Municipal Fleet
Fleet Electrification Assessment

ICF

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Glossary of Terms

BEV: Battery Electric Vehicle

DCFC: Direct Current Fast Charger

EV: Electric Vehicle

EVSE: Electric Vehicle Supply Equipment

L2 Charger: Level Two Charger

PHEV: Plug-In Hybrid Electric Vehicle

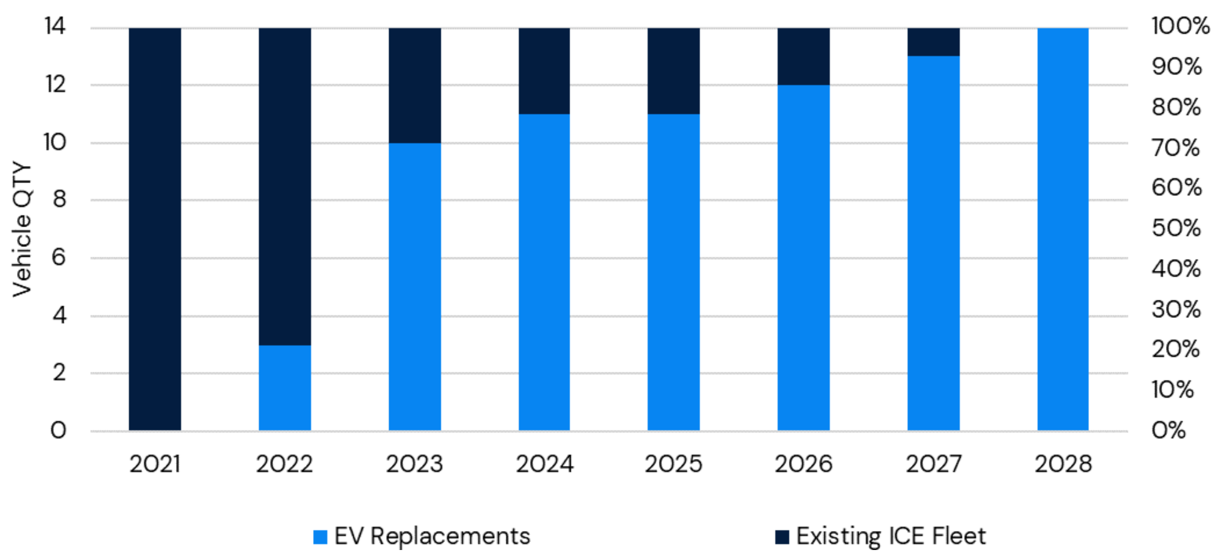
TCO: Total Cost of Ownership

Executive Summary

ICF, on behalf of Consumers Energy, provides fleet electrification recommendations and objective guidance from our team of electric vehicle (EV) experts. We are here to help you, CUSTOMER NAME (CUSTOMER), understand the impacts of shifting your fleet to EVs and support you every step of the way. This custom report identifies the vehicles that would be most cost-effective to convert to electric and summarizes the associated financial and environmental benefits.

The timeframe identified for the vehicle replacements is 2022 to 2028, based on the retirement schedule CUSTOMER provided for the existing fleet However, the fleet total cost of ownership (TCO) analysis extends to 2034 to account for the ongoing fuel and maintenance costs from the vehicles acquired in 2028. We assessed the economic feasibility of 14 on-road vehicles in CUSTOMER fleet, all of which have EV options available and would be beneficial to convert over the next 7 years. Chart A illustrates the phasing in of these electric vehicles as you replace your existing fleet vehicles. These 14 vehicles would result in a net present value (NPV) TCO savings of $1,660,956 over the next 13 years, which accounts for the savings across the vehicles' full lifespans.

Chart A: Recommended EV Replacement Timeline: Fuel Types



Based on our analysis, converting 14 on-road vehicles to EVs is estimated to produce the following impacts:

$1,660,956
TCO savings over 13 years*

$368,479
fuel cost savings over 13 years*

$739,014
maintenance savings over 13 years*

1,916 metric tons (MT) of CO_2 eliminated over 13 years

*NPV assumes a 5% discount rate

Over 13 years, those estimated CO_2 reductions equate to:

eliminating **220** homes' energy use for one year, or:

switching **72,821** incandescent lamps to LEDs, or:

recycling **652** tons of waste instead of landfilling it, or:

planting **31,620** trees.

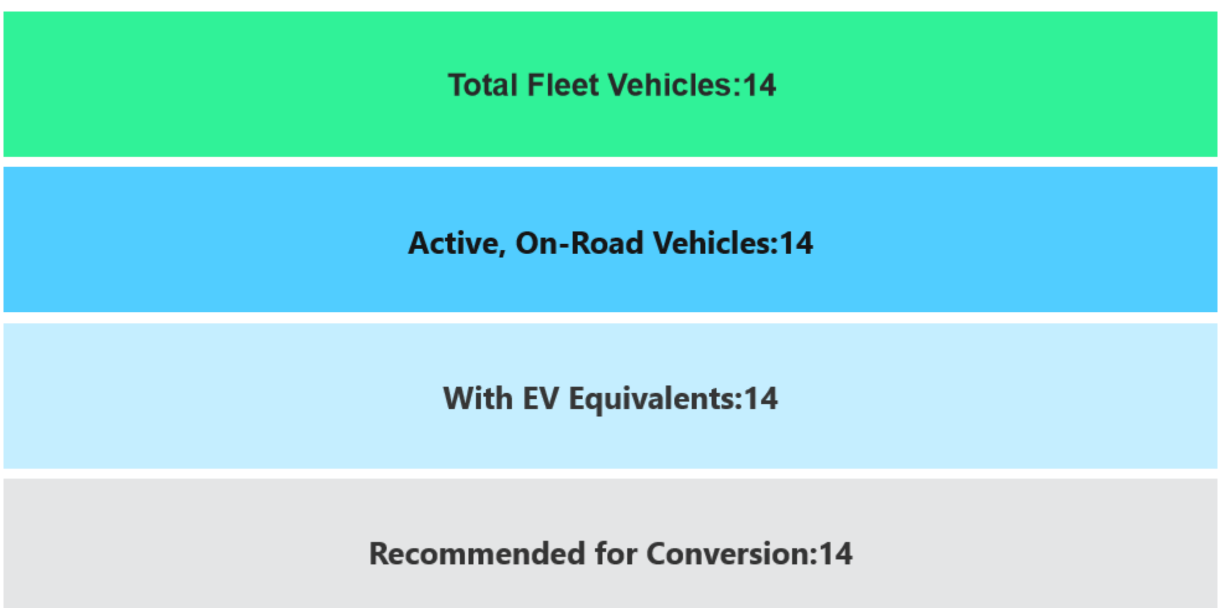
Project Information

On April 27, 2022, representatives from CUSTOMER met with the ICF Account Manager and other program staff for an initial intake call. The discussion covered topics including an overview of the PowerMIFleet Program, fleet data availability, fleet usage characteristics, and the fleet's motivation for exploring EV options. A key takeaway of the intake call was CUSTOMER's concern about the high capital cost of electrification and their interest in pursuing FTA grant opportunities. To address this, we incorporated the FTA's Low or No Emission Vehicle grant program into the analysis and included practical information about program offerings and deadlines.

CUSTOMER provided an initial fleet dataset on April 8, 2022. The Account Manager provided follow up questions on April 27, 2022, and the fleet responded on April 29, 2022. CUSTOMER's fleet dataset was used to establish a fleet baseline in the model and we presented the initial results for feedback on June 3, 2022.

There are 14 on-road vehicles in the CUSTOMER's current fleet. Of the 14 on-road vehicles, 14 have EV equivalents commercially available, and all 14 would be cost beneficial to convert to EVs at this time. This breakdown is illustrated in Chart B.

Chart B: Fleet Assessment Vehicle Breakdown



Existing On-Road Fleet Makeup

There are 14 on-road vehicles in CUSTOMER's current fleet, all of which are gasoline-powered shuttle buses as shown in Table A. CUSTOMER provided the estimated retirement schedule for their existing fleet, illustrated in Chart C. This schedule informs the recommended EV replacement schedule, which is shown later in chart G

Table A: Existing Fleet Fuel Type Distribution

Vehicle Type	Gasoline	Diesel
Shuttle Bus	14	**0**
TOTAL	**14**	**0**

Chart C: Existing Fleet – Model Years

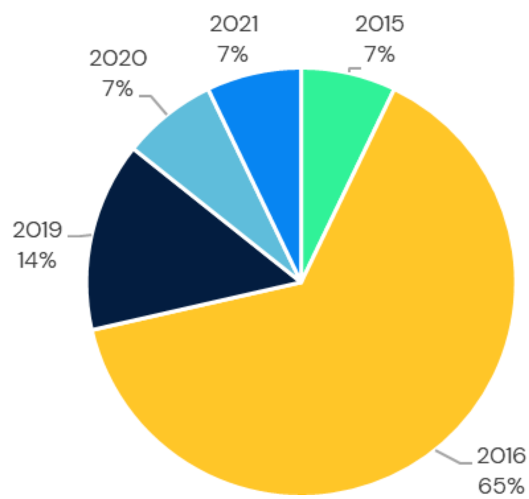
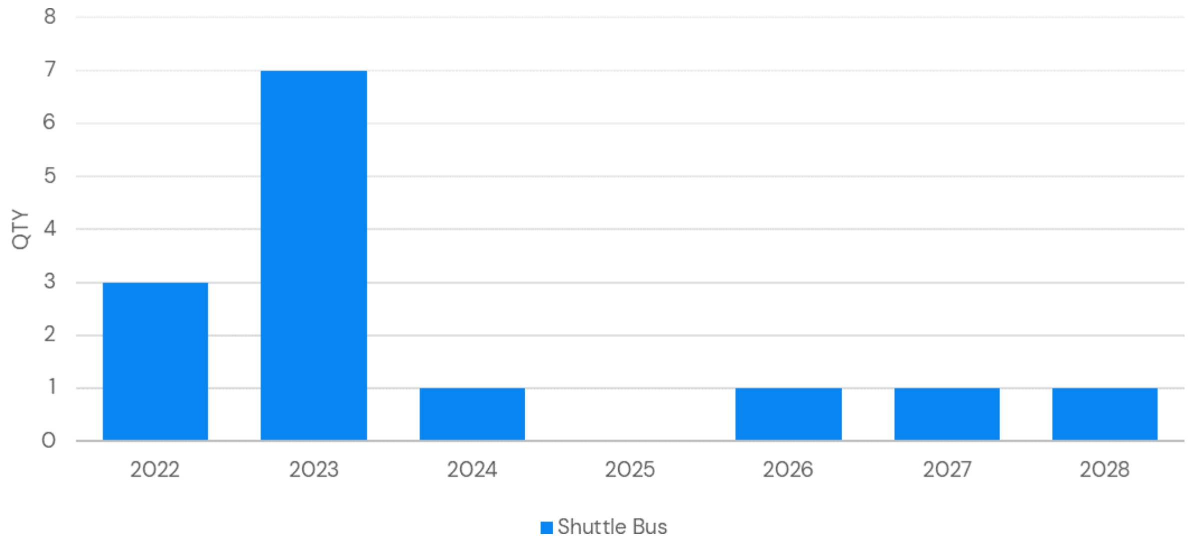


Chart D: Existing Fleet - Retirement Schedule



Key Assumptions

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

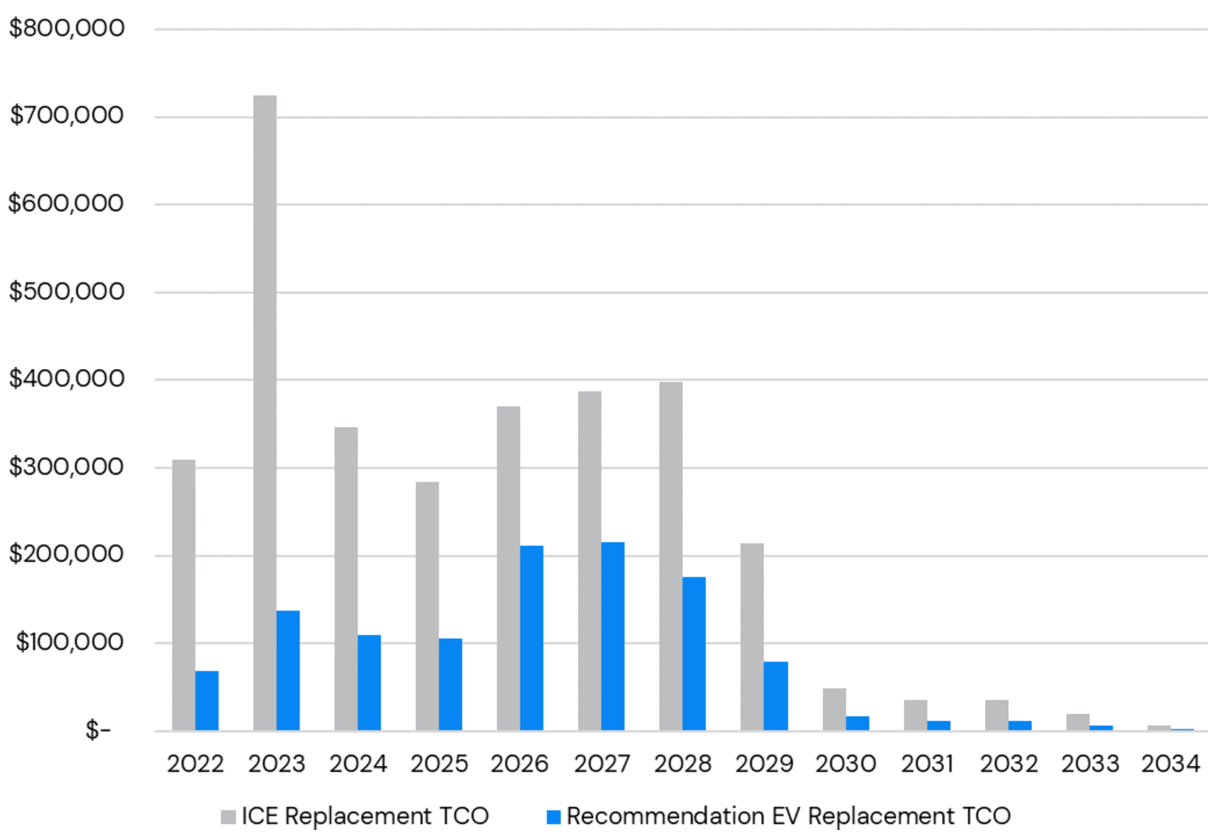
- **Recommendation Threshold**: EVs are recommended only when the EV TCO is less than the TCO of the comparable internal combustion engine (ICE) vehicle.
- **Vehicle Pricing**: The model uses manufacturer suggested retail prices (MSRPs) for EVs where available. When MSRP pricing is unavailable, the model 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 CaleETC report for the California Electric Transportation Coalition.
- **Fuel**: The model uses the U.S. EIA's average gasoline and diesel prices in Michigan for the past five years, which is $2.86 per gallon of diesel and $2.53 per gallon of gasoline. The model determines the average annual fuel use for each vehicle based on its average annual mileage and average fuel economy (miles per gallon), and then multiplies the fuel use value by the price per gallon of fuel. ICF uses annual mileage and fuel efficiency assumptions by vehicle and fuel type from the AFLEET Tool and ICF's *CalETC report*.
- **Maintenance**: ICF uses dollar per mile maintenance cost assumptions by vehicle type and fuel type from Argonne National Laboratory's AFLEET Tool and ICF's *CalETC Report*. Maintenance costs were escalated 2.2% annually.
- **Electricity Pricing**: The model uses Consumers Energy's General Service Secondary Time of Use Rates (which is an average of $0.12/kWh) for electricity pricing, escalated annually using projections from the U.S. EIA's 2022 AEO Reference Case for Transportation: Electricity. See the Rate Analysis Section for a comparison of other electric rate options.
- **Vehicle Replacements**: CUSTOMERNAME retirement schedule identified the vehicles for replacement each year, with the minimum being 2022.

- **Timeframe**: This analysis focuses on vehicle replacements for 2022 through 2028, with TCO calculations extending out across the vehicle lifespans to 2034.
- **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 17 to 82°F to assess the potential impact temperatures can have on EV ranges; this reduced EV model ranges to 80% of their maximum mileage range.
- **Electric Vehicle Supply Equipment (EVSE) Pricing and Incentives**: The EVSE pricing assumptions and incentive program amounts applied in the analysis are detailed further in the Incentives and Funding Source Assumptions Applied section below.

Electric Vehicle Acquisition Recommendations

There are 14 CUSTOMER vehicles scheduled for retirement between 2022 and 2028, and all of them will be cost effective to convert to battery electric vehicles (BEVs) or plug-in hybrid electric vehicles (PHEVs). Chart E below shows the TCO for the 14 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 Chart D above. Based on these estimates, you may see immediate financial payback in 2022. Annual EV costs and the overall cumulative EV TCO are lower than ICE vehicles due to incentives and reduced operational costs, as shown in Chart F.

CHART E. Fleet Recommended Replacements TCO Comparison – Annual[1]



[1] The annual costs for the 1 vehicle with a lifespan extending to 2034 is too low to appear clearly in Chart E. The annual cost of an ICE replacement in 2034 is $5,897 and the annual cost of the recommended EV replacement in 2034 is $1,716.

Chart F: Fleet Recommended Replacements TCO Comparison – Cumulative

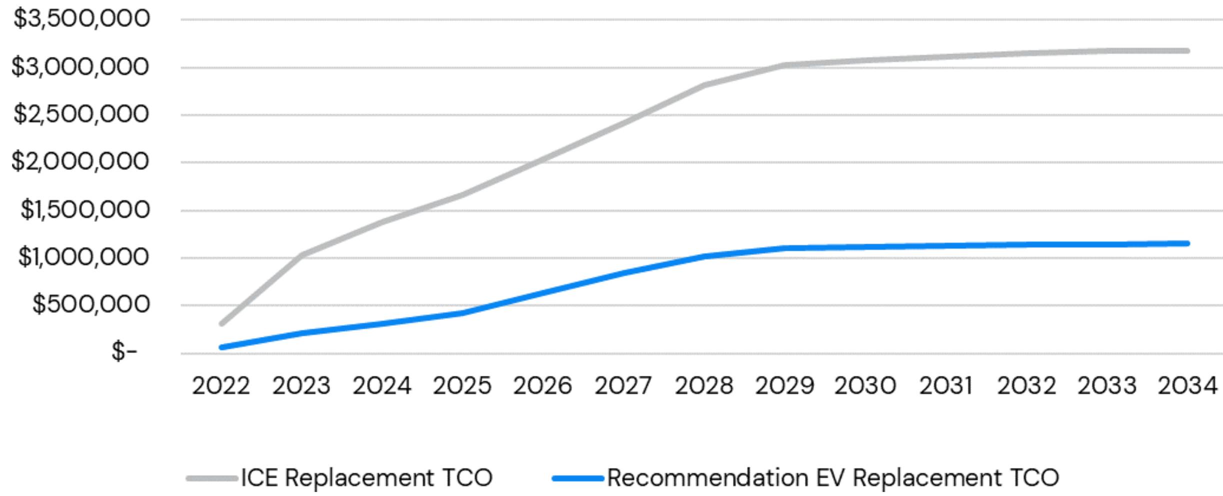


Table B on the next page identifies the vehicles that will be cost effective to convert to electric within the next 7 years. Chart G illustrates the recommended replacement timeline for these vehicles. Each vehicle within your fleet has been assessed to identify the lowest cost option, while also accounting for potential mileage and charging time restrictions. Please note that only 7 electric shuttle buses are considered Buy America compliant and only 1 of the 7 shuttle buses is available through the Michigan MiDEAL State Contract. These models are detailed in Table E in the Model Comparison section.

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:

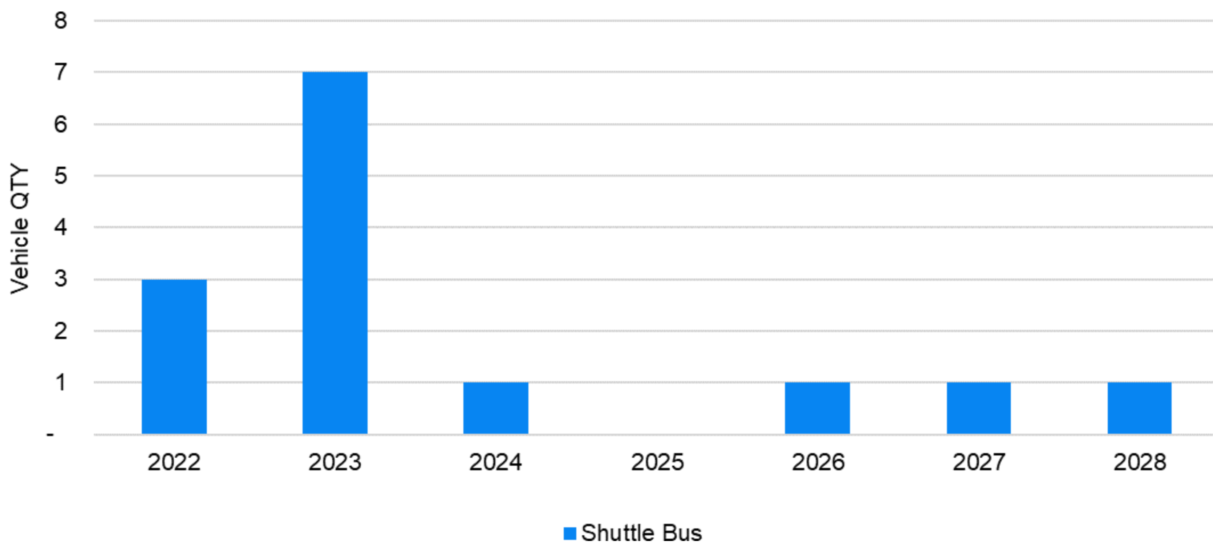
- Capital costs
- Charging infrastructure hardware costs
- Charging infrastructure installation costs
- Annual fuel costs
- Annual maintenance costs
- Potential EV or EVSE incentives or grants

Table B: 7-Year Electrification Recommendations

Vehicle Type	Quantity Up for Retirement (in 7 Years)	Quantity Recommended to Convert to Electric	Recommended Make/ Model/ EV Type	Financial Savings (across 7 years)	GHG Emission Reductions (across 7 years, MT)	EVSE	
						L2	DCFC
Shuttle Bus	14	3	SEA Electric / SEA Ford F-650 EV/BEV	$659,364	701	0	3
		11	Ford / E-Transit Van(Cutaway)[2]	$1,001,593	1,216	2	9
TOTAL	**14**	**14**		**$1,660,956**	**1,916**	**2**	**12**

Note that SEA Electric currently only sells upfits for vehicles. CUSTOMER must acquire both the base vehicle and the upfit. We recommend speaking with SEA Electric prior to procuring the base vehicle. SEA Electric can provide guidance to ensure that CUSTOMER procures the base vehicle with the correct specifications for SEA Electric's electric drive system.

Chart G: Recommended EV Replacement Timeline: Vehicle Types



[2] The Ford E-Transit Cutaway is available through Michigan's MiDEAL state contract for a starting MSRP of $39,385.

EV Charging Infrastructure Assumptions Applied

About EV Charging Infrastructure

EVs require access to chargers, also known as Electric Vehicle Supply Equipment (EVSE). In a fleet application, the majority of charging is typically done at the fleet facility – overnight or between shifts. Facility-based charging can be supplemented with periodic charging at workplaces, idle locations, and public destinations as needed.

There are three types of EV chargers: Level 1, Level 2, and Direct Current (DC) Fast.

> **Level 1** chargers provide charging through a 120-volt (V) AC plug. A Level 1 charger plugs directly into a household outlet on one end, and into the vehicle's SAE J1772 charge port on the other end. Level 1 chargers are the slowest category of EVSE and provide 2 to 5 miles of range per hour of charging.
>
> **Level 2** chargers provide charging through 240 V or 208 V electrical service. Level 2 charging equipment is common for home, public, and workplace charging. The large majority of public chargers in the United States are Level 2. Level 2 chargers can operate at up to 80 Amperes (Amps) and 19.2 kilowatts (kW), and provide faster charging than Level 1 EVSE. Typically, a Level 2 charger provides 10 to 20 miles of range per hour of charging.
>
> **DC Fast** chargers enable rapid charging through 208/480 V three-phase input. Installing DC Fast chargers may require infrastructure upgrades and these high-powered chargers cost significantly more than a Level 2 charger. DC Fast chargers will typically add 75-150 miles of range for every 30 minutes spent charging. The range of miles added depends on various factors, such the vehicle type and the DC Fast charger capacity. For example, the Chevrolet Bolt can add about 85 miles per 30 minutes charging and the Nissan LEAF PLUS can add about 150 miles per 30 minutes charging. A transit bus or heavy truck will be able to add 60-125 miles for every 30 minutes spent charging, depending on the capacity of the DC Fast charger.

Vehicle-to-Grid (V2G) Charging

Vehicle-to-grid (V2G) charging is the bi-directional flow of energy and data between an EV and the grid. V2G strengthens resilience by enabling EVs to be used as energy storage assets that provide on-demand back-up power to a building or to the grid. V2G can also help users optimize energy consumption by charging only when energy rates are low and exporting stored power back to the grid only when energy rates are high. A bidirectional charger is required for V2G capability. It relies on the presence of an AC current in the vehicle's battery to reverse the direction of charge. Only CHAdeMO charger adapters currently support bi-directional charging, but V2G-capable CCS charger adapters are in development now and expected to be available to consumers by 2025. Most V2G projects are still in pilot stages, such as the school bus pilot in Beverly, MA.

V2X refers to the applications that EVs batteries can support for purposes other than powering the car. It is a collective term for referring to capabilities such as V2G, vehicle-to-home, and vehicle-to-vehicle. As an example of vehicle-to-vehicle capabilities, the Hyundai Ioniq 5 EV can charge other EVs using its battery. If you are interested in learning more about V2G and V2X, refer to a recent report from the U.S. Department of Transportation Federal Highway Administration and reach out to your Account Manager to discuss opportunities for your fleet.

EV Charging Infrastructure Assumptions in Your Analysis

CUSTOMER will need a maximum of 12 DCFC and 2 Level 2 chargers to support the recommended 14 EVs. This conservatively assumes a one-to-one charger-to-vehicle ratio and does not account for any existing chargers at CUSTOMER’s fleet facilities. Depending on the scheduled duty cycles of the vehicles, it may be possible to reduce the number of chargers. The determination of charger type (Level 2 versus DC Fast) is made based on battery size, range, mileage, number of shifts per day, and time charge between shifts and at night.

It may be possible to reduce the number of chargers, including the number of DC Fast chargers, by:

- Manipulating the duty cycles of the vehicles to allow for successive (non-overlapping) charging schedules;
- Identifying managed charging solutions to optimize charger use; and
- Garaging EVs together to allow for shared chargers.
- Leveraging publicly available EVSE, where appropriate

The charger equipment and installation cost assumptions used for your analysis are summarized in Table C below:

Table C: EVSE Equipment and Installation Cost Assumptions

Vehicle Type	L2 Charger Cost Assumptions		DC Fast Charger Cost Assumptions	
	Equipment Cost	Installation Cost	Equipment Cost	Installation Cost
Shuttle Bus	$5,000	$20,000	$29,000	$37,500

Note that these are estimates and do not consider any incentives (see below for more information). We strongly encourage CUSTOMER to reach out to Consumers Energy before installing any new charging infrastructure. Your ICF Account Manager can also answer questions on charging best practices.

Site Assessment

CUSTOMER will need a maximum of 12 DCFC and 2 Level 2 chargers to support the recommended 14 EVs. This conservatively assumes a one-to-one charger-to-vehicle ratio and does not account for any existing chargers at CUSTOMER's fleet facilities. This will result in an estimated incremental 512 kW total power demand and 398,664 annual kWh at CUSTOMER's sites. Depending on the scheduled duty cycles of the vehicles, it may be possible to reduce the number of chargers.

Table D: Site Load Impact Study

Charging Site	L2 (QTY)	DCFC (QTY)	Estimated Total Power Demand (kW)	Annual kWH
Site 1	2	12	512	398,664
TOTAL	**2**	**12**	512	398,664

Electric Rate Analysis

The ICE and EV TCO comparison used Consumers Energy's General Service Secondary Time of Use rate to calculate incremental electricity bills. The electric rate analysis identified this rate as the most cost-effective rate option to support the recommended 14 EVs at CUSTOMER's site. The rate analysis also compared this rate against Consumers Energy's General Service Secondary rate. Chart H summarizes the fleet annual fuel costs across each rate, and Chart I summarizes the cumulative fuel costs across each scenario over time.

Chart H: Rate Analysis Fleet Annual Fuel Cost Comparison

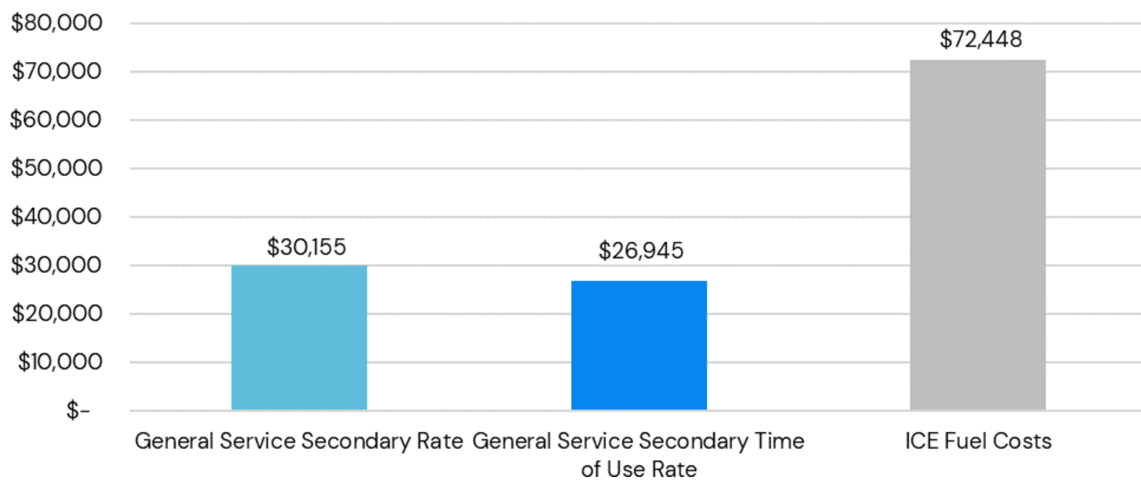
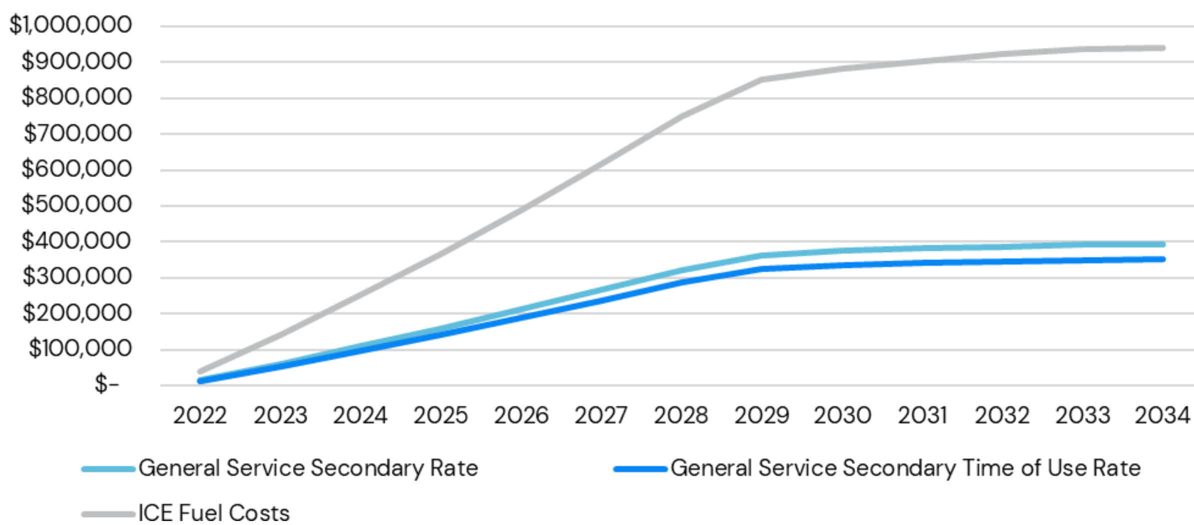


Chart I: Rate Analysis Fleet Cumulative Fuel Cost Comparison



Incentives and Funding Source Assumptions Applied

Incentives are available for the purchase of EVs and EVSE. Table D summarizes the incentives included in your fleet analysis, as well as additional information about how to capitalize on these incentives. Incentives in the analysis are capped at 100% of the vehicle capital and EVSE costs, so the table identifies how the incentives were prioritized and specifically applied through the TCO analysis.

CUSTOMER may also want to reach out to their local planning agency to discuss Congestion Mitigation and Air Quality Improvement (CMAQ) and other funding opportunities. The local transportation planning agencies may be able to assist cities and transit agencies with grants that reduce emissions

Table E: Incentive and Funding Sources

Program	Light Duty	Medium Duty	Heavy Duty	Administrator	Vehicle Costs	EVSE	EVSE Hardware	Program Offerings	Upcoming Deadlines	TCO Funding Assumptions
Medium- and Heavy-Duty Grant Program		✓	✓	Michigan Department of Environment, Great Lakes, and Energy	✓		✓	Up to 50% of incremental capital costs, must replace a pre-2009 diesel vehicle with 3,000+ annual miles	Round 3: October 19, 2021 to December 17, 2021	50% capital costs with 3000+ annual miles and model pre-2009.
PowerMIFleet Program: Commercial Electric Supply Equipment (EVSE) Rebates	✓	✓	✓	Consumers Energy			✓	Up to $5,000 per Level 2 Charge Port (limit 10 per site); Up to $35,000 per non-public DC Fast Charger; Up to $70,000 per public use DC Fast Charger	3-year voluntary pilot	$5,000 for L2 chargers, $35,000 per DCFCs installed before 2025
PowerMIFleet Program: Make Ready Upgrades	✓	✓	✓	Consumers Energy		✓		Funding of "reasonable costs" for the construction of infrastructure to power charging stations purchased through the PowerMIFleet Program	3-year voluntary pilot	EVSE installation costs for vehicles replaced before 2025
Diesel Emission Reduction Act (National)		✓	✓	EPA	✓			Up to 45% of EV and EVSE costs, must replace a diesel vehicle with 7,000+ annual miles	TBD[3]	45% of capital costs with 7,000+ annual miles
Low or No Emission Vehicle Program			✓	FTA	✓	✓	✓	85% funding for purchase or lease of zero-emission and low-emission transit buses & acquisition of required supporting facilities. [4]	FY2022 deadline: 5/31/2022 Funded until: 9/30/25	85% of capital costs and installation costs

[3] Most recent deadline was 3/16/2021, but the Consolidated Appropriations Act passed on 12/22/2020 included reauthorization of the DERA Program through 2024.

[4] Applicants may be eligible for grants up to 90% of project costs for fleet and charging facilities. Due to the competitive nature of the funding, this assessment applies a conservative 85% funding match. Applications require the submission of a Zero-Emission Transition plan. For projects focused on improving the age and condition of a fixed-route fleet, consider

the Grants for Buses and Bus Facilities program.

EV Model Comparison

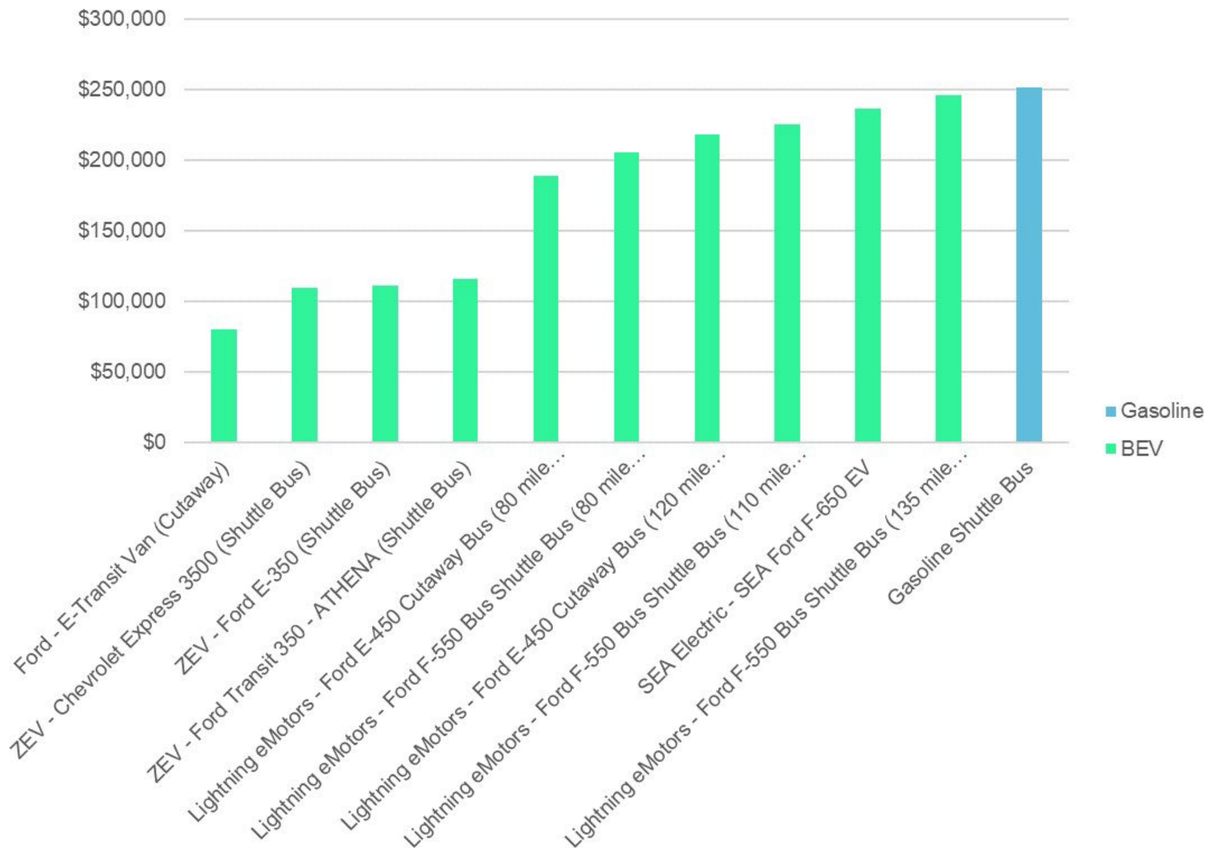
There are over 500 EV models in our EV library that were assessed across your fleet's vehicle types and range requirements to compare TCOs and recommend replacement models. While our EV acquisition recommendations are based on the model with the lowest TCO available that fits your fleet's needs, there may be additional EV models within the same price range. Chart J highlights the lowest TCO shuttle buses. This analysis is uses CUSTOMER's average annual mileage (25,969) and miles driven per day (85), and assumes a 7 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.

Table F: Buy America Compliant Electric Shuttle Bus Models

Vehicle Type	Make	Model	Range (miles)[5]
Shuttle Bus	Ford	E-Transit (Cutaway)[6]	126
Shuttle Bus	GreenPower	AV Star	150
Shuttle Bus	GreenPower	EV Star	150
Shuttle Bus	GreenPower	EV Star+	150
Shuttle Bus	Lightning eMotors	Ford E-450 Cutaway Bus	80/120
Shuttle Bus	Lightning eMotors	Ford F-550 Shuttle Bus	80/110/135
Shuttle Bus	Phoenix	ZEUS 400	70/100/130/160
Van (Passenger)	Lightning eMotors	Ford Transit 350HD	60/120

[5] Multiple electric range estimates are shown for vehicles with more than 1 battery size option.
[6] Buy America certification applies to Hoekstra Transportation upfit per documentation provided by Steve Bolin, Commercial Products Manager for Hoekstra Transportation.

Chart J: Shuttle Bus EV Model TCO Comparison



Sample Shuttle Bus Financial Analysis

Table F provides a sample TCO comparison for a single, purchased shuttle bus. This analysis uses a 7-year vehicle life and 25,696 annual miles assumption, based on the average annual mileage for shuttle buses within your fleet.

Table G: Shuttle Bus TCO Comparison

	Gasoline	**BEV** (Ford – E-Transit Cutaway)
Capital Cost	$65,000	$43,295
Charging Infrastructure Hardware (DCFC)	N/A	$29,000
Charging Infrastructure Installation	N/A	$37,500
Incentives[7]	N/A	($109,795)
Annual Fuel/Energy Costs	$9,187	$400
Annual Maintenance Costs	$6,681	$4,882
13-Year Total Costs[8]	$153,722	$30,563

[7] Assumes FTA Low-No Emission Vehicle Program, Consumers Energy PowerMIFleet EVSE Program, and Make-Ready Program incentives. EV capital and infrastructure costs shown in table does not have incentives applied.
[8] NPV assumes a 5% discount rate.

Charts K and L provide a visual representation of the annual and cumulative cost comparisons across a gasoline and BEV shuttle bus. Incentives and lower operational costs result in lower annual and overall TCO costs for the BEV option.

Chart K: Shuttle Bus 7-Year Annual Cost Comparison

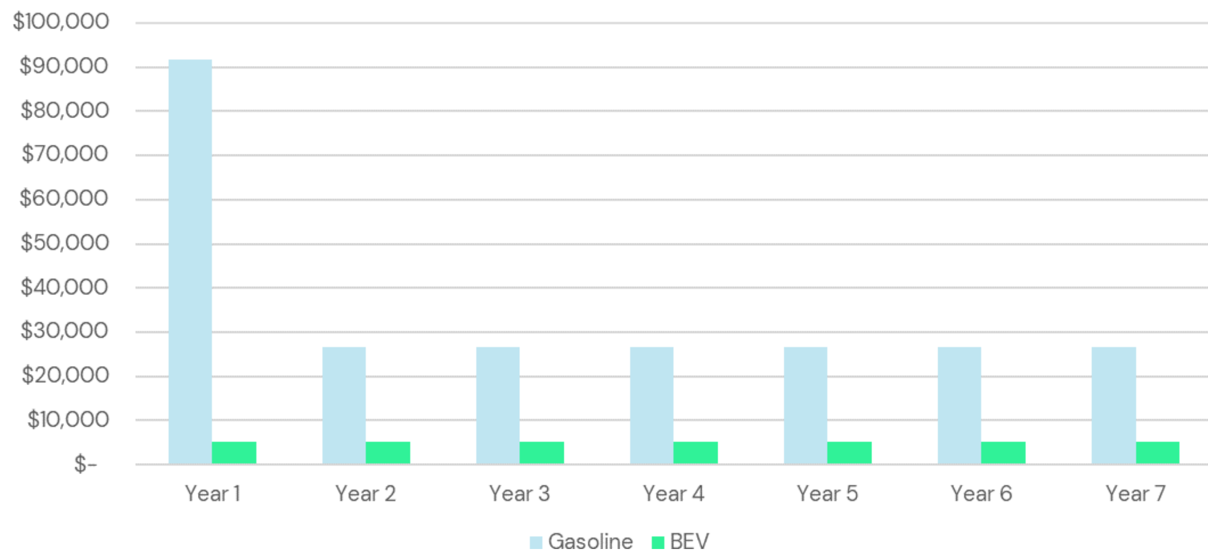
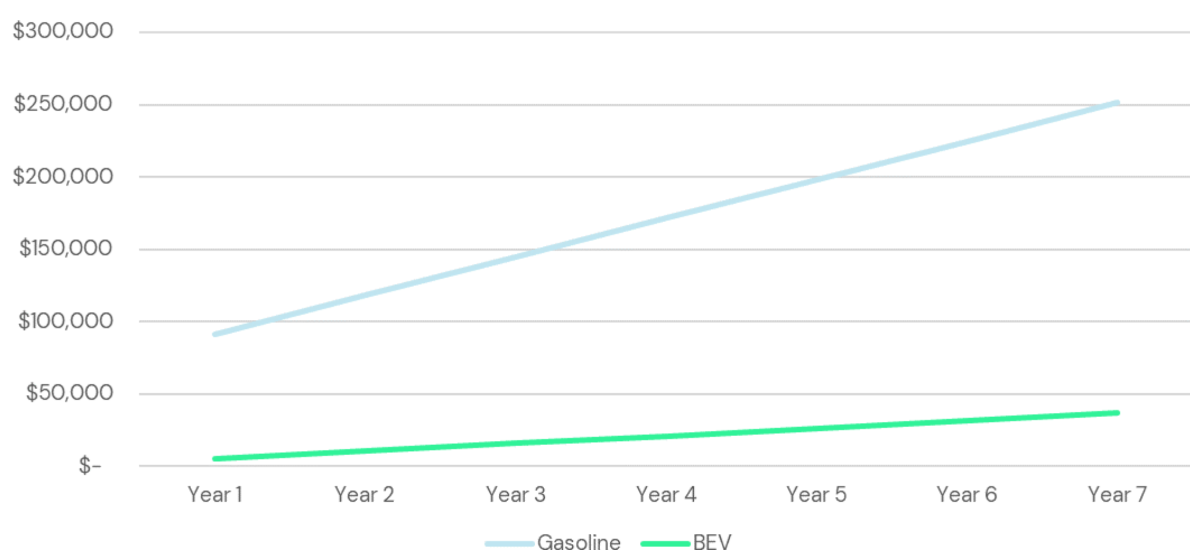


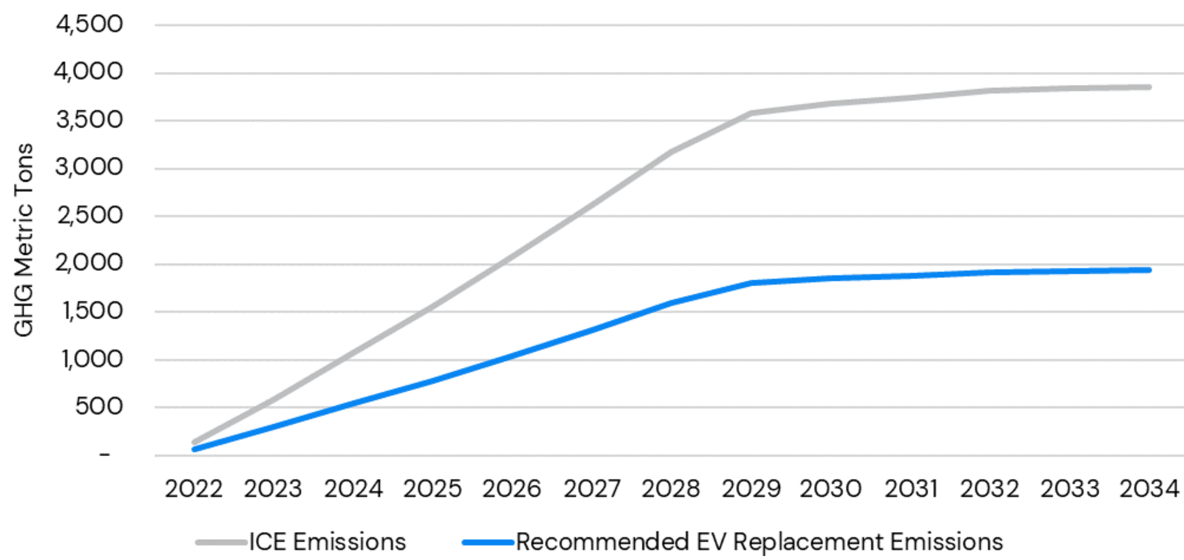
Chart L: Shuttle Bus 7-Year Cumulative Cost Comparison



Fleet Environmental Impact Analysis

By converting the 14 recommended vehicles to EVs, you could reduce GHG emissions by 1,916 MT and NOx emissions by 14,708 pounds (lbs) over 13 years. Chart M below illustrates the cumulative GHG emissions for ICE replacements compared to EV replacements. The GHG emissions included in this analysis account for both tailpipe and source (fuel production) emissions, while the NOx emissions account for only tailpipe emission reductions.

Chart M: Cumulative Fleet Green House Gas Emissions



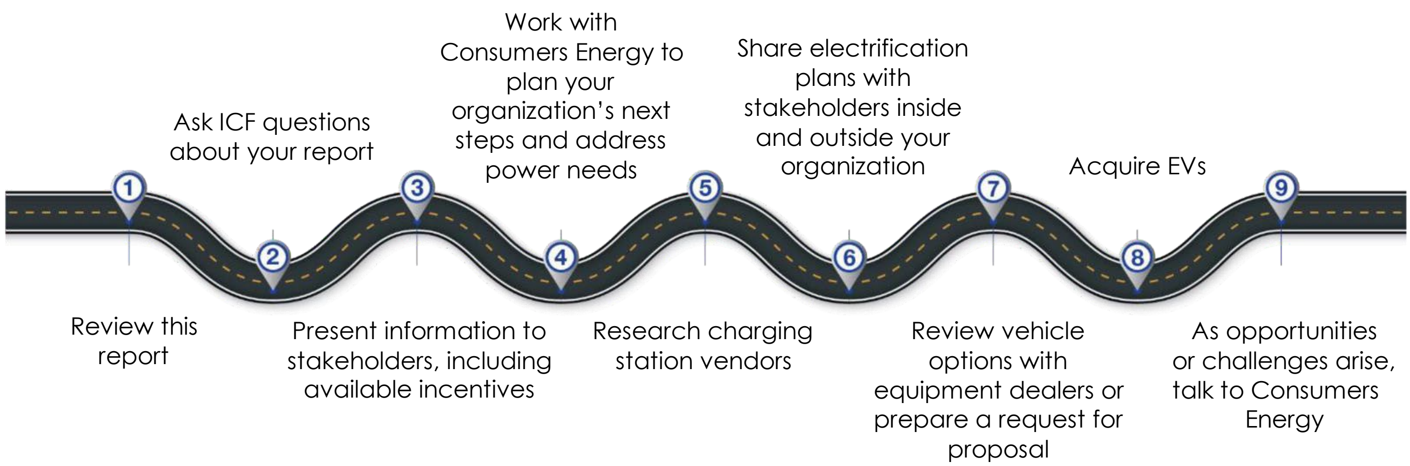
1,916 GHG Emission Reductions (MT over 13 years)

414 Equivalent to removing passenger vehicles from the road for one year

14,708 NOx Emission Reductions (Lbs. over 13 years)

31,620 Equivalent to tree seedlings grown for 10 years

Next Steps: Your Roadmap to Fleet Electrification



We're here to help.

Contact us for help with your report, support navigating next steps, or just to speak with an expert.

WEB: PowerMIFleet™ | Consumers Energy

EMAIL: PowerMIFleet@cmsenergy.com

Frequently Asked Questions

Will additional training be needed for our drivers or maintenance staff?

Driving an EV is very similar to an ICE, but there are a few differences that your team may need help with, such as charging the vehicle and how to shift it into "drive." The level of training needed may vary depending on the vehicle type.

What is the impact of cold weather on electric vehicle (EV) operation?

This assessment accounts for potential regional temperature impacts on range prior to identifying recommended vehicle replacements. Extreme outside temperatures do reduce range, because more energy must be used to heat or cool the cabin. In Michigan, this can equate to small range reductions in the fall and spring, and up to 30-50% in the winter. The higher end of that spectrum would be during extreme cold.

How long do EVs last?

A manufacturer's warranty of a light-duty EV typically covers 8 years or 100,000 miles, and the expected battery lifetime is 10 to 12 years. Batteries in newer EV models should be capable of longer miles and lifetimes. On average, EV battery degradation is about 2% per year. An EV reaches the end of its useful life when the battery has less than 80% of its initial capacity remaining.

What electrical infrastructure upgrades will be needed to install chargers for my fleet? What are the associated costs?

While the specifics around electrical upgrades are not the focus of this analysis, Consumers Energy can help connect you with vetted charging station installers to better understand the costs of upgrades. We will also estimate the cost of charging infrastructure in the TCO calculation in this report.

If my fleet doesn't have the budget to purchase vehicles right now, how should we proceed?

This report provides 7-year recommendations for EV purchases. It also identifies applicable incentives and funding that may help cover some of the costs. Future EV models, pricing reductions, and grant programs may open up additional opportunities for electrification.