# NETL Life Cycle Inventory Data
# Process Documentation File

**Process Name:** Pipeline Transport of Crude Petroleum, Operation

**Reference Flow:** 1 kg of Cargo

**Brief Description:** This unit process includes transport of crude petroleum via a pipeline, which is powered by electric pumps. It is assumed that no loss of crude petroleum occurs during pipeline transport.

## Section I: Meta Data

**Geographical Coverage:** US **Region:** Not Applicable

**Year Data Best Represents:** 2009

**Process Type:** Transport Process (TP)

**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:**

| | |
|---|---|
| Distance | *Transport distance (length of pipeline). Default value is 1 mile.* |
| Mass_Eff | *Mass based loss factor for crude petroleum during pipeline transport. Default is assumed to be 0.0 (no loss).* |

**Tracked Input Flows:**

| | |
|---|---|
| Cargo [Other] | *Crude petroleum being transported.* |
| Power [Electric Power] | *Electricity supplied via grid; recommend using average US electricity grid, unless specific region of pipeline transport is identified.* |

**Tracked Output Flows:**

Cargo [Other] *Reference flow*

## Section II: Process Description

### Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_Stage2_O_Pipeline_Crude_Petroleum_Transport_2011.01.xls*, which provides additional details regarding relevant, calculations, data quality, and references.

### Goal and Scope

The scope of this process covers pipeline transport of crude petroleum in the United States, using electric motors to drive pipeline transport pumps. This transport occurs within Life Cycle (LC) Stage #2, in support of transport of crude petroleum to refining/energy conversion facilities. The pipeline operation unit process includes electricity use of pumps used to move the liquid fuel, and is based on the reference flow of 1 kg of diesel fuel cargo delivered. Considered is the consumption of electricity, as well as pipeline mileage and fuel loss/emissions during transport.

### Boundary and Description

**Figure 1** provides an overview of the boundary of this unit process. Upstream emissions from the production of electricity are calculated outside the boundary of this unit process, based on proprietary profiles available within the GaBi model.

The pipeline is assumed to be either an industrial pipeline or major trunk-line. Power to pump the diesel is assumed to be obtained from U.S. electricity grid. Energy consumption is calculated based on an energy intensity per ton-mile factor obtained from a Franklin Associates report, Appendix A (Oregon DEQ 2004). The power factor is based on 1993 transport data.

Because this process was built for use in a study using the Petroleum LCA as a Baseline Document (NETL 2009), energy consumption for the pipeline is taken directly from that source. Energy consumption is thus calculated by multiplying the power factor by the pipeline distance and by the quantity of diesel transported (in the appropriate units). Pipeline distance is included as an adjustable parameter, which is applied linearly as a scalar to the electricity use factor for the pipeline. The default value of 1 mile would not likely be applicable, and under typical conditions would be tens to hundreds of miles.

No loss of crude petroleum is assumed during pipeline transport. Therefore, a default mass efficiency of 100% is included in the model. However, an adjustable parameter has been included to account for evaporative losses of crude petroleum, in the event that more recent data are found. If a loss of liquid fuels is assumed, 100% of the total quantity lost is assumed to be through evaporative emissions and assigned to non-methane volatile organic compounds

(NMVOCs) released to the air. The loss factor for a specific type of fuel is a data limitation within this unit process and is recommended for sensitivity analysis, or replacement with updated loss factor values as available.

**Figure 1: Unit Process Inputs, Outputs, and Boundaries**

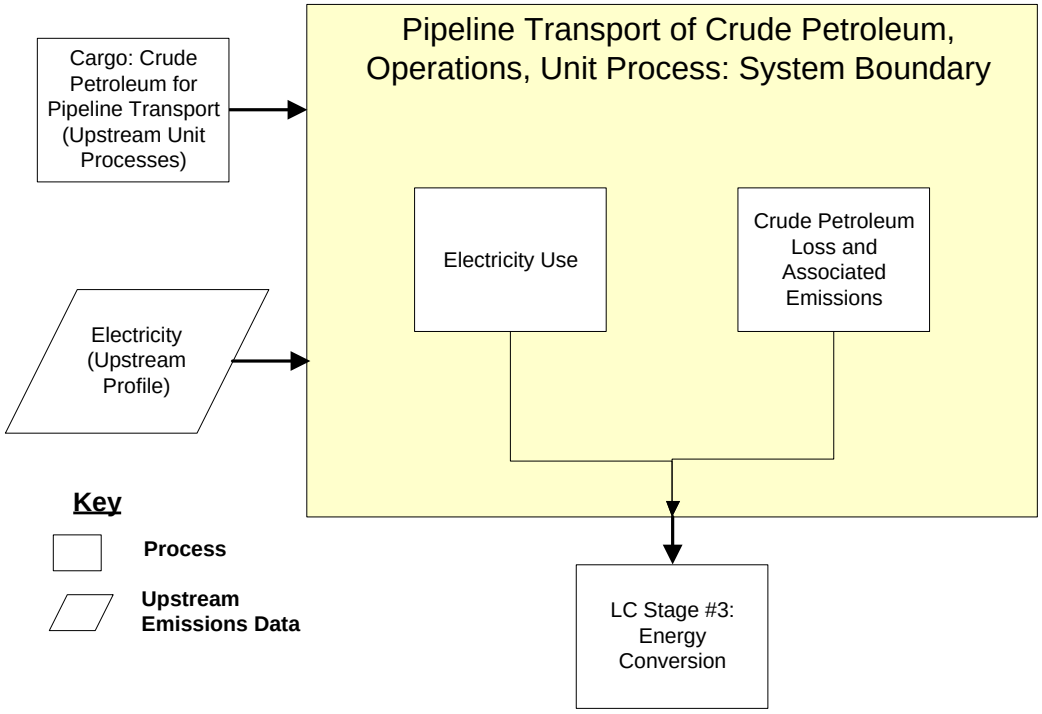


**Table 1** provides an overview of energy requirements for pumping of diesel fuel along a pipeline, as well as other key data points for this unit process. **Table 2** provides a summary of modeled input and output flows. Additional detail regarding input and output flows, including calculation methods, is contained in the associated DS.

**Table 1: Energy Requirements and Other Key Data Points**

| Flow Name | Value | Units | Reference |
|---|---|---|---|
| Energy Required to Power Crude Petroleum Pipeline | 260 | Btu/ton-mile | NETL, 2009 |
| Electricity Required to Power Crude Petroleum Pipeline | 2.772E-05 | kWh/kg-mile | NETL Engineering Calculation |
| Default Pipeline Transport Distance | 1.00 | Mile | NETL Engineering Judgment |
| Default Percentage of Crude Petroleum Loss | 0.00% | Percent | Oregon DEQ 2004 |

**Table 2: Unit Process Input and Output Flows**

| Flow Name* | Value | Units (Per Reference Flow) |
|---|---|---|
| **Inputs** | | |
| **Cargo [Other]** | **1** | **kg** |
| **Power [Electrical power]** | **2.77193E-05** | **kWh** |
| **Outputs** | | |
| Cargo [Other] | 1.00 | kg |
| NMVOCs [Inorganic emissions to air] | 0.00 | kg |

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

## Embedded Unit Processes

None

## References


NETL 2008 — NETL. 2009. *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.

Oregon DEQ 2004 — Oregon Department of Environmental Quality. 2004. *Life Cycle Inventory of Packaging Options for Shipment of Retail Mail-Order Soft Goods: Appendix A - Energy Requirements and Environmental Emissions for Fuel Consumption*. Report prepared by Franklin Associates, Inc. for U.S. Environmental Protection Agency.


## Section III: Document Control Information

**Date Created:** September 1, 2011

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**Revision History:**

Original/no revisions

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