nationalgrid

Town of Millbury

Fleet Electrification Assessment
12.30.2021

Fleet advisory services provided by ICF

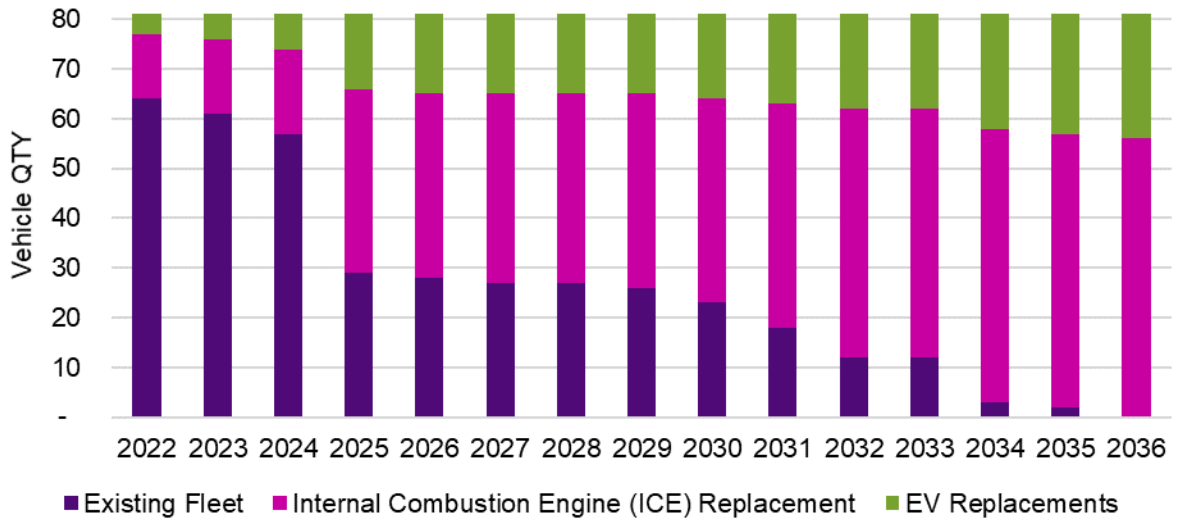
Table of Contents

Executive Summary

National Grid's Massachusetts (MA) Fleet Advisory Services Program provides fleet electrification recommendations and objective guidance from our team of electric vehicle (EV) experts. We are here to help you, the Town of Millbury (Millbury), 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 2036, which accounts for a maximum vehicle life of 15 years. However, the fleet total cost of ownership (TCO) analysis extends to 2050 to account for the ongoing fuel and maintenance costs from the vehicles acquired in 2036. We assessed the economic feasibility of 113 vehicles in Millbury's fleet and identified 67 on-road vehicles[1] that have EV options available and 25 that would be beneficial to convert over the next 15 years. Chart A illustrates the phasing in of these EVs as you replace your existing fleet vehicles. These 25 vehicles would result in a net present value (NPV) TCO savings of $729,268 over the next 29 years, which accounts for the savings across the vehicles' full lifespans.

Chart A. Recommended EV Replacement Timeline: Fuel Types



The report also details the analysis assumptions, specific vehicle recommendations, financial and environmental impacts, and next steps. Your MA Fleet Advisory Services Program Account Manager (Account Manager) will continue to check in with you and provide one-on-one support for the length of the program as you navigate fleet electrification. Please review this report and reach out to your Account Manager at FleetAdvisoryMA@icf.com or 617-218-2100 with any questions or to discuss next steps.

[1] There are 32 non-road vehicles included in the total vehicle counts that 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.

Add EVs to your fleet. Cut costs. Here's how.

Based on our analysis, converting 25 on-road vehicles to EVs is estimated to produce the following impacts:

729,268
TCO savings over **29** years*

$111,687
fuel cost savings over **29** years*

$701,831
maintenance savings over **29** years*

1,102
metric tons (MT) of CO_2 eliminated over **29** years

Over 29 years, those estimated CO_2 reductions equate to:

eliminating **127** homes' energy use for one year, or:

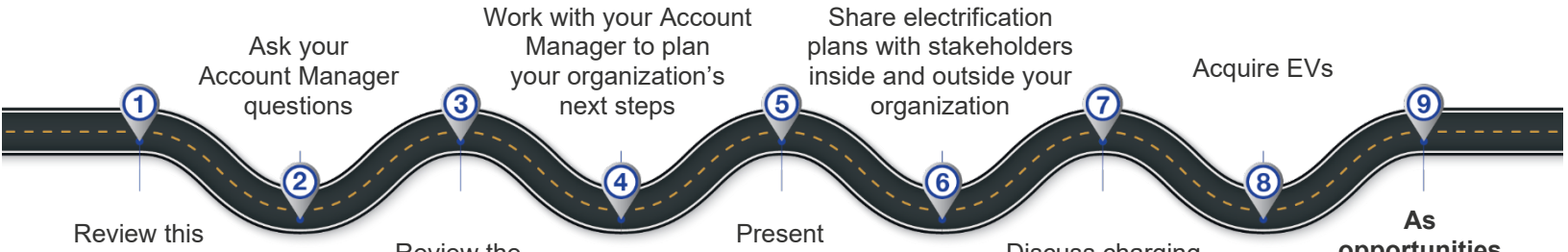
switching **41,885** incandescent lamps to LEDs, or:

recycling **375** tons of waste instead of landfilling it, or:

planting **18,187** trees.

* NPV assumes a 5% discount rate.

Your Roadmap to Fleet Electrification



1. Review this report
2. Ask your Account Manager questions
3. Review the MA Fleet Advisory Services Program portal at www.FleetAdvisoryMA.NationalGrid.com for resources on incentives, grants, training, news, updates, and more
4. Work with your Account Manager to plan your organization's next steps
5. Present information to stakeholders, including available incentives and the National Grid Infrastructure Program
6. Share electrification plans with stakeholders inside and outside your organization
7. Discuss charging infrastructure with National Grid
8. Acquire EVs
9. **As opportunities or challenges arise, talk to your Account Manager**

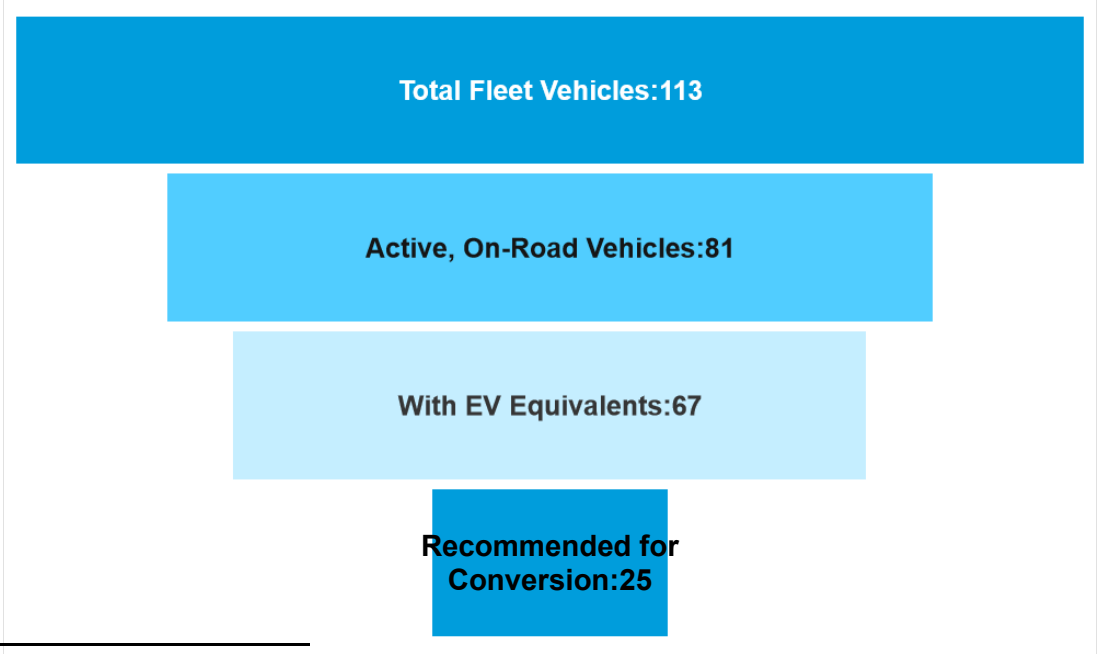
Project Information

On August 5, 2021, Conor McCormack, Assistant Planner, met with the Account Manager, Meggie Devlin, and other program staff for an initial intake call. The discussion covered topics including an overview of the MA Fleet Advisory Services Program, fleet data availability, fleet usage characteristics, and the fleet's motivation for exploring EV options. A key takeaway of the intake call was Millbury's negative experience with early Nissan Leaf BEV models (2016-2017) due to their limited range. Millbury also requested that vehicle recommendations be limited to only the makes and models available for purchase off Massachusetts state contracts.[2] The extended hours of service for Department of Public Works and Police Department vehicles were identified as a possible barrier to electrification, while costs associated with the purchase of electric school buses were identified as the primary barrier for the School Department.

Millbury provided an initial fleet dataset on July 20, 2021. The Account Manager provided follow up questions on August 5, 2021, and Millbury responded with additional data between August 13, 2021 and August 20, 2021. Millbury's fleet dataset was used to establish a fleet baseline in the model.

There are 113 vehicles in Millbury's current fleet, 81 on-road vehicles and 32 pieces of non-road equipment. Only 67 of the on-road vehicles have EV equivalents available, 25 of which would be cost beneficial to convert to EVs at this time. This breakdown is illustrated in Chart B. 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.

Chart B. Fleet Assessment Vehicle Breakdown



[2] Appendix A provides EV recommendations for the fleet should Millbury be open to exploring procurement options outside of state contracts. The Excel supplement also includes vehicle recommendation details for both scenarios.

Existing Fleet Makeup

There are 81 on-road vehicles in Millbury's current fleet, most of which are gasoline- and diesel-powered as shown in Table A. Approximately one-third of the fleet is made up of light-duty vehicles which is illustrated in Chart C below. Police patrol vehicles are assessed separately due to their significantly different duty cycles and applications. The estimated retirement schedule for the existing fleet is represented in Chart D. This schedule informs the recommended EV replacement schedule, which is shown later in Chart G. We understand that replacing 25 vehicles in 2022 would not be feasible, so the acquisitions are spread out and only 4 vehicles are recommended for replacement in 2022.

TABLE A. Existing Fleet Fuel Type Distribution

Vehicle Type	Gasoline	Diesel	BEV
Sedan	7	-	4
Sport Utility Vehicle (SUV)	14	-	-
Light-Duty Pickup	3	-	-
Medium-Duty Pickup	6	11	-
Van	3	-	-
Medium-Duty Vocational Truck	1	1	-
Street Sweeper	-	1	-
School Bus	2	-	-
Heavy Truck	-	14	-
Other	3	11	-
TOTAL	**39**	**38**	**4**

Chart C. Existing Fleet - Vehicle Types

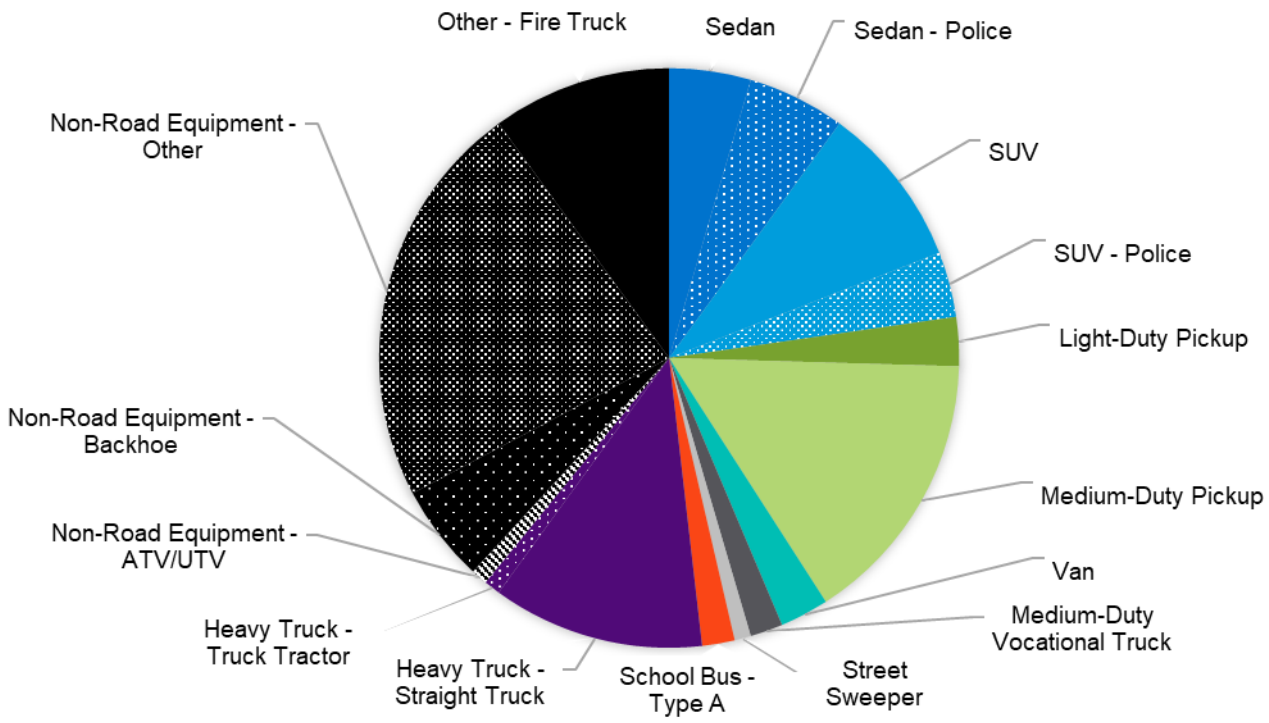
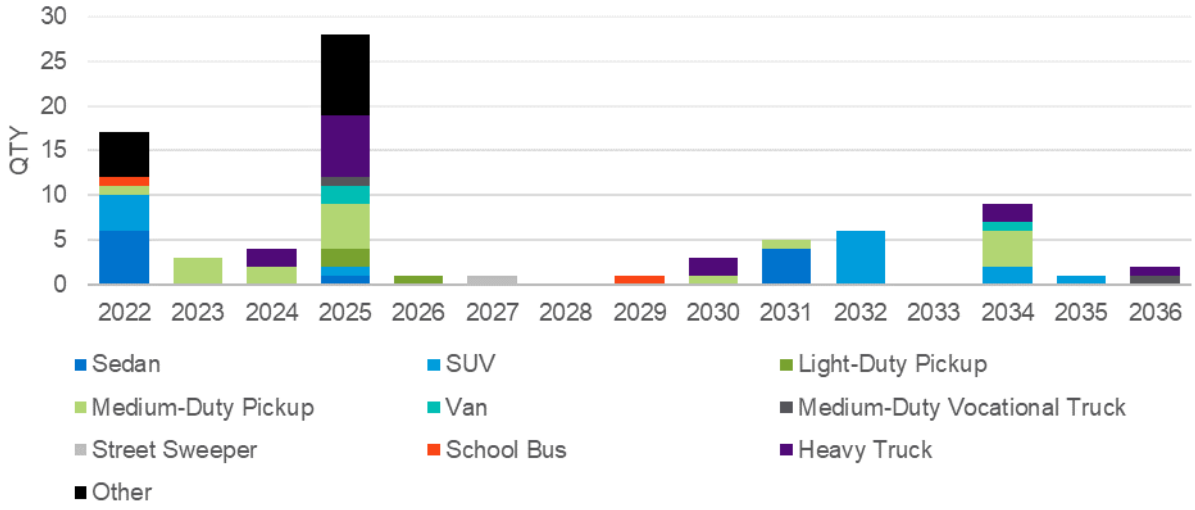


Chart D. Existing Fleet – Retirement Schedule



There are 50 vehicles, summarized in Table B below, that were excluded from this analysis and the Electric Vehicle Acquisition Recommendations section of this report for one of four reasons:

- 11 vehicles were excluded because they do not currently have any plug-in hybrid electric vehicle (PHEV) or battery electric vehicle (BEV) options available
- 3 vehicles were excluded from the analysis as they are inactive.
- 4 sedans were excluded from the analysis as they are already BEVs.
- 32 vehicles are non-road equipment that are assessed separately in the report

Follow-up report refreshes will be available as additional EV models become available.

TABLE B. Vehicle Types Excluded from Analysis

Vehicle Type	Quantity	Reason for Exclusion
Fire Trucks	11	No EV models commercially available
Sedans	1	Inactive vehicles
SUV	1	
Medium-Duty Pickup	1	
Sedans	4	BEVs (already converted to electric)
Non-Road Equipment	32	Non-Road Equipment assessed separately in report
TOTAL	**50**	

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.
- **State Contract Requirement:** The EV recommendations are restricted to just those vehicles available through state contracts. See Appendix A for the results from an additional scenario where all commercially available EV models are considered, regardless of their inclusion or exclusion on state contracts.
- **Vehicle Pricing:** The model uses the current vehicle prices available through the state contracts. The model uses the current "owned" classification for each vehicle for future replacements.
- **Fuel:** The existing fleet fuel costs were estimated using the vehicles' annual mileage, AFLEET fuel economy assumptions by vehicle and fuel type, and base fuel prices per gallon. The model uses $2.82 per gallon of diesel and $2.46 per gallon of gasoline, based on the U.S. EIA's New England average pricing for the past 5 years. The model escalates gasoline and diesel prices annually using projections from the U.S. EIA's 2020 AEO Reference Case for Transportation.
- **Maintenance:** Existing fleet maintenance costs were estimated using AFLEET dollar per mile assumptions by vehicle type and by fuel type. Maintenance costs were escalated 2% annually.
- **Electricity Pricing:** The model uses $0.17/kWh base rate, escalated annually using projections from the U.S. EIA's 2020 AEO Reference Case for Transportation: Electricity.
- **Vehicle Replacements:** Retirement years were provided for 9 vehicles in Millbury's fleet. For each vehicle without an existing retirement year, the model uses the vehicle model year and AFLEET vehicle life assumptions to estimate the replacement year, with the minimum being 2022. Per Millbury's request, any vehicles older than 15 years of age were scheduled for retirement in 2025 because there are no plans to replace these vehicles in the near future.
- **Timeframe:** This analysis focuses on vehicle replacements for 2022 through 2036, with TCO calculations extending out across the vehicle lifespans to 2050.
- **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 22 to 88°F to assess the potential impact temperatures can have on EV ranges; this reduced EV model ranges to 80% of their maximum mileage range. For the vehicles with annual mileage provided, average daily mileage was calculated by dividing annual mileage by 250 days per year. All other vehicles used AFLEET daily mileage assumptions based on vehicle type with a maximum of 50 miles per day.

- **Reclassified Vehicle Fuel Types:** The team reclassified 1 existing Ford Explorer in the fleet to "Gasoline" fuel type instead of "HEV" because the vehicle's primary fuel type is gasoline, and it is not a PHEV. Additionally, 1 existing Ford F-350 was reclassified as "Diesel" fuel type instead of "Gasoline."

- **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. These assumptions take into account Millbury's status as a specially-eligible Green Community, which may qualify you for increased incentive values.

Electric Vehicle Acquisition Recommendations

There are 81 Millbury vehicles scheduled for retirement between 2022 and 2036, and 25 of them will be cost effective to convert to BEVs or PHEVs. Chart E below shows the TCO for the 25 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 outline in Chart D above. Based on these estimates, you may see an immediate financial payback in 2022. While Chart E shows annual EV costs that are higher than ICE costs in 2023 and 2024, the overall TCO is lower as shown in Chart F.

Chart E. TCO Fleet Comparison - Annual

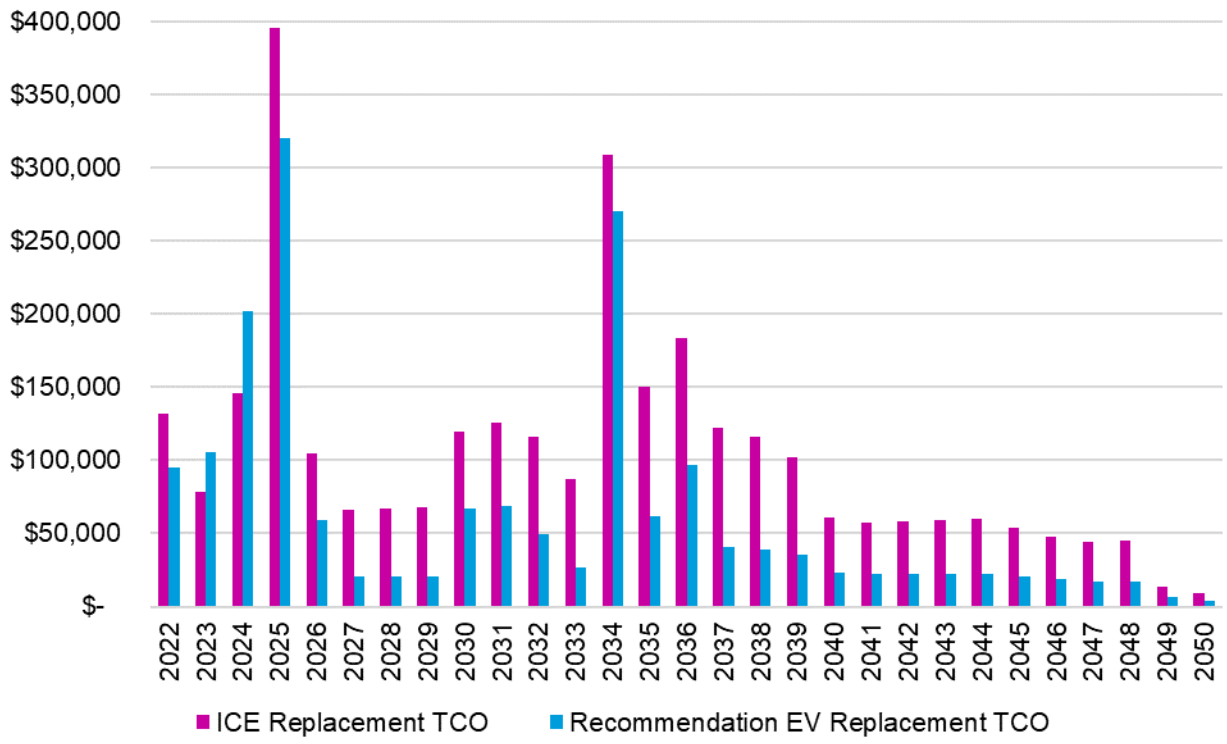


Chart F. TCO Fleet Comparison - Cumulative

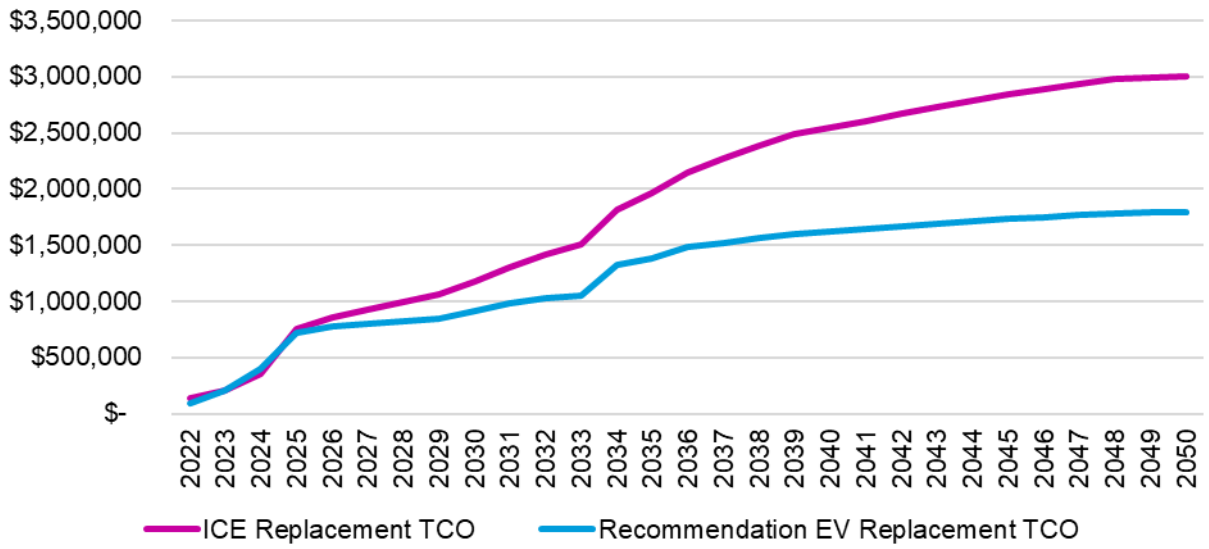


Table C on the next page identifies the vehicles that will be cost effective to convert to electric within the next 15 years. Chart G illustrates the recommended replacement timeline for these vehicles. Each vehicle within your fleet has been assessed to identify the lowest cost option, while also accounting for potential mileage and charging time restrictions.

The financial savings and greenhouse gas (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

There are 42 vehicles with EV equivalents that are not recommended for conversion, either due to already being an EV (e.g., the 4 existing BEVs), the currently available EV model mileage ranges being too low, or the TCO for the ICE vehicle being lower than any of the EV option's TCO. Additionally, the EV recommendations are restricted to just those vehicles available through state contracts. Future EV model

options or incentive program availability may open opportunities for these to be converted; this will also be considered in future report updates.

There are 11 fire trucks that were excluded from the analysis because electric emergency vehicles, such as fire trucks and ambulances, are currently in the development and testing phases. Pierce Manufacturing delivered its first plug-in hybrid electric fire truck to the Madison Fire Department in Madison, WI, for testing in June, and Rosenbauer is developing an extended range plug-in hybrid electric fire truck, which the Los Angeles Fire Department (LAFD) will receive later this year. Lightning eMotors and REV Group Inc. expect to deliver their first electric ambulance by the end of this year. These models will be included in future analyses if deemed suitable for Millbury's fleet.

TABLE C. 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 (across 29 years)	GHG Emission Reductions (across 29 years, MT)	Recommended EVSE	
						L2	DCFC
Sedans	11	3	Chevrolet/ Bolt EV LT Fast Charge (Police)/ BEV	$34,291	34	3	0
		1	Toyota/ Prius Prime LE/ PHEV[3]	$5,586	2	1	0
SUVs	14	3	Hyundai/ Kona Electric SEL/ BEV	$72,210	226	3	0
Light-Duty Pickups	3	3	XL Fleet/ Ford F-150 2WD/ PHEV[4]	$13,717	112	3	0
Medium-Duty Pickups	17	13	XL Fleet/ Ford F-350/ PHEV[5]	$553,333	529	9	4

[3] BEV option with the lowest TCO is a Nissan Leaf S. Additional low TCO PHEV and BEV options are further highlighted in the EV Model Comparison section.
[4] No BEV options are available on state contract (VEH98). Additional low TCO PHEV options are further highlighted in the EV Model Comparison section.
[5] No BEV options are available on state contract (VEH98). Additional low TCO PHEV options are further highlighted in the EV Model Comparison section.

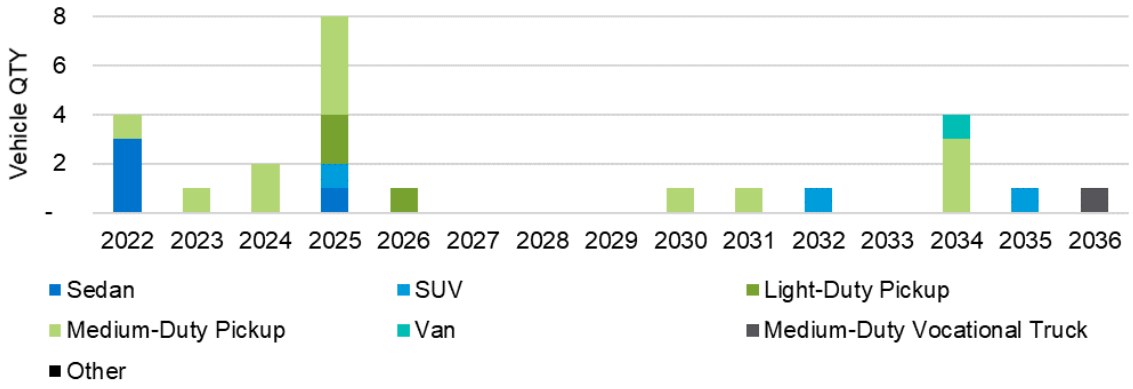
Vehicle Type	Quantity Up for Retirement (in 15 Years)	Quantity Recommended to Convert to Electric	Recommended Make/ Model/ EV Type	Financial Savings (across 29 years)	GHG Emission Reductions (across 29 years, MT)	Recommended EVSE	
						L2	DCFC
Vans	3	1	Lightning eMotors/ Ford Transit 350HD LEV120T/ BEV	$4,981	103	1	0
Medium-Duty Vocational Truck	2	1	Lightning eMotors/ Ford E-450 Cargo Truck LEV80E/ BEV	$45,150	97	1	0
Street Sweeper	1	0	-	-	-	-	-
School Buses	2	0	-	-	-	-	-
Heavy Truck	14	0	-	-	-	-	-
TOTAL	**67**	**25**		**$729,268**	**1,102**	**21**	**4**

Note that XL Fleet upfits are available on state contract (VEH102). Millbury must acquire both the base vehicle and the upfit. We recommend speaking with XL Fleet prior to procuring the base vehicle. XL Fleet can provide guidance to ensure that Millbury procures the base vehicle with the correct specifications for XL Fleet's plug-in hybrid electric drive system.

Note that Lightning eMotors' upfits are available on state contract (VEH102). Millbury must acquire both the base vehicle and the upfit. We recommend speaking with Lightning eMotors prior to procuring the base vehicle. Lightning eMotors can provide guidance to ensure that Millbury procures the base vehicle with the correct specifications for Lightning eMotors' electric drive system.

School buses are excluded from Millbury's electrification recommendations because the analysis determined they are not cost effective to purchase at this time. However, other acquisition models, such as leases or subscription services, offer cost-effective alternatives to traditional school bus ownership. For example, Highland Electric Fleets offers a mileage-based electric school bus subscription service that includes the necessary buses, charging infrastructure, and training for technicians and operators. Highland also plans to leverage their electric buses to support the grid through vehicle-to-grid (V2G) charging, earn supplemental income, and lower the price of their service. Millbury should consider leases and subscription services that could enable the town to avoid the high upfront costs of electric school buses while capturing significant emissions benefits.

Chart G. Recommended EV Replacement Timeline: Vehicle Types



EV Charging Infrastructure Assumptions Applied

About EV Charging Infrastructure

EVs require access to chargers, also known as EVSE. In a fleet application, most of the 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. Most 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 will be able to add 60-125 miles for every 30 minutes spent charging, depending on the capacity of the DC Fast charger.

EV Charging Infrastructure Assumptions in Your Analysis

Millbury will need a maximum of 4 DCFC and 21 Level 2 chargers to support the recommended 25 EVs. See Table C for more specifics on the chargers recommended for each vehicle type. This conservatively assumes a one-to-one charger-to-vehicle ratio and does not account for any existing chargers at Millbury'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. For any vehicles that Millbury identified as not having time to charge overnight or more than 2 hours between shifts, the model recommends a DC Fast charger. All DC Fast chargers recommended are for medium-duty EV applications (e.g., medium-duty pickup trucks).

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 as follows:

- Level 2:
    - Sedan: $3,450 equipment + $6,650 installation
    - Sedan - Police: $3,450 equipment + $6,650 installation
    - SUV: $3,450 equipment + $6,650 installation
    - Light-Duty Pickup: $3,450 equipment + $6,650 installation
    - Medium-Duty Pickup: $3,450 equipment + $6,650 installation
    - Van: $3,450 equipment + $6,650 installation
    - Medium-Duty Vocational Truck: $5,000 equipment + $20,000 installation
- DC Fast:
    - Medium-Duty Pickup: $24,000 equipment + $27,500 installation

Note that these are estimates and do not consider any incentives (see below for more information). For more detail on estimated hardware, permitting, and installation costs by charger type, see the Resources page of the MA Fleet Advisory Services Program portal

(*www.FleetAdvisoryMA.NationalGrid.com/Resources*). The Resources page of the portal also provides information on:

- Operational (including maintenance and warranty) costs;
- Code requirements, including federal, state, and municipal codes and standards;
- Siting considerations, including mounting, location, Americans with Disabilities Act requirements, signage, and pavement markings;
- Opportunities for maximizing your charging station investment (e.g., accessibility for public and workplace charging when not in use by the fleet);
- Networked stations, managed charging, and vehicle-to-grid opportunities;
- Other considerations (e.g., screen protection, collision protection, cord length, cord management);
- A checklist for charger installation; and
- Chargers available to fuel vehicles off-site or when traveling long distances.

We strongly encourage Millbury to reach out to National Grid before installing any new charging infrastructure. Your Account Manager can also answer questions on charging best practices.

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.

Millbury 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 D. Incentive and Funding Sources

Program	Light Duty EVs	Medium Duty EVs	Heavy Duty EVs	Administrator	Vehicle Costs	EVSE Installation	EVSE Hardware	Program Offerings	Upcoming Deadlines	TCO Funding Assumptions
EV Charging Station Program	✓	✓	✓	National Grid		✓	✓	Up to 50% of EVSE hardware and 100% of installation costs for BEV fleets[6]	12/21/2021 (Have until 2023 to install)	50% of EVSE hardware and 100% of installation costs for BEV vehicles EVSE installed before 2024
MassEVIP Fleet Incentives	✓			Massachusetts Department of Environmental Protection (MassDEP)	✓			Light-duty vehicles only. BEVs: $7500/purchase; PHEVs: $5000/purchase[7]	First-come, first-serve	BEVs: $7500/purchase ; PHEVs: $5000/purchase
MassEVIP EVSE	✓	✓	✓	MassDEP		✓	✓	Up to 60% of EVSE hardware and installation costs[8]	First-come, first-serve	60% of EVSE installation costs for PHEV vehicle EVSE
MOR-EV Trucks		✓	✓	MA DOER	✓			$7,500 - $90,000 per vehicle over 8,501 GVWR (lbs.)[9]	First-come, first-serve	$15,000 for medium duty pickups, $30,000 for shuttle buses

[6] Up to 75% of hardware costs covered for publicly accessible ports and 100% for environmental justice (EJ) community sites. Prescriptive incentives are available for less than five charging stations. Equipment must be installed by 12/21/2023.
[7] MassEVIP application caps were considered in this analysis. MassEVIP Fleet incentives for vehicles have a limit of 25 vehicles per applicant, so incentives were only applied to the first 25 vehicles to retire.
[8] MassEVIP EVSE incentives have a limit of $50,000 per site, so reductions to the incentive amounts were evenly distributed across applicable vehicles for the 6 sites.
[9] Purchases of BEVs with a sales price of more than fifty thousand dollars ($50,000) and having a gross vehicle weight rating (GVWR) of more than 8,500 pounds made on or after February 16, 2021 are eligible for a rebate in the MOR-EV Trucks Program. Rebates vary depending on vehicle GVWR and block schedule.

Program	Light Duty EVs	Medium Duty EVs	Heavy Duty EVs	Administrator	Vehicle Costs	EVSE Installation	EVSE Hardware	Program Offerings	Upcoming Deadlines	TCO Funding Assumptions
Green Communities Grant Program	✓	✓	✓	MA DOER	✓			BEVs: $15,000/purchase; PHEVs: $10,000/purchase [10]	Block 1: 4/9/2021 Block 2: 10/8/2021 (Program offered annually)	$15,000 for BEVs and $10,000 for PHEVs purchased

[10] Millbury is a Specially Eligible Community that qualifies for these higher grant amounts. Additional funds available for charging stations (up to $7,500) but they must be publicly accessible and were excluded from this analysis. Green Communities Grant Program funding may be available in future years but amounts by year vary.

EV Model Comparison

There are over 400 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 H through Chart M highlight the lowest TCOs for each vehicle type within your fleet that are available on the Massachusetts state contracts. This analysis uses the Millbury's average annual mileage and miles driven per day by vehicle type and assumes a 15-year vehicle life unless otherwise noted. 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.

Chart H. Sedan EV Model TCO Comparison

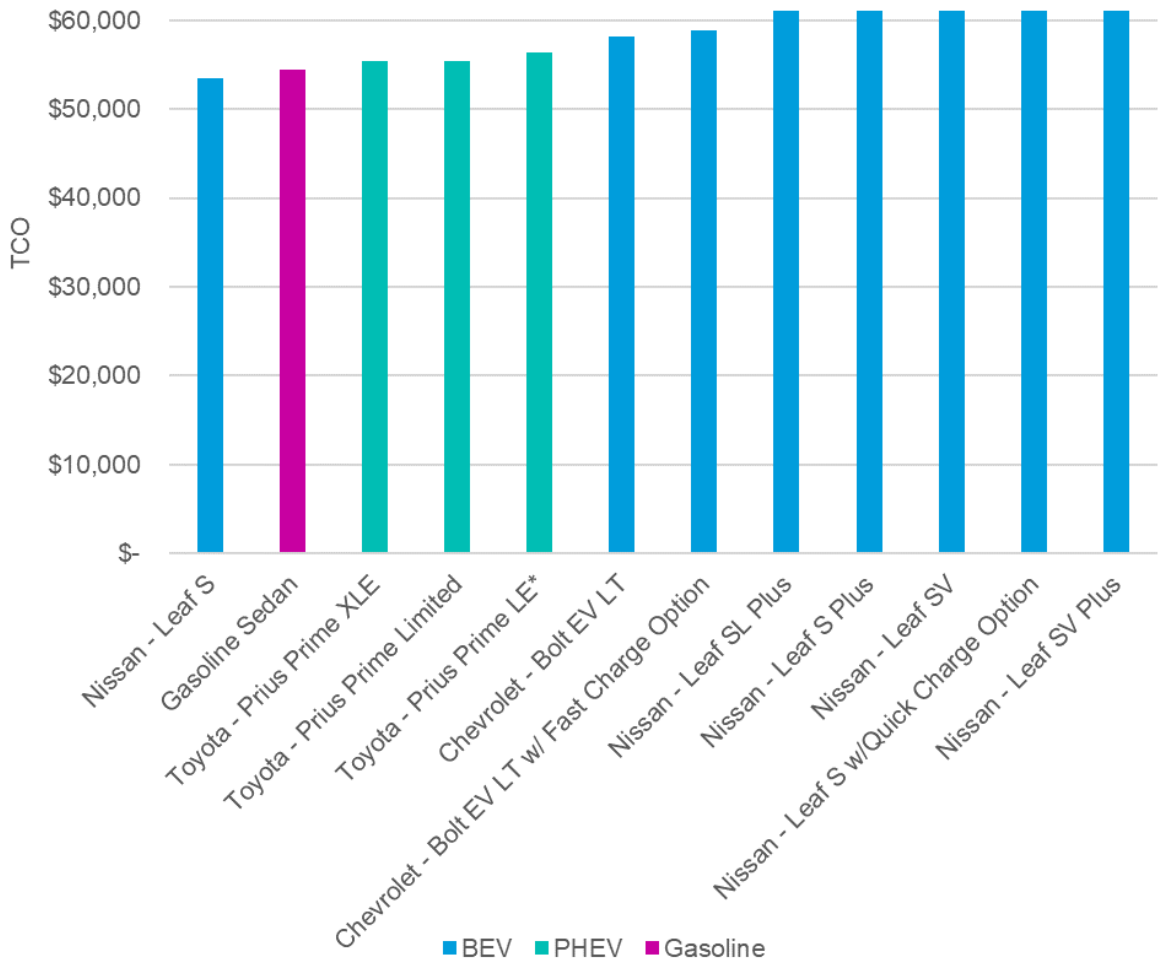


Chart I. SUV EV Model TCO Comparison

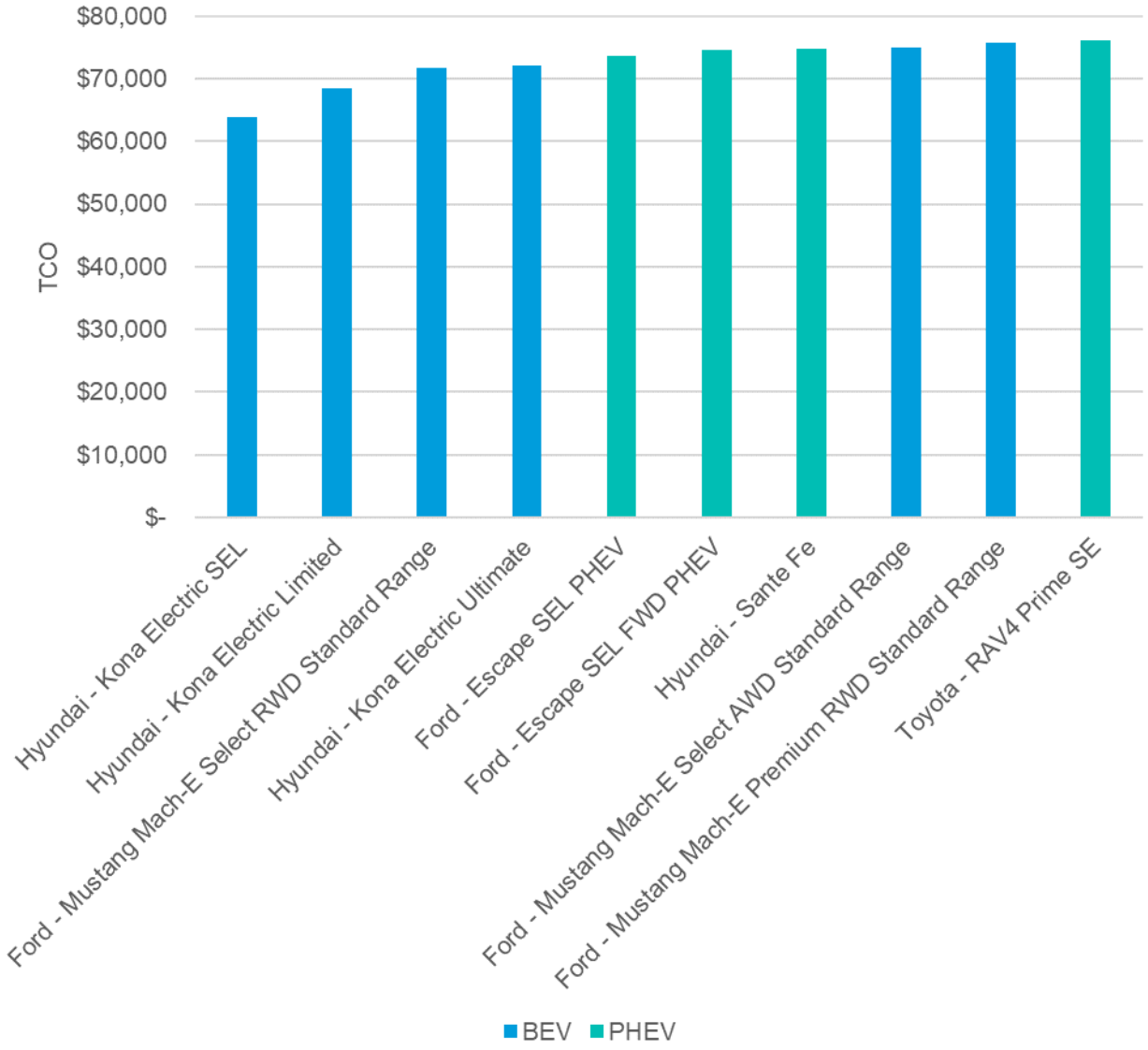


Chart J. Light-Duty Pickup EV Model TCO Comparison

Chart K. Medium-Duty Pickup EV Model TCO Comparison

Chart L. Van EV Model TCO Comparison

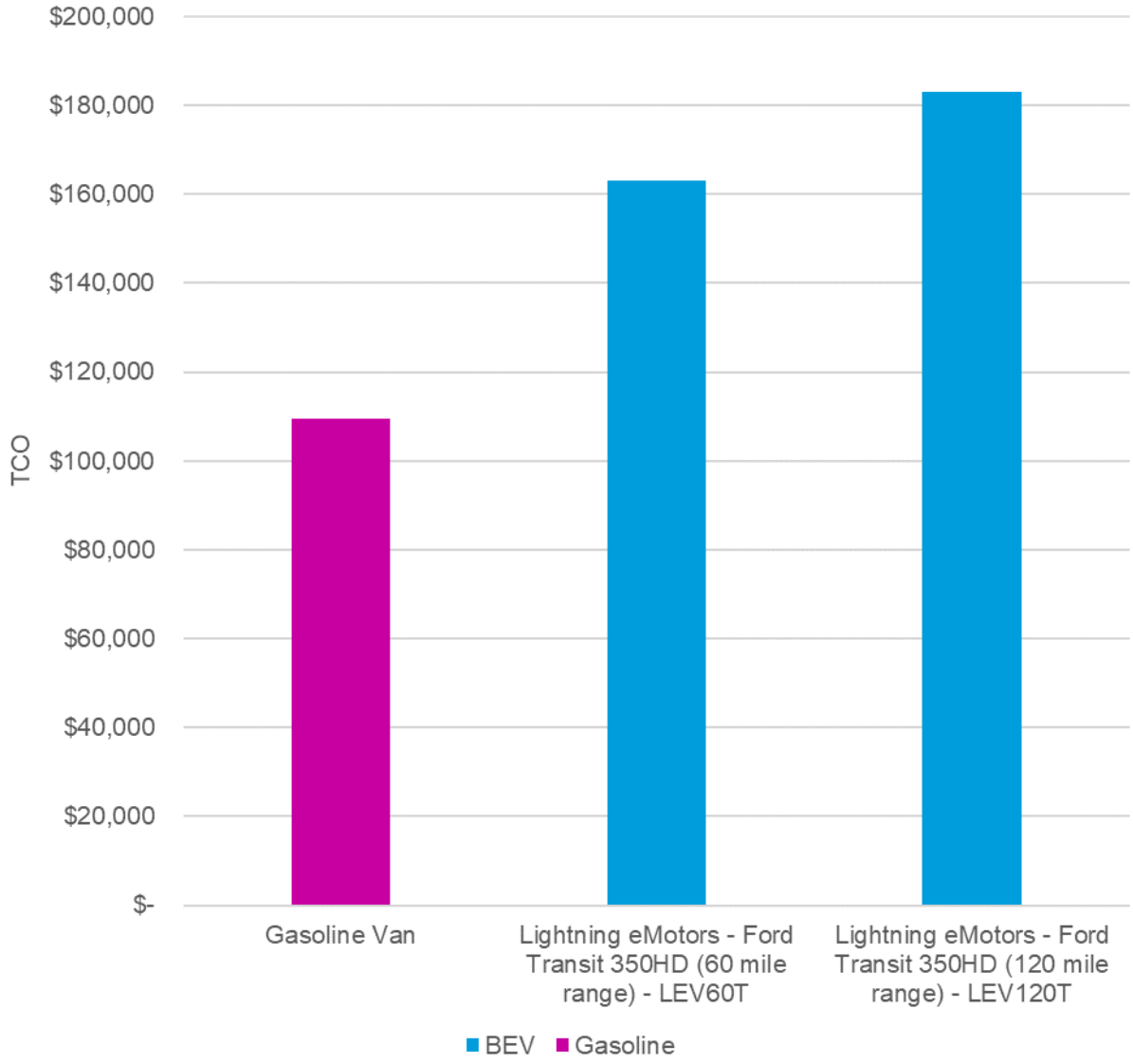
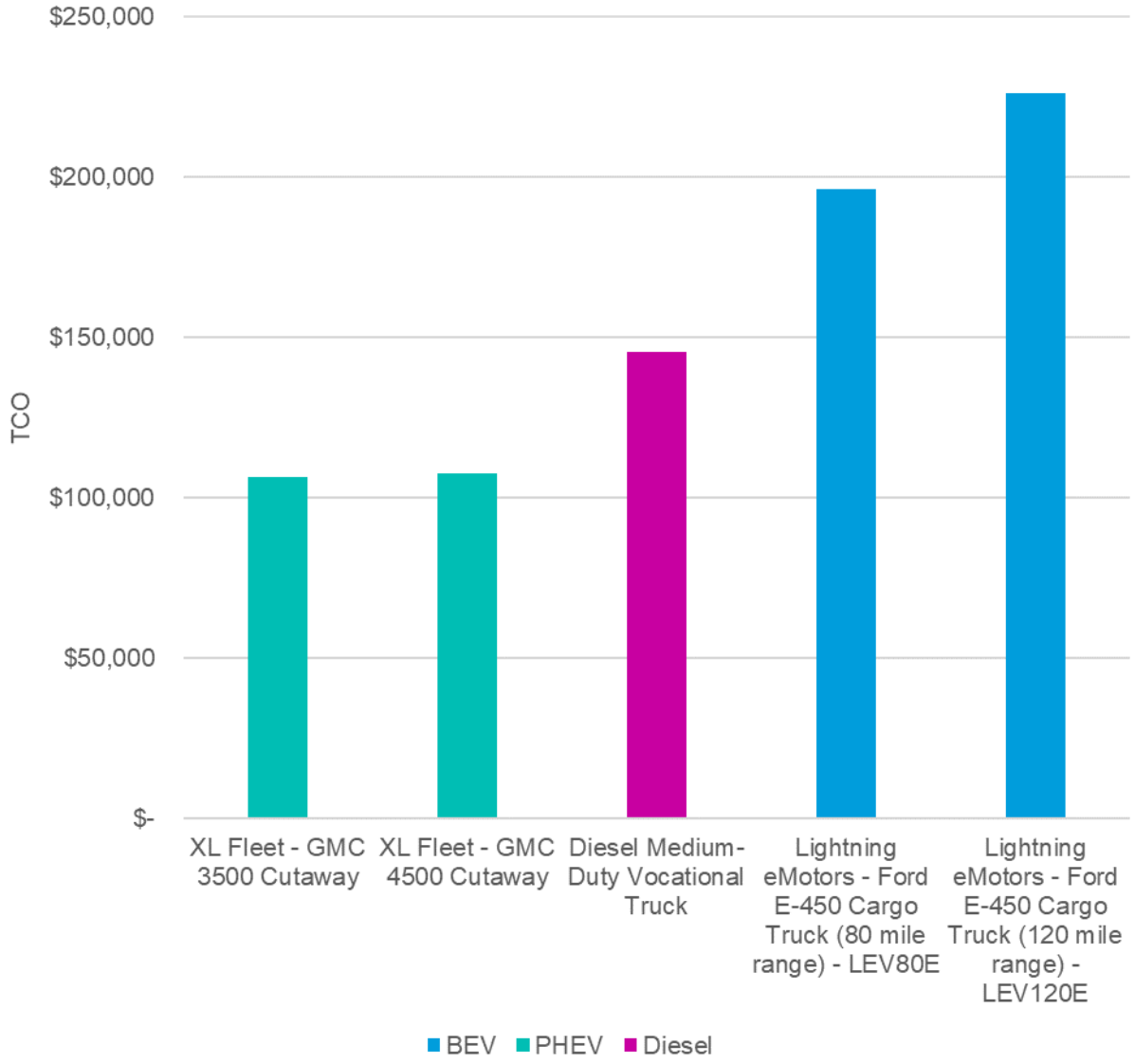


Chart M. Medium-Duty Vocational Truck EV Model TCO Comparison



Electric Police Patrol Vehicles

Currently, only five EV models, including three sedans and two SUVs, are being used as police patrol vehicles in a handful of police fleets in the United States. These models have been considered in Millbury's fleet analysis, and additional models will be added as more EVs are piloted for police use. Additionally, the Hyundai Kona Electric SUV is being piloted by police fleets in Europe, and will be included in future analyses if deemed suitable for Millbury's police fleet. The models that are currently in use by police fleets in the United States are listed below, and have a TCO range between $44,854 and $50,804 based on Millbury's average annual milage (10,182), average miles driver per day (41), and average vehicle life (3.4).

- Chevrolet Bolt (sedan)
- Tesla Model 3 (sedan)
- Tesla Model S (sedan)
- Mustang Mach-E (SUV)
- Tesla Model Y (SUV)

Electric Snowplows

There are no commercially available EVs that are compatible with snowplows. However, several PHEV aftermarket conversions are capable of plowing. These PHEVs are equipped with more torque and longer range than their ICE counterparts, making them especially capable of pushing heavy loads for many hours at a time. Available PHEVs that are compatible with snowplows are:

- XL Fleet Ford F-Series
- XL Fleet GM 2500/3500 HD
- XL Fleet GMC 3500/4500 Cutaway

Sample Medium-Duty Pickup Financial Analysis

Table E provides a sample TCO comparison for a single, purchased medium-duty pickup. This analysis uses a 15-year vehicle life and a 11,924 annual mileage assumption, based on the average annual mileage for medium-duty pickups within your fleet.

TABLE E. Medium-Duty Pickup TCO Comparison

	Diesel	PHEV (XL Fleet – Ford F-350)[10]	BEV (Atlis – XT 300 mi)[11]
Capital Cost	$53,000	$55,750	$45,000
Charging Infrastructure Hardware (DCFC)	N/A	$24,000	$24,000
Charging Infrastructure Installation	N/A	$27,500	$27,500
Incentives[12]	N/A	($39,400)	($81,500)
Annual Fuel/Energy Costs	$2,156	$1,297	564
Annual Maintenance Costs	$3,732	$2,246	1,549
15-Year Total Costs[13]	$111,590	$101,390	$46,684

Charts N and O provide a visual representation of the annual and cumulative cost comparisons across a diesel and PHEV medium-duty pickup. The PHEV has a higher upfront cost than the diesel option because the available incentives only partially cover the charging infrastructure costs. However, the maintenance and fuel cost savings make up for this resulting in $230 savings per year in this scenario.

[11] The XL Fleet – Ford F-350 is available on Massachusetts state contracts for $55,750. There are currently no BEV medium-duty pickups available on state contracts, but the Atlis XT (300 mi) has been provided for comparison.
[12] Assumes National Grid Electric Vehicle Charging Station Program (100% of BEV EVSE installation costs), MOR EV Trucks ($15,000 per medium-duty EV pickup), and Mass DEP MassEVIP (60% of PHEV EVSE installation costs; $7,500 per BEV and $5,000 per PHEV) incentives. EV capital and infrastructure costs shown in table do not have incentives applied.
[13] NPV assumes a 5% discount rate.

Chart N. Medium-Duty Pickup 15-Year Annual Cost Comparison

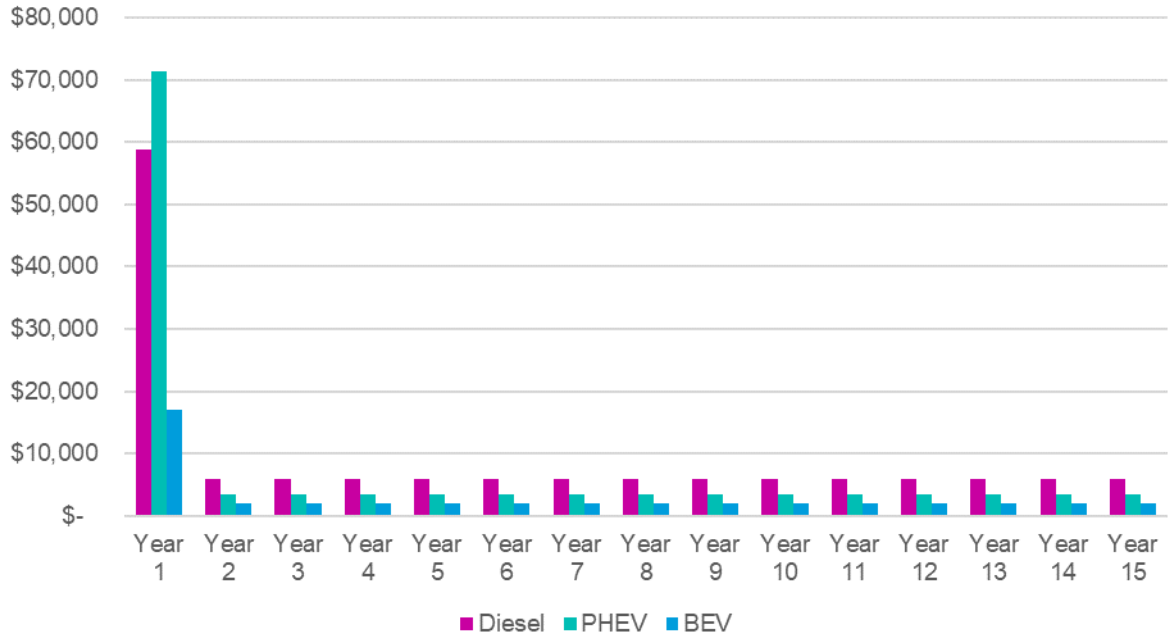
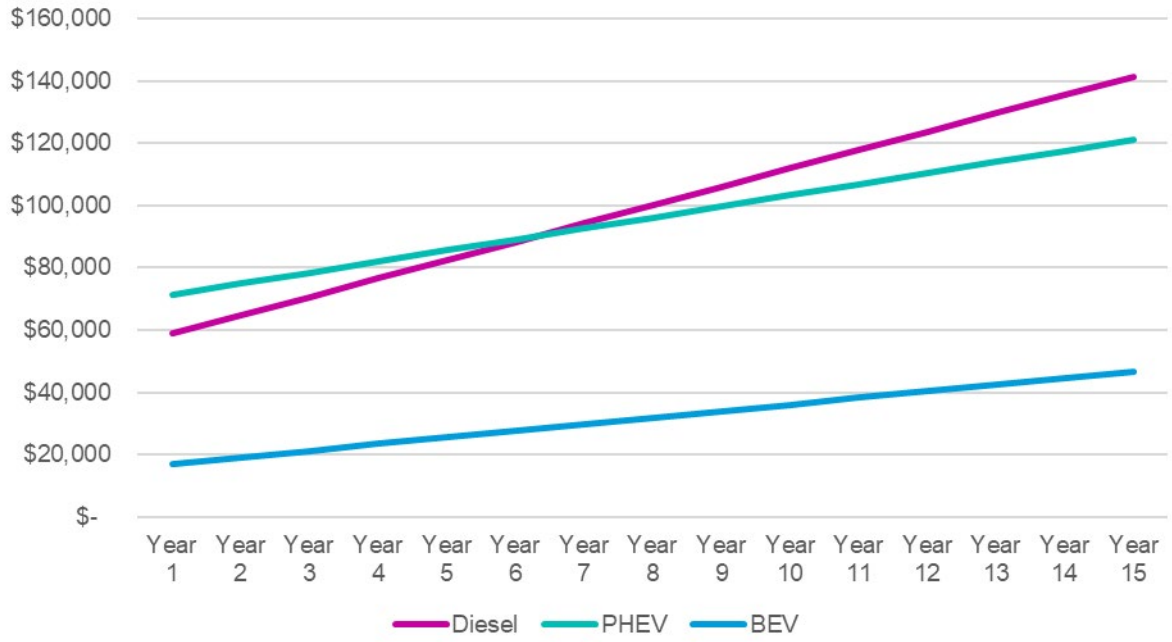


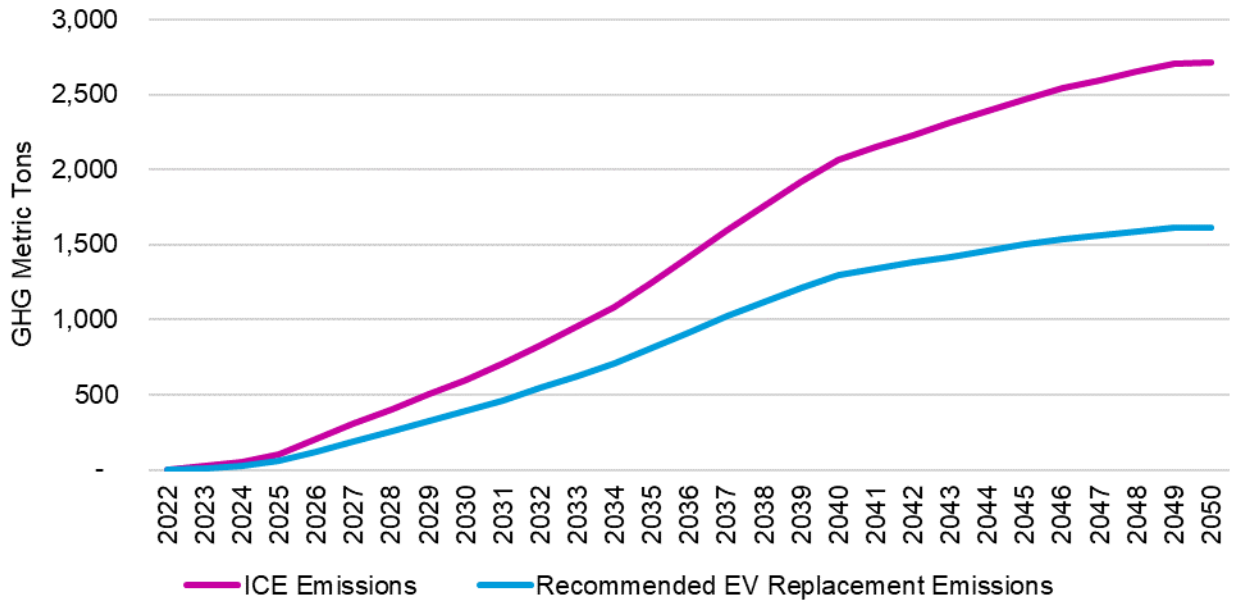
Chart O. Medium-Duty Pickup 15-Year Cumulative Cost Comparison



Fleet Environmental Impact Analysis

By converting the 25 recommended on-road vehicles to EVs, you could reduce GHG emissions by 1,102 MT and NOx emissions by 5,735 pounds (lbs) over 29 years. Chart P 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 P. Cumulative Greenhouse Gas Emissions



1,102 GHG Emission Reductions (MT over 29 years)

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

5,735 NOx Emission Reductions (Lbs. over 29 years)

18,187 Equivalent to tree seedlings grown for 10 years

Non-Road Equipment

There are 32 vehicles in Millbury's fleet identified as non-road equipment, summarized in Table F below. Of these vehicles, 1 all-terrain vehicle (ATV) was identified as cost beneficial to convert to electric. Electric non-road equipment could help Millbury further reduce fuel costs, maintenance costs, and site emissions.

TABLE F. Non-Road Equipment

Equipment Type	Quantity	Quantity Recommended to Convert to Electric	Financial Savings (across equipment lifespan)	GHG Emission Reductions (MT, across equipment lifespan)
ATV/UTV	1	1	$8,984	38
Backhoe	6	0	N/A	N/A
Other	25	0	N/A	N/A
Total	**32**	**1**	**$8,984**	**38**

ATVs/UTVs

Millbury's current ATV is a gasoline powered 1999 Honda Foreman. We recommend Millbury explore electric ATV and utility task vehicle (UTV) options when looking to replace this ATV. Electric ATVs and UTVs are cost competitive with gasoline and diesel ATVs and UTVs, as seen in Chart Q, and can help reduce fuel and maintenance costs by up to 60%. In the sample ATV/UTV TCO Comparison shown in Table G, the electric option results in an overall $8,984 TCO savings.

Chart Q. Comparable UTV Capital Costs

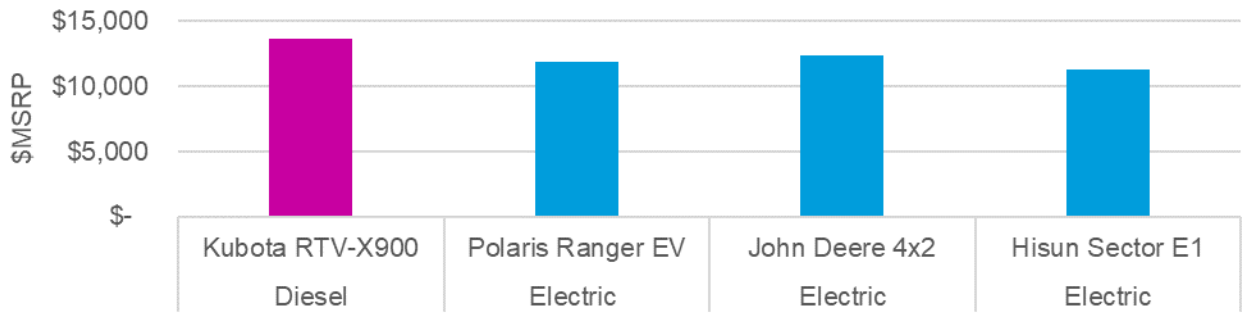


TABLE G. ATV/UTV TCO Comparison

	Diesel	Electric
Capital Cost	$13,700	$11,900
10-Year Fuel/Energy Costs[14]	$8,784	$5,461
10-Year Maintenance Costs[12]	$7,722	$3,861
10-Year Total Costs[12]	$30,206	$21,222

Backhoes

Millbury currently owns 6 diesel backhoes. We recommend Millbury explore electric backhoe options when looking to replace their backhoe fleet. While a relatively new technology, there are a few electric backhoe models available through CASE, Volvo, John Deere, JCB, 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. National Grid is partnering with CASE and John Deere to test fully electric backhoe options.

[14] NPV assumes a 5% discount rate.

Next Steps

☐ Get Support.

Have questions about this report? Contact your Account Manager to discuss challenges and answer questions.

☐ Explore Resources for Electrifying.

Log onto the MA Fleet Advisory Services Program's online portal to find resources about available incentives, charger and vehicle trainings, checklists, news and updates, and more.

☐ Move Forward with Electrifying Your Fleet.

Circulate the findings of this report with key stakeholders in your organization. Contact your Account Manager for additional support in preparing to present these findings.

☐ Connect with National Grid for EV infrastructure needs.

Your Fleet Advisory Portal has the tools you need to succeed.

Log in at www.FleetAdvisoryMA.NationalGrid.com and you can:

- See your MA Fleet Advisory Services reports
- Explore funding opportunities
- Find RFP language to help your fleet acquire EVs
- Find partners that can support your transition to EVs
- Find information about EV and EVSE operation and maintenance
- Identify trainings
- Stay up to date on the latest industry news

We're here to help.

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

Web: www.FleetAdvisoryMA.NationalGrid.com

Email: FleetAdvisoryMA@icf.com

Phone: 617-218-2100

Appendix A: TCO Procurement Comparison

The comparison below highlights the potential impacts of considering vehicle procurement options outside of the state contracts. Your Account Manager is here to help you navigate independent purchasing and connect you to helpful resources to explore these options.

Recommendation impacts using the available state contracts for vehicle procurement:

25
Vehicles converted over **15** years

$729,268
TCO savings over **29** years*

$111,687
fuel cost savings over **29** years*

$701,831
maintenance savings over **29** years

1,102
metric tons (MT) of CO_2 eliminated over **29** years

Recommendation impacts using purchasing options outside of state contracts for vehicle procurement:

41
Vehicles converted over **15** years

$2,837,805
TCO savings over **29** years*

$946,465
fuel cost savings over **29** years*

$627,494
maintenance savings over **29** years

7,899
metric tons (MT) of CO_2 eliminated over **29** years

* NPV assumes a 5% discount rate.

Appendix B: 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. The MA Fleet Advisory Services Program portal (*www.FleetAdvisoryMA.NationalGrid.com)* provides training materials to help address your needs.

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 New England, 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 (i.e., temperatures not often seen in Massachusetts).

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, your Account Manager can connect you with vetted charging station installers, as well as the National Grid EV Implementation Team, to better understand the costs of upgrades. We will also estimate the cost of charging infrastructure in the TCO calculation in this report.

Which Massachusetts fleets have gone electric and what funding did they receive?
The MA Fleet Advisory Services Program portal (*www.FleetAdvisoryMA.NationalGrid.com)* provides links to case studies of EV fleet deployment in Massachusetts. If you would like additional or more specific examples, please contact your Account Manager.

If my fleet doesn't have the budget to purchase vehicles right now, how should we proceed?
This report provides 15-year recommendations for EV purchases. It also identifies applicable incentives and funding that may help cover some of the costs. You and your Account Manager will develop a schedule for report refreshes over the next few years, as more funding and vehicle models become available.