



NETL Life Cycle Inventory Data

Process Documentation File

Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_RMA_PowderRiverBasin_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 acquisition (RMA) as shown in **Figure 1**. At the downstream boundary for RMA, one kilogram of coal is at the life cycle (LC) Stage #2 boundary.

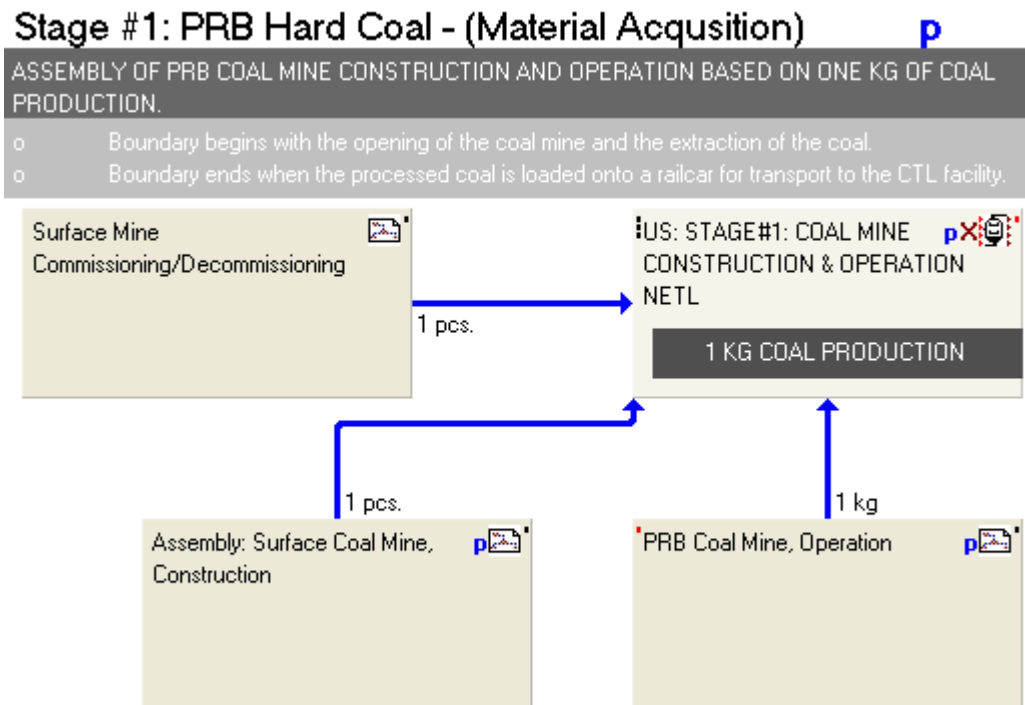
Boundary and Description

LC Stage #1, RMA for subbituminous Powder River Basin (PRB) coal, includes the construction of a PRB coal mine and required operation equipment, the operation of the coal mine, and the commissioning and decommissioning of the mine. The mine was modeled based on a compilation of surface mines in Wyoming and Montana that produce Powder River Basin Coal.

Each of the three processes included in RMA for PRB coal include upstream processes (for example, diesel fuel or steel). Coal mine construction and operation include individual construction unit processes for key equipment, which are aggregated within the model as described below. The plan for RMA of PRB coal is provided in **Figure 1**.

Coal mine commissioning and decommissioning integrates diesel and gasoline use during the commissioning and decommissioning of the PRB mine. Due to lack of available data, coal mine decommissioning was assumed to require 10 percent of the commissioning inputs. Coal mine operation includes energy from the power grid and diesel use for the operation of the mine and mine equipment. Coal mine methane emissions are included as an adjustable parameter in this process.

Figure 1: Plan for RMA of PRB Coal, Including Operations, Construction, and Commissioning/Decommissioning Profiles



The construction process contains all of the machinery needed for the initial clearing of the site and the extraction of the coal. The machinery includes:

- Blasthole Drill
(DS/DF_Stage1_C_Blasthole_Drill_250000lb_2010.01.doc)
- Coal Loading Silo
(DS/DF_Stage1_C_Coal_Loading_Silo_PRB_2010.01.doc)
- Conveyor System
(DS/DF_Stage1_C_Conveyor_System_48_Inch_2010.01.doc)
- Dragline
(DS/DF_Stage1_C_Dragline_8200ton_2010.01.doc)
- Coal Loader
(DS/DF_Stage1_C_Track_Loader_239_HP_2010.01.doc)
- Mining Truck
(DS/DF_Stage1_C_Mining_Truck_623690kg_2010.01.doc)
- Electric Shovel
(DS/DF_Stage1_C_Electric_Shovel_120_Tons_Payload_2010.01.doc)

- Coal Crusher
(DS/ DF_Stage1_C_Coal_Crusher_254000lb_2010.01.doc)

Each piece of equipment is scaled to coal mine production, accounting for the lifetime of each piece of equipment, as relevant. The profiles and processes included in RMA are provided in **Table 1**. Those shown in bold face were developed by NETL.

Table 1: Profiles and Processes Included in RMA for Powder River Basin Coal

Stage #1: PRB Hard Coal - (Material Acquisition)

Assembly: Surface Coal Mine, Construction

Blasthole Drill, Construction

US: Blasthole Drill, Construction NETL

WOR: Steel Plate, BF, Manufacture NETL <u-so>

Coal Crusher, Construction

DE: Steel cold rolled PE

US: Coal Crusher, Construction NETL

Coal Loader, Construction

US: Track Loader, 239 Horsepower (HP), Construction NETL <u-so>

WOR: Steel Plate, BF, Manufacture NETL <u-so>

Coal Loading Silo, Construction

DE: Steel cold rolled PE

North American Average Electricity Mix, 2007 NETL

US: Coal Loading Silos, Construction NETL

US: Concrete, ready mixed, R-5-0 (100% Portland Cement) NETL <u-so>

Conveyor System, Construction

BF: Hot-dip Galvanized NETL

DE: Steel cold rolled PE

DE: Styrene-butadiene rubber mix (SBR) PE

US: Steel-Cord Conveyor System, 72", Construction NETL <u-so>

Dragline, Construction

US: Dragline, 8,200 ton, Construction NETL <u-so>

WOR: Steel Plate, BF, Manufacture NETL <u-so>

Electric Shovel, Construction

US: Electric Shovel, 120 tons payload, Construction NETL <u-so>

WOR: Steel Plate, BF, Manufacture NETL <u-so>

Mining Truck, Construction

DE: Styrene-butadiene rubber mix (SBR) PE

US: Mining Truck for Surface Mine, 623,690 kg, Construction NETL <u-so>

WOR: Steel Plate, BF, Manufacture NETL <u-so>

US: PRB Coal Surface Mine Assembly, Construction NETL <u-so>

PRB Coal Mine, Operation

North American Average Electricity Mix, 2007 NETL

RER: Ammonium nitrate PE

US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
 US: Fuel oil light at refinery PE
 US: Powder River Basin Surface Subbituminous Coal Mine, Operations NETL <u-so>
 Surface Mine Commissioning/Decommissioning
 US: Commissioning and Decommissioning of Powder River Basin Coal Mine NETL <u-so>
 US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
 US: STAGE#1: COAL MINE CONSTRUCTION & OPERATION NETL

Parameters and Balances

The parameters for the highest level modeling plans for RMA of PRB subbituminous coal 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 RMA plan.

Table 2: Adjustable Parameters for RMA of PRB Coal

Plan	Parameter	Value	Comment
<i>LC Stage #1</i>			
Stage #1: PRB Hard Coal	CH4_PRO	0.000149	[kg/kg coal] Amount of methane released from the mining and coal cleaning process
Stage #1: PRB Hard Coal	CONS_MAT	1	[pcs/kg] Number of pieces per kg of coal production
Stage #1: PRB Hard Coal	S1_OPER_TIME	30	[years] Length of study period, assumed to be the lifetime of the mine

Table 2: Inputs and Output Balances for RMA of PRB Coal (kg/kg delivered)

Process or Category	Cradle to Gate (RMA)
Inputs	
Flows	9.065E-02
Resources	9.065E-02
Energy resources	1.904E-03
Non renewable energy resources	1.904E-03
Crude oil (resource)	8.122E-04
Hard coal (resource)	3.615E-04
Lignite (resource)	8.940E-05
Natural gas (resource)	6.410E-04
Uranium (resource)	4.148E-09
Renewable energy resources	8.865E-09
Biomass	3.859E-10
Renewable fuels	5.397E-12
Wood	8.473E-09

Process or Category	Cradle to Gate (RMA)
Unspecified	0.000E+00
Land use	0.000E+00
Material resources	8.875E-02
Non renewable elements	3.361E-07
Aluminum	8.591E-12
Chromium	2.496E-14
Copper	1.053E-14
Iron	3.342E-07
Lead	1.497E-14
Magnesium	2.918E-17
Mercury	7.510E-15
Nickel	9.533E-17
Phosphorus	2.916E-12
Sulphur	2.567E-11
Zinc	1.860E-09
Non renewable resources	1.720E-03
Barium sulphate	2.378E-17
Basalt	1.339E-07
Bauxite	4.134E-07
Bentonite	3.136E-06
Calcium carbonate (CaCO ₃)	5.591E-08
Calcium chloride	2.434E-15
Chalk (Calcium carbonate)	5.100E-41
Chromium ore (39%)	3.595E-09
Clay	4.002E-07
Colemanite ore	5.623E-10
Copper - Gold - Silver - ore (1,0% Cu; 0,4 g/t Au; 66 g/t Ag)	2.941E-08
Copper - Gold - Silver - ore (1,1% Cu; 0,01 g/t Au; 2,86 g/t Ag)	1.792E-08
Copper - Gold - Silver - ore (1,16% Cu; 0,002 g/t Au; 1,06 g/t Ag)	1.011E-08
Copper - Molybdenum - Gold - Silver - ore (1,13% Cu; 0,02% Mo; 0,01 g/t Au; 2,86 g/t Ag)	5.879E-09
Copper ore (0.14%)	1.102E-07
Copper ore (1.2%)	3.050E-09
Copper ore (4%)	1.600E-18
Copper ore (sulphidic, 1.1%)	3.834E-09
Dolomite	1.438E-07
Feldspar (aluminum silicates)	2.057E-12
Ferro manganese	4.540E-15
Fluorspar (calcium fluoride; fluorite)	3.074E-09

Process or Category	Cradle to Gate (RMA)
Granite	5.708E-22
Gravel	2.961E-07
Gypsum (natural gypsum)	1.405E-07
Heavy spar (BaSO ₄)	7.584E-06
Ilmenite (titanium ore)	5.490E-13
Inert rock	1.628E-03
Iron ore (56,86%)	4.189E-05
Iron ore (65%)	6.827E-10
Kaolin ore	1.008E-09
Lead - zinc ore (4.6%-0.6%)	6.278E-07
Limestone (calcium carbonate)	2.297E-05
Magnesit (Magnesium carbonate)	2.878E-12
Magnesium chloride leach (40%)	4.295E-07
Manganese ore	7.007E-10
Manganese ore (R.O.M.)	3.296E-07
Molybdenite (Mo 0,24%)	3.599E-09
Molybdenum ore (0.1%)	3.859E-11
Natural Aggregate	6.243E-06
Nickel ore (1,5%)	6.601E-11
Nickel ore (1.6%)	1.161E-06
Olivine	4.732E-14
Peat	3.170E-07
Phosphate ore	1.578E-11
Phosphorus minerals	4.030E-09
Phosphorus ore (29% P ₂ O ₅)	4.128E-14
Potassium chloride	6.188E-11
Precious metal ore (R.O.M)	1.715E-10
Quartz sand (silica sand; silicon dioxide)	8.595E-07
Raw pumice	9.757E-11
Rutile (titanium ore)	7.562E-13
sand	6.950E-12
Slate	1.002E-13
Sodium chloride (rock salt)	2.680E-06
Sodium nitrate	2.848E-21
Sodium sulphate	2.466E-11
Soil	1.938E-06
Sulphur (bonded)	1.070E-13
Talc	1.793E-11

Process or Category	Cradle to Gate (RMA)
Tin ore	2.062E-18
Titanium ore	1.030E-08
Zinc - copper ore (4.07%-2.59%)	1.164E-07
Zinc - lead - copper ore (12%-3%-2%)	5.313E-08
Zinc - lead ore (4.21%-4.96%)	5.464E-19
Zinc ore (4%)	-6.036E-08
Zinc ore (sulphidic, 4%)	9.298E-18
Renewable resources	8.703E-02
Water	6.933E-02
Water (ground water)	3.362E-02
Water (lake water)	2.708E-07
Water (municipal)	2.413E-07
Water (sea water)	2.283E-05
Water (surface water)	3.557E-02
Water (well water)	2.067E-08
Water (well-produced water)	1.197E-04
Water (with river silt)	2.093E-16
Air	1.769E-02
Carbon dioxide	3.661E-06
Nitrogen	6.565E-10
Oxygen	0.000E+00
Unspecified	2.465E-09
Unspecified minerals	5.608E-10
Unspecified resources	1.904E-09
Area of Production Land	0.000E+00
Output	
Flows	1.029E-01
Resources	3.520E-02
Energy resources	0.000E+00
Land use	0.000E+00
Material resources	3.520E-02
Renewable resources	3.520E-02
Water	3.520E-02
Water (feed water)	3.851E-07
Water (river water)	3.454E-02
Water (wastewater)	1.305E-04

Process or Category	Cradle to Gate (RMA)
Water (wastewater)	5.314E-04
Nitrogen	0.000E+00
Oxygen	1.959E-06
Ecoinvent	6.345E-07
Long-term emission	6.345E-07
Fresh water	6.345E-07
Chloride	6.345E-07
Dissolved organic carbon, DOC (Ecoinvent)	1.019E-13
Production residues in life cycle	1.964E-05
Hazardous waste for disposal	1.166E-07
Chromium containing slag	3.836E-12
Dross (Fines)	7.732E-10
Sodium oxide	1.314E-09
Red mud (dry)	1.142E-07
Soil and sand containing heavy metals	1.933E-10
Toxic chemicals (unspecified)	1.341E-10
Hazardous waste for recovery	2.897E-06
Used oil	2.131E-10
Waste water processing residue	2.897E-06
Waste for disposal	1.392E-05
Incineration good	7.370E-11
Sludge from water works (6% dry matter-content)	3.805E-12
Waste (solid)	1.558E-07
Waste for disposal (unspecified)	7.441E-08
Waste from steel works	1.369E-05
Waste for recovery	2.700E-06
Aluminum scrap	1.445E-15
Chemicals (unspecified)	3.979E-11
Cooling water	1.895E-06
Cryolite	3.604E-10
Dross	2.159E-10
Filter dust	6.089E-13
Furnace clinker	1.522E-13
Gypsum (contaminated)	2.428E-17
Gypsum (FDI)	4.850E-13
Plastic (unspecified)	7.609E-11
Production residues (unspecified)	6.180E-13
Rolling gravel	7.694E-08

Process or Category	Cradle to Gate (RMA)
Rolling tinder	8.524E-14
Slag	5.707E-07
Slag (containing precious metal)	5.631E-14
Slag (Iron plate production)	1.276E-09
Slag (Mn 6,5%)	1.556E-07
Waste paper	9.599E-14
Wood	1.254E-13
Wooden pallet (EURO)	2.238E-19
Mixed Waste (Hazardous or Radioactive)	3.044E-09
Neutralized residues	8.842E-14
Emissions to air	2.456E-02
Heavy metals to air	2.239E-09
Antimony	2.564E-12
Arsenic (+V)	2.717E-11
Arsenic trioxide	4.215E-16
Cadmium (+II)	4.409E-12
Chromium (+III)	1.092E-13
Chromium (+VI)	8.659E-17
Chromium (unspecified)	4.141E-11
Cobalt	8.836E-12
Copper (+II)	2.209E-11
Heavy metals to air (unspecified)	2.681E-13
Hydrogen arsenic (arsine)	3.499E-14
Iron	5.154E-11
Lanthanides	9.649E-16
Lead (+II)	1.934E-10
Manganese (+II)	5.933E-11
Mercury (+II)	2.860E-11
Molybdenum	3.943E-12
Nickel (+II)	1.305E-10
Palladium	6.739E-20
Rhodium	6.505E-20
Selenium	5.583E-11
Silver	8.842E-20
Tellurium	1.456E-14
Thallium	4.527E-13
Tin (+IV)	1.911E-11
Titanium	6.161E-14

Process or Category	Cradle to Gate (RMA)
Vanadium (+III)	1.058E-09
Zinc (+II)	5.309E-10
Inorganic emissions to air	1.080E-02
Ammonia	1.583E-06
Ammonium	1.574E-14
Ammonium nitrate	6.275E-16
Argon	1.631E-13
Barium	4.838E-09
Beryllium	5.110E-13
Boron compounds (unspecified)	6.542E-10
Bromine	1.864E-10
Carbon dioxide	7.363E-03
Carbon dioxide (biotic)	1.153E-11
Carbon dioxide (biotic)	7.952E-07
Carbon disulphide	1.432E-14
Carbon monoxide	3.798E-05
Carbon monoxide (biotic)	7.025E-14
Chloride (unspecified)	8.828E-10
Chlorine	4.559E-12
Cyanide (unspecified)	2.368E-11
Fluoride	5.735E-10
Fluorides	1.512E-12
Fluorine	2.881E-14
Helium	5.741E-12
Hydrogen	2.439E-09
Hydrogen bromine (hydrobromic acid)	1.244E-12
Hydrogen chloride	1.303E-08
Hydrogen cyanide (prussic acid)	5.350E-13
Hydrogen fluoride	1.164E-09
Hydrogen iodide	1.274E-15
Hydrogen phosphorous	2.199E-15
Hydrogen sulphide	1.173E-08
Lead dioxide	1.251E-13
Nitrogen (atmospheric nitrogen)	2.866E-07
Nitrogen (N-compounds)	3.189E-14
Nitrogen dioxide	2.495E-05
Nitrogen monoxide	2.331E-11
Nitrogen oxides	2.087E-05

Process or Category	Cradle to Gate (RMA)
Nitrous oxide (laughing gas)	7.127E-06
Oxygen	7.488E-07
Scandium	4.577E-16
Steam	3.340E-03
Strontium	1.825E-14
Sulphur dioxide	6.397E-06
Sulphur hexafluoride	2.042E-10
sulphur oxide	1.898E-09
Sulphuric acid	2.496E-12
Tin oxide	2.813E-17
Unspecified Particles	4.590E-09
Zinc oxide	5.627E-17
Zinc sulphate	8.807E-13
Organic emissions to air (group VOC)	1.620E-04
Group NMVOC to air	1.759E-06
Group PAH to air	2.872E-10
Anthracene	9.040E-14
Benzo(a)anthracene	4.549E-14
Benzo(a)pyrene	1.273E-11
Benzo(ghi)perylene	4.058E-14
Benzofluoranthene	8.116E-14
Chrysene	1.117E-13
Dibenz(a)anthracene	2.529E-14
Indeno[1,2,3-cd]pyrene	3.019E-14
Naphthalene	9.494E-12
Phenanthrene	2.982E-12
Polycyclic aromatic hydrocarbons (PAH)	2.616E-10
Halogenated organic emissions to air	9.890E-11
Dichloroethane (ethylene dichloride)	4.422E-15
Dichloromethane (methylene chloride)	3.455E-16
Dioxins (unspec.)	2.127E-17
Halogenated hydrocarbons (unspecified)	3.913E-14
Polychlorinated biphenyls (PCB unspecified)	7.686E-14
Polychlorinated dibenzo-p-dioxins (2,3,7,8 - TCDD)	5.383E-17
R 11 (trichlorofluoromethane)	3.025E-11
R 114 (dichlorotetrafluoroethane)	3.098E-11
R 116 (hexafluoroethane)	1.407E-12
R 12 (dichlorodifluoromethane)	6.503E-12

Process or Category	Cradle to Gate (RMA)
R 13 (chlorotrifluoromethane)	4.083E-12
R 22 (chlorodifluoromethane)	7.108E-12
Tetrafluoromethane	1.296E-11
Vinyl chloride (VCM; chloroethene)	5.492E-12
Acetaldehyde (Ethanal)	2.609E-09
Acetic acid	1.049E-08
Acetone (dimethylcetone)	2.599E-09
Acrolein	6.379E-13
Aldehyde (unspecified)	1.264E-11
Alkane (unspecified)	1.096E-08
Alkene (unspecified)	1.299E-09
Aromatic hydrocarbons (unspecified)	1.017E-09
Benzene	2.254E-09
Butadiene	1.336E-14
Butane	8.555E-08
Butane (n-butane)	2.531E-09
Caprolactam	1.820E-14
Cumene (isopropylbenzene)	5.404E-21
Cyclohexane (hexahydro benzene)	2.125E-13
Diethylamine	3.394E-19
Ethane	2.703E-07
Ethanol	5.104E-09
Ethene (ethylene)	1.882E-11
Ethyl benzene	8.013E-10
Fluoranthene	2.944E-13
Fluorene	9.343E-13
Formaldehyde (methanal)	1.010E-08
Heptane (isomers)	1.990E-09
Hexamethylene diamine (HMDA)	7.860E-16
Hexane (isomers)	3.194E-09
Mercaptan (unspecified)	7.246E-11
Methanethiol	1.167E-10
Methanol	5.085E-09
NM VOC (unspecified)	9.337E-07
Octane	1.095E-09
Pentane (n-pentane)	3.640E-08
Phenol (hydroxy benzene)	8.855E-15
Propane	3.678E-07

Process or Category	Cradle to Gate (RMA)
Propene (propylene)	7.190E-11
Propionic acid (propane acid)	1.690E-13
Styrene	3.127E-16
Toluene (methyl benzene)	3.977E-10
Trimethylbenzene	2.740E-16
Xylene (dimethyl benzene)	3.335E-09
Hydrocarbons (unspecified)	4.534E-10
Methane	1.598E-04
Methane (biotic)	1.228E-10
Organic chlorine compounds	4.829E-14
Unspecified Organic Compounds	3.190E-15
VOC (unspecified)	4.335E-07
Other emissions to air	1.350E-02
Aldehydes, unspecified	1.595E-15
Exhaust	7.692E-03
Particulate Matter, unspecified	1.145E-08
Sand (Silica) (SiO ₂)	3.041E-11
Used air	5.808E-03
Particles to air	9.483E-05
Dust (PM ₁₀)	3.194E-08
Dust (PM _{2,5} - PM ₁₀)	8.150E-14
Dust (PM _{2.5})	5.760E-08
Dust (Portland cement kiln)	7.611E-08
Dust (unspecified)	9.466E-05
Metals (unspecified)	1.326E-13
Unspecified Organic Chlorine Compounds	2.105E-14
Wood (dust)	1.038E-14
Radioactive emissions to air	3.539E-11
Uranium (total)	3.539E-11
Unspecified Heavy Metals	1.644E-18
Emissions to fresh water	4.314E-02
Analytical measures to fresh water	2.852E-02
Adsorbable organic halogen compounds (AOX)	6.779E-10
Biological oxygen demand (BOD)	2.938E-08
Chemical oxygen demand (COD)	2.280E-07
Nitrogenous Matter (unspecified, as N)	1.416E-09
Solids (dissolved)	2.852E-02
Total dissolved organic bounded carbon	8.574E-09

Process or Category	Cradle to Gate (RMA)
Total Dissolved Solids	7.940E-07
Total organic bounded carbon	1.354E-08
Heavy metals to fresh water	2.119E-05
Aluminium	4.322E-07
Antimony	3.829E-09
Arsenic (+V)	5.698E-08
Cadmium (+II)	1.271E-09
Chromium (+III)	1.036E-11
Chromium (+VI)	2.277E-14
Chromium (unspecified)	2.241E-08
Cobalt	6.416E-13
Copper (+II)	6.374E-08
Heavy metals to water (unspecified)	4.986E-11
Iron	1.521E-05
Lead (+II)	5.904E-08
Manganese (+II)	3.950E-06
Mercury (+II)	2.110E-10
Molybdenum	9.261E-11
Nickel (+II)	5.559E-07
Selenium	3.636E-08
Silver	3.740E-09
Strontium	2.969E-09
Thallium	1.488E-14
Tin (+IV)	1.963E-12
Titanium	9.596E-12
Unspecified Substance	1.422E-14
Uranium	2.037E-07
Vanadium (+III)	3.561E-11
Zinc (+II)	5.881E-07
Inorganic emissions to fresh water	1.375E-02
Acid (calculated as H+)	1.171E-10
Aluminum (+III)	8.110E-07
Ammonia	1.268E-09
Ammonia, as N	1.347E-11
Ammonium (total N)	4.678E-06
Ammonium / ammonia	1.248E-05
Barium	3.391E-08
Beryllium	1.068E-13

Process or Category	Cradle to Gate (RMA)
Boron	1.072E-09
Bromate	4.574E-16
Bromine	1.860E-13
Calcium (+II)	2.747E-07
Carbonate	2.746E-07
Chlorate	4.226E-13
Chloride	6.456E-06
Chlorine (dissolved)	7.395E-09
Copper ion (+II/+III)	1.784E-15
Cyanide	3.479E-08
Fluoride	4.126E-07
Fluorine	5.699E-12
Hydrogen chloride	1.159E-13
Hydrogen fluoride (hydrofluoric acid)	2.479E-13
Hydrogen Ions (H+)	3.174E-12
Hydroxide	2.506E-10
Inorganic salts and acids (unspecified)	3.269E-19
Iron ion (+II/+III)	4.113E-11
Magnesium (+III)	3.517E-08
Magnesium chloride	1.833E-14
Metal ions (unspecific)	2.890E-10
Neutral salts	6.100E-13
Nickel ion (+III)	1.007E-14
Nitrate	1.470E-06
Nitrate (as total N)	5.099E-14
Nitrogen	2.946E-05
Nitrogen (as total N)	6.275E-10
Nitrogen organic bounded	5.546E-09
Phosphate	2.085E-09
Phosphorus	7.048E-07
Potassium	1.073E-10
Silicate particles	3.853E-11
Sodium (+I)	1.051E-06
Sodium chloride (rock salt)	6.613E-07
Sodium hypochlorite	1.354E-12
Sulfates	4.962E-08
Sulphate	1.369E-02
Sulphide	7.379E-09

Process or Category	Cradle to Gate (RMA)
Sulphite	2.749E-10
Sulphur	5.559E-11
Sulphuric acid	1.494E-11
Unspecified Iron Oxides	3.641E-14
Unspecified Oil	1.290E-13
Unspecified Organic Chlorine compounds	2.923E-16
Unspecified Salt	1.170E-12
Unspecified Solids (Suspended)	4.541E-12
Organic emissions to fresh water	1.345E-06
Halogenated organic emissions to fresh water	3.302E-13
1,2-Dibromoethane	4.993E-17
Chlorinated hydrocarbons (unspecified)	1.709E-14
Chloromethane (methyl chloride)	3.118E-13
Dichloroethane (ethylene dichloride)	1.850E-16
Dichloropropane	6.309E-19
Polychlorinated dibenzo-p-dioxins (2,3,7,8 - TCDD)	6.030E-19
Vinyl chloride (VCM; chloroethene)	1.084E-15
Hydrocarbons to fresh water	1.335E-06
Acenaphthene	1.274E-13
Acenaphthylene	5.167E-14
Acetic acid	2.307E-10
Acrylonitrile	4.614E-14
Anthracene	1.912E-13
Aromatic hydrocarbons (unspecified)	9.815E-11
Benzene	2.518E-10
Benzo{a}anthracene	1.716E-14
Benzofluoranthene	8.938E-15
Chrysene	7.624E-14
Cresol (methyl phenol)	1.440E-12
Ethyl benzene	1.252E-11
Fluoranthene	2.575E-14
Hexane (isomers)	1.572E-13
Hydrocarbons (unspecified)	9.136E-10
Methanol	1.093E-06
Oil (unspecified)	2.402E-07
Phenol (hydroxy benzene)	2.939E-10
Polycyclic aromatic hydrocarbons (PAH, unspec.)	9.057E-11
Toluene (methyl benzene)	1.530E-10

Process or Category	Cradle to Gate (RMA)
Xylene (isomers; dimethyl benzene)	6.644E-11
Carbon, organically bound	9.520E-09
Naphthalene	7.484E-12
N-unspecified (N)	1.010E-13
Organic chlorine compounds (unspecified)	7.339E-15
Organic compounds (dissolved)	2.665E-12
Organic compounds (unspecified)	8.635E-13
Unspecified wastewater	7.634E-11
Other emissions to fresh water	0.000E+00
Particles to fresh water	8.430E-04
Metals (unspecified)	7.852E-13
Silicon dioxide (silica)	5.337E-13
Soil loss by erosion into water	4.252E-12
Solids (suspended)	8.430E-04
Suspended solids, unspecified	2.891E-09
Unspecified Oxides	3.027E-14
Radioactive emissions to fresh water	0.000E+00
Bromide	0.000E+00
Radionuclide	0.000E+00
Sulfite	0.000E+00
Unspecified Solids (Dissolved)	8.752E-12
Uranium (total)	1.893E-14
Emissions to sea water	2.616E-05
Analytical measures to sea water	4.931E-08
Adsorbable organic halogen compounds (AOX)	1.981E-15
Biological oxygen demand (BOD)	2.185E-09
Chemical oxygen demand (COD)	4.494E-08
Total organic bounded carbon	2.185E-09
Heavy metals to sea water	9.353E-09
Arsenic (+V)	1.240E-10
Cadmium (+II)	6.219E-11
Chromium (unspecified)	2.234E-10
Cobalt	1.083E-10
Copper (+II)	2.981E-10
Iron	1.561E-09
Lead (+II)	7.196E-11
Manganese (+II)	1.619E-10
Mercury (+II)	1.480E-12

Process or Category	Cradle to Gate (RMA)
Molybdenum	1.456E-11
Nickel (+II)	1.407E-10
Silver	5.332E-12
Strontium	4.337E-09
Tin (+IV)	6.387E-12
Titanium	6.505E-13
Vanadium (+III)	7.506E-11
Zinc (+II)	2.160E-09
Inorganic emissions to sea water	2.435E-05
Aluminum (+III)	2.094E-11
Ammonia	6.223E-10
Barium	4.783E-09
Beryllium	6.088E-12
Boron	3.386E-10
Calcium (+II)	3.698E-08
Carbonate	3.005E-07
Chloride	2.377E-05
Magnesium	9.308E-09
Nitrate	3.900E-10
Sodium (+I)	4.363E-08
Sulphate	1.279E-07
Sulphide	5.447E-08
Sulphur	1.812E-10
Organic emissions to sea water	1.440E-08
Hydrocarbons to sea water	1.424E-08
Acenaphthene	4.954E-12
Acenaphthylene	1.889E-12
Acetic acid	1.233E-11
Anthracene	1.370E-12
Aromatic hydrocarbons (unspecified)	2.185E-11
Benzene	1.140E-09
Benzo{a}anthracene	1.106E-12
Benzo{fluoranthene	1.223E-12
Chrysene	6.236E-12
Cresol (methyl phenol)	4.693E-12
Ethyl benzene	1.340E-10
Fluoranthene	1.291E-12
Hexane (isomers)	5.124E-13

Process or Category	Cradle to Gate (RMA)
Oil (unspecified)	9.547E-09
Phenol (hydroxy benzene)	2.079E-09
Toluene (methyl benzene)	6.785E-10
Xylene (isomers; dimethyl benzene)	6.000E-10
Naphthalene	1.625E-10
Particles to sea water	1.739E-06
Solids (suspended)	1.739E-06
Emissions to agricultural soil	0.000E+00
Emissions to industrial soil	6.555E-06
Heavy metals to industrial soil	6.457E-06
Antimony	7.457E-21
Arsenic (+V)	3.561E-09
Cadmium (+II)	5.500E-13
Chromium (+III)	3.351E-13
Chromium (+VI)	2.702E-20
Chromium (unspecified)	9.670E-11
Cobalt	1.717E-12
Copper (+II)	1.309E-12
Iron	6.372E-06
Lead (+II)	2.546E-08
Manganese (+II)	2.080E-11
Mercury (+II)	6.587E-11
Nickel (+II)	3.015E-11
Selenium	4.230E-10
Strontium	3.223E-08
Thallium	3.079E-09
Vanadium (+III)	1.944E-08
Zinc (+II)	1.205E-11
Inorganic emissions to industrial soil	9.777E-08
Aluminum (+III)	1.085E-10
Ammonia	5.079E-08
Bromide	1.471E-11
Calcium (+II)	3.328E-10
Chloride	1.719E-08
Chlorine	6.304E-18
Fluoride	4.905E-10
Magnesium (+III)	4.615E-11
Phosphorus	5.242E-09

Process or Category	Cradle to Gate (RMA)
Potassium (+I)	1.235E-08
Sodium (+I)	2.908E-11
Sulphate	1.597E-09
Sulphide	9.583E-09
Organic emissions to industrial soil	2.197E-10
Oil (unspecified)	2.197E-10
Radioactive emissions to industrial soil	0.000E+00
Calcium Fluoride	4.863E-10
Radionuclide	0.000E+00

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