NETL Life Cycle Inventory Data
Process Documentation File

Process Name: Domestic Natural Gas-to-liquid Plant Operation

Reference Flow: 1 kg of Fischer-Tropsch diesel (FTD)

Brief Description: Inputs and outputs for a Fischer-Tropsch (FT) diesel production by a 50,000-barrel-per-day GTL plant using domestic natural gas feed and equipped with carbon dioxide capture.

Section I: Meta Data

Geographical Coverage: Midwest **Region:** USA

Year Data Best Represents: 2012

Process Type: Energy Conversion (EC)

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

Allocation Applied: No

Completeness: All Relevant Flows Captured

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	☐ Other
Releases to Water:	☐ Inorganic	☐ 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:

Natural gas [Domestic]	*[Technosphere] Processed domestic natural gas*
Butane (n-butane)	*[Technosphere] Butane*
Water (ground water) [Water]	*[Resource]*

Water (municipal) [Water]	*[Resource]*

Tracked Output Flows:

Fischer-Tropsch diesel (FTD)	*Reference flow*
Carbon dioxide [Inorganic emissions to air]	*Emission to air*
Nitrogen oxides [Inorganic emissions to air]	*Emission to air*
Carbon dioxide [Inorganic intermediate products]	*Captured CO_2*
Gasoline [Crude Oil Products]	*Produced gasoline*
Electricity [Electric Power]	*Produced electricity*
Water (wastewater) [Water]	*Renewable resources*

Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) *Stage3-O-Natural_Gas_to_Liquids_Plant_Operation_2013.01.xlsx*, which provides additional details regarding relevant calculations, data quality, and references.

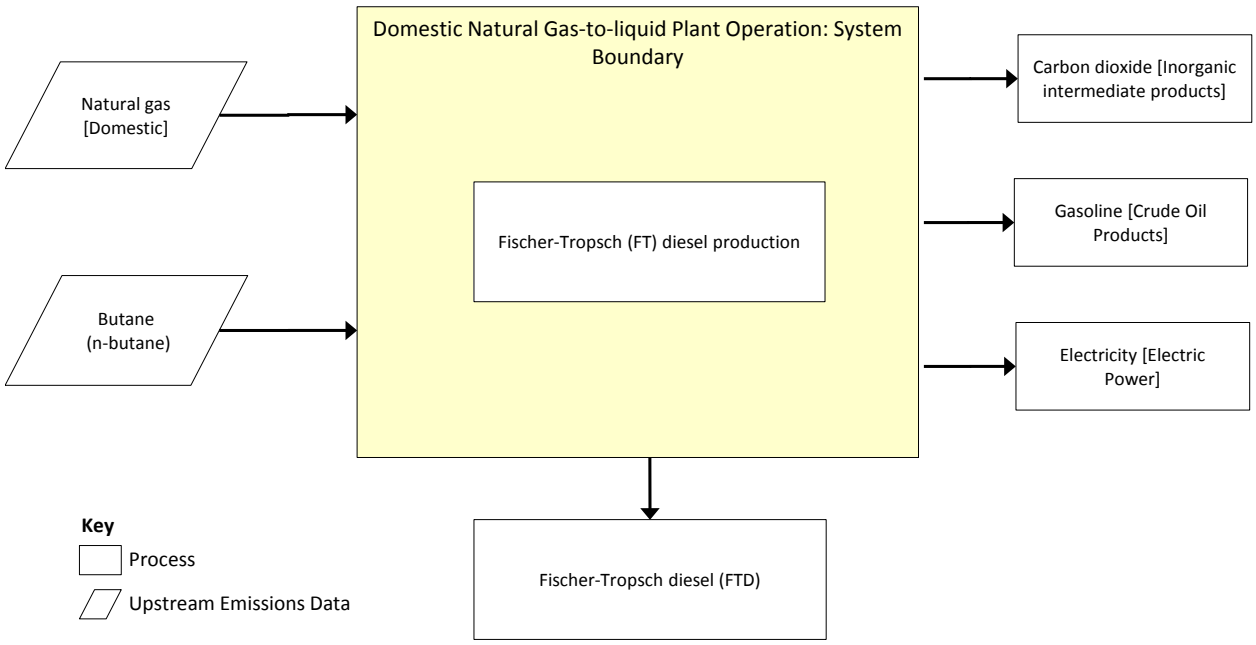
Goal and Scope

This unit process provides a summary of relevant input and output flows associated with the production of Fischer-Tropsch diesel (FTD) with co-products of gasoline and electricity. These include natural gas, butane, water withdrawal, water discharge, and air emissions. The plant is equipped with an amine-based carbon capture system, and the electricity is provided by the combustion of tail gas in a steam boiler coupled to a steam turbine generator. The reference flow of this unit process is: 1 kg of FTD.

Boundary and Description

Figure 1 provides an overview of the boundary of this unit process. Rectangular boxes represent relevant sub-processes, while trapezoidal boxes indicate upstream data that are outside of the boundary of this unit process. As shown, the upstream emissions from natural gas and butane are calculated in another unit process which should be added to this to provide an accurate inventory value. The methods for calculating these operating activities are described below.

Figure 1: Unit Process Scope and Boundary



The material flows for this unit process are based on an Aspen Plus® (Aspen) model of a Natural Gas-to-liquids Plant, as discussed in *Analysis of Natural Gas-to-Liquid Transportation Fuels via Fischer-Tropsch* (NETL,2013). The fuel output of the facility is 34,543 barrels (bbl) of diesel per day and 15,460 bbl of gasoline per day for a total of 50,003 bbl/day of liquids. The inputs and outputs of the system are based on the stream table or other data tables available in the report, which are included in the accompanying data summary (DS) sheet. The specified flow, stream numbers, and values are shown in **Table 1**. These values are divided by the diesel mass flow rate (the reference flow) and converted as necessary to provide the flows in **Table 2**.

Table 1: Flow and Reference Stream Number or Data Table

Flow	Stream Number or Data Table	Value
Inputs		
Natural Gas	1, 16	354,365 kg/hr
Butane	24	18,843 kg/hr
Water withdrawal	GTL Water Balance	31.81 m^3/min
Outputs		
Diesel	21	174,497 kg/hr
Gasoline	23	73,331 kg/hr
Electricity	GTL Energy Balance	40,800 kWe
Carbon dioxide emissions	31	11773 kg/hr
Captured carbon dioxide	8	212188 kg/hr
NO_X emissions	GTL Air Emissions	3 tonne/yr
Water discharge	GTL Water Balance	7.42 m^3/min

Table 2: Unit Process Input and Output Flows

Flow Name	Value	Units (Per Reference Flow)
Inputs		
Natural gas [Domestic]	2.03	kg
Butane (n-butane)	0.11	kg
Water (ground water) [Water]	5.47	L
Water (municipal) [Water]	5.47	L
Outputs		
Fischer-Tropsch diesel (FTD)	1.00	kg
Carbon dioxide [Inorganic emissions to air]	0.07	kg
Nitrogen oxides [Inorganic emissions to air]	1.96E-06	kg
Carbon dioxide [Inorganic intermediate products]	1.22	kg
Gasoline [Crude Oil Products]	0.42	kg
Electricity [Electric Power]	2.34E-04	MWh
Water (wastewater) [Water]	2.55	L

* **Bold face** clarifies that the value shown *does not* include upstream environmental flows.

Embedded Unit Processes

None.

References

Section III: Document Control Information

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