Argonne NATIONAL LABORATORY

... for a brighter future

Demonstration of GREET 2.7

II. Total Energy-Cycle Simulations through the Excel Spreadsheet

Andrew Burnham and Ye Wu
Center for Transportation Research
Argonne National Laboratory

GREET User Workshop
Argonne, IL, June 25-26, 2007

U.S. Department of Energy

UChicago Argonne LLC

A U.S. Department of Energy laboratory managed by UChicago Argonne, LLC

Total Energy-Cycle Major Assumptions Requires Use of Both GREET 1.7 and 2.7

- Taking this into account the weight needs to be consistent between GREET 1.7 and 2.7 as the fuel economy for specific vehicles in 1.7 are set to match the weights in 2.7
  - If the fuel economy to weight relationship strays too far from the default the results may not be reliable (Veh_Inputs)

ICEV: Conventional Material	ICEV: Lightweight Material	HEV: Conventional Material	HEV: Lightweight Material	FCV: Conventional Material	FCV: Lightweight Material
3,330	1,970	2,810	2,000	3,020	2,280

607 13. Fuel Economy and Emission Rates of Baseline Vehicles: gasolin

	Gasoline Car
Gasoline Equivalent MPG	24.80
Exhuast VOC	0.1220
Evaporative VOC	0.0580
CO	3.7450
NOx	0.1410

620

621 14. Fuel Economy and Emission Changes by Alternative-Fueled Vel

622 14.1) Passenger Car and LDT1 Technologies: SI Technologies Are Relative to

	Gasoline Vehicle: CARFG	Grid-Independent SI HEV: CG and FRFG	Hydrogen Fuel-Cell Vehicle	Methanol Fuel-
Gasoline Equivalent MPG	100.0%	150.0%	232.0%	158.0
Exhuast VOC	100.0%	54.0%	0.0%	20.0

GREET1.7

98

99 8. Ratios of Fuel Economy of Lightweight Material Vehicles Relative to Thei

ICEV: Lightweight Material	HEV: Lightweight Material	FCV: Lightweight Material
132%	119%	118%

100

101

102

103

104

105

GREET2.7

Total Energy-Cycle Major Assumptions Requires Use of Both GREET 1.7 and 2.7

- Another important factor is the lifetime vehicle miles traveled (VMT)
  - In a TEC simulation, selecting the VMT is done to translate the vehicle-cycle results which are “per-vehicle” to “per-mile” which is consistent with the well-to-pump and vehicle operation stages
  - The vehicle lifetime is set at 160,000 miles for GREET 2.7
    - *The midpoint vehicle life for those in GREET 1.7 is 80,000 miles*
  - However the user can adjust the value for each vehicle within reason and obtain reliable results (Veh_Inputs)

ICEV: Conventional Material	ICEV: Lightweight Material	HEV: Conventional Material	HEV: Lightweight Material	FCV: Conventional Material	FCV: Lightweight Material
160,000	160,000	160,000	160,000	160,000	160,000

Combining GREET1.7 and GREET2.7 to Generate the Results for Each Stage of Total Energy Cycle

2. Well-to-Wheels Energy Consumption and Emissions: per Mile

Gasoline Vehicle: CG and RFG

Item	Btu/mile or grams/mile				Percer
	Feedstock	Fuel	Vehicle Operation	Total	Feedstock
Total Energy	177	1,012	4,631	5,820	3.0%
Fossil Fuels	171	931	4,535	5,637	3.0%
Coal	33	172	0	205	16.0%
Natural Gas	82	314	0	395	20.6%
Petroleum	56	445	4,535	5,036	1.1%
CO2	10	70	356	437	2.4%
CH4	0.422	0.083	0.015	0.520	81.2%
N2O	0.000	0.006	0.012	0.018	1.9%
GHGs	20	74	359	454	4.5%
VOC: Total	0.016	0.109	0.180	0.305	5.2%
CO: Total	0.030	0.039	3.745	3.815	0.8%
NOx: Total	0.113	0.118	[illegible]	[illegible]	[illegible]
PM10: Total	0.009	0.047	0.029	0.084	10.4%
PM2.5: Total	0.004	0.017	0.015	0.036	11.1%
SOx: Total	0.039	0.078	0.006	0.123	31.4%
VOC: Urban	0.003	0.069	0.112	0.184	1.5%
CO: Urban	0.001	0.018	2.329	2.349	0.1%
NOx: Urban	0.005	0.049	0.088	0.142	3.6%
PM10: Urban	0.000	0.009	0.018	0.027	0.8%
PM2.5: Urban	0.000	0.005	0.009	0.015	1.0%
SOx: Urban	0.003	0.033	0.004	0.040	8.5%

GREET1.7

Energy Use and Emissions of Well-to-Pump, Vehicle Cycle and Vel

1) Per-Mile Well-to-Pump, Vehicle Cycle and Vehicle Operation Ene

Gasoline Vehicle: CG and RFG, Conventional Material

Item	Btu/mile or grams/mile			
	WTP	Vehicle Cycle	Vehicle Operation	Total
Total energy	1,189	627	4,631	6,448
Fossil fuels	1,102	596	4,535	6,233
Coal	205	228	0	433
Natural gas	395	241	0	636
Petroleum	502	127	4,535	5,164
CO2	81	48	356	484
CH4	0.505	0.083	0.015	0.602
N2O	0.006	0.001	0.012	0.019
GHGs	94	50	359	504
VOC: Total	0.125	0.206	0.180	0.512
CO: Total	0.070	0.250	3.745	4.064
NOx: Total	0.232	0.076	0.141	0.448
PM10: Total	0.055	0.083	0.029	0.167
PM2.5: Total	0.021	0.028	0.015	0.065
SOx: Total	0.117	0.139	0.006	0.262
VOC: Urban	0.072	0.114	0.112	0.298
CO: Urban	0.019	0.002	2.329	2.351
NOx: Urban	0.054	0.008	0.088	0.150
PM10: Urban	0.010	0.002	0.018	0.029
PM2.5: Urban	0.006	0.001	0.009	0.016
SOx: Urban	0.037	0.013	0.004	0.054

2. Well-to-Wheels Energy Consumption and Emissions: pe

Gasoline Vehicle: CG and RFG

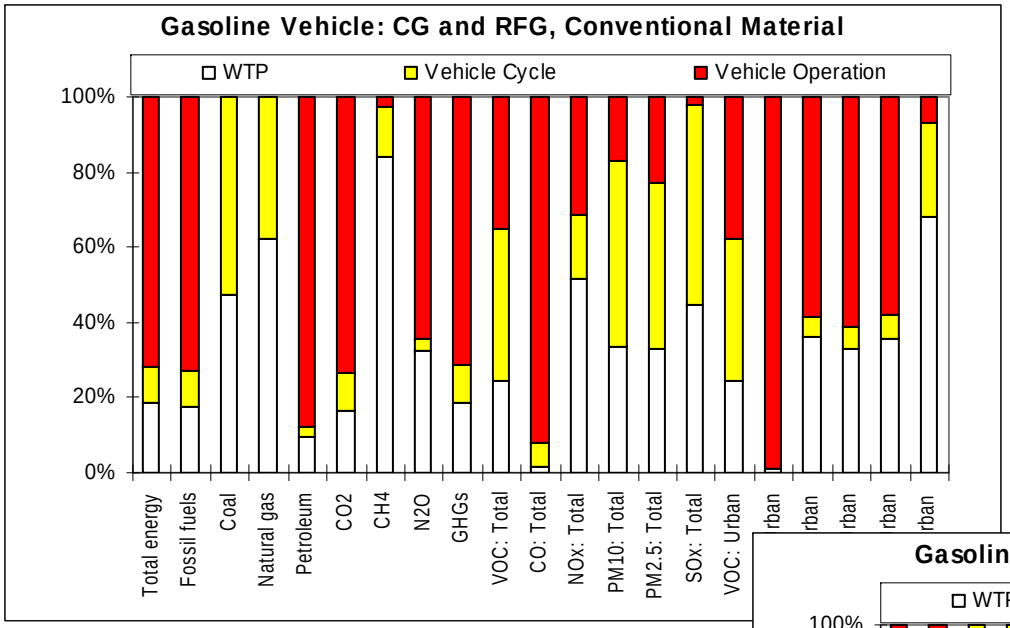
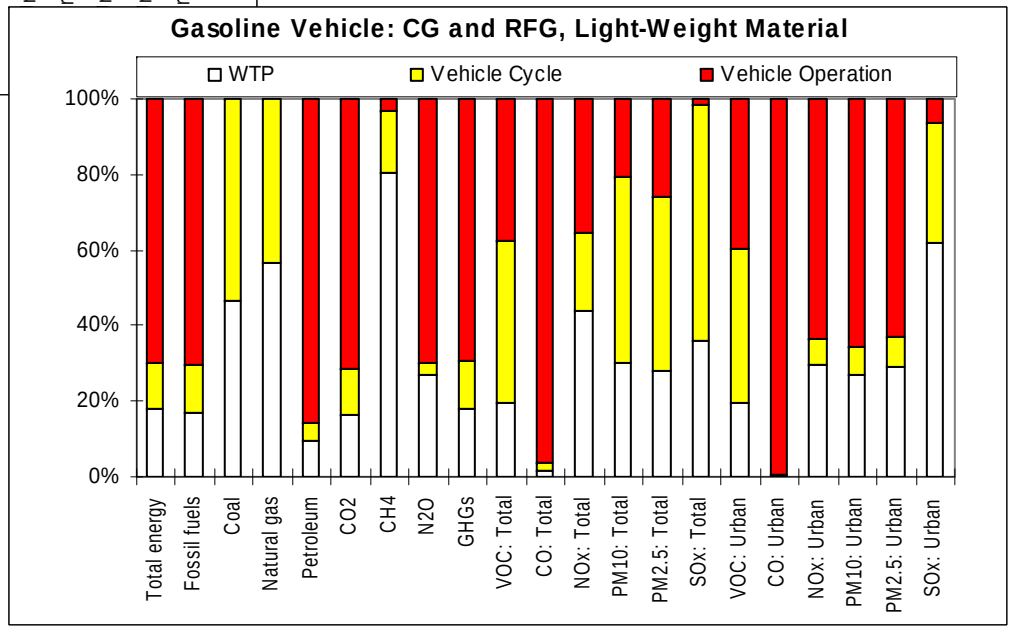
Item	Btu/mile or grams/mile				Fe
	Feedstock	Fuel	Vehicle Operation	Total	
Total Energy	177	1,012	4,631	5,820	
Fossil Fuels	171	931	4,535	5,637	
Coal	33	172	0	205	
Natural Gas	82	314	0	395	
Petroleum	56	445	4,535	5,036	
CO2	10	70	356	437	
CH4	0.422	0.083	0.015	0.520	
N2O	0.000	0.006	0.012	0.018	
GHGs	20	74	359	454	
VOC: Total	0.016	0.109	0.180	0.305	
CO: Total	0.030	0.039	3.745	3.815	
NOx: Total	0.113	0.118	0.141	0.373	
PM10: Total	0.009	0.047	0.029	0.084	
PM2.5: Total	0.004	0.017	0.015	0.036	
SOx: Total	0.039	0.078	0.006	0.123	
VOC: Urban	0.003	0.069	0.112	0.184	
CO: Urban	0.001	0.018	2.329	2.349	
NOx: Urban	0.005	0.049	0.088	0.142	
PM10: Urban	0.000	0.009	0.018	0.027	
PM2.5: Urban	0.000	0.005	0.009	0.015	
SOx: Urban	0.003	0.033	0.004	0.040	

GREET1.7

2) Summary of Energy Consum

ICEV: Conventional Material Ligh

Lifetime VMT	160,000
Total energy	627
Fossil fuels	596
Coal	228
Natural gas	241
Petroleum	127
CO2	48
CH4	0.083
N2O	0.001
GHGs	50
VOC: Total	0.206
CO: Total	0.250
NOx: Total	0.076
PM10: Total	0.083
PM2.5: Total	0.028
SOx: Total	0.139
VOC: Urban	0.114
CO: Urban	0.002
NOx: Urban	0.008
PM10: Urban	0.002
PM2.5: Urban	0.001
SOx: Urban	0.013

GREET2.7

Combining GREET1.7 and GREET2.7 to Generate the Results for Each Stage of Total Energy Cycle