NETL Life Cycle Inventory Data
Process Documentation File

Process Name: Gasoline Passenger Vehicle (2005), Construction

Reference Flow: 1 piece (pcs) of Gasoline Passenger Vehicle per MJ

Brief Description: Materials for the construction of an average U.S. gasoline passenger vehicle for the 2005 average fleet, allocated to 1 megajoule (MJ) of gasoline use.

Section I: Meta Data

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

Year Data Best Represents: 2005

Process Type: Manufacturing Process

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 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:

Fuel Economy Standard (Vehicle_eff)	*Gasoline fuel economy standard for the passenger vehicle*
Energy Content (Gaso_energy)	*Gasoline fuel energy content*
Gasoline combusted per mile (Veh_life_km)	*Amount of gasoline combusted per kilometer in the passenger vehicle*

Tracked Input Flows:

Steel Plate, BF (85% Recovery Rate) [Metals]	*Steel plate from blast furnace (BF) used to construct the vehicle, assumes 85% recycled/recovery rate*

Stainless Steel [Metals]	*Stainless steel (High Strength Steel) used to construct the vehicle*
Cast iron part [Metal parts]	*Formed cast iron used to construct the vehicle*
Aluminum sheet [Metals]	*Aluminum sheet used to construct the vehicle*
Magnesium [Metals]	*Magnesium used to construct the vehicle*
Polypropylene granulate (PP) [Plastics]	*Polypropylene used to construct the vehicle*
Unspecified material [Metals]	*Unspecified materials used to construct the vehicle*

Tracked Output Flows:

Vehicle Construction [Construction]	*Construction of a gasoline passenger vehicle based per 1 MJ of fuel combusted*

Section II: Process Description

Associated Documentation

This unit process is composed of this document and data sheet (DS) *DS_Stage5_C_Gasoline_Passenger_Vehicle05_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 used for the construction of a gasoline-powered passenger vehicle that is representative of the 2005 average passenger vehicle fleet. The process is based on a reference flow of pieces of the vehicle per MJ of gasoline combustion, as described below and shown in Figure 1. The vehicle is assumed to be constructed of steel plate, stainless steel, cast iron, aluminum, magnesium, and polypropylene. Upstream emissions associated with the production and deliveries of these materials are accounted for outside of the boundary of this unit process. This unit process is used in Life Cycle (LC) Stage #5, which accounts for the combustion of transportation fuels and is the final life cycle stage for conventional gasoline. The unit processes that are upstream of this unit process include operation and construction activities for the production and delivery of gasoline. There are no unit processes downstream of this unit process.

Boundary and Description

The LC boundary of this unit process starts with materials ready for the construction of a gasoline vehicle and ends with a gasoline vehicle ready for use. The data in this unit process is representative of a light-duty, spark-ignition gasoline passenger vehicle constructed in 2005. The construction materials are based on a compilation of data sources. Additionally, the lifetime distance traveled by the vehicle and energy intensity per unit distance of travel is used to apportion the construction material requirements to a basis of 1 MJ of gasoline combustion.

Figure 1 provides an overview of the boundaries of this unit process. Rectangular boxes represent relevant sub-processes, while trapezoidal boxes indicate upstream data that are outside of the boundaries of this unit process. As shown, upstream resource consumption and emissions to the environment associated with the production and delivery of construction materials are not accounted for in this unit process, but are accounted for by upstream unit processes. The methods for calculating the construction requirements of the vehicle are described below.

The average lifetime mileage of the vehicle is 245,000 km (152,000 miles) (NHTSA 2006). The average fuel economy standard for gasoline powered vehicles in 2005 is assumed to be 10.3 km/L (24.3 miles/gallon) (USEPA 2007, ORNL 2007, Bandivadeka 2008). Assuming that the energy content of the gasoline is 32.3 MJ/L (0.116 MMBtu/gallon) (NETL 2008) the energy intensity is 3.14 MJ/km (0.00478 MMBtu/mile). By multiplying the energy intensity per mile of vehicle travel by the total lifetime mileage of the vehicle, the total lifetime energy consumption of the vehicle is calculated as 768,000 MJ (728 MMBtu). The total lifetime energy consumption of the vehicle is used to translate the values for materials from a basis of quantity per passenger vehicle to a basis of quantity per MJ. The primary components include steel plate, stainless steel, cast iron, aluminum sheeting, magnesium, and polypropylene. **Table 1** shows the breakdown by weights of each material used to construct a passenger vehicle, model year 2005.

Table 1: Material Used to Construct a Gasoline Passenger Vehicle

Total Weight of Gasoline Vehicle	Weight	Reference
Carbon steel parts	813 kg	Mastny 2005; Bandivadekar 2008
Stainless steel parts	180 kg	Mastny 2005; Bandivadekar 2008
Cast iron part	231 kg	Mastny 2005; Bandivadekar 2008
Aluminum sheet parts	130 kg	Mastny 2005; Bandivadekar 2008
Magnesium parts	4.93 kg	Mastny 2005; Bandivadekar 2008
Polypropylene granulate (PP) parts	150 kg	Mastny 2005; Bandivadekar 2008
Unspecified materials parts	371 kg	Mastny 2005; Bandivadekar 2008

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

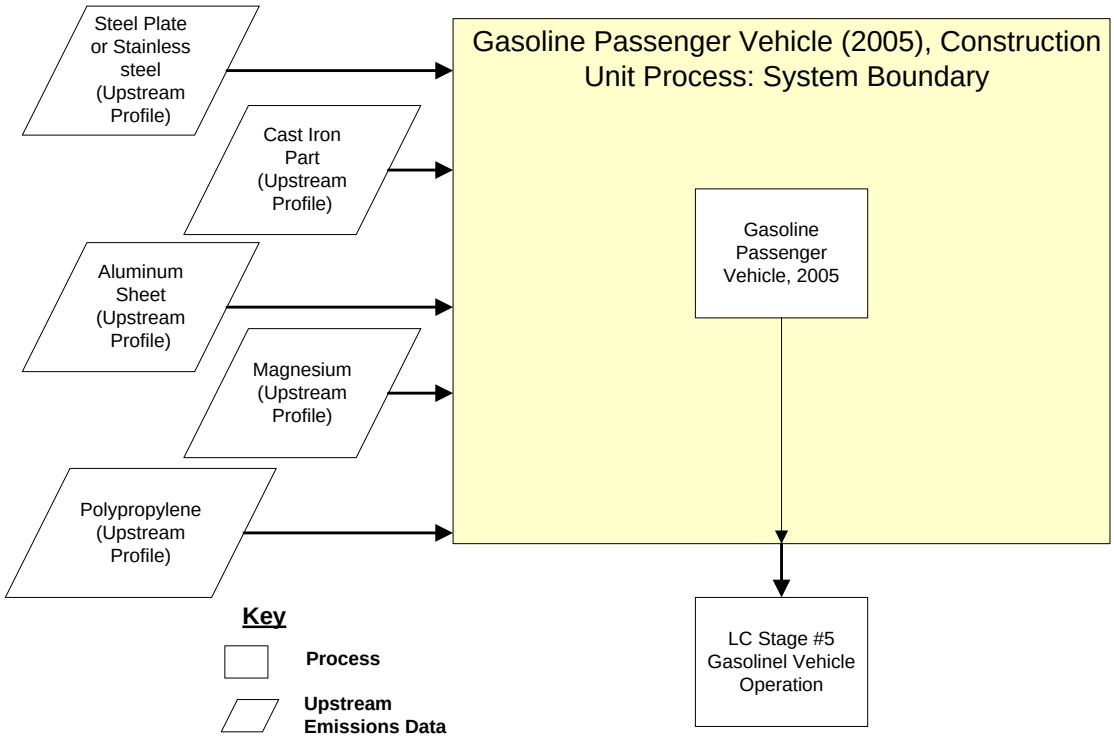

Table 2: Unit Process Input and Output Flows

Flow Name*	Value	Units (Per Reference Flow)
Inputs		
Steel Plate, BF (85% Recovery Rate) [Metals]	**1.06E-03**	**kg/MJ**
Stainless Steel [Metals]	**2.34E-04**	**kg/MJ**
Cast iron part [Metal parts]	**3.00E-04**	**kg/MJ**
Aluminum sheet [Metals]	**1.69E-04**	**kg/MJ**
Magnesium [Metals]	**6.41E-06**	**kg/MJ**
Polypropylene granulate (PP) [Plastics]	**1.96E-04**	**kg/MJ**
Unspecified materials [Metal/plastic parts]	4.83E-04	kg/MJ
Outputs		
Gasoline Passenger Vehicle [Construction]	1.00	pcs/MJ

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

Embedded Unit Processes

None.

References

Mastny 2005 — Mastny, L. 2005. Vital signs 2005: the trends that are shaping our future. Worldwatch Institute, United Nations Environment Programme. W. W. Norton & Company.

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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.

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Section III: Document Control Information

Date Created: February 4, 2010

Point of Contact: Timothy Skone (NETL), Timothy.Skone@NETL.DOE.GOV

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