NETL Life Cycle Inventory Data
Process Documentation File

Process Name: Railroad, Petroleum Products, Transport

Reference Flow: 1 kg of Cargo

Brief Description: This process includes all inputs and outputs for the raw material transportation of 1 kg of petroleum or petroleum based fuel, delivered by US domestic railroad using a diesel locomotive.

Section I: Meta Data

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

Year Data Best Represents: 2015

Process Type: Transport Process (TP)

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

Allocation Applied: No

Completeness: Individual 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_EVAP	*The fraction of petroleum fuel transported that is evaporated during the transport process*
TRAIN_DISTANZ	*The distance travelled by the train in support of domestic railroad transport of cargo; 2-way transport distance*

Tracked Input Flows:

Fuel Train Transport, Operation	*Operation of a train used to transport generic petroleum based fuels*

Fuel Train, Construction	*Construction for a train used to transport generic petroleum based fuels*

Tracked Output Flows:

Cargo [Valuable substance]	*Cargo output from the RMT process; cargo is used generically to refer to generic petroleum based fuels*

Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_RMT_Petroleum_Rail_2011.01.xls*, which provides additional details regarding relevant calculations, data quality, and references.

Goal and Scope

The scope of this unit process covers all aspects of raw material transportation (RMT), from the downstream boundary of raw materials acquisition (RMA) to the upstream boundary of the energy conversion facility (ECF). At the end of RMT, one kilogram of cargo is delivered to the ECF, the life cycle (LC) Stage #3 boundary.

Boundary and Description

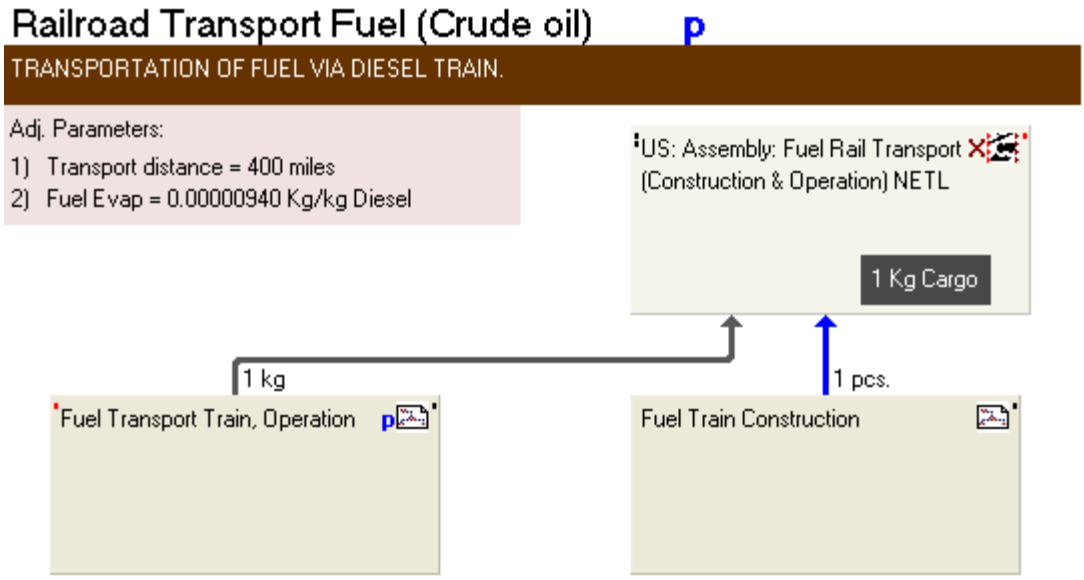
LC Stage #2 (RMT) includes the transport of generic petroleum products via railroad. Petroleum products transported may include crude oil or refined oil products such as gasoline, diesel, and jet fuel. Construction of relevant machinery for RMT is included in the process, as is operation of railcars that are assembled into 100-unit trains within a discrete assembly unit process. Operation of a train is also considered, where the train engines are presumed to be diesel powered. Finally, construction and operations processes are combined within a separate assembly process for fuel rail transport. The plan for RMT of generic petroleum products via rail is provided in **Figure 1.** Additional boundary and process details for each of the NETL-generated unit processes are contained in the documentation for those unit processes.

The construction processes for machinery used in support of RMT were created. The machinery includes:

- Coal Railcar, 244000 lbs. Net Capacity, Construction
  (DS/DF_Stage2_C_Coal_Railcar_244000_lbs_Net_Capacity_2009.01.doc)
- Tanker Railcar, 26,470 Gal Net Capacity, Construction
  (DS/DF_Stage2_C_Tanker_Railcar_26470_Gal_Net_Capacity_2010.01.doc

- Tanker Unit Train Assembly, 100 Railcars, Construction (DS/DF_Stage2_C_Assembly_Tanker_Unit_Train_100_Railcars_2010.01.doc)

Figure 1: Plan for RMT for Domestic Railroad Transport of Petroleum Products, Including Construction and Operation of Profiles for Transport



Each piece of equipment is scaled to the production of one kilogram of cargo (petroleum products). The profiles and processes included in RMT are provided in **Table 1**. Those shown in bold face were developed by NETL.

Table 1: Profiles and Processes Included in RMT for Domestic Railroad Transport of Petroleum Products

Railroad Transport Fuel (Crude oil)
- Fuel Train Construction
  - RER: Aluminum sheet mix PE
  - US: Coal Railcar, 244000 lbs Net Capacity, Construction NETL <u-so>
  - US: Tanker Railcar, 26,470 Gal Net Capacity, Construction NETL <u-so>
  - US: Tanker Unit Train Assembly, 100 Railcars, Construction NETL <u-so>
  - WOR: Steel Plate, BF, Manufacture NETL <u-so>
- Fuel Transport Train, Operation
  - US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
  - US: Petroleum-Based Fuel, Train Transport NETL <u-so>
- US: Assembly: Fuel rail Transport (Construction & Operation) NETL

Parameters and Balances

The parameters for the highest level modeling plans for RMT for railroad transport of petroleum products are shown in **Table 2**. These parameters may or may not include the adjustable parameters shown previously, depending on how the model was created. **Table 3** presents the input and output balances for resources and emissions of interest for the RMT plan.

Table 2: Adjustable Parameters for RMT for Domestic Railroad Transport of Petroleum Products

Plan	Parameter	Value	Comment
LC Stage #2			
Railroad Transport Fuel (Crude Oil)	FUEL_EVAP	9.40E-06	[kg/kg] Fuel evaporation
Railroad Transport Fuel (Crude Oil)	TRAIN_DISTANZ	400	[miles] Round trip transport distance in miles; default value = 200 miles one-way

Table 3: Inputs and Output Balances for RMT for Domestic Railroad Transport of Petroleum Products (kg/kg delivered)

Process or Category	Gate to Gate (RMT)
Inputs	
Flows	1.604E-02
Resources	1.604E-02
Energy resources	6.087E-04
Non renewable energy resources	6.087E-04
Crude oil (resource)	2.499E-04
Hard coal (resource)	1.333E-04
Lignite (resource)	1.371E-04
Natural gas (resource)	8.845E-05
Uranium (resource)	6.970E-09
Renewable energy resources	2.809E-08
Biomass	1.547E-10
Renewable fuels	2.297E-13
Wood	2.793E-08
Unspecified	0.000E+00
Land use	0.000E+00
Material resources	1.543E-02
Non renewable elements	4.206E-08
Aluminum	1.744E-13
Chromium	1.157E-14

Process or Category	Gate to Gate (RMT)
Copper	9.047E-16
Iron	4.181E-08
Lead	7.139E-15
Magnesium	1.366E-17
Mercury	3.403E-15
Nickel	4.284E-17
Phosphorus	1.366E-12
Sulphur	1.332E-11
Zinc	2.328E-10
Non renewable resources	2.847E-03
Barium sulphate	4.531E-16
Basalt	6.529E-06
Bauxite	4.119E-04
Bentonite	9.841E-07
Calcium carbonate (CaCO3)	1.135E-09
Calcium chloride	4.639E-14
Chalk (Calciumcarbonate)	1.268E-41
Chromium ore (39%)	4.793E-09
Clay	1.922E-07
Colemanite ore	2.581E-09
Copper - Gold - Silver - ore (1,0% Cu; 0,4 g/t Au; 66 g/t Ag)	3.447E-08
Copper - Gold - Silver - ore (1,1% Cu; 0,01 g/t Au; 2,86 g/t Ag)	2.100E-08
Copper - Gold - Silver - ore (1,16% Cu; 0,002 g/t Au; 1,06 g/t Ag)	1.185E-08
Copper - Molybdenum - Gold - Silver - ore (1,13% Cu; 0,02% Mo; 0,01 g/t Au; 2,86 g/t Ag)	2.888E-08
Copper ore (0.14%)	5.726E-08
Copper ore (1.2%)	3.575E-09
Copper ore (4%)	3.386E-18
Copper ore (sulphidic, 1.1%)	7.784E-11
Dolomite	6.257E-09
Feldspar (aluminum silicates)	9.631E-13
Ferro manganese	2.108E-15
Fluorspar (calcium fluoride; fluorite)	3.095E-06
Granite	2.609E-22
Gypsum (natural gypsum)	1.035E-07
Heavy spar (BaSO4)	2.375E-06
Ilmenite (titanium ore)	2.145E-17
Inert rock	2.360E-03
Iron ore (56,86%)	2.626E-06

Process or Category	Gate to Gate (RMT)
Iron ore (65%)	9.521E-09
Kaolin ore	4.632E-09
Lead - zinc ore (4.6%-0.6%)	1.998E-07
Limestone (calcium carbonate)	2.973E-05
Magnesit (Magnesium carbonate)	3.494E-12
Magnesium chloride leach (40%)	4.259E-07
Manganese ore	9.974E-10
Manganese ore (R.O.M.)	5.462E-08
Molybdenite (Mo 0,24%)	1.781E-08
Natural Aggregate	1.382E-05
Nickel ore (1,5%)	7.937E-13
Nickel ore (1.6%)	6.954E-08
Olivine	2.197E-14
Peat	2.824E-07
Phosphate ore	3.394E-12
Phosphorus minerals	1.317E-10
Phosphorus ore (29% P2O5)	1.398E-13
Potassium chloride	1.934E-11
Precious metal ore (R.O.M)	8.783E-10
Quartz sand (silica sand; silicon dioxide)	1.408E-07
Raw pumice	4.976E-11
Rutile (titanium ore)	4.195E-13
sand	3.245E-12
Slate	4.795E-14
Sodium chloride (rock salt)	9.661E-06
Sodium nitrate	7.275E-22
Sodium sulphate	3.124E-10
Soil	4.496E-06
Sulphur (bonded)	1.393E-13
Talc	1.010E-11
Tin ore	3.929E-17
Titanium ore	9.054E-09
Zinc - copper ore (4.07%-2.59%)	4.363E-08
Zinc - lead - copper ore (12%-3%-2%)	2.215E-08
Zinc - lead ore (4.21%-4.96%)	1.156E-18
Zinc ore (4%)	-2.506E-09
Zinc ore (sulphidic, 4%)	6.960E-18
Renewable resources	1.258E-02

Process or Category	Gate to Gate (RMT)
Water	8.217E-03
Water	1.083E-03
Water (feed water)	2.881E-06
Water (ground water)	1.132E-03
Water (sea water)	4.036E-06
Water (surface water)	5.995E-03
Water (well water)	9.648E-09
Water (with river silt)	2.478E-16
Air	4.356E-03
Carbon dioxide	8.561E-06
Nitrogen	0.000E+00
Oxygen	0.000E+00
Unspecified	5.005E-11
Unspecified minerals	1.139E-11
Unspecified resources	3.866E-11
Area of Production Land	0.000E+00
Output	
Flows	1.483E-02
Resources	5.454E-03
Energy resources	0.000E+00
Land use	0.000E+00
Material resources	5.454E-03
Renewable resources	5.454E-03
Water	5.448E-03
Water (river water)	5.442E-03
Water (wastewater)	5.963E-06
Nitrogen	1.409E-09
Oxygen	5.945E-06
Ecoinvent	2.068E-15
Long-term emission	2.068E-15
Fresh water	2.068E-15
Dissolved organic carbon, DOC (Ecoinvent)	2.068E-15
Production residues in life cycle	1.202E-04
Hazardous waste for disposal	1.190E-04
Dross (Fines)	7.911E-07
Natrium oxide	1.345E-06

Process or Category	Gate to Gate (RMT)
Red mud (dry)	1.168E-04
Soil and sand containing heavy metals	3.925E-12
Toxic chemicals (unspecified)	6.292E-11
Hazardous waste for recovery	3.261E-07
Used oil	2.127E-07
Waste water processing residue	1.134E-07
Waste for disposal	5.146E-07
Incineration good	3.433E-11
Sludge from water works (6% dry matter-content)	1.977E-12
Waste (solid)	7.814E-08
Waste from steel works	4.364E-07
Waste for recovery	4.279E-07
Aluminum scrap	7.884E-16
Chemicals (unspecified)	1.886E-11
Cooling water	5.845E-08
Cryolite	3.688E-07
Dross	1.178E-10
Gypsum (FDI)	1.824E-17
Plastic (unspecified)	3.543E-11
Production residues (unspecified)	2.614E-13
Rolling tinder	3.207E-24
Slag	5.070E-10
Waste paper	5.206E-15
Wood	1.977E-14
Wooden pallet (EURO)	1.052E-19
Mixed Waste (Hazardous or Radioactive)	0.000E+00
Neutralized residues	3.454E-18
Emissions to air	9.240E-03
Heavy metals to air	4.124E-09
Antimony	8.161E-12
Arsenic (+V)	1.128E-10
Arsenic trioxide	1.328E-16
Cadmium (+II)	5.606E-12
Chromium (+III)	8.014E-14
Chromium (unspecified)	3.508E-11
Cobalt	1.620E-11
Copper (+II)	2.734E-11
Heavy metals to air (unspecified)	1.151E-13

Process or Category	Gate to Gate (RMT)
Hydrogen arsenic (arsine)	1.102E-14
Iron	1.956E-11
Lanthanides	5.700E-15
Lead (+II)	1.684E-10
Manganese (+II)	8.961E-11
Mercury (+II)	1.382E-11
Molybdenum	9.548E-13
Nickel (+II)	6.570E-10
Palladium	1.284E-18
Rhodium	1.239E-18
Selenium	1.493E-10
Silver	1.458E-19
Tellurium	1.068E-14
Thallium	9.159E-14
Tin (+IV)	9.996E-11
Titanium	3.604E-13
Vanadium (+III)	2.470E-09
Zinc (+II)	2.496E-10
Inorganic emissions to air	4.728E-03
Ammonia	7.268E-08
Ammonium	7.090E-15
Ammonium nitrate	7.947E-16
Barium	1.731E-09
Beryllium	2.607E-12
Boron compounds (unspecified)	1.738E-09
Bromine	5.822E-10
Carbon dioxide	2.898E-03
Carbon dioxide (biotic)	4.420E-07
Carbon disulphide	2.609E-13
Carbon monoxide	1.390E-05
Chloride (unspecified)	9.627E-10
Chlorine	2.110E-11
Cyanide (unspecified)	4.771E-12
Fluoride	5.840E-08
Fluorides	8.384E-13
Fluorine	2.819E-14
Helium	8.678E-12
Hydrogen	1.185E-08

Process or Category	Gate to Gate (RMT)
Hydrogen bromine (hydrobromic acid)	1.755E-12
Hydrogen chloride	4.830E-08
Hydrogen cyanide (prussic acid)	9.242E-12
Hydrogen fluoride	5.830E-08
Hydrogen iodide	1.909E-15
Hydrogen phosphorous	1.939E-12
Hydrogen sulphide	6.770E-08
Lead dioxide	4.005E-15
Nitrogen (atmospheric nitrogen)	1.089E-07
Nitrogen dioxide	1.966E-08
Nitrogen monoxide	7.649E-13
Nitrogen oxides	6.510E-06
Nitrous oxide (laughing gas)	6.368E-08
Oxygen	4.550E-07
Scandium	2.932E-15
Steam	1.802E-03
Strontium	1.085E-13
Sulphur dioxide	6.103E-06
Sulphur hexafluoride	1.028E-13
Sulphuric acid	1.374E-11
Tin oxide	1.280E-16
Unspecified Particles	9.318E-11
Zinc oxide	2.561E-16
Zinc sulphate	2.770E-13
Organic emissions to air (group VOC)	8.555E-04
Group NMVOC to air	8.523E-04
Group PAH to air	5.063E-09
Anthracene	3.126E-14
Benzo{a}anthracene	1.573E-14
Benzo{a}pyrene	8.651E-11
Benzo{ghi}perylene	1.403E-14
Benzofluoranthene	2.807E-14
Chrysene	3.864E-14
Dibenz(a)anthracene	8.744E-15
Indeno[1,2,3-cd]pyrene	1.044E-14
Naphthalene	3.284E-12
Phenanthrene	1.031E-12
Polycyclic aromatic hydrocarbons (PAH)	4.972E-09

Process or Category	Gate to Gate (RMT)
Halogenated organic emissions to air	1.453E-08
Dichloroethane (ethylene dichloride)	3.700E-18
Dichloromethane (methylene chloride)	1.660E-16
Dioxins (unspec.)	-3.565E-19
Halogenated hydrocarbons (unspecified)	1.770E-14
Polychlorinated biphenyls (PCB unspecified)	2.433E-14
Polychlorinated dibenzo-p-dioxins (2,3,7,8 - TCDD)	1.013E-15
R 11 (trichlorofluoromethane)	5.095E-11
R 114 (dichlorotetrafluoroethane)	5.218E-11
R 116 (hexafluoroethane)	1.439E-09
R 12 (dichlorodifluoromethane)	1.096E-11
R 13 (chlorotrifluoromethane)	6.879E-12
R 22 (chlorodifluoromethane)	1.197E-11
Tetrafluoromethane	1.295E-08
Vinyl chloride (VCM; chloroethene)	1.147E-12
Acetaldehyde (Ethanal)	4.473E-10
Acetic acid	1.916E-09
Acetone (dimethylcetone)	4.445E-10
Acrolein	2.206E-13
Aldehyde (unspecified)	2.719E-11
Alkane (unspecified)	3.863E-09
Alkene (unspecified)	2.219E-09
Aromatic hydrocarbons (unspecified)	1.732E-10
Benzene	9.336E-10
Butadiene	6.814E-15
Butane	2.339E-08
Butane (n-butane)	1.605E-09
Caprolactam	1.009E-14
Cyclohexane (hexahydro benzene)	5.926E-12
Diethylamine	1.772E-19
Ethane	6.934E-08
Ethanol	8.991E-10
Ethene (ethylene)	4.201E-12
Ethyl benzene	2.136E-09
Fluoranthene	1.018E-13
Fluorene	3.231E-13
Formaldehyde (methanal)	3.172E-09
Heptane (isomers)	6.891E-10

Process or Category	Gate to Gate (RMT)
Hexamethylene diamine (HMDA)	4.008E-16
Hexane (isomers)	1.051E-09
Mercaptan (unspecified)	1.485E-11
Methanethiol	2.369E-12
Methanol	8.661E-10
NMVOC (unspecified)	8.520E-04
Octane	3.791E-10
Pentane (n-pentane)	1.174E-08
Phenol (hydroxy benzene)	1.478E-13
Propane	1.105E-07
Propene (propylene)	1.939E-10
Propionic acid (propane acid)	7.361E-14
Styrene	6.604E-15
Toluene (methyl benzene)	9.891E-10
Trimethylbenzene	1.247E-15
Xylene (dimethyl benzene)	8.932E-09
Hydrocarbons (unspecified)	1.659E-11
Methane	2.602E-06
Organic chlorine compounds	2.243E-14
Unspecified Organic Compounds	6.477E-17
VOC (unspecified)	5.552E-07
Other emissions to air	3.654E-03
Aldehydes, unspecified	3.238E-17
Exhaust	3.651E-03
Particulate Matter, unspecified	5.927E-09
Sand (Silica) (SiO2)	6.174E-13
Used air	3.736E-06
Particles to air	1.991E-06
Dust (PM10)	2.706E-08
Dust (PM2.5)	1.378E-07
Dust (unspecified)	1.826E-06
Metals (unspecified)	1.832E-14
Unspecified Organic Chlorine Compounds	4.273E-16
Wood (dust)	4.725E-14
Radioactive emissions to air	5.988E-11
Uranium (total)	5.988E-11
Unspecified Heavy Metals	3.337E-20
Emissions to fresh water	1.373E-05

Process or Category	Gate to Gate (RMT)
Analytical measures to fresh water	2.801E-07
Adsorbable organic halogen compounds (AOX)	2.314E-10
Biological oxygen demand (BOD)	2.582E-09
Chemical oxygen demand (COD)	2.643E-07
Nitrogenous Matter (unspecified, as N)	4.647E-11
Solids (dissolved)	8.810E-09
Total dissolved organic bounded carbon	3.465E-12
Total organic bounded carbon	4.224E-09
Heavy metals to fresh water	1.551E-06
Aluminium	2.397E-07
Antimony	2.124E-09
Arsenic (+V)	6.836E-09
Cadmium (+II)	6.957E-10
Chromium (+III)	1.901E-11
Chromium (+VI)	2.451E-14
Chromium (unspecified)	1.180E-08
Cobalt	1.929E-13
Copper (+II)	9.953E-09
Heavy metals to water (unspecified)	3.043E-12
Iron	7.543E-07
Lead (+II)	2.313E-08
Manganese (+II)	6.415E-10
Mercury (+II)	1.168E-10
Molybdenum	1.429E-10
Nickel (+II)	1.822E-07
Selenium	2.548E-11
Silver	2.074E-09
Strontium	1.346E-09
Thallium	4.664E-15
Tin (+IV)	6.294E-13
Titanium	1.560E-11
Unspecified Substance	2.887E-16
Vanadium (+III)	4.626E-11
Zinc (+II)	3.161E-07
Inorganic emissions to fresh water	1.006E-05
Acid (calculated as H+)	8.184E-08
Aluminum (+III)	4.670E-09
Ammonia	9.582E-11

Process or Category	Gate to Gate (RMT)
Ammonium (total N)	2.594E-06
Ammonium / ammonia	4.020E-09
Barium	2.505E-10
Beryllium	1.792E-13
Boron	9.979E-10
Bromate	1.966E-16
Bromine	3.903E-14
Calcium (+II)	4.646E-07
Carbonate	1.518E-08
Chlorate	1.882E-13
Chloride	4.007E-06
Chlorine (dissolved)	6.410E-09
Copper ion (+II/+III)	2.914E-17
Cyanide	1.929E-08
Fluoride	4.394E-07
Fluorine	3.831E-12
Hydrogen chloride	8.454E-14
Hydrogen fluoride (hydrofluoric acid)	4.916E-14
Hydrogen Ions (H+)	6.445E-14
Hydroxide	2.524E-07
Inorganic salts and acids (unspecified)	1.367E-20
Magnesium (+III)	3.128E-08
Magnesium chloride	3.493E-13
Metal ions (unspecific)	8.913E-12
Neutral salts	3.266E-13
Nitrate	1.585E-08
Nitrate (as total N)	1.035E-15
Nitrogen	1.124E-10
Nitrogen organic bounded	1.345E-09
Phosphate	2.134E-10
Phosphorus	2.290E-07
Potassium	3.967E-11
Silicate particles	3.786E-14
Sodium (+I)	8.058E-07
Sodium chloride (rock salt)	6.920E-13
Sodium hypochlorite	2.510E-12
Sulphate	1.082E-06
Sulphide	2.784E-09

Process or Category	Gate to Gate (RMT)
Sulphite	2.926E-10
Sulphur	1.772E-11
Sulphuric acid	1.090E-11
Unspecified Iron Oxides	7.392E-16
Unspecified Oil	2.619E-15
Unspecified Organic Chlorine compounds	5.935E-18
Unspecified Salt	2.375E-14
Unspecified Solids (Suspended)	9.218E-14
Organic emissions to fresh water	4.982E-09
Halogenated organic emissions to fresh water	5.561E-13
1,2-Dibromoethane	1.392E-15
Chlorinated hydrocarbons (unspecified)	2.344E-19
Chloromethane (methyl chloride)	5.537E-13
Dichloroethane (ethylene dichloride)	9.924E-21
Dichloropropane	3.217E-19
Polychlorinated dibenzo-p-dioxins (2,3,7,8 - TCDD)	5.108E-22
Vinyl chloride (VCM; chloroethene)	1.037E-15
Hydrocarbons to fresh water	2.019E-09
Acenaphthene	4.488E-14
Acenaphthylene	1.859E-14
Acetic acid	3.633E-11
Acrylonitrile	2.353E-14
Anthracene	7.131E-14
Aromatic hydrocarbons (unspecified)	2.574E-11
Benzene	9.261E-11
Benzo{a}anthracene	5.881E-15
Benzofluoranthene	2.524E-15
Chrysene	2.510E-14
Cresol (methyl phenol)	4.590E-13
Ethyl benzene	5.028E-12
Fluoranthene	7.890E-15
Hexane (isomers)	5.020E-14
Hydrocarbons (unspecified)	6.974E-11
Methanol	6.468E-10
Oil (unspecified)	5.428E-10
Phenol (hydroxy benzene)	1.044E-10
Polycyclic aromatic hydrocarbons (PAH, unspec.)	4.037E-10
Toluene (methyl benzene)	5.821E-11

Process or Category	Gate to Gate (RMT)
Xylene (isomers; dimethyl benzene)	3.335E-11
Carbon, organically bound	2.956E-09
Naphthalene	2.845E-12
N-unspecified (N)	2.050E-15
Organic chlorine compounds (unspecified)	3.776E-15
Organic compounds (dissolved)	1.427E-12
Organic compounds (unspecified)	3.976E-13
Unspecified wastewater	1.550E-12
Other emissions to fresh water	0.000E+00
Particles to fresh water	1.836E-06
Metals (unspecified)	1.367E-13
Silicon dioxide (silica)	5.155E-19
Soil loss by erosion into water	9.150E-13
Solids (suspended)	1.835E-06
Suspended solids, unspecified	7.945E-11
Unspecified Oxides	6.145E-16
Radioactive emissions to fresh water	0.000E+00
Bromide	0.000E+00
Radionuclide	0.000E+00
Sulfite	0.000E+00
Unspecified Solids (Dissolved)	1.777E-13
Uranium (total)	0.000E+00
Emissions to sea water	5.732E-06
Analytical measures to sea water	1.617E-08
Adsorbable organic halogen compounds (AOX)	8.700E-16
Biological oxygen demand (BOD)	9.597E-10
Chemical oxygen demand (COD)	1.425E-08
Total organic bounded carbon	9.597E-10
Heavy metals to sea water	3.175E-09
Arsenic (+V)	4.662E-11
Cadmium (+II)	2.435E-11
Chromium (unspecified)	8.887E-11
Cobalt	1.530E-11
Copper (+II)	1.195E-10
Iron	3.033E-10
Lead (+II)	3.006E-11
Manganese (+II)	3.100E-11
Mercury (+II)	4.585E-13

Process or Category	Gate to Gate (RMT)
Molybdenum	8.968E-13
Nickel (+II)	4.489E-11
Silver	2.661E-12
Strontium	2.151E-09
Tin (+IV)	3.187E-12
Titanium	3.246E-13
Vanadium (+III)	1.089E-11
Zinc (+II)	3.020E-10
Inorganic emissions to sea water	4.945E-06
Aluminum (+III)	1.045E-11
Ammonia	3.105E-10
Barium	9.630E-10
Beryllium	8.245E-13
Boron	1.690E-10
Calcium (+II)	1.845E-08
Carbonate	6.055E-08
Chloride	4.804E-06
Magnesium	4.622E-09
Nitrate	7.852E-11
Sodium (+I)	1.917E-08
Sulphate	2.562E-08
Sulphide	1.101E-08
Sulphur	9.042E-11
Organic emissions to sea water	2.938E-09
Hydrocarbons to sea water	2.912E-09
Acenaphthene	7.549E-13
Acenaphthylene	2.896E-13
Acetic acid	1.566E-12
Anthracene	2.746E-13
Aromatic hydrocarbons (unspecified)	9.597E-12
Benzene	2.796E-10
Benzo{a}anthracene	1.639E-13
Benzofluoranthene	1.768E-13
Chrysene	9.152E-13
Cresol (methyl phenol)	2.342E-12
Ethyl benzene	2.369E-11
Fluoranthene	1.922E-13
Hexane (isomers)	2.557E-13

Process or Category	Gate to Gate (RMT)
Oil (unspecified)	1.929E-09
Phenol (hydroxy benzene)	3.794E-10
Toluene (methyl benzene)	1.722E-10
Xylene (isomers; dimethyl benzene)	1.113E-10
Naphthalene	2.591E-11
Particles to sea water	7.638E-07
Solids (suspended)	7.638E-07
Emissions to agricultural soil	0.000E+00
Emissions to industrial soil	2.965E-08
Heavy metals to industrial soil	6.633E-09
Arsenic (+V)	9.894E-15
Cadmium (+II)	1.065E-13
Chromium (+III)	1.253E-14
Chromium (unspecified)	2.164E-11
Cobalt	3.441E-13
Copper (+II)	2.107E-13
Iron	2.919E-11
Lead (+II)	2.434E-14
Manganese (+II)	7.408E-12
Mercury (+II)	5.084E-16
Nickel (+II)	1.706E-11
Strontium	6.554E-09
Zinc (+II)	2.758E-12
Inorganic emissions to industrial soil	2.252E-08
Aluminum (+III)	2.706E-11
Ammonia	1.034E-08
Bromide	2.949E-12
Calcium (+II)	1.513E-09
Chloride	3.528E-09
Fluoride	9.831E-11
Magnesium (+III)	2.091E-10
Phosphorus	1.067E-09
Potassium (+I)	2.884E-09
Sodium (+I)	1.323E-10
Sulphate	3.885E-10
Sulphide	2.331E-09
Organic emissions to industrial soil	4.909E-10
Oil (unspecified)	4.909E-10

Process or Category	Gate to Gate (RMT)
Radioactive emissions to industrial soil	0.000E+00
Calcium Fluoride	0.000E+00
Radionuclide	0.000E+00

Embedded Unit Processes

NETL (2010). *NETL Life Cycle Inventory Data – Unit Process: 100 Railcar Tanker Unit Train Assembly, Construction.* U.S. Department of Energy, National Energy Technology Laboratory. Last Updated: February 2010 (version 01). www.netl.doe.gov/energy-analyses (http://www.netl.doe.gov/energy-analyses)

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