

NOVEMBER 7, 2022
GREET TRAINING WORKSHOP



GREET 1 Model: Fuel Cycle Analysis

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Energy Systems and Infrastructure Analysis Division
Argonne National Laboratory

GREET®

Publications

Databases

GREET Model Platforms

GREET .Net

GREET Excel

Fuel-Cycle Model

Vehicle-Cycle Model

GREET Tools

WTW Calculator

AFLEET Tool

AWARE-US Model

FD-CIC Tool

Refinery Products VOC

GREET Building Module

GREET Aviation Module

GREET w/ H₂ User Interface

Other Related Models

Workshops

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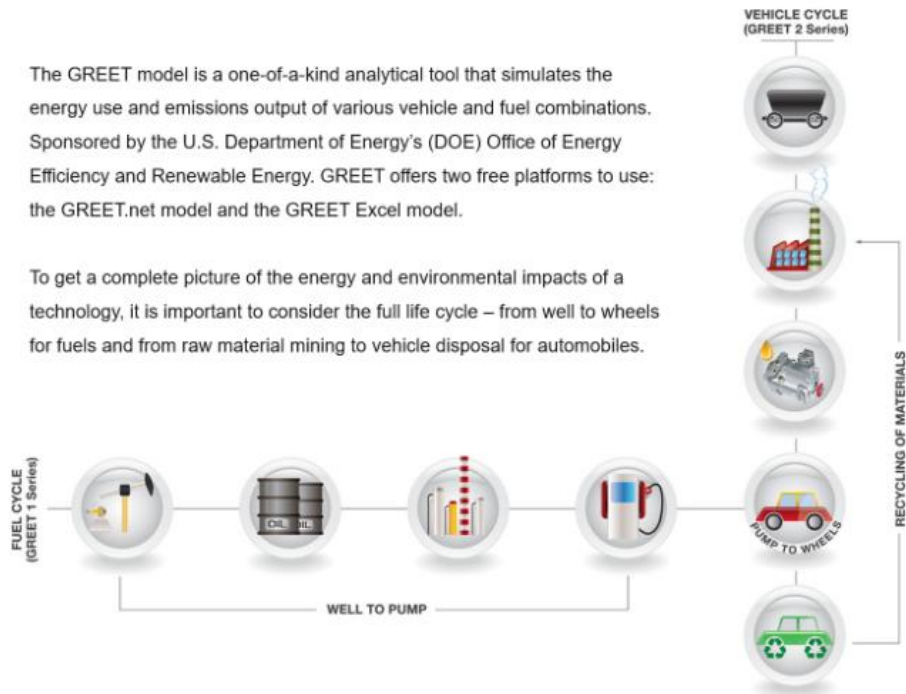
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GREET® Model

The **G**reenhouse gases, **R**egulated **E**missions, and **E**nergy use in **T**echnologies Model

The GREET model is a one-of-a-kind analytical tool that simulates the energy use and emissions output of various vehicle and fuel combinations. Sponsored by the U.S. Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy. GREET offers two free platforms to use: the GREET.net model and the GREET Excel model.

To get a complete picture of the energy and environmental impacts of a technology, it is important to consider the full life cycle – from well to wheels for fuels and from raw material mining to vehicle disposal for automobiles.



GREET News

GREET User Training Workshop at Argonne

Argonne National Laboratory is pleased to announce an in-person GREET user workshop to be held at Argonne, November 7-8, 2022. For event details, please visit:

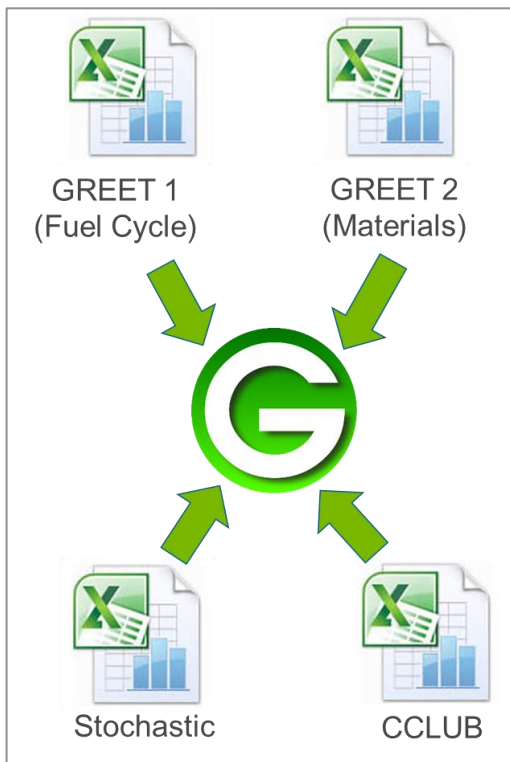
<https://www.anl.gov/event/greet-training-workshop>.

Nov 7, 2022 - Nov 8, 2022

GREET Excel version is completely transparent with multiple modules

[illegible]

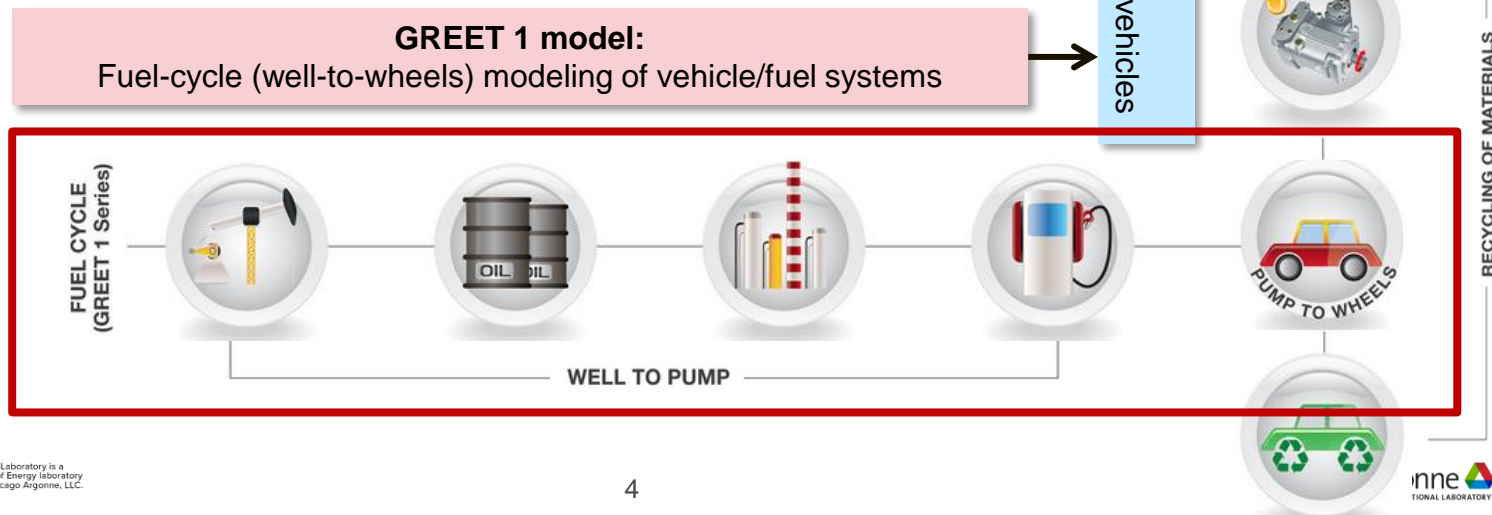
The screenshot displays a spreadsheet application with a menu bar (A-G), a toolbar (Home, Results, Petroleum, etc.), and a large blue box with the word "Stochastic" in white text. Below the box, a "Distributions" dialog box is open, showing options for Normal, Lognormal, Uniform, Triangular, Weibull, Beta, Gamma, Exponential, Pareto, and Logistic distributions. The "Normal" distribution is selected. The background spreadsheet shows data for "Light-Duty Trucks (LDT)" and "Eagle Ford".

[illegible]

The GREET model framework

- **GREET1: Fuel cycle**

- Includes the entire supply chain of energy production
- [Well-to-pump] + [Pump-to-wheels] = [Well-to-wheels]
- Interacts with GREET2



GREET1: Microsoft Excel-based LCA tool

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GREET1 MODEL

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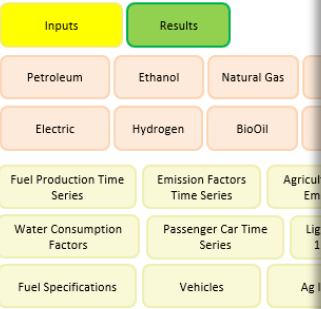
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Inputs

Results

Petroleum
Co_processing
NG
MeOH&FTD
EtOH
Electric
Bio_electricity
Hydrogen
BioOil
Algae
Macroalgae
Waste
RNG
Pyrolysis_IDL
IBR
PUP_conversion
E_fuel
Fuel_Prod_TS
EF_TS
AgMining_EF_TS
EF
WCF
Fuel_Specs
Car_TS
LDT1_TS
LDT2_TS
Vehicles
Urban_Shares
Compression

59 tabs in GREET1

Coal
T&D_Flowcharts
T&D
Uranium
ASU
Ag_Inputs
Enzymes_Yeast
Pretreatment
Catalyst
Steam_Cracking
Chemicals
Plastics
Animal_Feed
EtOH-Diesel_Additives
OilGasCoalInfra
ElecInfra
Woody
HDV_TS
HDV_WTW
JetFuel_WTP
JetFuel_PTWa
JetFuel_WTWa
Rail_PTW
Rail_WTW
MarineFuel_WTH
Dist_Specs
Forecast_Specs
Forecast_Deleted

GREET1 major components

Energy/Fuels

- Petroleum
- Natural gas
- Electricity
- Hydrogen
- Biofuels
- E-fuels
- Waste-to-Energy
- Coal
- Nuclear

Intermediates/ Products

- Chemicals
- Catalysts
- Enzymes
- Ag. inputs
- Plastics
- Animal feed

Applications

- LDVs
- HDVs
- Rail
- Marine
- Aviation

Supporting information

- Emission factors
- Fuel specs
- Time-series values
- Water consumption factors
- Stochastic simulation

Each tab includes detailed modeling parameters enabling comprehensive LCA

Petroleum to Gasoline, Liquefied Petroleum Gas, Residual Oil, Diesel, and Naphtha

1) Scenario Control and Key Input Parameters

Gasoline oxygen content (by weight)

Gasoline blendstock	0.0%
Gasoline	3.6%
CA Gasoline	3.6%

[Home](#)[Inputs](#)[Results](#)

	Gasoline Blendstock	Gasoline	CA Gasoline
Type of additive to be used	5	4	4

(Selected from Input tab: 1 -- MTBE, 2 -- ETBE, 3 -- TAME, 4 -- Ethanol, 5 -- No additive)

Share of Crude Feedstocks to US Refinery

Vol. Share
Energy Share

Parameters for Dilbit

Virgin Diluent Share

Electricity Generation

1) Scenario Control and Key Input Parameters (from the Inputs sheet)

Control variable for selecting power plant emission factors
1 -- GREET-calculated emissions factors via emission factors in EF Sheet
2 -- Emission factors based on EIA/GRID database

Selecting nuclear reactor technologies for electrolysis at refueling stations

Conversion factor for nuclear power plants (MWh/g of U-235)

Energy Use of Power Plant Infrastructure

Mass Ratio to Bitmen plus Unrecovered Diluent

Energy Ratio to Bitmen plus Unrecovered Diluent

Shale Oil Production Parameters

Flaring Intensity (scf/mmBtu)

CO2 emission factor (gCO2/scf flared)

CH4 emission factor (gCH4/scf flared)

Fugitive Intensity (scf/mmBtu)

CO2 emission factor (gCO2/scf fugitive)

CH4 emission factor (gCH4/scf fugitive)

High Octane Fuel Assumptions

Ethanol's Energy Content for High Octane Gasoline

E10

E25

E40

Selection of Refinery Parameters for High Octane Fuel

Energy efficiency

Energy ratio of crude oil feeds to product (mmBtu of crude/mmBtu of fuel throughput)

Shares of process fuels

Residual oil

Natural gas

Electricity

Hydrogen

Butane

Blendstock

2) Electricity Generation Mixes, Combustion Technology

2.1) Regional Combustion Technology Shares and Power

Fuel

Combustion Technology

Efficiency

Region

Technology Share

Emissions (g/kWh)

VOC

CO

NOx

PM10

PM2.5

SOx

BC

OC

CH4

N2O

Fuel

Combustion Technology

Efficiency

Technology Share

Emissions (g/kWh)

unc

Hydrogen Production Pathways: from NG, Electrolysis, Solar Photovoltaics, Nuclear Energy, Coal, Biomass, Coke Oven Gas, Ethanol, and Methanol

1) Scenario Control and Key Input Parameters (from the Inputs sheet)

Hydrogen Production Facility

Share of H2 Production: G H2

Share of H2 Production: L H2

CO2 Sequestration in Central H2 Plants: Per

NG-to-H2 Plant

Coal-to-H2 Plant

Biomass-to-H2 Plant

Ref. Coke-to-H2 Plant

Conversion factor for HTGR (MWh of electricity of Conversion factor for High Temperature Electrolysis)

Selection of Method for Estimating Credits

Central Plant G H2

Central Plant L H2

Central Plant G H2

Central Plant L H2

Central Plant G H2

Central Plant L H2

Central Plant G H2

Central Plant L H2

Central Plant G H2

Central Plant L H2

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GREET LCA Methodology: Well-to-Pump

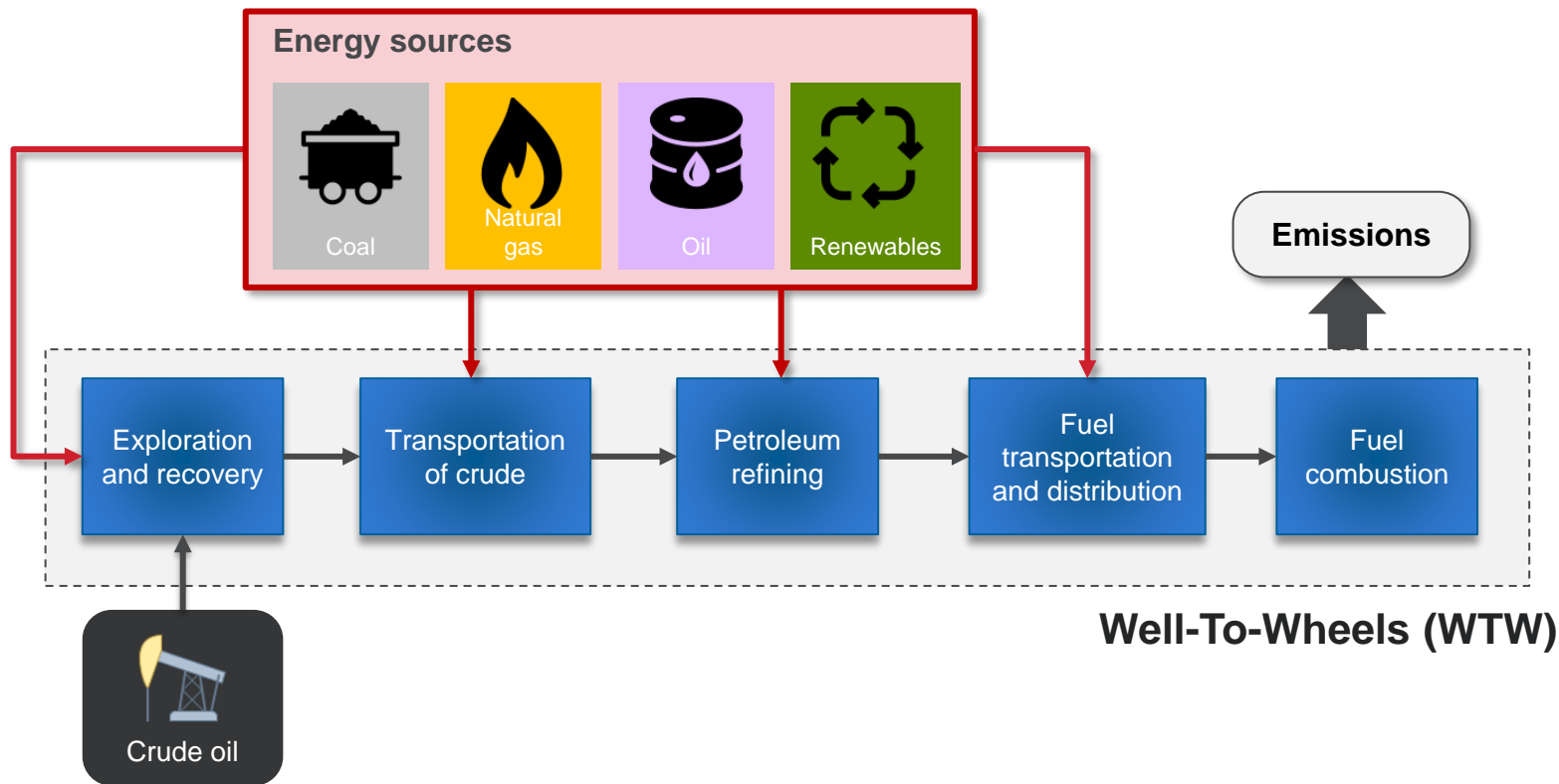


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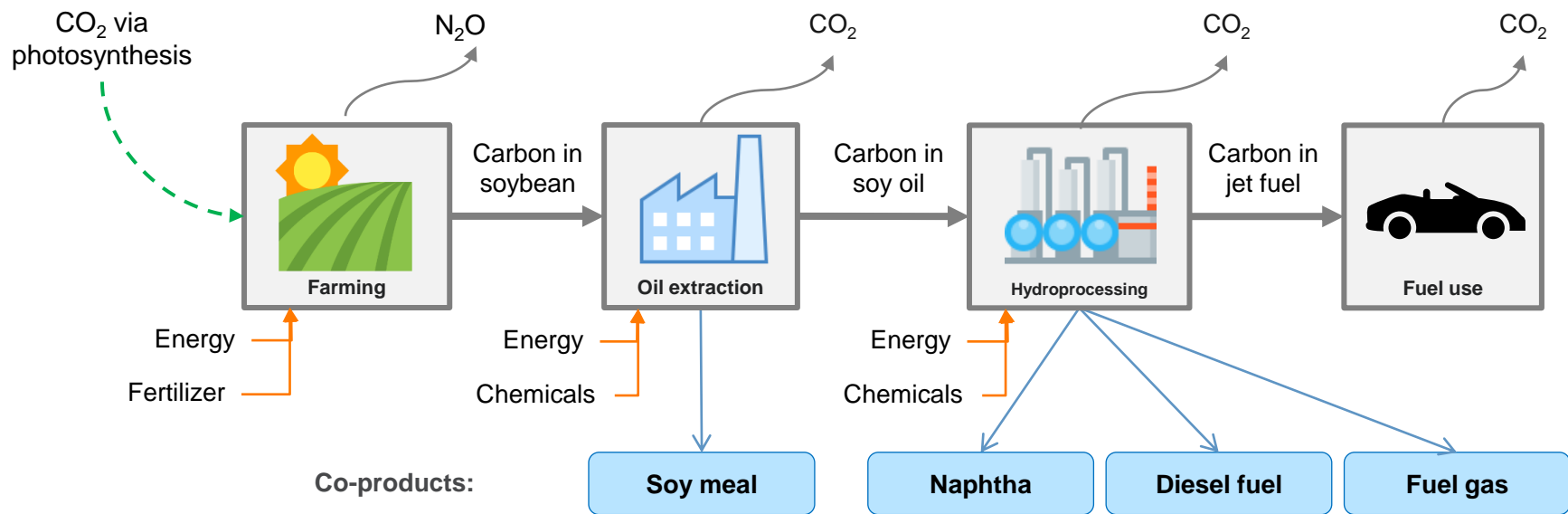


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1946–2021

Fuel Pathways: Petroleum Fuels

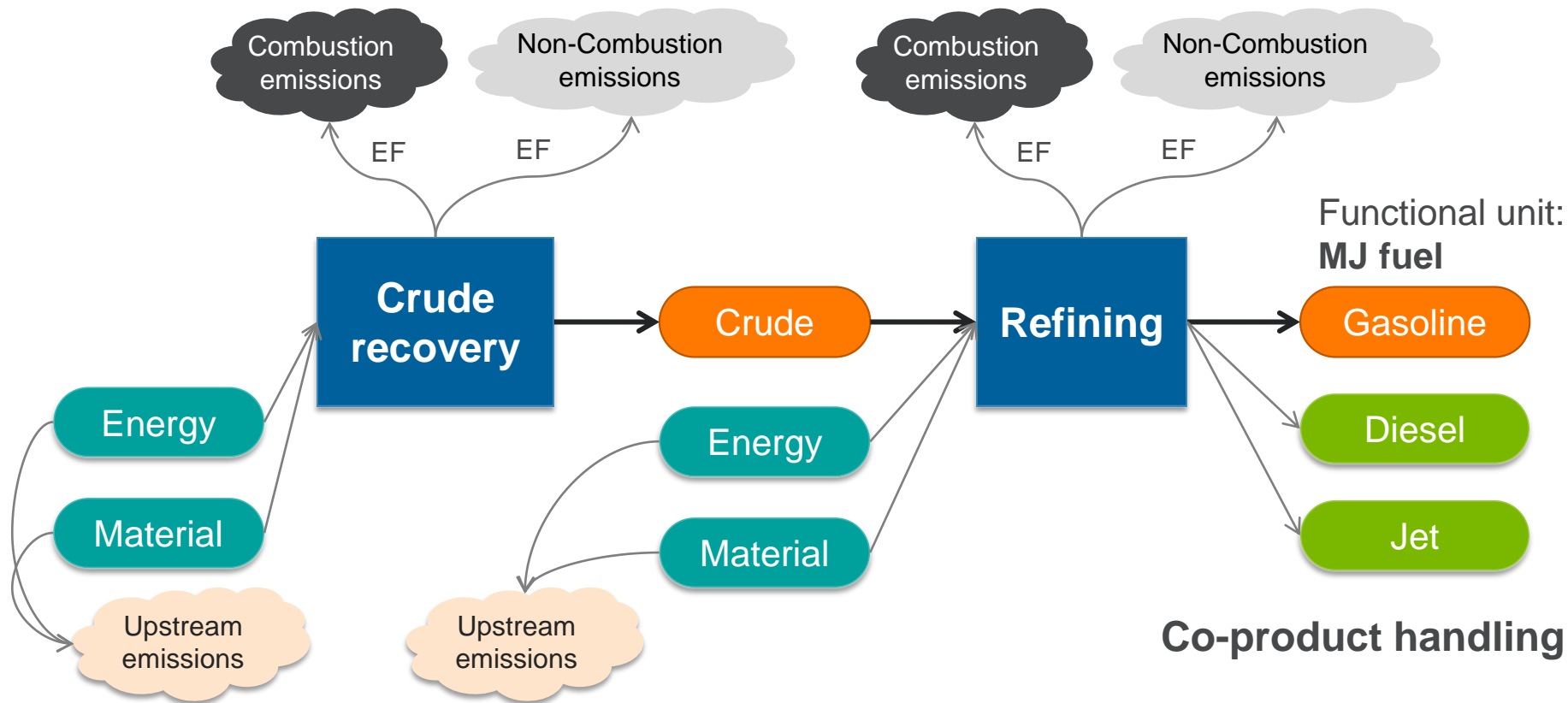


Fuel Pathways: Biofuels



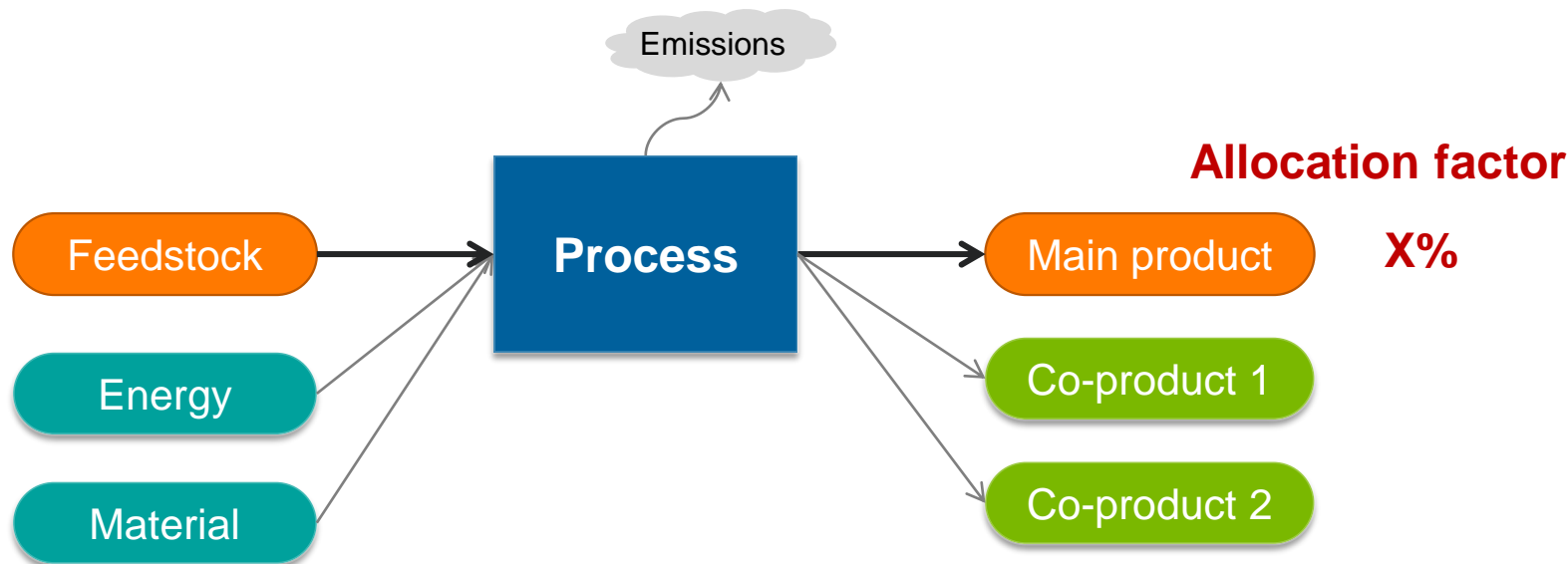
- Carbon cycle via photosynthesis provides key CO_2 benefits with biofuel pathways.

REET1 example fuel production pathway (simplified)



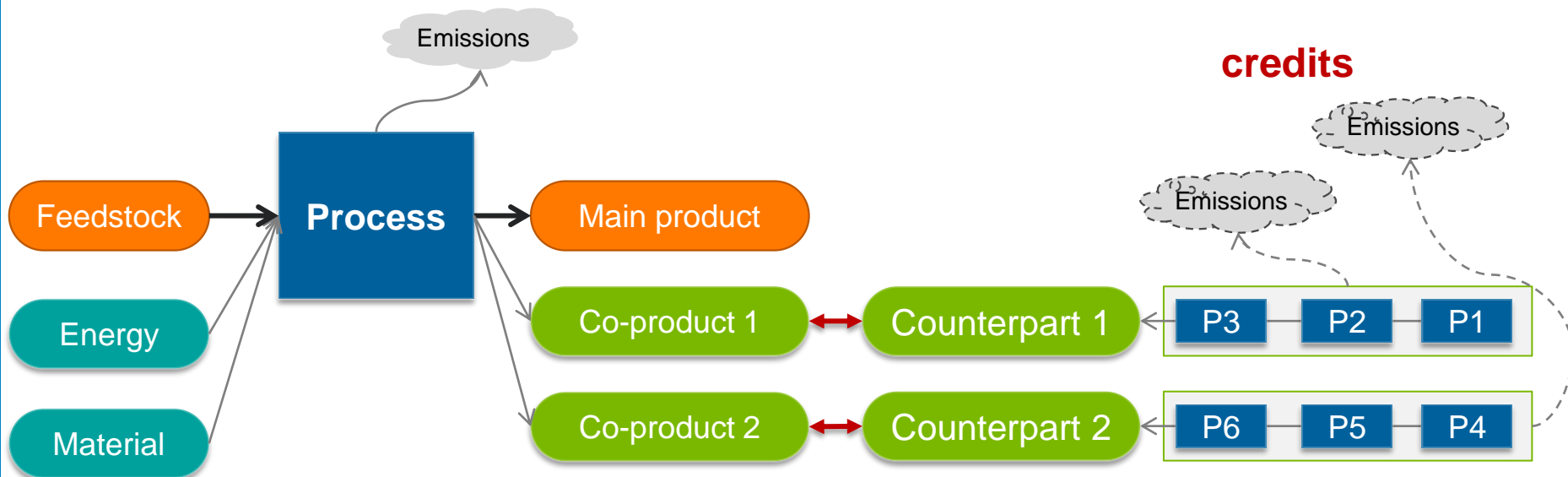
Co-product handling: allocation

- Main product and co-product carry energy and emissions burdens and can be allocated based on their relative ratios in the total product slate;
- Allocation can be done based on mass, energy, or market-value.



Co-product handling: displacement (substitution)

- Main product carries the burden of all process energy and emissions, and all life-cycle energy and emissions of the displaced product are credited to the main product.

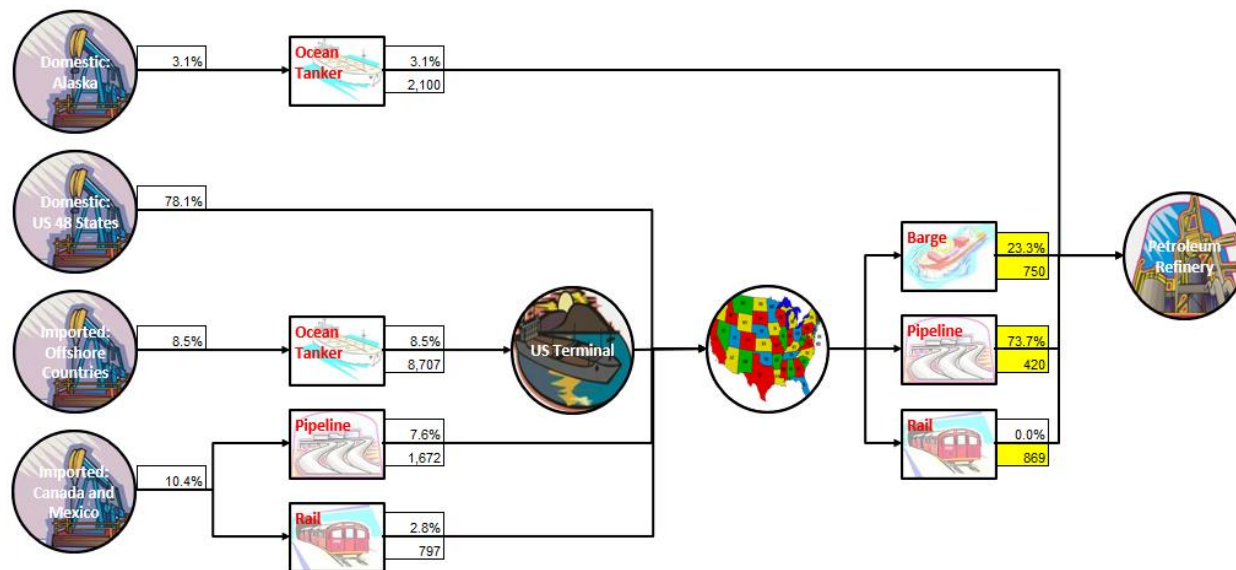


Users can select the co-product handling method in GREET

Transportation process

- Transportation modes: ocean tanker, barge, truck, rail, and pipeline
- Parameters: payload (ton), energy consumption (Btu/ton-mi), distance (mi), mode share (%), fuel type (diesel, residual oil, natural gas, and electricity, back-haul)

1. Conventional Crude Oil for Use in US Refinery



GREET outputs include energy use, criteria pollutants, greenhouse gases, and water consumption

Energy use

- **Total energy:** fossil energy and renewable energy
- **Fossil energy:** petroleum, natural gas, and coal
- **Renewable energy:** biomass, nuclear energy, hydro-power, wind power, and solar energy

Air pollutants

- VOC, CO, NO_x, PM₁₀, PM_{2.5}, and SO_x
- Estimated separately for total and urban (a subset of the total) emissions

Greenhouse gases (GHG)

- CO₂, CH₄, N₂O, black carbon, and surface albedo
- CO_{2e} of the five (combined with their global warming potentials)

Water consumption

- Freshwater consumption
- Water stress, considering water supply and demand (energy-water nexus)

GREET LCA Methodology: Pump-to-Wheels (Vehicle Operation)



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Pump-to-Wheels

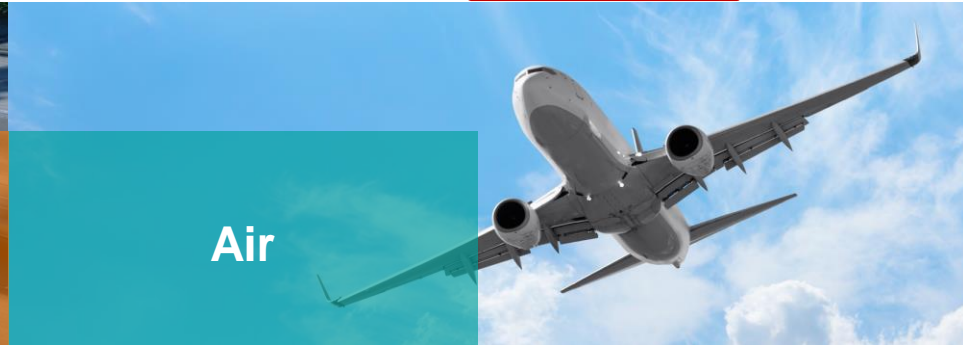
FUEL CYCLE
(GREET 1 Series)



WELL TO PUMP



Road



Air



Rail



Marine

Urban Emis
MPGGE (pe
Total fuel u
Fossil fuel
Coal use (E
Natural gas
Petroleum

Emissions:
VOC: ex
VOC: eva
CO
NOx
PM10: ex
PM10: br
PM2.5: ex
PM2.5: br
SOx
BC
OC
CH4
N2O
CO2
CO2 (w/ f
GHGs
Misc. item

- | | | | | | | | |
|-----------------|-------|------|-------|-------|-----|-------|-----|
| LH2 ICE Vehicle | 70.0% | 31.4 | 3,574 | 3,574 | (0) | 3,574 | (0) |
|-----------------|-------|------|-------|-------|-----|-------|-----|

[illegible]

CIDI Vehicle: Conventional and LS Diesel

- | |
|-------|
| 31.6 |
| 3,553 |
| 3,553 |
| 0 |
| 3,553 |
| 0.14 |
| 0.00 |
| 3.53 |
| 0.09 |
| 0.00 |
| 0.03 |
| 0.00 |
| 0.00 |
| 0.00 |
| 0.00 |
| 0.00 |
| 0.09 |
| 0.00 |
| 27 |
| 28 |
| 28 |

0.014	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.141
0.000	0.161	0.161	0.161	0.161	0.161	0.161	0.161	0.161	0.137	0.137	0.009
0.548	2.741	2.741	2.741	2.741	2.741	2.741	2.741	2.741	2.741	2.741	3.531
0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.091
0.000	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.003
0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031
0.000	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
0.000	0.000	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.000	0.001	0.002
0.000	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000
0.001	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.092
0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
0	317	308	337	308	307	306	281	281	281	276	276
1	322	313	342	313	312	312	286	286	286	272	281
2	324	314	343	315	314	313	288	288	288	274	283
	-322	-313	-342	-20	-54	-91	-19	-19	-19	0	-214

Light-duty vehicles: Fuel economy and emission factors

- Fuel economy values are based on Argonne's Autonomie, which is a detailed vehicle simulation model.
- Emission factors are based on EPA's MOVES model (the latest MOVES3)
- Light-duty vehicles include three types: passenger cars, sports utility vehicles (LDV1), and pickup truck (LDV2)

1) Fuel Economy and Emission Rates of Passenger Cars Baseline Vehicles: gasoline-equivalent MPG and grams/mile emissions (fuel economy is adjusted for on-road performance using the EPA mpg-based method, and using 43%city/57%highway VMT split)

Model Year **2016**

Lag year **5**

Gasoline Car: Values from non-stochastic simulations and for adjustments to distribution functions

Model year is 5 years earlier than simulated technology year

	26.16	0.069	0.161	2.741	0.082	0.004	0.031	0.003	0.004	0.002	0.001	0.015	0.004
	26.16	0.069	0.161	2.741	0.082	0.004	0.031	0.003	0.004	0.002	0.001	0.015	0.004
Model Year	MPGGE	VOC (Exhaust)	VOC (Evap.)	CO	NOx	PM10 (Exhaust)	PM10 (TBW)	PM2.5 (Exhaust)	PM2.5 (TBW)	BC	OC	CH4	N2O
MY 1990	22.10	1.071	2.641	13.152	2.908	0.021	0.031	0.018	0.004	0.004	0.010	0.179	0.040
MY 1995	21.70	0.658	2.626	9.472	1.860	0.014	0.031	0.012	0.004	0.003	0.006	0.110	0.027
MY 2000	22.00	0.244	2.611	5.791	0.812	0.006	0.031	0.006	0.004	0.001	0.003	0.041	0.014
MY 2005	23.40	0.115	0.166	3.871	0.203	0.002	0.031	0.002	0.004	0.000	0.001	0.022	0.006
MY 2010	26.08	0.074	0.164	2.986	0.090	0.002	0.031	0.002	0.004	0.001	0.001	0.016	0.006
MY 2015	26.16	0.069	0.161	2.741	0.082	0.004	0.031	0.003	0.004	0.002	0.001	0.015	0.004
MY 2020	30.70	0.040	0.114	1.466	0.039	0.004	0.031	0.004	0.004	0.003	0.001	0.008	0.004
MY 2025	31.49	0.029	0.101	1.016	0.021	0.004	0.031	0.004	0.004	0.003	0.001	0.005	0.004
MY 2030	35.43	0.029	0.099	1.011	0.021	0.004	0.031	0.003	0.004	0.003	0.001	0.005	0.004
MY 2035	38.28	0.028	0.098	1.006	0.021	0.004	0.031	0.003	0.004	0.003	0.001	0.005	0.004
MY 2050	44.48	0.027	0.096	0.993	0.020	0.004	0.031	0.003	0.004	0.002	0.001	0.005	0.004

Heavy-duty vehicles: Fuel economy and emission factors

- HDV_TS and HDV_TWT tabs

Types of HDVs in GREET

- Combination Long-Haul Trucks
- Combination Short-Haul Trucks
- Heavy Heavy-Duty Vocational Vehicles
- Medium Heavy-Duty Vocational Vehicles
- Light Heavy-Duty Vocational Vehicles
- Heavy-Duty Pick-Up Trucks and Vans
- Refuse Trucks
- School Buses
- Transit Buses
- Intercity Buses

Types of fuels for HDVs

- Diesel
- Biodiesel
- Renewable diesel
- DME/F-T diesel/Methanol
- CNG/LNG
- Electricity
- Hydrogen

Rail, marine, and aviation modules can generate results for different service functional units

- Rail (per ton-mi or per passenger-mi results)
 - Rail types: freight rails, intercity rails, commuter rails, and transit rails
 - Fuel types: diesel, LNG, LPG, DME, FTD, RD, RG, H₂, and electricity

- Marine (per million tonne-km or per defined trip)
 - Vessel types: bulk, container-large, and tanker VLCC
 - Trip types: domestic-domestic, domestic-CA, CA-CA, domestic-international, and CA-international
 - Regions: Pacific, Atlantic, Gulf of Mexico, and Great Lakes
 - Fuel types: HFO, MDO, MGO, LNG, FTD, Pyrolysis oil, methanol, ammonia, etc.

- Aviation (per passenger-km or per kg-km)
 - Aircraft types (passenger and freight): single aisle, small twin aisle, large twin aisle, large quad, and regional jet
 - Fuel types: petroleum jet and sustainable aviation fuels (SAF)

Time-series tables characterize technology advancement over time and enable simulating temporal effects

Fuel_Prod_TS	EF_TS	AgMining_EF_TS	EF	WCF	Fuel_Specs	Car_TS	LDT_TS	LDT2_TS
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- Many major parameters have time-series (TS) values.

5-year period	Residual Oil	Natural Gas	Coal	Nuclear	Biomass	Others
1990	4.2%	12.3%	52.5%	19.0%	1.1%	10.9%
1995	2.2%	14.8%	51.0%	20.1%	1.2%	10.7%
2000	2.9%	15.8%	51.7%	19.8%	1.1%	8.7%
2005	2.9%	15.7%	51.7%	20.3%	1.2%	8.2%
2010	0.9%	22.7%	46.0%	20.3%	0.3%	9.8%
2013	0.6%	26.2%	40.3%	20.2%	0.3%	12.3%
2014	0.7%	26.2%	39.8%	20.2%	0.4%	12.6%
2015	0.7%	31.6%	34.2%	20.3%	0.4%	12.8%
2016	0.6%	32.7%	31.4%	20.5%	0.3%	14.5%
2017	0.5%	30.6%	31.0%	20.9%	0.4%	16.6%
2018	0.4%	33.4%	29.0%	20.3%	0.3%	16.5%
2019	0.4%	36.7%	24.6%	20.4%	0.3%	17.5%
2020	0.4%	39.6%	20.0%	20.4%	0.3%	19.4%
2021	0.3%	36.5%	23.8%	19.6%	0.3%	19.5%
2025	0.2%	34.7%	17.7%	18.9%	0.3%	28.3%
2030	0.2%	33.5%	16.1%	16.7%	0.3%	33.3%
2035	0.2%	32.6%	14.0%	15.4%	0.3%	37.5%
2040	0.1%	33.0%	12.3%	14.7%	0.2%	39.5%
2045	0.1%	34.0%	11.1%	14.2%	0.2%	40.3%
2050	0.1%	34.2%	10.5%	13.4%	0.2%	41.6%

1. Key Options for Simulation

1.1) Target Year for Simulation

2021

- Depending on the selected simulation year, GREET reads the parameters in the TS tables of relevant parameters for the simulation year.

What can we do with GREET?



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1946-2021

GREET 1 can simulate various fuel production pathways in specific scenarios

Inputs

Scenario Control Variables and Input Assumptions

1. Key Options for Simulation

1.1) Target Year for Simulation

2021

Restore Time Series
Table Value

1.2) Point-Estimation or Probability-Estimation Option

Load Stochastic Toolkit

Load Stochastic Toolkit ... To load the stochastic toolkit
Unload Stochastic Toolkit ... To unload the stochastic toolkit

2. Vehicle Types for Simulation

1 -- Passenger Cars; 2 -- Light-Duty Trucks 1 (LD1) (Sports utility vehicles (SUV)); 3 -- Light-Duty Trucks 2 (LD2) (Pickup Truck (PUT))

3. Petroleum-Based Fuels

3.1) Petroleum Recovery Options

3.1.a) Share of crude oil sources

EIA projection
User defined
Used in calculation
API gravity
S Content (wt %)
Average transportation distances (mi)
U.S. Domestic crude
API gravity
Vol. Share (%)

3.1.b) Efficiency for Petroleum Recovery

Conventional Crude Recovery

98.0%

3.1.c) Key parameters of Oil Sands Recovery Methods and Products

Dilbit Composition
Volumetric Shares
Recovered Diluent in Refineries
Share of oil sands recovery methods and products
Volumetric Share
Mass Share
Energy Share

3.2) Conventional Crude Transport Options

	Domestic: Alaska	Domestic: U.S. 48 States	Countries	Imported Canada and Mexico
Domestic Share of Crude Input to Refineries		78.1%		
Mode Shares				
Ocean Tanker	3.1%		8.5%	
Pipeline		See T&O_Flowcharts tab		7.6%
Rail		See T&O_Flowcharts tab		2.8%
Average transportation distances (mi)				
Ocean Tanker	2,100		8,707	

- Technology options
- Technology shares
- Efficiencies / yields
- Emission factors
- Etc.

Results

Home | **WTW Results Menu** | Select a vehicle type from a pink drop down menu, then press "Go"

Inputs | **WTP Results** | **WTW Changes**

SI ICE Vehicles | **SI Hybrid Vehicles (HEV)** | **SI Plug-in Hybrid**

Select Fuels | Select Fuels | Select Fuels

SIDI ICE Vehicles | CIDI Hybrid Vehicles (HEV) | CIDI Plug-in Hybrid

Select Fuels | Select Fuels | Select Fuels

CIDI ICE Vehicles | BEV and FCV | GC ICE Vehicle

Select Fuels | Select Fuels | Select Fuels

Unit Selection | Select units from a pink drop down menu for the Results

Per Vehicle Distance Traveled | Per Energy in Fuels

Energy Unit: Btu | Emission Unit: g | Energy Unit: Btu | Emission Unit: g

Service Functional Unit: mile | Energy Functional Unit: mmBtu

2. Well-to-Wheels Energy Consumption, Water Consumption, and Emissions: per mile and per mmBtu

Item	Btu/mile or Gallon/mile or g/mile				Btu/mmBtu or Gallon/mmBtu or g/mmBtu			
	Feedstock	Fuel	Vehicle Operation	Total	Feedstock	Fuel	Vehicle Operation	Total
Total Energy	233	953	4,289	5,478	54,414	222,307	1,000,000	1,276,720
Fossil Fuels	219	846	4,003	5,069	51,118	197,360	933,326	1,181,804
Coal	23	34	0	57	5,361	7,863	0	13,224
Natural Gas	158	541	0	699	36,792	126,052	0	162,844
Petroleum	38	272	4,003	4,314	8,965	63,445	933,326	1,005,736
Water Consumption	0.1	0.2	0	0	15	38	0	53
CO2 (w/ C in VOC & CO)	-2	63	329	390	-527	14,689	76,702	90,864
CH4	0.320	0.187	0.015	0.522	74.590	43.607	3.414	121.611
N2O	0.000	0.012	0.004	0.016	0.073	2.827	0.911	3.811
GHGs	7	72	330	410	1,716	16,780	77,053	95,529
VOC: Total	0.013	0.114	0.230	0.357	3.008	26.513	53.597	83.119
CO: Total	0.027	0.043	2.741	2.811	6.187	10.113	638.104	655.404
NOx: Total	0.042	0.072	0.082	0.196	9.729	16.848	19.209	45.786
PM10: Total	0.002	0.010	0.035	0.047	0.502	2.407	8.044	10.953
PM2.5: Total	0.002	0.007	0.007	0.016	0.420	1.532	1.729	3.680
SOx: Total	0.011	0.022	0.002	0.035	2.470	5.172	0.456	8.098
BC Total	0.000	0.001	0.003	0.004	0.074	0.183	0.609	0.866
OC Total	0.001	0.001	0.002	0.004	0.152	0.272	0.415	0.838
VOC: Urban	0.002	0.066	0.161	0.229	0.534	15.298	37.518	53.351
CO: Urban	0.001	0.011	1.919	1.931	0.256	2.580	447.373	450.210
NOx: Urban	0.002	0.017	0.058	0.078	0.514	3.853	13.446	17.813
PM10: Urban	0.000	0.004	0.024	0.028	0.039	0.830	5.631	6.500
PM2.5: Urban	0.000	0.003	0.005	0.008	0.034	0.723	1.210	1.966
SOx: Urban	0.001	0.006	0.001	0.009	0.278	1.393	0.319	1.991
BC: Urban	0.000	0.000	0.002	0.002	0.003	0.082	0.426	0.512
OC: Urban	0.000	0.000	0.001	0.002	0.010	0.106	0.290	0.407

Users can change the value

Users can select an option

GREET generates substantial and reliable datasets for energy/transportation technologies

GREET includes

- Feedstock specifications
- Fuel specifications
- Major parameters (e.g., fuel yield, energy and material inputs, etc.) of various fuel production technologies
- Major parameters of various material production technologies
- Vehicle fuel economy and emission factors

<https://greet.es.anl.gov/publications>

Technical Publications

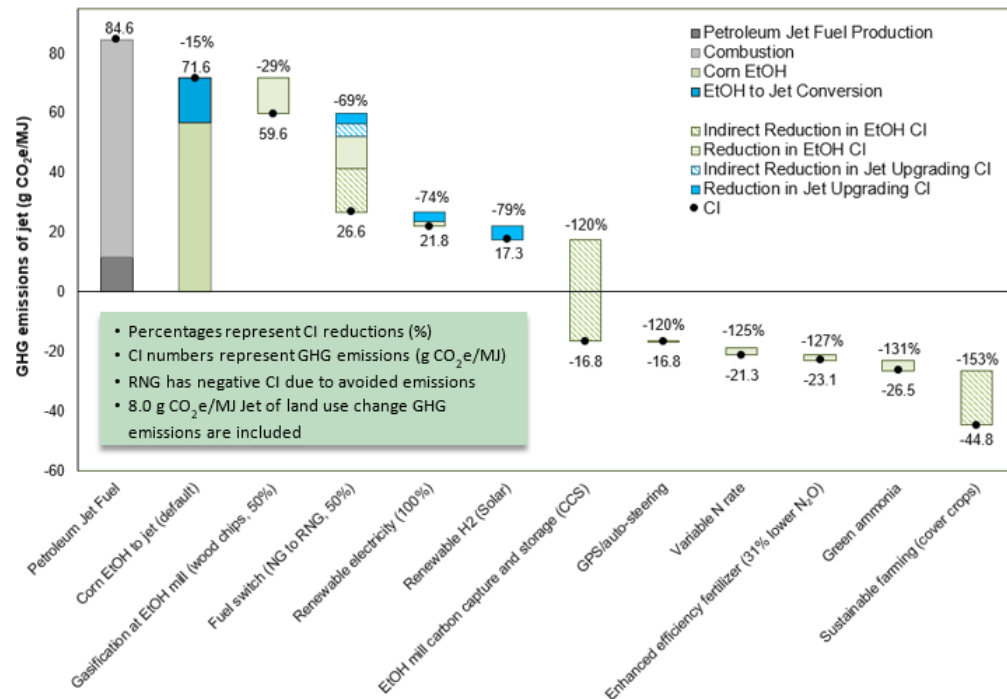
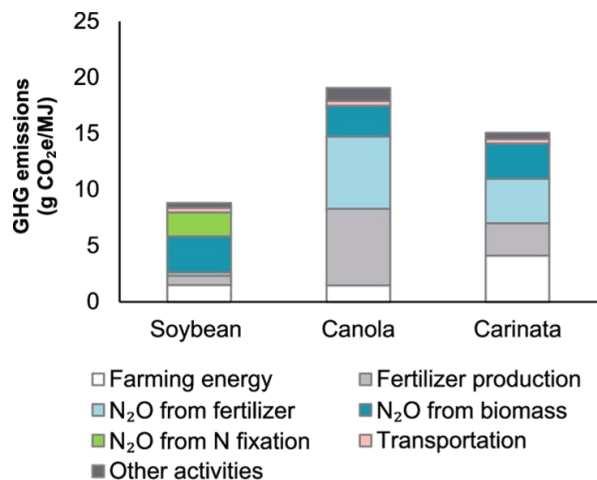
[Back to Categories](#)

Title	Authors	Date	File
Economic and environmental analysis to evaluate the potential value of co-optimal diesel bioblendstocks to petroleum refiners	Y. Jiang, G. Zaimes, S. Li, T. Hawkins, A. Singh, N. Carlson, M. Talmadge, D. Gaspar, M. Ramirez-Corredores, A. Beck, B. Young, L. Sittler, A. Brooker	10-20-2022	publication link
Updates to Vehicle-Cycle Inventory for Select Component Duty Vehicle	R. Iyer, J. Kelly	10-13-	
Hydrogen			
Lithium Pr			
Updated F			
Anodes for Battery Chemistries			
Addition of End-of-Life Recycling Methodology to GREET® 2022 for Steel and Aluminum	J. Kelly, C. Kolodziej	10-01-2022	261.94 KB
Updated Natural Gas Pathways in GREET 2022	A. Burnham	10-01-2022	230.08 KB
Sector and Environmental	P. Benavides, A. Bartling, S. Phillips, T. Hawkins, A. Singh, G. Zaimes, M. S. Bartley, T.	08-03-2022	publication link

All parameters, conditions, and assumptions are clearly documented in journal articles, technical reports, and memos.

GREET 1 identifies hotspots and opportunities for technology improvement

- Results can be presented at the process level showing the contribution of major parameters.
- Can help reduce environmental impacts through multiple options available in GREET.



Source: Jim Spaeth (2021)
<https://www.energy.gov/eere/bioenergy/articles/sustainable-aviation-fuels-low-carbon-ethanol-production>

Stochastic simulation in GREET1 quantifies uncertainties

- Stochastic simulation feature is incorporated in GREET
 - Assign probability distribution functions to the input variables
 - Specify the number of samples required and the sampling technique
 - Define the forecast variables
 - Propagate the uncertainties
 - Statistically analyze the outputs



Scenario Control Variables and Input Assumptions

1. Key Options for Simulation

1.1) Target Year for Simulation

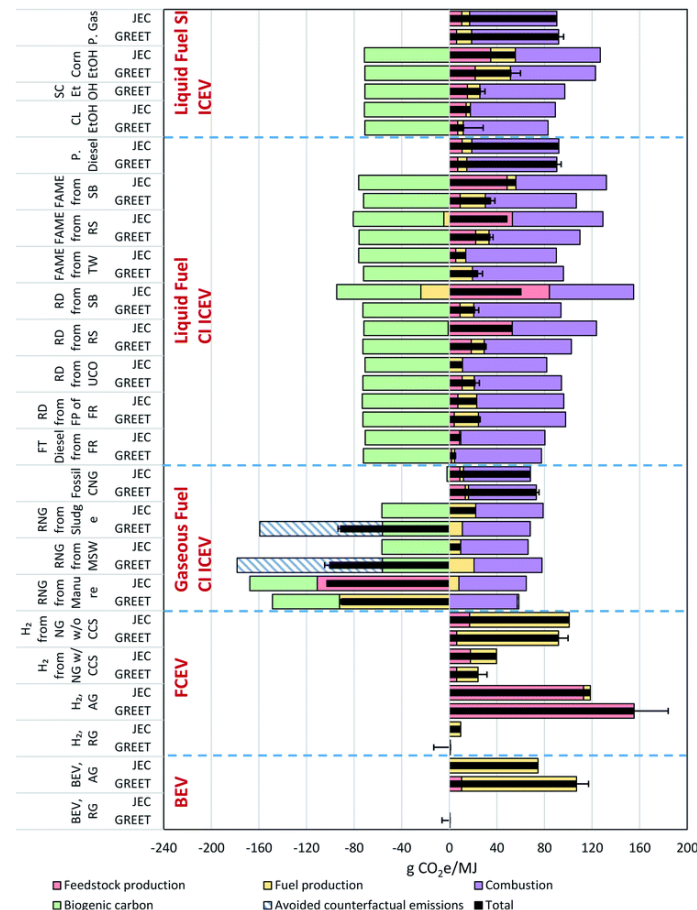
2021

Restore Time Series Table Value

1.2) Point-Estimation or Probability-Estimation Option

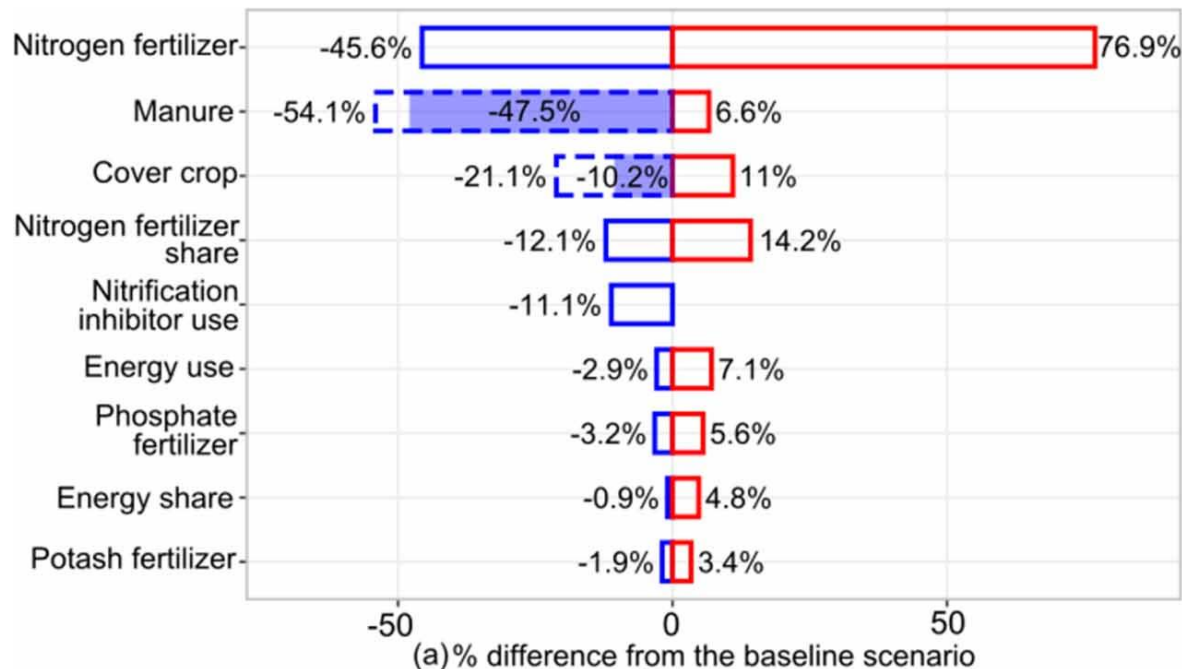
Load Stochastic Toolkit

Load Stochastic Toolkit ... To load the stc
Unload Stochastic Toolkit ... To unload the



Sensitivity analysis with transparent access and modifications to key inputs

- Sensitivity analysis help reveal the impact of each parameter



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Day 2 8:30am – GREET1 Demonstration

Visit <https://greet.es.anl.gov/>

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GREET Questions: best way via emails

- Greet@anl.gov
- Subject: area of your questions (such as biofuels, electric vehicles, hydrogen, etc.)
- Questions in email text