

# ICEVs/HEVs/PHEVs/EVs/FCVs

Let's learn about the R&D GREET model's capability to model on-road vehicles (ICEVs/HEVs/PHEVs/EVs/FCVs). This worksheet will help you harness the R&D GREET model in cases related to on-road vehicles.

## R&D GREET problem solving

When running on-road vehicle simulations, where would you find the major outputs for light-duty, medium-duty, and heavy-duty vehicles?

- 1 Light-duty vehicle outputs =
- 2 Medium-duty vehicle outputs =
- 3 Heavy-duty vehicle outputs =

## List the primary tabs in R&D GREET 1 that include on-road vehicle-specific information.

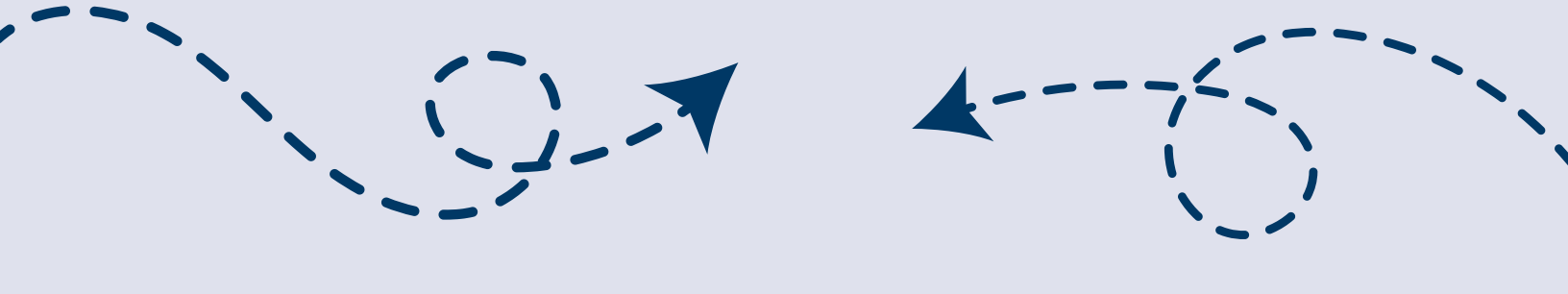
Answer here

## On-road vehicles in R&D GREET

Explore the major worksheets related to on-road vehicles in R&D GREET.

## Life cycle impacts with different powertrains

Model a sport utility vehicle (SUV) built and used in 2022 with the following powertrains: internal combustion engine vehicle (ICEV), hybrid electric vehicle (HEV), plug-in hybrid electric vehicle (PHEV) with a 50-mi range, battery electric vehicle (BEV) with a 400-mi range, and a fuel-cell vehicle (FCV) fueled with gaseous hydrogen. All other settings should be set as default.



**What is the default rated all-electric range (RAER) for PHEVs and BEVs in R&D GREET?**

- 1 RAER [miles] for a PHEV =
- 2 RAER [miles] for a BEV =

**Fill out the following table using R&D GREET 1.**

	<b>Feedstock GHG Emissions (g CO<sub>2</sub>e/mile)</b>	<b>Fuel GHG Emissions (g CO<sub>2</sub>e/mile)</b>	<b>Vehicle Operation GHG Emissions (g CO<sub>2</sub>e/mile)</b>	<b>Total Fuel Cycle GHG Emissions (g CO<sub>2</sub>e/mile)</b>
ICEV	Answer here	Answer here	Answer here	Answer here
HEV	Answer here	Answer here	Answer here	Answer here
PHEV	Answer here	Answer here	Answer here	Answer here
BEV	Answer here	Answer here	Answer here	Answer here
FCV	Answer here	Answer here	Answer here	Answer here

**List the powertrains from the lowest to highest feedstock GHG emissions.**

Answer here





**List the powertrains from the lowest to highest total fuel cycle GHG emissions.**

Answer here

**Which vehicles do not produce any vehicle operation emissions? Explain.**

Answer here

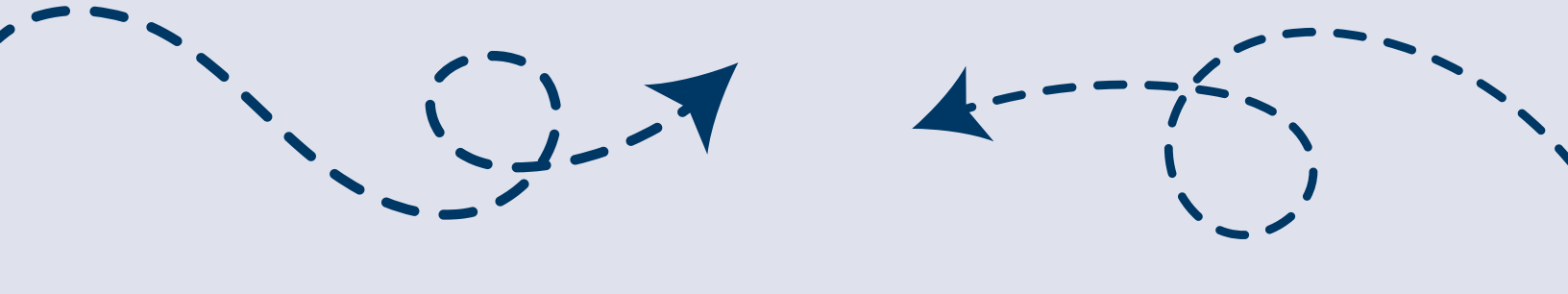
**Fill out the following table using R&D GREET 2.**

	<b>WTP GHG Emissions (g CO<sub>2</sub>e/mile)</b>	<b>Vehicle Cycle GHG Emissions (g CO<sub>2</sub>e/mile)</b>	<b>Vehicle Operation GHG Emissions (g CO<sub>2</sub>e/mile)</b>	<b>Total Vehicle Cycle GHG Emissions (g CO<sub>2</sub>e/mile)</b>
ICEV	Answer here	Answer here	Answer here	Answer here
HEV	Answer here	Answer here	Answer here	Answer here
PHEV	Answer here	Answer here	Answer here	Answer here
BEV	Answer here	Answer here	Answer here	Answer here
FCV	Answer here	Answer here	Answer here	Answer here

**List the powertrains from the lowest to highest vehicle cycle GHG emissions.**

Answer here





List the powertrains from the lowest to highest total vehicle cycle GHG emissions.

Answer here

Calculate the percentage reduction in total vehicle cycle GHG emissions compared to the same vehicle using an ICEV fueled with gasoline.

- 1 Reduction for an HEV =
- 2 Reduction for a PHEV =
- 3 Reduction for a BEV =
- 4 Reduction for a FCV =

$$\text{Percent reduction} = 100 \times \left( 1 - \frac{\text{total powertrain-specific emissions}}{\text{total ICEV emissions}} \right)$$

### Vehicle cycle impacts with different battery chemistries

Model a sport utility vehicle (SUV) built and used in 2022 running on an NMC811 battery with the following powertrains: plug-in hybrid electric vehicle (PHEV) with a 50-mi range and a battery electric vehicle (BEV) with a 400-mi range. All other settings should be set as default.

What is the default battery chemistry used in PHEVs and BEVs?

Answer here

How often does R&D GREET assume a vehicle will have the battery replaced by default?

Answer here



Fill out the following table using R&D GREET 2.

	WTP GHG Emissions (g CO <sub>2</sub> e/mile)	Vehicle Cycle GHG Emissions (g CO <sub>2</sub> e/mile)	Vehicle Operation GHG Emissions (g CO <sub>2</sub> e/mile)	Total Vehicle Cycle GHG Emissions (g CO <sub>2</sub> e/mile)
PHEV	Answer here	Answer here	Answer here	Answer here
BEV	Answer here	Answer here	Answer here	Answer here

Calculate the percentage reduction in total vehicle cycle GHG emissions compared to the same vehicle powertrain using the default battery chemistry.

- 1 Reduction for a PHEV =
- 2 Reduction for a BEV =

### Fuel-cell vehicle powered by gaseous hydrogen

Model a fuel-cell vehicle (FCV) sport utility vehicle (SUV) built and used in 2022 and fueled by gaseous hydrogen produced from **steam methane reforming without carbon capture and sequestration** (CCS). All other settings should be set as default.

	Feedstock GHG Emissions (g CO <sub>2</sub> e/mile)	Fuel GHG Emissions (g CO <sub>2</sub> e/mile)	Vehicle Operation GHG Emissions (g CO <sub>2</sub> e/mile)	Total Fuel Cycle GHG Emissions (g CO <sub>2</sub> e/mile)
FCV	Answer here	Answer here	Answer here	Answer here





## Solar-powered hydrogen

Model a fuel-cell vehicle (FCV) sport utility vehicle (SUV) built and used in 2022 and fueled by gaseous hydrogen produced from **solar-powered PEM electrolysis**. All other settings should be set as default.

	Feedstock GHG Emissions (g CO <sub>2</sub> e/mile)	Fuel GHG Emissions (g CO <sub>2</sub> e/mile)	Vehicle Operation GHG Emissions (g CO <sub>2</sub> e/mile)	Total Fuel Cycle GHG Emissions (g CO <sub>2</sub> e/mile)
FCV	Answer here	Answer here	Answer here	Answer here

**Compare the GHG emissions results of an FCV fueled by solar-powered PEM electrolysis to the GHG emissions results of an FCV fueled by NG SMR without CCS hydrogen.**

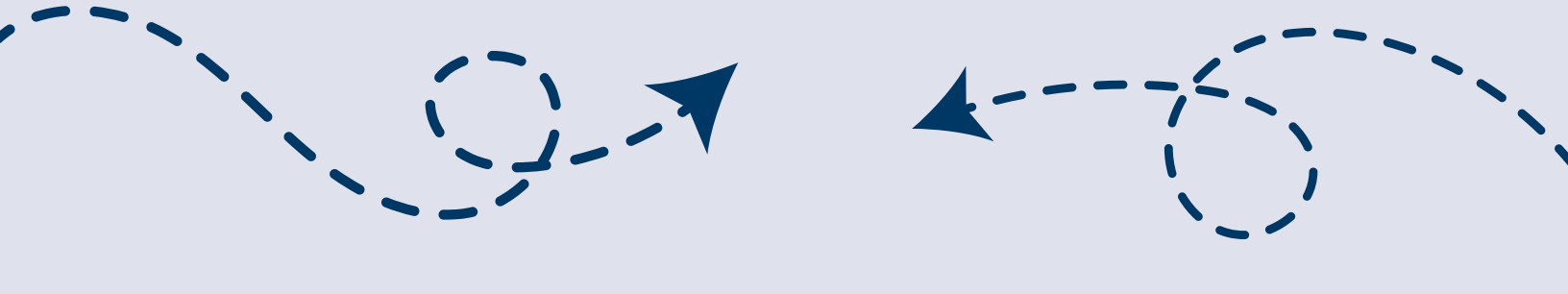
Answer here

## Solar infrastructure

Model a fuel-cell vehicle (FCV) sport utility vehicle (SUV) built and used in 2022 and fueled by gaseous hydrogen produced from solar-powered PEM electrolysis **including the embodied emissions of the solar infrastructure and storage**. All other settings should be set as default.

	Feedstock GHG Emissions (g CO <sub>2</sub> e/mile)	Fuel GHG Emissions (g CO <sub>2</sub> e/mile)	Vehicle Operation GHG Emissions (g CO <sub>2</sub> e/mile)	Total Fuel Cycle GHG Emissions (g CO <sub>2</sub> e/mile)
FCV	Answer here	Answer here	Answer here	Answer here





## Wind infrastructure

Model a fuel-cell vehicle (FCV) sport utility vehicle (SUV) built and used in 2022 and fueled by gaseous hydrogen produced from **wind-powered** PEM electrolysis including the embodied emissions of the solar infrastructure. All other settings should be set as default.

	Feedstock GHG Emissions (g CO <sub>2</sub> e/mile)	Fuel GHG Emissions (g CO <sub>2</sub> e/mile)	Vehicle Operation GHG Emissions (g CO <sub>2</sub> e/mile)	Total Fuel Cycle GHG Emissions (g CO <sub>2</sub> e/mile)
FCV	Answer here	Answer here	Answer here	Answer here

## Compare the embodied emissions from solar infrastructure and wind infrastructure.

Answer here

