NETL Life Cycle Inventory Data
Process Documentation File

Process Name: Passenger Vehicle, 2012-2042 U.S. Average, Fischer Tropsch Diesel, Operation

Reference Flow: 1 MJ of Fischer Tropsch Diesel

Brief Description: This process calculates emissions incurred from combustion of 1 MJ of Fischer-Tropsch diesel (FTD) in an average U.S. passenger vehicle operating during the temporal boundary of 2012 to 2042.

Section I: Meta Data

Geographical Coverage: US **Region:** Not Applicable

Year Data Best Represents: 2012-2042

Process Type: Basic Process (BP)

Process Scope: Gate-to-Gate Process (GG)

Allocation Applied: No

Completeness: Individual Relevant Flows Recorded

Flows Aggregated in Data Set:

☒ Process ☒ Energy Use ☐ Energy P&D ☐ Material P&D

Relevant Output Flows Included in Data Set:

Releases to Air:	☒ Greenhouse Gases	☒ Criteria Air Pollutants	☐ Other
Releases to Water:	☐ Inorganic Emissions	☐ Organic Emissions	☐ Other
Water Usage:	☐ Water Consumption	☐ Water Demand (throughput)	
Releases to Soil:	☐ Inorganic Releases	☐ Organic Releases	☐ Other

Adjustable Process Parameters:

None.

Tracked Input Flows:

FTD	*Fischer-Tropsch Diesel produced from coal, biomass, or some combination of feedstocks*

Tracked Output Flows:

None.

Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_Stage5_O_Passenger_Vehicle_2012-2042_US_Average_F-T_Diesel_2010.01.xls*, which provides additional details regarding relevant, calculations, data quality, and references.

Goal and Scope

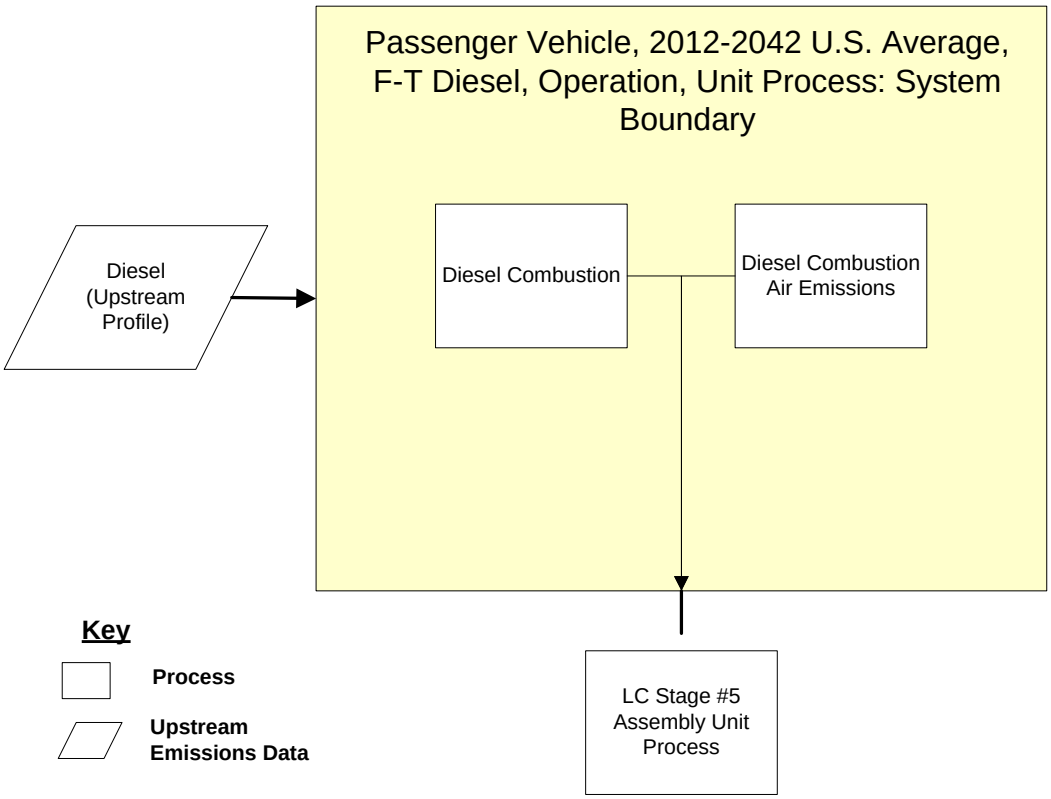
The scope of this unit process covers the combustion of 1 MJ of FTD fuel in a passenger vehicle in Life Cycle (LC) Stage #5. The chosen vehicle represents the U.S. average fuel economy for the 30 year study period 2012 to 2042. This unit process is combined with a vehicle construction process to calculate the total emissions that would result from combustion of FTD in a passenger vehicle.

Boundary and Description

Figure 1 provides an overview of the boundary of this unit process. Emissions related to the construction and final disposal of the vehicle are considered in another unit process. The process of refueling the vehicle is contained within LC Stage #4 in a refueling station operations unit process. As shown in Figure 1 and discussed above, the vehicle operated in this unit process is incorporated into the LC Stage #5 assembly process.

The primary source for greenhouse gas emissions from the combustion of FTD is the EPA's proposed rule (May 26, 2009) for *Regulation of Fuels and Fuel Additives: Changes to Renewable Fuel Standard Program*. Other air emissions, including criteria air pollutants, are taken from a Life Cycle Inventory (LCI) completed at the University of California, Berkeley (Chester, 2008). However, all data from both sources originated from the EPA MOVES model version 6.2.

Figure 1: Unit Process Inputs, Outputs, and Boundaries



Emissions data were reported in terms of mass per vehicle mile traveled. In order to determine the emissions on the basis of FTD energy consumed, average vehicle fuel economy over the study period (2012-2042) was estimated from available resources. Average vehicle fuel economy in 2007 was given as 22.5 mpg by the ORNL 2007 Transportation Energy Data Book. For the years 2020 forward, vehicle fuel economy is required by the 110th Congress to reach 35 mpg. Averaging of these values over the study years was accomplished by assigning 8 years of 2007 efficiency and 22 years of 2020 efficiency. The resulting fuel economy is 31.6 mpg.

Table 1 shows relevant properties used to calculate the emissions from combustion of 1 MJ FTD. **Table 2** provides a summary of modeled input and output flows. Additional detail regarding input and output flows, including calculation methods, is contained in the associated DS.

Table 1: Properties of F-T Diesel and Passenger Vehicle

Property	Value	Reference
F-T Diesel Energy Content (LHV) MJ/m^3 (Btu/gal)	27,595 (118905)	NETL 2009
Vehicle Fuel Economy km/m^3 (mpg)	11,210 (31.6)	ORNL 2007, 110th Congress 2007

Table 2: Unit Process Input and Output Flows

Flow Name*	Value	Units (Per Reference Flow)
Inputs		
F-T Diesel	**1**	**MJ**
Outputs		
Carbon dioxide [Inorganic emissions to air]	7.4651E-02	kg
Carbon monoxide [Inorganic emissions to air]	4.6193E-03	kg
Methane [Organic emissions to air (group VOC)]	4.1704E-07	kg
Nitrous oxide (laughing gas) [Inorganic emissions to air]	2.1914E-06	kg
VOC [emissions to air]	8.0270E-05	kg
Nitrogen Oxides [Inorganic emissions to air]	2.5747E-04	kg
Sulphur dioxide [Inorganic emissions to air]	5.3008E-06	kg
Particulate Matter, unspecified [Other emissions to air]	1.1940E-04	kg

* **Bold face** clarifies that the value shown *does not* include upstream environmental flows. Upstream environmental flows were added during the modeling process using GaBi modeling software, as shown in Figure 1.

Embedded Unit Processes

None

References

110th Congress 2007 — 110th Congress. 2007. *Energy Independence and Security Act of 2007, Page 121 STAT. 1499. Public Law 110-140*.

Bandivadekar et al 2008 — Bandivadekar, A. et al. 2008. *On the Road in 2035: Reducing Transportation's Petroleum Consumption and GHG Emissions*. Massachusetts Institute of Technology, Laboratory for Energy and the Environment. July 2008.

Chester 2008	Chester, M.V. 2008. *Life-cycle Environmental Inventory of Passenger Transportation in the United States*. Dissertation. University of California, Berkeley, Institute of Transportation Studies.
NARA 2009	National Archives and Records Administration. 2009. "Regulation of Fuels and Fuel Additives: Changes to Renewable Fuel Standard Program; Proposed Rule." *Federal Register* 74(99). http://www.epa.gov/oms/renewablefuels/rfs2_1-5.pdf (Accessed December 18, 2009).
NETL 2009	NETL. 2009. *Affordable, Low-Carbon Diesel Fuel from Domestic Coal and Biomass*. DOE/NETL-2009/1349. U.S. Department of Energy, National Energy Technology Laboratory. Pittsburgh, PA.
ORNL 2007	ORNL. 2007. *Transportation Energy Data Book, Edition 28. Chapter 4: Light Vehicles and Characteristics*. U.S. Department of Energy, Oak Ridge National Laboratory.

Section III: Document Control Information

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