NETL Life Cycle Inventory Data
Process Documentation File

Process Name: Refueling Station, Ethanol, Operation

Reference Flow: 1 MMBtu of Ethanol Blended Fuel

Brief Description: This unit process includes the emissions from the operation of a refueling station for an ethanol and gasoline blended fuel. Electricity demand and emissions from fuel evaporation during station filling and vehicle filling are also included.

Section I: Meta Data

Geographical Coverage: US **Region:** N/A

Year Data Best Represents: 1997

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:

Evaporative Loss	*Amount of ethanol/gasoline blend which evaporates during loading and unloading of refueling station's storage tank*
Electricity Consumption	*Electricity consumed during loading and unloading of refueling station's storage tank*
Ethanol Type	*Binary switch to choose which type of ethanol, E10 or E85, is being distributed at the refueling station*

Tracked Input Flows:

Blended Fuel (E10) [Biomass fuels]	*Quantity of E10 blend entering the refueling station, in kg*
Blended Fuel (E85) [Biomass fuels]	*Quantity of E85 blend entering the refueling station, in kg*
Power [Electric power]	*U.S. National Average electricity profile, in kWh*

Tracked Output Flows:

Ethanol Blended Fuel	*Reference Flow, in MMBtu*

Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_Stage4_O_Refueling_Station_Ethanol_2010.01.xls*, which provides additional details regarding relevant calculations, data quality, and references.

Goal and Scope

This unit process describes the operation of a refueling station within the distribution stage (Life Cycle (LC) Stage #4) of a fuel lifecycle. An ethanol-gasoline blend is brought to the station by a tanker truck. The fuel is pumped into a vehicle for combustion (LC Stage #5). Truck unloading (filling of the refueling station tanks) and vehicle refueling operations are contained within the process. The reference flow of this unit process is 1 MMBtus of ethanol-gasoline blend transferred into a vehicle tank as described below and shown in **Figure 1**. Electricity is the only additional flow needed in the transfer of the fuel.

This unit process is the final portion of LC Stage #4. The stage starts with the fuel being transported from the energy conversion facility (LC Stage #3) to the bulk storage facility; this transportation can occur by pipeline, train, water carrier, or truck. The ethanol and gasoline are stored separately in the bulk storage facility until it is time for transport; at this time, the gasoline and ethanol are splash blended while being transferred into the tanker for transport to the refueling station. The blended fuel will reside in the refueling station's storage tank until pumped into a vehicle fuel tank for combustion in LC Stage #5.

Boundary and Description

Inputs into the unit process, as shown in Figure 1 and described above, include ethanol blends E10 and E85, gasoline, and electricity. It is assumed that the dispensing regulations for ethanol blends would be the same as those for gasoline. The electrical consumption for the gasoline dispensing unit was

calculated based on assumptions made about the dispensing unit and the amount of fuel it dispensed. The power output for the motor in the dispensing unit is rated at 750 W (CHG 2008). The EPA regulated the flow rate of gasoline dispensing units is 10 gal/min or 600 gal/hour. By taking the power and dividing it by the flow rate, the amount of energy consumed by the motor for an hour per gallon is found. Dispensing gasoline into vehicles required 0.00125 kWh per gallon of gasoline dispensed (Skone et al 2008).

This unit process is designed to adjust its factors based on the type of ethanol passing through it. It has the ability to model E10 and E85 compositions of ethanol. The results from both are shown in **Table 2**. The evaporative loss factor can be adjusted based on the scenario and how the fuel acts in such a climate and storage container. The value should never be negative or over 1. The electricity consumed to power the pump may also be adjusted. Values should be researched based on the size of the pump that will be used.

Table 1 shows gasoline properties used for calculation of evaporation of fuel in this unit process. **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.

Figure 1: Unit Process Scope and Boundary

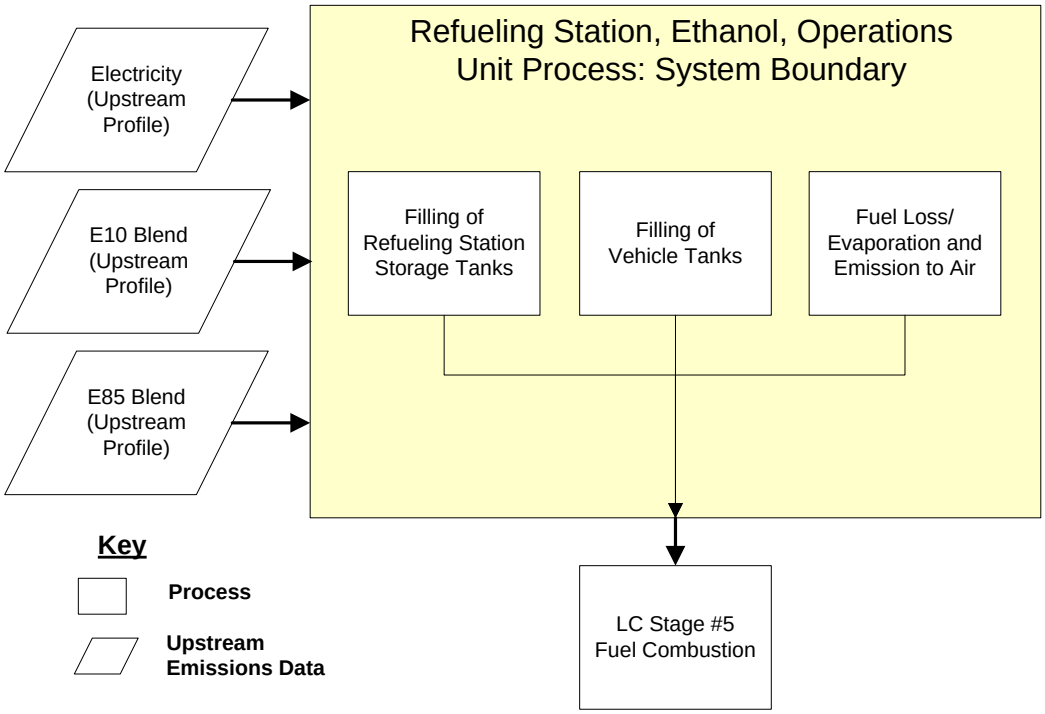

Table 1: General Properties

Property	Weight	Reference
Gasoline Density, kg/m^3 (lb/gal)	737.04 (6.151)	NETL 2008
Gasoline Lower Heating Value (LHV), MJ/m^3 (Btu/gal)	32,356 (116,090)	NETL 2008
Ethanol 10 Density, kg/m^3 (lb/gal)	743.22 (6.202)	NETL Engineering Calculation
Ethanol 10 Lower Heating Value, MJ/m^3 (Btu/gal)	31,296 (112,274)	NETL Engineering Calculation
Ethanol 85 Density, kg/m^3 (lb/gal)	775.77 (6.474)	NETL Engineering Calculation
Ethanol 85 Lower Heating Value, MJ/m^3 (Btu/gal)	24,488 (87,852)	NETL Engineering Calculation

Table 2: Unit Process Input and Output Flows

Flow Name*	Value E10	Value E85	Units (Per Reference Flow)
Inputs			
Blended Fuel (E10) [Biomass fuels]	**25.4653**	**0.0000**	**kg**
Blended Fuel (E85) [Biomass fuels]	**0.0000**	**34.6134**	**kg**
Power [Electric power]	**0.0114**	**0.0155**	**kWh**
Outputs			
Ethanol Blends	1	1	pcs
NMVOC (unspecified) [Group NMVOC to air]	3.0139E-03	4.0966E-03	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

CHG 2008 — China Hongyoung Group. 2008. *Explosion proof motor product IS: U701*-A. Wenzhou City, China.

NETL 2008 — NETL. (2008). Development of Baseline Data and Analysis of Life Cycle Greenhouse Gas Emissions of Petroleum-Based Fuels. DOE/NETL-2009/1346. U.S. Department of Energy, National Energy Technology Laboratory, Pittsburgh, PA. November 26, 2008.

Section III: Document Control Information

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