AVFT Tool Help

Introduction

The AVFT Tool can be used to develop the AVFT (Alternate Vehicle Fuel and Technology) table, which allows users to modify the fraction of vehicles capable of using different fuels and technologies. Specifically, for each source type and model year, the AVFT table allows users to define the fraction of vehicles that use:

- gasoline,
- diesel,
- E-85,
- CNG,
- battery electric (BEV), and
- fuel cell electric (FCEV)

The decimal values between 0 and 1 in the AVFT table represent the fraction of each model year and source type that use each of the above fuels and technologies; they sum to 1 for each model year of each source type.[1] When using the AVFT table, MOVES requires fuel type distributions for every model year included in the run. MOVES models vehicles from age 0 to age 30. For example, if you are modeling calendar year 2030, MOVES would require a fuel type distribution for every model year between 2000-2030.

The purpose of this tool is to project future fuel type distributions based on the combination of local historic data and projected national trends. It can also gap-fill local historic fuel type distribution data if necessary. The projections are applied to model years beyond the last complete model year in the input data to the user-specified analysis year. If multiple calendar years are to be modeled, you can select the latest analysis year and use the tool output for all MOVES runs.

The resulting AVFT table can then be imported into MOVES using the County Database Manager, Project Database Manager, or the Input Data Sets command.

Using the Tool

1. Preparing Input Data

The local historic data used as input to the AVFT Tool should be provided in the format of the AVFT table.[2] These local inputs can be derived from vehicle registration data. For example, the following steps describe a high-level overview of how you can transform such data into the AVFT table format:

[1] Note that the AVFT Tool is not applicable for motorcycles (sourceTypeID 11) because MOVES only models gasoline motorcycles. The tool will produce the right number of rows for motorcycles but there are no methods for them, and they do not need to be present in the input data.

[2] A template for the AVFT table can be generated by clicking the "Create Template" button in the "Input/Output Files" section of the AVFT Tool.

a. Map vehicle types to MOVES source types (sourceTypeIDs) and fuel types to combinations of MOVES fuel types (fuelTypeIDs) and engine technologies (engTechIDs). MOVES source types, fuel types, engine technologies, and their allowable combinations are listed in the onroad cheat sheet (available in the Help menu in MOVES), and are described in detail in Section 2 of the Vehicle Population and Activity (EPA-420-R-23-005) technical report.
b. Sum the vehicle counts by sourceTypeID, modelYearID, fuelTypeID, and engTechID.
c. Sum the total counts by sourceTypeID and modelYearID.
d. Calculate the fuel type distributions by dividing the vehicle counts (step b) by the total counts (step c), and save these fractions in a column called fuelEngFraction.
e. The resulting table should have the following columns in this order:
    i. sourceTypeID
    ii. modelYearID
    iii. fuelTypeID
    iv. engTechID
    v. fuelEngFraction

2. Tool Input Selections

Specify the input parameters for the tool in the Tool Input Selections section. See the MOVES4 Technical Guidance for EPA recommendations for these inputs.

a. **Last complete model year in input data.** The model year selected for this parameter becomes the baseline for the future projections made by the tool. Specifically, the last complete model year is needed, as partial model years are common in vehicle registration data. For example, if your vehicle registration data were pulled on July 1, 2023, they would contain a partial view of the model year 2023 cohort since not all model year 2023 vehicles were sold by this date. In addition, the data may contain early model year 2024 registrations. In this example, you would select 2022 as the last complete model year in the input data.
b. **Analysis year.** Enter the calendar year you are intending to model here (i.e., the year selected on the Time Spans panel in the RunSpec). The tool will project fuel type distributions for all model years between the last complete model year and the analysis year (inclusive).
c. **Gap-filling Method.** If gaps exist in the input data, the AVFT Tool will fill them to avoid getting errors when you use the results of this tool. Gaps may exist for several reasons, such as if a fuel type is not present in the original data source and is simply not included in the input data (e.g., there is no CNG use in the local area, so the input data are missing rows for CNG [fuelTypeID 3]), or if certain model year and source type combinations are not present in the original data source (e.g., no transit buses in the local area were purchased in a particular year). The gap-filling method is selected individually for each source type and specifies how the AVFT Tool should address these issues:
    - Fill with 0s. This method simply provides all missing key combinations with a fuelEngFraction of 0.
        - In the missing CNG rows example above, the AVFT Tool would add rows for all model years and fuelTypeID 3 for the selected source type.
        - If this method were used in the transit bus missing model years example above, the AVFT Tool would add 0s for *all* fuel types, which would result in an error message. Therefore, this would not be a viable method for that scenario.

- Use defaults and renormalize. This method inserts the national default fuelEngFractions for missing key combinations, and then proportionally reduces the user-provided fuelEngFractions so that the distributions sum to 1 for all model years.
  - If a source type is completely missing from the input data, selecting this method will result in the default fractions used as-is for that source type.
  - In the missing model years example, the AVFT Tool would add the default fuel type distributions for all missing model years.
  - If this method were applied in the missing CNG rows example, the AVFT Tool would add the default CNG fractions and then proportionally reduce all the other fuels so that the distributions sum to 1. Since in this specific example it is known that no CNG is used, selecting this method would provide incorrect inputs for that scenario, although the tool will not report an error.
  - This method renormalizes user-provided fuelEngFractions when a non-zero fraction is added from the defaults or when the provided fuelEngFractions did not originally sum to 1. A warning message will be reported in the latter case.
- Note that regardless of which gap-filling method is selected, the AVFT Tool limits the model years in the results to 30 years before the "last complete model year in input data" selection. For example, if your last complete model year is 2022, the output would contain model years going back to 1992 regardless of the number of years in your input data.
- If you need to model a calendar year prior to your last complete model year, you will need to run the AVFT Tool twice:
  - For the first run, select the actual last complete model year in input data.
  - For the second run, select the earliest calendar year that you need to model. This will ensure that the tool will output data for model years going back to 30 years before your earliest calendar year.
  - Then combine the results from the two runs into a single AVFT file to import into MOVES. Where model years overlap in the output between the two runs, take the results from the first run.
- If it is desirable to use the "defaults and renormalize" method, but gaps exist where there are known 0s (e.g., CNG is known to be 0 and is missing from the input data), you will first need to manually add the known 0s to the input data before running the tool.

d. **Projection Method.** The projection method is selected individually for each source type and specifies how the AVFT Tool should estimate fuel type distributions for model years between the last complete model year and the analysis year. Detailed descriptions of each method are provided in an appendix of the MOVES Vehicle Population and Activity technical report, but they are briefly described as follows:
   - Proportional. This method projects future fuel type distributions based on proportional differences between the local and the national distributions in the last complete model year in the input data. This preserves differences between local conditions and the national average, while still accounting for expected changes in national fuel type distribution trends. Note that this method includes boundary limits so that extreme differences between the national averages and local conditions will not be fully reflected in the projected data.

- National Average. This method applies the national default fuel type distributions for all model years beyond the last complete model year in the input data.
- Known Fractions. The known fractions method allows you to provide known fuel fractions for specific fuel types. The proportional method is then used to project any fuel types not provided. The input format for the known fractions is the same as the other input data for this tool. Known fractions can be provided for one or more fuel types and should be provided for all projected model years (that is, all model years between the last complete model year and the analysis year). If this method is used for multiple source types, a single known fractions input file should be used, containing the known fractions for each source type projected with this method.
- Constant. This method applies the last complete model year in the input data distributions as-is to all projected model years.

3. Input/Output Files

In the Input/Output Files section, specify the file path to your input data (as prepared in step 1). The input data may be provided in MS Excel format (.xlsx or .xls) or comma-separated values format (.csv). If you use Excel, the tool will ask you to specify which tab contains your data. If you need a template to ensure your data are formatted correctly, you can create one by clicking the "Create Template" button.

If you have selected the "Known Fractions" method for one or more source types, the "Known Fractions" controls will be enabled. These controls function the same as the "Input AVFT File" controls described above.

Finally, specify the file name and location where the results of the AVFT Tool should be saved. Note that the tool's output must have the .xlsx extension.

4. Run the Tool

Once all the controls are filled out, run the tool by clicking "Run AVFT Tool". If there are any warning or error messages, they will be displayed in the Messages box. These messages can be saved for further investigation using the "Save Messages" button. Any error messages will need to be addressed before output will be generated.

5. Quality Assurance Steps

The output of the tool is an Excel file which contains the resulting AVFT table and graphs of each source type's fuel type distributions. The graphs are not needed by MOVES but are provided so that modelers can ensure that the results of this tool appear reasonable. Note that the graphs require Excel 2021 or later (or a continuously updated Excel product, such as Microsoft 365) to work automatically. If this product is not available to you, you may need to use an alternative method to visually inspect the resulting AVFT table.

6. Input into MOVES

To use the results of this tool with MOVES, use the AVFT importer in the MOVES input database manager's Fuel Tab to select the output file and import it into your run's input database.