



NETL Life Cycle Inventory Data

Process Documentation File

Process Name: Illinois No. 6 Coal, Extraction

Reference Flow: 1 kg of Illinois No. 6 Coal

Brief Description: This process includes all inputs for the raw material acquisition for 1 kg of extracted Illinois No. 6 bituminous coal.

Section I: Meta Data

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

Year Data Best Represents: 2006

Process Type: Extraction Process (EP)

Process Scope: Cradle-to-Gate Process (CG)

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:

Coal_mine_methane *The amount of methane released during extraction and processing of the coal*

Tracked Input Flows:

I6 Commissioning *The energy required for the commissioning and decommissioning of the mine*

Hard Coal (Illinois No. 6) *Coal, including mine operations, energy, and water requirements*

Coal Preparation Facility *Construction of a coal preparation facility*

Underground coal mine *Construction of the underground coal mine*

Energy Resources *Energy required for RMA of Illinois No. 6 coal*



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Tracked Output Flows:

Illinois No. 6 Coal

Extracted Illinois No. 6 coal

Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_RMA_IllinoisNo6_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 seen in **Figure 1**. At the end, one kilogram of coal is extracted and stops at the life cycle (LC) Stage #2 boundary.

Boundary and Description

LC Stage #1, raw material acquisition of bituminous coal, includes the construction of an Illinois No. 6 (I-6) coal mine and the required operation equipment, the operation of the coal mine, and the commissioning and decommissioning of the mine. The mine was modeled based on the Galatia Mine in Galatia, Illinois, an underground mine producing I-6 bituminous coal.

Each of the processes included in RMA for I-6 coal includes upstream processes (for example, diesel fuel or steel). Coal mine construction includes individual construction unit processes for key equipment, which are aggregated within the model as described below. The plan for RMA of I-6 coal is provided in **Figure 1**.

Coal mine commissioning and decommissioning both integrate diesel and gasoline use during commissioning and decommissioning of the I-6 mine. Due to lack of available data, coal mine decommissioning was assumed to require 10 percent of the commissioning inputs. The coal mine operation includes energy from the power grid and diesel use for operating the mine and mine equipment. Coal mine methane emission rate is an adjustable parameter in this process.

Figure 1: Plan for RMA of Illinois No. 6 Coal, Including Operation, Construction, and Commissioning/Decommissioning Profiles

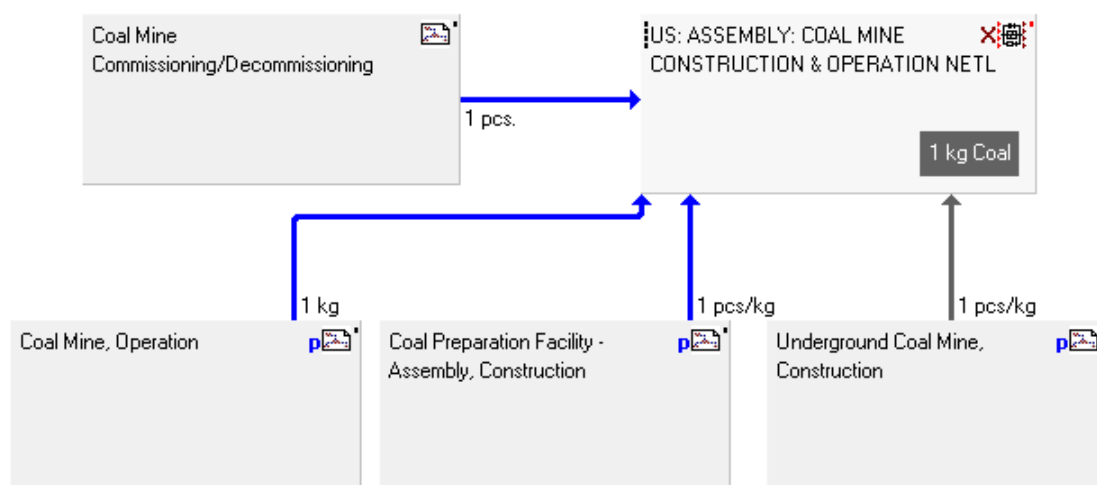
Stage #1: Hard Coal Material (Illinois #6)

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ASSEMBLY OF COAL MINE CONSTRUCTION AND OPERATION BASED ON ONE KG OF COAL PRODUCTION.

- o Boundary begins with the opening of the coal mine and the extraction of the coal.
- o Boundary ends when the processed coal is loaded onto a railcar for transport to the CTL facility.

Adj: 1. Methane (CBM = 360)
2. Mining Time = 30 yrs
3. Coal Production = 5,998,926 tons/yr



The construction process is broken down into two main sub-processes: 1) the construction of the coal preparation facility, which consists of the above-ground processing and sizing components of the mine, and 2) the construction of the underground mine and extraction machinery. The coal preparation facility process includes the following construction unit processes:

- Coal cleaning facility
(DS/DF_Stage1_C_Coal_Cleaning_Facility_2010.01)
- Coal crusher facility
(DS/DF_Stage1_C_Coal_Crusher_Facility_2010.01)
- Coal loading silo
(DS/DF_Stage1_C_Steel_Coal_Loading_Silo_325_Tons_2010.01)
- Coal mine wastewater treatment plant
(DS/DF_Stage1_C_Wastewater_Treatment_Plant_Underground_Coal_Mine_2010.01)
- Stacker reclaimer
(DS/DF_Stage1_C_Coal_Stockpile_Stacker_2010.01)

- All site work
(DS/DF_Stage1_C_CoalMineSite_I6_2010.01)

The underground mine includes the following construction unit processes:

- Continuous miner
(DS/DF_Stage1_C_Continuous_Miner_755_HP_2010.01)
- Conveyor system
(DS/DF_Stage1_C_Conveyor_System_48_Inch_2010.01)
- Longwall miner system
(DS/DF_Stage1_C_Assembly_Longwall_Mining_System_2010.01)
- Shuttle car
(DS/DF_Stage1_C_Shuttle_Car_2010.01)

Each piece of equipment is scaled to correspond to the role it performs in a functioning coal mine, with the equipment's expected lifetime taken into account 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 Illinois No. 6 Coal

Stage #1: Hard Coal Material (Illinois #6)

Coal Mine Commissioning/Decommissioning

US: Commissioning and Decommissioning of Illinois No. 6 Coal Mine NETL <u-so>

US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>

US: GASOLINE, NATIONAL AVERAGE, 2009 NETL <u-so>

Coal Mine, Operation

North American Average Electricity Mix, 2007 NETL

US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>

US: Underground Mine, Illinois No. 6 Bituminous Coal, Operation <u-so>

Coal Preparation Facility - assembly, Construction

Coal Cleaning Facility, Construction

DE: Stainless steel cold roll PE

DE: Zinc redistilled mix PE

North American Average Electricity Mix, 2007 NETL

US: Coal Cleaning Facility, Construction NETL

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

WOR: Rebar Wire Rod, BF Manufactures NETL

Coal Crusher Facility, Construction

North American Average Electricity Mix, 2007 NETL

US: Coal Crusher Facility, Construction NETL

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

WOR: Rebar Wire Rod, BF Manufactures NETL

WOR: Steel Plate, BF, Manufacture NETL <u-so>
 Coal Loading Silo, Construction
 DE: Steel cold rolled PE
 US: Steel Coal-Loading Silo, 325 Tons, Construction NETL <u-so>
 Coal Mine Wastewater Treatment Plant, Construction
 BF: Hot-dip Galvanized NETL
 DE: Cast iron part PE <p-agg>
 DE: Copper mix PE
 North American Average Electricity Mix, 2007 NETL
 RER: Polyvinylchloride pipe (PVC) PlasticsEurope
 US: Concrete, ready mixed, R-5-0 (100% Portland Cement) NETL <u-so>
 US: Thermal energy from heavy fuel oil PE
 US: Wastewater Treatment Plant, Underground Coal Mine, Construction NETL <u-so>
 WOR: Steel, Stainless, 316 2B, 80% Recycled NETL <u-so>
 Stack Reclaimer, Construction
 US: Coal Stockpile Stack, 450 Tonnes, Construction NETL <u-so>
 WOR: Steel Plate, BF, Manufacture NETL <u-so>
US: Illinois No. 6 Coal Preparation Facility Assembly, Construction NETL <u-so>
 Underground Coal Mine, Construction
 Continuous Miner, Construction
 US: Continuous Miner, 755 Horsepower, Construction NETL <u-so>
 WOR: Steel Plate, BF, Manufacture NETL <u-so>
 Conveyor System, Construction
 BF: Hot-dip Galvanized NETL
 DE: Steel cold rolled PE
 DE: Styrene-butadiene rubber mix (SBR) PE
 US: Conveyor System, 48 Inches, Construction <u-so>
 Longwall Miner System, Construction
 US: Longwall Miner System, Construction NETL
 WOR: Steel Plate, BF, Manufacture NETL <u-so>
 Shuttle Car, Construction
 DE: Steel cold rolled PE
 US: Shuttle Car, Construction NETL
 Site Paving, Construction
 GAB II, ASPHALT (Medium water content)
 DK: GAB II, ASPHALT (Medium water content)
 DK: Gravel round: at mine/CH S NETL
 EU-15: Bitumen at refinery PE
 North American Average Electricity Mix, 2007 NETL
 US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
 US: Natural Gas RMA/RMT, Mix Nominal, 060911 NETL
 North American Average Electricity Mix, 2007 NETL

US: Concrete, ready mixed, R-5-0 (100% Portland Cement) NETL <u-so>
 US: Illinois No. 6 Underground Bituminous Coal Mine Site, Construction NETL <u-so>

US: Underground Coal Mine, Construction NETL

US: ASSEMBLY: COAL MINE CONSTRUCTION & OPERATION NETL

Parameters and Balances

The parameters for the highest level modeling plans for RMA of I-6 bituminous 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 Illinois No. 6 Coal

Plan	Parameter	Value	Comment
LC Stage #1			
Stage #1: Hard Coal Material (Illinois #6)	S1_CBM	360	[scf/ton coal] Average methane emissions from Galatia mine
Stage #1: Hard Coal Material (Illinois #6)	S1_COAL_PRO_YR	6E+09	[kg/yr] Coal production from Galatia Mine. See coal mine operation sheet.
Stage #1: Hard Coal Material (Illinois #6)	S1_MINE_OP_TIME	30	[years] Coal mine will be operated for X years.

Table 3: Inputs and Output Balances for RMA of Illinois No. 6 Coal (kg/kg delivered)

Process or Category	Cradle to Gate (RMA)
Inputs	
Flows	1.169E+00
Resources	1.169E+00
Energy resources	1.791E-02
Non renewable energy resources	1.791E-02
Crude oil (resource)	3.968E-04
Hard coal (resource)	1.474E-02
Lignite (resource)	7.752E-06
Natural gas (resource)	2.761E-03
Uranium (resource)	6.281E-10
Renewable energy resources	4.203E-08
Biomass	3.525E-09
Renewable fuels	8.401E-13
Wood	3.851E-08
Unspecified	0.000E+00
Land use	0.000E+00

Process or Category	Cradle to Gate (RMA)
Material resources	1.151E+00
Non renewable elements	6.081E-06
Aluminum	1.923E-10
Chromium	3.717E-13
Copper	9.725E-12
Iron	6.047E-06
Lead	3.327E-13
Magnesium	1.139E-16
Mercury	3.053E-13
Nickel	4.595E-15
Phosphorus	1.143E-11
Sulphur	1.234E-11
Zinc	3.366E-08
Non renewable resources	2.763E-03
Barium sulphate	5.914E-18
Basalt	1.075E-07
Bauxite	1.880E-06
Bentonite	1.239E-06
Calcium carbonate (CaCO ₃)	1.251E-06
Calcium chloride	6.055E-16
Chalk (Calciumcarbonate)	2.799E-38
Chromium ore (39%)	1.622E-06
Clay	4.267E-07
Colemanite ore	7.386E-09
Copper - Gold - Silver - ore (1,0% Cu; 0,4 g/t Au; 66 g/t Ag)	8.642E-07
Copper - Gold - Silver - ore (1,1% Cu; 0,01 g/t Au; 2,86 g/t Ag)	5.264E-07
Copper - Gold - Silver - ore (1,16% Cu; 0,002 g/t Au; 1,06 g/t Ag)	2.972E-07
Copper - Molybdenum - Gold - Silver - ore (1,13% Cu; 0,02% Mo; 0,01 g/t Au; 2,86 g/t Ag)	9.874E-08
Copper ore (0.14%)	1.382E-06
Copper ore (1.2%)	8.962E-08
Copper ore (4%)	6.029E-18
Copper ore (sulphidic, 1.1%)	8.580E-08
Dolomite	7.160E-06
Feldspar (aluminum silicates)	7.992E-12
Ferro manganese	1.628E-13
Fluorspar (calcium fluoride; fluorite)	1.413E-08
Granite	2.291E-20
Gravel	1.065E-03

Process or Category	Cradle to Gate (RMA)
Gypsum (natural gypsum)	2.667E-07
Heavy spar (BaSO ₄)	2.969E-06
Ilmenite (titanium ore)	1.868E-11
Inert rock	7.972E-04
Iron ore (56,86%)	6.538E-04
Iron ore (65%)	1.541E-07
Kaolin ore	1.326E-08
Lead - zinc ore (4.6%-0.6%)	3.003E-07
Limestone (calcium carbonate)	1.642E-04
Magnesit (Magnesium carbonate)	7.933E-12
Magnesium chloride leach (40%)	4.160E-08
Manganese ore	1.049E-08
Manganese ore (R.O.M.)	9.450E-07
Molybdenite (Mo 0,24%)	6.029E-08
Molybdenum ore (0.1%)	2.321E-09
Natural Aggregate	4.454E-05
Nickel ore (1,5%)	9.616E-07
Nickel ore (1.6%)	4.031E-06
Olivine	1.683E-12
Peat	9.756E-09
Phosphate ore	5.101E-12
Phosphorus minerals	3.117E-08
Phosphorus ore (29% P ₂ O ₅)	3.273E-13
Potassium chloride	4.395E-10
Precious metal ore (R.O.M)	1.270E-08
Quartz sand (silica sand; silicon dioxide)	1.938E-06
Raw pumice	1.286E-09
Rutile (titanium ore)	2.416E-13
sand	8.224E-11
Slate	1.062E-12
Sodium chloride (rock salt)	3.162E-06
Sodium nitrate	1.431E-18
Sodium sulphate	2.164E-12
Soil	9.448E-06
Sulphur (bonded)	1.454E-13
Talc	2.236E-10
Tin ore	5.129E-19
Titanium ore	2.428E-08

Process or Category	Cradle to Gate (RMA)
Zinc - copper ore (4.07%-2.59%)	3.198E-07
Zinc - lead - copper ore (12%-3%-2%)	2.157E-07
Zinc - lead ore (4.21%-4.96%)	2.059E-18
Zinc ore (4%)	-3.671E-06
Zinc ore (sulphidic, 4%)	3.019E-17
Renewable resources	1.148E+00
Water	1.145E+00
Water	5.385E-04
Water (ground water)	3.853E-01
Water (lake water)	6.286E-06
Water (municipal)	5.602E-06
Water (sea water)	5.507E-06
Water (surface water)	7.560E-01
Water (well water)	1.648E-07
Water (well-produced water)	2.788E-03
Water (with river silt)	1.539E-17
Air	3.743E-03
Carbon dioxide	2.942E-06
Nitrogen	9.647E-09
Oxygen	0.000E+00
Unspecified	5.517E-08
Unspecified minerals	1.255E-08
Unspecified resources	4.262E-08
Area of Production Land	0.000E+00
Output	
Flows	1.765E+00
Resources	1.724E+00
Energy resources	0.000E+00
Land use	0.000E+00
Material resources	1.724E+00
Renewable resources	1.724E+00
Water	1.724E+00
Water (feed water)	1.236E-05
Water (river water)	1.709E+00
Water (wastewater)	2.791E-03
Water (wastewater)	1.234E-02

Process or Category	Cradle to Gate (RMA)
Nitrogen	0.000E+00
Oxygen	1.689E-06
Ecoinvent	2.282E-03
Long-term emission	2.282E-03
Fresh water	2.282E-03
Chloride	2.282E-03
Dissolved organic carbon, DOC (Ecoinvent)	2.279E-12
Production residues in life cycle	7.678E-04
Hazardous waste for disposal	6.242E-07
Chromium containing slag	9.926E-08
Dross (Fines)	3.455E-09
Sodium oxide	5.874E-09
Red mud (dry)	5.104E-07
Soil and sand containing heavy metals	4.327E-09
Toxic chemicals (unspecified)	8.884E-10
Hazardous waste for recovery	6.752E-08
Used oil	9.294E-10
Waste water processing residue	6.659E-08
Waste for disposal	7.494E-04
Incineration good	7.039E-10
Sludge from water works (6% dry matter-content)	6.730E-12
Waste (solid)	9.177E-07
Waste for disposal (unspecified)	2.097E-07
Waste from steel works	7.483E-04
Waste for recovery	1.764E-05
Aluminum scrap	5.951E-12
Chemicals (unspecified)	5.962E-10
Cooling water	1.466E-05
Cryolite	1.611E-09
Dross	1.488E-10
Filter dust	1.576E-08
Furnace clinker	3.939E-09
Gypsum (contaminated)	6.283E-13
Gypsum (FDI)	4.854E-10
Plastic (unspecified)	7.823E-10
Production residues (unspecified)	6.811E-11
Rolling gravel	2.428E-07
Rolling tinder	2.206E-09

Process or Category	Cradle to Gate (RMA)
Slag	2.149E-06
Slag (containing precious metal)	1.457E-09
Slag (Iron plate production)	8.340E-08
Slag (Mn 6,5%)	4.739E-07
Waste paper	9.343E-11
Wood	9.373E-11
Wooden pallet (EURO)	5.714E-18
Mixed Waste (Hazardous or Radioactive)	7.066E-08
Neutralized residues	3.009E-12
Emissions to air	3.782E-02
Heavy metals to air	2.867E-08
Antimony	1.751E-12
Arsenic (+V)	7.857E-11
Arsenic trioxide	2.029E-16
Cadmium (+II)	8.302E-11
Chromium (+III)	4.684E-13
Chromium (+VI)	5.236E-15
Chromium (unspecified)	1.171E-09
Cobalt	1.256E-11
Copper (+II)	3.413E-11
Heavy metals to air (unspecified)	3.057E-12
Hydrogen arsenic (arsine)	1.684E-14
Iron	2.472E-11
Lanthanides	1.002E-15
Lead (+II)	3.455E-09
Manganese (+II)	9.789E-11
Mercury (+II)	6.149E-10
Molybdenum	3.022E-12
Nickel (+II)	2.703E-10
Palladium	1.676E-20
Rhodium	1.618E-20
Selenium	4.799E-11
Silver	5.365E-17
Tellurium	2.747E-14
Thallium	1.135E-12
Tin (+IV)	1.823E-11
Titanium	6.684E-14
Vanadium (+III)	2.333E-09

Process or Category	Cradle to Gate (RMA)
Zinc (+II)	2.042E-08
Inorganic emissions to air	2.711E-02
Ammonia	5.313E-08
Ammonium	5.614E-11
Ammonium nitrate	8.074E-16
Argon	3.786E-12
Barium	1.903E-09
Beryllium	1.888E-12
Boron compounds (unspecified)	3.402E-10
Bromine	1.385E-10
Carbon dioxide	2.551E-02
Carbon dioxide (biotic)	4.146E-08
Carbon dioxide (biotic)	5.614E-07
Carbon disulphide	3.457E-14
Carbon monoxide	2.339E-05
Carbon monoxide (biotic)	2.527E-10
Chloride (unspecified)	1.922E-10
Chlorine	1.774E-11
Cyanide (unspecified)	1.334E-11
Fluoride	3.199E-10
Fluorides	4.836E-13
Fluorine	1.887E-13
Helium	9.142E-12
Hydrogen	8.926E-10
Hydrogen bromine (hydrobromic acid)	1.379E-13
Hydrogen chloride	1.871E-07
Hydrogen cyanide (prussic acid)	1.264E-12
Hydrogen fluoride	7.613E-10
Hydrogen iodide	1.165E-16
Hydrogen phosphorous	1.276E-14
Hydrogen sulphide	4.891E-08
Lead dioxide	2.798E-12
Nitrogen (atmospheric nitrogen)	4.583E-07
Nitrogen (N-compounds)	7.405E-13
Nitrogen dioxide	4.229E-07
Nitrogen monoxide	1.802E-10
Nitrogen oxides	4.244E-05
Nitrous oxide (laughing gas)	4.491E-07

Process or Category	Cradle to Gate (RMA)
Oxygen	3.683E-07
Scandium	4.751E-16
Steam	1.455E-03
Strontium	1.879E-14
Sulphur dioxide	7.668E-05
Sulphur hexafluoride	4.741E-09
sulphur oxide	6.715E-08
Sulphuric acid	1.839E-12
Tin oxide	4.302E-16
Unspecified Particles	1.027E-07
Zinc oxide	8.604E-16
Zinc sulphate	4.222E-13
Organic emissions to air (group VOC)	7.665E-03
Group NMVOC to air	6.585E-06
Group PAH to air	4.376E-10
Anthracene	3.346E-14
Benzo{a}anthracene	1.684E-14
Benzo{a}pyrene	2.760E-10
Benzo{ghi}perylene	1.502E-14
Benzofluoranthene	3.004E-14
Chrysene	4.136E-14
Dibenz(a)anthracene	9.360E-15
Indeno[1,2,3-cd]pyrene	1.118E-14
Naphthalene	3.514E-12
Phenanthrene	1.104E-12
Polycyclic aromatic hydrocarbons (PAH)	1.569E-10
Halogenated organic emissions to air	9.375E-11
Dichloroethane (ethylene dichloride)	4.858E-12
Dichloromethane (methylene chloride)	3.262E-14
Dioxins (unspec.)	-3.033E-15
Halogenated hydrocarbons (unspecified)	1.637E-12
Polychlorinated biphenyls (PCB unspecified)	3.117E-14
Polychlorinated dibenzo-p-dioxins (2,3,7,8 - TCDD)	1.840E-16
R 11 (trichlorofluoromethane)	4.491E-12
R 114 (dichlorotetrafluoroethane)	4.599E-12
R 116 (hexafluoroethane)	6.285E-12
R 12 (dichlorodifluoromethane)	9.656E-13
R 13 (chlorotrifluoromethane)	6.063E-13

Process or Category	Cradle to Gate (RMA)
R 22 (chlorodifluoromethane)	1.055E-12
Tetrafluoromethane	5.997E-11
Vinyl chloride (VCM; chloroethene)	9.220E-12
Acetaldehyde (Ethanal)	8.494E-10
Acetic acid	3.380E-09
Acetone (dimethylcetone)	8.479E-10
Acrolein	2.361E-13
Aldehyde (unspecified)	8.142E-12
Alkane (unspecified)	4.082E-09
Alkene (unspecified)	8.957E-10
Aromatic hydrocarbons (unspecified)	3.383E-10
Benzene	4.775E-10
Butadiene	1.761E-13
Butane	2.290E-08
Butane (n-butane)	2.783E-10
Caprolactam	5.808E-15
Cumene (isopropylbenzene)	1.398E-16
Cyclohexane (hexahydro benzene)	3.371E-13
Diethylamine	5.525E-18
Ethane	6.309E-08
Ethanol	1.680E-09
Ethene (ethylene)	1.626E-11
Ethyl benzene	7.305E-10
Fluoranthene	1.090E-13
Fluorene	3.458E-13
Formaldehyde (methanal)	2.907E-09
Heptane (isomers)	7.546E-10
Hexamethylene diamine (HMDA)	1.036E-14
Hexane (isomers)	2.925E-09
Mercaptan (unspecified)	1.238E-11
Methanethiol	2.612E-09
Methanol	1.742E-09
NMVOC (unspecified)	6.349E-06
Octane	4.151E-10
Pentane (n-pentane)	8.603E-09
Phenol (hydroxy benzene)	2.396E-14
Propane	1.122E-07
Propene (propylene)	6.631E-11

Process or Category	Cradle to Gate (RMA)
Propionic acid (propane acid)	9.492E-15
Styrene	4.311E-16
Toluene (methyl benzene)	3.425E-10
Trimethylbenzene	4.191E-15
Xylene (dimethyl benzene)	3.054E-09
Hydrocarbons (unspecified)	1.006E-08
Methane	7.658E-03
Methane (biotic)	4.589E-10
Organic chlorine compounds	1.220E-12
Unspecified Organic Compounds	7.140E-14
VOC (unspecified)	5.585E-07
Other emissions to air	3.039E-03
Aldehydes, unspecified	3.570E-14
Exhaust	2.979E-03
Particulate Matter, unspecified	2.947E-08
Sand (Silica) (SiO ₂)	6.806E-10
Used air	5.985E-05
Particles to air	3.218E-06
Dust (PM ₁₀)	1.349E-07
Dust (PM _{2.5} - PM ₁₀)	1.892E-12
Dust (PM _{2.5})	5.566E-08
Dust (Portland cement kiln)	2.845E-07
Dust (unspecified)	2.743E-06
Metals (unspecified)	2.698E-12
Unspecified Organic Chlorine Compounds	4.711E-13
Wood (dust)	1.588E-13
Radioactive emissions to air	6.300E-12
Uranium (total)	6.300E-12
Unspecified Heavy Metals	3.679E-17
Emissions to fresh water	3.813E-04
Analytical measures to fresh water	1.029E-04
Adsorbable organic halogen compounds (AOX)	3.597E-10
Biological oxygen demand (BOD)	3.515E-07
Chemical oxygen demand (COD)	5.459E-07
Nitrogenous Matter (unspecified, as N)	7.725E-08
Solids (dissolved)	8.324E-05
Total dissolved organic bounded carbon	1.995E-07
Total Dissolved Solids	1.849E-05

Process or Category	Cradle to Gate (RMA)
Total organic bounded carbon	5.697E-09
Heavy metals to fresh water	8.432E-06
Aluminium	1.381E-07
Antimony	1.223E-09
Arsenic (+V)	3.821E-08
Cadmium (+II)	4.420E-10
Chromium (+III)	1.161E-09
Chromium (+VI)	9.663E-13
Chromium (unspecified)	3.106E-08
Cobalt	4.155E-13
Copper (+II)	4.644E-08
Heavy metals to water (unspecified)	1.145E-09
Iron	1.086E-06
Lead (+II)	1.399E-08
Manganese (+II)	5.170E-08
Mercury (+II)	6.796E-11
Molybdenum	2.247E-11
Nickel (+II)	1.684E-06
Selenium	1.150E-10
Silver	1.196E-09
Strontium	1.787E-09
Thallium	7.220E-15
Tin (+IV)	1.470E-12
Titanium	2.132E-12
Unspecified Substance	3.182E-13
Uranium	4.731E-06
Vanadium (+III)	1.165E-11
Zinc (+II)	6.042E-07
Inorganic emissions to fresh water	2.427E-04
Acid (calculated as H ⁺)	7.501E-10
Aluminum (+III)	1.134E-08
Ammonia	5.304E-08
Ammonia, as N	5.267E-10
Ammonium (total N)	1.495E-06
Ammonium / ammonia	3.682E-06
Barium	7.750E-07
Beryllium	1.609E-14
Boron	2.139E-09

Process or Category	Cradle to Gate (RMA)
Bromate	4.335E-14
Bromine	3.233E-14
Calcium (+II)	8.614E-07
Carbonate	5.490E-06
Chlorate	2.573E-11
Chloride	8.465E-06
Chlorine (dissolved)	8.296E-08
Copper ion (+II/+III)	5.310E-14
Cyanide	1.112E-08
Fluoride	2.889E-07
Fluorine	1.315E-11
Hydrogen chloride	2.883E-13
Hydrogen fluoride (hydrofluoric acid)	1.293E-13
Hydrogen Ions (H+)	7.104E-11
Hydroxide	1.124E-09
Inorganic salts and acids (unspecified)	2.601E-20
Iron ion (+II/+III)	1.484E-09
Magnesium (+II)	9.609E-08
Magnesium chloride	4.559E-15
Metal ions (unspecific)	2.235E-09
Neutral salts	9.623E-14
Nickel ion (+II)	6.057E-13
Nitrate	2.888E-08
Nitrate (as total N)	1.141E-12
Nitrogen	1.141E-07
Nitrogen (as total N)	1.461E-08
Nitrogen organic bounded	1.671E-09
Phosphate	2.858E-10
Phosphorus	1.459E-07
Potassium	1.492E-10
Silicate particles	8.918E-10
Sodium (+I)	2.868E-06
Sodium chloride (rock salt)	1.540E-05
Sodium hypochlorite	1.458E-13
Sulfates	1.155E-06
Sulphate	2.017E-04
Sulphide	2.568E-09
Sulphite	1.922E-10

Process or Category	Cradle to Gate (RMA)
Sulphur	4.092E-11
Sulphuric acid	3.716E-11
Unspecified Iron Oxides	8.149E-13
Unspecified Oil	2.887E-12
Unspecified Organic Chlorine compounds	6.542E-15
Unspecified Salt	2.618E-11
Unspecified Solids (Suspended)	1.016E-10
Organic emissions to fresh water	5.576E-06
Halogenated organic emissions to fresh water	1.923E-12
1,2-Dibromoethane	7.919E-17
Chlorinated hydrocarbons (unspecified)	3.968E-13
Chloromethane (methyl chloride)	3.580E-13
Dichloroethane (ethylene dichloride)	2.035E-13
Dichloropropane	8.316E-18
Polychlorinated dibenzo-p-dioxins (2,3,7,8 - TCDD)	6.624E-16
Vinyl chloride (VCM; chloroethene)	9.640E-13
Hydrocarbons to fresh water	5.570E-06
Acenaphthene	4.560E-14
Acenaphthylene	1.876E-14
Acetic acid	3.898E-11
Acrylonitrile	6.082E-13
Anthracene	5.819E-14
Aromatic hydrocarbons (unspecified)	3.915E-11
Benzene	8.723E-11
Benzo{a}anthracene	7.062E-15
Benzofluoranthene	4.594E-15
Chrysene	3.339E-14
Cresol (methyl phenol)	1.060E-12
Ethyl benzene	4.409E-12
Fluoranthene	8.234E-15
Hexane (isomers)	1.160E-13
Hydrocarbons (unspecified)	2.024E-08
Methanol	4.505E-09
Oil (unspecified)	5.544E-06
Phenol (hydroxy benzene)	8.927E-11
Polycyclic aromatic hydrocarbons (PAH, unspec.)	1.350E-09
Toluene (methyl benzene)	5.701E-11
Xylene (isomers; dimethyl benzene)	2.921E-11

Process or Category	Cradle to Gate (RMA)
Carbon, organically bound	3.701E-09
Naphthalene	2.742E-12
N-unspecified (N)	2.259E-12
Organic chlorine compounds (unspecified)	8.874E-14
Organic compounds (dissolved)	5.131E-12
Organic compounds (unspecified)	1.912E-11
Unspecified wastewater	1.708E-09
Other emissions to fresh water	0.000E+00
Particles to fresh water	2.165E-05
Metals (unspecified)	1.669E-11
Silicon dioxide (silica)	3.210E-11
Soil loss by erosion into water	1.596E-11
Solids (suspended)	2.150E-05
Suspended solids, unspecified	1.499E-07
Unspecified Oxides	6.774E-13
Radioactive emissions to fresh water	0.000E+00
Bromide	0.000E+00
Radionuclide	0.000E+00
Sulfite	0.000E+00
Unspecified Solids (Dissolved)	1.959E-10
Uranium (total)	4.395E-13
Emissions to sea water	6.297E-06
Analytical measures to sea water	1.499E-08
Adsorbable organic halogen compounds (AOX)	7.311E-16
Biological oxygen demand (BOD)	8.065E-10
Chemical oxygen demand (COD)	1.338E-08
Total organic bounded carbon	8.065E-10
Heavy metals to sea water	3.235E-09
Arsenic (+V)	4.551E-11
Cadmium (+II)	2.507E-11
Chromium (unspecified)	7.253E-11
Cobalt	1.994E-11
Copper (+II)	1.096E-10
Iron	3.416E-10
Lead (+II)	2.694E-11
Manganese (+II)	3.513E-11
Mercury (+II)	4.372E-13
Molybdenum	2.971E-10

Process or Category	Cradle to Gate (RMA)
Nickel (+II)	4.395E-11
Silver	2.228E-12
Strontium	1.802E-09
Tin (+IV)	2.669E-12
Titanium	2.718E-13
Vanadium (+III)	1.401E-11
Zinc (+II)	3.955E-10
Inorganic emissions to sea water	5.634E-06
Aluminum (+III)	8.751E-12
Ammonia	2.600E-10
Barium	1.101E-09
Beryllium	1.098E-12
Boron	1.415E-10
Calcium (+II)	1.545E-08
Carbonate	6.923E-08
Chloride	5.486E-06
Magnesium	3.871E-09
Nitrate	8.975E-11
Sodium (+I)	1.611E-08
Sulphate	2.921E-08
Sulphide	1.260E-08
Sulphur	7.571E-11
Organic emissions to sea water	3.298E-09
Hydrocarbons to sea water	3.266E-09
Acenaphthene	9.130E-13
Acenaphthylene	3.498E-13
Acetic acid	1.897E-12
Anthracene	3.035E-13
Aromatic hydrocarbons (unspecified)	8.065E-12
Benzene	2.874E-10
Benzo[a]anthracene	2.003E-13
Benzofluoranthene	2.179E-13
Chrysene	1.123E-12
Cresol (methyl phenol)	1.961E-12
Ethyl benzene	2.445E-11
Fluoranthene	2.335E-13
Hexane (isomers)	2.141E-13
Oil (unspecified)	2.195E-09

Process or Category	Cradle to Gate (RMA)
Phenol (hydroxy benzene)	4.487E-10
Toluene (methyl benzene)	1.736E-10
Xylene (isomers; dimethyl benzene)	1.220E-10
Naphthalene	3.184E-11
Particles to sea water	6.419E-07
Solids (suspended)	6.419E-07
Emissions to agricultural soil	0.000E+00
Emissions to industrial soil	1.492E-04
Heavy metals to industrial soil	1.492E-04
Antimony	1.930E-16
Arsenic (+V)	8.268E-08
Cadmium (+II)	7.512E-13
Chromium (+III)	2.641E-12
Chromium (+VI)	6.991E-16
Chromium (unspecified)	2.286E-11
Cobalt	4.361E-13
Copper (+II)	2.988E-12
Iron	1.479E-04
Lead (+II)	5.912E-07
Manganese (+II)	1.516E-11
Mercury (+II)	1.529E-09
Nickel (+II)	4.612E-11
Selenium	9.822E-09
Strontium	5.230E-09
Thallium	7.149E-08
Vanadium (+III)	4.513E-07
Zinc (+II)	1.400E-11
Inorganic emissions to industrial soil	2.521E-08
Aluminum (+III)	3.541E-11
Ammonia	8.318E-09
Bromide	2.283E-12
Calcium (+II)	5.084E-09
Chloride	2.958E-09
Chlorine	1.631E-13
Fluoride	7.612E-11
Magnesium (+III)	7.025E-10
Phosphorus	8.535E-10
Potassium (+I)	3.352E-09

Process or Category	Cradle to Gate (RMA)
Sodium (+I)	4.447E-10
Sulphate	4.840E-10
Sulphide	2.904E-09
Organic emissions to industrial soil	1.919E-10
Oil (unspecified)	1.919E-10
Radioactive emissions to industrial soil	0.000E+00
Calcium Fluoride	1.129E-08
Radionuclide	0.000E+00

Embedded Unit Processes

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

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