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# ELECTRIFYING UD'S MAINTENANCE FLEET: FEASIBILITY ASSESSMENT & RECOMMENDATIONS



MAST664: Environmental Issues Capstone

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# PRESENTATION OUTLINE

1

PROJECT OVERVIEW

2

PROJECT CONTEXT

3

STUDY CAVEAT

4

## METHODS

- Identify Replacement Vehicles
- Develop Cost Table Variables
- Data Assumptions
- Data Collection
- Difference in Cost Comparison

5

RESULTS

6

FINDINGS

7

LIMITATIONS

8

FUTURE SUGGESTIONS

9

COST TABLE

# PROJECT OVERVIEW

**Problem Statement:** The University of Delaware Parking and Transportation Services is exploring the electrification of its maintenance (FREAS) vehicle fleet.

**Objective:** Evaluate the economic and operational viability of transitioning a portion of the University of Delaware's FREAS vehicle fleet to electric vehicles (EVs).

This includes identifying fleet vehicles with EV options, comparing various operational costs and requirements, and delivering purchasing and implementation recommendations to the client.

# PROJECT CONTEXT

**Universities across the United States are increasingly exploring fleet electrification as part of broader sustainability and emissions reduction goals.**

Demonstrated EV adoption system, and that various components are required to evaluate feasibility.



Demonstrated full detailed cost analysis of what it would take to electrify an entire university fleet.



Proved life cycle cost analysis is critical for identifying cost-effective electrification opportunities and strategies.



# STUDY CAVEATS

## **Made a few overarching assumptions that serve as important context:**

- The vehicles are kept for 5 years and have driven 50K miles.
- The resale value is based on years of ownership and mileage.
- Replacement of current vehicle with a new EV or an ICE that of similar specs.
- Did not consider infrastructure cost for chargers.

# METHODS

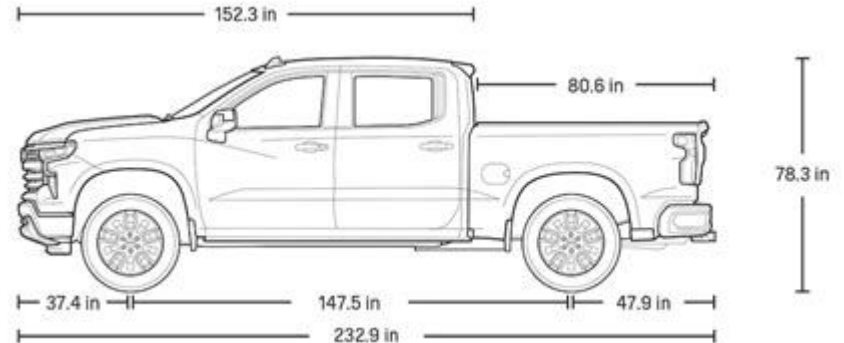


# IDENTIFY REPLACEMENT VEHICLES

- Obtained FREAS vehicle list.
- Used Edmund's, manufacturer websites, and interviews with FREAS managers to identify vehicles **without** EV alternatives.
- Eliminated vehicles according to size (heavy-duty vehicles like dump trucks were removed).
- Eliminated vehicles according to their departments (for ex. Plumbing, and Motor Pool vehicles were removed).
- Grouped remaining vehicles into 3 categories (sedan, trucks and vans).

# IDENTIFY REPLACEMENT VEHICLES

- Searched manufacturers' site for EV with similar specifications:
  - Bed length (in)
  - Cargo capacity (ft<sup>3</sup>)
  - Total distance on a full fuel load (mi)
  - Maximum payload (lbs)
  - Number of seats in vehicle
  - Basic warranty
  - Drivetrain warranty
  - Battery warranty
  - Towing capacity (lbs)



# IDENTIFY REPLACEMENT VEHICLES

- Identified replacement ICE and EV options for each vehicle type

<b>Fleet's Current ICE Vehicle</b>	<b>Replacement Option (ICE)</b>	<b>Replacement Option (EV)</b>
2016 Dodge Caravan SV	2026 Chrysler Pacifica	2026 Volkswagen ID. Buzz
2019 Chevrolet Colorado 4x4	2026 Chevy Colorado	2026 Rivian R1T
2023 Chevrolet Silverado	2026 Chevy Silverado	2026 Chevy Silverado
2017 Ford Transit Connect	2026 Ford Transit	2026 Rivian Delivery 500
2011 Ford E-250 Cargo Van	2026 Ford Transit 350 High Roof	2026 Chevy Brightdrop 400
2022 Toyota Prius Prime LE	2026 Toyota Corolla	2026 Nissan Leaf

# DEVELOP COST TABLE VARIABLES

- Selected variables for the cost table based on insights from interviews, midterm discussion, inputs from CVORG research group, and findings from studies done by Michigan State University and Liberty University.

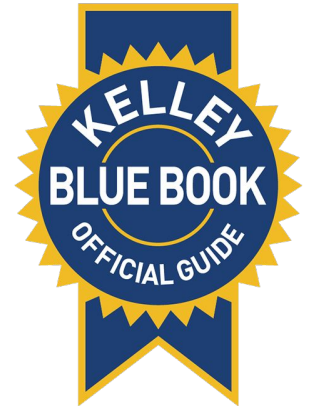
The variables include:

- Vehicle Specs and MSRP
- Vehicle Resale Price
- Fees
- Maintenance
- Fuel Cost
- Charger Costs
- Vehicle Resale Price
- Rebates and Offsets
- Social Cost of Carbon



# DATA ASSUMPTIONS

- **Only included variables that would be different between ICE and EV**
  - Ex. Insurance and accessories are the same cost for both ICE and EV
- Maintenance: 5-year maintenance costs for EVs were estimated by applying KBB's ICE-to-EV maintenance ratio to FREAS's ICE maintenance records
- Mileage: 10,000 miles/year
- UD's Electricity price: \$0.153/kWh (avg. for 5 years)
- Gas price: Gas prices are based on Delaware averages (\$4.20/gallon)
- Rebates: Assumed only state rebates were available
- Social Cost of Carbon (SCC): averaged EPA's SCC Biden and Trump's first term (Today SCC is \$0)



# DATA COLLECTION

- **For our data collection:**

- Reviewed FREAS' fleet data sheet for potential vehicles.
- Reviewed similar case studies from other universities.
- Interviewed FREAS decision makers.
- Reviewed FREAS 2024 & 2025 maintenance record.
- Researched vehicle rebates programs in Delaware.
- Researched motor vehicle fees for Delaware.
- Used fuel average for Delaware to determine fuel cost.
- Electricity rates were sourced by John Metz through City of Newark.
- SCC from EPA under President Biden and Trump (first term).

# METHODS RESULTS

## Three Findings Categories to Summarize Results:

- **Differential Cost**
  - ICE - EV subtotal cost = Differential cost.
  - Cost of owning and operating a vehicle, excluding the values that would be the same regardless of the vehicle you own.
- **Differential Cost (Including Rebates)**
  - Difference in costs including all categories with rebates.
  - DNREC rebates for EV purchase and charging hardware.
- **Differential Cost per Mile (Including Rebates)**
  - Difference in cost per mile to operate vehicle including rebates.
- **Carbon Emissions and Social Cost of Carbon for both vehicles**

# FINDINGS: SUMMARY

## **Between our cost analysis results and interview data:**

- EVs normally sell for less than ICE vehicles with similar mileage and years of ownership.
  - EVs have more purchasing fees than ICE vehicles.
- EVs have lower fuel cost than ICE vehicles.
- EV maintenance is generally less than ICE vehicles.
- EVs need infrastructure to operate (i.e. chargers).
- All EVs qualify for state rebates.
- EVs have a lower SCC and emissions rate for length of ownership

# FINDINGS: CHEAPER VEHICLE

## CHEAPER VEHICLE WITH REBATES

<b>FREAS Current ICE Vehicle</b>	<b>Replacement Option (ICE)</b>	<b>Replacement Option (EV)</b>
2016 Dodge Caravan SV	<b>2026 Chrysler Pacifica</b>	2026 Volkswagen ID. Buzz
2019 Chevrolet Colorado 4×4	<b>2026 Chevy Colorado</b>	<b>2026 Rivian R1T</b>
2023 Chevrolet Silverado	<b>2026 Chevy Silverado</b>	<b>2026 Chevy Silverado EV</b>
2017 Ford Transit Connect	<b>2026 Ford Transit</b>	2026 Rivian Delivery 500
2011 Ford E-250 Cargo Van	<b>2026 Ford Transit 350 High Roof</b>	2026 Chevy Brightdrop 400
2022 Toyota Prius Prime LE	<b>2026 Toyota Corolla</b>	2026 Nissan Leaf

# FINDINGS: CHEAPER VEHICLE

## CHEAPER VEHICLE WITH REBATES and SCC

<b>FREAS Current ICE Vehicle</b>	<b>Replacement Option (ICE)</b>	<b>Replacement Option (EV)</b>
2016 Dodge Caravan SV	2026 Chrysler Pacifica	<b>2026 Volkswagen ID. Buzz</b>
2019 Chevrolet Colorado 4x4	2026 Chevy Colorado	<b>2026 Rivian R1T</b>
2023 Chevrolet Silverado	2026 Chevy Silverado	<b>2026 Chevy Silverado</b>
2017 Ford Transit Connect	<b>2026 Ford Transit</b>	2026 Rivian Delivery 500
2011 Ford E-250 Cargo Van	<b>2026 Ford Transit 350 High Roof</b>	2026 Chevy Brightdrop 400
2022 Toyota Prius Prime LE	2026 Toyota Corolla	<b>2026 Nissan Leaf</b>

# FINDINGS: MINIVAN

Replacing 2016 Dodge Caravan SV

**2026 Chrysler Pacifica (ICE) difference in cost is \$12,467.16 less than the 2026 Volkswagen ID Buzz (EV) (\$7,467.16 less with rebates).**



**Cost difference: (+) = EV costs less**

Differential Cost	-\$12,467.16
Differential Cost (Including Rebates)	-\$7,467.16
Differential Cost per Mile (Including Rebates)	-\$0.15

# FINDINGS: SMALL TRUCK

Replacing 2019 Chevrolet  
Colorado 4x4

**2026 Chevy Colorado (ICE) difference in cost is \$2,703.03 less than the 2026 Rivian R1T (EV) (the EV cost \$2,296.97 less than the ICE with rebates).**



**Cost difference: (+) = EV costs less**

Differential Cost	-\$2,703.03
Differential Cost (Including Rebates)	\$2,296.97
Differential Cost per Mile (Including Rebates)	\$0.05

# FINDINGS: SMALL TRUCK

Replacing 2019 Chevrolet  
Colorado 4×4

**2026 Chevy Colorado (ICE)** cost is \$2,703.03 less than 2026 Rivian R1T (EV).

**Rivian R1T (EV)** cost is \$2,296.97 less than Chevy Colorado (ICE) **with rebates**.



**2026 Chevy Colorado**



**2026 Rivian R1T**

**NOTE:** The price difference is driven by the resale value of the Rivian, **\$42,740 after five years with 50,000 miles.**

# FINDINGS: MIDSIZE TRUCK

*Replacing 2023 Chevrolet  
Silverado*

**2026 Chevy Silverado (ICE) difference in cost is \$2,658.30 less than the 2026 Chevy Silverado (EV) (the EV cost \$2,341.70 less than the ICE with rebates).**



**Cost difference: (+) = EV costs less**

Differential Cost	-\$2,658.30
Differential Cost (Including Rebates)	\$2,341.70
Differential Cost per Mile (Including Rebates)	\$0.05

# FINDINGS: MIDSIZE TRUCK

*Replacing 2023 Chevrolet  
Silverado*

**2026 Chevy Silverado (ICE)** cost is \$2,658.30 less than 2026 Chevy Silverado EV.

**2026 Chevy Silverado (EV)** cost is \$2,341.70 less than Chevy Silverado (ICE) **with rebates.**



**2026 Chevy Silverado**



**2026 Chevy Silverado EV**

**NOTE:** The price difference is driven by the total cost of the fuel \$3,366.88 and the resale value of the Silverado, **\$32,320 after five years and 50,000 miles.**

# FINDINGS: CARGO VAN

Replacing 2017 Ford  
Transit Connect

2026 Ford Transit (ICE) difference in cost is \$30,954.74 less than the 2026 Rivian Delivery 500 (EV).



**Cost difference: (+) = EV costs less**

Differential Cost	-\$30,954.74
Differential Cost (Including Rebates)	-\$25,954.74
Differential Cost per Mile (Including Rebates)	-\$0.52

*Maintenance costs not included as we do not have access to maintenance data for EV cargo vans.*

# FINDINGS: MEDIUM CARGO VAN

Replacing 2011 Ford E-250  
Cargo Van

**2026 Ford Transit 350 High Roof (ICE) difference in cost is \$25,894.79 less than the 2026 Chevy Brightdrop 400 (EV).**



**Cost difference: (+) = EV costs less**

Differential Cost	-\$25,894.79
Differential Cost (Including Rebates)	-\$20,894.79
Differential Cost per Mile (Including Rebates)	-\$0.42

*Maintenance costs not included as we do not have access to maintenance data for EV cargo vans.*

# FINDINGS: SEDAN

Replacing 2022 Toyota PRIUS PRIME LE

**Toyota Corolla (ICE) difference in cost is \$11,902.86 less than the 2026 Nissan Leaf (EV).**



**Cost difference: (+) = EV costs less**

Differential Cost	-\$11,902.86
Differential Cost (Including Rebates)	-\$6,902.86
Differential Cost per Mile (Including Rebates)	-\$0.14

***Caveat: Assumed 50k miles driven by parking services in 5 years (underestimate)***

# LIMITATIONS

- Unable to use a 10 year life cycle because no empirical maintenance data available since modern EVs have not been out for 10 years.
- Any accessories (ladder-racks, accessories, toolboxes, etc.) were not included in analysis.
- Limited to current EVs on US market, new options will be available in coming years.

## **Potential barriers for implementation:**

- Limited charging infrastructure is currently on campus.

# FINDINGS: SMALL TRUCK

*Replacing 2019 Chevrolet Colorado 4x4*

**Future 2027 Ford EV Truck (EV) difference in cost is \$3,724.68 less than 2026 Chevy Colorado (ICE) and is \$16,224.68 less with V2G and rebates.**



<b>Cost difference: (+) = EV costs less</b>	
Differential Cost	\$3,724.68
Differential Cost (Including Rebates)	\$8,724.68
Differential Cost per Mile (Including Rebates)	\$0.13
Differential Cost (Including Rebates and V2G)	\$16,224.68

# FINDINGS: SMALL TRUCK

Replacing 2019 Chevrolet  
Colorado 4x4

Future 2027 Ford EV Truck (EV) difference in cost is \$3,724.68 less than 2026 Chevy Colorado (ICE) and is \$16,224.68 less with V2G and rebates.



**2026 Chevy Colorado**



**Future 2027 Ford EV Truck**

**NOTE:** With V2G revenue and rebates, the 2027 Ford EV truck is \$16,224.68 less than 2026 Chevy Colorado. The revenue from V2G of \$7,500 over 5 years would be a check sent directly to FREAS. Range **only** 150 miles.

# FINDINGS: MINIVAN

Replacing 2016 Dodge Caravan SV

Future 2028 Minivan (EV) difference in cost is \$2,270.36 less than 2026 Chrysler Pacifica (ICE) and is \$14,770.36 less with V2G and rebates.



**Cost difference: (+) = EV costs less**

Differential Cost	\$2,270.36
Differential Cost (Including Rebates)	\$7,270.36
Differential Cost per Mile (Including Rebates)	\$0.15
Differential Cost (Including Rebates and V2G)	\$14,770.36

# FINDINGS: MINIVAN

Replacing 2016 Dodge Caravan SV

Future 2028 Minivan (EV) difference in cost is \$2,270.36 less than 2026 Chrysler Pacifica (ICE) and is \$14,770.36 less with V2G and rebates.



**2026 Chrysler Pacifica**



**2028 Concept vehicle**

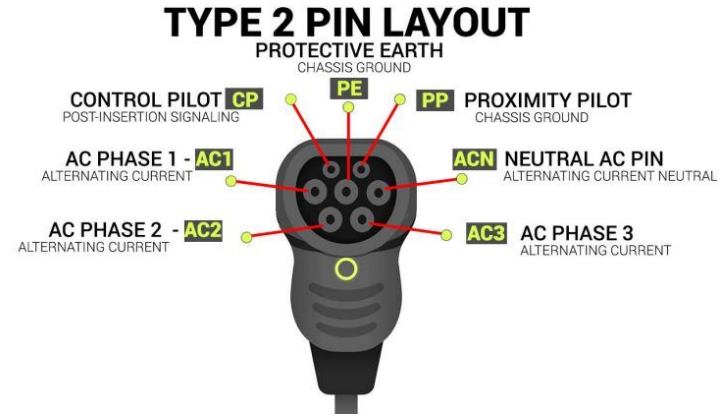
**Note:** With V2G revenue and rebates, the 2028 Concept vehicle is cheaper by \$14,770.36. The revenue from V2G of \$7,500 over 5 years would be a check sent directly to FREAS. Range **only** 150 miles.

# FUTURE SUGGESTIONS

1. Infrastructure for chargers.
2. Acquire 10 year maintenance data set.
3. Look into further rebates and grants.

## Implementation Future Endeavors:

1. How UD can implement a premium parking plan for electric vehicles.
2. How UD can use carry along cables to facilitate safe charging.
3. V2G implementation for future profit to FREAS.



# COST TABLE

## DESCRIPTION:

*This Cost Table is used for comparing Electric Vehicles (EV's) to Internal Combustion Engine Vehicles (ICE). The Assumptions tab is where you should put the necessary variables to determine your cost comparison. Here should include things like your inflation rate, and cost of electricity. This then will recalculate the cost comparisons of the pre done cars. Next to each stat there is a source if it isn't a commonly known value. NOTE THIS DOESN'T GIVE FINAL PRICE. ONLY THE DIFFERENCE OF COST OF 2 VEHICLES. For example registration price of both vehicles is left out intentionally since it is the same number for both. If you wish to add a new comparison, we recommend copying the sedans sheet in its entirety and put on a new tab and replace the values with your 2 new cars you are comparing. All assumptions are left in the assumptions column and be sure to understand color code key in top right for information certainly.*

## Relevant Cost Comparison of ICE and EV Alternative

2022 Toyota PRIUS PRIME LE REPLACEMENT OPTIONS	University		Difference in Costs (+) = EV costs less
	ICE Car	Electric Car	
	2026 Toyota Corolla	2026 Nissan Leaf	
<b>TOTAL COST :</b>	\$20,013.32	\$31,708.99	-\$11,695.67
<b>TOTAL COST (Including Rebates):</b>	\$20,013.32	\$26,708.99	-\$6,695.67
<b>Cost per mile (Including Rebates):</b>	\$0.40	\$0.53	-\$0.13

# THANK YOU!

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