Saving Taxpayer Money on Florida’s Vehicle Fleet:

Total Cost of Ownership Survey and Savings

Advanced Energy United and the Electrification Coalition
March 2023

Executive Summary

As Florida policymakers consider ways to save taxpayer dollars and keep operating costs low in these turbulent economic times, one potential area for consideration is procurement of the state's vehicle fleet, and how the state chooses which new vehicles to purchase for that fleet. By applying what is known as a total cost of ownership (TCO) analysis in making those fleet vehicle choices, Florida could better factor in all of the lifetime costs of operating various vehicles, and make smarter purchasing decisions accordingly. To help illustrate the economic benefits of such an approach, this analysis examines the existing state fleet, and projects potential savings from applying a TCO analysis to new fleet vehicle purchases.

Specifically, through analysis of the state's vehicle data provided by the Florida Department of Management Services, four internal combustion engine (ICE) vehicle types were identified as most widely used in the state's fleet: pickups, sedans, SUVs, and vans. These light-duty vehicles account for **88% of all vehicles** in the fleet. For each of those vehicle types, factors related to a TCO analysis were averaged across the most popular models in Florida's fleet (manufacturer suggested retail price (MSRP), annual fuel cost, and maintenance cost). Comparable electric vehicles (EVs) were selected based on these vehicle models and the same set of statistics were gathered and compiled into the table below.

Table 1 - Savings per Vehicle Type

Vehicle Type	Pickup		Sedan		SUV		Van	
Fuel Type	ICE	EV	ICE	EV	ICE	EV	ICE	EV
% of Light Duty Fleet	35%		33%		13%		12%	
Avg MSRP (Low End)	$26,609	$53,737	$27,436	$32,370	$29,209	$43,262	$31,190	$49,575
Avg MSRP (High End)	$55,350	$81,937	$39,960	$35,792	$34,212	$46,493	$32,067	$56,895
Avg Annual Fuel Cost	$2546	$1000	$2619	$600	$2511	$640	$4084	$2000
Avg Annual Maintenance Cost	$682	$341	$483	$241	$481	$240	$885	$442
Cost to Install Level 2 Charger	N/A	$5,000	N/A	$5,000	N/A	$5,000	N/A	$5,000
Savings Per Vehicle	**$13,500**		**$19,000**		**$19,000**		**$23,000**	

Notes: Savings per vehicle calculated over a 15 year estimated life span of each vehicle.

Savings = [15 Year ICE TCO] - [15 year EV TCO]
*[15 Yr ICE TCO] = (average ICE MSRP + 15 * (annual fuel cost + annual maintenance cost))*
*[15 Yr EV TCO] = (**EV MSRP*** + 5k for charger + 15* (annual fuel cost + annual maintenance cost))*
**Because EV MSRPs range widely, MSRPs that were comparable to ICE vehicle counterparts were used, as long as they were still within the MSRP range in the table (usually around $5-10k more)*

From this data, the following conclusions became apparent:

- EVs offered an average of over $18,000 in savings per vehicle over 15 years and over $2,800 in 10 years
- Generally after the fifth year of use, maintenance fees of ICE vehicles increase drastically when compared to equivalent EVs
- Fuel costs differ drastically, with electricity being consistently more stable and lower in price
- EVs are seen to be more cost effective than ICE vehicles after as little as 5-8 years

Based on these findings, it was deduced that by fully transitioning the total fleet (17,500 vehicles) to comparable electric alternatives, the state would save about **$277 million over 15 years**.

Note: Explanations of how these figures were calculated can be found in the TCO Parameters Sections

Potential Benefits of Fleet Optimization

A total cost of ownership (TCO) analysis is the most accurate and fiscally responsible approach to fleet procurement in Florida. This approach will ensure that Florida procures vehicles that are the most affordable over the lifetime of the vehicle, which will result in significant savings for the state and for taxpayers. This is especially important in today's economy, with the rising cost of living and inflation making every dollar matter to Florida families. Additionally, this analysis is likely to result in the procurement of newer, more modern, and more efficient vehicles.

This approach will save Florida money on fuel, maintenance, and repairs. For example, we know that a TCO analysis often reveals that electric vehicles have lower lifetime costs than gas-powered vehicles. This means that if the state only considers upfront price during procurement, it may forgo potential savings. On average, fueling EVs in Florida saves approximately 64% more when compared to equivalent gas-powered vehicles. Maintenance costs of EVs are three times lower than for gas vehicles in the first three years alone. By considering these factors, and working to procure more electric vehicles when it is cheaper to do so, Florida can save taxpayers $277 million over 15 years.

Fleet vehicles are also prime candidates for this analysis and for electrification because of their usage patterns. With their pattern of returning to depots when not in use, fleet vehicles are good candidates for electrification because EV chargers can be installed at depots to fit into the routine of vehicle use. This routine also allows for predictable charging when the vehicles are stationary.

Savings From Sample Fleet

Using the Alternative Fuels Data Center's (AFDC) Vehicle Cost Calculator, the figures below are the long-term savings for the sample fleet.[1][2] While the MSRP of EVs on average was $10,000 more than the MSRP of conventional ICE vehicles, EVs offered an average of over $23,500 in savings over a 15 year period.

The following vehicles were identified to replace the most common ICE vehicles in Florida for a TCO analysis.[3][4][5] The EV models were selected based on similar MSRP and use case of ICE model choices.

Table 2 - Savings per Vehicle Type from Sample Fleet

Vehicle Type	Pickup	Sedan	SUV	Van
ICE Model	2017 Ford F150	2018 Ford Fusion	2020 Chevrolet Equinox	2011 Ford E350
ICE Estimated TCO	$100,000	$98,000	$89,000	$130,000
EV Model	2022 Ford F150 Lightning	2019 Chevrolet Bolt EV	2020 Hyundai Kona Electric EV	2023 Ford E-Transit
EV Estimated TCO	$85,000	$76,000	$76,000	$93,000
Savings per Vehicle	**$15,000**	**$22,000**	**$13,000**	**$37,000**

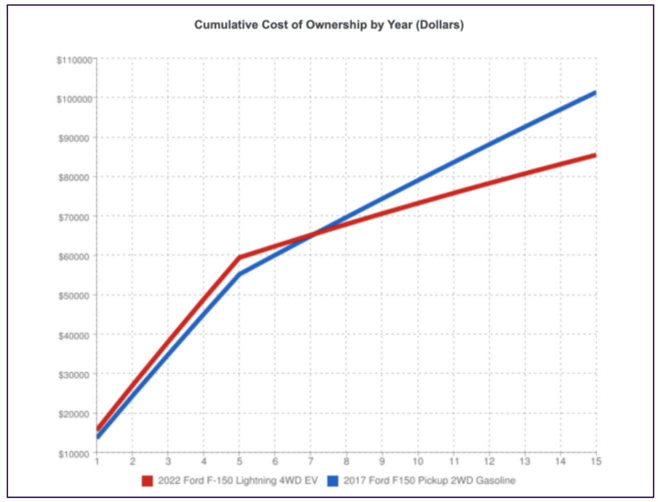
Notes: ICE vehicles were selected as the most frequent make/model/year from the dataset provided by Florida; EV models were selected based on similar years and MSRPs.

---

1 AFDC. https://afdc.energy.gov/calc/
2 The average fuel cost for an EV van was estimated at $2000 per year.
3 ICE models picked from the most frequent make model year of each vehicle type from the dataset. The TCO is based on 15 years, 15,000 miles/year, 55% city driving. Due to insufficient data on the 2023 Ford E-Transit, its estimated TCO was calculated by using $56,000 MSRP, $2000 annual fuel cost, and $442 annual maintenance cost.
4 Savings for fleet sector based on the percentage of vehicle type for 17,500 light-duty vehicle fleet, the difference between TCO estimates (does not include insurance)*(MSRP) + 15*(annual fuel + maintenance costs)
5 AFDC. https://afdc.energy.gov/calc/

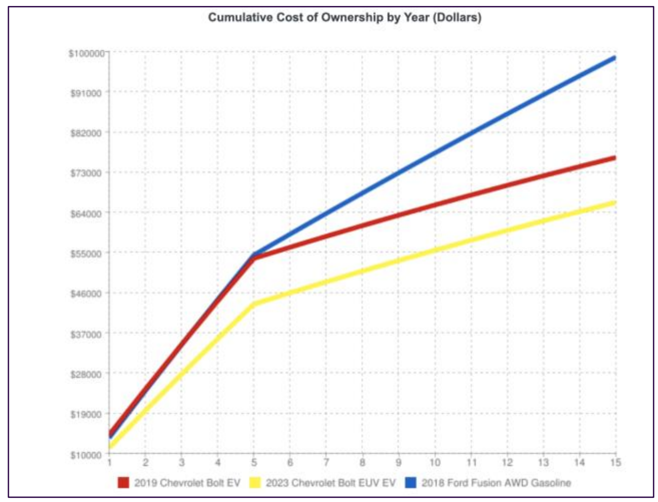
Ford F-150 Pickup Sample

In Florida, the most common pickup truck is the 2017 Ford F-150, with 329 vehicles in the state's fleet. Using the Vehicle Cost Calculator, a 2017 Ford F-150 2WD and a 2022 Ford F-150 Lightning 4WD were compared.[6] By the seventh year, the F-150 Lightning is less costly than the ICE F-150.



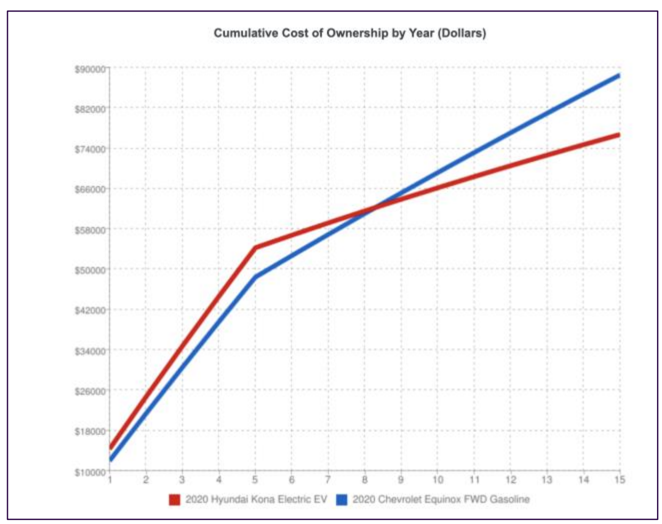
Chevrolet Bolt Sedan Sample

In Florida, the most common sedan is the 2018 Ford Fusion FWD, with 179 vehicles in the state's fleet. Using the Vehicle Cost Calculator, a 2018 Ford Fusion FWD, a 2023 Chevrolet Bolt EUV, and a 2019 Chevrolet Bolt EV were compared.[7] In the first year, the Bolt EUV is less costly than both the Bolt and Fusion. By the fifth year, the Bolt is less costly than the Fusion. It is also interesting to note that the 2023 model of the Chevrolet Bolt EV has the potential to save about $10,000 more than the 2019 model.



Hyundai Kona SUV Sample

In Florida, the most common SUV vehicle is the 2020 Chevrolet Equinox, with 110 vehicles in the state's fleet. Using the Vehicle Cost Calculator, a 2020 Chevrolet Equinox and a 2020 Hyundai Kona Electric were compared.[8] By the eighth year, the Kona is less costly than an Equinox.



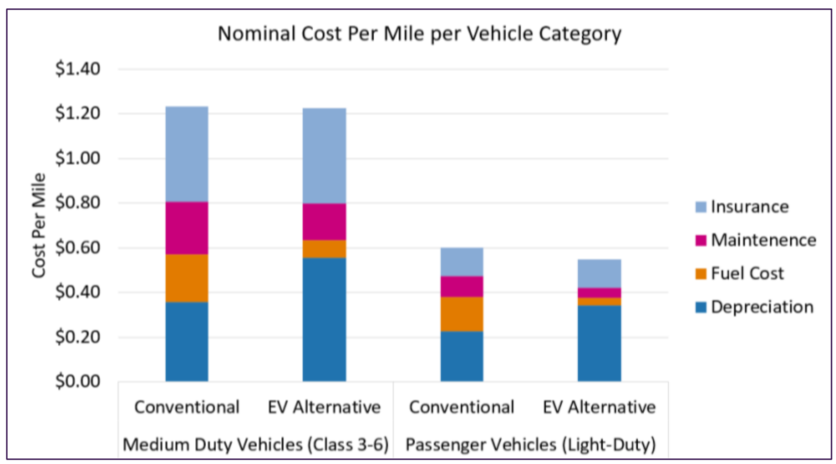
[6] AFDC. https://afdc.energy.gov/calc/
[7] AFDC. https://afdc.energy.gov/calc/
[8] AFDC. https://afdc.energy.gov/calc/

DRVE Tool Sample Analysis Results

A separate analysis was performed to provide a moderate estimate to better reflect fleet vehicles that are used less and switched out more frequently. Across the sample fleet, current EVs were found to be more cost-effective when compared to popular ICE models used in Florida. In running the sample fleet analysis in the Dashboard for Rapid Vehicle Electrification (DRVE Tool), the results showed cost savings over 7 years of use and 10,000 miles traveled per year.[9] If all vehicles were replaced with EVs, the sample fleet would have an average total net present value (NPV) cost of $0.72 ($50,342.15) if replaced with EVs, whereas conventional replacement vehicles would cost an average of $0.76 ($53,144.68). This saves the fleet $0.04 per mile, or $2,802.53.[10] For the full table, please see Appendix A.

Below are figures which break down the itemized costs per mile by vehicle category. Each light-duty category displays at least $0.08 per mile savings on EV maintenance compared to its ICE alternative. Regarding fuel costs, there is a sharp contrast between ICE vehicles and EVs, as electricity prices are generally lower and less volatile than gasoline or diesel.[11]

For both passenger and medium-duty vehicles in the figure below, passenger EVs save an average total NPV of $0.55 per mile ($38,500.94) when compared to passenger ICE vehicles. In the medium-duty category, both the EV and ICE vehicles save an average total NPV of $1.23 per mile ($85,865.79).[12] These EV cost savings are expected to continue to improve, as the EV market growth continues, driving down the cost of batteries and other components.



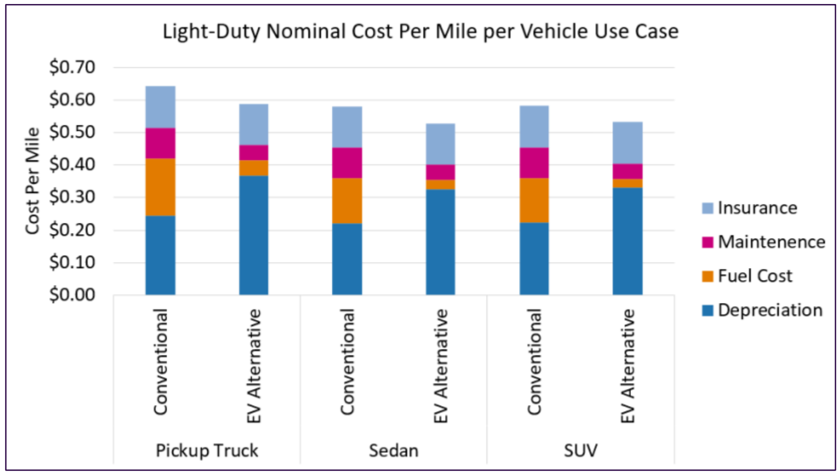
9 Electrification Coalition. https://electrificationcoalition.org/resource/drve/

10 Note: This average is drastically skewed due to the current costs of medium-duty EVs and ICE vehicles. Light-duty EVs save $0.05 per mile ($3,585.39) when compared to equivolent ICE vehicles.

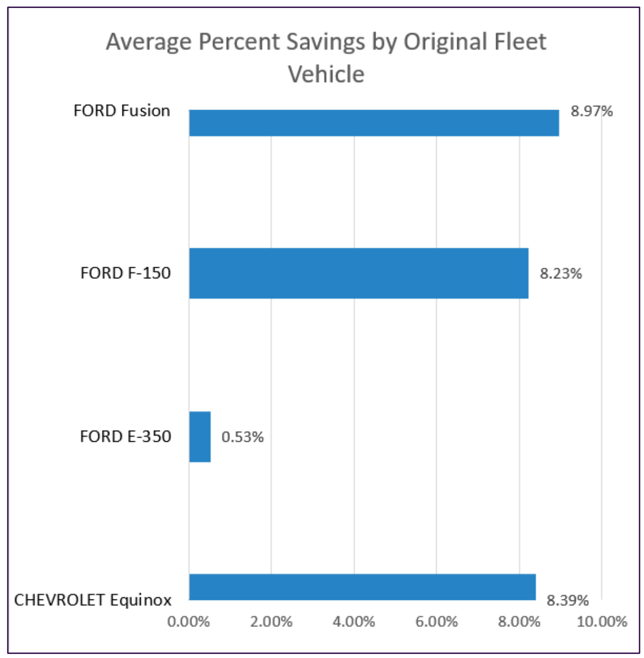
11 Fuel prices are based on the current average costs in Orlando for gasoline ($3.17 per gallon), diesel ($4.51 per gallon), and the commercial estimate to charge ($0.0966 per kilowatt hour). For the Van category, a 2023 Ford E-350 was used to best compare with a 2023 Ford eTransit Cargo Van. For the Pickup category, a 2022 Ford F-150 4WD was used to best compare with a 2022 Ford F-150 Lightning 4WD. For the Sedan category, a 2020 Ford Fusion FWD was used to best compare with a 2020 Chevy Bolt EV. No tax incentives were included in the results.

12 Electrification Coalition. https://electrificationcoalition.org/wp-content/uploads/2021/11/DRVE-User-Guide-1.6-1.pdf

The figure to the right shows passenger or light-duty EVs saving at least $0.05 per mile, and an itemized breakdown of costs by pickup truck, sedan, and SUV.



The figure to the right displays the percentages of savings by each vehicle if replaced with a comparable EV alternative. As shown, all EV alternatives have net positive savings.



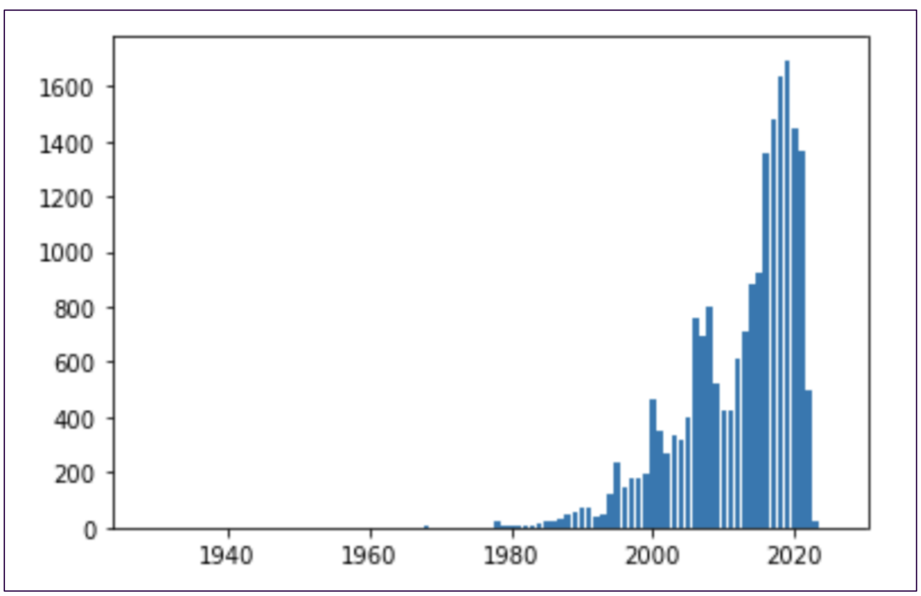
Methodology

Initial Data Analysis

A dataset provided by the State of Florida included a list of just under 20,000 vehicles currently in their statewide fleet. Each vehicle has a corresponding agency, model year, make, model, and vehicle type. In addition, two more columns in the dataset are labeled "Total Expenses" and "Total Fuel Cost." This dataset was helpful in developing a TCO for this fleet but required some modifications and cleaning to address issues of missing data and to make the data more robust.

For example, 61% of vehicles listed had no associated expense cost (0's in "Total Expenses" field), and 32% of vehicles had no associated fuel cost (zeros in "Total Fuel Cost" field). This posed questions of accuracy for the dataset, as some vehicles listed with no fuel cost did have expenses. In addition to these inconsistencies, the data features themselves were not very specific, as it was unclear whether "Total Fuel Cost" referred to the total cost of fuel over the lifespan of the vehicle, or just from a year of use. There was also a wide range of vehicle model years that greatly extended past the generally accepted 10-12 years of use, with the oldest vehicle being from 1929. Although a majority of the vehicles were from after 2005, this uncertainty led to the use of a supplementary dataset to create a fair comparison to comparable electric vehicles for this specific fleet.

Vehicle Year Distribution



Data Cleaning and Supplementing

To assess the benefits of switching to EVs more accurately, the dataset was split into three categories by vehicle type (light, medium, and heavy-duty vehicles) because each class can vary in usage and infrastructure required.[13]

Table 3 - Vehicle Class Breakdown

Vehicle Class	Light-Duty	Medium-Duty	Heavy Duty
Weight Range (lbs.)	< 14,000	14,001 – 26,000	> 26,000
% of Dataset	87.8%	4.7%	6.5%

Once the dataset was split, it was condensed into around 14,000 unique combinations of vehicle makes, models, and years, to which a new data feature (counts) could be added. This allowed for a smaller dataset to add more features without unnecessary repetitiveness in the data. To supplement the data, another dataset was isolated from fueleconomy.gov, which is updated weekly by the U.S. Department of Energy and the U.S. Environmental Protection Agency. The two datasets were merged based on make, model, and year.

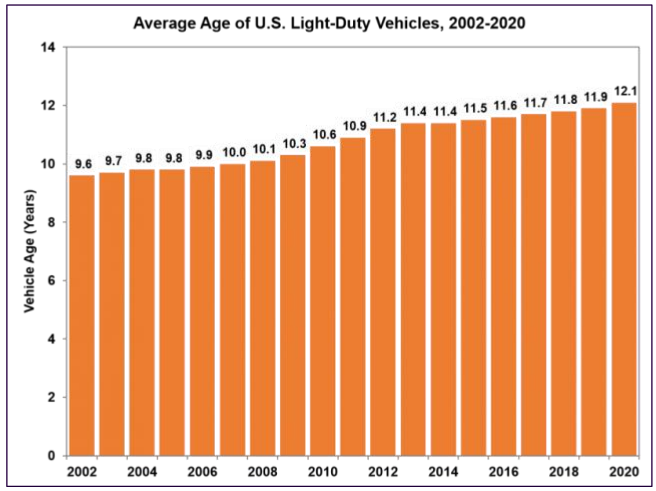
Due to the variability and uncertainty of the original dataset's "Total Expenses" and "Total Fuel Cost" features, these were removed from the dataset. In their place, data columns were chosen from the dataset to supplement fuel costs–namely, "fuelCost08" and "fuelCostA08" which are estimations of annual fuel costs "based on 15,000 miles, 55% city driving, and the price of fuel used by the vehicle."[14] Because this resource has this data for all vehicles from the original dataset, as well as any comparable EV models, it provides a more general and fair way to compare fuel costs.

[13] Vehicle weight ranges were decided based on the Florida Department of Management Services classifications. https://www.dms.myflorida.com/content/download/153614/1020594/Logs_Required_&_Optional.pdf

[14] AFDC. https://www.fueleconomy.gov/feg/ws/index.shtml

TCO Parameters

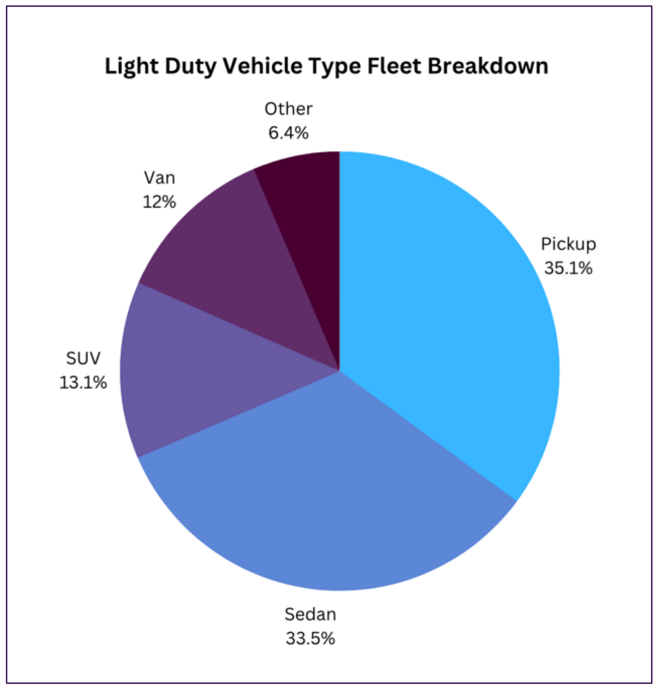
Expected Vehicle Lifetime



From 2002 to 2020, the life expectancy of light-duty vehicles in the U.S. rose by an average of 2.5 years (i.e., 12.1 years total).[15] Vehicles from 2009 to 2013 have the most increased age range.

Total Fleet MSRP

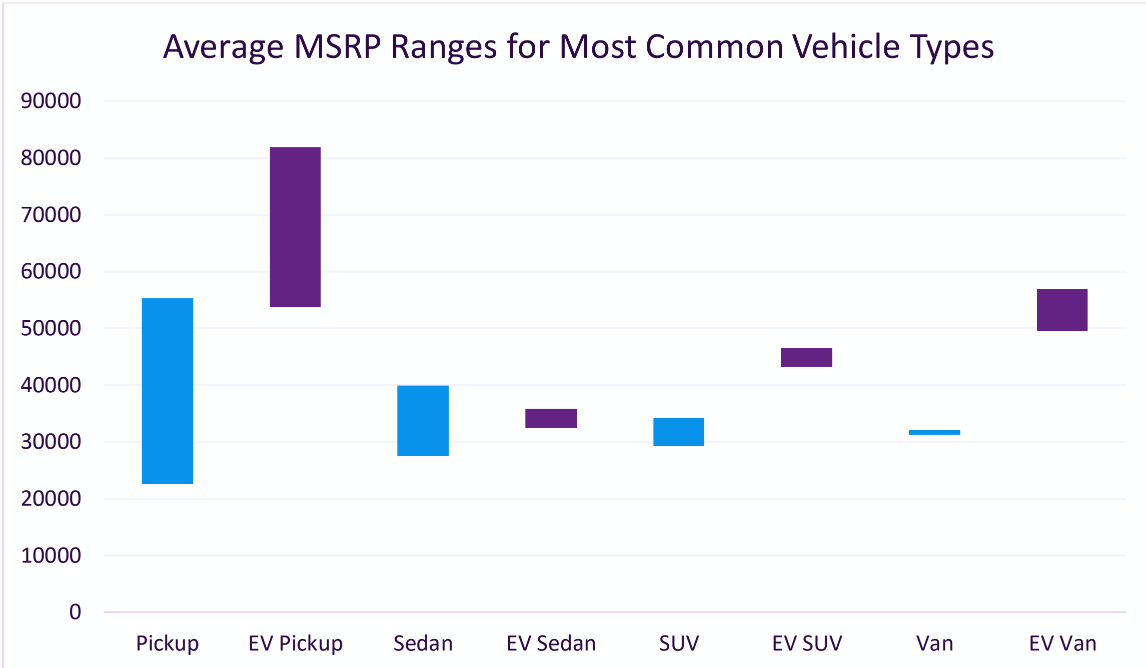
Because there is not an adequate dataset that details MSRPs for all the vehicles in this fleet, some deeper analysis was required to understand how much was generally being spent on these vehicles. First, it was determined that of the roughly 17,500 light duty vehicles in the fleet, 93% of them fell into one of four vehicle type categories (Pickup, Sedan, SUV, and Van).



The four most common vehicle types were then broken down to extrapolate the vehicles with the most frequent make, model, and year. As MSRPs are generally based on all three factors, it was important to isolate vehicles based on these parameters. The top five most frequent vehicles were then researched using the Vehicle Cost Calculator and supplementary sources for vehicles not included in that source to find the low and high ends of their MSRP. These high- and low-end values were calculated by a weighted average of the vehicle frequency and MSRPs.

Once those values were determined, fueleconomy.gov was used once again to find comparable EVs for each of the four major categories of vehicle. Then the same process was conducted to find high- and low-end MSRP values for available EV models.

[15] DOE. https://www.energy.gov/eere/vehicles/articles/fotw-1198-august-9-2021-average-age-us-light-duty-vehicles-reached-new-high



MSRP Limitations and Assumptions

The source fueleconomy.gov does not contain some of the more specialized vehicles, like the Ford E-350, so additional sources were used to estimate MSRPs. These sources are found in the dataset. When determining EV models that are comparable to the most common vehicles in the fleet, there was a difference in the variety of EV models. Ford has become a leader in the vocational space for trucks and vans with the launch of the F-150 Lightning and eTransit, which were used as the EV comparison. This is reflected in the chart above by the more variable MSRPs for Pickups and Vans.

Annual Fuel Cost

With the original fleet, the same vehicles from the MSRP analysis in the section "Total Fleet MSRP" were used, and then that dataset was merged with the Vehicle Cost Calculator to get the annual fuel costs. This was due to 30% of the vehicles missing fuel costs in the dataset that was received. For a fair comparison, the average annual fuel costs were based on 15,000 miles, 55% city driving, and the price of fuel used by the vehicle for each of the sample vehicles, with the assumption that each vehicle is driven the same way. Fuel prices for E85, LPG, and CNG are from the Office of Energy Efficiency and Renewable Energy's 2021 Alternative Fuel Price Report and are updated quarterly.[16] On average, **EVs save 64% on fuel cost**.

[16] Office of Energy Efficiency and Renewable Energy. https://www.energy.gov/eere/vehicles/articles/fotw-1179-march-29-2021-all-electric-vehicles-have-lowest-estimated-annual

Table 4 - Average Annual Fuel Cost

Vehicle Class	Pickup	Sedan	SUV	Van
Existing Fleet	$2,546	$2,619	$2,511	$4,084
EV Equivalents	$1,000	$600	$640	$2,000

Notes: Annual fuel cost is based on 15,000 miles, 55% city driving, and the price of fuel used by the vehicle. Van EV Equivalent fuel cost is estimated at $2,000 because there are not currently widely used fully electric vans on the market. Instead, half of Existing Fleet Van fuel cost was used to reflect the trend that EVs reliably reduce fuel costs by at least half.[17]

Maintenance Cost

Using maintenance costs from the original dataset, we assumed about half of the costs will remain for EVs, as Consumer Reports found the maintenance and repair costs of gasoline vehicles ($9,200) to be more than EVs ($4,600).[18]

Charging Infrastructure Cost

There are three levels of charging stations:[19]

- **Level 1 -** Uses a standard 120V wall outlet, mostly for residential charging, and adds 4-5 miles of range per hour.
- **Level 2 -** Uses a 220V outlet similar to that used for larger household appliances, is most used for residential, workplace, hotel, or shopping center charging, and adds 25 miles of range per hour.

---

[17] Consumer Reports. https://www.consumerreports.org/hybrids-evs/evs-offer-big-savings-over-traditional-gas-powered-cars/

[18] Great Plains Institute. https://betterenergy.org/blog/consumer-reports-study-finds-electric-vehicle-maintenance-costs-are-50-less-than-gas-powered-cars/

[19] JD Power. https://www.jdpower.com/cars/shopping-guides/how-much-does-it-cost-to-install-an-ev-charger?make=&model=#:~:text=Most%20Common%20Charging%20Stations%20And,%E2%80%93%20something%20between%20%24200%20%2D%20%24500

- **Level 3 -** Uses a high power direct current (DC) output (50 to 350 kW) and is used for highway corridors, commercial vehicles and high traffic public areas. Full charges most light duty vehicles in 30-45 minutes and larger vehicles in 2-3 hours.

For the purposes of this research, we used an estimate for the cost to install a Level 2 charger of $5,000 for every EV in a 17,500 vehicle fleet, which amounts to $87.5 million in total. In real world applications it is unlikely every vehicle would require its own dedicated charging equipment.

Best Case Estimation

Below is another model to estimate infrastructure costs based on the assumption that one charger can support multiple EVs. The Level 2 charger (most common for commercial uses) uses a 240 V unit, with a charge rate of 19.2 kW. Below is a table detailing the method used to estimate how many chargers would be needed to support a 17,500 vehicle fleet (Vans were excluded from calculations as there is insufficient data).

Table 5 - Charging Time Calculations

Vehicle Type	Pickup	Sedan	SUV
Time to Fully Charge	11.5 hours	5.5 hours	8 hours
Avg MPGe	70 miles	115 miles	110 miles
Time to Refuel 41 miles	1 hour	0.63 hours	0.65 hours

Method used to calculate time to fully charge a vehicle based on type:

- (Vehicle kWh capacity) / (Charge capacity for Level 2 charger) = Hours to fully charge

Common Level 2 chargers include 2 ports, and cost around $7,200 to install.[20] All above calculations assume a yearly usage of 15,000 miles and 55% city driving, which roughly translates to 41 miles/day every day for 1 year.[21] While this is not a universal model of vehicle usage, it serves as a comparison point for EVs and gasoline vehicles. Assuming the state has a fleet of 17,500 light-duty vehicles that drive around 41 miles a day, that would only require about an hour a day to replenish the energy for the 41 miles. If a vehicle only needs to be plugged in for around an hour a day, it is feasible for 1 charger to support many EVs. If one

[20] https://futureenergy.com/installing-a-commercial-ev-charging-station/
[21] Most Americans drive around 30-40 miles per day. https://www.thezebra.com/resources/driving/average-miles-driven-per-year/#states-where-americans-drive-the-most

charger has 2 ports, it is reasonable to assume about 8 vehicles can be supported by each charger, and this would only require the charger to be in use for 4 hours a day, so the number of vehicles supported could be much more.

In a scenario where the state's vehicle charging needs are optimally managed using shared charging equipment (8 vehicles/charger), only 2,200 chargers would need to be installed, amounting to only $15,750,000 in installation costs. This Best Case Estimation would bring total savings from $277 million to **$349 million over 15 years**, compared to the '1 vehicle/charger' assumption used earlier.

Related Work

- Electrification Coaltion's Dashboard for Rapid Vehicle Electrification allows users to upload their fleet data to receive a customized analysis with potential EV replacements, all based on the total cost of ownership.
- World Resources Institute's Electric School Bus Initiative is a collaborative effort to equitably transition the entire U.S. school bus fleet to electric by 2030, bringing health, climate and economic benefits to children and families across the country and normalizing electric mobility for an entire generation.

Appendix A - Additional DRVE Tool Results

Below is a comparison of each sample vehicle's net present value. In every use case category for the most commonly used vehicles, ICE vehicles cost more per mile than EVs.

Table 3 - Average Total Net Present Value Cost ($/Mile)

Use Case	Average Total NPV Cost ($/Mile)	Total NPV Cost
Pickup Truck		
2022 Ford F-150 Pickup 4WD (Conventional)	$0.64	$44,923.53
2022 Ford F-150 Lightning 4WD (EV Alternative)	$0.59	$41,228.14
Sedan		
2020 Ford Fusion (Conventional)	$0.58	$40,636.91
2020 Chevrolet Bolt EV (EV Alternative)	$0.53	$36,990.84
SUV		
2020 Chevrolet Equinox AWD (Conventional)	$0.58	$40,698.55
2020 Hyundai Kona Electric (EV Alternative)	$0.53	$37,283.84
Vans		
2023 Ford E-350 (Conventional)	$1.23	$86,319.73
2023 Ford E-Transit Cargo Van (EV Alternative)	$1.23	$85,865.79