NETL Life Cycle Inventory Data
Process Documentation File

Process Name: Tractor Trailer Biomass Transport, Class 8B, Operation

Reference Flow: 1 kg of Cargo

Brief Description: Transport of an unspecified type of prepared biomass via tractor trailer to the energy conversion facility. Assumes backhaul and front haul have different energy intensity. Includes diesel consumption.

Section I: Meta Data

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

Year Data Best Represents: 2006

Process Type: Transport Process (TP)

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

Allocation Applied: No

Completeness: All 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:

Distance	*One way trip distance in miles*
Capacity	*Max quantity of cargo being transported, determined by the trailer attached*
Fuel Economy Unloaded	*The fuel economy the tractor is expected to get when empty*
Fuel Economy Loaded	*The fuel economy the tractor is expected to get when filled with biomass*
Fuel Density	*The density of diesel fuel used in the tractor*

Tracked Input Flows:

Diesel [Crude oil products]	*Diesel from crude oil for transport*
Cargo [Other]	*Unspecified type of prepared biomass for transport*

Tracked Output Flows:

Cargo [Other]	*Unspecified type of prepared biomass received, reference flow*

Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_Stage2_O_TractorTrailer_Biomass_Transport_Class8B_2012.03.xls*, which provides additional details regarding calculations, data quality, and references as relevant.

Goal and Scope

The scope of this process covers the transportation of prepared biomass from the end of Life Cycle (LC) Stage #1 at the farm to the energy conversion facility for commencement of LC Stage #3 (e.g., the conversion of biomass into energy) and the empty return trip back to the farm by a tractor-trailer combination truck fueled by diesel. This process encompasses all of LC Stage #2. This process is based on the reference flow of 1 kg of an unspecified type of biomass being delivered to the energy conversion facility and is shown in **Figure 1**. Considered are the consumption of diesel and the resulting emissions from diesel combustion.

Boundary and Description

The tractor-trailer is designed to be independent of the type of biomass being transported and the location of transport within the United States. This unit process assumes that the unspecified prepared biomass is loaded into the trailer during a previous unit process. This unit process transports the unspecified prepared biomass from an unspecified type of farm to an unspecified type of energy conversion facility.

Based on the function which the tractor trailer will perform, this unit process assumes that the engine is equivalent to that of a Class 8B truck. The truck and trailer combination is classified to have >60,000 lbs of gross vehicle weight. The truck is assumed to be loaded to capacity on the initial haul to the energy conversion facility and to return empty to the farm after unloading. The truck is assumed to be powered by 100 percent conventional diesel fuel from crude oil. **Table 1** provides the biomass parameters which should be used in the calculations based on which is being transported.

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, upstream emissions associated with the production diesel fuel and processed cargo (biomass) are accounted for outside of the boundary of this unit process.

This unit process has 2 variable parameters which can be adjusted to match the scenarios being examined. Table 1 provides the suggested parameters for biomass types which are currently being examined by NETL (switchgrass, corn stover, and short rotation woody crops). Based on the type of biomass which is being transported, the trailer's capacity needs to be entered into the associated DS file from the trailer construction file, DS_Stage2_C_Bale_Truck_Biomass_2010.01.xls for corn stover or switchgrass transport and DS_Stage2_C_Chip_Truck_Biomass_2010.01.xls for short rotation woody crops. **Table 2** provides emission factors for operation of the tractor trailer, while **Table 3** provides a review of the input and output flows contained in the DS.

Figure 1. Unit Process Scope and Boundary

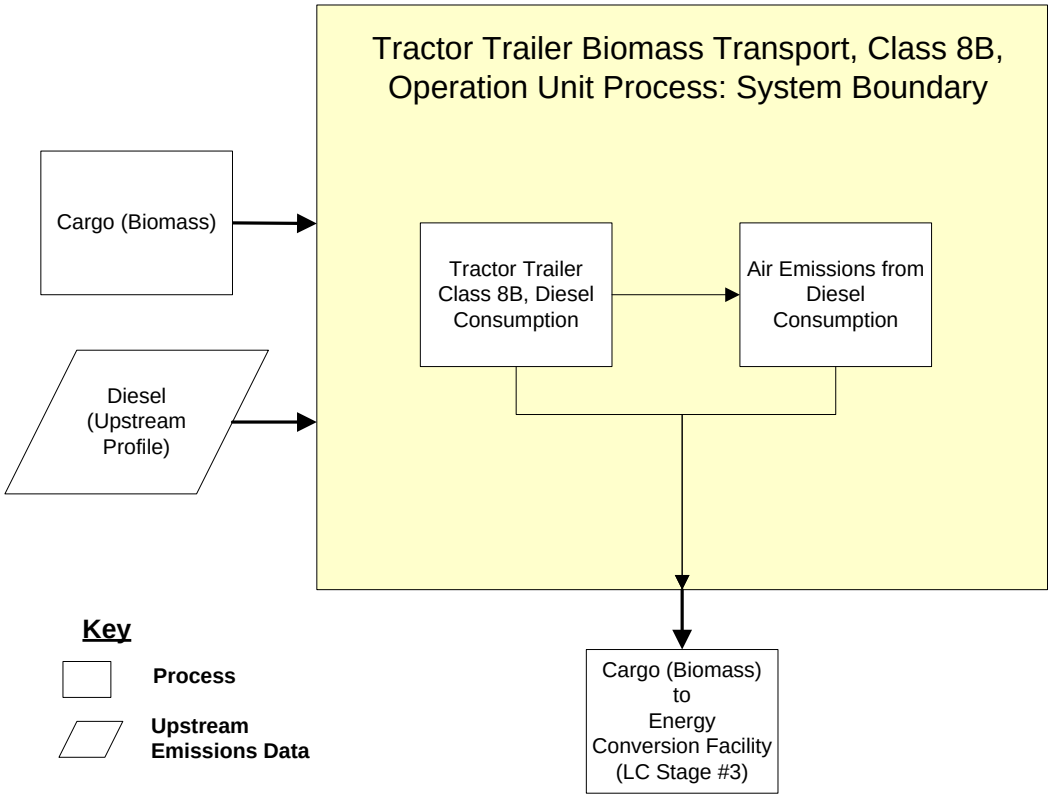

Table 1. Biomass Parameters for Tractor Trailer Transport

Parameter	Units	Switchgrass	Corn Stover	Short Rotation Woody Crops
Fuel Efficiency, Empty	miles/ gallon	9.4	9.4	9.4
Fuel Efficiency, Loaded	miles/ gallon	5.1	5.1	5.1
Distance to Plant	miles	33.83	10.49	11.16
Capacity	kg	22801	22801	24071

Table 2. Emission Factors for Tractor Trailer Transport

Emission	Value	Units (per kg cargo transported)	Reference
Carbon Dioxide	4.09E-03	kg	GREET (ANL 2006)
Methane	8.19E-08	kg	GREET (ANL 2006)
Nitrous Oxide	1.05E-07	kg	DieselNet, 2007
Sulphur Oxide	2.89E-08	kg	GREET (ANL 2006)
Nitrogen Oxides	3.00E-07	kg	GREET (ANL 2006)
Particulate Matter, unspecified	1.50E-08	kg	DieselNet, 2007
VOCs, unspecified	1.77E-06	kg	GREET (ANL 2006)
Carbon Monoxide	9.40E-06	kg	GREET (ANL 2006)
Mercury (+II)	2.22E-19	kg	Conaway et al., 2005
Ammonia	1.85E-07	kg	Battye, 1994

Table 3: Unit Process Input and Output Flows

Flow Name*	Value	Units (Per Reference Flow)
Inputs		
Unspecified Biomass	**1.00E+00**	**kg**
Diesel [Crude oil products]	**1.42E-03**	**kg**
Outputs		
Cargo [Other]	1.00	kg
VOC (unspecified) [Organic emissions to air (group VOC)]	1.77E-06	kg
Carbon dioxide [Inorganic emissions to air]	4.09E-03	kg
Methane [Organic emissions to air (group VOC)]	8.19E-08	kg
Nitrous oxide (laughing gas) [Inorganic emissions to air]	1.05E-07	kg
Sulphur oxide [Inorganic emissions to air]	2.89E-08	kg
Particulate matter, unspecified [Other emissions to air]	1.50E-08	kg
Nitrogen oxides [Inorganic emissions to air]	3.00E-07	kg
Carbon monoxide [Inorganic emissions to air]	9.40E-06	kg
Mercury (+II) [Heavy metals to air]	2.22E-19	kg
Ammonia [Inorganic emissions to air]	1.85E-07	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

ANL 2006 — Argonne National Laboratory. 2006. Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) Model, Version 1.7. DOE, Argonne National Laboratory. Ann Arbor, MI.

Battye et al 1994 — Battye R., Battye, W., Overcash, C., Fudge, S. 1994. Development and Selection of Ammonia Emissions Factors, Final Report. US Environmental Protection Agency, Washington, D.C. http://www.epa.gov/ttn/chief/old/efdocs/ammonia.pdf (Accessed December 16, 2009).

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Section III: Document Control Information

Date Created:	April 9, 2012
Point of Contact:	Timothy Skone (NETL), Timothy.Skone@NETL.DOE.GOV
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