# Greenhouse Gases, Regulated Emissions, and Energy use in Transportation (GREET™) Model

(Argonne National Laboratory)

Objectives

Evaluate and compare energy and environmental impacts of transportation fuels and vehicle technologies on a life-cycle basis.

Key Attributes & Strengths

Provides a consistent life-cycle analysis (LCA) platform with reliable, widely accepted methods/protocols. Consists of two modules: 1) GREET1 evaluates well-to-wheels (WTW) energy use and emissions of vehicle/fuel systems, and 2) GREET2 evaluates energy use and emissions of vehicle manufacturing cycle. Evaluates over 100 alternative fuel pathways and over 80 vehicle technologies. Includes aviation fuels and aircraft operation as well as marine fuels and vessel operation. Conducts life cycle evaluation of primary energy use (e.g., petroleum, natural gas, coal) and of emissions by category such as greenhouse gases (CO_2, N_2O, CH_4) and air pollutants (SO_x, NO_x, VOC, CO, PM_{10}, $PM_{2.5}$). The GREET™ model is widely recognized as the "gold standard" for life-cycle analysis with over 20,000 registered users worldwide. GREET is used by regulatory agencies for WTW evaluation of various fuels (e.g., EPA for RFS2 and California for LCFS). Documentation of the modeling approach and data sources are available on the GREET website.
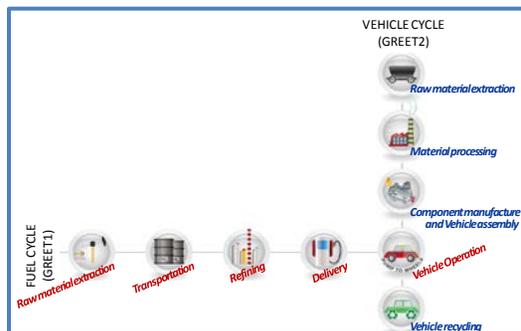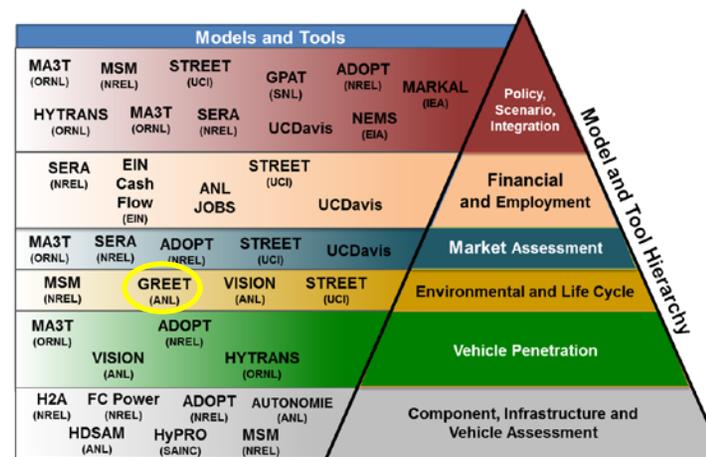
Platform, Requirements & Availability

Excel with Visual Basic graphical user interface program. Also developed in .net platform which allows custom building of pathways via drag-and-drop using default or user defined databases. Freely available to the public from the GREET™ website: http://greet.es.anl.gov.

INPUTS

- Process level energy inputs and outputs for feedstock recovery and fuel production processes.
- Emission factors for stationary combustion and power generation technologies.
- Fuel economy and emission factors for vehicles.
- Payload fuel energy intensity and emission factors for trucks, rail, aircraft, and marine vessel operations.
- Other data from open literature and engineering modeling.

ASSUMPTIONS & DATA

- EIA and AEO for current and future energy projections.
- EPA eGrid for electric systems and emissions inventories.
- USDA, USGS, and National Agricultural Statistics Service for biofuels.
- H2A models for hydrogen.
- Simulations for future technologies (e.g., ASPEN, MOVES, Autonomie, etc.).
- Peer-reviewed publications for data on existing technologies.
- Input from industry stakeholders and other researchers.

OUTPUTS

- Energy use (total, fossil, petroleum, coal, natural gas, and renewable energy).
- GHG emissions (CO_2, CH_4, N_2O and total CO_{2e}).
- Emissions of criteria pollutants (VOC, CO, NO_x, PM_{10}, $PM_{2.5}$ and SO_x); separated into total and urban emissions.