NETL Life Cycle Inventory Data
Process Documentation File

Process Name:	Chip Truck, Biomass Transport, Construction
Reference Flow:	1 kg of Cargo
Brief Description:	Combined construction/assembly process that includes material requirements for construction of a tractor and chip trailer for short rotation woody crop (SRWC) biomass transport, and apportions those materials to 1 kg of cargo.

Section I: Meta Data

Geographical Coverage:	US	**Region:**	N/A
Year Data Best Represents:	2009		
Process Type:	Manufacturing Process (MP)		
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:

Tractor Service Life	*Service life of a tractor for road transport of biomass*
Trailer Service Life	*Service life of a chip trailer for road transport of biomass*
Tire Service Life	*Service life of tires for a tractor and trailer combination truck*

Tracked Input Flows:

Steel plate, blast furnace (BF)

(85% Recovery Rate) [Metals]	*Steel plate used in construction of a tractor and chip trailer combination truck, 85% of material assumed to be recovered*
Aluminum [Metals]	*Aluminum used in construction of a tractor and chip trailer combination truck*
Nylon 6.6 granulate (PA 6.6) [Plastics]	*Nylon used in construction of tractor engine parts*
Polyurethane flexible foam (PU) [Plastics]	*Polyurethane used in construction of tractor foams and other parts*
Lead [Metals]	*Lead material used in construction of a tractor*
Styrene-butadiene-rubber (SBR) [Plastics]	*SBR rubber used in tires for a tractor and trailer combination truck*

Tracked Output Flows:

Cargo [Others]	*Reference flow*

Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_Stage2_C_Chip_Truck_Biomass_Transport_2010.01.xls*, which provides additional details regarding relevant calculations, data quality, and references.

Goal and Scope

The scope of this unit process encompasses the materials and weights of those materials necessary to construct a tractor and trailer combination truck for the transport of short rotation woody crop (SRWC) biomass. The unit process is based on the reference flow of 1 kg of biomass, as described below and shown in **Figure 1.** The materials required for the truck are based on manufacturer specifications for the indicated equipment.

This unit process is used during Life Cycle (LC) Stage #2 for the transport of biomass to the energy conversion facility (LC Stage #3). The construction of the chip truck is used in combination with a tractor-trailer operation unit process (DF_Stage2_O_Tractor-Trailer_Transport_Biomass_2010.01) to quantify the LC Stage #2 emissions from transport of 1 kg of SRWCs to an energy conversion facility (LC Stage #3). Because this is the only equipment construction unit process needed for LC Stage #2 of the SRWC biomass pathway, the equipment construction and assembly calculations have been combined into this single unit process; tracked inputs are all raw materials for construction, and the sole tracked output is 1 kg of cargo.

Boundary and Description

This unit process describes the materials used for the construction of a truck and chip trailer used to transport biomass from a biomass farm to a liquid fuel production facility. Two major components are included: (1) the truck (referred to as the tractor in this unit process) and (2) a chip trailer used for transporting SRWCs.

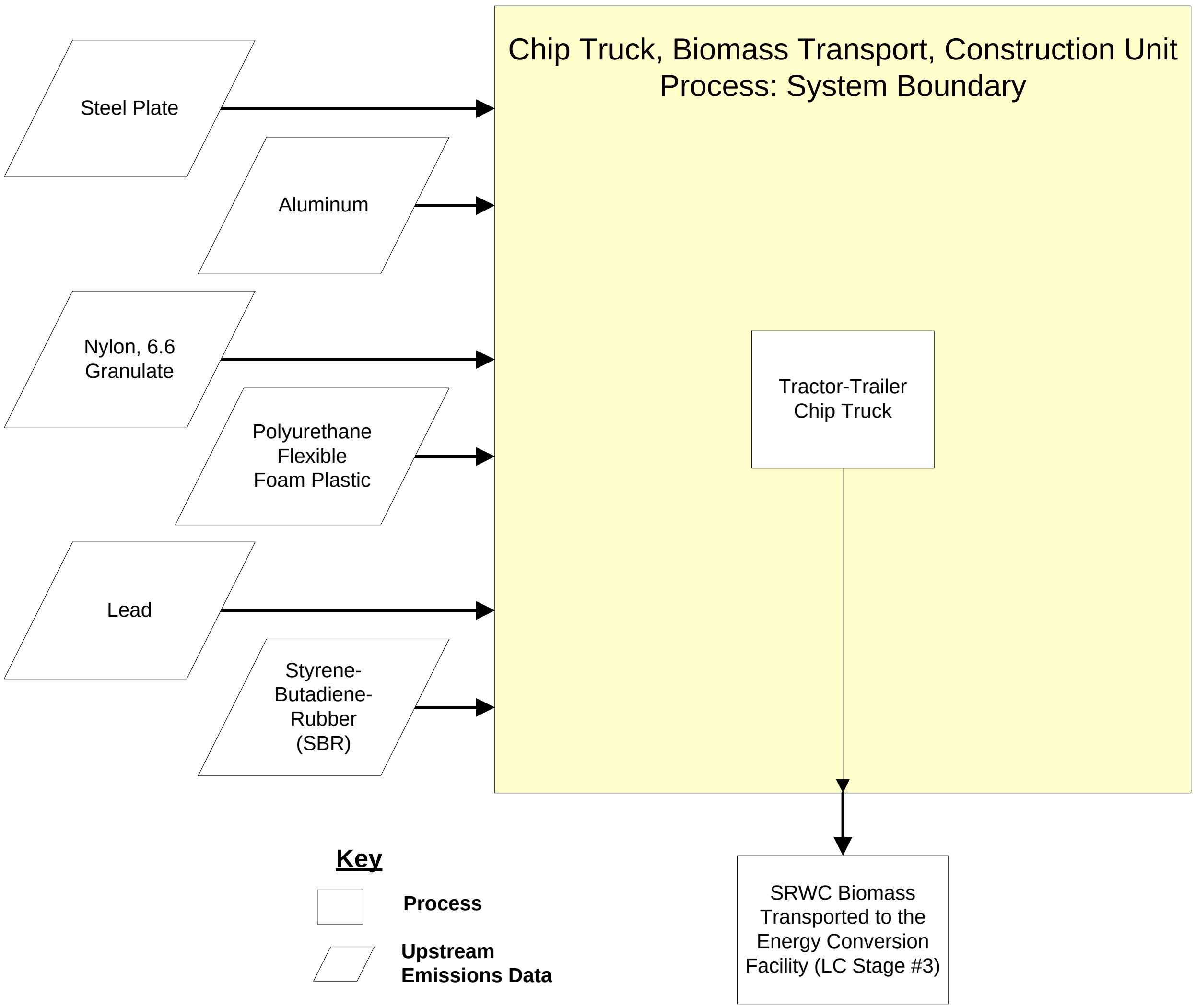
Figure 1 provides an overview of the boundary of this unit process. Emissions related to the physical assembly of the tractor-trailer chip truck components (e.g., emitted while putting together the components of a tractor-trailer, including transport of those components) are not considered in this study. Upstream emissions from the production of raw materials used for the construction of the tractor-trailer (e.g., steel plate, aluminum) are calculated outside the boundary of this unit process, based on profiles developed elsewhere, such as with the GaBi model. As shown in **Figure 1** and discussed above, the tractor-trailer chip truck constructed in this unit process is incorporated into the biomass transport assembly process for LC Stage #2.

This unit process is applicable to the modeling of SRWC transport. To apportion the materials used to construct the tractor and trailer, the useful life and payload capacity of each piece of equipment is specified. This unit process has adjustable parameters that allow user specification of equipment lifetime. By default, the useful life of the tractor is assumed to be 5 years, the useful life of the trailer is assumed to be 10 years, and the useful life of tires is assumed to be 1 year. Limited data are available on the service lives of these pieces of equipment, as relevant to this unit process; therefore, the above values for useful life are based on professional judgment. The payload (the maximum cargo weight) of each scenario is based on U.S. Department of Transportation regulations, which state that the gross weight of commercial vehicles cannot exceed 80,000 lbs. The payload was calculated by subtracting the tractor and trailer weights from the maximum gross weight.

<u>Truck Materials</u>

The types of materials used for the construction of the truck include carbon steel, aluminum, thermoplastics, rubber, and lead, and are based on information from Volvo Truck Corporation’s Environmental Product Declaration (EPD) for its FH12 and FM12 truck series. While the EPD is representative of European production and operation, it is assumed that the weight and materials for this type of truck are comparable between Europe and the U.S. The materials are scaled to the basis of 1 kilogram of cargo transported, which requires the use of adjustable parameters for truck and trailer life (in years) and the annual transport capacity of cargo (in kg).

Figure 1: Unit Process Scope and Boundary



Volvo's EPD does not specify the types of thermoplastics or rubber used for truck construction. It was therefore assumed that nylon, which endures high temperatures and is a common material for automotive parts, represents half of the weight of thermoplastics, and that polyurethane, which is used for interior furnishings and other truck components, represents the other half of the weight of thermoplastics. Styrene butadiene rubber (SBR) is assumed to represent all of the weight of rubber material used for truck construction.

Rubber accounts for approximately 7 percent of the truck's total curb weight. It is assumed that tires account for a significant share of this weight of rubber. The tires on a truck are changed many times during the truck's service life. An adjustable parameter for tire life (in years) has been included.

Trailer Materials

The SRWC scenarios use a chip trailer, which is an open-top trailer made mostly of steel and aluminum. The weights of two trailers, a 42-ft 2001 model and a 45-ft 1977 model, from Pinnacle Trailers (Pinnacle 2009) rental equipment specification sheets were averaged. The resulting material input to the trailer was calculated to be 5,216 kg. The information from Pinnacle suggests some parts of the trailer are made of steel and other parts are made of aluminum, but does not give a mass breakdown between steel and aluminum. Therefore, it was assumed that this mass was divided between steel and aluminum.

Table 1 summarizes the relevant properties and assumptions used to calculate the amount of each material used to construct a tractor-trailer. **Table 2** provides a summary of modeled input and output flows. Additional details regarding input and output flows, including calculation methods, are contained in the associated DS sheet.

Table 1: Properties of the Tractor-Trailer Bale Truck

Property	Value	Reference
Weight of a single tractor, kg (lb)	7,000 (15,432)	Volvo 2001
Weight of a 42 ft 2001 Model Chip Trailer, kg (lb)	4,762 (10,500)	Pinnacle 2009
Weight of a 45 ft 1977 Model Chip Trailer, kg (lb)	5,669 (12,500)	Pinnacle 2009
Gross Vehicle Weight	36,287 (80,000)	FHA 2003

Table 2: Unit Process Input and Output Flows

Flow Name*	Value	Units (Per Reference Flow)
Inputs		
Steel plate, BF (85% Recovery Rate) [Metals]	**1.54E-04**	**kg**
Aluminum [Metals]	**3.43E-05**	**kg**
Nylon 6.6 granulate (PA 6.6) [Plastics]	**3.86E-06**	**kg**
Polyurethane flexible foam (PU) [Plastics]	**3.86E-06**	**kg**
Lead [Metals]	**2.16E-06**	**kg**
Styrene-butadiene-rubber (SBR) [Plastics]	**5.22E-05**	**kg**
Outputs		
Cargo [Others]	1.00	kg

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

Embedded Unit Processes

None.

External References

FHA 2003	Federal Highway Administration. 2003. Commercial Vehicle Size and Weight Program. U.S. Department of Transportation, Federal Highway Administration. http://ops.fhwa.dot.gov/freight/sw/overview/index.htm (Accessed December 16, 2009).
Pinnacle 2009	Pinnacle Trailers. 2009. Equipment Specifications: Chip Trailers. Pinnacle Trailers. http://www.pinnacletrailers.com/trailer_inventory.asp?type=10 (Accessed December 16, 2009).
Volvo 2001	Volvo Truck Corporation. 2001. Environmental Product Declaration: Volvo FH12 and Volvo FM12, Euro 3. Volvo Truck Corporation. http://www.volvo.com/NR/rdonlyres/E8FD3F6B-B06B-4EBE-BA7D-A529AFE0BFD0/0/euro3_03.pdf (Accessed December 16, 2009).

Section III: Document Control Information

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