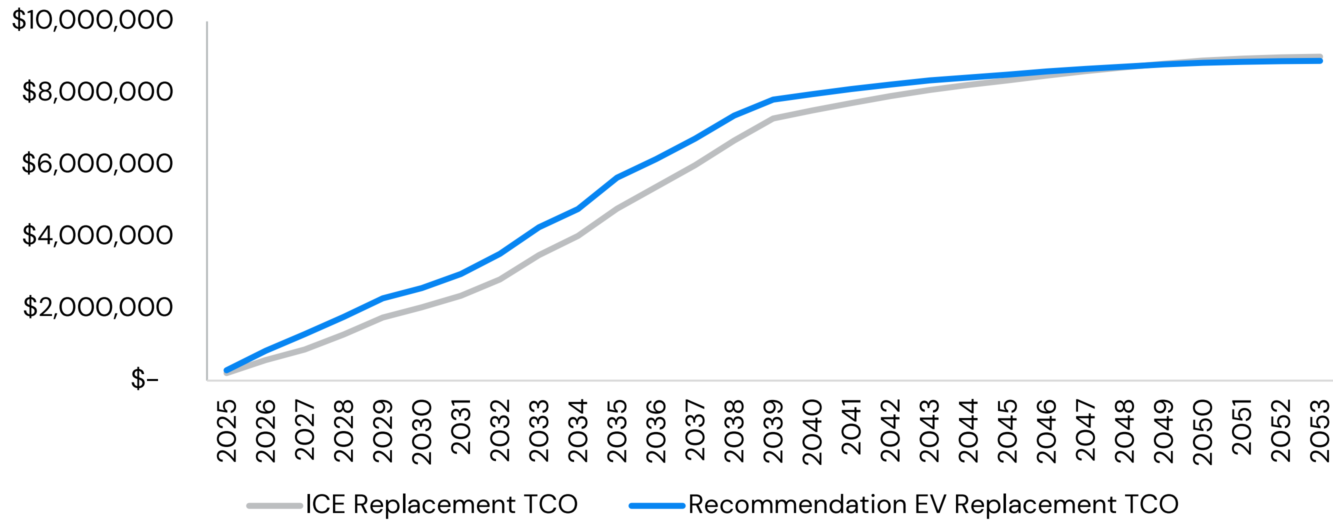


Table 5 identifies the vehicles that are recommended to be replaced with EVs within the next 15 years and Figure 6 illustrates the recommended replacement timeline for these vehicles. Each vehicle within Midpen's fleet has been assessed to identify the lowest cost option, while also accounting for potential mileage and charging time restrictions. The financial savings and GHG emission reductions represent the difference between replacing the recommended vehicles with EVs compared to replacing them with ICE vehicles. The TCO used in the financial savings accounts for the following, as applicable:

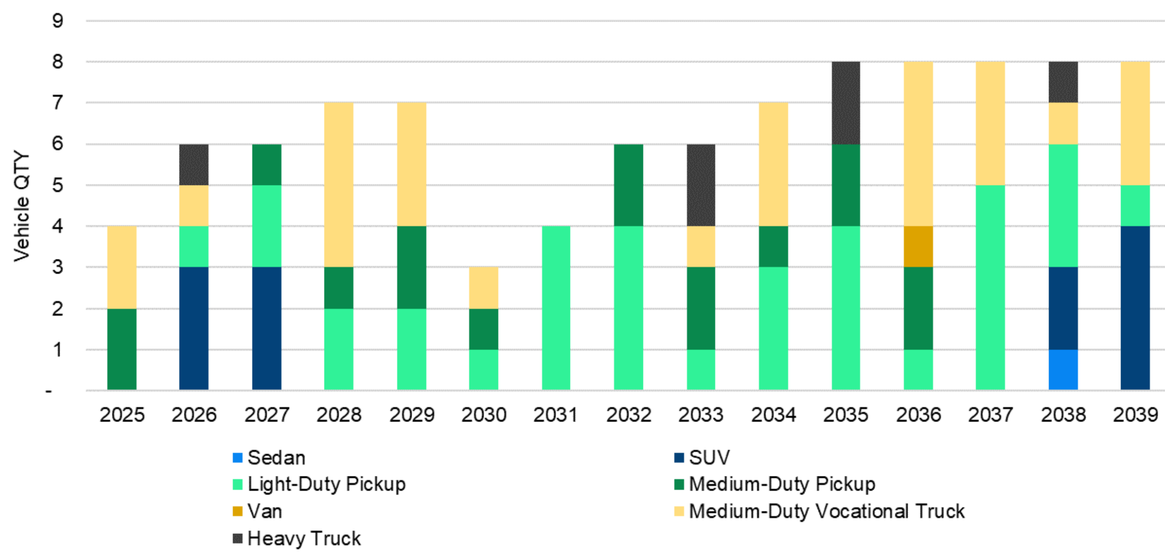
- Capital costs,
- Charging infrastructure hardware costs,
- Charging infrastructure installation costs,
- Annual fuel costs, and
- Annual maintenance costs.

It should be noted that at the time of the assessment, ZEVx offered retrofit packages to convert existing F350 and F450 models to zero-emission technology. However, ZEVx has since discontinued production of these conversion packages. Some major OEMs, such as General Motors, are actively working on introducing models in this category, but currently, there are no EV medium-duty pickups available on the market. Given that one of the main objectives of this report is to advise on the required charging infrastructure over the next 10 to 15 years, the project team continued with the assumption that EV models for medium-duty pickups will become available in the future and used ZEVx F350 and F450 specifications as surrogates to develop a comprehensive charging infrastructure solution that can accommodate the potential demand from all vehicles, if and when they transition to EVs.

Table 5. 15-Year Electrification Recommendations

Vehicle Type	Quantity Up for Retirement (in 15 Years)	Quantity Recommended to Convert to Electric	Recommended Make/ Model/ EV Type	Financial Savings (2025 - 2053)	GHG Emission Reductions[12] (2025 - 2053, MT)	EVSE[13]	
						L2	DCFC
Sedans	3	1	Nissan/Leaf S/BEV	-$1,211	8	1	0
SUVs	12	8	Chevrolet/Equinox EV 1LT/BEV	$70,807	335	12	0
		4	Chevrolet/Blazer EV PPV (Police)/BEV	-$119,950	176		
LD Trucks	37	34	Ford/F-150 Lightning Pro SSV LR[14]	-$519,263	1102	34	0
Medium-Duty Pickups	16	13	ZEVx/Ford F-350/BEV[15]	-$74,529	1,316	16	0
		3	ZEVx/Ford F-450/BEV	-$77,138	886		
Vans	1	1	Ford/E-Transit Cargo Van/BEV	$22,407	88	1	0
Heavy Trucks	6	6	Peterbilt/220EV/BEV	-$109,227	230	6	0
Medium-Duty Vocational	26	26	Ford/E-Transit Chassis Cab/BEV	$529,835	3,370	26	0
TOTAL	**101**	**96**		**-$278,268**	**7,518**	**96**	**0**

Figure 6. Recommended EV Replacement Timeline: Vehicle Types



[12] Emission reductions reflect a weighted average electricity carbon intensity (0.00002127 MT/kWh) based on the percent of vehicles and the expected load at each of the Districts' dwelling sites.
[13] See page 12 for a description of different types of EV charging stations.
[14] While there were other light duty pickups also available such as Chevrolet Silverado EV, according to Midpen's experience and testing, they preferred F150 Lightning SSV LR as those seem to be more suitable for their fleet.
[15] At the time of writing this report, ZEVx has discontinued production of ZEV conversion packages for Ford F350 and Ford F450.

While the project team has provided recommendations for all vehicle classes and types, it is critical to acknowledge that some of these recommendations, such as medium duty pickups are not currently offered by major Original Equipment Manufacturers (OEMs) and have not been thoroughly tested for applications like those utilized by Midpen. Therefore, it is important for Midpen to stay vigilant about new offerings in medium-duty pickups and ensure that the EVs they select are capable of meeting their operational needs. For the time being, the project team has included these EVs in their evaluation to assess both the cost and potential infrastructure requirements that need to be established prior to the procurement and deployment of the actual vehicles.

Important Consideration for Fleet Electrification

While Recommendations extend to all vehicle classes, but medium-duty pickups are not yet available or tested for Midpen's specific needs, requiring careful strategy adjustments.

Non-Road Equipment

There are 99 vehicles in Midpen's fleet identified as non-road equipment, summarized in Table 6 below. Of these vehicle types, 3 types were identified as having electric equivalents options: Alternative Terrain Vehicles (ATVs)/Utility Terrain Vehicles (UTVs), backhoes/mini-excavators, and mowers. Also included among these 99 pieces of equipment are several trailers that do not use any fuel, and therefore, do not require replacement.

Table 6. Non-Road Equipment

Equipment Type	Quantity	Quantity Recommended to Convert to Electric	Financial Savings (across vehicle lifespan)	GHG Emission Reductions (across vehicle lifespan)
ATV/UTV	32	27	$243,265	1,788
Mower	6	6	$9,789	92
Backhoe/Mini-Excavators	6	6	-$345,861	513
Other	55	0	$0	0
TOTAL	**99**	**39**	**-$92,808**	**2,393**

Mowers

Midpen currently owns six mowers including one Robomax received as of June 2024. A high-user commercial lawn mower can consume more fuel than a typical car. Electric mowers are quiet, require little maintenance, and produce no site emissions. Some electric mower examples include Weibang's E-Rider (MRSP $3,250), Ryobi's Zero-Turn Rider (MSRP $4,399) and Cub Cadet's Ultima (MSRP $4,999). These brands, in addition to Turf One and Ariens, produce a range of electric battery models including rear engine riders and zero turn mowers.

ATV/UTVs

Midpen's currently owns 32 ATVs/UTVs/off-road motorcycles of which five of them are already electric. We recommend Midpen explore electric options when looking to replace these equipment. Electric ATV/UTVs/Motorcycles are cost competitive with diesel and gasoline options and can help reduce fuel and maintenance costs by up to 60%. Transitioning Midpen's ATV/UTV/Motorcycles to electric could produce estimated lifetime savings of about $243,265.

Backhoes/Mini-Excavators

Midpen currently owns one backhoe and 5 mini or compact excavators that could be replaced with electric backhoes. While a relatively new technology, there are a few electric backhoe models available through CASE, Volvo, John Deere, and MultiOne. While capital costs are much higher than diesel backhoes (2-3 times the cost) electric backhoes can help reduce operational costs, noise, and emissions.

Others

The "Other" category encompasses a diverse array of equipment, including skid steer tractors, mid to large-sized excavators, dozers, as well as a variety of trailers and non-powered equipment.[16] Currently, there are no commercially available and tested zero-emission technologies suitable for these large equipment, although some demonstration projects have been conducted. Consequently, the project team is not recommending any EV replacements for these vehicles. Furthermore, it is noteworthy that Midpen is already utilizing renewable diesel for its diesel equipment, thereby ensuring the District is maximizing the potential emissions benefits achievable with these types of equipment

Fleet EV Charging Infrastructure

This section presents the charging infrastructure recommendations for vehicles eligible for conversion to EVs, as detailed in the Fleet Transition Plan outlined previously. For this analysis, the project team evaluated two charging infrastructure scenarios, assessing the advantages and disadvantages of each, particularly in terms of costs and deployment challenges.

In the first scenario (Scenario A), known as the 1:1 vehicle-to-port (V2P) ratio, the team assessed the need, including the number and power level of electric vehicle service equipment (EVSE), for charging infrastructure that assumed a dedicated charging plug for each vehicle. Because in this scenario the team assumes the use of dual-port charging stations (DPCs), two vehicles will share one charging station and it is assumed that both vehicles will be charged in parallel.

In the second scenario (Scenario B), the project team explored enhancing the V2P ratio to minimize the need for additional EVSEs while ensuring the fleet's charging demands are met. This approach leverages an optimization algorithm to allow more EVs to share a single charging port by aligning with their duty cycles. The variance in outcomes between this and the original scenario can be significant or negligible, largely influenced by the EVs' duty cycles and range. For instance, vehicles that deplete most of their range daily are less suitable for port sharing, necessitating a 1:1 V2P ratio for such EVs with identical types and parking spots, even in this scenario.

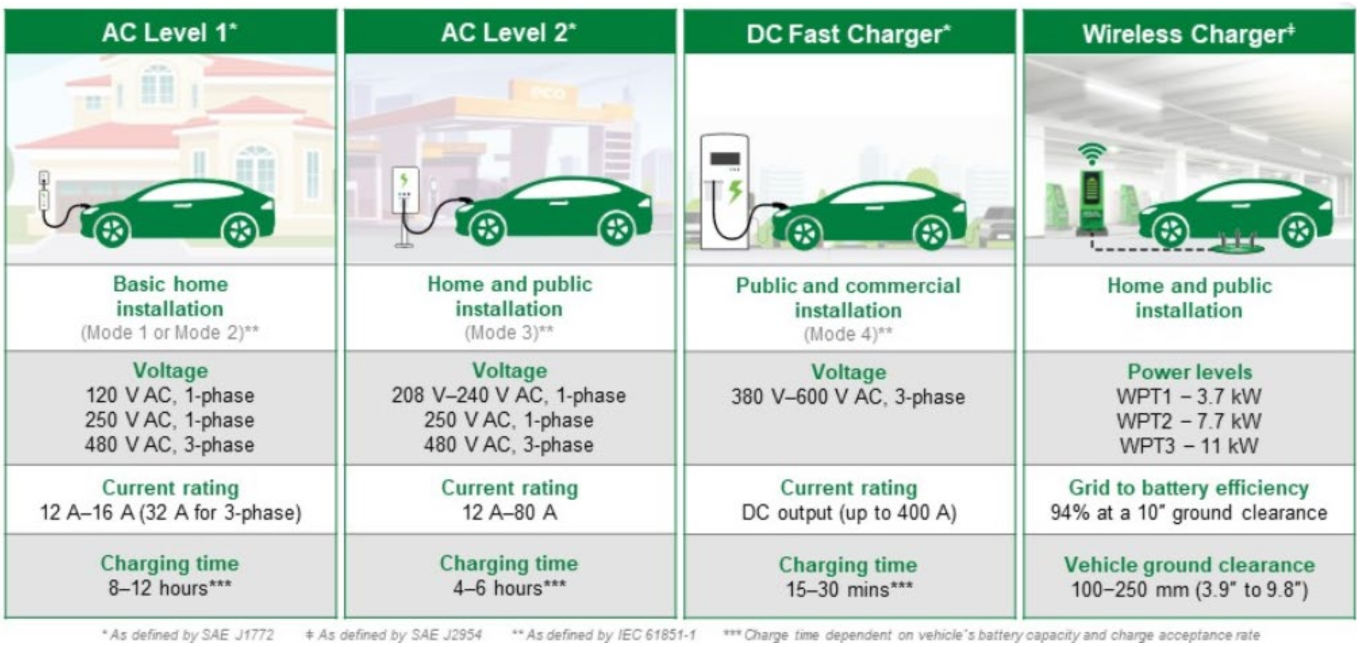
Charging Technology Options

This section delves into the various options for EV charging technology, beginning with a comprehensive overview of the different types of charging infrastructure available. It then proceeds to examine the current and emerging industry standards for charging connectors, providing detailed comparisons and analyses.

Overview of Charging Infrastructure

EV charging stations are available in three distinct types: Level 1, Level 2, and DC fast charging (DCFC). Level 1 charging employs a 120-volt alternating current (AC) plug and is typically utilized for light-duty EVs in residential and workplace environments. The charge rate is slow, delivering only 2 to 5 miles of range per hour of charging. With a level 1 charging station, PHEVs can be fully charged in 2-7 hours, depending on the battery size, while BEVs may take 14-20+ hours to fully charge. Level 2 charging uses a 208/240V AC plug, providing 10-20 miles of range per hour of charging for light and medium-duty electric vehicles. It is suitable for residential, workplace, and public charging settings and can fully charge a BEV in 4 to 8 hours. DCFC is the most powerful charging infrastructure, offering 60-80 miles of range in approximately 20 minutes of charging for light-, medium-, and heavy-duty EVs. It employs a 208/480V AC circuit with a three-phase service connection and necessitates specialized connectors such as the Combined Charging System (CCS), CHAdeMO, or Tesla Supercharger. DCFC is typically used for public charging and fleet applications.

Figure 7. Charging Station Types



Source: Charged EVs[17]

Connector Standards

The EV industry utilizes a variety of charging connectors to accommodate different charging levels, vehicle types, and regional requirements. Table 7 presents an overview of the most prevalent connector standards, including their maximum output power and typical applications. Understanding these standards is crucial when planning and implementing smart charging stations for an electric vehicle fleet, as they influence the compatibility, charging speeds, and functionality of the infrastructure.

For example, the SAE J1772 connector is widely used in North America for Level 1 and Level 2 charging at homes, workplaces, and public stations. It was developed by the Society of Automotive Engineers (SAE) and has been adopted by most North American automakers. The SAE J1772 connector has a J-shaped design and is comprised of five pins. The top and bottom pins are used for AC charging, while the two pins in the middle are used for communication between the vehicle and the charging station.

[17] https://chargedevs.com/sponsored/designing-dc-fast-charging-stations-for-next-gen-evs/

The fifth pin is a ground pin. The connector is designed for charging at a maximum of 240 volts and 80 amps for Level 2 charging, and up to 120 volts for Level 1 charging.

In contrast, Combined Charging System (CCS) and CHAdeMO connectors enable fast charging for a broader range of vehicle models at private and public charging stations. CCS connectors use a single plug that combines both AC and DC charging, and are capable of providing charging power up to 350 kW, allowing for charging times as low as 15-20 minutes. The CCS connector has two additional DC pins compared to the SAE J1772 connector, which enables the higher charging power output. CCS connectors are designed to be compatible with all types of EVs. Many EVs manufactured today are now equipped with CCS ports for fast charging, and CCS charging infrastructure is expanding rapidly. One of the main benefits of CCS connectors is their ability to support bidirectional charging, which means that the charging station can also discharge power from the EV battery back into the grid. This is important for enabling vehicle-to-grid (V2G) applications, where EVs can help stabilize the grid by providing energy storage and balancing services.

CHAdeMO is another type of DCFC connector that is primarily used in Japan but is also found in other parts of the world. The name CHAdeMO is an abbreviation of "CHArge de MOve", which roughly translates to "charge for moving". Additionally, the name is also a play on words with the Japanese phrase "O cha demo ikaga desuka," which roughly translates to "Let's have a cup of tea while charging." The CHAdeMO connector uses a separate connector for DC charging and a different connector for AC charging. It is capable of providing up to 62.5 kW of charging power, which is less than the 350 kW provided by CCS connectors. However, CHAdeMO charging is still significantly faster than Level 1 and Level 2 charging. The CHAdeMO connector is compatible with a wide range of EVs, including models from Nissan, Mitsubishi, Kia, and Hyundai. In addition to fast charging, CHAdeMO also supports bidirectional charging, which enables V2G applications.[18] One of the challenges with CHAdeMO is that it is not as widely available as other types of connectors, particularly outside of Japan. This can make it more difficult for drivers of CHAdeMO-equipped vehicles to find charging stations when traveling to other countries. In 2020, Nissan has abandoned the CHAdeMO DCFC standard in favor of the CCS standard, leaving the Mitsubishi Outlander PHEV and some older Nissan and Kia EVs as the only models that use CHAdeMO. Electrify America also decided to phase out CHAdeMO support at its stations outside of California beginning in January 2022.

Tesla produces another set of connectors designed specifically for Tesla vehicles. The connector is a modified version of the SAE J1772 connector and is called the Tesla Connector or North America Charging Standards (NACS). It features a unique pin configuration and a liquid-cooled cable that enables faster charging speeds compared to standard EV charging connectors. As of February 29, 2024, Tesla has made some of its Supercharger fast-charging stations available to non-Tesla EVs. Owners of Ford Mustang Mach-E and F-150 Lightning vehicles can access these chargers with a purchased adapter compatible with Tesla's NACS. Several other automakers, including BMW, Genesis, General Motors, Honda, Hyundai, Jaguar, Kia, Lucid, Mini, Mercedes-Benz, Nissan, Polestar, Rivian,

[18] Note that not all CHAdeMo compatible EVs are V2G capable. V2G capability depends on the EVs onboard hardware and software.

Toyota, and Volvo, have announced that their vehicles will be compatible with Tesla's Superchargers throughout 2024.

As the EV industry continues to evolve, new technologies and standards are being developed to address specific applications and needs. Emerging technologies such as SAE J2954, J3068, J3105, and CharIN Megawatt Charging System (MCS) are designed to address specific applications and needs, such as wireless power transfer, three-phase charging, and high-power charging for medium- and heavy-duty (MHD) vehicles.

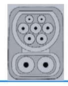
Wireless charging, also known as inductive charging, is a technology that allows EVs to charge without the need for a physical connection between the charging station and the vehicle. Instead, the charging station uses an electromagnetic field to transfer energy wirelessly to the vehicle's battery through a receiver coil.

Overhead charging technology, also known as pantograph charging, is another charging technology that allows electric buses and other heavy-duty vehicles to charge while stationary or in motion. The charging process involves a pantograph arm extending from a charging station and connecting with a receptor on the vehicle's roof. This connection allows for high-power charging, making it possible to quickly recharge the vehicle's battery. The overhead charging system can be installed in existing infrastructure, such as bus depots or train stations, making it an efficient option for public transportation. This technology also reduces the need for additional charging infrastructure, such as charging cables and plugs, which can improve the overall appearance of charging areas.

The MCS is a high-powered charging connector designed for large battery EVs. Developed by the CharIN organization, the connector is rated for a maximum charging rate of 3.75 megawatts, with the aim of becoming a worldwide standard for charging large and medium commercial vehicles. The standards are still under development.

Table 7. Existing and Upcoming Charging Connector Standards

Diagram	Connector Standard	Maximum Output Power	Application Notes
	SAE J1772	19.2 kW AC	Used for Level 1 and Level 2 charging in North America. Commonly found on home, workplace, and public chargers.
	CCS	450 kW DC	Used for DC fast charging most vehicle models in North America. Generally installed at public charging stations.
	CHAdeMO	400 kW DC	Used for DC fast charging select vehicles models in North America. Generally installed at public charging stations.
	Tesla	22 kW AC 250 kW DC	Used for both AC and DC fast charging for Tesla models only.
	SAE J2954	22 kW light-duty, 200 kW MD/HD	Wireless power transfer. The standard for MD/HD vehicles is under development.

Diagram	Connector Standard	Maximum Output Power	Application Notes
	SAE J3068	133 kW to 166 kW DC	Developed for three-phase charging, which the SAE J1772 and J1772 combo can only accommodate single-phase charging.
	SAE J3105	>1 MW	Automated connection device to charge MD/HD vehicles. Variants include pantograph "up" or "down" and pin-and-socket. LA Metro has already deployed this technology on the G/Orange Line.
	CharIN Megawatt Charging System	4 MW	Conductive MW-level charging for MD/HD road vehicles, ships and planes. The technical specification is expected in 2024.

This analysis refrains from endorsing specific EVSE models or manufacturers, maintaining neutrality towards any particular brand. Instead, its aim is to facilitate a high-level understanding of the fleet's charging requirements and to initiate considerations of how these needs will translate into practical implementations.

Process for Determining the EV Charging Infrastructure Needs

The first step in estimating the charging infrastructure needs for the electrified vehicle fleet is to understand the energy demands of vehicles by determining the daily mileage requirements. While the analysis primarily focused on daily energy demands based on maximum vehicle range, it is possible that some fleet vehicles may require Power Take Off (PTO) systems. PTOs transfer engine power to external devices such as pumps or compressors. Given the unique energy needs of PTO-equipped vehicles, it is crucial to consider the implications on charging infrastructure planning. For vehicles with PTOs, specific considerations may need to be accounted for. Particularly, some PTO systems will necessitate a dedicated plug and potentially an additional EVSE while a new generation of ePTO pull power directly from the truck's battery pack[19] and do not require a separate plug.

Once the team had confidence in the daily vehicle mileage and energy demand data, we calculated the necessary charging power level for each vehicle by simply dividing the energy consumption by the available charging time of 14 hours for all vehicle types and base locations other than patrol (i.e., pursuit rated) vehicles which have an assumed dwell time of 8 hours.[20] Lastly, for the four newly acquired F-150 Lightnings, two of these vehicles, expected to cover 100 miles daily, will be stationed at the FFO. The other two, with an estimated daily mileage of 50, will be located at the SFO. Both sets of vehicles are rated for patrol duties and are projected to have a dwell time of 8 hours. With the daily mileage along with the dwell time of each vehicle, the team determined how much power each vehicle would need to meet its daily travel requirements. The collected data was then categorized into three charging categories: Light-Duty, Medium-Duty, and Heavy-Duty. For each category and at each dwell location, the team identified the number of required charging stations and the necessary power levels for these chargers. Note that the charging time assumption is based on a constant charging rate for

[19] https://www.trucknews.com/equipment/navistar-signals-plans-for-electric-class-8-unveils-epto/1003174918/

[20] The model assumes a 2-hour dwell time for the 2 recently procured Ford - F-150 Lightning Pro SSV LR (patrol vehicles).

charging time hours even though certain vehicles will charge at different rates depending on various factors including the battery state-of-charge (SOC), temperature variations, and differences in battery management systems (BMS).[21]

Scenario A – 1:1 Vehicle to Port Ratio Charging Infrastructure Scenario

This scenario assumes a dedicated plug for each EV. To determine the power requirements (kW) of each EVSE, the maximum daily mileage for each vehicle as well as vehicle efficiency assumptions were used. Additionally, the location of chargers is assumed to be the same as the dwelling location of EVs. Table 8 illustrates the number of DPC (Dual Port Chargers) stations by maximum power level that the project team estimated for this scenario. Please note that the power is for the whole DPC station, and not for the single port. Furthermore, the project team opted for the nearest charging power levels presently offered in the market for Level 2 and DCFCs. As a result, in nearly all situations, the actual power required for charging is lower than the recommended power levels for the chargers. An important consideration for the Midpen when deciding on the specific model of DPC stations is to ensure the ability to sequentially charge (i.e., simultaneously charge two vehicles on one DPC station).[22]

Important Note

The EV charging infrastructure recommendations provided in this report are based on the energy demand of each vehicle and the EVSE power levels currently available in the market, rather than specific charging station models. It is essential to recognize that not all chargers are universally compatible with every type of vehicle. Therefore, Midpen must collaborate closely with charging providers and vehicle manufacturers to ensure that the procured charging stations align with the specific vehicle models in their fleet. This collaboration is crucial because certain vehicles have minimum amperage requirements and specific communication protocols, which can limit the type of chargers they can effectively utilize which is why it is critical to work in conjunction with both charging providers and vehicle manufacturers to guarantee that the selected charging infrastructure is suitable for the fleet and meets the necessary technical specifications to ensure seamless and efficient charging operations.

The table below presents the estimated number of DPC stations, categorized by maximum power level. It is important to understand that the indicated power is for the entire DPC station, not just a single port assuming that the charging station has a parallel charging capability. Consider, for instance, two light-duty pick-ups charging in parallel would each receive 12.5 kW; however, if only one vehicle is charging sequentially, the vehicle would receive the full 25 kW. It should be noted that some

[21] https://www.evgo.com/ev-drivers/charging-basics/#how-long-to-charge-ev

[22] Blink 50 kW chargers can be used in parallel. For example, when two vehicles are connected the charger will split the power to 25 kW for each vehicle. URL: https://blinkcharging.com/wp-content/uploads/2021/12/Wall-50kW-DCFC-Blink-Specs-1.pdf.

charging stations only allow for sequential charging and therefore shall not be considered for this scenario.

Table 8. Number of Chargers by Max Power Level (kW) under Dual-port 1:1 V2P Ratio Scenario

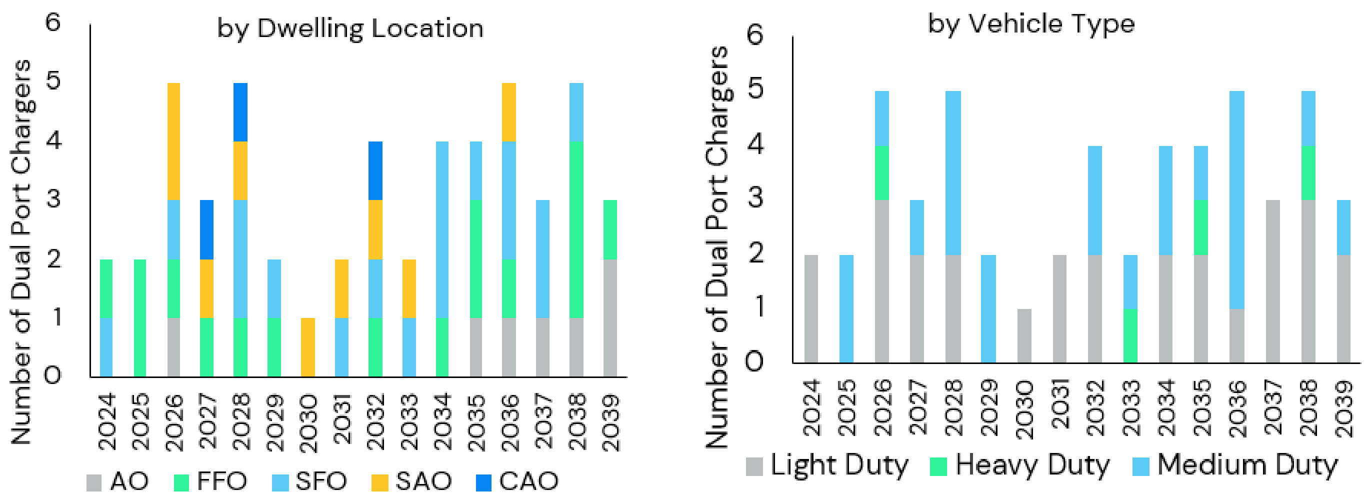
Dwell Location ID	Number of EVSE			Max Power Level (kW)			Total Power Demand (kW)
	Light Duty	Medium Duty	Heavy Duty	Light Duty	Medium Duty	Heavy Duty	
AO	**7**			6.6			46
CAO	**2**	**1**		15.4	19.2		50
FFO	**5**	**9**	**2**	15.4	19.2	15.4	280
SAO	**5**	**4**		15.4	19.2		154
SFO	**8**	**7**	**2**	15.4	19.2	6.6	271
# of EVSE	**27**	**21**	**4**	-	-	-	**801**
# of Vehicles	**52**	**42**	**6**				

The outcomes of the 1:1 V2P scenario indicate the necessity for 52 Level 2 charging stations with varying power capacities. The light-duty vehicle category comprises one sedan, twelve SUVs, thirty-four light-duty pickups, and one cargo van. Notably, all vehicles in this category, except for the AO require EVSE rated at 15.4 kW. Medium-duty vehicles, irrespective of their location, need a 19.2 kW Level 2 charging station. For heavy-duty vehicles stationed at the FFO, a 15.4 kW charger is essential due to their higher daily mileage. In contrast, heavy-duty trucks at the SFO require a less powerful, 6.6 kW charger.

1:1 V2P Rollout Schedule

The rollout schedule of charging stations for the 1:1 scenario, as shown in Figure 8, indicates a steady but modest demand for EVSE installations from 2025 through 2039. The peak requirement in any given year is five chargers, which occurs in four different years: 2026, 2028, 2036, and 2038. There are three years—2032, 2034, and 2035—where four chargers are needed. In another set of three years—2027, 2037, and 2039—three chargers will be necessary. Two chargers are planned for installation in four years: 2025, 2029, 2031, and 2033. Lastly, a single charger installation is slated for 2030. Also note that the two chargers to accommodate the recently acquired Ford F-150 Lightnings represent the 2 EVSE in 2024.

Figure 8. 1 to 1 V2P Scenario Rollout Schedule by Base Location (Left) and by Vehicle Type (Right)



Scenario B – Optimized V2P Ratio Charging Infrastructure Scenario

For the maximum V2P ratio scenario, we first needed to determine the maximum number of vehicles that could share one EVSE plug while maintaining their duty cycle. In order to estimate the maximum V2P ratio, the nominal VMT for each vehicle and the assumed vehicle efficiency was used to calculate the number of days for the vehicle to reach 20 percent battery state-of-charge (SOC), which is the industry standard for requiring a vehicle to be re-charged.

Using these data points, the total number of vehicles in each vehicle class that could successfully complete its duty cycle was determined. This was performed for each vehicle class and for each of the base locations with BEV replacements. Note that one of the EVs at the AO facility is a pool vehicle anticipated to be used intermittently for long-distance travel. Given that the peak daily mileage of this vehicle could exceed 120 miles, there is a need for a dedicated charger for this specific vehicle. Therefore, to ensure that the rest of the vehicles at the AO facility can share chargers while this specific vehicle has its dedicated charger, the project team is assigning a different dwelling location to this vehicle (i.e., AO High Mileage). In practice, this will be the same location as other vehicles at the AO office, but the charger will be designated exclusively for this vehicle. It should also be noted that there is another high-mileage pool vehicle at this facility. However, since that vehicle is already a Plug-in Hybrid Electric Vehicle (PHEV), the project team has not recommended an EV replacement for it, and therefore, no dedicated charger is required. The maximum V2P ratio for each vehicle type and base location is shown in the table below.

Table 9. Maximum V2P Ratio

Dwelling Location	Light Duty	Medium Duty	Heavy Duty
AO	4		
AO (High Mileage)	1		
CAO	2	1	
FFO	2	1	1
SAO	2	1	
SFO	2	1	3

To illustrate how the maximum V2P ratio may look, assume that the maximum V2P ratio for light-duty pickup trucks at base location "A" is 5. This means that one dual-port charging station can be shared by 10 light duty pickup vehicles. The charging schedule for this scenario would entail a pair of vehicles charging every 5 days, as illustrated in the table below.

Table 10. Hypothetical Vehicle Charging Schedule

<table>
<tr><th rowspan="2">Day</th><th rowspan="2">Plug #1</th><th rowspan="2">Plug #2</th><th colspan="10">Vehicle ID</th></tr>
<tr><th>A</th><th>B</th><th>C</th><th>D</th><th>E</th><th>F</th><th>G</th><th>H</th><th>I</th><th>J</th></tr>
<tr><td>1</td><td>A</td><td>B</td><td></td><td></td><td></td><td></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="3">5 Days</td><td rowspan="3">5 Days</td><td rowspan="4">5 Days</td><td rowspan="4">5 Days</td></tr>
<tr><td>2</td><td>C</td><td>D</td><td rowspan="4">5 days</td><td rowspan="4">5 days</td><td></td><td></td></tr>
<tr><td>3</td><td>E</td><td>F</td><td rowspan="4">5 Days</td><td rowspan="4">5 Days</td><td></td><td></td></tr>
<tr><td>4</td><td>G</td><td>H</td><td rowspan="4">5 Days</td><td rowspan="4">5 Days</td><td></td><td></td></tr>
<tr><td>5</td><td>I</td><td>J</td><td rowspan="4">5 Days</td><td rowspan="4">5 Days</td><td></td><td></td></tr>
<tr><td>6</td><td>A</td><td>B</td><td></td><td></td><td rowspan="4">5 Days</td><td rowspan="4">5 Days</td></tr>
<tr><td>7</td><td>C</td><td>D</td><td rowspan="4">5 days</td><td rowspan="4">5 days</td><td></td><td></td></tr>
<tr><td>8</td><td>E</td><td>F</td><td rowspan="3">5 Days</td><td rowspan="3">5 Days</td><td></td><td></td></tr>
<tr><td>9</td><td>G</td><td>H</td><td rowspan="2">5 Days</td><td rowspan="2">5 Days</td><td></td><td></td></tr>
<tr><td>10</td><td>I</td><td>J</td><td>5 Days</td><td>5 Days</td><td></td><td></td></tr>
</table>

Table 11 illustrates the number of chargers by power level that project team estimated for this scenario. Please note that the power rating is for the whole dual-port EVSE and not for the single plug.

Table 11. Number of Chargers by Max Power Level (kW) under Maximum V2P Ratio Scenario

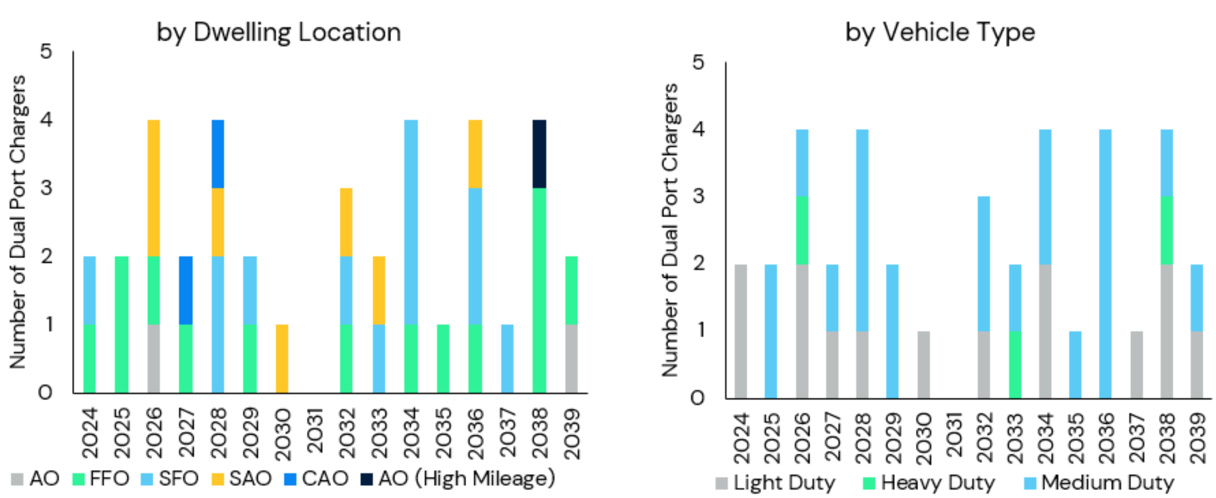
Dwell Location ID	Number of EVSE			Max Power Level (kW)			Total Power Demand (kW)
	Light Duty	Medium Duty	Heavy Duty	Light Duty	Medium Duty	Heavy Duty	
AO	**2**			25			50
AO (High Mileage)	**1**			6.6			6.6
CAO	**1**	**1**		50.0	19.2		69
FFO	**3**	**9**	**2**	25.0	19.2	15.4	254
SAO	**3**	**4**		25.0	19.2		152
SFO	**4**	**7**	**1**	50.0	19.2	15.4	350
# of EVSE	**15**	**21**	**3**	-	-	-	**939**
# of Vehicles	**52**	**42**	**6**				

The infrastructure recommendations for the Optimized V2P scenario align closely with those of Scenario A, particularly for medium- and heavy-duty vehicles. The notable difference lies in the recommendations for light-duty EVSE, where a shift towards installing fewer (15 charging stations) but higher powered (25 kW or greater) stations is advised, as illustrated in Table 11. For medium-duty vehicles, the recommendation to use 19.2 kW EVSE remains consistent across all locations. In the heavy-duty category, due to an increase in the V2P ratio from 1 to 3, there is a need for a more robust 15.4 kW EVSE to accommodate the three vehicles at the SFO.

Maximum V2P Rollout Schedule

The deployment schedule for charging stations in the optimized scenario, illustrated in Figure 9, while similar to the one-to-one scenario in pattern, differs significantly in two key aspects: the annual distribution of charging station recommendations and the total number of charging stations required. This scenario proposes a total of 38 charging stations, in contrast to the 52 recommended in Scenario A. The peak annual demand is four chargers per year, occurring in 2026, 2028, 2034, 2036, and 2038. Three chargers are needed in 2032. Two chargers are recommended in 2024, 2025, 2027, 2029, 2033, and 2039. Finally, only one charging station is recommended for the years: 2030, 2035, and 2037.

Figure 9. Optimized V2P Scenario Rollout Schedule by Base Location (Left) and by Vehicle Type (Right)



Charging Infrastructure Cost

With respect to cost for charging infrastructure deployment, the project team is using cost estimates based on a comprehensive literature review that ICF has conducted. This included reviewing the work completed by International Council on Clean Transportation[23] (ICCT), National Renewable Energy Laboratory[24] (NREL), Rocky Mountain Institute[25] (RMI), Environmental Defense Fund[26] (EDF), Department of Energy[27] (DOE), Electric Power Research Institute[28] (EPRI), National Renewable Energy Laboratory[29] (NREL) and many others where they quantified both the cost of equipment as well as charger installation. It should be noted that the costs mentioned only cover the equipment and its installation and do not take into account any electrical infrastructure upgrades required, such as distribution upgrades, which may need to be carried out by the utilities. A summary of these costs can be found in the table below.

Table 12. Charger Equipment and Installation Cost by Capacity[30]

Charger Capacity (kW)	EVSE Capital Cost	EVSE Installation Cost	Total Cost
6.6	$2,500	$3,500	$6,000
7.7	$3,500	$5,000	$8,500
9.6	$4,500	$6,500	$11,000
11.0	$5,000	$7,000	$12,000
15.4	$6,500	$9,500	$16,000
19.2	$8,000	$12,000	$20,000
25	$12,500	$19,000	$31,500
50	$29,500	$48,000	$77,500
100	$59,500	$54,500	$114,000
150	$89,500	$61,500	$150,500
350	$151,500	$107,500	$259,000

As illustrated in Figure 10, the approximate total cost of DPC stations in the 1-to-1 V2P ratio scenario is $554,678 in net present value assuming a 5% discount rate. This includes $223,898 for EVSE hardware costs and $330,780 for installation costs. Among all dwelling locations, FFO will require the largest investment to install charging stations at approximately $196,000. The second largest investment comes out to roughly $180,000 at SFO, followed by SAO at approximately $115,000. The remaining 2 dwell locations all require investments of less than $40,000.

The total cost of the Maximum V2P ratio scenario amounts to $772,754. This includes $303,317 for hardware costs and $469,437 for installation costs. One notable observation is that this scenario

[23] https://theicct.org/sites/default/files/publications/ICCT_EV_Charging_Cost_20190813.pdf
[24] https://www.sciencedirect.com/science/article/pii/S2542435120302312
[25] https://rmi.org/wp-content/uploads/2020/01/RMI-EV-Charging-Infrastructure-Costs.pdf
[26] http://blogs.edf.org/energyexchange/files/2021/03/EDF-GNA-Final-March-2021.pdf
[27] https://afdc.energy.gov/files/u/publication/evse_cost_report_2015.pdf
[28] https://www.epri.com/research/products/000000003002000577
[29] https://www.cell.com/action/showPdf?pii=S2542-4351percent2820percent2930231-2
[30] Costs vary significantly by manufacturer; these cost assumptions are meant to reflect market averages.

increases the overall power demand across the 5 dwelling locations by almost 100 kW compared to the 1 to 1 scenario. See Table 13 for a side-by-side comparison of the costs.

Figure 10. Infrastructure cost estimates (hardware and installation) for the two examined scenarios

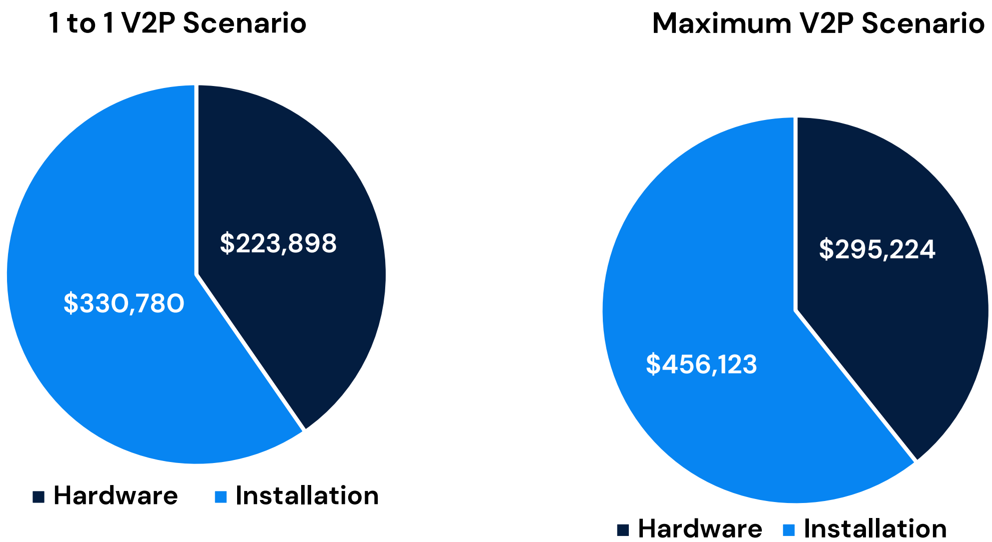


Table 13. Scenario Side-by-Side Cost Comparison

Dwelling Location	1:1 V2P Scenario			Max V2P Scenario		
	L2	DCFC	EVSE Cost (NPV)	L2	DCFC	EVSE Cost (NPV)
AO	7	0	$23,120		2	$41,641
AO (High Mileage)				1		$2,886
CAO	3	0	$39,148	1	1	$79,430
FFO	16	0	$196,330	11	3	$206,165
SAO	9	0	$115,331	4	3	$125,734
SFO	17	0	$180,750	8	4	$316,898
Total	52	0	$554,678	25	13	$772,754

Weighing the Benefits and Drawbacks of the Two Charging Infrastructure Alternatives

When considering the transition to an electrified fleet, it is important to weigh the pros and cons of the various charging infrastructure scenarios. Here, we contrast the benefits and drawbacks of the two scenarios under consideration: the 1:1 V2P ratio (scenario A) and the maximum V2P ratio (scenario B).

Scenario A: 1:1 V2P Ratio Scenario

The 1:1 scenario presents several advantages over the optimized scenario, most notably in terms of cost-effectiveness, saving over $200,000, and requiring about 100 kW less power capacity across the five base locations. This approach simplifies charging logistics, as each vehicle has its own dedicated charger, eliminating the need for scheduling and reducing the complexity of charging operations. However, this scenario has its downsides. It does not necessitate the use of DC fast chargers based on current fleet needs, yet incorporating higher-powered charging stations could future-proof the fleet's charging capabilities as it transitions to full electrification. Additionally, the higher the number of chargers, the higher the construction cost (for digging, trenching, and electrical work) needed to build out such charging infrastructure. Parking space limitations pertaining to this scenario should also be considered.

Scenario B: Optimized V2P Ratio Scenario

In contrast, the optimized V2P scenario introduces significant enhancements. Utilizing higher-powered chargers facilitates faster charging times than Level 2 stations, addressing the increasing demands of a growing electrified fleet. This scenario's efficiency in requiring fewer charging stations potentially conserves space, a critical consideration where space is at a premium. Nonetheless, it comes with higher costs, and the logistical demand of scheduling vehicles for charging introduces the need for dedicated staff or a fleet manager to ensure smooth operations. Each scenario offers distinct benefits and challenges, making the choice between them dependent on specific priorities such as cost, space, and operational simplicity.

Grid- and Site-Level Electrical System Capacity and Potential Upgrades

Aside from procuring vehicles and charging equipment, the deployment of charging infrastructure for EVs necessitates enhancements to the existing electrical infrastructure. As fleets transition to EVs, they typically require a significantly higher electrical load for charging purposes. This increase in demand often mandates considerable upgrades at both the facility and grid levels. For instance, a fleet facility that previously accommodated conventional vehicles might need to upgrade its transformers, install new electrical panels, and reinforce its connection to the local power grid to handle the increased load from EV chargers.

To evaluate the impact of Midpen's fleet transition to EVs on the electrical infrastructure at each of five vehicle dwelling locations, ICF estimated the additional load from EV charging based on the previously described 1 to 1 V2P ratio charging scenario. Table 14 illustrates the incremental power demand expected at each Midpen facility.

Table 14. Incremental Charging Demand – 1 to 1 V2P Scenario

Dwell Location	Power Demand (kW)
AO	46
CAO	50
FFO	280
SAO	154
SFO	271

On the customer side, the necessary upgrades include the electrical panel, conduit and cable, trenching, the meter, and associated installation costs. On the utility side, the primary requirements involve upgrading the transformer and the costs associated with its installation. This analysis operates under the assumption that each of the five base locations lacks the existing capacity to support the additional load from the EV charging stations, necessitating upgraded transformers at each site to handle the increased demand. If it is demonstrated that the grid distribution infrastructure has the capacity to absorb the extra load from EV charging, the utility-side electrical infrastructure upgrades will not be needed anymore.

The estimated total cost for the make-ready infrastructure is approximately $408,500. Utility-side upgrades account for about 55% of these costs, totaling roughly $225,000 which include the installation of three 300 kVa transformers at the FFO, SAO, and SFO, and 50 kVa transformers at the AO and CAO. The most significant expense on the customer side is attributed to upgrading the electrical panels, with an estimated cost of $62,000. This includes the recommendation to install 1500A panels at both the FFO and SFO to accommodate their maximum power demands of 281 kW and 271 kW, respectively. The summary table provided below outlines the complete list of make-ready costs by dwelling location.

Table 15. Make-Ready Infrastructure Cost Estimates

	Customer-Side						Utility-Side			
Dwell Location	**Electric Panel**	**Conduit & Cable**	**Trenching**	**Conduit & Cable Installation**	**Panel Installation**	**Meter**	**Transformer Installation**	**Transformer**	**Line Extension**	**Total**
AO	$2,542	$7,559	$3,779	$1,512	$508	$2,160	$380	$1,900	$9,580	**$29,920**
CAO	$2,421	$3,085	$1,543	$617	$484	$2,057	$362	$1,810	$9,580	**$21,958**
FFO	$24,490	$17,007	$8,503	$3,401	$4,898	$2,268	$9,615	$48,073	$9,580	**$127,834**
SAO	$6,479	$9,718	$4,859	$1,944	$1,296	$2,160	$9,157	$45,783	$9,580	**$90,975**
SFO	$25,714	$20,238	$10,119	$4,048	$5,143	$2,381	$10,095	$50,476	$9,580	**$137,794**

Funding & Financing Programs

Following the completion of the fleet transition as well as charging infrastructure plan, the project team created a funding and financing plan aimed at reducing the cost of transitioning to an all-electric fleet for Midpen. The plan was created after researching various grants, rebates, and incentives that the District may be eligible for. To conduct this research, the team utilized the Alternative Fuels Data Center's (AFDC) Laws and Incentives Database[31], which contains information on nearly 1,000 laws, incentives, and programs related to EVs and EVSE. Furthermore, the team leveraged its knowledge of California's policy environment to identify and outline other funding opportunities for the District.

The funding section of the plan details various programs available for EV procurement and charging infrastructure development. This includes federal initiatives like the tax rebates for EVs and charging infrastructure under the Inflation Reduction Act (IRA). State programs, such as the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) managed by the California Air Resources Board (CARB), are also covered. Additionally, the plan underscores local schemes like the Bay Area AQMD (BAAQMD) Charge! program and PG&E's Charging Infrastructure Rebates from its EV Fleet Program, both of which could offer EVSE funding opportunities for the District's fleet electrification efforts. The plan provides information on eligibility requirements, application procedures, and the possibility of stacking multiple funding sources; a summary of funding and financing options is available in Table 16, and stacking opportunities are summarized in Table 17. Please note that while the California Clean Vehicle Rebate Project (CVRP) has historically played a critical role in providing incentives to transition the state's light-duty vehicles to zero emissions, this program is no longer accepting applications and, therefore, is not included in the list of incentive programs provided in this section.

The financing aspect of the plan outlines methods to minimize the expenses associated with transitioning to a fully electric fleet. This can be achieved through public-private partnerships (PPP), charging infrastructure-as-a-service, and low-interest loans. In a PPP, the public sector partners with a private company to jointly finance, build, and operate a project or service. This type of partnership can bring together the resources, expertise, and incentives of both the public and private sectors to achieve a common goal. In the context of charging infrastructure deployment, a PPP can be used to finance the installation and maintenance of charging stations. The private partner could be an infrastructure provider, such as an energy company, a charging network operator, or a private equity firm. Under a PPP arrangement, the private partner could provide the financing for the charging infrastructure in exchange for a long-term contract with the public sector to operate and maintain the charging stations. This would provide the private partner with a steady revenue stream, while also enabling the public sector to benefit from increased access to charging infrastructure.

With respect to Charging Infrastructure-as-a-Service (ClaaS), a provider offers charging infrastructure for EVs on a subscription or pay-per-use basis. This model enables customers, such as fleet operators and commercial property owners, to access charging stations without having to invest in and maintain their own physical charging infrastructure. In a ClaaS model, the provider is

[31] https://afdc.energy.gov/laws/state_summary?state=CA

responsible for the installation, operation, and maintenance of the charging stations, which can range from simple Level 2 charging to fast-charging stations. Customers pay for the charging services they use, typically based on the amount of energy consumed or the length of time spent charging. By providing access to charging stations, the ClaaS model enables fleet operators to transition to electric fleets without having to make significant upfront investments. The choice between these business models, as well as the loan financing options, will depend on the specific characteristics of the fleet. The plan considers the pros and cons of each option and evaluates which one would be most suitable for Midpen's fleet transition.

Table 16. Summary of funding and financing programs

Program	Type	Eligibility	Funding Amount
IRA	Federal tax credit	Individuals, businesses, and tax-exempt organizations	Up to $7,500 for light-duty ZEVs Up to $40,000 for medium- and heavy-duty ZEVs
Alternative Fuel Infrastructure Tax Credit	Federal tax credit	Individuals and businesses	30% of the cost or 6% in the case of property subject to depreciation, not to exceed $100,000
CMAQ Program	Federal grant program	Public and private organizations	Up to 50 percent of identified funds
HVIP	Point-of-sale incentive	Class 2b-8 ZEVs purchased by individuals and businesses	$7,500 to $120,000 (Base)
Carl Moyer	State incentive	Clean combustion and Zero emissions Requires scrappage	Up to $160,000 for 0.02 engines Up to $410,000 for ZE trucks
EnergIIZE	State incentive	Public and private fleets of medium and heavy-duty vehicles as well as public charging	Up to 50 percent of the project cost
LCFS	Credit based program	Non-residential EV charging	Number of credits earned x Credit price
TCIRP	State grant	Clean vehicle replacement and EV infrastructure deployment	Project specific
BAAQMD Charge!	Regional grant	Grants for EVSE deployment	Project specific up to 85% of project cost
PG&E Charging Infrastructure Rebates	Utility Rebates	Fleet Operators	$4,000 per vehicle
PPP	Joint financing	Public and private organizations	Varies
Sourcewell	Purchasing contracts	Individuals, businesses, and tax-exempt organizations	EV lease- to -purchase pathways
IBank	Loan financing	Individuals, businesses, and tax-exempt organizations	Between $1,000,000 and $65,000,000 Loan terms vary
ClaaS	EV charger revenue	Individuals and businesses	Varies by electric utility rates

Stacking Opportunities

Aside from each incentive program providing funding to facilitate the transition to clean vehicle technologies, to the extent possible, fleets may want to stack up and combine multiple funding sources to reduce the cost of transition. Examples include using one grant to fund vehicles and another to fund charging infrastructure, using a state grant to meet the match requirements of a federal grant, or stacking non-utility funding with participation in a utility program. It should be noted that despite the incentive programs having their own unique eligibility criteria, these programs often provide stacking opportunities. For example, with respect to HVIP program, local- and federal-funded incentives may be combined with HVIP vouchers, so long as each incentive program is not paying for the same incremental costs, or the total sum of incentives does not exceed the total cost of the vehicle. Local incentives that may be combined with HVIP include programs administered by local air districts or local municipalities that are locally funded. Federal incentive programs may be combined with HVIP vouchers, including funding provided by the Federal Transit Administration (FTA), the Department of Energy (DOE), and other federal agencies. Except for public transit buses, stacking HVIP with State-funded incentives is not allowed. To clarify this, the table below shows the stacking opportunities across various funding sources described in this report. Each cell in the table shows whether the two funding programs (the one representing the row and the one representing the column) can be stacked or not. In cases where one funding program only pays for infrastructure and the other program only pays for vehicles, we marked those as "No Overlap".

Table 17. Stacking Opportunities across various programs

Program	IRA	Alt. Fuel Infrastructure Tax Credit	CMAQ Program	HVIP	Carl Moyer	EnergIIZE	LCFS	TCIRP	BAAQMD Charge!	PG&E Charging Infrastructure Rebates
IRA	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Alternative Fuel Infrastructure Tax Credit	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CMAQ	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes
HVIP	Yes	Yes	Yes	N/A	No	No	N/A	No	No Overlap	No Overlap
Carl Moyer	Yes	Yes	Yes	No	N/A	No	Yes	No	No Overlap	No Overlap
EnergIIZE	Yes	Yes	Yes	No	No	N/A	N/A	No	Yes	Yes
LCFS	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes
TCIRP	Yes	Yes	Yes	No	No	No	Yes	N/A	Yes	Yes
BAAQMD Charge!	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes
PG&E Charging Infrastructure Rebates	Yes	Yes	Yes	No Overlap	No Overlap	Yes	Yes	Yes	Yes	N/A

Funding Strategy Recommendations

Fleet electrification is crucial for reducing emissions and achieving sustainability goals, but it poses challenges such as high upfront costs, limited charging infrastructure, and the need for specialized maintenance and training. Although zero-emission vehicle and infrastructure costs are expected to decrease over time, present financial burdens are hindering more widespread or rapid adoption. This guide identifies funding and financing options that can help advance fleet electrification and infrastructure deployment. Various funding and financing sources are available, including federal, state, and utility programs. The programs identified in this guide were selected based on the District's likely eligibility to receive funds, based on each specific program's requirements. Most programs identified in this guide do not require matching funds and can offer tens to hundreds of thousands of dollars in fleet electrification support; however, most of these programs only provide funding for either just zero-emission vehicle purchases or just refueling infrastructure. Additionally, total funding amounts vary based on vehicle size and purpose, as well as charger power levels in the case of EV infrastructure. As the District embarks on its fleet electrification process, the following recommendations based on vehicles and infrastructure may be considered. For more detailed explanations of the various funding and financing options, see Appendix E of this report.

Options for Medium- and Heavy-Duty EVs

A funding strategy to consider for medium- to heavy-duty zero-emission vehicles that combines different incentives for maximum financial support is listed below:

1. State programs (non-stackable) directed towards fleet vehicles, such as one of:
    a. California Clean Vehicle Rebate Project (CVRP) – *Funding has expired for this program and the Midpeninsula Regional Open Space District is unlikely to receive any CVRP funds.*
    b. Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP)
    c. Carl Moyer Program
    d. VW Environmental Mitigation Program
2. Federal program directed towards fleet vehicles and EV charging infrastructure, such as the:
    a. Inflation Reduction Act
    b. CMAQ Improvement Program
3. Financing for leased or owned fleet vehicles, through options such as:
    a. Public-Private Partnerships such as Sustainability Partners
    b. Purchasing Contracts from Sourcewell

First, consider the funding potential from State programs. The funding potential of State programs is significant, ranging between thousands and hundreds of thousands of dollars for eligible zero-emission vehicles. However, funding provided by one State program cannot be stacked with funding from another State program. Moreover, any additional funds towards the same vehicle or fleet of vehicles must come from other sources, which can either be the applicant's own matching funds or funds from local and federal incentives.

The choice between one of the three primary State programs can be narrowed down based on the District's specific vehicle needs. For example, HVIP offers funding for more vehicle classes. HVIP's maximum base amount of funding increases incrementally between Class 2b through 8 vehicle classes, ranging between $7,500 to $120,000 (as shown in Table 20). Since the District has more medium-duty vehicles than heavy-duty vehicles, funding potential could be maximized through the

HVIP program and a combination of other local or federal incentives On the other hand, if the District foresees higher utilization of heavy-duty vehicles into the future, it may consider the Carl Moyer Program or VW Mitigation Program instead. However, pursuing either the Carl Moyer or VW Mitigation programs would mean the District would have to adhere to model year and scrappage requirements set by those programs.

Assuming the District selects one of the three primary State programs, the next applicable pool of funding could come from the IRA, which would pay the minimum of 30% of the vehicle purchase price or the funding cap based on the GVWR. Additionally, the District may submit a CMAQ Program application for zero-emission vehicle and infrastructure funding, if it can demonstrate emission reductions that would benefit a nonattainment zone.[32] It is likely the case that federal funding would be applied after whatever amount is discounted by the selected State program, and any remaining balance due on the vehicle purchase would need to be fulfilled either by the District or through a financing agreement in the form of a loan or bond program.

Options for Light-Duty ZEVs

A funding strategy to consider for light-duty zero-emission vehicles that combines different incentives for maximum financial support is listed below:

1. State program directed towards passenger vehicles, such as:
    a. California Clean Vehicle Rebate Project (CVRP) – *Funding has expired for this program and the Midpeninsula Regional Open Space District is unlikely to receive any CVRP funds.*
2. Federal program directed toward passenger vehicles, such as:
    a. Inflation Reduction Act
    b. CMAQ Improvement Program
3. Financing for leased or owned passenger vehicles, through options such as:
    a. Public-Private Partnerships
    b. Purchasing Contracts from Sourcewell

Based on current program descriptions and requirements, there are fewer funding opportunities for light-duty zero-emission vehicles compared to those for medium- and heavy-duty zero emission vehicles. Accordingly, most of the funding that the District may find itself eligible for is through the IRA or approved CMAQ Program project, in the form of direct payments and grants, respectively. Alternatively, the District may consider mixed ownership contracts through innovative PPPs or Sourcewell contracts.

[32] A nonattainment zone is an area that does not meet the national ambient air quality standards (NAAQS) for certain pollutants, as defined by EPA. These areas require special regulatory measures to improve air quality.

Options for Charging Infrastructure

A funding strategy to consider for charging infrastructure that combines different incentives for maximum financial support is listed below:

1. State programs, such as some of:
    a. Energy Infrastructure Incentives for Zero-Emission (EnergIIZE)
    b. California Energy Commission (CEC) Block Grants toward public fleets
    c. California Electric Vehicle Infrastructure Project (CALeVIP) – *The Midpeninsula Regional Open Space District is not currently eligible for funding through this program*
    d. Low Carbon Fuel Standard (LCFS)
2. Utility programs directed towards charging infrastructure, such as the:
    a. PG&E Charging Infrastructure Rebates
3. Local programs directed toward charging infrastructure, such as the:
    a. BAAQMD Charge! Program
4. Federal programs, such as the:
    a. Inflation Reduction Act
    b. CMAQ Improvement Program
5. Financing programs, such as the:
    a. Charging Infrastructure-as-a-service
    b. Financing Options through IBank, namely:
        i. Infrastructure State Revolving Fund (ISRF)
        ii. Climate Tech Finance

Based on current program descriptions and requirements, the greatest stacking potential exists within the charging infrastructure landscape. In the case of funding for charging infrastructure, most State program incentives can be combined with other federal, state, or local agency incentives; it should be noted, however, that applicants are ineligible to receive from CALeVIP if the applicant has already received funds from investor-owned utilities (IOUs).

As mentioned earlier, Midpen is currently ineligible for funding from CaleVIP however the district can benefit from CEC's EnergIIZE and also generate and sell LCFS credits from the electricity dispensed by its charging infrastructure through a broker to secure additional funds.

Similar to vehicle procurement, the IRA offers a way to lower the costs of charging infrastructure projects through the Alternative Fuel Refueling Property Credit, assuming the site fulfills the specified environmental justice requirements. If the District does not qualify for these tax credits, it can leverage other options such as the ISRF and CIaaS for the acquisition or operational phases, respectively.

Projected Costs-Benefit & Barriers to Fleet Conversion

This section delineates the total costs associated with owning and operating an EV fleet in comparison to a fleet of ICE vehicles. It evaluates the economic impacts of various incentive programs on the transition to an EV fleet. While the previous section outlined various incentive programs; this section narrows the focus to those for which Midpen is definitively eligible and where the incentive amounts are clear and quantifiable, we will detail these three selected incentive programs below.

Subsequently, a comprehensive cost analysis of transitioning to an EV fleet, taking into account vehicle acquisition costs, fuel, and maintenance expenses will be detailed. For EVs, this also includes the costs related to establishing charging infrastructure. Additionally, we will explore how incentive programs can help mitigate the costs of purchasing alternative battery electric vehicles.

The three incentive programs chosen for this analysis include:

- The Commercial Clean Vehicle Credit (CCVC) program (i.e., IRA Tax Credit),
- The Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP), and
- The PG&E EV Fleet program, as detailed in Table 18.

These programs have been selected due to their potential to significantly reduce the cost differential between EVs and conventional vehicles, facilitating a smoother and more financially viable transition.

Table 18. Summary of Funding Programs

Program	Type	Eligibility	Funding Amount
Commercial Clean Vehicle Credit Program	Federal tax credit	Individuals, businesses, and tax-exempt organizations	Up to $7,500 for light-duty ZEVs Up to $40,000 for medium- and heavy-duty ZEVs
Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP)	Point-of-sale incentive	Class 2b-8 ZEVs purchased by individuals and businesses	$7,500 to $120,000 (Base)
PG&E EV Fleet Program	Utility Rebates	Fleet Operators	$4,000 per vehicle

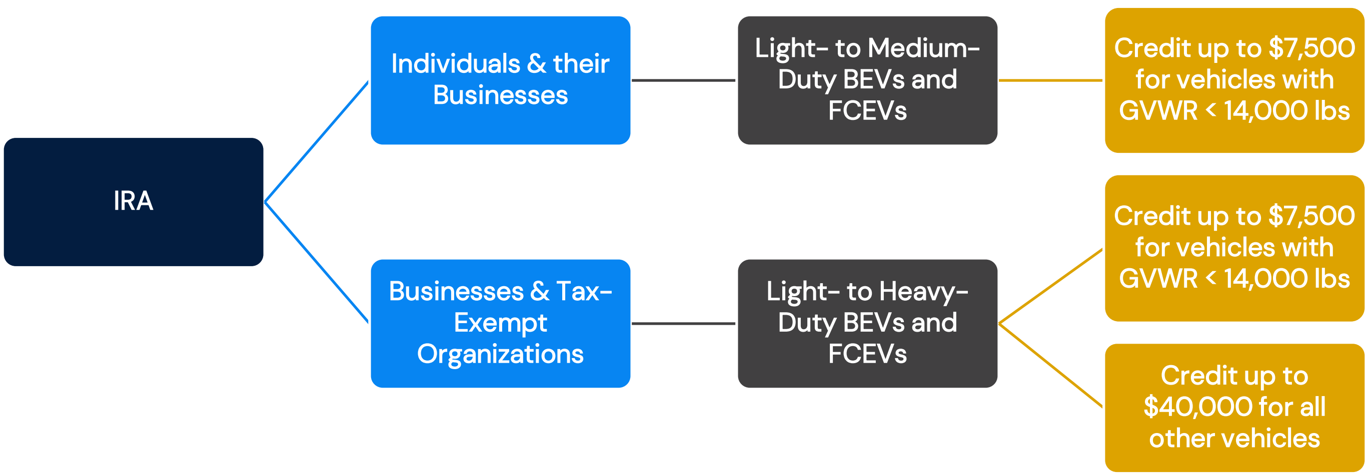
Inflation Reduction Act – Commercial Clean Vehicle Credit Program

The IRA contains several provisions aimed at increasing the number of clean fuels and vehicles used by private and public fleets. The IRA will offer refundable income tax credits for qualifying EVs and extends tax credits for alternative fuel refueling property through 2032. Notably, the IRA will provide different tax benefits based on the type of applicant and type of EVs being considered for purchase. Figure 11 features an illustration that breaks down eligible applicants, types of EVs, and maximum applicable tax credits under the IRA. The final tax credit amount offered through IRA is the smallest of the following amounts:

- 30% of the vehicle purchase price for EVs and FCEVs

- The incremental cost of the vehicle compared to an equivalent internal combustion engine vehicle

Figure 11. Summary of IRA Tax Credits Available for Individuals and Commercial Entities



The IRA has several clean vehicle credit options, most notably: 1) Credits for New Clean Vehicles Purchased in 2023 or After and 2) Commercial Clean Vehicle Credits. Individuals and their businesses may qualify for a credit up to $7,500 when buying new, qualified battery electric vehicles (BEV) or fuel cell electric vehicles (FCEV) assembled in North America. Qualifying BEVs must have a battery capacity of at least 7 kilowatt-hours (kWh) and have a gross vehicle weight rating (GVWR) of less than 14,000 lbs.; no restrictions are set for FCEVs. Additionally, the vehicle's manufacturer suggested retail price (MSRP) cannot exceed $55,000 for light-duty vehicles or $80,000 for vans, SUVs, and pickup trucks. Credit for new clean vehicle purchases between 2023 through 2032 can be claimed by filing Form 8936, Qualified Plug-In Electric Drive Motor Vehicle Credit, and providing the vehicle identification number (VIN).

Businesses and tax-exempt organizations can receive a tax credit of up to $40,000 for buying a qualified commercial clean vehicle under IRC 45W. The credit amount is based on the lesser of 15% of the vehicle's basis or the incremental cost of the vehicle. The maximum credit is $7,500 for qualified vehicles with GVWRs under 14,000 pounds and $40,000 for all other vehicles. To qualify, the vehicle must be made by a qualified manufacturer as defined in IRC 30D(d)(1)(C), be for use in the business, not for resale, primarily used in the US, and not have received a credit under sections 30D or 45W. The vehicle must meet also one of the following requirements a) It must be treated as a motor vehicle for purposes of title II of the Clean Air Act and manufactured primarily for use on public roads (excluding vehicles operated exclusively on a rail or rails), or b) It must be classified as mobile machinery according to IRC 4053(8), including vehicles that are not designed to transport a load over a public highway. Additionally, the vehicle or machinery must be either a plug-in electric vehicle that draws significant propulsion from an electric motor with a battery capacity of at least 7 kilowatt hours if the gross vehicle weight rating is under 14,000 pounds, or 15 kilowatt hours if the GVWR is 14,000 pounds or more. Alternatively, it can be a fuel cell motor vehicle that meets the requirements of IRC

30B(b)(3)(A) and (B). There is no limit to the number of credits an entity (businesses or tax-exempt entities) can claim.

Credit for new clean vehicle purchases between 2023 through 2032 can be claimed by first registering for elective payment through the IRS. To make an elective payment an authorized representative from the District must:

- Use the IRS Online Tool to create an Energy Credits Online (ECO) account
- Get a registration number for each applicable credit property

After registering for electric payment, the District can file Form 8936, Qualified Plug-In Electric Drive Motor Vehicle Credit, and providing the vehicle identification number (VIN). Following Form 8936, the District will need to fill out two forms for direct pay applicants, including Form 3800, General Business Credit form for Direct Pay applicants and Form 990-T, which is an Exempt Organization Business Income Tax Return for Direct Pay Applicants. The District can use the same 3800 and 990-T forms for both EVs and EVSE it procures in a given tax year.[33] In filling out the forms, District should include registration number for their Energy Credits Online (ECO) account on above mentioned Tax forms (i.e., Form 8936, Form 3800, and Form 990-T).

ICF estimates Midpen is eligible to receive up to $315,000 (in net present value) in tax credits from the IRA program, equating to roughly $10,500 per vehicle for 30 eligible vehicles.

Additionally, the IRA offers the Alternative Fuel Refueling Property Credit, a federal income tax credit for businesses and individuals who install alternative fuel infrastructure. As of January 1, 2023, fueling equipment for natural gas, propane, hydrogen, electricity, E85, or diesel fuel blends containing a minimum of 20% biodiesel, is eligible for a tax credit of 30% of the cost or 6% in the case of property subject to depreciation, not to exceed $100,000. Note that permitting and inspection fees are not included as part of the covered expenses.

Eligible fueling equipment must be installed in locations that meet one of the following census tract requirements:

- The census tract is not an urban area which applies to SFO, FFO, and CAO;
- A population census tract where the poverty rate is at least 20%; or
- Metropolitan and non-metropolitan area census tract where the median family income is less than 80% of the state median family income level which applies to SAO as it meets the definition of “low-income community” in Internal Revenue Code section 45D(e), using the 2016-2020 New Markets Tax Credit (NMTC) designations and the 2020 census tract boundaries (“2016-2020 NMTC tracts”).

Eligible projects must also meet workforce requirements, such as apprenticeships and prevailing wages. To apply for the credit, the Internal Revenue Service (IRS) requires that Form 8911 be completed and filed with a federal income tax return. Although Midpen’s facilities (SFO, FFO, CAO, and SAO)meet

[33] Elective Pay Under the IRA - Electrification Coalition

at least one of the criteria listed, there are more granular determinations for eligibility that were not considered at this time.

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

The Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) is a first-come, first-served, point-of-sale incentive program. HVIP funding is available for vehicles between Class 2b through 8 weight classes: the funding amounts for zero-emission vehicles by weight class for FY23-24 is shown in Table 19. Additionally, incentives for ePTO may cover up to 65% of the incremental cost of the ePTO, not to exceed the funding amounts listed in Table 20.

Table 19. HVIP FY22-23 Zero-Emission Funding Table

Vehicle Weight Class	Funding Amount (Base)
Class 2b	$7,500
Class 3	$45,000
Class 4-5	$60,000
Class 6-7	$85,000
Class 8	$120,000

Table 20. HVIP FY22-23 Eligible ePTO Voucher Table

Energy Storage Capacity	Base Vehicle Incentive
3 – 10 kWh	$20,000
10 – 15 kWh	$30,000
16 – 25 kWh	$40,000
>25 kWh	$50,000

For HVIP, purchasers are not required to apply for a voucher, instead, HVIP has streamlined the process by having dealers become HVIP-approved and having dealers submit requests for HVIP vouchers to CARB. Upon approval, the voucher amount is discounted from the purchase order. This process makes it simpler for purchasers to explore the HVIP-eligible vehicle catalog and work with HVIP-approved dealers for direct access to incentives. Currently, HVIP offers vouchers for 151 vehicles, many of which can be found across at least 65 HVIP-approved dealers in California.

Individuals who wish to purchase vehicles are allowed to request a maximum of 30 vouchers annually. It is worth mentioning that the voucher amount may be adjusted based on the type of applicant and vehicle. Table 21 outlines the voucher adjustments based on the applicant type, while Table 22 describes the adjustments based on the vehicle type. These adjustments to the voucher amount will be applied by the dealership, so it is recommended that buyers contact dealers ahead of time to find out if they are eligible for any increased voucher amounts. For instance, the District may be eligible for a 15% increase in the HVIP voucher amount, as census tracts in the area have been identified as disadvantaged communities by CARB [34].

[34] CARB Climate Investments Priority Populations 2022 CES 4.0

Noteworthy to mention is that except for public transit buses, HVIP cannot be stacked with State-funded incentives. However, local- and federal-funded incentives may be combined with HVIP vouchers, so long as each incentive program is not paying for the same incremental costs, or the total sum of incentives does not exceed the total cost of the vehicle.

Table 21. HVIP FY22-23 Public and Private Fleet Voucher Adjustments

Voucher Adjustment Type	Voucher Adjustment Base
Public and Private fleets with 10 or fewer medium- and heavy-duty vehicles	+15%
Public fleets with 11 or more medium- and heavy-duty vehicles	0%
Private fleets with between 11 and 100 medium- and heavy-duty vehicles	0%
Private fleets with between 101 and 400 medium- and heavy-duty vehicles	-20%
Private fleets with more than 500 medium- and heavy-duty vehicles	-50%

Table 22. HVIP FY22-23 Vehicle Voucher Modifiers

Modifier Type	Modifier Amount
Class 8 Drayage Truck Early Adopter*	+25%
Refuse*	+25%
Disadvantaged Community**	+15%
Class 8 Fuel Cell	+100%
Public Transit Agencies***	+15%
School Buses for Public School Districts (not including Set-Aside funds)	+65%
Plug-in Hybrid	-50%
In-Use Converted/Remanufactured	-50%

*As part of CARB's Refuse Reimagined initiative, a voucher enhancement of 25% is applied to HVIP eligible refuse vehicles used for solid waste collection starting November 18, 2022. This increased incentive amount is available until Dec. 31, 2023. The existing Drayage Truck Early Adopter 25% voucher enhancement is also extended until Dec. 31, 2023.

**For vehicles domiciled in a disadvantaged community that are purchased or leased by any public or private small fleet with 10 or fewer trucks or buses, and less than $50 million in annual revenue for private fleets, or for any purchase or lease by a California Native American tribal government. There is no revenue provision for public fleets.

***The Public Transit Modifier is reserved for transit buses purchased by a District or county government; a transportation district/transit district; or a public agency. Public transit includes paratransit services.

ICF estimates Midpen could receive $630,000 (in net present value) in incentives through HVIP, with 22 vehicles receiving an average per vehicle incentive amount of roughly $28,600.

PG&E EV Fleet Program

PG&E has a comprehensive EV Fleet program that includes incentives and rebates, site design and permitting, construction and activation, as well as maintenance and upgrades. PG&E offers incentives to offset charging infrastructure costs for medium,- and heavy-duty electric vehicles. To be eligible for the general EV Fleet Program, an entity needs:

- To be a PG&E electric customer (Midpen is a PG&E customer)
- Own or lease its property
- Acquire at least 2 medium- or heavy-duty EVs
- Agree to program requirements

Midpen is eligible for the incentive amounts listed below in Table 23. The District has 49 medium- or heavy-duty vehicles (above 10,000 lbs. GVWR) that will be part of its fleet transition. These vehicles fall under the "School buses, local delivery trucks, and other vehicles" classification. **ICF estimates the District could receive $196,000 in incentives to support for transitioning these vehicles**.

Table 23. PG&E Charging Infrastructure Incentive Amounts

Vehicle Type	Per Vehicle Incentive Cap
Off-road vehicles including forklifts	$3,000 per vehicle
School buses, local delivery trucks, and other vehicles	$4,000 per vehicle

The impact of these three incentive programs is substantial, providing an estimated total incentive amount of roughly $1,140,000 million or roughly $767,000 in net present value terms. These incentive programs collectively reduce the cost discrepancy between EV replacements and ICE replacements by roughly 64 percent.

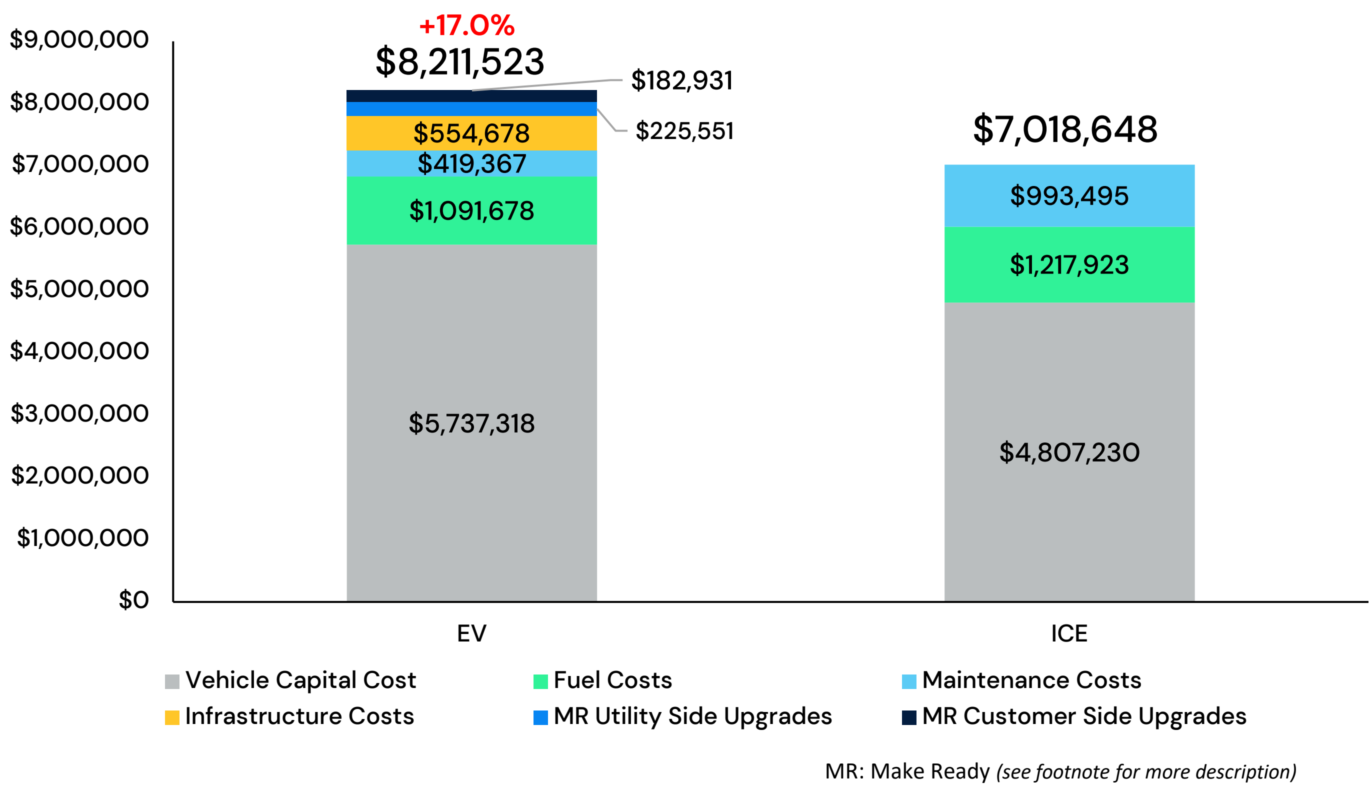
Cost of Transition of Fleet Electrification

This section delves into the comparative total cost of ownership (TCO) between scenarios where vehicles are replaced with EVs and those where replacements are traditional internal combustion engine (ICE) vehicles. The first section assesses the total costs associated with EVs and their ICE counterparts excluding the financial impact of the three incentive program's outlined above. The second part of this section looks at the impact of the incentive programs estimated funding contribution on the TCO. Note that for an apple-to-apple comparison this TCO analysis excludes the capital and operating costs of recently added four F-150 Lightnings since those were new additions to the fleet. However, it does include the charging infrastructure cost needed for them.

TCO without Incentives

The total cost of ownership encompasses the capital and operational expenses of the vehicles, alongside the infrastructure and make ready costs. In the scenario where no incentives are applied, the TCO for EVs is approximately 20 percent higher than that for ICE vehicles. Our preliminary findings indicate a roughly 17 percent difference in capital costs when comparing EVs with their ICE counterparts, leading to a higher TCO for EVs. Although EVs offer approximately 32 percent savings in operating costs—accounting for fuel and maintenance—over the vehicles' lifespan, these savings are not enough to offset the initial cost difference. As a result, the TCO for EVs remains almost $1.2M higher compared to ICE vehicles (Figure 12).

***Figure 12. TCO without Incentives*[35]**

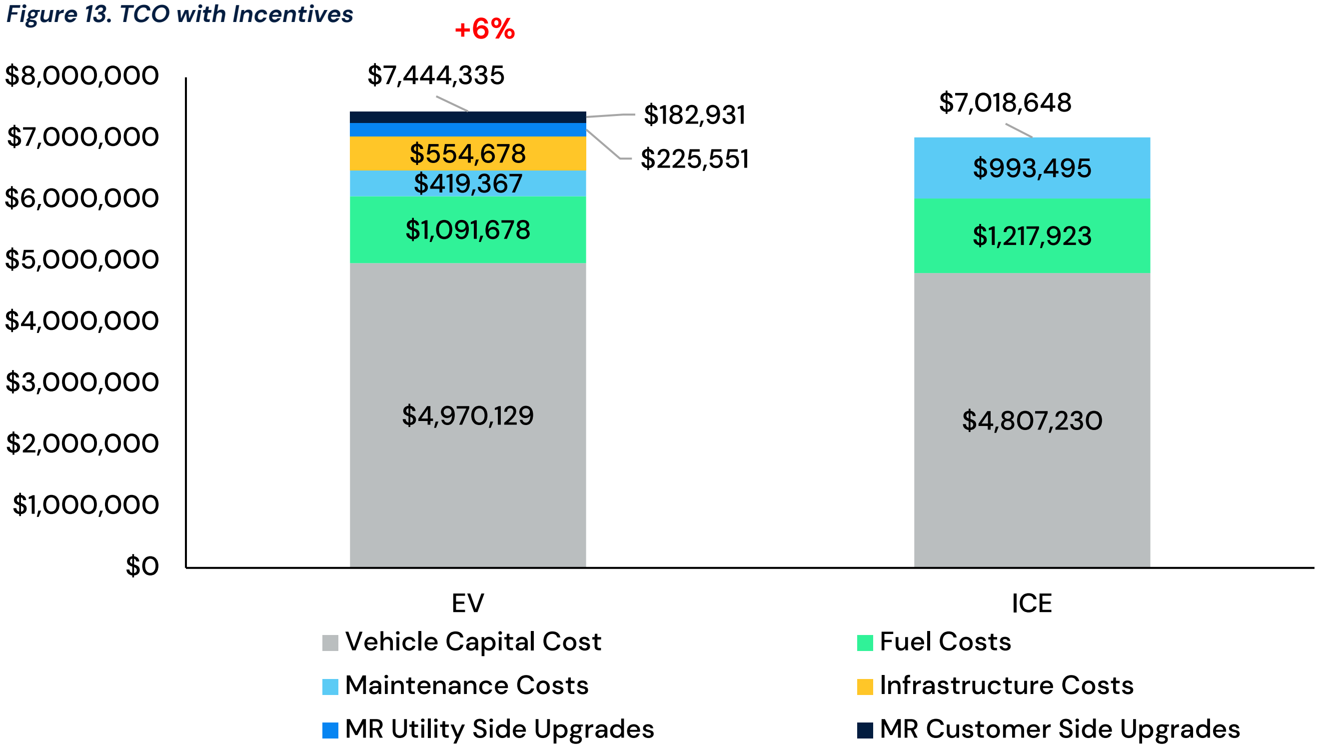


[35] Make-ready (MR) infrastructure includes electrical panel, trenching, conduit and cable, electric meter, transformer.

TCO with Incentives

We also evaluated the total cost of ownership when incorporating incentives from the IRA, the California HVIP, and the PG&E EV Fleet Program. These programs significantly lowers the capital cost for EVs and our analysis shows that when including all three programs, that EVs capital costs in NPV will drop from $5.7M to almost $5M. However, despite the significant capital cost reductions resulting from these three incentive programs as well as cost savings associated with operating expenses (maintenance & fuel), the TCO for EV is still roughly 6 percent higher as compared to the ICE replacement scenario (Figure 13).

Figure 13. TCO with Incentives

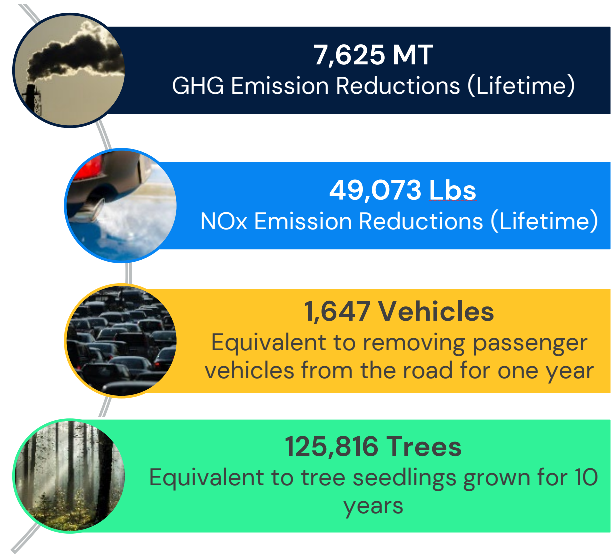


MR: Make Ready

Environmental Benefit of the Transition

Our analysis indicates that the transition to EVs can provide substantial environmental benefits for Midpen. Specifically, we found that transitioning the 96 vehicles to EVs could result in a reduction of more than 7,000 metric tons (MT) of GHG emissions over the lifespan of the vehicles (Figure 15). Additionally, on an annual basis, the electrification of Midpen's fleet could reduce its on-road fleet emission by 50 percent by 2030, and more than 98 percent by 2040 (Figure 16). Of course, these emissions reductions are under a "no growth" assumption. As Midpen's fleet expands, these numbers may change depending on whether the growth results from the addition of ICE vehicles or EVs.

Figure 14. Summary of Environmental Benefits with the EV Replacement Scenario



It is important to note that the methodology employed in this assessment to calculate total fleet GHG emissions differs from the methodology used by the District for its official GHG emissions inventory. In this assessment, our project team utilized vehicle counts and estimated annual mileage associated with each vehicle, occasionally adopting conservative assumptions regarding vehicle annual and daily mileage to ensure replacement vehicles meet all operational demands when transitioning to EVs. In contrast, the District's official GHG inventory relies on actual fuel use data obtained from fuel cards or reported by the fleet to calculate total fleet emissions, which provides a more accurate total as a biennial snapshot but does not address individual vehicle emissions. Consequently, the estimated GHG emissions provided in this project appear notably higher than those reported in the District's official emissions inventory. The use of annual mileage in this methodology was essential for projecting emissions out to 2040.

According to the latest GHG emissions inventory published by the District, vehicles and equipment were responsible for 503 metric tons of carbon dioxide equivalent (CO_2e) emissions in 2022, which is 13 percent lower than the 2016 baseline emissions. With implementation of this fleet electrification plan, and assuming no fleet growth, the District fleet's emissions are expected to be 47 percent below the 2016 baseline by 2030 and 98 percent below the 2016 level by 2040. While it is understood that fleet growth will be necessary, by implementing this fleet electrification plan, the District should be able to achieve its 2030 GHG reduction goals for the fleet and meet its 2050 emissions reduction goal, potentially much earlier than 2050.

The cumulative emissions reduction over the lifetime of the replaced vehicles would be equivalent to removing more than 1,600 personal passenger vehicles from the California roadways for the period of one year or planting approximately 125,000 trees. Additionally, over 49,000 lbs. of nitrogen oxide (NOx) emissions would be eliminated. These results highlight the significance of sustainable transportation practices in reducing the transportation carbon footprint and addressing the adverse impacts of climate change.

Figure 15. Total Fleet Cumulative GHG Emissions (MT), by Vehicle Replacement Scenario

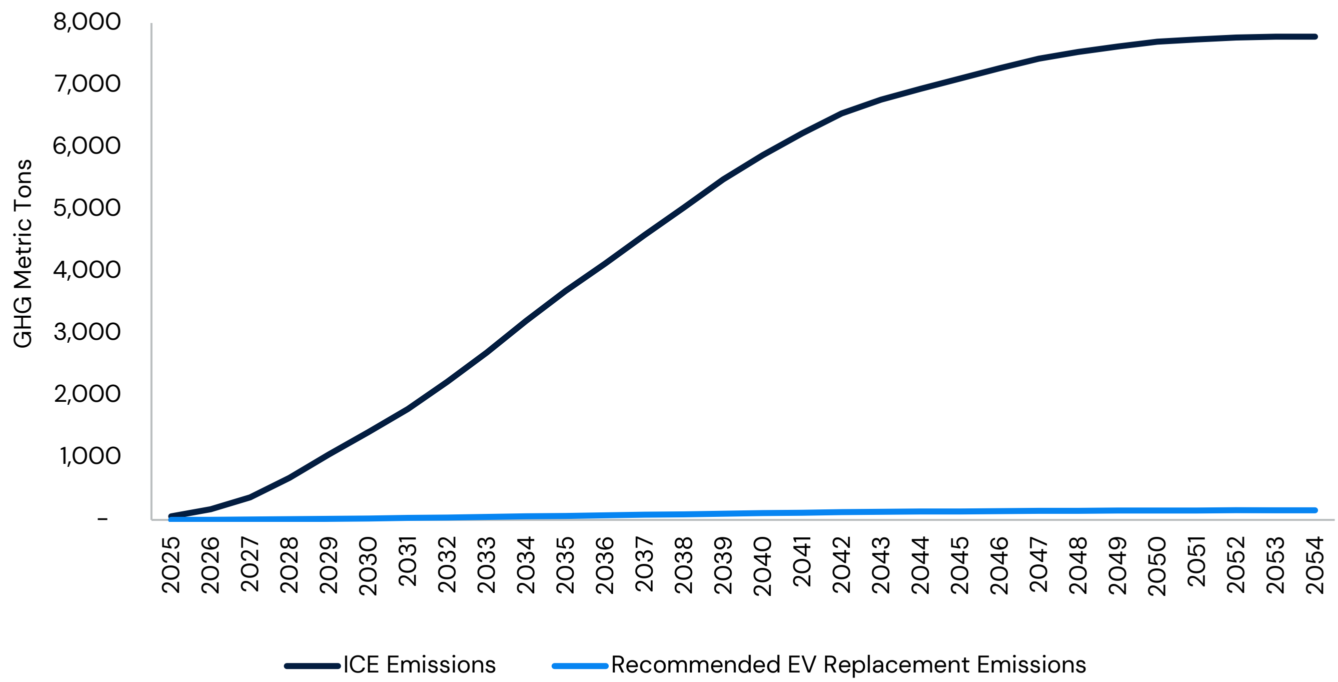
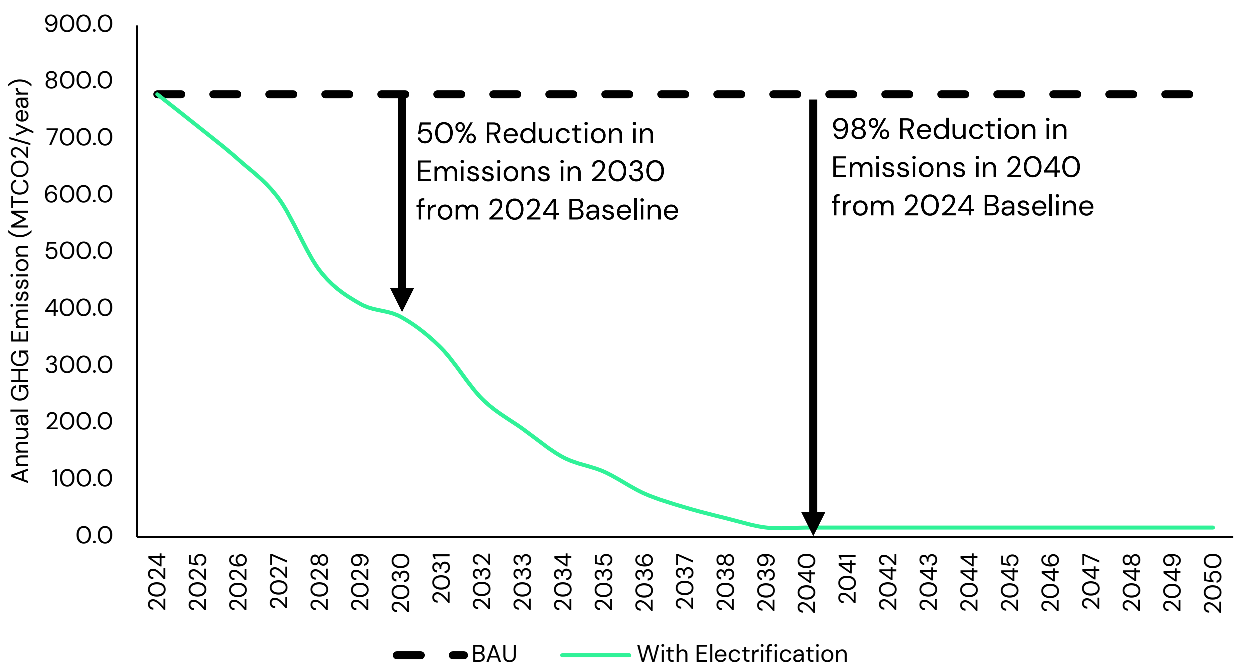


Figure 16. Midpen's On-Road Fleet GHG Emission (MTCO2e per year) under BAU as well as Electrification scenarios



Barrier to Transition

Moving to an EV fleet involves a complicated and diverse approach that requires Midpen to undertake careful consideration. There are numerous significant obstacles to transitioning the fleet to EVs, including the higher initial expenses of EVs relative to ICE vehicles, the limited availability of EV models, the possibility of production capacity constraints, an ever-changing distribution network, and the necessity for charging infrastructure development. Moreover, factors such as range anxiety, reliance on the power grid, space constraints for charging, and workforce training for EV and EVSE maintenance could pose challenges in the transition process. This section delves deeper into some of these challenges.

Technology Availability & Procurement Challenges

One of the most significant procurement challenges associated with fleet electrification is the limited availability of vehicles and charging infrastructure at hand or ready to deploy. On the vehicle side, although the number of EV models on the market is increasing, the selection remains limited compared to ICE vehicles. This can pose challenges for agencies trying to find the right type of EV to meet specific needs and requirements for various municipal services. Furthermore, EV manufacturers may encounter limited production capacity, potentially leading to longer delivery times for vehicle fleets purchasing EVs. The COVID-19 pandemic has underscored the vulnerability of global supply chains, with disruptions in parts and components supply impacting EV production. Despite the availability of EV technologies, the distribution network is still evolving. In some regions, dealership networks might be limited, making it more difficult for cities to access and purchase EVs for their fleets. Ultimately, these issues could affect the pace of fleet electrification.

Regarding infrastructure, the manufacturing of specialty equipment, like transformers, can involve long lead-times, potentially delaying planned vehicle or charger purchases. This is because, without the added load capacity, the grid might be unable to accommodate the increased power demand. Coordination with suppliers and contractors to identify areas where site readiness can be expedited will be critical for seamless EV charger installations.

Infrastructure Buildout Challenges

As Midpen moves towards expanding its fleet of EVs, it must proactively anticipate and address the challenges associated with installing sufficient charging stations to support its goals. Deploying charging infrastructure in a strategic and planned manner can help address these challenges more effectively. One of the challenges that Midpen will likely face is electric grid limitations as well as site electrical infrastructure constraints. Therefore, it is necessary to review the distribution network by utility representatives to determine whether upgrades will be required or recommended. Interconnection challenges may vary based on the location, number, and schedule of charging stations, as well as charging speed. There is another potential challenge that may arise during the transition to an all-electric fleet, which is related to site constraints. EV charging infrastructure typically requires dedicated parking spaces for charging, potentially affecting the availability of parking for other vehicles. This can be particularly challenging in areas where parking is already limited.

Moreover, EVs rely on electricity, and disruptions to the power grid can impact Midpen's ability to charge its vehicles. This is particularly challenging during extreme weather events that cause widespread power outages. Most EV charging stations lack backup power sources, which can impact the ability of Midpen to keep its EV fleets charged and operational during emergencies. Additional costs could potentially be incurred as it relates to back-up generation sources and fuel to operate said equipment.

Emergency Response Vehicles

Transitioning emergency response vehicles – such as patrol vehicles – to EV presents a unique set of challenges that need to be carefully considered and addressed. One of the primary concerns is ensuring that EVs can meet the rigorous performance and reliability standards required for emergency response, including high-speed acceleration, extended driving range, and the ability to handle diverse driving conditions. Additionally, these vehicles must be able to support the power demands of specialized equipment, such as communication systems, emergency lights, and other life-saving tools, without significantly reducing their driving range. Another challenge lies in the availability and deployment of charging infrastructure that can provide fast and reliable charging for emergency response vehicles. These vehicles may require more frequent charging due to the high energy demands associated with emergency response operations, which could lead to increased downtime if charging infrastructure is insufficient or unreliable. Ensuring that charging stations are strategically located near emergency response facilities and are compatible with the unique needs of emergency vehicles is essential to maintaining an effective response capability.

It should be noted that while Midpen has some take-home ranger vehicles that required infrastructure support, the chargers for these vehicles are being to planned to be installed at field offices. This approach considers employee turnover and the challenges associated with setting up charging infrastructure at residences, ensuring that these obstacles do not impede the transition of these vehicles to EVs. Naturally, with this strategy, Midpen must implement charging policies to guarantee that these first responder vehicles maintain sufficient charge to fulfill their operational requirements.

Fleet Management & Operations

Unlike traditional internal combustion engine vehicles, EVs require different maintenance needs and operational considerations, highlighting the importance of specialized knowledge and practices. Additionally, maintaining EV charging infrastructure is crucial. This includes regular inspections and maintenance of charging stations to ensure they function properly and safely, minimizing downtime and maintaining consistent availability for users. This section aims to outline key maintenance and operational considerations crucial for the efficient operation of EVs and their charging infrastructure. The discussion focuses on best practices and strategies vital for optimizing performance and extending the longevity of these systems

Staffing Recommendation

As the first step toward an optimized management of an EV fleet, the project explored how Midpen could evolve its fleet management structure to enhance its fleet management efficiency and provide robust support through the transition to EV.

Currently, at the core of fleet management is Brandon Stewart, the Land & Facilities Manager, who oversees financial transactions related to the fleet. He is responsible for approving all maintenance transactions exceeding $5,000, authorizing the retirement of vehicles, and approving requests for replacement and additional fleet or equipment. His role is crucial in reviewing and approving Capital Purchases Board Reports before they are submitted for board approval, ensuring fiscal responsibility and adherence to the District's strategic objectives.

Supporting the management structure is Ben Talavera, Management Analyst II, a role critical for the financial and operational oversight of the fleet. This position entails developing and tracking the budget for capital equipment, which covers fuel, maintenance, repair, equipment purchases, and outfitting. The Management Analyst II executes on-call contracts with maintenance vendors, handles the striping of new vehicles, renews all permits and licenses relating to the fleet, and manages the surplus of equipment and vehicles through platforms like GovDeals. Additionally, the Management Analyst II is in charge of managing recalls, FastTrack accounts, inventory, quarterly vehicle inspections, and preparing board reports for capital purchases. They also have the authority to approve maintenance transactions up to $5,000 and coordinating with Risk Management to keep all vehicles and equipment active on the insurance schedule.

The Area Superintendent and Area Managers play a pivotal role in the hands-on management of vehicles. They are responsible for filtering vehicle-related concerns to the Management Analyst for approval, developing specifications for ranger vehicles, coordinating maintenance and outfitting, and handling the logistics of maintenance requests, vehicle inspections, and fuel deliveries.

At the ground level, the Land & Facilities Administrative Assistant (AO Admin), Foothills Field Office (FFO) Admin, and Maintenance Supervisor at Skyline Field Office (SFO) act as points of contact for vehicle-related queries and concerns. Their duties include processing and paying vehicle and equipment invoices, entering maintenance data into the CityWorks software by asset, managing

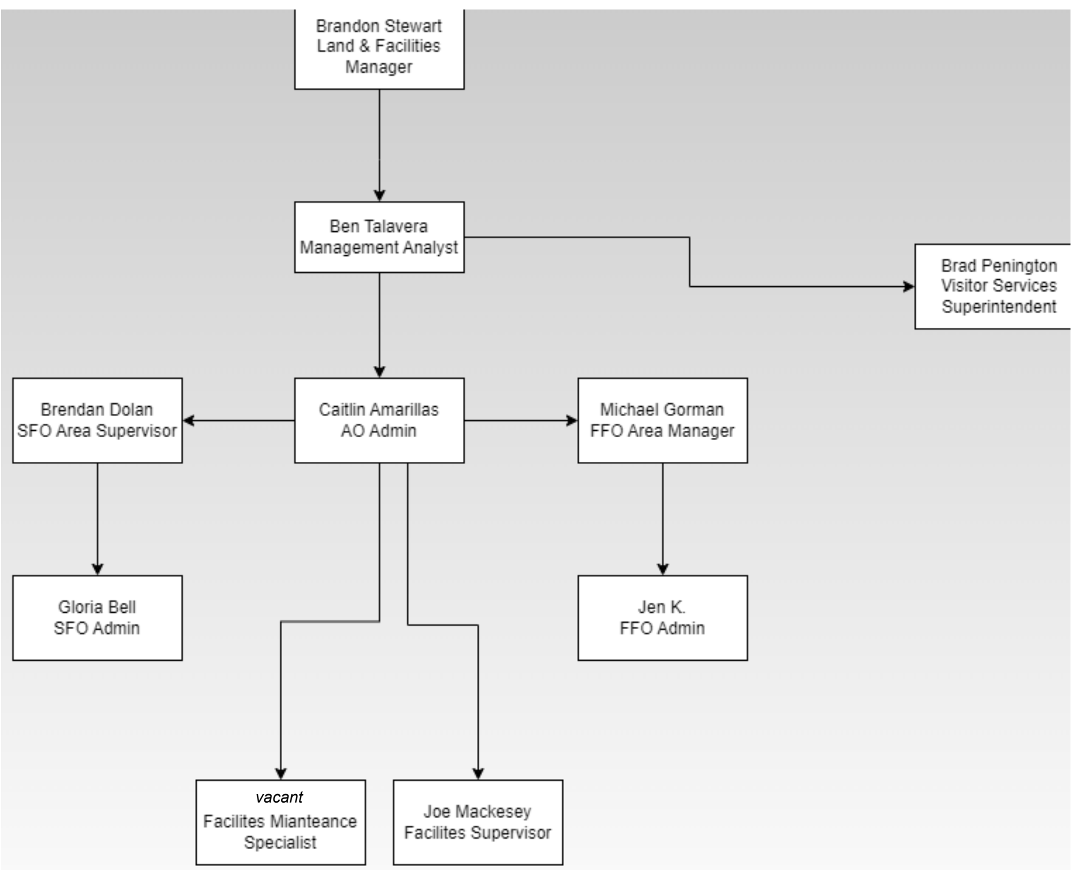
FastTrack accounts, and coordinating the logistics of vehicle maintenance. Each facility also has its own maintenance contract, which means Land and Facilities has three different maintenance contracts for its overall fleet. The Facilities Supervisor oversees service-related issues for Blink Charging Stations, and the Facilities Maintenance Specialist assists in vehicle upkeep and transportation to maintenance vendors.

This approach has historically been allowing the District to manage a fleet that operates across different locations and departments, ensuring a streamlined operation that supports the District's mission of preserving open spaces and providing public access to natural environments. However, the District wants to adjust its operational structure for the following reasons:

- Decentralized management leads to opportunity for error with fleet data tracking
- The District wants to have a more uniform fleet to make operating and maintaining the fleet easier
- A centralized procurement structure will help the District grow its fleet as demand for more vehicles increases

Overall, the figure below illustrates the District's current organizational structure. Lines between key staff reflect collaboration more than they do reporting efforts.

Figure 17. Midpen's Current Fleet Management Structure



Interviews with other Fleet Management Teams

To explore best practices for fleet management, the project team met with fleet management teams in three municipalities that have a similar fleet size to Midpen's fleet. ICF interviewed the cities of Laguna Beach and Pittsburg in California, as well as Iowa City, Iowa. The teams ICF interviewed were primarily responsible for vehicle procurement, maintenance, managing invoices and purchasing, fuel contracts, smog inspections, and regulatory compliance, with most fleet repairs conducted in-house. Several patterns and best practices emerged from these interviews, detailed below:

- **Team Composition:** Each fleet manager typically has one administrative assistant and technicians in repair shops.
    - The city of Laguna Beach has a Fleet Supervisor responsible for all invoices, procurement, contracts, and compliance with regulations. The fleet supervisor has a senior mechanic and three equipment mechanics. An administrative assistant helps with invoices and data input.
    - The city of Pittsburg has an Assistant Director of Public Works who oversees the fleet department and each respective City division's fleet. The City also has a Fleet Supervisor with two mechanics on the team conducting maintenance and an Administrative Assistant. The Assistant Director of Public Works and Fleet Department are responsible for overseeing the operations, maintenance, and procurement of vehicles. The Fleet Department works directly with the City's finance team to assist departments with their procurement requests.
    - Iowa City has a Fleet Manager, Equipment Superintendent, 7 technicians, and an Administrative Assistant. The Fleet Manager's department oversees operation and maintenance. It also leads all procurement and budget efforts. Iowa City projects its fleet replacement schedule 35 years into the future to help with budgeting and procurement. The Administrative Assistant for the fleet management department prepares all bidding documents and enters data into the bidding platform.
- **Departmental Management of Fleets:** Departments manage their own fleets with superintendents overseeing vehicle operations, coordinating with fleet managers for new vehicle needs, regular maintenance, and repairs.
    - The City of Laguna Beach has Superintendents for each department managing their own fleets.
    - The city of Pittsburg has supervisors/superintendents responsible for the day to day operations of their respective fleets.
    - Iowa City has Superintendents for each department/division. Superintendents manage the day-to-day operations of their respective fleets and coordinate with the Fleet Manager if vehicles need to be replaced or sent to the maintenance shop.

- **Use of Fleet Maintenance Systems:** Fleet maintenance systems help departments with data tracking and preventative maintenance scheduling.
    - The city of Laguna Beach employs a fleet maintenance system (called AMCS) for maintenance scheduling and notifications. Additionally, department superintendents use iPads with a dedicated tab to log repair needs and schedule maintenance.
    - The city of Pittsburg has fleet diagnostics software which helps with maintenance and operations decisions.
    - Iowa City employs a fleet maintenance system (called FASTER) for parts, equipment, and maintenance. The fleet management team enters fuel and mileage data into FASTER to track vehicles operations. FASTER will tell the fleet management department when vehicles are due for maintenance.

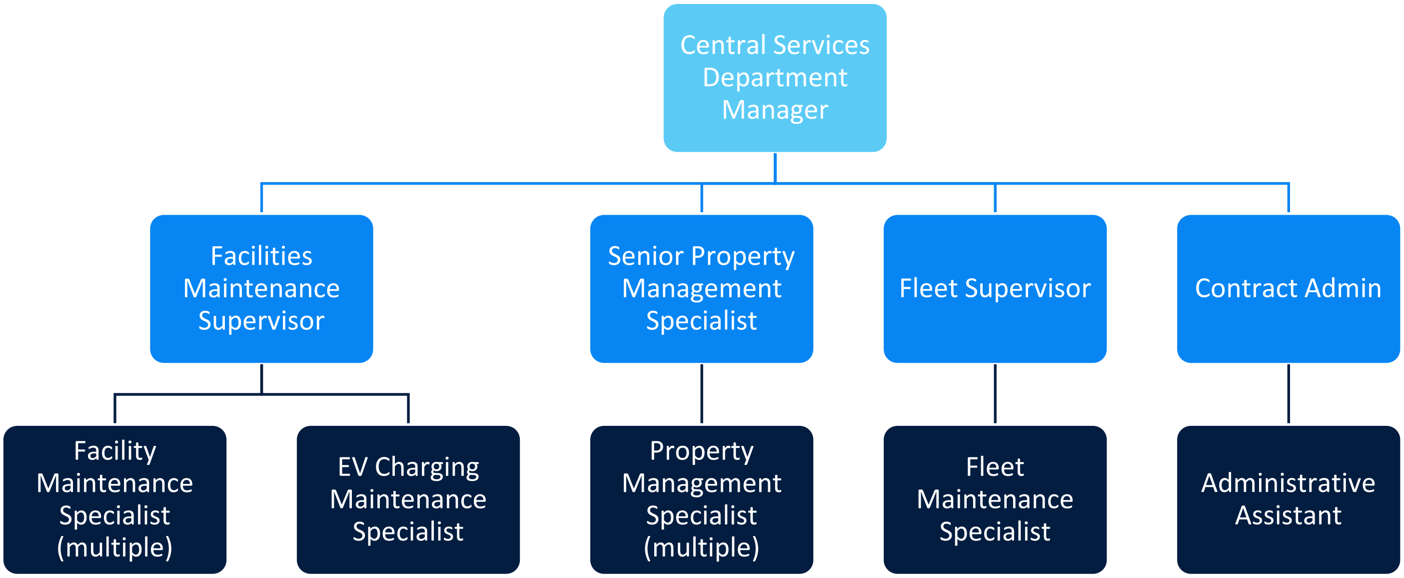
Recommendations for Midpeninsula Regional Open Space District's New Fleet Management Organization

Based on the research and interviews with Laguna Beach, Pittsburg, and Iowa City, ICF has the following recommendations to help the District improve its fleet management for its future needs:

- **Adopt Centralized Procurement and Maintenance:** Implement a central system for vehicle procurement and maintenance, mirroring the efficient practices observed in other municipalities, to streamline processes and improve resource management.
- **Establish a Dedicated Fleet Management Team:** Form a specialized team focused on fleet management, similar to other cities, to handle all aspects of vehicle upkeep, including in-house repairs, invoice management, and regulatory compliance.
- **Integrate Departmental Coordination:** Allow individual departments to manage the operational aspects of their fleets, while coordinating closely with the central fleet management team for maintenance, repairs, and new vehicle acquisitions.
- **Implement a Fleet Maintenance System:** Introduce a technology solution like AMCS for proactive maintenance scheduling and tracking, enhancing the efficiency of vehicle upkeep.
- **Utilize Technology for Maintenance Requests:** Equip Area Superintendents and Area Managers with digital tools (e.g., tablets with maintenance request apps) to log vehicle repair needs and schedule maintenance, ensuring timely and organized fleet management.

To accomplish these recommendations, ICF recommends the organizational structure illustrated in Figure 18, which will allow staff to specialize in key areas and streamline procurement efforts. This structure also resembles recent recommendations made by Baker Tilly (formerly Management Partner) through the Financial and Operational Sustainability Model (FOSM) Refresh. This structure will also make it easier to homogenize and grow the Midpen's fleet. The FOSM Refresh report provides the findings from interviews held with staff and the Board, including focus group meetings, about existing work processes, gaps, challenges, and high-level considerations to best position the agency for the next ten plus years. The report includes 49 recommendations to enable the organization to continue to execute on its current workload as well as position the organization for sustainable growth for the next decade. As part of the growth, the report recommends a total of 93.25 Full Time Equivalent positions (FTE), including 28 FTEs as a more immediate catch-up to readjust the organization to the new workload.

Figure 18. Suggested Fleet Management Organizational Structure for Midpeninsula Regional Open Space District



Under the proposed organizational structure, a Central Services Department will be established to oversee the management of facilities, properties, and the on-road fleets operated by Midpen. This department will play a pivotal role in streamlining operations and ensuring the efficient utilization of resources. Central to this department will be the appointment of a Fleet Manager to act as the central point of contact for all matters pertaining to fleet maintenance, repairs, and the acquisition of new vehicles. The Fleet Manager will collaborate closely with the Visitor Services Area Superintendents, and Land & Facilities Area Managers. This collaboration is critical for maintaining the fleet's operational integrity, ensuring timely repairs, and overseeing the procurement and acquisition processes to meet the fleet's evolving needs.

Assisting the Fleet Supervisor, a Fleet Maintenance Specialist will take the helm in managing the regular maintenance of the fleet, as well as coordinating with other departments, repair shops, and dealerships for any necessary repairs and maintenance activities. Especially as the District transitions to EVs, there is an anticipated increase in reliance on dealerships for conducting repairs in the near term. The Fleet Maintenance Specialist can help coordinating these repairs with the dealerships and specialized repair shops while over the long term, the District could explore the feasibility of establishing its own dedicated repair shop for EVs. This would enable more direct control over the regular maintenance of the vehicles, potentially improving efficiency and reducing downtime.

The Facility Maintenance Supervisor will be charged with the comprehensive management of Midpen's facilities. This will include the oversight of an EV charging infrastructure maintenance specialist, a role dedicated to the regular maintenance, repair, and, when necessary, the in-house troubleshooting of charging stations to ensure their optimal operation.

The FOSM Refresh recommends the existing Senior Property Management Specialist position will report to the Central Services Department Manager. This position will not have any direct oversight over fleet management.

Additionally, the integration of these roles and sub-departments within the Central Service Department will be further strengthened by the support of a Contract Administration Manager and an Administrative Assistant. The Contract Administration Manager will be pivotal in overseeing and managing contracts related to procurement, maintenance, and vehicle acquisition, processing invoices and ensuring that all contractual obligations are met efficiently and effectively. This role will serve as a crucial link between external service providers and the Central Service Department, facilitating smooth operations and adherence to contractual terms.

We believe that this proposed structure will not only enhance the management of Midpen's fleet in its current state but will also provide invaluable support as Midpen transitions to an EV fleet. The inclusion of specialized roles, such as EV charging and fleet maintenance specialists, is pivotal for ensuring the smooth operation of the fleet. These specialists will play a crucial role in maintaining operational efficiency, guaranteeing that vehicles remain functional, and that accessible charging infrastructure is always available.

Fleet Management Software Solutions

As Midpen plans to transition its fleet to EVs, the need for a suitable fleet and data management system becomes increasingly evident. The current operational framework, characterized by the use of CityWorks[36] for maintenance management alongside Enterprise ERP (formerly Munis by Tyler Technologies)[37] for financial operations, have highlighted critical inefficiencies.

Moreover, the anticipated growth of Midpen, with a projected staff increase of 93 positions over the next decade, necessitates a corresponding fleet expansion to support this enlarged workforce. This scenario not only calls for the enhancement of current systems but also ensures that the fleet's evolution towards electrification is seamlessly managed. With departmental restructuring on the horizon and the introduction of a dedicated Fleet Manager role (as described in the previous sub-section), there arises an opportunity to implement a system that not only caters to the imminent expansion but also significantly supports the transition to an all-electric fleet. Such a system will play a critical role in facilitating better vehicle maintenance practices, streamlining operational efficiencies, and achieving Midpen's ambitious sustainability objectives.

[36] https://www.cityworks.com/
[37] https://www.tylertech.com/products/enterprise-erp

Current Fleet Management Practices and Challenges

To determine the fleet management solution that best meets the operational needs of Midpen, the project team conducted several interviews with members of Midpen's fleet, IT, and sustainability teams. These discussions provided valuable insights into the specific challenges that the Midpen team faces and aims to address with the fleet management solution. Each interview helped to identify and clarify the unique requirements and obstacles that a suitable fleet management system must overcome, ensuring that the selected solution effectively supports Midpen's operational goals and sustainability efforts.

Starting with fleet maintenance, Midpen's vehicle maintenance strategy operates within fixed constraints, primarily relying on six-month service intervals and a vendor located roughly 45 minutes away from where most vehicles are dwelled. This rigid schedule, while consistent, does not account for the varied wear and usage rates across the fleet, potentially leading to oversight of vehicles requiring more immediate attention. The distance to the vendor further compounds the challenge, increasing vehicle downtime and impacting operational efficiency. Within this framework, the current practices may miss opportunities to tailor maintenance more closely to each vehicle's needs, underlining the importance of enhanced tracking and management through the fleet software to ensure no vehicle is overlooked.

The practice of manually recording fuel consumption for each vehicle underscores a significant gap in data management and automation. This labor-intensive process is prone to errors and inconsistencies, offering limited insight into fuel efficiency and operational costs. As Midpen looks forward to integrating EVs into their fleet, the need for an accurate and automated system to track energy consumption becomes even more pronounced.

Additionally, interviews revealed that the necessity for dual data entry, stemming from using CityWorks for maintenance management alongside Enterprise ERP for financial operations, leads to inefficiencies and a higher risk of errors. Moreover, the lack of consistent vehicle mileage tracking—vital for emissions inventories, maintenance planning, operational strategy, and total cost of ownership analysis—highlights the current system's shortcomings. These discrepancies compromise not just fleet management efficiency but also the accuracy of sustainability reports and strategic decisions.

These challenges underscore the pressing need for a more integrated, efficient, and forward-thinking fleet management solution. As the district prepares for this significant transition, addressing these foundational aspects of fleet management becomes indispensable to achieving their environmental objectives and operational efficiency.

Desired Features for New Fleet Management Software

In selecting a new fleet management software, Midpen is focused on finding a solution that can support both its immediate needs and long-term strategic initiatives. The software must address present inefficiencies while being adaptable enough to handle the demands of an evolving fleet, particularly the shift towards EVs. The section below outlines the specific functional requirements, user expectations, and technical needs identified through interviews with Midpen staff. In addition, the cost of the software should be no more than $40,000 per year.

Functional Requirements:

- **Vehicle Tracking and Diagnostics:** Real-time monitoring of both on-road and non-road vehicles, including essential diagnostics to preempt and address maintenance needs.
- **Fuel and Energy Consumption Monitoring:** Detailed tracking of fuel and energy use per vehicle to support efficiency and sustainability analyses.
- **Charging Schedule and Optimization:** Tools to manage and optimize EV charging schedules, enhancing energy utilization and vehicle readiness.
- **Maintenance Scheduling and Alerts:** Automated alerts and scheduling tools to maintain proactive maintenance practices, reducing downtime and extending vehicle lifespans.
- **System Integration:** Seamless integration capabilities with existing systems, such as internal fuel pumps (and possibly Enterprise ERP), to ensure a unified operational workflow.

User Requirements:

- **UI/UX Design:** An intuitive and accessible interface that supports customization to meet diverse user needs.
- **Customizable Reports:** Enhanced reporting features with robust filter functionality, enabling the generation of tailored insights.
- **Training and Support Services:** Comprehensive training programs and ongoing support services to ensure smooth adoption and utilization. Preference for implementation of software to be conducted by software developer, rather than a third-party provider.
- **Mobile Access and Alerts:** (While not critical) Mobile accessibility and notification features to facilitate on-the-go management and alerts.

Technical Requirements:

- **Cloud-based Solutions:** Software should be cloud-based (SAAS), , to ensure flexibility, scalability, and remote accessibility.
- **Offline Operation**: Software must be able to operate properly in a disconnected environment (e.g., vehicles should be able to seamlessly connect between connected and disconnected environments (e.g., cache data).
- **Security Features**: SOC2 requirement (software must be SOC2 compliant); single sign-on (SSO) .
- **Compatibility and Scalability**: System compatibility with a variety of EV models and EVSE, alongside potential for scaling in line with Midpen's growth.

In summary, as Midpen undergoes this transition to an all-electric fleet, it is important to secure a fleet and data management system that not only bridges current operational gaps but also fully supports the organization's future direction. Functional, user, and technical specifications, along with compliance requirements, were defined to guarantee that the chosen system addresses current inefficiencies and adapts to Midpen's changing landscape.

EV and EVSE Operation and Maintenance Best Practices

Maintenance of Charging Stations: Maintaining charging stations is crucial, particularly for DC Fast Chargers due to their complex cooling systems and filters. It is likely that Midpen will install such stations at some juncture during this transition to EVs. Most suppliers of charging stations provide warranties and service plans tailored to the specific usage and site requirements of each station. These plans are crucial as they can offer significant savings on maintenance, repairs, and replacement costs, making them a wise investment for long-term operational efficiency.

Preventive Measures for Charging Station Maintenance: Several preventive strategies are recommended to enhance the durability and functionality of charging stations. Protective screens should be used to shield the stations from direct sunlight, thereby reducing overheating risks and preventing malfunctions. Additionally, installing bollards and clear signage can protect the stations from accidental vehicle collisions. Using shorter charging cords or establishing procedures for secure cord storage when not in use can also minimize damage risks, protecting the cords from unnecessary exposure to vehicles and pedestrians.

Security and Theft Prevention for Electric Vehicle Supply Equipment: Security is a vital consideration for EVSE. Many systems come equipped with theft-deterrent devices or security cameras. To further enhance security, best practices include installing charging stations in well-lit, visible areas, or behind restricted-access barriers such as gates. The use of dashboard cameras in EVs can also monitor surroundings during parking. Additionally, implementing protocols such as locking vehicles during charging sessions and possibly employing a parking attendant can significantly bolster security measures.

Cybersecurity for Networked Charging Stations: For networked charging stations, adhering to the latest cybersecurity standards is essential. Standards like ISO 15118, which governs vehicle-to-grid communication interfaces, should be implemented. Additionally, seeking cloud-based security solutions from cybersecurity firms can provide an extra layer of protection against potential cyberattacks, ensuring the integrity and reliability of the charging network.

Strategies for Power Outage Resiliency: Considering the battery storage capabilities of most EVs, which allow them to go without charging for a day or two, it is still wise to have a resilience strategy for power outages. Implementing off-grid solutions like generators or additional energy storage systems can be an effective way to ensure continuous operation of the fleet during power disruptions.

Safety Protocols for Accidents and Fires Involving Electric Vehicles: In the event of an accident or fire involving an EV, specific safety protocols should be followed. If feasible, the vehicle should be moved to a safe location 50 feet away from any structure or other vehicle, secured, and turned off, with the hazard lights activated. Contacting emergency services and keeping a safe distance is critical in case of a fire. Personnel should not attempt to handle exposed electrical components or leaking fluids. Training courses like Safe Handling of High Voltage Battery Systems from SAE International and Electric Vehicle Community Preparedness Online Training from the National Fire Protection Association can greatly enhance staff knowledge and preparedness for dealing with electric vehicles and their batteries. Additionally, if thermal runaway occurs, the vehicle should be isolated at least 50 feet away from the nearest structure. Midpen personnel must contact emergency responders to direct water at the battery and immediately call the vehicle manufacturer. Engineers from the manufacturer will likely need to disassemble and de-energize the battery to mitigate serious electrical hazards.[38]

[38] https://www.nfpa.org/news-blogs-and-articles/nfpa-journal/2020/01/01/ev-stranded-energy

Recommendations For Implementation

Taking an EV transition plan into the implementation phase requires a significant amount of planning, coordination, and allocation of resources. It is a complex process that involves multiple steps and considerations, as outlined in this report.

The starting point of this process should be the creation of a comprehensive implementation plan. This plan must outline specific steps to be taken, establish timelines for each action, and allocate the necessary budget for shifting to an EV fleet. Key elements in the plan should include necessary electrical infrastructure upgrades, the full infrastructure layout, budget planning, procurement strategies, and coordination with utilities. For example, one of the most important next steps is to conduct a comprehensive analysis of the charging infrastructure. This includes the development of engineering documents outlining the technical specifications for the charging stations to ensure their safe and efficient installation. These engineering drawings should layout the precise location of EV charging infrastructure as well as the layout of equipment, service equipment locations, and service line connections.

Securing adequate funding is a pivotal aspect of this transition. Midpen should explore diverse funding avenues like grants, loans, and other financial mechanisms to ensure the transition is both timely and cost-effective. Additionally, the District must evaluate various procurement strategies for acquiring EVs, which could range from leasing to outright purchasing, based on specific needs and resource availability.

Forming a dedicated project team with expertise in fleet management, EV charging infrastructure, procurement, and finance is crucial for a successful transition. Collaborating with key stakeholders, including utility companies, EV manufacturers, and charging infrastructure providers, will also be integral. A critical step in implementation, for example, will involve discussions with PG&E to prepare potential charging sites to handle the required load and number of charging stations. These discussions may lead to upgrades in distribution infrastructure, such as transformers, and enhancements at the site level, like electrical panel upgrades, to accommodate the increased demand from charging stations.

Another key implementation step is establishing a pilot program. Pilot programs offer a strategic avenue to test the feasibility of the transition plan on a smaller scale. This approach allows Midpen to identify and resolve potential challenges or issues before committing to a full-scale implementation, paving the way for a smoother and more efficient transition to an EV fleet. As noted in the document, Midpen has already initiated small pilot program with the acquisition of multiple F150 Lightnings and Chevy Silverado EVs. This acquisition, although modest in scale, will provide valuable information and feedback to the fleet management team, facilitating the broader transition of the remaining 96 vehicles to electric. By testing these specific models, Midpen gains crucial insights into the practical aspects of operating and maintaining EVs, as well as the efficiency of the necessary charging infrastructure.

The transition of a mid-size fleet, such as that of Midpen to EVs, also underscores the importance of effective change management strategies. Given the relatively nascent status of EV technology and the perceived uncertainties associated with it, such transitions can often be met with apprehension. Concerns typically revolve around the higher upfront costs of EVs—despite the operational savings they promise in the long run—which can lead to opposition and reluctance within various departments. These challenges highlight the need for Midpen to employ robust change management solutions. By engaging in comprehensive communication and education with both staff as well as the board, the District can address misconceptions, highlight the long-term benefits of EVs, and foster a culture of innovation and sustainability. Achieving buy-in from different departments and the board is crucial for the smooth deployment of EVs and for ensuring that the transition aligns with the District's environmental and fiscal goals.

Appendix A: Vehicle Type and Classification

Table 24 below presents the various vehicle types within Midpen's fleet, along with descriptions for each. Vehicle classification generally considers multiple factors, such as engine type, suspension system, and size.

Table 24. Vehicle Type and Classification

Vehicle Type	Sub-Type	Description	FHWA Vehicle Class	Weight Range (lbs.)
Sedan	N/A	A light-duty car used to transport passengers. Coupes, compacts cars, and station wagons fall under this vehicle type. Examples include the Chevrolet Cruze and the Ford Fusion.	Class 1	<6,000
SUV	N/A	A light-duty truck used to transport passengers. This vehicle type has off-road features, including four-wheel drive. Examples include the Chevrolet Tahoe and the Ford Explorer.	Class 1	<6,000
Light-Duty Pickup	N/A	A light-duty truck used to transport passengers and equipment. This vehicle type includes pickup trucks with a GVWR of <6,000 to 10,000 lbs. Examples include the Chevrolet Silverado 1500 and 2500, and the Ford F-150 and F-250.	Class 1/2	<6,000-10,000
Medium-Duty Pickup	N/A	A medium-duty truck used to transport passengers and equipment. This vehicle type includes pickup trucks with a GVWR of 10,001 to 19,500 Examples include the Chevrolet Silverado 3500, and the Ford F-350, F-450, and F-550.	Class 3/4/5/6	10,001-26,000
Van	N/A	A light-duty commercial van used to transport passengers or cargo. Also known as a cargo van.	Class 2	6,001-10,000
Bucket Truck	N/A	A medium-duty truck equipped with an aerial lift or movable boom carrying a large bucket.	Class 5	16,001-19,500
Heavy Truck	Straight Truck	A heavy-duty straight truck that has all axles attached to a single frame and can be configured for specific vocations, such as a snowplow, sander, or dump truck.	Class 8	>33,000
Other	N/A	All other vehicle or equipment types (examples include but are not limited to ambulances, fire trucks, trailers, and RVs)	N/A	N/A

Appendix B: EV Model Comparison

There are over 500 EV models in our EV library that were assessed across Midpen fleet's vehicle types and range requirements to compare TCOs and recommend replacement models. While our EV acquisition recommendations are based on the model with the lowest TCO available that fits Midpen's fleet's needs, there may be additional EV models within the same price range. Figure 19 through Figure 25 highlight the lowest TCOs for each vehicle type within your fleet. This analysis is for 1 vehicle for each vehicle type, uses the Midpen's average annual mileage and miles driven per day by vehicle type, and assumes a 15 year vehicle life. This simple comparison across EV model types does not include any charging infrastructure costs or apply any potential grants or incentives for EVs, however that level of detail is included in the sample financial analysis on the following pages.

Figure 19. Sedan EV Model TCO Comparison

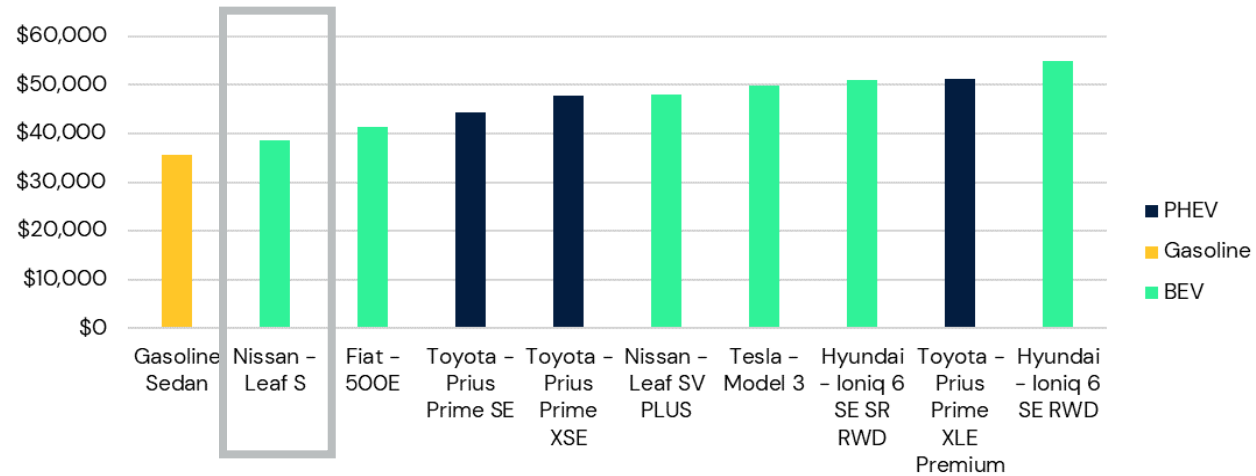


Figure 20. SUV EV Model TCO Comparison

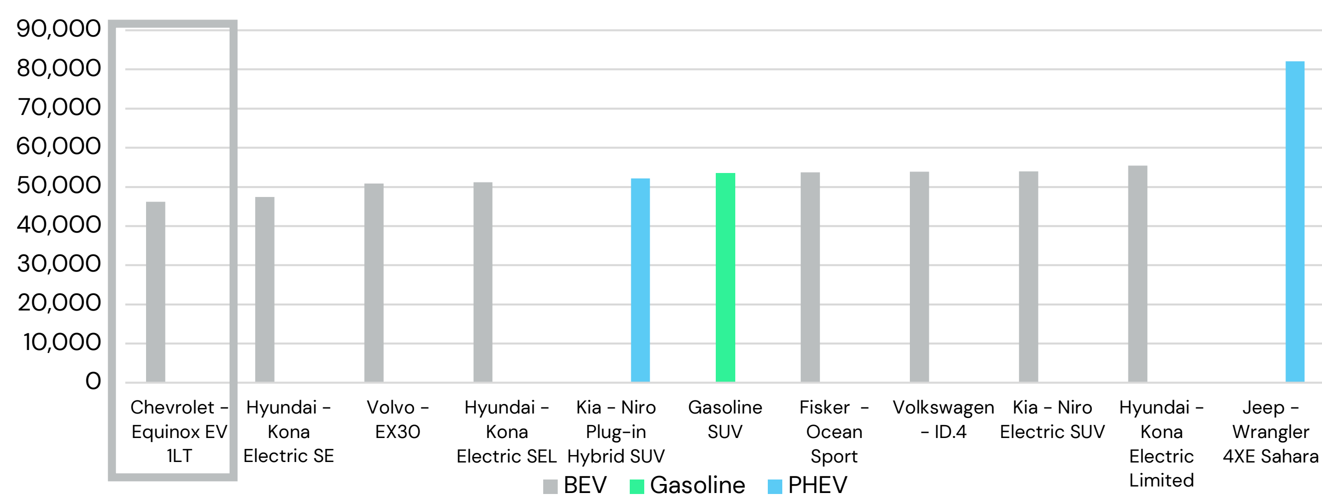


Figure 21. Pursuit Rated Light-Duty Pickup EV Model TCO Comparison

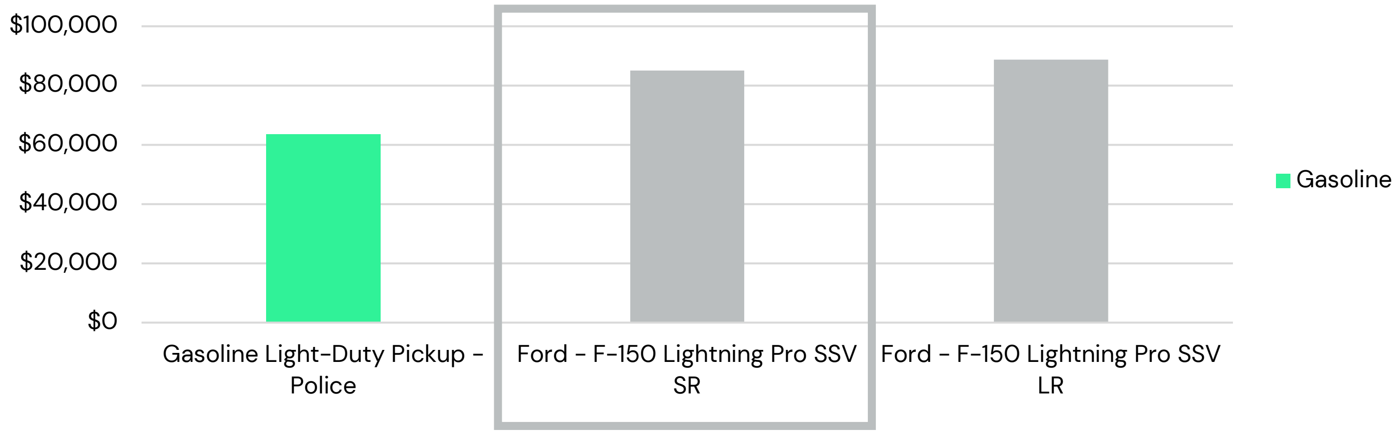


Figure 22. Medium-Duty Pickup EV Model TCO Comparison

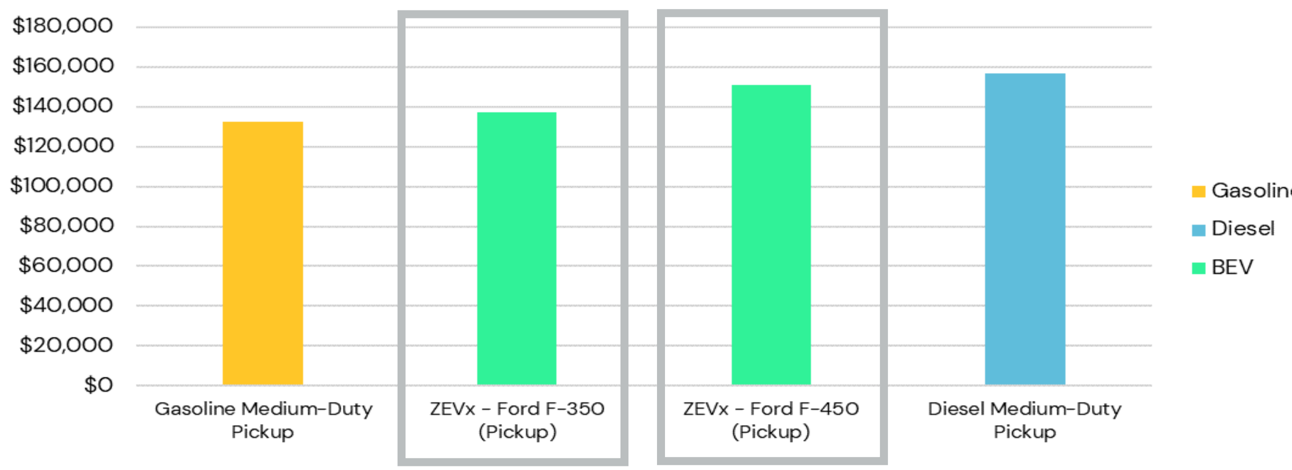


Figure 23. Van EV Model TCO Comparison

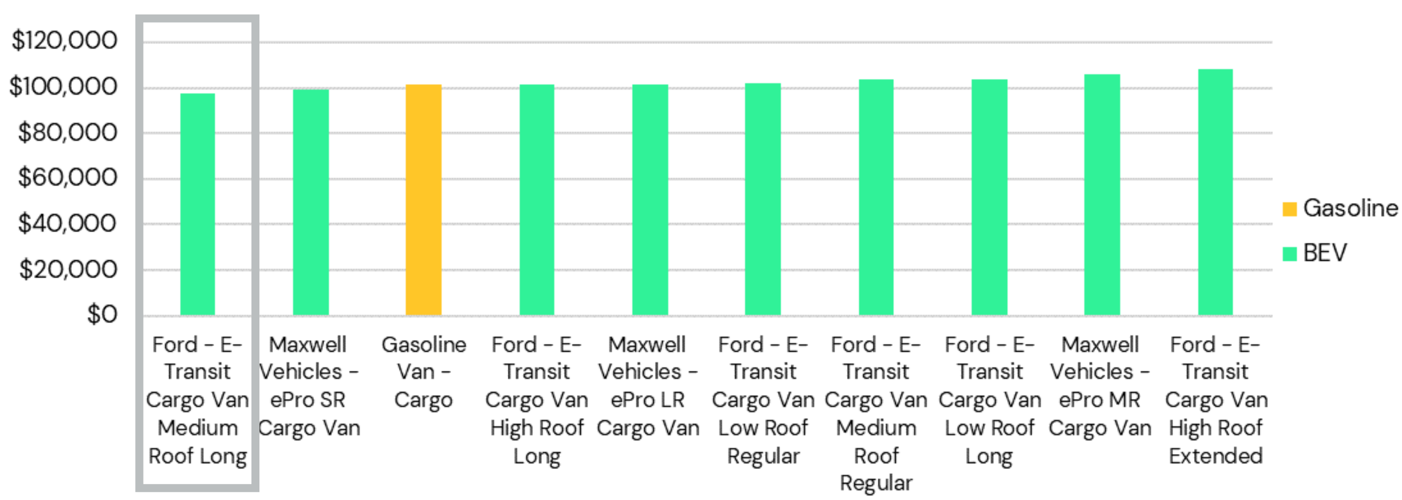


Figure 24. Medium Duty Vocational Truck EV Model TCO Comparison

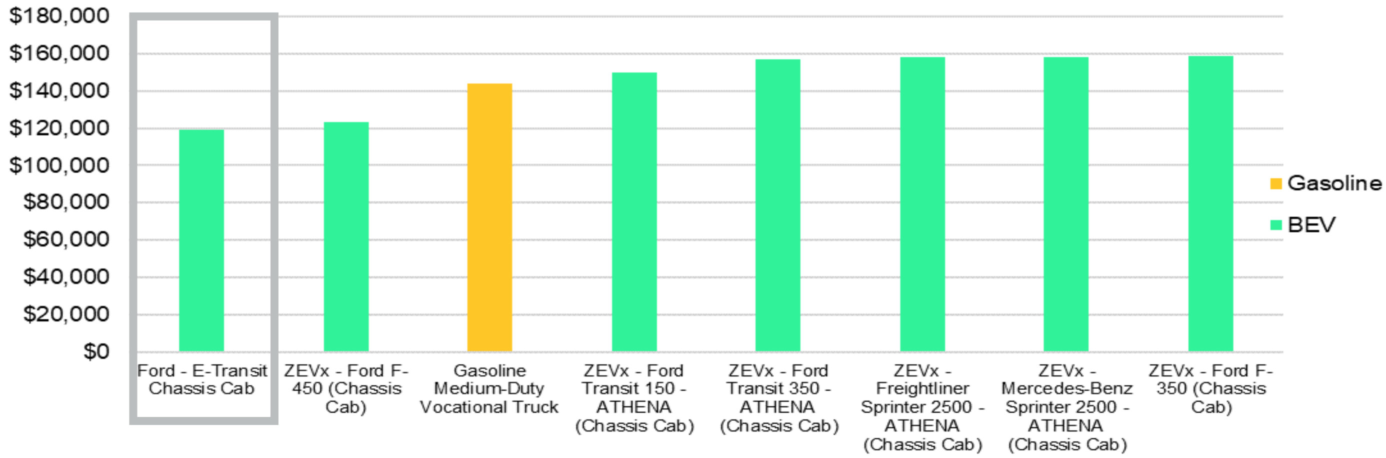
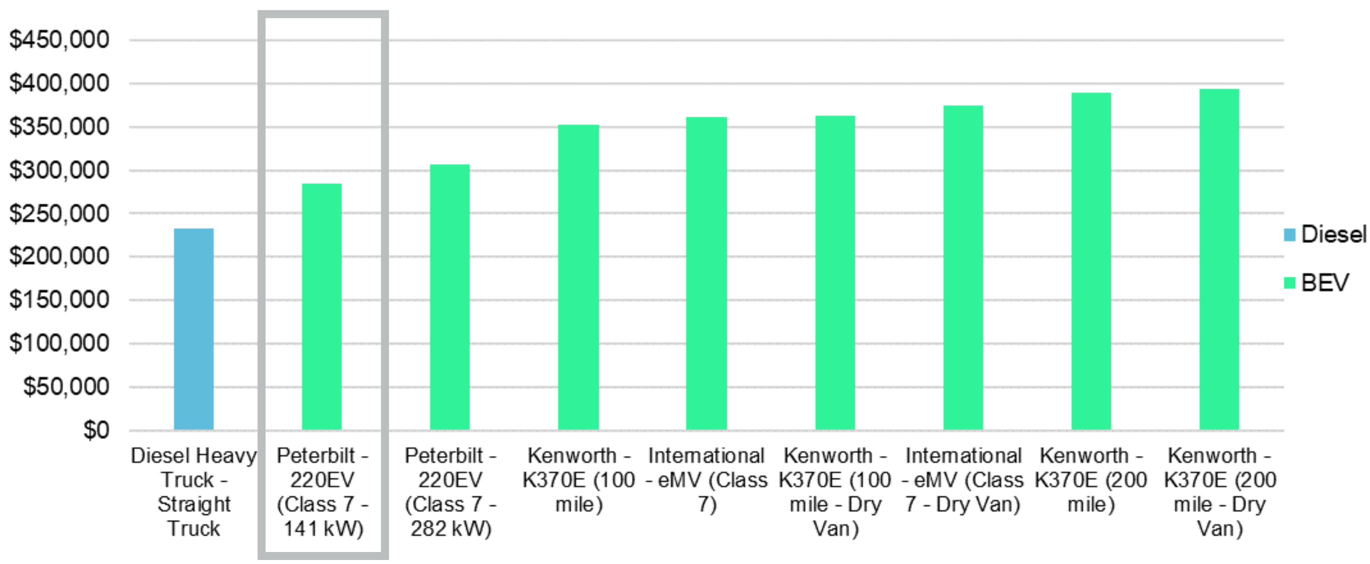


Figure 25. Heavy Duty Straight Truck EV Model TCO Comparison



Sample SUV Financial Analysis

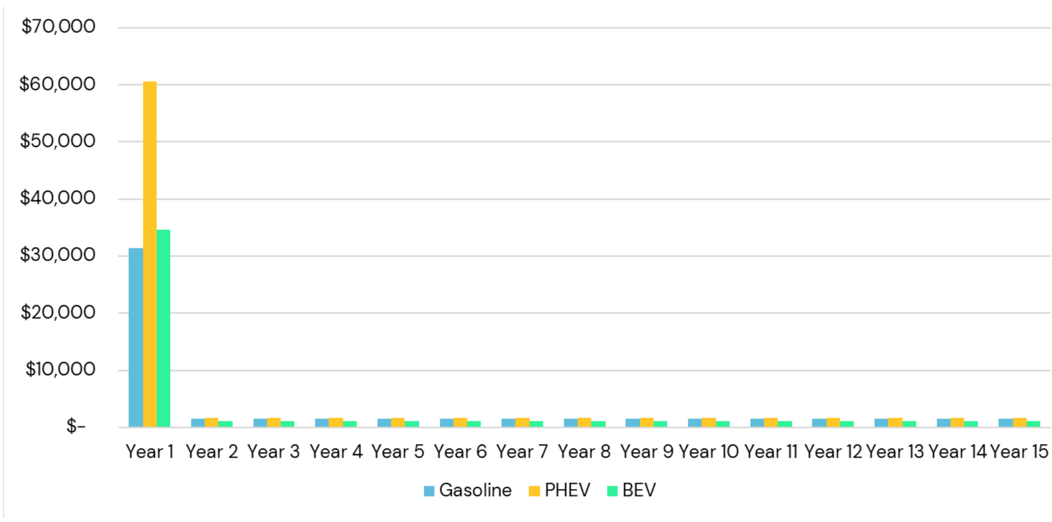
Table 25 provides a sample TCO comparison for a single, purchased SUV. This analysis uses a 15-year vehicle life and 13,000 annual miles assumption, based on the average annual mileage for SUVs within your fleet.

Table 25. SUV TCO Comparison

	Gasoline	PHEV (Jeep – Wrangler 4XE Willys)	BEV (Chevrolet – Equinox EV 1LT)
Capital Cost	$29,800	$55,350	$30,000
Charging Infrastructure Hardware (L2)	N/A	$450	$450
Charging Infrastructure Installation	N/A	$3,150	$3,150
Annual Fuel/Energy Costs	$847	$971	$615
Annual Maintenance Costs	$737	$674	$465
15-Year Total Costs7F[39]	$44,823	$73,214.77	$43,211

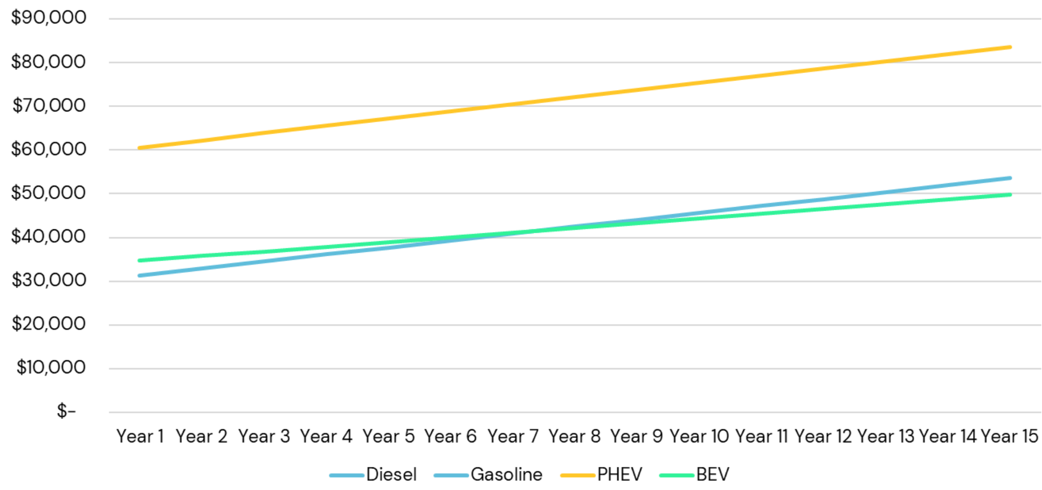
provide a visual representation of the annual and cumulative cost comparisons across a gasoline, PHEV, and BEV SUV.

Figure 26. SUV 15 Year Annual Cost Comparison[40]



[39] NPV assumes a 5% discount rate.
[40] This chart shows the annual cost breakdown for representative ICE, PHEV, and BEV SUVs. Year 1 indicates the highest cost, incorporating the capital cost. Years 2 to 15 reflect the costs for operation and maintenance of the vehicles.

Figure 27. SUV 15 Year Cumulative Cost Comparison



Appendix C: California State Contracts

The table below summarizes the current EVs available through California State Contracts.

Table 26. EVs Currently Available Through California State Contracts

Vehicle Category	Vehicle Type	Make – Model	Range (mi)	California State Contract
Medium-Duty	Box Truck	International - eMV (Class 6 - Dry Van)	135	$339,945
Medium-Duty	Medium-Duty Vocl.	Ford - E-Transit Chassis Cab	126	$41,728
Medium-Duty	Shuttle Bus	Ford - E-Transit Cutaway	126	$41,212aa
Medium-Duty	Step Van	Freightliner - MT50e	170	$235,875
Medium-Duty	Van	Ford - E-Transit Cargo Van High Roof Long	108	$49,221
Medium-Duty	Van	Ford - E-Transit Cargo Van Medium Roof Long	116	$45,584
Light-Duty	Light-Duty Pickup	Chevrolet - Silverado EV	450	$42,248
Light-Duty	Light-Duty Pickup	Ford - F-150 Lightning Pro (Fleet Only)	240	$48,817
Light-Duty	SUV	Audi - Q4 40 e-tron	265	$52,500
Light-Duty	SUV	Audi - Q4 50 e-tron	236	$58,300
Light-Duty	SUV	Ford - Mustang Mach-E Select AWD Standard Range	226	$47,199
Light-Duty	SUV	Ford - Mustang Mach-E Select RWD Standard Range	250	$44,199
Light-Duty	SUV	Volkswagen - ID.4 Pro	275	$46,865
Light-Duty	SUV	Volkswagen - ID.4 Pro AWD	255	$49,605
Heavy-Duty	Heavy Truck	International - eMV (Class 7)	135	$339,945
Heavy-Duty	Heavy Truck	Volvo - VNR Electric Straight Truck (4x2)	230	$353,442
Heavy-Duty	Heavy Truck	Volvo - VNR Electric 6x4 Tractor (375kWh)	175	$385,487
Heavy-Duty	Heavy Truck	Volvo - VNR Electric 6x4 Tractor (565kWh)	275	$431,187
Heavy-Duty	Refuse Truck	Battle Motors - Battle LET	100	$426,560
Heavy-Duty	Refuse Truck	Battle Motors - Battle LNT	100	$381,784
Heavy-Duty	Refuse Truck	Mack - LR Electric	80	$429,647

Appendix D: Detailed EV Replacement Recommendations

Table 27. Detailed EV Replacement Recommendations

ID	Vehicle Type	Make	Model	Engine Fuel Type	Year of Transition	Replacement Fuel Type	Replacement Make/Model
1	SUV	Ford	Expedition	Gasoline	2027	BEV	Chevrolet – Equinox EV 1LT
2	SUV	Ford	Escape	Gasoline	2026	BEV	Chevrolet – Equinox EV 1LT
4	Light-Duty Pickup – Police	Toyota	Tacoma	Gasoline	2035	BEV	Ford – F-150 Lightning Pro SSV LR
5	SUV	Toyota	4Runner	Gasoline	2038	BEV	Chevrolet – Equinox EV 1LT
6	SUV	Jeep	Wrangler	Gasoline	2039	BEV	Chevrolet – Equinox EV 1LT
8	Light-Duty Pickup – Police	Ford	F150 crew cab	Gasoline	2037	BEV	Ford – F-150 Lightning Pro SSV LR
9	Light-Duty Pickup – Police	Ford	F150 super cab	Gasoline	2036	BEV	Ford – F-150 Lightning Pro SSV LR
10	SUV	Ford	Explorer	Gasoline	2039	BEV	Chevrolet – Equinox EV 1LT
11	Light-Duty Pickup – Police	Ford	F150	Gasoline	2035	BEV	Ford – F-150 Lightning Pro SSV LR
12	SUV	Jeep	Wrangler	Gasoline	2038	BEV	Chevrolet – Equinox EV 1LT
13	Sedan	Toyota	Prius	Gasoline	2038	BEV	Nissan – Leaf S
14	SUV	Jeep	Grand Cherokee	Gasoline	2039	BEV	Chevrolet – Equinox EV 1LT
16	SUV	Jeep	Wrangler	Gasoline	2039	BEV	Chevrolet – Equinox EV 1LT
18	Heavy Truck – Straight Truck	Sterling	7yd Dump	Diesel	2026	BEV	Peterbilt – 220EV (Class 7 – 141 kW)
19	Heavy Truck – Straight Truck	Freightliner 13w 8y dump	13w 8y dump	Diesel	2033	BEV	Peterbilt – 220EV (Class 7 – 141 kW)
20	Medium-Duty Vocational Truck	Ford	F350 mechanic	Gasoline	2029	BEV	Ford – E-Transit Chassis Cab
21	Medium-Duty Vocational Truck	Ford	F550	Diesel	2039	BEV	Ford – E-Transit Chassis Cab
22	Light-Duty Pickup – Police	Ford	F150	Diesel	2039	BEV	Ford – F-150 Lightning Pro SSV LR
23	Medium-Duty Vocational Truck	Ford	F550 3y FB dump	Diesel	2034	BEV	Ford – E-Transit Chassis Cab
24	Medium-Duty Vocational Truck	Ford	F550 FB Dump DRW	Diesel	2034	BEV	Ford – E-Transit Chassis Cab
25	Medium-Duty Vocational Truck	Ford	F350 4X4 SUP CAB	Diesel	2038	BEV	Ford – E-Transit Chassis Cab
26	Medium-Duty Vocational Truck	Ford	F550 EMO truck	Diesel	2030	BEV	Ford – E-Transit Chassis Cab
27	Light-Duty Pickup – Police	Ford	F150	Gasoline	2034	BEV	Ford – F-150 Lightning Pro SSV LR
28	Light-Duty Pickup – Police	Ford	F150	Gasoline	2034	BEV	Ford – F-150 Lightning Pro SSV LR
29	Medium-Duty Pickup	Ford	F350 super cab-v	Gasoline	2025	BEV	ZEVx – Ford F-350 (Pickup)
30	Medium-Duty Pickup	Ford	F350 super cab	Gasoline	2025	BEV	ZEVx – Ford F-350 (Pickup)
31	Medium-Duty Pickup	Ford	F350 super cab	Gasoline	2035	BEV	ZEVx – Ford F-350 (Pickup)
32	Medium-Duty Pickup	Ford	F350	Gasoline	2029	BEV	ZEVx – Ford F-350 (Pickup)
33	Medium-Duty Pickup	Ford	F350 reg cab	Gasoline	2036	BEV	ZEVx – Ford F-350 (Pickup)

ID	Vehicle Type	Make	Model	Engine Fuel Type	Year of Transition	Replacement Fuel Type	Replacement Make/Model
34	Medium-Duty Pickup	Ford	F350	Gasoline	2030	BEV	ZEVx - Ford F-350 (Pickup)
35	Light-Duty Pickup - Police	Toyota	Tacoma	Gasoline	2035	BEV	Ford - F-150 Lightning Pro SSV LR
36	Heavy Truck - Straight Truck	International	Workstar	Diesel	2038	BEV	Peterbilt - 220EV (Class 7 - 141 kW)
37	Medium-Duty Vocational Truck	Ford	F350 Crew Cab	Gasoline	2036	BEV	Ford - E-Transit Chassis Cab
38	Medium-Duty Pickup	Ford	F350	Gasoline	2029	BEV	ZEVx - Ford F-350 (Pickup)
39	Medium-Duty Pickup	Ford	F350 Regular Cab	Gasoline	2032	BEV	ZEVx - Ford F-350 (Pickup)
40	Medium-Duty Pickup	Ford	F350 Super Cab	Diesel	2033	BEV	ZEVx - Ford F-350 (Pickup)
41	Medium-Duty Pickup	Ford	F350 Regular Cab	Gasoline	2034	BEV	ZEVx - Ford F-350 (Pickup)
42	Light-Duty Pickup - Police	Toyota	Tacoma	Gasoline	2035	BEV	Ford - F-150 Lightning Pro SSV LR
43	Medium-Duty Pickup	Ford	F350	Gasoline	2036	BEV	ZEVx - Ford F-350 (Pickup)
44	Medium-Duty Vocational Truck	Ford	F550	Diesel	2036	BEV	Ford - E-Transit Chassis Cab
45	Light-Duty Pickup - Police	Chevrolet	Colorado	Gasoline	2034	BEV	Ford - F-150 Lightning Pro SSV LR
46	Light-Duty Pickup - Police	Toyota	Tacoma	Gasoline	2037	BEV	Ford - F-150 Lightning Pro SSV LR
47	Medium-Duty Vocational Truck	Ford	F550	Diesel	2037	BEV	Ford - E-Transit Chassis Cab
48	Medium-Duty Vocational Truck	Ford	F550	Diesel	2037	BEV	Ford - E-Transit Chassis Cab
49	Light-Duty Pickup - Police	Ford	F150	Gasoline	2030	BEV	Ford - F-150 Lightning Pro SSV LR
50	Light-Duty Pickup - Police	Ford	F250	Diesel	2038	BEV	Ford - F-150 Lightning Pro SSV LR
51	Light-Duty Pickup - Police	Chevy	Colorado	Gasoline	2037	BEV	Ford - F-150 Lightning Pro SSV LR
52	Light-Duty Pickup - Police	Ford	F150 Supercab	Gasoline	2037	BEV	Ford - F-150 Lightning Pro SSV LR
53	Medium-Duty Pickup	Ford	F350	Diesel	2032	BEV	ZEVx - Ford F-350 (Pickup)
54	Light-Duty Pickup - Police	Ford	F250 Crewcab	Gasoline	2029	BEV	Ford - F-150 Lightning Pro SSV LR
55	Medium-Duty Vocational Truck	Ford	F550 EMO	Diesel	2036	BEV	Ford - E-Transit Chassis Cab
56	Medium-Duty Vocational Truck	Ford	F550 Aerial Lift	Diesel	2037	BEV	Ford - E-Transit Chassis Cab
57	Van - Cargo	Chevrolet	Express Van	Gasoline	2036	BEV	Ford - E-Transit Cargo Van Medium Roof Long
58	Heavy Truck - Straight Truck	International	Workstar	Diesel	2035	BEV	Peterbilt - 220EV (Class 7 - 141 kW)
59	Medium-Duty Vocational Truck	Ford	F550 Flatbed Dump Truck	Diesel	2034	BEV	Ford - E-Transit Chassis Cab
60	Medium-Duty Vocational Truck	Ford	F550	Diesel	2036	BEV	Ford - E-Transit Chassis Cab
61	Light-Duty Pickup - Police	Ford	F150 Supercab	Diesel	2038	BEV	Ford - F-150 Lightning Pro SSV LR
62	Medium-Duty Pickup	Ford	F350	Diesel	2035	BEV	ZEVx - Ford F-350 (Pickup)
63	Medium-Duty Vocational Truck	Ford	F550 Reg Cab	Diesel	2039	BEV	Ford - E-Transit Chassis Cab
64	Medium-Duty Vocational Truck	Ford	F550 Reg Cab	Diesel	2039	BEV	Ford - E-Transit Chassis Cab
65	Light-Duty Pickup - Police	Ford	F150 Supercab	Diesel	2038	BEV	Ford - F-150 Lightning Pro SSV LR

ID	Vehicle Type	Make	Model	Engine Fuel Type	Year of Transition	Replacement Fuel Type	Replacement Make/Model
66	Light-Duty Pickup - Police	Ford	F150 Crewcab	Gasoline	2033	BEV	Ford - F-150 Lightning Pro SSV LR
68	SUV - Police	Ford	Escape Hybrid	Gasoline	2026	BEV	Chevrolet - Blazer EV PPV (Police)
71	Medium-Duty Vocational Truck	Ford	F350 super cab	Gasoline	2025	BEV	Ford - E-Transit Chassis Cab
73	Medium-Duty Vocational Truck	Dodge	Ram 3500	Gasoline	2033	BEV	Ford - E-Transit Chassis Cab
74	Medium-Duty Pickup	Dodge	Ram 3500	Gasoline	2033	BEV	ZEVx - Ford F-450 (Pickup)
77	Light-Duty Pickup - Police	Ford	F150	Gasoline	2032	BEV	Ford - F-150 Lightning Pro SSV LR
78	Light-Duty Pickup - Police	Ford	F150	Gasoline	2032	BEV	Ford - F-150 Lightning Pro SSV LR
79	Medium-Duty Vocational Truck	Ford	F350	Gasoline	2025	BEV	Ford - E-Transit Chassis Cab
80	Light-Duty Pickup - Police	Ford	F150	Gasoline	2032	BEV	Ford - F-150 Lightning Pro SSV LR
81	SUV - Police	Ford	Expedition	Gasoline	2027	BEV	Chevrolet - Blazer EV PPV (Police)
82	Light-Duty Pickup - Police	Ford	F150	Gasoline	2032	BEV	Ford - F-150 Lightning Pro SSV LR
83	Light-Duty Pickup - Police	Ford	F150	Gasoline	2031	BEV	Ford - F-150 Lightning Pro SSV LR
84	Medium-Duty Vocational Truck	Ford	F350 super cab	Gasoline	2026	BEV	Ford - E-Transit Chassis Cab
85	Light-Duty Pickup - Police	Ford	F150 super cab	Gasoline	2027	BEV	Ford - F-150 Lightning Pro SSV LR
86	Light-Duty Pickup - Police	Ford	F150 super cab	Gasoline	2026	BEV	Ford - F-150 Lightning Pro SSV LR
87	Medium-Duty Pickup	Ford	F350 super cab	Gasoline	2027	BEV	ZEVx - Ford F-450 (Pickup)
88	SUV - Police	Ford	Expedition	Gasoline	2026	BEV	Chevrolet - Blazer EV PPV (Police)
89	SUV - Police	Ford	Expedition	Gasoline	2027	BEV	Chevrolet - Blazer EV PPV (Police)
90	Medium-Duty Vocational Truck	Ford	F350 Supercab	Gasoline	2028	BEV	Ford - E-Transit Chassis Cab
91	Medium-Duty Vocational Truck	Ford	F350 Supercab	Gasoline	2028	BEV	Ford - E-Transit Chassis Cab
92	Medium-Duty Vocational Truck	Ford	F350 Supercab	Gasoline	2028	BEV	Ford - E-Transit Chassis Cab
93	Light-Duty Pickup - Police	Ford	F150 Crewcab	Gasoline	2027	BEV	Ford - F-150 Lightning Pro SSV LR
95	Light-Duty Pickup - Police	Chevrolet	Tahoe	Gasoline	2037	BEV	Ford - F-150 Lightning Pro SSV LR
96	Light-Duty Pickup - Police	Ford	F150 Crewcab	Gasoline	2028	BEV	Ford - F-150 Lightning Pro SSV LR
97	Medium-Duty Pickup	Ford	F350 Supercab	Gasoline	2028	BEV	ZEVx - Ford F-450 (Pickup)
98	Light-Duty Pickup - Police	Ford	F150 Crewcab	Gasoline	2029	BEV	Ford - F-150 Lightning Pro SSV LR
99	Light-Duty Pickup - Police	Ford	F150 Crewcab	Gasoline	2028	BEV	Ford - F-150 Lightning Pro SSV LR
100	Medium-Duty Vocational Truck	Ford	F350	Gasoline	2028	BEV	Ford - E-Transit Chassis Cab
101	Medium-Duty Vocational Truck	Ford	F350	Diesel	2029	BEV	Ford - E-Transit Chassis Cab
102	Medium-Duty Vocational Truck	Ford	F350	Diesel	2029	BEV	Ford - E-Transit Chassis Cab
103	Light-Duty Pickup - Police	Ford	F150 Crewcab	Gasoline	2031	BEV	Ford - F-150 Lightning Pro SSV LR
104	Light-Duty Pickup - Police	Ford	F150 Crewcab	Gasoline	2031	BEV	Ford - F-150 Lightning Pro SSV LR
105	Light-Duty Pickup - Police	Ford	F150 Crewcab	Gasoline	2031	BEV	Ford - F-150 Lightning Pro SSV LR

ID	Vehicle Type	Make	Model	Engine Fuel Type	Year of Transition	Replacement Fuel Type	Replacement Make/Model
107a	Heavy Truck – Straight Truck	International	1800 G Watertruck	Diesel	2033	BEV	Peterbilt – 220EV (Class 7 – 141 kW)
107b	Heavy Truck – Straight Truck	International	2000 G Watertruck	Diesel	2035	BEV	Peterbilt – 220EV (Class 7 – 141 kW)

Appendix E: Details of Funding & Financing Programs

Funding Programs

Federal Programs

There are several federal incentive programs that are aimed at increasing the adoption of EVs and the installation of EV charging stations. Some of the key federal incentive programs include the Inflation Reduction Act (IRA) and the Alternative Fuel Infrastructure Tax Credit (see "Projected Costs-Benefit & Barriers to Fleet Conversion" section). These incentive programs offer different tax credits for qualifying vehicles and can reduce EV charging equipment installation costs. The federal government has initially aimed its incentive programs towards the promotion of light-duty electric vehicles (EVs) and the installation of lower-power EV charging stations. However, there are now programs available that cater to medium-duty and heavy-duty EVs as well. This section is meant to provide a general overview of the federal incentive programs that the District may be eligible for and serve as a starting point for the application process.

CMAQ Improvement Program

The Infrastructure Investment and Jobs Act (IIJA), also known as the Bipartisan Infrastructure Law (BIL), continues the Congestion Mitigation and Air Quality Improvement Program (CMAQ). The CMAQ Program provides funding to State DOTs and MPOs for projects that reduce mobile source emissions in nonattainment or maintenance areas. Eligible project types include transit improvements, travel demand management strategies, congestion relief efforts (such as high occupancy vehicle lanes), diesel retrofit projects, alternative fuel vehicles and infrastructure, and medium- or heavy-duty zero emission vehicles and related charging equipment. Projects supported with CMAQ funds must demonstrate emissions reductions, be in or benefit a U.S. EPA-designated nonattainment or maintenance area and be a transportation project. Descriptions for projects relevant to fleet electrification and eligible for CMAQ funding are listed below:

1. **Diesel Retrofits:** Vehicle and engine replacements, engine rebuild and conditioning, after-treatment or other technologies, heavy-duty vehicle retirement programs; applies to on-road vehicles, non-road construction equipment, and freight and intermodal projects.
2. **Alternative Fuel Vehicles and Infrastructure:** Purchases, conversion to alternative fuels, diesel alternatives, hybrids; fueling facilities that dispense one or more alternative fuels (public and private facilities eligible).

The FHWA administers the federal-aid program through State DOTs and MPOs, which make decisions about how to spend federal transportation funds through a continuous transportation planning process. All eligible CMAQ funded projects must be included in the MPO's metropolitan transportation plans and transportation improvement program (TIP) where applicable, and the State DOTs statewide transportation improvement program (STIP). The Midpeninsula Regional Open Space

District's MPO is the Metropolitan Transportation Commission (MTC), which most recently issued a call for projects using CMAQ funds in May of 2022.[41]

Projects are ranked based on CARB's cost effectiveness calculation methodology[42], which calculates air quality benefits of a project as CMAQ dollars per pound of emissions, and the lower the value, the higher the rank. In other words, MTC reviews transportation projects with the lowest cost-effectiveness values to determine the final funding recommendations. Although no local match is required, the CARB cost effectiveness calculation methodology will estimate a lower cost effectiveness value if a project utilized local dollars, which would make the project rank higher and increase the likelihood of approval.

To apply for CMAQ Program funding, the District would need to wait for the next call for projects by MTC and submit an application similar to MTC's One Bay Area Grant (complete with air quality calculations, project description, and work phase timeline). Note that private agencies and non-profit agencies can submit a CMAQ Program project application only if it establishes a partnership with a public agency, which would oversee the application and investment process.

State Programs

The State of California has its own set of programs that provide financial incentives to purchase or lease EVs. For example, the Clean Vehicle Rebate Project (CVRP) provides rebates up to $7,000 for the purchase or lease of a new, eligible zero-emission or plug-in hybrid light-duty vehicle. Additionally, CARB has several programs in place to increase the adoption of medium- and heavy-duty EVs and installation of charging stations. The Electric Truck and Bus Voucher Incentive Project (ETVIP) provides vouchers to cover a portion of the cost of medium- and heavy-duty electric trucks, buses and delivery vehicles. The HVIP program, as described in the previous section, provides vouchers for the purchase or lease of hybrid and zero-emission medium- and heavy-duty trucks and buses. The Carl Moyer Program provides grants for the purchase of cleaner-than-required engines, including electric powertrains, for medium- and heavy-duty vehicles. The following sections are intended to provide high-level descriptions of State incentive programs the District may be eligible for and provide starting points for application processes.

Carl Moyer Program

The Carl Moyer Memorial Air Quality Standards Attainment Program (Carl Moyer Program) is a grant program in California that provides funding to offset the incremental cost of purchasing or leasing eligible equipment or technologies that reduce emissions from mobile sources, such as medium- and heavy-duty trucks, buses, and other off-road vehicles and equipment. The Carl Moyer Program provides funding for the purchase or lease of new, cleaner engines and equipment and the retrofit or replacement of existing engines and equipment. This program covers a wide range of equipment types and technologies, including electric and hydrogen fuel cell vehicles, hybrid vehicles, and technologies to reduce emissions from diesel engines, such as diesel particulate filters and diesel oxidation catalysts. The program also provides funding for the purchase of alternative fuel vehicles

[41] https://mtc.ca.gov/news/one-bay-area-grants-calls-projects-open-may
[42] https://ww2.arb.ca.gov/resources/documents/congestion-mitigation-and-air-quality-improvement-cmaq-program

and the installation of alternative fueling infrastructure such as electric vehicle charging stations, hydrogen fuel stations, and compressed natural gas fueling stations.

The Carl Moyer program is an example of a program that cannot be stacked with other State-funded programs, such as HVIP, and there are other caveats that make Carl Moyer distinct from HVIP and similar programs. One of the key differences between HVIP and Carl Moyer is the scrappage requirement. An applicant is required to scrap existing vehicles in order to use funds from the Carl Moyer program. This is to ensure that the funding will achieve early or extra emission reductions beyond the natural turnover of vehicles. Additionally, the Carl Moyer program only provides funding to replace vehicles that are six years and older. For example, this year, the newest existing engine model year that is eligible to participate in the program would be 2017, and 2018 to 2023 model year vehicles would not be eligible to be scrapped, leaving them available for purchase by any consumer.

Moreover, the Carl Moyer program applies a cost-effectiveness limit to calculate the amount of funding that can be allocated to a certain project. On November 19, 2021, CARB approved amendments to the Carl Moyer program's cost effectiveness limits and funding caps for optional advanced technology and ZE replacement on-road projects. The amended cost-effectiveness limits are presented in the table below.

Table 28. Amended Cost-Effectiveness Limits for Carl Moyer Program

Cost-Effectiveness (CE) Limit Types	Old CE Limits ($/ton)	New CE Limits ($/ton)
Base Limit	$30,000	$33,000
Optional Advanced Technology Limit	$100,000	$109,000
On-Road Optional Advanced Technology Limit – 0.02 g/bhp-hr or cleaner	$100,000	$200,000
On-Road Optional Zero-Emission Limit	$100,000	$500,000
School Bus (combustion)	$276,230	$300,000

To apply for funding through the Carl Moyer Program, eligible entities must submit a grant application during the annual application period, and follow the guidelines and requirements outlined in the grant application. CARB evaluates applications based on specific criteria and selects the most promising projects for funding. Applicants must bear in mind that the Carl Moyer program also has tax implications. Current federal and state laws do not exclude Carl Moyer Program grants from gross income, and therefore, the grant received through these programs is subject to federal and state income tax. In other words, a fraction of the grant may have to be paid as income tax, which can increase out of the pocket costs for purchasing new vehicles with the Carl Moyer program.

VW Environmental Mitigation Program

The California Volkswagen (VW) Environmental Mitigation Program is a state initiative that aims to reduce the impact of VW's excess diesel emissions on the environment. It provides funding opportunities for eligible entities to implement projects that reduce NOx emissions from mobile sources like heavy-duty vehicles, trucks, and buses, as well as off-road equipment, ferries, and shore power systems. The program has a total allocation of $423 million, of which $90 million is allocated to zero-emission Class 8 trucks, including waste haulers, dump trucks, and concrete mixers. Public agencies, private companies, and nonprofit organizations are eligible to apply for funding on a first-come, first-served basis.

The VW Environmental Mitigation program has a vehicle scrappage requirement and requires that both the old and new vehicles operate within the State 75% or more of the time. It should be noted that as with most State programs, VW Trust funding cannot be stacked with other State funding sources, such as HVIP or Carl Moyer. However, like HVIP, transit agencies may stack Federal Transit Administration (FTA) funds with VW Mitigation Trust funds for purchasing zero-emission transit buses and supportive infrastructure. One caveat is that VW funds cannot be stacked with any other funding sources that takes credit for NOx emission reductions.

The table below illustrates the eligibility criteria for VW Trust Fund. As shown, for government fleets, the program covers up to 100% of the cost of zero-emissions trucks (with the maximum funding of $200,000). As an example, if a new Class 8 ZE truck costs $350,000 before taxes, the amount of funding is calculated as the minimum of a) 100% x 350,000 = $350,000, and b) funding cap of $200,000. In this example, the available funding is $200,000.

Table 29. Eligibility Criteria for VW Environmental Mitigation Program for HD Vehicles

Baseline Equipment	Baseline Technology	Replacement Technology	Ownership Category	Maximum Incentive Percentage (of cost)	Maximum Incentive Cap (per equipment)
Class 8 Freight Trucks (including drayage trucks, waste haulers, dump trucks, and concrete mixers)	Engine Model Years 1992 to 2012*	Zero-Emission Vehicle	Non-Government	75%	$200,000
			Government	**100%**	
	Engine Model Years 1992-2012*	Low NOx (certified 0.02 g/bhp-hr)	Non-Government	25% (Non-Drayage)	$85,000
				50% (Drayage)	
			Government	**100%**	

Energy Infrastructure Incentives for Zero-Emission (EnergIIZE)

The California Energy Commission (CEC) Clean Transportation Program is a program that provides funding to support the development and deployment of clean transportation technologies in California, including EVs and EV charging infrastructure. The program offers funding for a wide range of clean transportation projects, including fleet electrification and charging infrastructure for medium- and heavy-duty vehicles.

As part of the draft funding allocations for FY 2022–23, CEC has allocated more than $160 million to support medium- and heavy-duty ZEV infrastructure to address the need for rapid transition to ZE technologies across the state. To facilitate distribution of the Clean Transportation Program funds allocated to MD-HD vehicles, in March 2022 the CEC and CALSTART launched the $50 million EnergIIZE Commercial Vehicles block grant which will provide exclusive zero-emission infrastructure funding to support the transition of MD-HD vehicles to BEVs and FCEVs. Participation in the EnergIIZE incentive project requires that the applicant or the funding recipient belong to one of the following categories: a) a business, organization, or individual responsible for the operation of a MD-HD ZEV (vehicle Class 2b and above) in the State, or b) a business, organization, or individual responsible for the engineering, construction, procurement, and completion of a ZE infrastructure site in the state of California which shall service MD-HD ZEVs Class 2b or above. EnergIIZE also establishes four "Funding Lanes" each with differing qualifications and incentive structures, as shown in Table 30. Of the four available funding lanes, the EV Fast-Track is the most accessible funding lane for the Midpeninsula Regional Open Space District to participate in, since any of the following that apply mean that the fleet is eligible:

EnergIIZE EV Fast-Track Eligibility for Commercial Fleets

- Can provide proof of ownership for MD/HD ZEV(s) registered in the state of California.
- Can show proof of purchase order (PO) for a vehicle(s) registered in the State of California, funded or otherwise incentivized through state/federal projects. Funding and incentive sources may include but are not limited to: Clean Off-Road Equipment Voucher Incentive Project (CORE), Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP), VW, Carl Moyer, AB 6178, California Secure Transportation Energy Partnership (CALSTEP) CMO, and DERA.
- MD/HD off-road equipment does not require vehicle registration, but must reside and operate 75% of its time in the state of CA.

Table 30. EnergIIZE incentive structure across four funding lanes

	EV Fast-Track	EV Jump Start	Public Charging Station	Hydrogen Fueling
Type of Application	First Come, First Served	Competitive	Competitive	Competitive
Maximum Incentive Offering	50% of Hardware and Software Costs Incurred	75% of Hardware, Software, and Soft Costs	50% of Hardware and Software Costs Incurred	50% of Hardware and Software Costs Incurred
Eligible for Milestone Payments	Yes	Yes	Yes	Yes
Maximum Project Cap	$500,000	$750,000	$500,000	$2,000,000

California Electric Vehicle Infrastructure Project (CALeVIP)

Note: As of December 2023, there are no CALeVIP rebate funds available for entities in California. However, if the California Energy Commission provides eligible rebates in the future, the Midpeninsula Regional Open Space District can use the information below as a guide for eligibility and the application process.

The California Electric Vehicle Infrastructure Project (CALeVIP) was introduced by the California Energy Commission (CEC) in December 2017 to provide incentives for electric vehicle charging infrastructure. The project simplifies the funding process and accelerates charger deployment, with each project targeting specific regions throughout the state that have low rates of infrastructure installation. Through 2022, the CEC has allocated $200 million for charger rebates through CALeVIP, and 13 regional incentive projects covering 36 counties have been launched. Funding amounts are also available for disadvantaged communities and multifamily complexes, and CEC staff works with local governments to leverage other funding opportunities to increase chargers in focused locations. To apply for CALeVIP, the applicant needs to follow these steps:

1. **Determine eligibility**: The CALeVIP program provides incentives for the installation of electric vehicle (EV) chargers in California. Eligible applicants include public agencies, non-profit organizations, businesses, and individuals who own or lease property in California where EV chargers will be installed.
2. **Choose project type**: CALeVIP offers two types of projects: Regional incentive projects and Equity incentive projects. Regional incentive projects provide incentives for EV chargers in specific regions throughout California, while equity incentive projects provide higher incentives for EV chargers installed in disadvantaged communities and multi-unit dwellings.
3. **Choose charger type**: CALeVIP provides incentives for Level 2 and DC fast chargers
4. **Apply for incentives**: Once the applicant has determined their eligibility and chosen their project and charger type, they can apply for incentives through the CALeVIP website. The application process involves submitting an online application, providing project details and specifications, and signing a rebate agreement.

Eligibility requirements for CALeVIP vary depending on the type of project and the applicant. However, generally, to be eligible for incentives, applicants must meet the following requirements:

- **Applicant Requirement**: To be eligible for any CALeVIP rebate, the applicant must be a site owner or authorized agent, a business, nonprofit, California Native American tribe or public/government entity based in California or operating as a California-based affiliate. Some projects require a valid California business license, except for public agencies or joint powers authority agencies.
- **Site Requirements**: To qualify for rebates for electric vehicle charging stations in California, the properties must be located in the state and comply with federal, state, and municipal laws. DC fast charging sites must be publicly available 24/7 and located in specific areas such as airports, gas stations, and hospitals. Level 2 charging sites must be located in eligible commercial sites, workplaces, multiunit dwellings, public facilities, or curbside charging sites. Some eligibility criteria only apply to certain rebate programs, and more information can be found on individual project pages.
- **Disadvantaged Community (DAC) and Low Income Community (LIC) Requirements**: Some CALeVIP rebates are only available for EV charger installation sites located in disadvantaged or low-income communities, which are identified by the CalEnviroScreen tool and census tracts that are at or below 80% of the statewide median income. These sites may qualify for

higher rebate amounts from some projects. As of October 2023, the Midpeninsula Regional Open Space District is considered a disadvantaged community.[43]

- **Installation Requirements**: According to CA Public Utilities Code 740.20, EV chargers must be installed by Electric Vehicle Infrastructure Training Program (EVITP) certified electricians for all CALeVIP projects except for the Central Coast, Northern California, San Joaquin Valley, and Sonoma Coast projects. If the charging installation supports a port supplying 25 kW or more, at least 25% of the electricians working on the crew must be EVITP certified. One crew member may be both the contractor and the EVITP-certified electrician. To find an EVITP-certified electrician or other EV charging provider, visit CALeVIP Connects.
- **Equipment Requirements:** To be eligible for CALeVIP rebate, DC fast charger equipment must be new, have at least an SAE CCS connector, be networked, capable of 50 kW or greater, use an open standard protocol, be approved by a Nationally Recognized Testing Laboratory (NRTL) Program, and accept some form of credit card and multiple forms of payment if payment is required. For Level 2 charging equipment, it must be new, ENERGY STAR certified, networked, capable of 6.2 kW or greater per connector, use an open standard protocol, have a minimum two-year networking agreement, and accept some form of credit card and multiple forms of payment if payment is required.

Eligible costs for CALeVIP projects include solar EV charging systems, demand management equipment, installation costs, network agreements, and other related expenses. Costs such as permits required by authorities having jurisdiction are not eligible for reimbursement, and certain projects may not cover upgrades of existing ADA noncompliance.

California Clean Vehicle Rebate Project (CVRP)
Note: As of November 2023, there are no CVRP rebate funds available for fleets. However, if the California Energy Commission provides eligible rebates to fleets in the future, the Midpeninsula Regional Open Space District can use the information below as a guide for eligibility and the application process.

The Clean Vehicle Rebate Project (CVRP) promotes clean vehicle adoption in California by offering rebates from $1,000 to $7,000 for the purchase or lease of new, eligible light-duty zero-emission vehicles, including EVs, PHEVs, and FCEVs. Applicants must be based in California and submit a CVRP application within three months of the vehicle purchase or lease date while funds are available. Eligible vehicles must meet the following criteria for a purchaser or lessee to qualify for a rebate:

- Have a base MSRP for the following vehicle categories:
  - Base MSRP of $60,000 or less for vehicles that fall under the Large Vehicles category (i.e., Minivans, Pickups, SUVs)

[43] Priority Populations 2023 (ca.gov)

- Base MSRP of $45,000 or less for light-duty vehicles (i.e., hatchbacks, sedans, wagons, and two-seaters)

With the exception of FCEVs, all vehicles must meet the base MSRP caps according to the listed vehicle categories above. According to the CVRP Implementation manual, the CVRP rebate can be combined with federal, state, or local agency incentives as well as Administrator match funding, if available, to help further buy-down an eligible vehicle's cost[44]. It should be noted that individuals and businesses are limited to one rebate for a non-FCEV and one rebate for a FCEV, for a total of two rebates; when individuals or businesses meet their two-rebate limit, they will remain ineligible for an additional rebate. In contrast, public fleets are eligible for up to 30 rebates per year.

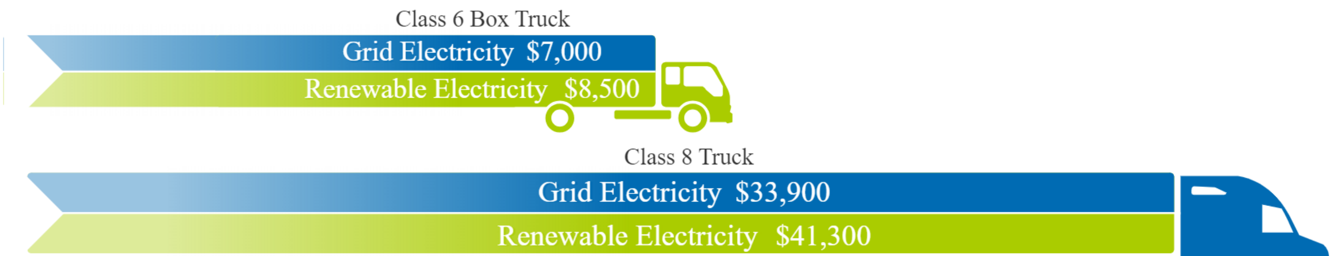
Low Carbon Fuel Standard (LCFS)

The Low Carbon Fuel Standard (LCFS) is a regulatory program that incentivizes fuel carbon intensity reduction and non-residential ZEV infrastructure. In particular, fleets that own Level 2 and DC fast chargers are eligible to apply for the generation of LCFS credits, since electricity is a low-carbon transportation fuel. The number of credits a fleet generates depends on the amount and carbon intensity of electricity dispensed to vehicles. By using renewable electricity for charging or purchasing Renewable Energy Certificates (RECs), fleets can increase their LCFS revenue streams, potentially by up to 20% as illustrated in Figure 28.

Participants in the LCFS program can manage fuel and credit transactions through the LCFS Reporting Tool and Credit Bank & Transfer System (LRT-CBTS), part of CARB's database management system for all LCFS processes. Credits earned through the LCFS program may be sold by a registered broker, and the value of the credits are generally required to be reinvested in electric vehicle infrastructure or services. This could include services such as EV purchases and maintenance, charging infrastructure purchases and maintenance, electricity costs, and administrative fees. The value of the LCFS credits for any one EV charging site is influenced by many factors including but not limited to: the number of EV chargers in operation, the type of EV chargers installed, the amount of fuel dispensed, and the value of the credit when sold. One limitation of LCFS credits are the fluctuations in their selling price, as illustrated in Figure 29, which can lower EV and EV charging infrastructure deployment potential. For example, while in 2020, the LCFS credits were traded at $200 per credit, the credit prices have dropped to ~$75 per credit in the third quarter of 2023.

[44] https://cleanvehiclerebate.org/sites/default/files/docs/nav/transportation/cvrp/documents/CVRP-Implementation-Manual.pdf

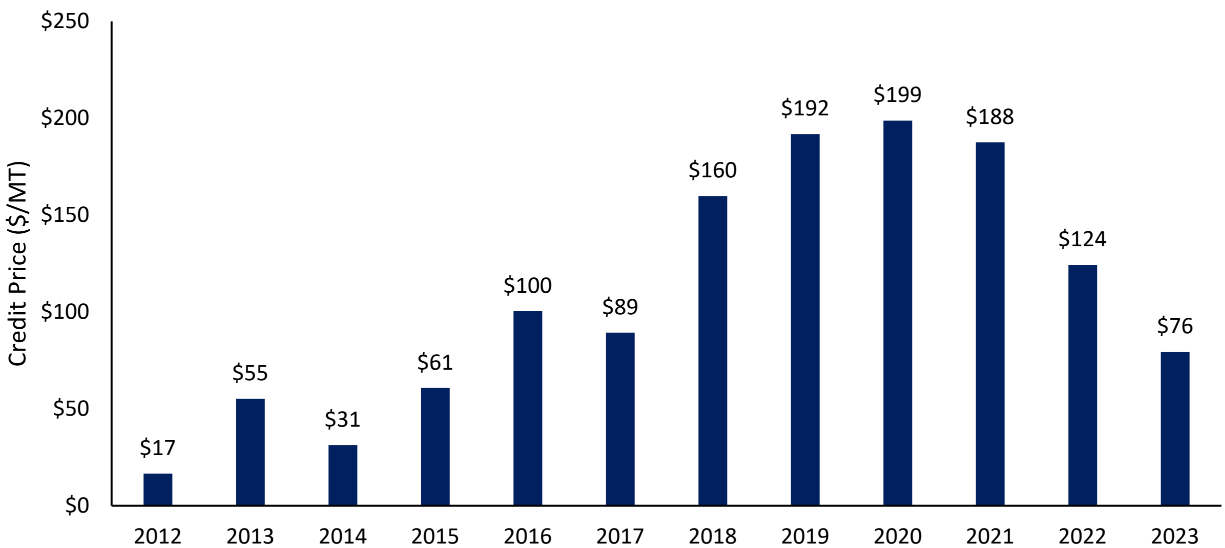
Figure 28. An Example of Annual Revenues Generated using LCFS



Source: https://www.act-news.com/low-carbon-revenue-opportunities/

Assumes Class 6 truck with 20,000 annual miles and 1.3 kWh/mi electricity consumption rate

Figure 29. Monthly LCFS Credit Price and Volume Transacted



Local Programs

Charge! Program[45]

The Bay Area Air Quality Management District (BAAQMD) operates the Charge! program, which is designed to incentivize and support the installation of EV charging infrastructure throughout the Bay Area region in California. The Charge! initiative offers a grant that can cover up to 85% of the expenses involved in purchasing and setting up new public charging stations at eligible facilities, as well as private charging units for multi-unit buildings or workplaces within the Air District's jurisdiction. These charging stations are intended for light-duty vehicles with a GVWR of 8,500 pounds or less. Both public entities and private enterprises can apply for this funding, which is competitive in nature. Once the charging stations are operational, the funding is provided to the grant recipients (referred to as "Project Sponsors") on a reimbursement model. The grant amount is determined by the expected utilization of the station, reflecting its potential to encourage EV adoption, decrease reliance on petroleum, and minimize air pollution.

[45] https://www.baaqmd.gov/funding-and-incentives/businesses-and-fleets/charge

The Charge! Program provides base funding for different charging station types: Level 1 stations receive $750 with a minimum usage requirement of 3,600 kWh over three years; Level 2 (3.3-6.3 kW) get $1,500 with a 9,000 kWh requirement; Level 2 (6.6+ kW) are allotted $3,000 with an 18,000 kWh requirement; and DC Fast stations receive $18,000 with a 90,000 kWh requirement over the same period. In addition to base funding, Plus-Up funding is available for certain qualifiers: Dual-port stations can get up to $10,000 with a 30,000 kWh additional usage requirement; solar power installations receive $1 for every watt of solar capacity up to $4,000 with an added usage requirement based on the investment; Transportation Corridor Facilities qualify for $7,000; and Multi-Unit Dwellings can get between $750 to $4,000 depending on the category, with corresponding usage requirements.

Eligible participants for the Charge! Program include businesses, non-profits, and public agencies that either own the property where the charging stations will be installed or can provide authorization from the property owner. Projects must be surplus and voluntary, with charging stations that are not mandated by any legal or regulatory obligations. All costs incurred before the finalization of a Funding Agreement with the Air District are not reimbursable, and a fully executed Funding Agreement is required for funding to be guaranteed. Projects must qualify for a minimum of $1,000,000 in Charge! Program funding, with certain exceptions, and applicants must be in good standing with all relevant air quality regulations. A single applicant is capped at receiving $3,000,000 in funding per fiscal year.

The facilities can fall into several categories such as multi-unit dwellings, workplaces, or transportation corridors. The charging stations funded must be new, meet specific public availability criteria, and comply with usage requirements. Any pre-existing or retroactively installed equipment is ineligible for funding. Additionally, certain facilities, particularly those in Environmental Justice communities or those supporting private fleets, may be exempt from public accessibility requirements. The Charge! Program offers reimbursement for specific costs associated with EV charging stations, including the hardware, installation, necessary electrical upgrades, permit fees, and equipment to record energy dispensed. Equipment vendors may request to use in-house labor for installation, but this requires approval and detailed documentation for reimbursement. Additionally, projects qualifying for solar power Plus-Up funding can also receive reimbursement for solar panels, inverters, battery storage hardware, and related installation costs. However, the program does not cover costs such as consultant fees, environmental review, maintenance, administrative costs, or improvements to the parking area that are unrelated to the charging station project.

Financing Component

Public-Private Partnerships

Public-private partnerships (PPP) can be used to build charging infrastructure by involving a private partner who finances initial capital costs with private debt and equity in exchange for returns on investment over time. This involves a partnership between a government entity and a private sector company, where the latter takes the lead in designing, financing, constructing, and operating the charging infrastructure. The government entity provides funding, land, and other resources, while the private partner is responsible for financing and operating the charging infrastructure. This model allows for the sharing of risks and benefits and can lead to the faster deployment of charging infrastructure, as well as increased innovation.

There are several PPP models that are available for charging infrastructure deployment. Some of the common PPP models include:

- **Build-Operate-Transfer (BOT) Model**: Under this model, a private partner is responsible for the design, construction, and operation of charging infrastructure, and transfers the ownership to the government or public entity after a specified period of time.
- **Design-Build-Finance-Operate-Maintain (DBFOM) Model**: Similar to the BOT model, a private partner takes responsibility for design, construction, financing, operation, and maintenance of charging infrastructure, but operates it for a specified period of time before transferring ownership back to the government or public entity.
- **Concession Model**: This model involves the government granting a private partner the right to build and operate charging infrastructure within a specified area for a specified period of time, in exchange for payment or a share of revenue.
- **Joint Venture Model**: This model involves the formation of a joint venture between the public and private sectors, where both partners collaborate to develop and operate charging infrastructure.

The choice of PPP model depends on the specific goals and needs of the government or public entity and the private partner. The model selected should allow for efficient and effective deployment of charging infrastructure while ensuring that public interest is protected.

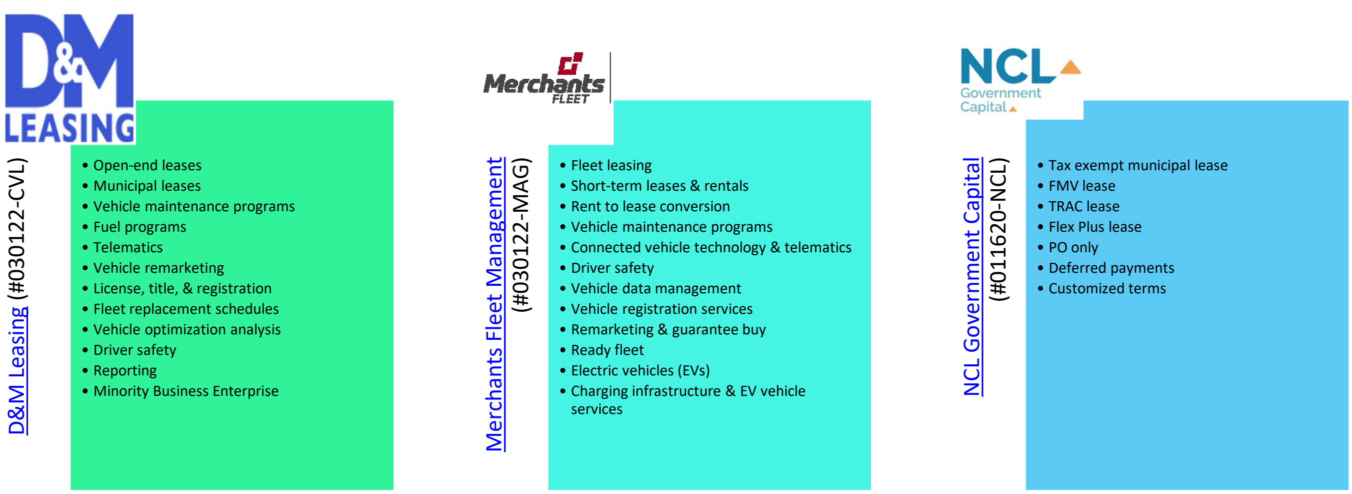
There are a few examples of public-private partnerships (PPPs) for medium- and heavy-duty electric vehicles. One example is the CARB and the South Coast Air Quality Management District (SCAQMD) partnership, which aims to accelerate the deployment of medium-duty and heavy-duty EVs in the state of California. The partnership provides funding for the deployment of these types of EVs, as well as for the construction of charging infrastructure. Another example is the partnership between the Port of Los Angeles and the private sector to deploy and test medium-duty electric delivery trucks. The partnership aims to reduce air pollution and greenhouse gas emissions from cargo movement in and out of the port, and to demonstrate the feasibility of electric trucks in a real-world commercial environment.

Purchasing Contracts from Sourcewell

Sourcewell is a government agency that provides cooperative purchasing contracts to public entities in the United States and Canada. Sourcewell financing is a way for entities to finance the purchase of goods or services, spreading the cost of the purchase over time. By pooling the purchasing power of its members, Sourcewell is able to negotiate lower prices and better terms on the products and services it procures. This allows its members to save time and money compared to if they had to purchase these products and services on their own. In terms of charging infrastructure, Sourcewell may negotiate contracts with suppliers and manufacturers of EV charging equipment and services and offer these contracts to its members. By leveraging the collective purchasing power of its members, Sourcewell may be able to secure more favorable pricing, terms, and conditions, which can help reduce the cost of procurement for its members.

There are a variety of [Sourcewell purchasing contracts available for fleet related services], including loan and lease programs for electric vehicles, charging equipment, and workforce training. The figure below shows some of Sourcewell's current finance and leasing contracts. These purchasing contracts can make it easier for entities with limited budgets to access the goods and services they need. D&M Leasing has partnered with Sourcewell to offer EV leasing and purchasing solutions to commercial and government entities. Municipal leases remain eligible for any applicable state and federal incentives, and D&M Leasing simplifies the process of receiving the largest federal tax-credit. Lease terms range from 24 through 60 months, and at the end of the lease, fleets may purchase the vehicles. Over the duration of the lease, fleets also have access to vehicle telematics and vehicle maintenance programs through D&M Leasing's fleet management program. Merchants Fleet Management is another Sourcewell partner that offers EV leasing and management solutions, along with EV fleet pilot programs. Merchants Fleet Management can facilitate the delivery of different EV models to help fleet managers understand vehicle capabilities and determine which subsections of their business should adopt more EVs. NCL Government Capital, another contract available through Sourcewell, differs from the two previous contracts by offering tax-exempt financing solutions to acquire light- through heavy-duty vehicles.

Figure 30. Sourcewell Financing & Leasing Contracts



Financing Options through IBank

The California Infrastructure and Economic Development Bank (IBank) is a state agency that has broad authority to issue tax-exempt and taxable revenue bonds, provide financing to public agencies, provide credit enhancements, acquire or lease facilities, and leverage State and Federal funds. IBank's current programs include the Infrastructure State Revolving Fund (ISRF) Loan Program and partnership with Climate Tech Finance. The ISRF offers low-cost financing to state and local government entities and non-profit organizations sponsored by a government entity for a wide variety of infrastructure and economic development projects. In partnership with Climate Tech

Finance, this program provides loan guarantees to de-risk the lending process for banks and open new sources of working capital for climate tech entrepreneurs. These financing options provide small- and mid-sized governments and businesses with low-cost and direct financing for EVs and EV charging infrastructure through different loan and repayment structures. Generally speaking, IBank interest rates are set based on a combination of an Interest Rate Benchmark and Interest Rate Adjustments, which are dependent upon the repayment source. The Interest Rate Benchmark will be based on the Thompson's Municipal Market Data Index (MMD) and use published letter category ratings for the pledged revenue stream to determine the base (market price) spread from the MMD AAA GO Scale applicable to the borrower. Interest Rate Adjustments will cause the interest rate on financing to generally be below the Interest Rate Benchmark. The specifics of these programs are discussed below.

Infrastructure State Revolving Fund (ISRF)

The ISRF most notably finances economic development and public infrastructure projects, but private developments, such as zero-emission vehicle fleets and charging stations, qualify as well. ISRF financing is available in amounts ranging from $1 million to $65 million, with loan terms for the useful life of the project—up to a maximum of 30 years. The origination fee for processing of an ISRF loan the greater of $10,000 or 1% of the original loan amount. Applications for ISRF are continuously accepted and can be filled out in detail after initial consultation with IBank to determine if the project meets creditworthiness and underwriting criteria. Applications approved by the IBank board can have funds issued within 45 to 90 days, and different financing repayment solutions, such as revenue producing enterprise systems or property/sales/special taxes, can be used to repay ISRF financings.

Climate Tech Finance

The Climate Tech Finance partnership is meant to accelerate the development and adoption of technologies that reduce greenhouse gases across California. The program is administered by the Bay Area Air Quality Management District (BAAQMD) in partnership with IBank, but is accessible to entities statewide. The BAAQMD recommends contacting their office via email for proposed projects. Through the IBank and Climate Tech Finance partnership, applications for loans and loan-guarantees are available for projects focusing on emission-reducing technologies. Climate Tech Finance offers loan guarantees of up to $5 million are offered on loans of up to $20 million, with up to a 7-year term (the loan term can be longer). For the loan guarantee, 80% of the loan amount is backed by a leveraged trust fund held by the State of California. A single loan guarantee is then issued by the State of California to cover the entire single 90% loan guarantee. IBank provides loans for public entities ranging from $500,000 to $30 million, with up to 30-year terms.

Charging Infrastructure-as-a-service

Charging Infrastructure-as-a-service (CIaaS) for EV chargers refers to the provision of EV charging infrastructure as a service to customers. CIaaS for EV chargers offer a range of charging solutions and services that can be tailored to the needs of businesses, municipalities, and property managers. This type of service allows them to provide charging infrastructure to their customers without having to invest in the equipment themselves, and also allowing them to manage the installation, maintenance, and billing of the service, which can make the adoption of EV more accessible and convenient for the end-users. Some established companies providing ClaaS for EV chargers include:

1. **Sustainability Partners**: Sustainability Partners (SP) offers a usage-based utility model targeting essential institutions like municipalities, schools, and hospitals. With no upfront costs, they provide month-to-month contracts, allowing institutions to replace outdated, unreliable infrastructure with modern, safe solutions. SP can cover the entire cost, including design, materials, installation, and ongoing maintenance. They also support state and federal grant funding requirements. Key benefits include usage-based billing over long-term debt, full control over asset use, a month-to-month leasing system with easy termination, options to own assets, full transparency in accounting, and real-time monitoring.
2. **ChargePoint**: This company offers a variety of EV charging solutions, including ClaaS for businesses, municipalities, and property managers. ChargePoint provides the charging stations and manages the installation, maintenance, and billing for the service.
3. **EVgo**: EVgo is another provider of ClaaS for EV chargers. The company offers a network of fast-charging stations for EV drivers and provides ClaaS to businesses, municipalities, and property managers. EVgo also offers a mobile app for customers to locate and pay for charging services.
4. **Blink Charging**: Blink Charging is a provider of EV charging equipment and services, including ClaaS for businesses, municipalities, and property managers. The company provides the charging equipment and manages the installation, maintenance, and billing for the service.
5. **Shell Recharge**: Shell Recharge (formerly Greenlots) is an open-source network provider of EV charging infrastructure and services. They offer a variety of charging solutions, including ClaaS for businesses, municipalities, and property managers. The company provides charging stations, manages the installation, maintenance, and billing, and also offers a mobile app for customers to locate and pay for charging services.
6. **SemaConnect**: SemaConnect is another provider of EV charging infrastructure and services. The company offers a range of charging stations and manages the installation, maintenance, and billing for the service. They also provide a web-based network management system that allows property managers and fleet operators to manage and monitor EV charging on their premises.