

# DRIVE USER GUIDE

## DASHBOARD FOR RAPID VEHICLE ELECTRIFICATION

**A Tool to Evaluate the Financial Viability and Environmental Impact of Fleet Vehicle Electrification**

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# About DRVE

Dashboard for Rapid Vehicle Electrification, or DRVE, is a powerful tool that equips users with decision-relevant information on the financial viability and environmental impact of light-, medium-, and heavy-duty vehicle fleet procurements across an entire fleet. The Microsoft Excel-based tool can evaluate a variety of procurement ownership structures, vehicle types, electric vehicle charging configurations, and many more scenarios.<sup>1</sup>

In a nutshell, the tool allows users to import all fleet vehicles and compare a fleet's conventional vehicles with an electric vehicle (EV) alternative. The analysis compares vehicles on a total cost of ownership basis along with well-to-wheels emissions based on regional electrical grid characteristics.

The tool is highly flexible and supports customizable market, charging, and procurement settings. The results of the tool can be explored directly within DRVE or imported for use by dashboarding software like Microsoft Power BI.

DRVE was created with support from the Electrification Coalition. See below for contact information for any questions about using DRVE.

Contact at Atlas Public Policy

Daniel Wilkins  
Policy Analyst  
[Daniel.wilkins@atlaspolicy.com](mailto:Daniel.wilkins@atlaspolicy.com)

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<sup>1</sup> DRVE is limited to 1 million scenarios for a single analysis, though it is recommended that you limit the number of scenarios to optimize runtime.

# Operating System and Excel Compatibility

## Supported Operating Systems

The following operating systems and versions are supported:

- Windows 10
- Windows 11

## Supported Excel Versions

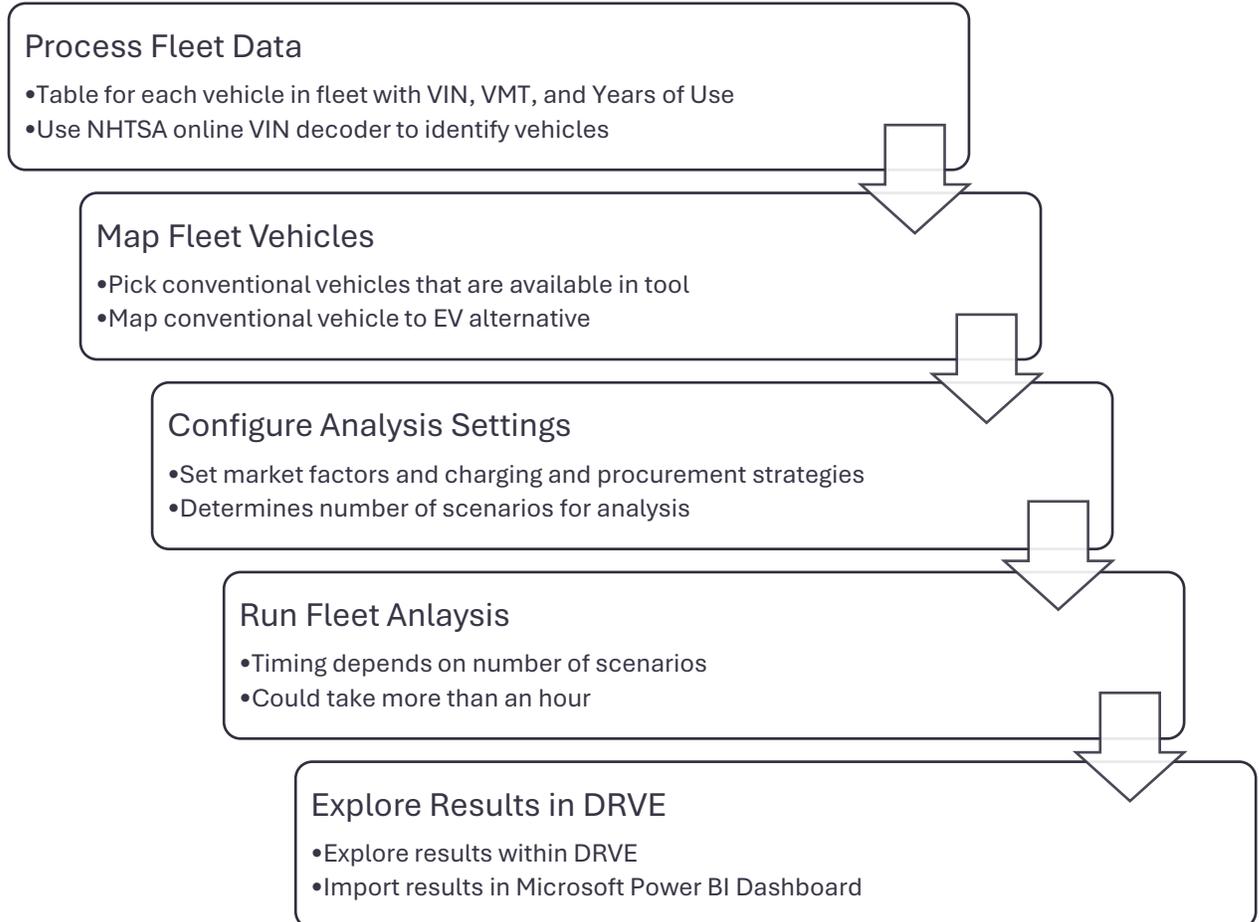
The following operating systems and versions are supported:

- Excel 2016
- Excel 2019, Excel 2021, Office 365 and subsequent (v16.0)

# Overview of the Tool Structure

DRVE was built using Microsoft Excel and is presented as a stand-alone application. The user follows 5 steps to run their analysis:

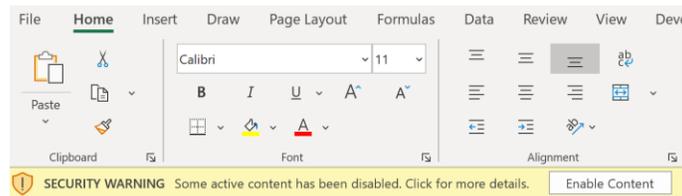
1. **Load Data:** The user will load their fleet's data by identifying required fields needed to load the data.
2. **Map Vehicles:** The user will create a mapping for each of their unique vehicles to the vehicle options that will be procured in place of them.
3. **Set Options:** The user will add various settings such as fuel costs, charging scenarios, and vehicle ownership structures.
4. **Run Analysis:** The tool will run the analysis with no actions required from the user.
5. **View Results:** The user will view their results in a sophisticated dashboard.



# Getting Started

## Step 1: Open the Tool

DRVE is a single Microsoft Excel file (“DRVE.xlsm”). In case it does not launch automatically, and a Microsoft Excel workbook is shown, you may need to select “Enable Content” and “Enable Editing” buttons that appear in the yellow bar below Excel’s toolbar (see screenshot below).

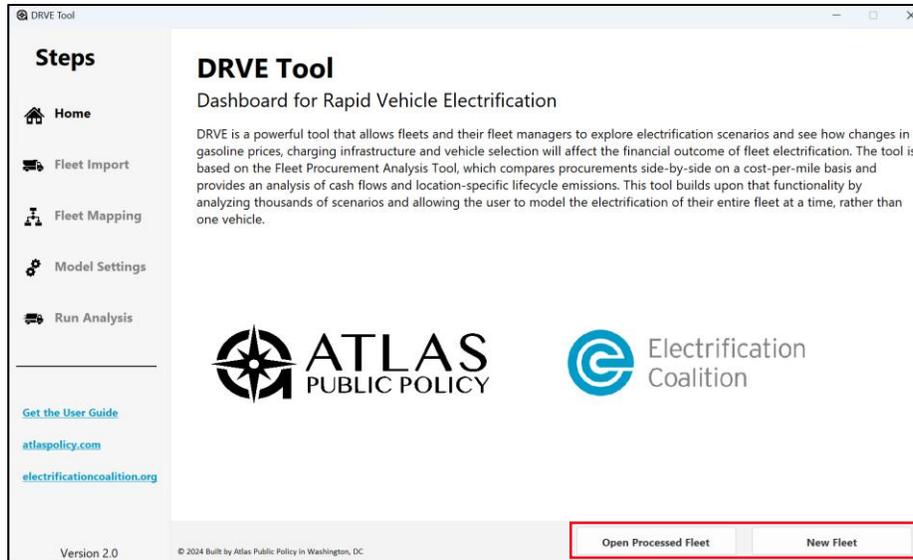


You may also need to manually enable macros depending on your system configuration (see Box 1). Once you’ve cleared the warning(s), DRVE should open automatically. If not, click the “Launch DRVE” button to begin your analysis.

### Box 1. Enabling Macros in Microsoft Excel

Macros must be enabled to use DRVE. You may need to manually enable them depending on your configuration of Microsoft Excel. To enable macros, go to File -> Options -> Trust Center -> Macros -> Enable Macros. This experience may vary depending on the version of Microsoft Excel you are using. For more information, visit Microsoft’s support page [here](#).

Launching DRVE will enable a series of pop-up screens that walk the user through each step of the analysis. The first screen is the home screen (pictured below), which allows users to choose how they would like to begin their analysis. Users may either pick up a previous analysis using the “Open Processed Fleet” button, or begin a new analysis by clicking the “New Fleet” button. The process for saving progress in DRVE is discussed in Box 2.



## Box 2. Saving Progress in DRVE

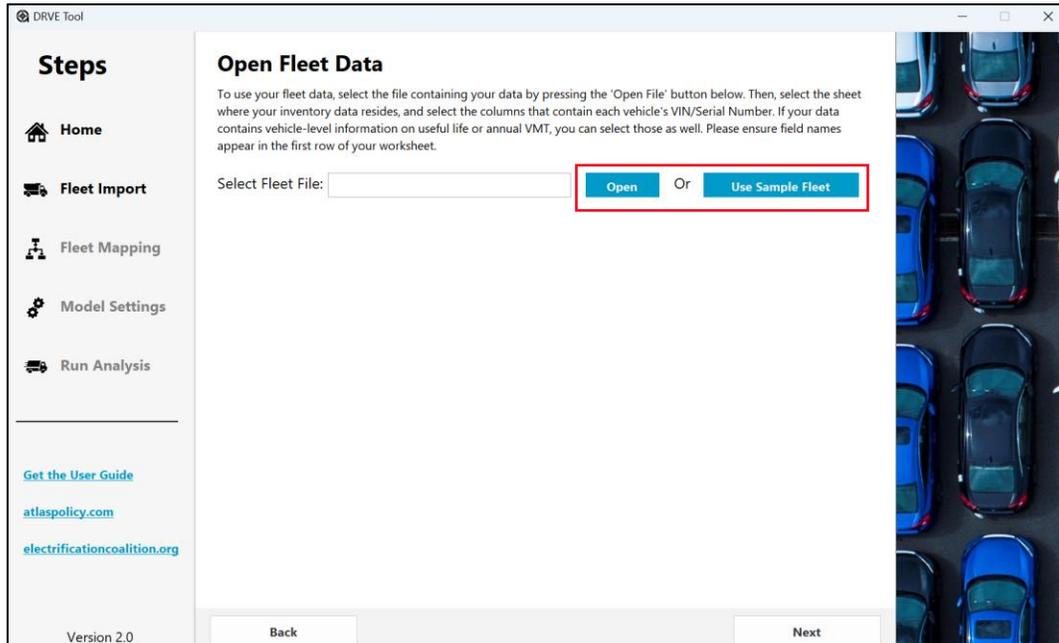
DRVE enables users to save their progress at multiple points in the process by exporting an Excel file that contain all of the data input by the user. The tool can then read these files and import the inputs that the user has saved. Note that files from previous versions may not be compatible with a more recent DRVE release.

There are two “checkpoints” for users to save their analysis. First, after the user imports and maps their fleet in Steps 2 and 3, they may save a “Fleet Export” that contains all of the data unique to each vehicle. Second, after the user configures analysis settings in Step 4, they may save an “Analysis Settings” file that contains all of the analysis-level settings.

Users can use these saved files to quickly rerun or modify an analysis without having to go through the entire process again. To rerun or adjust an analysis, users may select to “Open a Processed Fleet” from the home page, make any necessary adjustments to vehicle-level inputs, and then “Import Analysis Settings” to load in their analysis-level inputs. Then, having loaded in their chosen settings and adjusted as necessary, the user can run the analysis.

In addition, once an analysis has been completed, the results may be saved in either Excel or PDF format for later viewing or distribution.

## Step 2: Process Fleet Data



For new fleets, we must identify the vehicle makes and models for all vehicles. The data used must contain the vehicle identification number (VIN) for each vehicle to be analyzed. It can also include per-vehicle annual miles traveled (VMT), the expected years of use for the vehicle, and the location where the vehicle is domiciled. Annual miles traveled and expected years of use will be used to calculate the total cost of ownership. The vehicle location will be used in the results to show where the fleet will need charging infrastructure.

The tool supports Excel and CSV (comma-separated values) files. For Excel files, the user should ensure the following is true for the data being used:

- The data is contained in a single sheet, with valid column headers and rows for each vehicle.
- Column headers should be in the first row of the worksheet.
- There should be no additional data beneath the fleet inventory data.

First, press the “Open” button to open the fleet data file in CSV or Excel format. DRVE will then process your fleet file to determine if it can be used. Following processing, the “Required Fields” appears (see below). If an Excel file was selected, the “Inventory Worksheet” dropdown will populate with the names of the worksheets (tabs) in the workbook selected.

Required Fields

Inventory Worksheet Select Inventory Worksheet:

VIN/Serial Number Column Select VIN Column:

The “VIN/Serial Number Column” is a required column where the VIN for each vehicle in the fleet is located. DRVE decodes the vehicle make and models from the VINs to map those vehicles to ones available within DRVE along with their electric alternatives.

After selecting a valid VIN/Serial Number column, the “Optional Fields” section will become visible. The three optional fields are:

- **Expected Years of Use:** An integer representing the expected years of useful life for each vehicle in the fleet. This value is used to calculate the total cost of ownership across the vehicle’s useful life. Select a column containing this value or set a default to be used across all vehicles.
- **Annual VMT:** The average annual vehicle miles traveled for each vehicle in the fleet. Select a column containing this value or set a default to be used across all vehicles.
- **Vehicle Location:** The location where the vehicle is domiciled. This does not need to be a valid address. The field will only be used to show the charging infrastructure required at each location.

Optional Fields

Expected Years of Use Column:  Years of Use Column:  Or  Use Default  Years

Annual VMT:  VMT Column:  Or  Use Default  Miles/Year

Vehicle Location:  Location Column  Or  Do not include vehicle locations

Lastly, the user must input the ZIP code where the fleet resides. DRVE uses the Fleet ZIP Code to set default fuel and electricity prices and to calculate electricity emissions. To use the U.S. average, enter “00000.”

The Fleet ZIP Code is also used to identify incentives that may be available to the fleet. Once the user enters the ZIP Code and presses “enter” the button to “Apply State Incentives” will turn blue if there are incentives available in the fleet’s state.<sup>2</sup>

Fleet ZIP Code:  *Press enter after inputting ZIP*

Enter a ZIP Code above to determine if there are applicable incentives in your state.

<sup>2</sup> Note that local/utility incentives and competitive grant programs are not included.

Fleet ZIP Code:  OAKLAND, CA

**Apply State Incentives**

Incentives are available in your state. To customize incentives to apply, select the 'Apply State Incentives' button. (Note that you may customize specific incentives on the next page.)

Click Apply State Incentives to view the incentives available in the state. Click on an available program to view a brief description and a link to the program website. If the fleet is eligible for the program, click Add >> to include the incentive in the analysis. Note that some incentive programs may have limited eligibility and it is the responsibility of the fleet to determine if they are eligible for the program. If selected, the tool will automatically apply the appropriate incentive value to eligible vehicles based on the type of vehicle, taking into account limitations on vehicle MSRP, battery size, and electric range. The incentive amount for each vehicle can be edited in the next step. When done adding incentives, click Save to return to the Fleet Data window.

**Select State Incentives**

Select the incentive's to be automatically applied to vehicles in the fleet. Selecting a program from the list below to view a description and link to the program. These incentives can be adjusted on a vehicle-by-vehicle basis on the next page. If multiple programs apply to the same vehicle, incentive amounts will be summed together.

Available Programs

<b>California HVIP</b>	The HVIP program provides point-of-sale vouchers for the purchase of zero-emission medium- and heavy-duty vehicles.	
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<https://californiahvip.org/>

**Add >>** **Remove**

**Back** **Save**

Once completed, click “Next” to begin fleet processing.

## Processing the Fleet

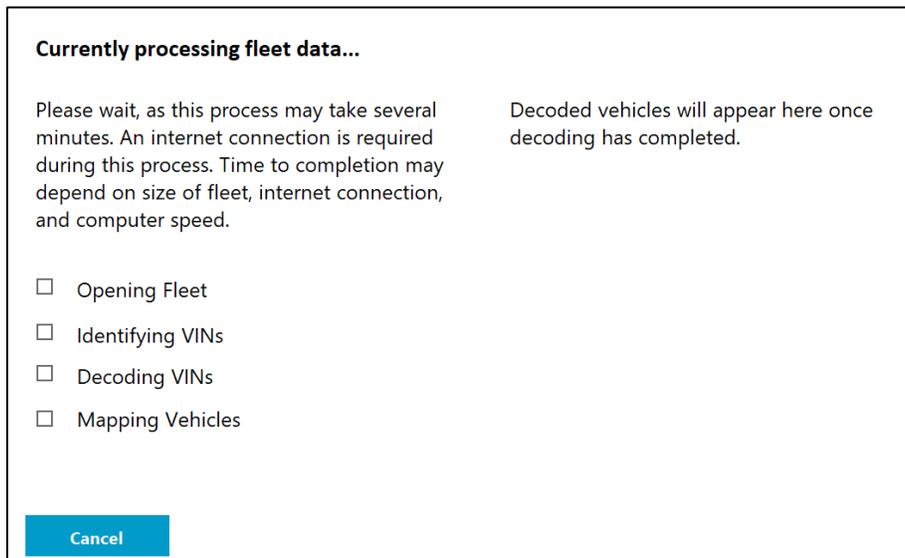
Processing a fleet is completed in three steps. First, the data from the fleet is imported; second the VINs from the fleet are decoded; and finally, the fleet vehicles are mapped to a conventional, internal combustion engine (ICE) replacement vehicle and an electric replacement vehicle.

DRVE uses the VIN decoding service provided by the National Highway Traffic Safety Administration (NHTSA) known as vPIC. (See Box 3 below).

### Box 3. VIN Decoding process using vPIC

VIN decoding is needed to identify vehicle makes and models from fleet data. A VIN is a unique set of characters that is issued by manufactures to identify vehicle model year, drivetrain, weight class, and more. Each unique VIN prefix (first 10 characters) represents a unique vehicle type and only needs to be decoded once, rather than decoded for each fleet vehicle. DRVE uses NHTSA's publicly available vPIC tool to decode VINs and generate a consistent naming process across all vehicles. The service has a 24/7 uptime, but occasionally will be down for maintenance. If the NHTSA service is unavailable or is down for maintenance, the fleet processing step will fail and DRVE will display an error message. More information on VPIC is here: <https://vpic.nhtsa.dot.gov>.

Below is a screenshot of the message will be shown when the fleet is being processed by the tool. The progress of this processing will be marked as each sub task is checked off. Once the fleet has been processed, identified vehicles will appear on the right-hand side of the window. The tool then notifies the user of how many VINs have been decoded, and how many have been dropped. A VIN will be dropped if it is in an invalid format or the decoding of it results in an error. If you do not want to fix any dropped VINs, the next step is to view and customize the vehicle mapping that DRVE created for your fleet.



**Fleet processing complete!**

Your fleet data has been processed, and the vehicles found in your fleet are displayed in the box below. You may save your fleet on the next page.

- Opening Fleet
- Identifying VINs
- Decoding Vehicle Type 15 of 15
- Mapping Vehicles

**Vehicles Found in Your Fleet**

CHEVROLET EXPRESS

GMC SIERRA

GMC SIERRA

GMC SIERRA

FORD F-350

GMC SAVANA

FORD F-350

FORD F-350

FORD F-350

FORD F-350

FORD F-350

FORD F-350

Total VINs 15

Total VINs Dropped: 2

Fix Dropped VINs
Next

## Fixing Dropped VINs

Users can overwrite any dropped VINs with the correct vehicle they would like modeled in the tool. To perform this, overwrite, they can select the “Fix Dropped VINs” button on the page above. They will then be brought to a page where they can select each dropped VIN and overwrite it with a valid value.

**Dropped VIN Fix**

On this page, you can iterate through VINs that have been dropped from the analysis and override them with values that can be used inside the tool. A VIN can be dropped for a number of reasons, such as an invalid VIN, or a missing bodyclass or vehicle name from the VIN decoder. For each vehicle, please select a body class/use case, and select or enter a vehicle name. You can also edit the VIN to give it a custom name, but be sure it is unique from other VIN values in your fleet.

ID	VIN	Decoded Use Case	Decoded Full Vehicle Name
16	1GCCS196258256704		CHEVROLET
17	3GSC193Z19S588925		SATURN

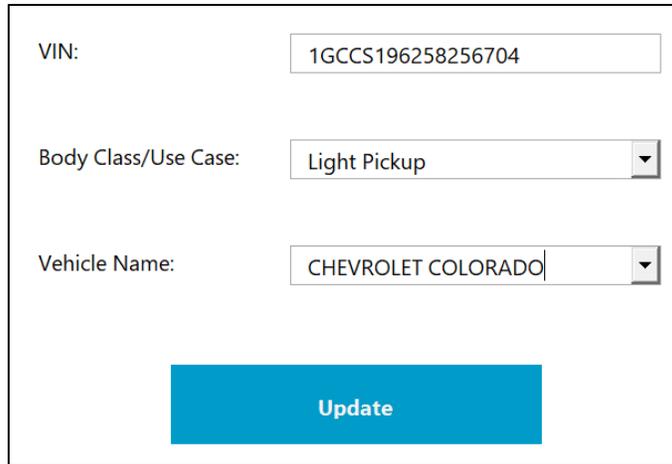
VIN:

Body Class/Use Case: Select a Use Case ▼

Vehicle Name: Select or Enter a Vehicle Name ▼

Update

In order to be included in the analysis, the user must assign the VIN a Use Case and a Vehicle Name. The user may select from a list of common vehicle names or enter a custom name. Once these fields have been filled out, the user must hit **Update** for the changes to appear in the table.



VIN:

Body Class/Use Case:

Vehicle Name:

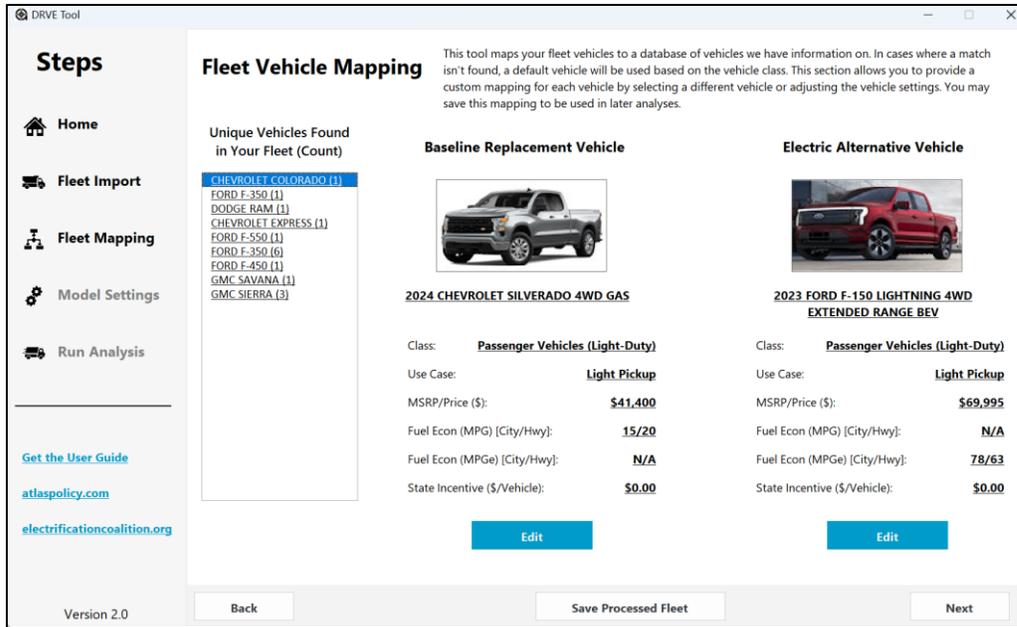
Once updated, the changes will be reflected in the dropped VINs table. After all the VINs that the user wishes to have modeled have been overwritten, the user can hit the “Done” button to return to the import page and continue with the analysis.

### Step 3: Map Fleet Vehicles

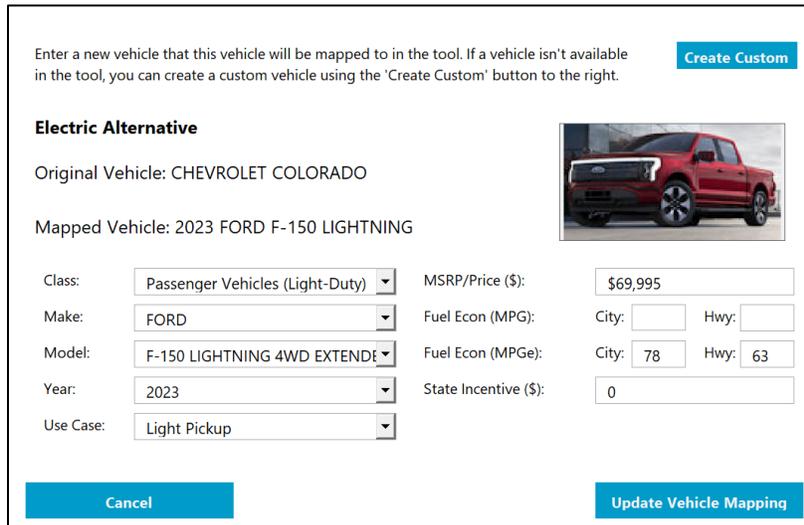
You can now go through each unique vehicle that was found in the fleet and customize which conventional vehicle and which EV DRVE will model as its replacement. DRVE identifies unique vehicles based on the decoded make, model, and use case.

Nearly all passenger vehicles available in DRVE were imported directly from the FuelEconomy.gov, a joint effort by the U.S. Department of Energy and U.S. Environmental Protection Agency to catalog details on all passenger vehicles from 1984 to the present day; the website also includes the manufacturer’s suggested retail price (MSRP) for many vehicles. DRVE uses FuelEconomy.gov for vehicle makes and models, fuel economy ratings, and MSRP where available. For medium- and heavy-duty vehicles along with some passenger vehicles, Atlas Public Policy maintains a database that is updated on a rolling basis, as no public source provides makes this information available. Atlas retrieves details on these vehicles directly from manufacturer’s websites or other reputable sources. For vehicles not yet available for purchase, Atlas may rely on press reports or other third parties to determine vehicle characteristics.

A screenshot of the fleet mapping screen is presented below.



To change the modeled replacement vehicle, or to update the vehicle characteristics, click the “Edit” button. This will bring up a new window to select and modify a replacement vehicle (shown below).



To select a replacement vehicle, the user must select the following fields in order:

1. **Class:** The vehicle’s GVWR category, either light-, medium-, or heavy-duty.
2. **Make:** The make of the vehicle to be procured.
3. **Model:** The model of the vehicle to be procured
4. **Year:** The model year of the vehicle to be procured.

As the user makes selections the subsequent dropdowns will reflect the remaining valid options. For example, once “Ford” has been selected as the make the tool will only show Ford models.

Once a vehicle has been selected, the vehicle characteristics will automatically populate from DRVE’s vehicle database. The user may edit these characteristics or use the default values. The customizable vehicle characteristics are:

- **Use Case:** The use case is used to determine the type of charging infrastructure that will be needed to support the vehicle. Users may choose between the 12 distinct DRVE use cases.
- **MSRP/Price (\$):** The manufacturer suggested retail price, or the estimated price of the vehicle. The estimated price of the vehicle does not include any additional options or upfits. Users are encouraged to customize the MSRP/Price based on their local market conditions and upfitting needs.
- **Fuel Economy Gasoline/Diesel (MPG) [City/Highway]:** The default value is the city/highway fuel economy for vehicles powered by gasoline or diesel in mile per gallon for the selected vehicle from FuelEconomy.gov for passenger vehicles and from Atlas’s internal database otherwise. This field is not relevant for battery electric vehicles.
- **Fuel Economy Electric (MPGe) [City/Highway]:** The default value is the city/highway fuel economy for vehicles powered by batteries in mile per gallon of gasoline equivalent for the selected vehicle from FuelEconomy.gov for passenger vehicles and from Atlas’s internal database otherwise. This field is not relevant for gasoline or diesel vehicles.
- **State Incentive (\$/Vehicle):** Total state incentive value based on the incentive programs added in the previous step. The value for each vehicle is based on the vehicle use case taking into account limitations on vehicle MSRP, battery size, and electric range. Users may overwrite this value for each vehicle.

Once the user is happy with the replacement vehicle, click the “Update Vehicle Mapping” button to save the mapping.

## Add Custom Vehicle

If the vehicle you wish to model is not included in the available options, you can add a custom vehicle by clicking the “Add Custom” button for either the baseline replacement vehicle or the EV replacement vehicle, as shown below.

Enter a new vehicle that this vehicle will be mapped to in the tool. If a vehicle isn't available in the tool, you can create a custom vehicle using the 'Create Custom' button to the right. Create Custom

Clicking this button will bring you to a page where you can add all of the relevant settings for the vehicle, as shown below. Once all of the relevant information is entered, the user can hit "Add" and the vehicle will be added to the model, and the user will be able to use this vehicle as an alternative for any other vehicles in the fleet. These custom vehicles will be saved and imported along with the rest of the custom fleet by saving the processed fleet file.

**Add Custom Vehicle** Create a custom vehicle by entering values for each setting below. Once created, the custom vehicle can be used for any mapping, and will be saved with the exported fleet.

Class:	<input type="text" value="Select a Class"/>	Drivetrain:	<input type="text" value="Select a Drivetrain"/>
Make:	<input type="text"/>	MSRP/Purchase Price (\$):	<input type="text"/>
Model:	<input type="text"/>	Fuel Economy (MPG):	City: <input type="text"/> Hwy: <input type="text"/>
Year:	<input type="text"/>	Fuel Economy (MPGe):	City: <input type="text"/> Hwy: <input type="text"/>
Use Case:	<input type="text" value="Light Pickup"/>		

Cancel
Add

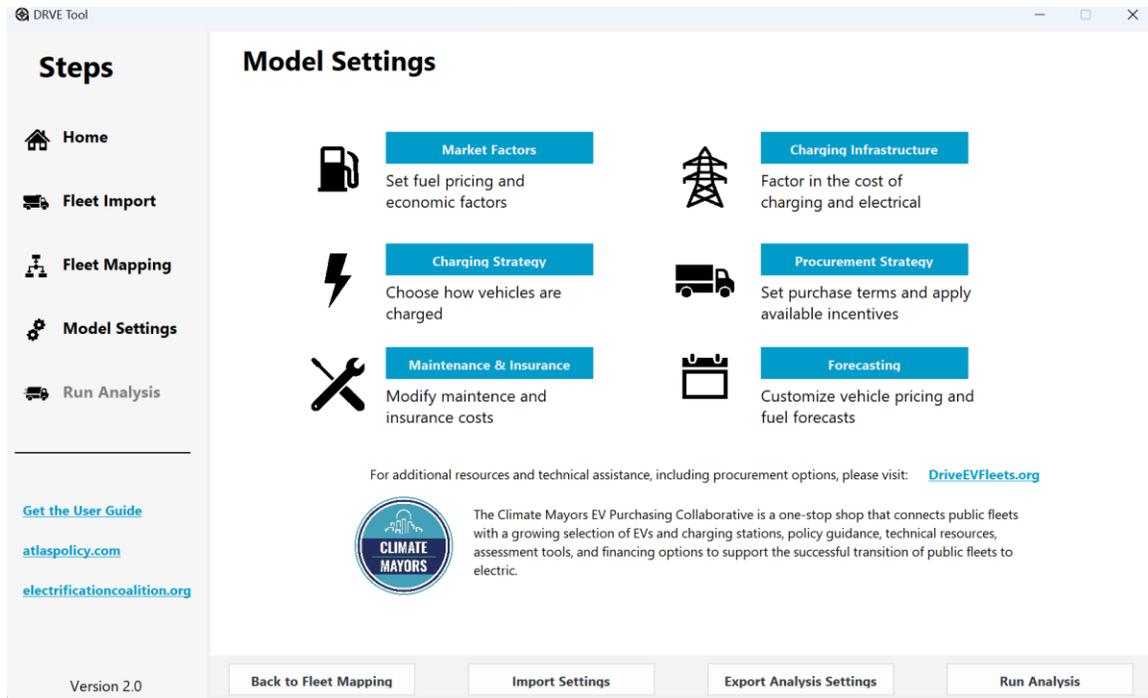
### Save Processed Fleet File

The fleet can be saved at any point while the user is on the mapping screen by clicking "Save Processed Fleet." Saving the processed fleet will not only save all of the VINs that have been decoded, but also all of the replacement vehicle mappings and their characteristics. It is recommended that users save the processed fleet to save time in future analyses.

Saving the processed fleet will generate an Excel file. The next time the user opens DRVE, they can choose to import this processed fleet file to skip directly to this step.

## Step 4: Configure Analysis Settings

Once the fleet has been imported and mapped to replacement vehicles, the next step is to configure the analysis settings. From the analysis settings page (pictured below) the user may either run the analysis with current settings ("Run Analysis"), import previously saved settings ("Import Settings"), or customize the analysis settings by clicking on one of the groups.



There are six categories of customizable analysis settings in DRVE:

- **Market Factors:** Set these key market inputs: gas price, diesel price, inflation rate, discount rate, and cost of carbon.
- **Charging Infrastructure:** configure the cost of installing charging stations and the ratio of vehicles to chargers.
- **Charging Strategy:** Decide the share of charging that happens at public, en-route, and depot charging stations and the electricity prices at each location.
- **Procurement Strategy:** Choose a cash, lease, or loan purchase structure and apply sales and excise tax.
- **Maintenance & Insurance:** Set the annual cost of insurance and the per-mile cost of maintenance and repair for fleet vehicles.
- **Forecasting:** Model how projected changes in vehicle prices, fuel economy, and fuel prices will impact the total cost of ownership for future procurements.

The process for configuring each of these groups of settings is described below. Detailed explanations of the settings themselves and their default values are included in : User Input Descriptions and Default ValuesAppendix A.

#### **Box 4. Scenario Analysis in DRVE**

DRVE supports multi-variate scenario analysis which allows users to analyze multiple inputs in a single analysis. For example, users can input two gasoline prices, and the tool will assess the total cost of ownership for all vehicles under both scenarios. When viewing results, the user will then have the option to view results under either gasoline price.

Increasing the number of scenarios increases the complexity of the analysis. The tool runs a baseline of three scenarios per fleet vehicle, one ICE scenario, and two EV scenarios (one with charging infrastructure and one without). Each additional input will generally double the number of scenarios, unless it is limited to just ICE or EV scenarios. More complex analyses take longer to run and may be more prone to technical difficulties. While DRVE supports up to one million scenarios per analysis it is recommended to limit this to under 100,000 for best performance.

For many settings, multiple inputs are grouped together into one “Scenario Grouping” to make the tool more efficient. For example, the gasoline and diesel price inputs are grouped together in the “Fuel Price Scenario.” The scenario groupings are: Fuel Price, Charging Strategy, Procurement Strategy, and Forecasting.

## Market Factors

### Market Factors

In this section, you'll be able to add market settings you would like to use in the analysis. You may add multiple inputs for each setting. The tool will model each input, and then you will be able to view and compare the results from each scenario in the results dashboard.



**Fuel Prices (\$/gallon)**

The price of gasoline and diesel fuel.

Fuel Price Scenario	Gasoline Price	Diesel Price
Default Scenario	\$4.88	\$5.359

Name:

Gas:

Diesel:



**Inflation Rate (%)**

The annual rate of increase for all non-energy prices. Note that energy price inflation is calculated separately.

2.00%



**Discount Rate (%)**

The discount rate for net present value calculations.

2.00%



**Cost of Carbon (\$/ton)**

The social cost of carbon to be included based on well-to-wheel emissions.

\$0.00

Market settings include the “Fuel Price Scenario” as well as individual inputs for Inflation Rate, Discount Rate, and Cost of Carbon. To update market settings, enter a new value and select “Add” to add it to the analysis. You may either keep the existing setting to run both scenarios or remove the existing setting. Note that the Inflation Rate and Discount Rate must be entered as decimal numbers (i.e. 5% should be entered as 0.05).

The user may either edit the default fuel price scenario using by selecting the scenario and using the “Edit” button, or they may add a new fuel price scenario using the “add” button. Once finished, click the blue “Save” button to save changes to the selected scenario.

Once all inputs have been set, click the grey “Save” button at the bottom of the page to return to the main analysis settings page.

For detailed descriptions of the settings in this section and their default values, please refer to *Appendix A*.

## Charging Infrastructure

### Charging Infrastructure

In this section, you will be able to adjust the cost of charging infrastructure to be used in the analysis. You will be able to view the results both with and without the cost of charging infrastructure, with no charging infrastructure displayed by default. Here, you may add, remove, or modify the charging infrastructure scenarios to be modeled. If adding or removing scenarios or use cases be careful to ensure that each use case still has an associated charging infrastructure scenario.

#### Modeled Infrastructure

Select a scenario below to view, edit, or remove.

- Depot L2 - LDVs
- Depot L2 - Class 2b/3 trucks
- Depot L2 - Class 4-8 trucks
- Buses
- Heavy-Duty Straight Trucks
- Tractors

[Add](#)

[Remove](#)

#### Configuration

Port Type: 30A L2  
 Charging Ratio (Vehicles/Port): 1

#### Costs

Per Port Upfront Cost: \$3,286  
 Per Port Annual Cost: \$99

#### Incentives

Include Alternative Fuel Vehicle Refueling Property Credit (30C)? [\(Check Eligibility\)\\*](#)   
 Include 30C Prevailing Wage and Apprenticeship Bonus? [\(Check Requirements\)\\*](#)   
 Additional State/Utility/Local Incentives [\(Find Incentives\)](#) \$0

#### Ownership Strategy

Cash/Loan: Purchase (Cash)

[Edit Selected Scenario](#)

#### Vehicle Use Cases

- Car
- SUV/MPV
- Minivan
- Light Pickup
- Cargo Van
- Step Van
- Medium-Duty Pickup
- MD Straight Truck
- HD Straight Truck
- Tractor
- Shuttle Bus
- School Bus
- Coach Bus

\*The DRVE tool does not constitute legal or financial advice of any other kind. Your use of information from DRVE or materials linked from DRVE is at your own risk.

Name: Depot L2 - LDVs

[Save](#)

Charging infrastructure settings include inputs related to the cost of installing charging stations as well as the number and types of vehicles served by each station. Regardless of the charging infrastructure inputs selected, DRVE will run two scenarios for each modeled EV, one including the cost of charging infrastructure and one excluding the cost of charging infrastructure. Users will have the option to toggle between the two in the results.

By default, each Use Case has been assigned a charger type and associated cost. Users may edit the charging station costs, the mapping of Use Cases to charging stations, or both.

To begin, select one of the infrastructure types in the “Modeled Infrastructure” table and choose “Edit Selected Scenario.” The inputs in the middle will show the type of charger and the associated costs and the “Vehicle Use Cases” table on the right will show the Use Cases that use that type of infrastructure.

To edit the station costs, the user may change the Port Type to load in default costs for that port type, or they may update the existing values. They may also choose to include incentives for charging infrastructure.

To edit the Use Cases associated with each charging type, click on the name of the use case in the Vehicle Use Case table to select or unselect the use case. Use cases highlighted in blue will be modeled with the selected charging type.

Once finished editing costs and mappings, click the blue “Save Scenario” button to save changes to the selected scenario. Once all scenarios have been set, click the grey “Save” button at the bottom of the page to return to the main analysis settings page.

Please note that by default, each use case is assigned to one and only one charging type. **If the user adds or removes charging types or use cases, they must take care to ensure that each use case is assigned to one and only one charging type.**

For detailed descriptions of the settings in this section and their default values, please refer to *Appendix A*.

## Charging Strategy

### Charging Strategy

In this section, you'll be able to create charging strategies to be used in the analysis. You may edit the default strategy or add additional strategies. The tool will model each strategy chosen, and then you will be able to view and compare different charging strategies in the results dashboard.

#### Modeled Strategies

Select a setting below to view, edit, or remove.

Default Charging Strategy 1

Add
Remove

Adjust the percent of charging that occurs at each location and the cost of electricity at that location.

Edit Strategy

#### At the Depot

% Charging at Depot Chargers:	100%
Electricity Price (\$/kWh):	\$0.23

#### At Public

% Charging at Public	0%
Public Charging Price (\$/kWh):	\$0.50
Public Charging Downtime Cost (\$/Hour):	\$43.00
Max Power for Public Charging (KW):	150

#### At En-Route Chargers

% Charging at En-Route Chargers:	0%
En Route Charging Price (\$/kWh):	\$0.25

Name: Default Charging Strategy 1

Save

Charging Strategy settings describe how vehicles will be charged. All inputs on this page are grouped into the “Charging Strategy” scenario grouping and the selected charging strategy is applied across all modeled EVs. DRVE supports three distinct types of charging: Depot, Public, and En-Route. To change the portion of charging or price at each the user may either click “edit strategy” to modify the default strategy, or click “Add” to add a new strategy to run in addition to the default strategy.

Once finished, click the blue “Save Scenario” button to save changes to the selected scenario. Once all scenarios have been set, click the grey “Save” button at the bottom of the page to return to the main analysis settings page.

For detailed descriptions of the settings in this section and their default values, please refer to *Appendix A*.

## Procurement Strategy

### Procurement Strategy

In this section, you'll be able to create procurement strategies to model scenarios where vehicles are procured by various means.

#### Modeled Strategies

Select a setting below to view, edit, or remove.

Default

Add

Remove

Adjust the percent of charging that occurs at each location and the cost of electricity at that location.

Edit Selected Scenario

#### Ownership Strategy

##### Taxes

Monetize Tax Credit?:

Yes

Sales Tax:

2.90%

Include 12% excise tax on HD trucks:

Purchase (Cash)

Name:

Default

Procurement Strategy settings describe how vehicles are purchased. All inputs on this page are grouped into the “Procurement Strategy” scenario grouping.

To begin, users may either edit the default scenario using the “Edit Selected Scenario” button or add an additional procurement strategy to be run alongside the default strategy.

When adding or editing a procurement strategy, the users may set tax-related inputs for all ownership strategies. If the user selects a lease or loan ownership strategy, then additional inputs will appear to configure the terms of the lease or loan selected.

Once finished, click the blue “Save Scenario” button to save changes to the selected scenario. Once all scenarios have been set, click the grey “Save” button at the bottom of the page to return to the main analysis settings page.

For detailed descriptions of the settings in this section and their default values, please refer to *Appendix A*.

## Maintenance & Insurance

### Maintenance & Insurance

Customize maintenance & insurance by use case.

[Reset All](#)

#### Passenger Vehicles (Light-Duty)

	ICE	PHEV	BEV
Vehicle Insurance Cost (\$/Year):	1194	1194	1194
Maintenance and Repair Cost - Years 1-5 (\$/Mile):	0.08	0.07	0.04
Maintenance and Repair Cost - Years 5+ (\$/Mile):	0.104	0.091	0.052

#### Medium Duty Vehicles (Class 3-6)

Vehicle Insurance Cost (\$/Year):	4000	4000	4000
Maintenance and Repair Cost - Years 1-5 (\$/Mile):	0.201	0.142	0.142
Maintenance and Repair Cost - Years 5+ (\$/Mile):	0.2613	0.1846	0.1846

#### Heavy-Duty Vehicles (Class 7-8)

Vehicle Insurance Cost (\$/Year):	10000	10000	10000
Maintenance and Repair Cost - Years 1-5 (\$/Mile):	0.199	0.168	0.168
Maintenance and Repair Cost - Years 5+ (\$/Mile):	0.2587	0.2184	0.2184

Maintenance and insurance costs are set based on the vehicle category and drive train. DRVE does not currently support multivariate scenario analysis for maintenance and insurance costs. Users may edit maintenance or insurance costs by clicking into a cell and editing the value directly. To reset all costs to default costs, click the “Reset All” button.

Once finished, click the grey “Save” button at the bottom of the page to return to the main analysis settings page.

For detailed descriptions of the settings in this section and their default values, please refer to *Appendix A*.

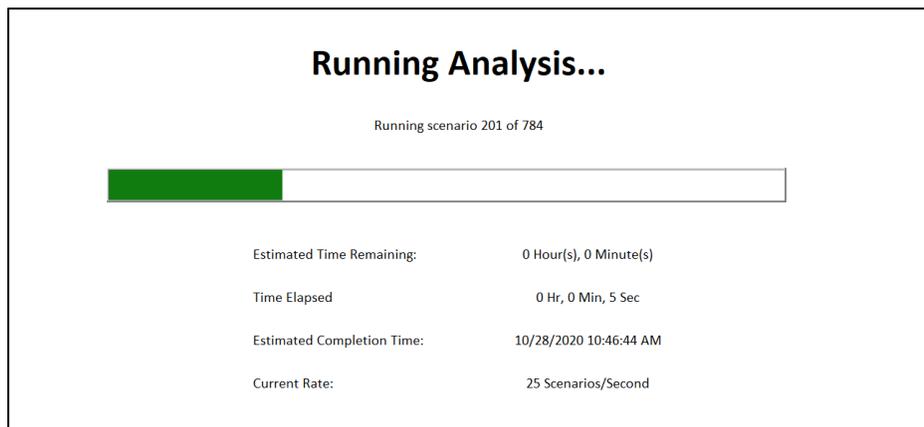


## Save Analysis Settings File

Once all the desired settings have been entered, click the “Export Analysis Settings” button on the bottom of the main analysis settings page to save an Excel file with the current settings. This will allow you to re-use the settings in a future DRVE analysis.

## Step 5: Run Fleet Analysis

After you’ve configured the desired analysis settings, you can begin the analysis by clicking the “Run Analysis” button on the bottom-right of the main analysis settings page. The next screen will allow you to monitor the progress of the analysis.



The process for running the analysis is described below:

1. Scenarios are built based on the vehicles in the fleet and the settings input by the user. The tool will apply each setting to each applicable vehicle in the fleet.
2. Each vehicle scenario is run through the financial and environmental model within DRVE, and the outputs are stored in a table.
3. After DRVE has finished the analysis, it loads the results into an interactive dashboard for the user to explore.

While running the analysis, the user will be provided with various progress metrics, including the following:

- **Estimated Time Remaining:** This estimate is based on the current rate of execution and could vary depending on the execution speed.
- **Time Elapsed:** This is the total time that has passed while running the analysis.

- **Estimated Completion Time:** This is an estimation of the exact time which the analysis will complete. This estimate is based on the current rate of execution and could vary depending on system resources.
- **Current Rate:** This will track the current rate of execution in scenarios per second, which can vary depending on the system resources. Tip: When running a large analysis, it is recommended to close as many applications as possible.

## Pausing or Stopping the Analysis

The analysis can be paused at any point by double-clicking the “Pause” button. To continue the analysis, simply hit resume.

If the analysis needs to be cancelled for any reason, it can be halted by double-clicking the “Stop” button. This will terminate the analysis, and you will not be able to resume it. You will be able to save the scenarios that were run if the analysis is canceled.

## Viewing the Analysis Results

Once the analysis has completed, you can view the results by clicking the “View Analysis Results” button on the bottom-right of the analysis window. This will prepare the results and present them in the tool’s dashboard.

**The process for loading the results dashboard can take several minutes. Please be patient as the results load and do not try to exit the tool before the results have loaded.**

Exiting the tool prematurely will lose the analysis results. Once the results have opened, the user will be able to save the results as a PDF report or an interactive Excel workbook.

## Step 6: Explore Results in DRVE

The DRVE dashboard allows you to explore the results of the analysis through a series of metrics, charts, and pivot tables. After clicking view results, the tool will open to the “Dashboard.” From here, users can view a high-level summary of the results, view and toggle between analysis inputs, navigate to more detailed results views, and save the analysis results.

***Note: You will not be able to save the results once you close the workbook. You must save the results before closing the dashboard in order to prevent the loss of your data.***

## EV Savings Categories

The Dashboard breaks down vehicles by their EV savings using the following definitions:

- **EV Savings:** The total lifetime cost of on a net present value basis of the electric replacement is at least five percent less than that of the conventional vehicle.
- **Cost Parity:** The total lifetime cost of on a net present value basis of the electric replacement is within five percent of that of the conventional vehicle.
- **EV Savings:** The total lifetime cost of on a net present value basis of the electric replacement is at least five percent more than that of the conventional vehicle.

## Viewing Scenario Analyses

Users may toggle between different input settings and scenarios using the “Inputs Dashboard” section of the Dashboard page. The slicers on this page are linked to every results view. When the workbook opens, every slicer is set to the first value. The user may click on the slicer to change the modeled input. All of the results across every results page will adjust to reflect the new modeled input.

*Note: users should take care not to select multiple values for any input slicer as this will result in the visuals showing the average of the two inputs.*

The following results views are available:

- **Dashboard:** This dashboard presents a high-level summary of results, includes modeled input slicers, allows users to save results and navigate to other results views.
- **Vehicle Summary:** This pivot table shows the comparative total cost of ownership for each original fleet vehicle in terms of both net present value and cost per mile.
- **Cost Breakdown:** This pivot table breaks down the total cost of ownership (TCO) for each original fleet vehicle to compare each cost component and the total costs per mile of the potential replacements.
- **Charging Needs:** This chart and pivot table allows the user to explore the modeled charging infrastructure needed to support the fleet, broken down by potential EV savings. If vehicle locations were included in the fleet import, it will display the charging infrastructure needed at each location.
- **Emissions:** This pivot table shows potential reductions in greenhouse gases and criteria air pollutants from electrification. It shows estimated annual well-to-wheel emissions on an average per-vehicle basis using emissions factors sourced from Argonne National Laboratory's GREET tool and U.S. EPA's eGrid.
- **Report:** This sheet includes a written report with integrated charts and tables which can be exported to PDF.

# Appendix A: User Input Descriptions and Default Values

This appendix describes each user input field. The DRVE Tool has seven categories of inputs: Fleet Import Inputs, Vehicle Inputs, Market Inputs, Charging Infrastructure Inputs, Charging Strategy Inputs, Procurement Inputs, Maintenance & Insurance Inputs, and Forecasting Inputs. For most inputs, users may use the tool’s default setting or customize the input.

DRVE supports multi-variate scenario analysis which allows users to vary multiple input fields in a single analysis. For example, users can input two gasoline prices, and the tool will assess the total cost of ownership for all vehicles under both scenarios. When viewing results, the user will then have the option to view results under either gasoline price. As you add more scenarios, the analysis becomes considerably more complex so this feature should be used judiciously.

For many inputs, the fields are grouped together into “Scenario Groupings” to make the tool more efficient. For example, the gasoline and diesel price inputs are grouped together. The scenario groupings are: Fuel Price, Charging Strategy, Procurement Strategy, and Forecasting Scenario. There are also inputs that can be varied individually, such as the inflation rate. Finally, there are inputs where scenario analysis is not supported or applicable, such as the Expected Years of Use.

The tables below describe all of the customizable inputs for DRVE and their default values.

## Fleet Import Inputs

Input Field	Scenario Grouping	Description
VIN	N/A	The Vehicle Identification Number for the vehicle. These VINs will be decoded to determine all information needed about the vehicle make, model, model year, and trim.
Expected Years of Use	N/A	The expected number of years that the replacement vehicle will be in use by the fleet. Lifetime costs including depreciation will be calculated over this time span. Users can use one default value for all vehicles in the fleet or

Input Field	Scenario Grouping	Description
		can set it for each vehicle using a column in their input data.
<b>Annual Vehicle Miles Traveled</b>	N/A	The average number of miles the replacement vehicle is expected to be driven per year over its lifetime in the fleet. Users can use one default value for all vehicles in the fleet or can set it for each vehicle using a column in their input data.
<b>Vehicle Location</b>	N/A	(Optional) The location where the vehicle is domiciled. This field is used to assess charging needs at specific facilities. This is a plain text field that does not need to be an address.
<b>ZIP Code</b>	N/A	The ZIP Code where the fleet is domiciled. For fleets that span multiple ZIP Codes, the ZIP where the majority of the fleet is located. This field is used to determine default inputs for fuel prices, check the availability of state incentives, and calculate electricity emissions.

## Vehicle Inputs

Input Field	Scenario Grouping	Description
<b>Class</b>	N/A	<p>The vehicle's weight class. Choose from:</p> <ul style="list-style-type: none"> <li>• Passenger Vehicles (Class 1-2)</li> <li>• Medium-Duty Vehicles (Class 3-6), or</li> <li>• Heavy-Duty Vehicles (Class 7-8)</li> </ul>
<b>Make</b>	N/A	This field is used to apply insurance and maintenance costs.
<b>Model</b>	N/A	The make of the replacement vehicle.
		The model of the replacement vehicle, including the trim (ex. AWD/FWD).

<b>Input Field</b>	<b>Scenario Grouping</b>	<b>Description</b>
<b>Year</b>	N/A	The model-year of the replacement vehicle.
<b>Use Case</b>	N/A	The type of vehicle. This field is used to apply charging infrastructure scenarios.
<b>MSRP/Price</b>	N/A	The price per vehicle before incentives or financing. If available, the tool will load an estimated price based on the make/model/year selection. It is recommended that users set a custom value based on their fleet's procurement options and/or necessary upfits.
<b>Fuel Economy Gas City (MPG)</b>	N/A	The average number of miles driven on one gallon of gas or diesel under city driving conditions. This will be used to calculate fuel use based on vehicle miles traveled. The default value is from <a href="http://www.fueleconomy.gov">www.fueleconomy.gov</a> . This field is not relevant for battery electric vehicles.
<b>Fuel Economy Gas Hwy (MPG)</b>	N/A	The average number of miles driven on one gallon of gas or diesel under highway driving conditions. This will be used to calculate fuel use based on vehicle miles traveled. The default value is from <a href="http://www.fueleconomy.gov">www.fueleconomy.gov</a> . This field is not relevant for battery electric vehicles.
<b>Fuel Economy Electric City (MPGe)</b>	N/A	The average number of miles driven for each gasoline gallon equivalent of electricity used under city driving conditions. One gallon of gasoline is equivalent to 33.7 kilowatt-hours of electricity. The default value is from <a href="http://www.fueleconomy.gov">www.fueleconomy.gov</a> . This field is not relevant for ICE vehicles.
<b>Fuel Economy Electric Hwy (MPGe)</b>	N/A	The average number of miles driven for each gasoline gallon equivalent of electricity used under highway driving conditions. One gallon of gasoline is equivalent to 33.7 kilowatt-hours of electricity. The default value is from

Input Field	Scenario Grouping	Description
		<a href="http://www.fueleconomy.gov">www.fueleconomy.gov</a> . This field is not relevant for ICE vehicles.
<b>State Incentive (\$/Vehicle)</b>	N/A	The total state or local incentives available for the vehicle. This value will be used to reduce the purchase price of the vehicle. Users can load in specific incentive programs during the Fleet Import step or customize values for each replacement vehicle in the Fleet Mapping step.

## Market Factors

Input Field	Scenario Grouping	Description
<b>Gasoline Price (\$/Gallon)</b>	Fuel Price	The price of gasoline that is paid for by the fleet. Default gasoline price is the average price for the last year available from the U.S. Energy Information Administration and set based on ZIP code. Some prices are available at the state level, while others are available at the regional level (PADD).
<b>Diesel Price (\$/Gallon)</b>	Fuel Price	The price of diesel that is paid for by the fleet. Default diesel price is the average price for the last year available from the U.S. Energy Information Administration and set based on ZIP code. Some prices are available at the state level, while others are available at the regional level (PADD).
<b>Inflation Rate (Excluding Fuel)</b>	Individual	The inflation rate determines the increase in maintenance and other operating costs over time, excluding fuel. The default inflation rate is two percent per year based on the Federal Reserve’s inflation target.

Input Field	Scenario Grouping	Description
		Inflation for fuel is calculated separately based on projections from the U.S. Energy Information Administration.
<b>Discount Rate</b>	Individual	The annual percentage rate to discount future cash flows for net present value calculations.  The default value is two percent.
<b>Cost of Carbon (\$/Ton)</b>	Individual	The social cost of each ton of carbon emitted by the fleet. Fleet emissions are calculated on a well-to-wheel basis including upstream emissions from electricity generation and oil and gas production.  The default cost of carbon is \$0, meaning that the social cost of carbon is not included in the analysis.

## Charging Infrastructure

By default, the tool runs two scenarios for each EV modeled, one with charging infrastructure and one without. Users have the option to view results with or without charging infrastructure costs factored into the vehicle’s total cost of ownership.

Charging infrastructure scenarios are set based on the use case of the replacement EV. Users can customize the type of charging, associated costs, incentives, and ownership strategy for each use case. Default options are loaded in for each use case based on estimated infrastructure needs of a typical vehicle. The type of charging assigned to each use case is based on the estimated energy use of a typical vehicle. The costs for each type of charging are based on a nationwide assessment of typical deployment costs including equipment, installation, and electrical upgrades.

### Charging Infrastructure Field Descriptions

Input Field	Scenario Grouping	Description
<b>Port Type</b>	Charging Infrastructure	The type of charger and approximate power level. Level 2 ports are measured in amps (A)

Input Field	Scenario Grouping	Description
		<p>while DCFC are measured in kilowatts (kW). This is used to set default per-port costs and to group the results.</p>
<b>Charging Ratio (Vehicles/Port)</b>	Charging Infrastructure	<p>The number of vehicles that will be used on each charger. The cost of charging infrastructure included in each vehicle’s TCO is divided by the charging ratio.</p>
<b>Per-Port Upfront Cost</b>	Charging Infrastructure	<p>The per-port cost to procure charging infrastructure. This could include equipment, installation, electrical upgrades, or other associated costs depending on what costs the fleet would like to include in the vehicle’s TCO.</p>
<b>Per-Port Annual Cost</b>	Charging Infrastructure	<p>The annual, per-port cost to maintain charging infrastructure. This could include warranty, networking, anticipated maintenance, or other associated costs depending on what costs the fleet would like to include in the vehicle’s TCO.</p>
<b>Include Alternative Fuel Vehicle Refueling Property Credit (30C)?</b>	Charging Infrastructure	<p>Binary field indicating if the <a href="#">Alternative Fuel Vehicle Refueling Property Credit (30C)</a> should be applied to the upfront cost of charging infrastructure. Eligibility for this credit depends on the census tract where the charging station is located.</p>
<b>Include 30C Prevailing Wage and Apprenticeship Bonus?</b>	Charging Infrastructure	<p>The value of the credit depends on the <i>Wage and Apprenticeship</i> selection.</p> <p>Binary field indicating if the <a href="#">prevailing wage and apprenticeship requirements</a> stipulated in the 30C credit should be included. If the requirements are met the credit is increased from 6% to 30% of the upfront cost, not to exceed \$100,000.</p>

Input Field	Scenario Grouping	Description
		Note: the value of the credit is calculated based on the upfront cost before any additional state/local/utility incentives are applied.
<b>Additional State/Utility/Local Incentives</b>	Charging Infrastructure	Total additional per-port incentives to be applied to the upfront cost of charging infrastructure. These incentives will be used to reduce the upfront cost of charging infrastructure.
<b>Ownership Strategy</b>	Charging Infrastructure	<p>The fleet’s purchasing approach for the charging infrastructure. Either:</p> <ul style="list-style-type: none"> <li>• Purchase (Cash), or</li> <li>• Purchase (Loan)</li> </ul> <p>If loan is selected, then the financing costs will be included.</p>
<b>Down Payment</b>	Charging Procurement	(Loan Only) The per-port down payment on the charging infrastructure loan.
<b>Interest Rate (APR - %)</b>	Charging Procurement	(Loan Only) The annual interest rate for the charging infrastructure loan.
<b>Loan Term (Years)</b>	Charging Procurement	(Loan Only) The length of the charging infrastructure loan in years. This cannot exceed the expected years of use of the vehicle.

### Default Charging Infrastructure Inputs

Use Case	Port Type	Per Port Capital Cost	Per Port Annual Operating Cost	Vehicles per Port
<b>Car SUV/MPV Minivan Light Pickup</b>	30A L2	\$3,286	\$99	1
<b>Cargo Van Shuttle Bus</b>	48A L2	\$6,107	\$183	1

<b>Medium-Duty Pickup</b>				
<b>Step Van</b>				
<b>School Bus</b>	80A L2	\$23,769	\$713	1
<b>Medium-Duty Straight Truck</b>				
<b>Coach Bus</b>	50kW	\$69,374	\$2,081	1
<b>Transit Bus</b>	DCFC			
<b>Heavy-Duty Straight Truck</b>	50kW DCFC	\$69,374	\$2,081	2
<b>Tractor</b>	150kW DCFC	\$214,937	\$6,448	2

## Charging Strategy

Input Field	Scenario Grouping	Description
<b>% Depot Charging</b>	Charging Strategy	The share of fleet charging that occurs at fleet depots. The default is 100%.
		The average cost per kWh for electricity used at fleet depots, inclusive of energy and demand charges as well as all applicable taxes, riders, and fees.
<b>Electricity Price (\$/kWh)</b>	Charging Strategy	The default price is set based on the state where the fleet is located and calculated using total revenue and energy delivered for commercial customers for the most recent year available from U.S. Energy Information Administration’s survey of electric utilities (EIA-861M).
<b>% Public Charging</b>	Charging Strategy	The share of charging done at publicly available charging stations. The default is 0%.

Input Field	Scenario Grouping	Description
<b>Public Charging Price (\$/kWh)</b>	Charging Strategy	The average cost per kWh for charging at public chargers. The default is \$0.50 per kWh based on a national sample of publicly listed public charging prices.
<b>Maximum Power for Public Charging Only (kW)</b>	Charging Strategy	The maximum power for public charging stations typically used by the fleet. This field is used to calculate the amount of time that drivers spend charging at public charging stations while “on the clock.”
<b>Public Charging Downtime Cost (\$/hour)</b>	Charging Strategy	The cost of wages incurred by the fleet for each hour spent by drivers charging at public charging stations.  The default is \$43 per hour.
<b>% En-Route Charging</b>	Charging Strategy	The share of charging done at company-owned charging stations away from the vehicle’s home base. The default is 0%.
<b>En-Route Charging Price</b>	Charging Strategy	The average cost per kWh of charging done at company-owned charging stations away from the vehicle’s home base.

## Procurement Strategy

### Common Inputs

Input Field	Scenario Grouping	Description
<b>Ownership Strategy</b>	Procurement Strategy	The ownership structure for fleet procurements. Choose from: <ul style="list-style-type: none"> <li>• Purchase (Cash)</li> <li>• Purchase (Loan)</li> <li>• FMV (Closed-End) Lease</li> <li>• FMV (Closed-End) Lease w/ Cash Purchase</li> </ul>

Input Field	Scenario Grouping	Description
		<ul style="list-style-type: none"> <li>• FMV (Closed-End) Lease w/ Loan Purchase</li> <li>• TRAC (Open-End) Lease</li> <li>• TRAC (Open-End) Lease w/ Cash Purchase</li> <li>• TRAC (Open-End) Lease w/ Loan Purchase</li> <li>• Tax-Exempt Lease Purchase (Cash)</li> </ul> <p>The default is a cash purchase.</p>
<b>Monetize Tax Credit?</b>	Procurement Strategy	Binary field indicating if the commercial vehicle (45W) tax credit should be included in the analysis.
<b>Sales Tax</b>	Procurement Strategy	<p>The tax to be paid as a percentage of the vehicles upfront purchase price at the time of purchase.</p> <p>The default is based on the vehicle sales tax in the state selected.</p>
<b>Include 12% excise tax on HD trucks?</b>	Procurement Strategy	Binary field to indicate if the analysis should include the federal <a href="#">Heavy Highway Vehicle Use Tax</a> for the “tractor” use case.

## Loan Inputs

Input Field	Scenario Grouping	Description
<b>Loan Down Payment (\$/Vehicle)</b>	Procurement Strategy	<p>The initial payment due at time of purchase.</p> <p>The default is \$0.00.</p>
<b>Loan Term (Years)</b>	Procurement Strategy	<p>The length of the loan repayment in years.</p> <p>Loan term cannot exceed the expected years of ownership.</p>

Input Field	Scenario Grouping	Description
		The default is 7 years.
<b>Loan Interest Rate (APR - %)</b>	Procurement Strategy	The annual interest rate charged on loan principle,  The default is seven percent.

## Lease Inputs

Input Field	Scenario Grouping	Description
<b>Lease Down Payment (\$/Vehicle)</b>	Procurement Strategy	Down payment in cash for each vehicle.  The default is \$0.00.
<b>Lease Term (Years)</b>	Procurement Strategy	The length of the lease in years. The lease term cannot exceed the expected years of ownership. For tax-exempt lease-purchase or leases where the purchase option is not pursued, the lease term must equal the years of ownership.
<b>Lease Interest Rate (APR - %) or Money Factor</b>	Procurement Strategy	Interest for leases is often discussed in a format call “Money Factor,” which is the annual percentage rate (APR) divided by 2,400. Users can input either APR or money factor and DRVE will automatically calculate the other.
<b>Lease Acquisition Fee (\$/Vehicle)</b>	Procurement Strategy	An acquisition fee is also known as an initiation fee or a bank fee if the lessor is a bank rather than a dealer.
<b>Lease Disposition Charge (\$/Vehicle)</b>	Procurement Strategy	Fee to cover the expense of cleaning up and selling the car after it is returned at the end of the lease.
<b>Lease Negotiated Residual Value (\$/Vehicle)</b>	Procurement Strategy	Value of the vehicle at the end of the lease term. For a Tax-Exempt Lease Purchase, the residual value must equal \$1.

Input Field	Scenario Grouping	Description
<b>Lease Mileage Included (Closed-End Only)</b>	Procurement Strategy	Annual mileage allowed in the lease agreement.
<b>Lease Excess Mileage Cost (\$ per Mile)</b>	Procurement Strategy	Cost per mile above the mileage included in the lease agreement.

## Maintenance and Insurance

Maintenance and insurance costs are set based on the vehicle's class (light-duty, medium-duty, or heavy-duty) and technology (BEV, PHEV, or ICE). Maintenance costs are further differentiated between the first five years of use and subsequent years. Users can use the default input for each grouping or customize their own.

### Maintenance and Insurance Input Descriptions

Input Field	Scenario Grouping	Description
<b>Maintenance and Repair Cost - Years 1 - 5 (\$ per Mile)</b>	N/A	<p>Maintenance and repair costs per vehicle per mile for the first five years of ownership. Default costs are adapted from Argonne National Laboratory <a href="#">Comprehensive Total Cost of Ownership Quantification for Vehicles with Different Size Classes and Powertrains</a>.<sup>3</sup></p> <p>Medium-duty costs are based on medium-duty pickups and vans while heavy-duty costs are based on dump trucks, utility trucks, and box trucks.</p> <p><i>See Maintenance Cost Table.</i></p>

<sup>3</sup> Burnham, Andrew, Gohlke, David, Rush, Luke, Stephens, Thomas, Zhou, Yan, Delucchi, Mark A., Birky, Alicia, Hunter, Chad, Lin, Zhenhong, Ou, Shiqi, Xie, Fei, Proctor, Camron, Wiryadinata, Steven, Liu, Nawei, and Bolor, Madhur. *Comprehensive Total Cost of Ownership Quantification for Vehicles with Different Size Classes and Powertrains*. United States: N. p., 2021. Web. doi:10.2172/1780970.

Input Field	Scenario Grouping	Description
<b>Maintenance and Repair Cost - Years 5+ (\$ per Mile)</b>	N/A	<p>Maintenance and repair costs per vehicle per mile for sixth and subsequent years of ownership. Default costs are adapted from Argonne National Laboratory <a href="#">Comprehensive Total Cost of Ownership Quantification for Vehicles with Different Size Classes and Powertrains</a>. Medium-duty costs are based on medium-duty pickups and vans while heavy-duty costs are based on dump trucks, utility trucks, and box trucks.</p> <p>See <i>Maintenance Cost Table</i></p>
<b>Cost to Insure (\$/Year)</b>	N/A	<p>The annual cost to insure a vehicle.</p> <p>Default costs are from Argonne National Laboratory's <a href="#">Comprehensive Total Cost of Ownership Quantification for Vehicles with Different Size Classes and Powertrains</a>.</p> <p>Light-Duty: \$600 per year                      Medium-Duty: \$4,000 per year                      Heavy-Duty: \$6,000 per year</p>

**Default Maintenance Costs (\$/Mile)**

Technology		BEV	PHEV	ICE
<b>Light-Duty Vehicles</b>	Years 1-5	\$0.0610	\$0.0900	\$0.1010
	Years 6+	\$0.0793	\$0.1170	\$0.1313
<b>Medium-Duty Vehicles</b>	Years 1-5	\$0.0660	N/A	\$0.1100
	Years 6+	\$0.1440		\$0.2400
<b>Heavy-Duty Vehicles</b>	Years 1-5	\$0.2550	N/A	\$0.4250
	Years 6+	\$0.4800		\$0.8000

## Forecasting Inputs

DRVE allows users to model replacing vehicles in the future to project how forecasted changes in technology will impact total cost of ownership. Users may choose to model procurements under current market conditions (default), or to choose a future forecast year. For future forecast years, users also select a technology scenario that determines the rate of technological improvements.

Input Field	Scenario Grouping	Description
<b>Procurement Year</b>	Forecast Scenario	The year that the vehicle will be procured. Purchase price, fuel economy, and fuel price inputs will be scaled based on forecasted changes in technology and market conditions.
<b>Technology Scenario</b>	Forecast Scenario	<p>The scenario used to forecast future vehicle prices and fuel economy. Choose from:</p> <ul style="list-style-type: none"> <li>• Low Technology Progress</li> <li>• High Technology Progress</li> </ul> <p>The “Low Technology Progress” scenario is aligned with business-as-usual regulatory and market environments, whereas the “High-Technology Progress” scenario sees faster improvements in fuel economy and faster reductions in EV costs.</p>

## Vehicle Price Projections

Future vehicle prices are projected based on the Annual Technology Baseline from the National Renewable Energy Laboratory. Specifically, vehicle price projections were derived from the [LDV Future Technology Prediction \(From 2023 Model\)](#) dashboard for light-duty vehicles and from the [MD/HD Future Technology Prediction \(From 2023 Model\)](#) dashboard for

medium- and heavy-duty vehicles. The methodology for these projections is described in the report available here: [ANL - TAPS-2303 Report](#).<sup>4</sup>

Atlas matched DRVE use case's to representative vehicle type's in the NREL model. Then Atlas calculated the relative change in vehicle prices from the baseline year for each year out to 2050 and applied it to current vehicle prices to yield the projected price in the procurement year.

Future vehicle price projections for each use case can be viewed on the *Data - Vehicle Prices Future* sheet of the tool.

## Vehicle Fuel Economy Projections

Future vehicle fuel economy is projected using data from the U.S. EIA's Annual Energy Outlook. Table 51. New Light-Duty Vehicle Fuel Economy is used for light-duty vehicles and Table 49. Freight Transportation Energy Use is used to estimate future medium- and heavy-duty fuel economy.

The relative change in fuel economy from the baseline year is calculated for each year out to 2050 and then applied to the current vehicle's fuel economy to yield the projected fuel economy in the procurement year.

Future vehicle fuel economy projections for each vehicle class can be viewed on the *Data - Vehicle Fuel Economy Future* sheet of the tool.

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<sup>4</sup> Ehsan Sabri Islam, Daniela Nieto Prada, Ram Vijayagopal, Charbel Mansour, Paul Phillips, Namdoo Kim, Michel Alhajjar, Aymeric Rousseau. "Detailed Simulation Study to Evaluate Future Transportation Decarbonization Potential", Report to the US Department of Energy, Contract ANL/TAPS-23/3, October 2023

# Appendix B: Implicit Inputs and Assumptions

This section describes the inputs and assumptions that are built into the tool which are not customizable by the user.

## Depreciation Costs

The depreciation cost represents the upfront cost paid for the vehicle minus the vehicle's resale value at the end of its expected years of use.

DRVE uses a regression model based on real-world used vehicle sales data to calculate the fair market value of the vehicle at the end of its expected years of use. In addition to the vehicle's drivetrain, the model takes into account the age of the vehicle, the miles traveled, the original price of the vehicle, the electric range, and the fuel economy of the vehicle.

Note that incentives, including the federal tax credit, reduce the upfront cost of the vehicle but do not impact the vehicle's resale value.

## Fuel Use by Plug-In Hybrid Electric Vehicles

DRVE models plug-in hybrid electric vehicles operating in all-electric mode until their electric range has been depleted and then switching to gas power. The tool assumes 260 days of use per year to calculate the average daily miles traveled. Then, DRVE uses the vehicles all-electric range (from fueleconomy.gov) to calculate the percent of daily miles driven on electricity. The tool then uses the percent of miles driven on electricity vs gas to calculate and sum the fuel costs and emissions for each driving mode.

## Emissions

While the primary purpose of the DRVE tool is total cost of ownership analysis, the tool also calculates estimated emissions from the modeled vehicles. All emissions are well to wheel emissions, meaning that they include upstream emissions from both electricity generation and oil and gas refining.

Note that the emissions factors used in the emissions model are based on current emissions intensities and do not adjust for future years.

## Gas and Diesel Emissions

Emissions for gas and diesel-powered vehicles,<sup>5</sup> are calculated based on the vehicle category (light-duty, medium-duty, or heavy-duty) using well-to-wheel emissions factors from Argonne National Laboratory's [GREET Model](#).

### **Electricity Emissions**

Emissions from electricity generation for electric vehicles are calculated using the total output emissions per kWh from EPA's eGRID. The emissions factor is used for the eGRID subregion where the fleet is located. In addition, the tool includes the upstream emissions associated with transporting fuel to generation facilities which falls outside the scope of eGRID. These upstream emissions factors are based on the eGRID subregion and are from the Union of Concerned Scientists' 2022 report, [Driving Cleaner: Electric Cars and Pickups Beat Gasoline on Lifetime Global Warming Emissions](#).

### **Fuel Price Inflation**

Fuel price inflation is calculated separately from general inflation in order to take into account unique factors impacting fuel prices as well as regional variations. DRVE uses regional fuel price projections from Tables 3.1 to 3.9 (Energy Prices by Sector) of the U.S. EIA's Annual Energy Outlook. The relative change in fuel prices from the base year is calculated for each year to 2050 and then applied to the user-input fuel prices.

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<sup>5</sup> Includes the miles driven by plug-in hybrid electric vehicles on gas,

# Appendix C: Version History

Version	Date	Author	Organization	Revisions
0.3	10/20/2020	Josh Rosenberg	<a href="#">Atlas Public Policy</a>	Beta Launch
0.4	11/3/2020	Josh Rosenberg	<a href="#">Atlas Public Policy</a>	Addressed cosmetic issues around procurement settings page.
0.5	11/3/2020	Josh Rosenberg	<a href="#">Atlas Public Policy</a>	Fixed refresh issue causing unexpected error when viewing results. Fixed memory allocation issue which caused program to run out of memory too early.
0.6	11/4/2020	Josh Rosenberg	<a href="#">Atlas Public Policy</a>	Fixed bug which didn't allow users to save the results from the dashboard.
0.7	12/7/2020	Josh Rosenberg	<a href="#">Atlas Public Policy</a>	Introduced performance improvement which fixed issue causing high memory usage. Introduces feature allowing using to specify maintenance, insurance, and fed incentive costs on a vehicle-by-vehicle basis. Minor bug fixes.
1.0	2/17/2021	Josh Rosenberg	<a href="#">Atlas Public Policy</a>	Official Launch. Minor bug fixes: resolved fields that allowed for bad input. Added report feature which summarizes analysis and provides ability to export report as a PDF.
1.1	3/1/2021	Josh Rosenberg	<a href="#">Atlas Public Policy</a>	Bug fixes: Resolved issue causing users to be unable to import a fleet file. Added support for transit, school, and coach

Version	Date	Author	Organization	Revisions
				buses. Next release will include optimization to VIN decoding process.
1.2	3/5/2021	Josh Rosenberg	<a href="#">Atlas Public Policy</a>	Bug fixes: Resolved other issue causing users to be unable to import a fleet file. Fixed bug causing application to crash upon inventory sheet selection. Optimization to VIN decoding process where processing time will be a function of unique models. Add user license.
1.3	3/31/2021	Josh Rosenberg	<a href="#">Atlas Public Policy</a>	Increased error reporting when fleet has no valid VINs. Updated data on vehicle availability, fuel prices, energy inflation, emissions, and insurance.
1.4	7/1/2021	Josh Rosenberg	<a href="#">Atlas Public Policy</a>	Bug fixes: Resolved issue causing buses to not be mapped. Feature updates: Added ability to set custom defaults for VMT and Years of Use. Added forecasting feature in the market settings. Added additional guidance on procurement settings. Added values for default charging procurements. Allowed users to start with all defaults pre-loaded into the tool.
1.5	10/7/2021	Josh Rosenberg	<a href="#">Atlas Public Policy</a>	Added functionality to overwrite dropped VINs. Added ability to add custom vehicles to use in analysis that are not present in default vehicles. Updated vehicles and incentives. Minor bug

Version	Date	Author	Organization	Revisions
				fixes and performance improvements.
<b>1.6</b>	11/5/2021	Josh Rosenberg	Atlas Public Policy	Fixed bug which caused visuals on dashboard to not refresh. Updating Dashboard and Report page visuals. Included Sandbox page to allow users to create their own tables and visuals.
<b>1.7</b>	9/30/2022	Spencer Burget, Josh Rosenberg	Atlas Public Policy	Updated fuel prices and available vehicles. Added ability to apply specific state incentives and rebates for a number of programs. Fixed minor bugs.
<b>1.8</b>	10/21/2022	Spencer Burget	Atlas Public Policy	Updated available vehicles and default vehicle mappings. Fixed formula for loan calculation. Previous calculation was attempting to do monthly accrual of principal and interest payments. This was inaccurate since the model is annual. This change affected loan calculations for vehicles and infrastructure.
<b>2.0</b>	4/24/2024	Spencer Burget	Atlas Public Policy	DRVE 2.0 completely reworked the user interface adding a modern look and feel designed to maximize intuitive use and transparency.  New substantive additions to DRVE 2.0 included the addition of a charging infrastructure planning model and a GHG and

Version	Date	Author	Organization	Revisions
				<p>criteria air pollutant emissions model.</p> <p>Lastly, DRVE 2.0 included a comprehensive update to underlying data including vehicles, fuel prices, charging infrastructure prices, forecasted vehicle prices, and the EV depreciation curve.</p>
<b>2.01</b>	8/30/2024	Spencer Burget	Atlas Public Policy	Updated data model to improve performance when opening the results, in addition to updating the result file’s default name to now be “DRVE_Results_Dashboard.”
<b>2.02</b>	2/05/2025	Daniel Wilkins	Atlas Public Policy	Fixed bug caused by Report tab not having enough rows to surface results by vehicle type. Added new 2024 – 2025 MY vehicles, removed EV models that are no longer in production and updated fuel economy standards for 2025 via fueleconomy.gov.
<b>2.03</b>	3/20/2025	Daniel Wilkins	Atlas Public Policy	Updated fuel prices for 2024 and vehicle availability through March 2025. Resolved bug with depreciation rate calculation that overestimated light duty BEV and PHEV residual values over longer (5+ year) ownership tenures.

# Appendix D: License

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