Nevada State Fleet Electrification Analysis

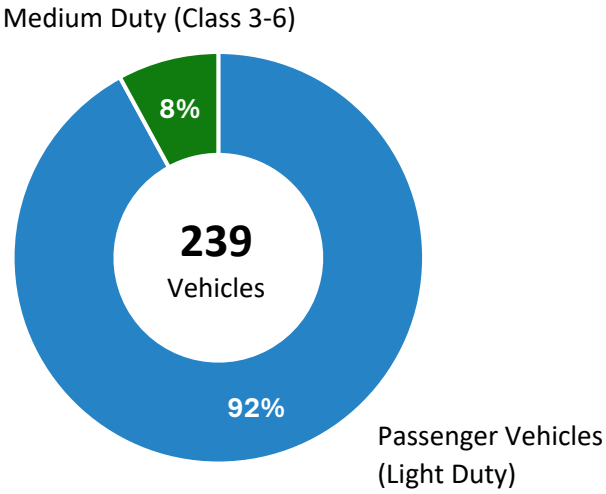
Key Highlights

- Nevada can realize savings even without rebates or grants by electrifying 210 light-duty vehicles and nine medium-duty vehicles, or 92 percent of the vehicles analyzed.
- Electric vans, SUVs, minivans, sedans, and pickup trucks all offer lower lifetime costs than conventional replacements on average.
- Electric work trucks and medium duty pickup trucks do not yet offer as favorable total costs of ownership as conventional vehicles.
- Plug-in hybrids such as the Chrysler Pacifica, Ford Escape, and Toyota Rav4 can enable cost effective electrification where viable all-electric vehicles are still limited.
- In some cases where exact EV replacements are not available, the fleet may benefit from downsizing if a smaller EV can still meet the requirements of the vehicle.
- In many cases, annual vehicle miles traveled makes or breaks the case for electrification, especially in the case of the Ford eTransit.

Fleet Breakdown

Atlas analyzed a subset of state fleet vehicles that are up for replacement. Overall, light-duty vehicles made up 92 percent of vehicles analyzed while medium-duty (class 3-6) vehicles make up the remaining eight percent. The high proportion of light-duty vehicles indicate cost and emissions savings potential for electrifying these vehicles across the fleet. However, the availability of electric medium-duty vehicles is still limited. Figure 1 shows the breakdown of vehicles scheduled for replacement in the Nevada state fleet by vehicle class.

Figure 1: Fleet Breakdown by Vehicle Class



Sedans account for two thirds of the light-duty vehicles in the fleet while SUVs account for one fifth. Minivans and pickup trucks account for seven and six percent, respectively. The most common passenger vehicle in the fleet is the Toyota Prius with 33 vehicles. Figure 2 provides a full breakdown of the light-duty fleet and Table 1 lists the top five passenger vehicles.

Figure 2: Light-Duty Fleet Breakdown by Vehicle Type

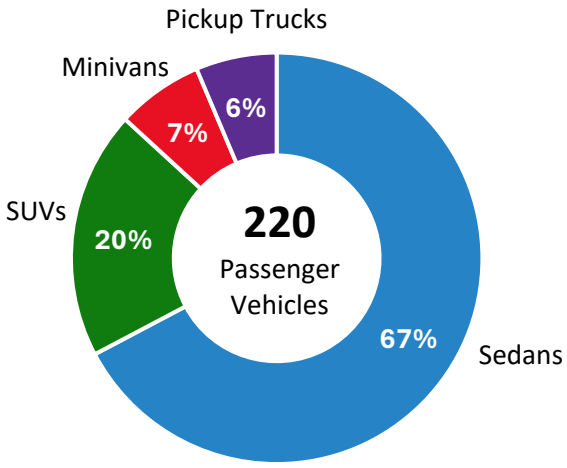


Table 1: Top 5 Passenger Vehicles

Vehicle	Use Case	Count
Toyota Prius	Sedan	33
Chevrolet Malibu	Sedan	23
Ford Focus	Sedan	21
Chevrolet Cobalt	Sedan	20
Chevrolet Impala	Sedan	17

The medium- and heavy-duty (MDHD) segment of the fleet is dominated by vans. Fifteen vans account for 79 percent of the medium and heavy-duty fleet. Three work trucks and one pickup truck make up the rest of the MDHD segment. The Chevrolet Express is the most common MDHD vehicle in the fleet with eight vehicles. Figure 3 provides a full breakdown of the medium- and heavy-duty segment of the fleet and Table 2 lists the top 5 MDHD vehicles.

Figure 3: Medium- and Heavy-Duty Fleet Breakdown by Vehicle Type

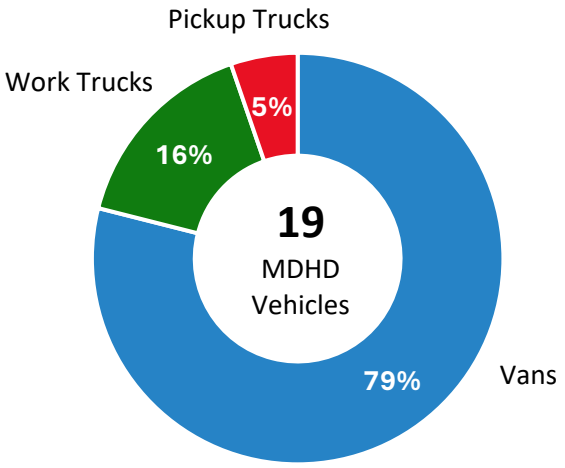


Table 2: Top 5 MDHD Vehicles

Vehicle	Use Case	Count
Chevrolet Express	Van	8
Ford Transit	Van	2
Ford Transit Connect	Van	2
Ford F-250	Work Truck	2
Tied		1

The top five vehicle models in each segment account for 52 and 79 percent of the light duty and MDHD fleet, respectively. Finding suitable and cost-effective electric alternatives for these vehicles will be essential for the successful electrification of the fleet. There are ample electric alternatives for the five sedans that make up the top five light-duty vehicles including the Chevrolet Bolt and the Toyota Prius Prime. Likewise, The Ford eTransit offers an exciting electric alternative for the van segment.

Total Cost of Ownership Analysis

This analysis was conducted using a total cost of ownership (TCO) approach to project the cost of all vehicles over their expected useful lives. TCO factors in the vehicle purchase price, operating and maintenance costs, and financing and insurance costs over the life of the vehicle. The expected years of use was 10 years or 125,000 miles. Annual vehicle miles traveled was provided by the fleet and ranged from a minimum of 504 miles to a maximum of 23,208 miles. Atlas set a floor of 7,000 miles per year to account for the minimum mileage expected of a new vehicle. After setting the floor, the average annual mileage for the fleet was 9,263.

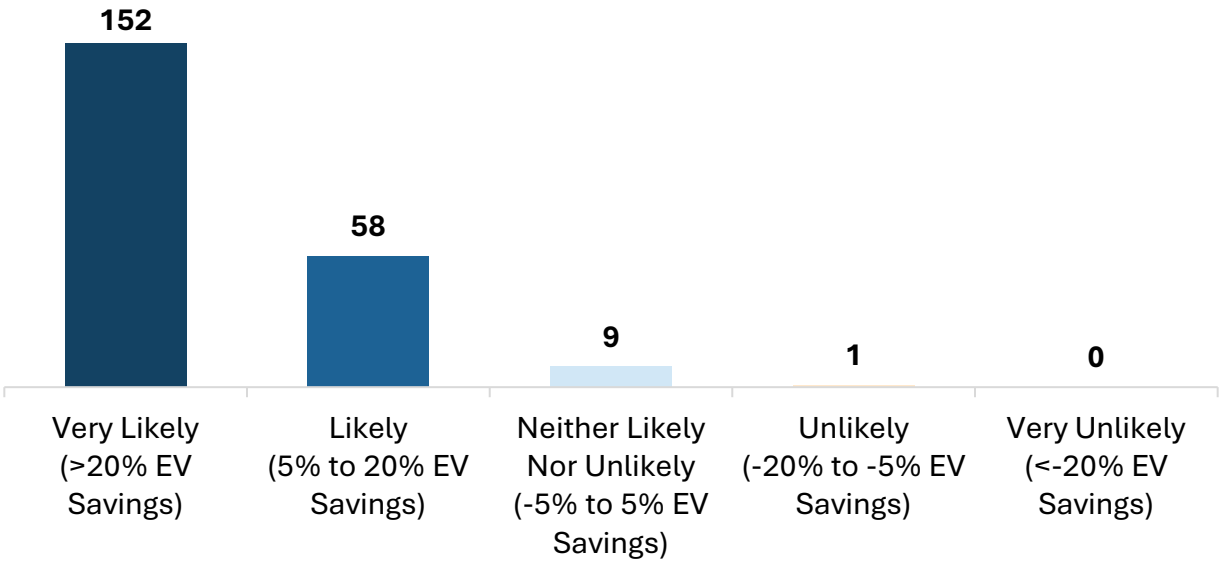
The analysis identifies conventional and electric replacements for each vehicle in the fleet and then calculates and compares the total cost of ownership of the potential replacements. To project the value of each vehicle, the analysis uses the depreciated value of the vehicle at the end of its useful life. Annual depreciation is calculated using the purchase price, range, and annual mileage for each vehicle and relies on a formula developed using real world used vehicle sales data. No federal, state, or local incentives were included in the analysis. A full list of inputs and assumptions can be found in the appendix.

Light-Duty Fleet

Of all vehicle classes, light-duty EVs tend to achieve the closest per mile cost compared to conventional vehicles. As new EVs continue to enter the market in, Nevada should rerun the analysis to determine how these new offerings compare to conventional vehicles. The competitiveness of light-duty EVs will increase even further if the state pursues additional tax credits, rebates, or grants to offset the upfront cost of EVs.

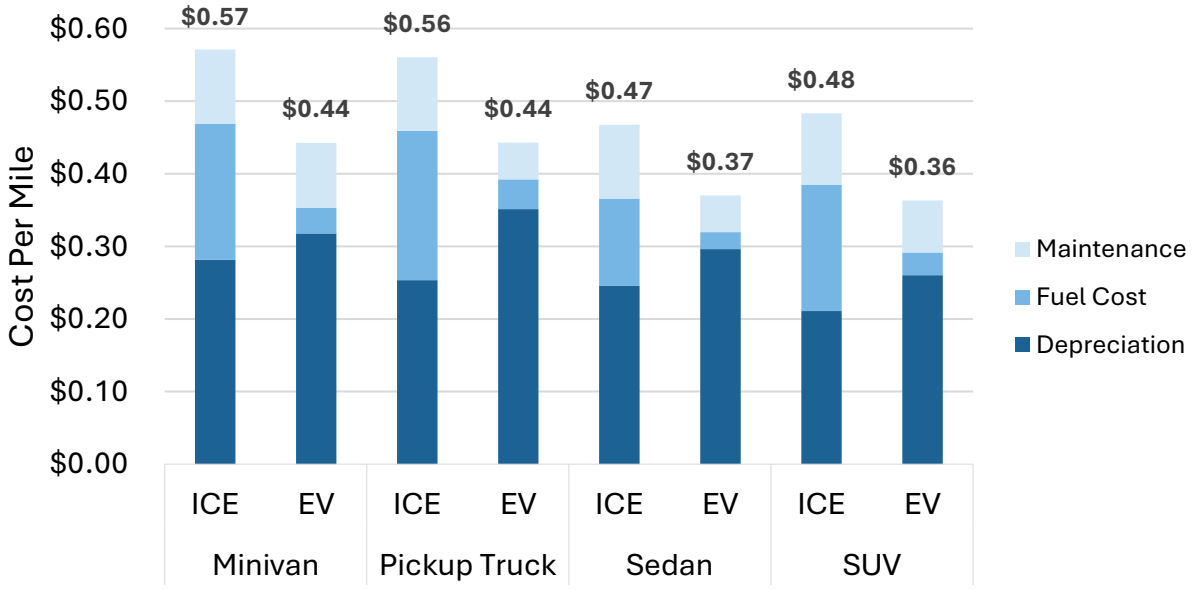
There are 210 out of 220 light-duty vehicles that are likely or very likely to offer lifetime savings today under current market conditions. There are nine vehicles that may offer lifetime savings within a five percent margin of error and one vehicle that is not likely to offer cost savings. Figure 4 shows the breakdown of light-duty fleet vehicles by the likelihood of EV savings.

Figure 4: Number of Light-Duty Vehicles by Likelihood of EV Savings



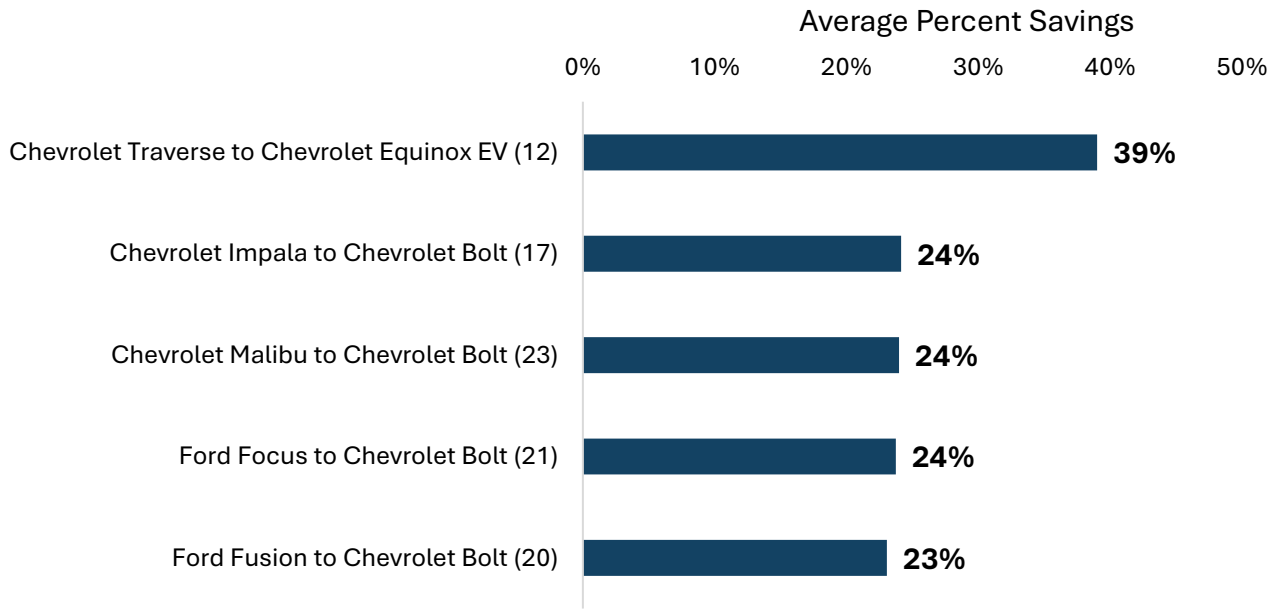
On average, replacing passenger vehicles with alternatives could save 22 percent over the lifetime of the vehicle. SUVs offer the largest savings at 26 percent followed by minivans at 23 percent, pickup trucks at 22 percent, and sedans at 21 percent. Figure 5 shows the average cost per mile comparison across each light-duty vehicle type.

Figure 5: Nominal Cost Per Mile for Passenger Vehicles by Vehicle Use Case



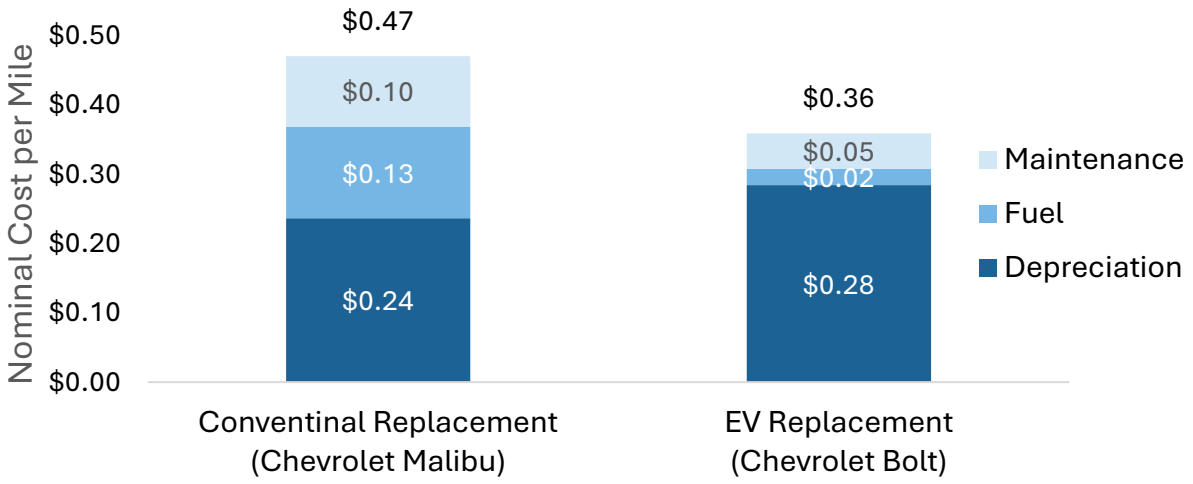
Potential EV savings can vary considerably within each vehicle type. For example, replacing the Chevrolet Traverse with the Chevrolet Equinox EV offers savings of 39 percent on average. The Equinox EV represents a downsize from the slightly larger Traverse. In some cases where exact EV replacements are not available, the fleet may benefit from downsizing if a smaller EV can still meet the requirements of the vehicle. The Chevrolet Bolt is the modeled EV alternative for most sedans and can offer considerable cost savings over conventional vehicles. The Bolt offers the greatest savings when replacing the Chevrolet Impala, Chevrolet Malibu, Ford Focus, and Ford Fusion. Figure 6 shows the top five light-duty vehicles to procure with the number of vehicles listed in parentheses.

Figure 6: Top 5 Light-Duty Vehicles to Procure



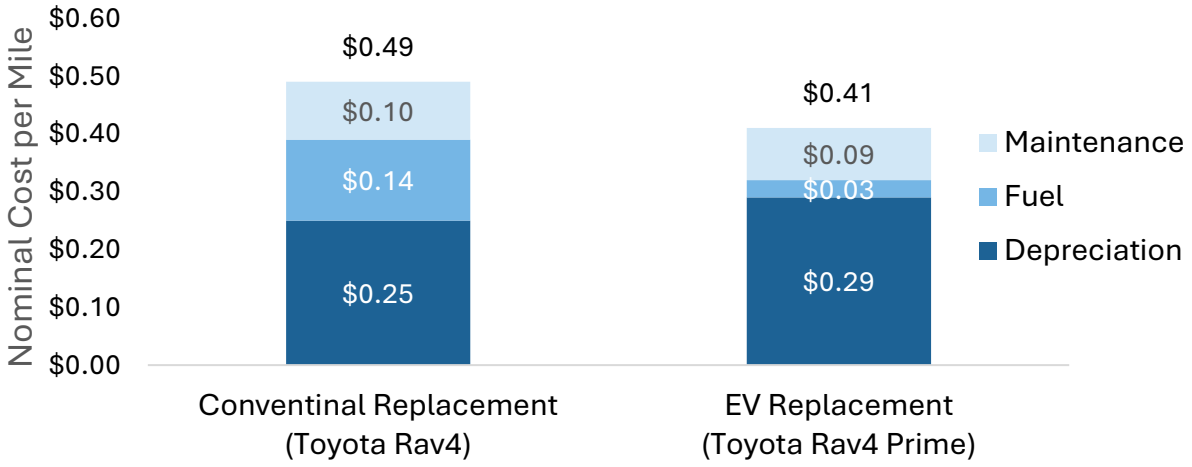
With 23 vehicles, the Chevrolet Malibu is one of the most common vehicles in the fleet. Atlas modeled replacing the Chevrolet Malibu with a new 2022 Chevrolet Malibu compared to a 2022 Chevrolet Bolt. The Bolt has a higher upfront cost of $31,000 compared to $23,400 for the Chevrolet Malibu, but over 10 years of expected use the Bolt more than makes up the difference through fuel and maintenance cost savings. Over the lifetime of the vehicle, the Bolt costs $0.36 per mile, $0.11 less than the Malibu. This amounts to savings of over $9,000 on a net present value basis. Figure 7 breaks down the nominal cost per mile for the potential replacements for the Chevrolet Malibu.

Figure 7: Comparative Nominal Cost Per Mile for Replacement of Chevrolet Malibu



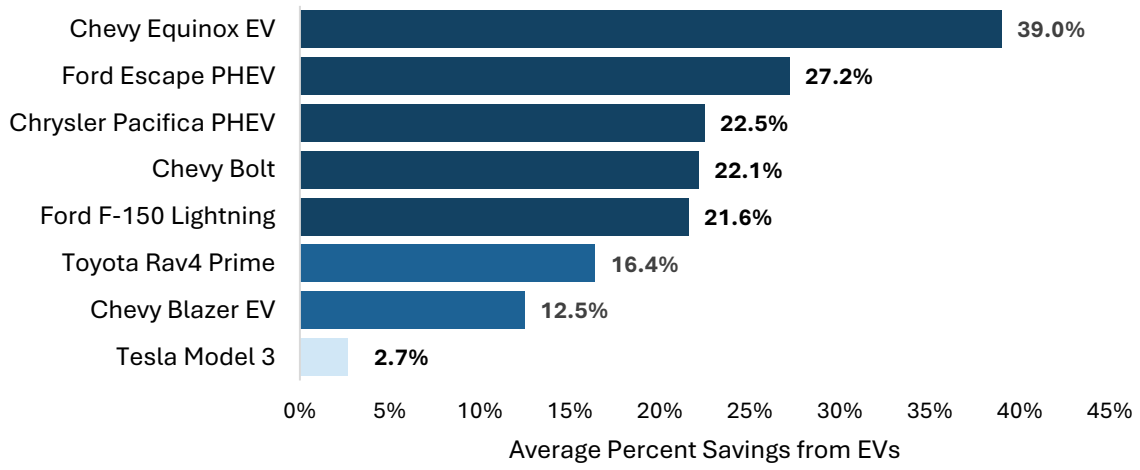
The Toyota Rav4 is the fleet's most common SUV with 14 vehicles. Atlas modeled replacing the Toyota Rav4 with a new 2022 ICE Rav4 at an upfront cost of $29,395 compared to a new 2022 Toyota Rav4 Prime for $40,300. The Rav4 Prime is a plug-in hybrid with an EPA estimated range of 42 miles. Across all plug-in electric vehicles (PHEVs), it is assumed that the vehicle will exhaust its electric-only range before turning to gasoline consumption. Fuel cost savings are high for vehicles that do not have an average daily driving range that is greater than the electric-only battery range. Based on average daily driving distances, Atlas estimates that 98 percent of miles driven by the Toyota Rav4 Prime could be driven on electricity. As a result, the Rav4 Prime costs $0.08 less per mile than the ICE version over the lifetime of the vehicle, amounting to over $6,500 in savings on a net present value basis. Figure 8 shows the nominal cost per mile comparison for the potential replacements for the Toyota Rav4.

Figure 8: Comparative Nominal Cost Per Mile for Replacement of Toyota Rav4



Average TCO varies significantly by vehicle model. The EV alternative for the compact SUV category, the upcoming 2023 Chevrolet Equinox EV, has the highest potential lifetime savings at nearly 40 percent. The premium sedan EV alternative, the Tesla Model 3, has the lowest potential lifetime savings at 2.7 percent. Figure 9 shows the average cost savings for each light-duty EV.

Figure 9: Average Percent Savings from Light Duty EVs



Key Insights from the Light-Duty Analysis

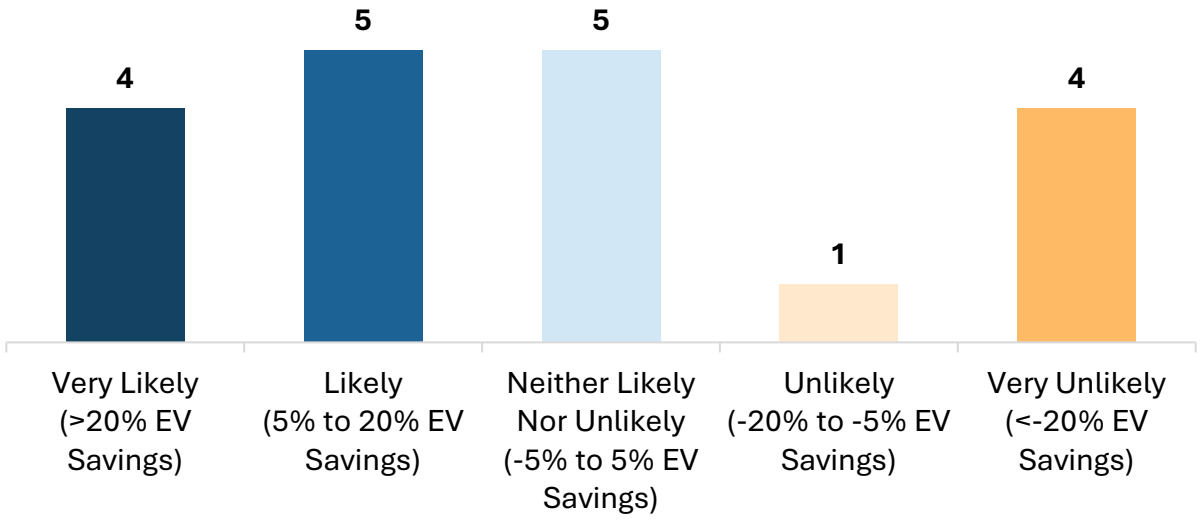
- Nevada can realize savings even without rebates or grants by electrifying 210 vehicles, or 95 percent of its light-duty fleet in the near-term.
- Electric SUVs, minivans, sedans, and pickup trucks all offer lower lifetime costs than conventional replacements.
- The Chevrolet Bolt can offer savings over a wide variety of sedans currently in the fleet.
- Plug-in hybrids such as the Chrysler Pacifica, Ford Escape, and Toyota Rav4 can enable cost effective electrification where viable all-electric vehicles are still limited.
- In some cases where exact EV replacements are not available, the fleet may benefit from downsizing if a smaller EV can still meet the requirements of the vehicle.

Medium- and Heavy-Duty Fleet

The high upfront cost of medium- and heavy-duty EVs and limited number of EV models available for several use cases can make this segment more challenging to electrify than light-duty vehicles. However, as new models enter the market at competitive price points, such as the 2022 Ford eTransit, fleet owners will have more options to choose from in this segment. Medium- and heavy-duty EVs can offer significant fuel and maintenance cost savings compared to conventional alternatives which can offset the higher upfront purchase price.

Without including any rebates or grants, nine out of 19 medium-duty EVs are likely to offer lifetime savings potential compared to conventional models. All nine of these vehicles are vans, with the Ford eTransit offering a cost-competitive EV alternative. Five vehicles may offer savings within a five percent margin of error, and five vehicles are not likely to offer EV savings. Figure 10 provides a summary of these vehicles.

Figure 10: Number of Medium-Duty Vehicles by Likelihood of EV Savings

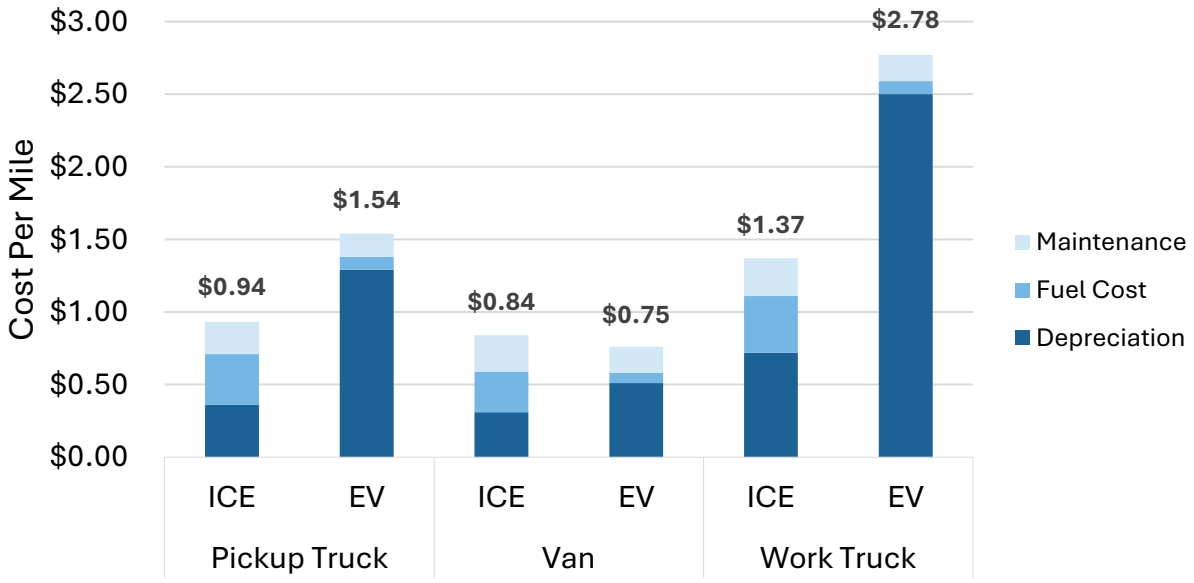


Electric vans offer a comparable cost per mile compared with conventional vans. While an electric van can have higher upfront costs than a conventional van, fuel and maintenance cost savings can lead to competitive lifetime costs. Electric vans offer cost savings of 13 percent on average.

Work trucks and medium-duty pickup trucks have fewer electric models available, and those that are available have high upfront costs compared to conventional vehicles. None of the four electric work trucks/medium-duty pickup trucks modeled have favorable total costs of ownership. The EV cost premium ranges from 63 percent to 110 percent. Generally, work trucks with the highest vehicle miles traveled have the best potential to offer cost savings because they unlock greater fuel and maintenance cost savings.

Figure 11 shows the cost per mile comparison for each use case.

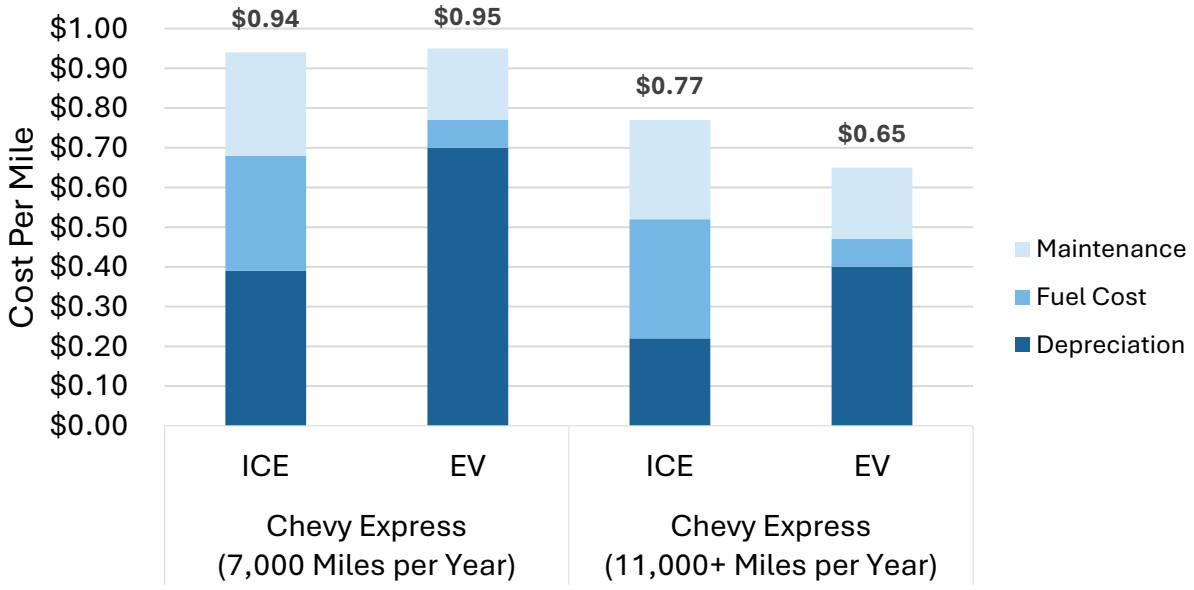
Figure 11: Medium- and Heavy-Duty Nominal Cost per Mile by Vehicle Use Case



The van segment is the most promising segment for electrification, offering 13 percent savings on average. The Chevrolet Express is the most common van in the fleet with eight vehicles. Atlas modeled replacing the Chevrolet Express with a new Chevrolet Express compared to a Ford eTransit. The Ford eTransit offers average savings of 9.35 percent, but savings vary greatly depending on the vehicle miles traveled. Four Chevrolet Express vans were modeled to travel 7,000 miles per year, the floor for the analysis. Replacing these four vehicles with the Ford eTransit would come at a cost premium of 0.5 to 2 percent. Four Chevrolet Express vans travel 11,000 or more miles per year, and could be replaced with a Ford eTransit with savings of 15 to 20 percent.

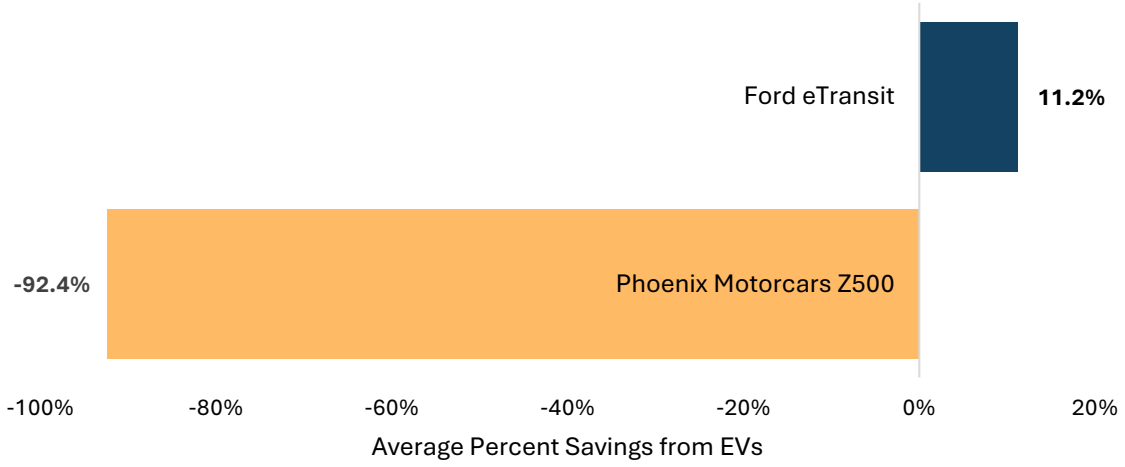
Figure 12 shows the cost per mile comparison for vehicles traveling 7,000 miles per year compared to vehicles traveling 11,000 or more miles per year.

Figure 12: Comparative Nominal Cost Per Mile for Replacement of Chevrolet Express



There are only two modeled medium-duty EV alternatives, the Ford eTransit for vans, and the Pheonix Motorcars Z500 for work trucks and medium-duty pickup trucks. The Z500 is a Ford E-450 Superduty Chassis retrofitted with an all-electric drivetrain. While the Z500 is likely an oversized replacement for the Ford F250 and Ram 2500, limited options exist for electric medium-duty trucks. On average, the eTransit offers cost savings of 11.2 percent while the Z500 comes at a cost premium of 92.4 percent. Figure 13 shows the average percent savings from medium-duty EVs.

Figure 13: Average Percent Savings from Medium-Duty EVs



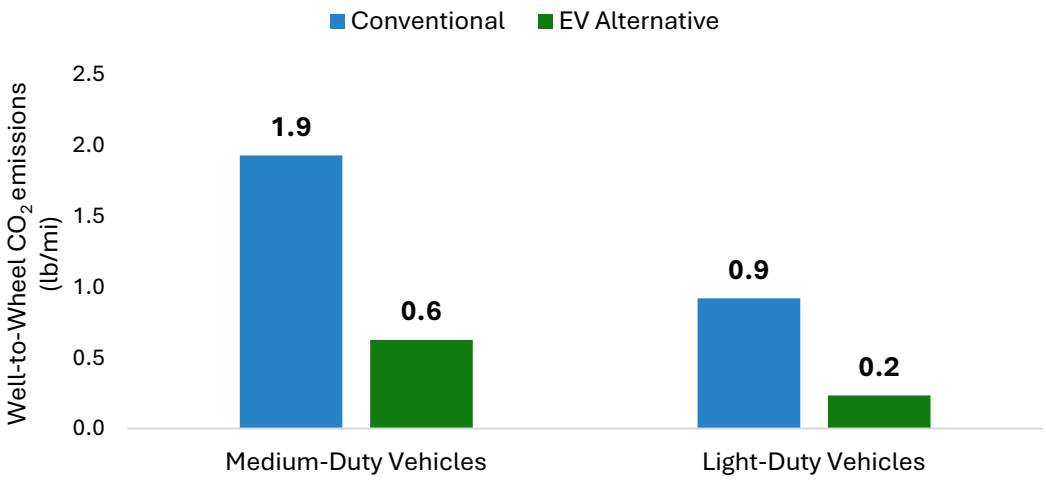
Key Insights from Medium- and Heavy-Duty Analysis

- Nevada can realize savings even without rebates or grants by electrifying nine out of 19 medium-duty vehicles, representing 47 percent of the medium-duty fleet.
- Electric vans such as the Ford eTransit offer lower lifetime costs than conventional vehicles on average.
- Annual vehicle miles traveled makes or breaks the case for electrification, especially in the case of the Ford eTransit.
- Electric work trucks and medium duty pickup trucks do not yet offer as favorable total costs of ownership as conventional vehicles.

Emissions Analysis

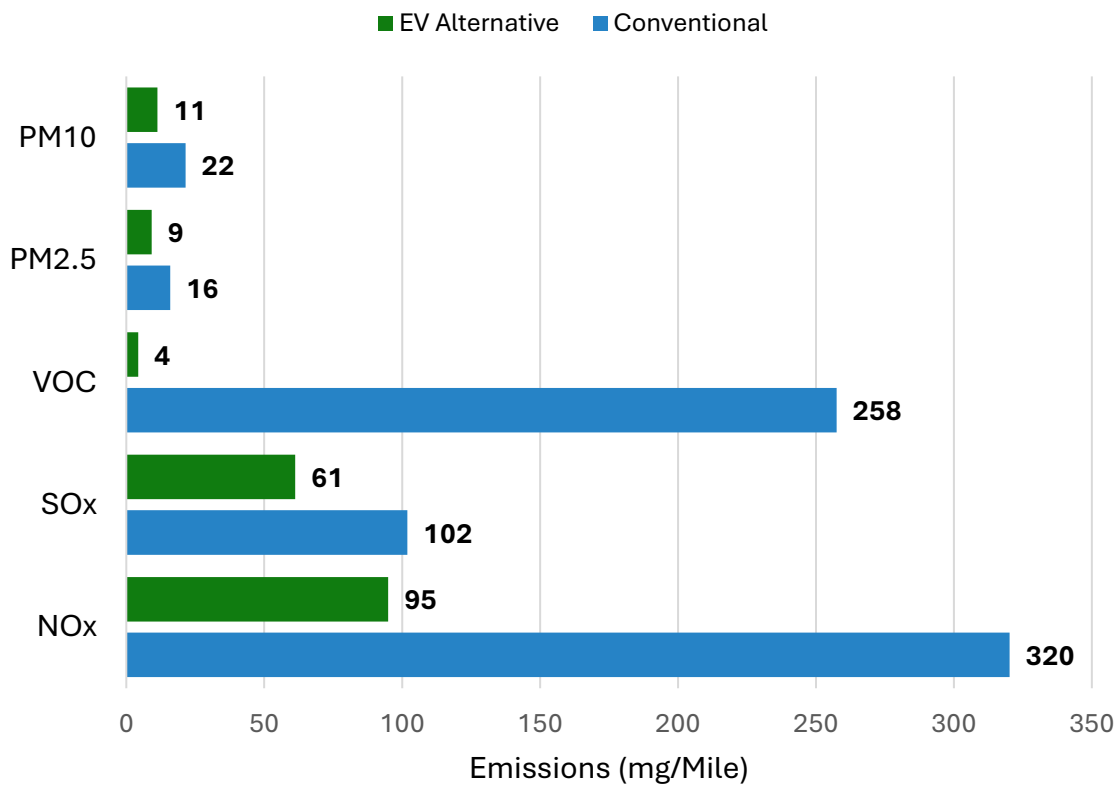
EVs across all vehicle types offer substantial emissions savings compared to conventional vehicles. Light-duty vehicles offer the greatest relative emissions savings, with EVs accounting for less than one-quarter the CO_2 of conventional vehicles. Electric medium- and heavy-duty vehicles emit roughly one-third the CO_2 of conventional vehicles. In total, electrifying Nevada's fleet under the current power mix could lead to 73 percent less CO2 emissions compared to conventional vehicle replacements on a per mile basis. Figure 14 shows this comparison.

Figure 14: Well-to-wheel CO2 Emission Comparison



In terms of other emissions, EVs emit less across all categories and could reduce emissions of criteria pollutants like NOx by a factor of three. EVs emit roughly two times less particulate matter compared to conventional vehicles. Figure 15 shows this comparison.

Figure 15: Criteria Air Pollutant Emissions Comparison Across Fleet



Appendix A: Analysis Inputs

Vehicle Inputs

Input Field	Assumption
Vehicle Prices	Vehicle purchase prices are based on MSRPs for light-duty vehicles and drawn from a variety of online sources and original research for MDHD vehicles
Expected Years of Use	10 years of use or 125,000 miles
Annual VMT	Annual VMT is calculated for each vehicle based on average monthly miles provided by the state fleet. A floor of 7,000 miles per year is used to account for the minimum mileage expected of a new vehicle
Maintenance Costs	Default maintenance and repair costs are used and depend on vehicle class and drivetrain
Insurance Costs	Insurance costs of $105.20 is used for light-duty vehicles. The default is used for MDHD.

Vehicle Procurement Inputs

Input Field	Assumption
Discount Rate	A discount rate of 0 percent is used to calculate net present value.
Pricing Approach	An “MSRP down” pricing approach is used.
Ownership Strategy	A cash purchase is assumed.
Tax Credit Monetization	The federal tax credit for EVs is not included in this analysis.
Incentives	No other state or local incentives are included in the analysis.

Market Inputs

Input Field	Assumption
Gasoline Price	Gasoline prices are set at the county level and range from $3.55 to $4.38 per gallon based on the trailing 12-month average calculated by EIA.
Diesel Price	$3.84 per gallon is used as the most recent estimate from EIA for the statewide average.
Electricity Price	$0.083/kWh is used as a weighted average of commercial electricity prices from EIA's survey of electric utilities.
Inflation Rate	An Inflation rate of 2.2% is used for maintenance and other operating costs based on the Federal Reserve's medium-term target. Inflation for fuel is based on data from EIA.
Cost of Carbon	The social cost of carbon is not included in this analysis

Charging Strategy

Input Field	Assumption
Charging Mix	All charging is assumed to occur at the depot or workplace.
Charging Procurement	The cost of purchasing and installing charging infrastructure is not included in this analysis.

Appendix B: Vehicle Mappings

Vehicle	Use Case	Conventional Replacement	Electric Alternative	Count	Avg Percent Savings from EVs
Toyota Prius	Sedan	Toyota Prius	Chevrolet Bolt EV BEV	33	16%
Chevrolet Malibu	Sedan	Chevrolet Malibu	Chevrolet Bolt EV BEV	23	24%
Ford Focus	Sedan	Chevrolet Malibu	Chevrolet Bolt EV BEV	21	24%
Chevrolet Cobalt	Sedan	Chevrolet Malibu	Chevrolet Bolt EV BEV	20	23%
Chevrolet Impala	Sedan	Chevrolet Malibu	Chevrolet Bolt EV BEV	17	24%
Ford Fusion	Sedan	Chevrolet Malibu	Chevrolet Bolt EV BEV	14	23%
Toyota Rav4	SUV	Toyota RAV4	Toyota RAV4 Prime PHEV	14	16%
Dodge Grand Caravan	Minivan	Chrysler Pacifica	Chrysler Pacifica Hybrid PHEV	12	22%
Chevrolet Traverse	SUV	Chevrolet Traverse	Chevrolet Equinox EV BEV	12	39%
Chevrolet Express	Van	Chevrolet Express	Ford eTransit - Passenger Van BEV	8	9%
Ford Explorer	SUV	Ford Explorer	Ford Escape PHEV PHEV	8	23%
Toyota Camry	Sedan	Toyota Camry LE/SE	Chevrolet Bolt EV BEV	5	24%
Ford Expedition	SUV	Ford Expedition	Ford Escape PHEV PHEV	4	35%
Ford Taurus	Sedan	Chevrolet Malibu	Tesla Model 3 BEV	4	2%
Gmc Canyon	Pickup Truck	Ford F150 Pickup	Ford F-150 Lightning BEV	3	23%
Ford F-150	Pickup Truck	Ford F150 Pickup	Ford F-150 Lightning BEV	3	25%
Chevrolet Silverado	Pickup Truck	Chevrolet Silverado	Ford F-150 Lightning BEV	3	20%
Dodge Caravan/Grand Caravan	Minivan	Chrysler Pacifica	Chrysler Pacifica Hybrid PHEV	3	22%
Toyota Corolla	Sedan	Toyota Corolla	Chevrolet Bolt EV BEV	2	21%
Honda Civic	Sedan	Honda Civic 4Dr	Chevrolet Bolt EV BEV	2	23%
Ford F-250	Work Truck	Ford F-250 Service Body	Phoenix Motorcars Z500 - Work Truck BEV	2	-109%

Vehicle	Use Case	Conventional Replacement	Electric Alternative	Count	Avg Percent Savings from EVs
Chevrolet Trailblazer	SUV	Chevrolet Trailblazer	Chevrolet Blazer EV BEV	2	-5%
Chevrolet Colorado	Pickup Truck	Chevrolet Colorado	Ford F-150 Lightning BEV	2	20%
Toyota Yaris	Sedan	Chevrolet Malibu	Tesla Model 3 BEV	2	3%
Chrysler Sebring	Sedan	Chrysler 300	Chevrolet Bolt EV BEV	2	35%
Ford Transit Connect	Van	Ford Transit Full Size Cargo Van	Ford eTransit - Cargo Van BEV	2	22%
Dodge Stratus	Sedan	Chevrolet Malibu	Tesla Model 3 BEV	2	3%
Ford Transit	Van	Ford Transit Full Size Cargo Van	Ford eTransit - Cargo Van BEV	2	23%
Toyota Highlander	SUV	Ford Explorer	Chevrolet Blazer EV BEV	1	11%
Dodge Dakota	Pickup Truck	Ram 1500	Ford F-150 Lightning BEV	1	24%
Dodge Ram	Van	Ford Transit Full Size Cargo Van	Ford eTransit - Cargo Van BEV	1	18%
Gmc Savana	Van	Ford Transit Connect Van	Ford eTransit - Cargo Van BEV	1	-51%
Ford E-350	Van	Ford E-350	Ford eTransit - Passenger Van BEV	1	-3%
Gmc Sierra	Pickup Truck	GMC Sierra	Ford F-150 Lightning BEV	1	16%
Chevrolet Cruze	Sedan	Chevrolet Malibu	Chevrolet Bolt EV BEV	1	24%
Dodge Ram Chassis Cab	Work Truck	Ford F-350 Service Body	Phoenix Motorcars Z500 - Work Truck BEV	1	-90%
Toyota Scion Xb	SUV	Ford Explorer	Chevrolet Blazer EV BEV	1	17%
Ram 2500	Pickup Truck	Ford F-250 Service Body	Phoenix Motorcars Z500 - Work Truck BEV	1	-64%
Chevrolet Tahoe	SUV	Chevrolet Tahoe	Chevrolet Blazer EV BEV	1	29%
Ford Ranger	Pickup Truck	Ford Ranger	Ford F-150 Lightning BEV	1	18%