NETL Life Cycle Inventory Data
Process Documentation File

Process Name: Ethanol via Lignocellulosic Combustion of Corn Stover, Acquisition, Transport, and Conversion

Reference Flow: 1 kg of Ethanol (E95)

Brief Description: This process includes all inputs for the raw material acquisition, raw material transportation, and energy conversion for 1 kg of ethanol, based on lignocellulosic combustion of corn stover.

Section I: Meta Data

Geographical Coverage: US **Region:** Midwest

Year Data Best Represents: 2009

Process Type: Energy Conversion (EC)

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

Allocation Applied: Yes

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:

BIO_YIELD	*Represents the weight of corn stover*
CBTL_bio_day	*Tons of biomass used per day for the CBTL plant*
CF	*Capacity factor of CBTL plant*
CORN_ALLOCATION	*Percentage of corn grain from the corn stover production system*
Yield_corn	*Mass of corn grain produced per mass of corn stover production*

Load_Trailer	*Maximum weight of corn stover transported by one trailer load*
S2_TRK_DIST	*Distance from the origin to the destination*
ETHANOL_PROD	*Ethanol production from refinery per 30-year study period*

Tracked Input Flows:

None

Tracked Output Flows:

Ethanol (E95) [Valuable substance]	*Ethanol fuel (E95) produced by the energy conversion facility and ready for transport*

Section II: Process Description

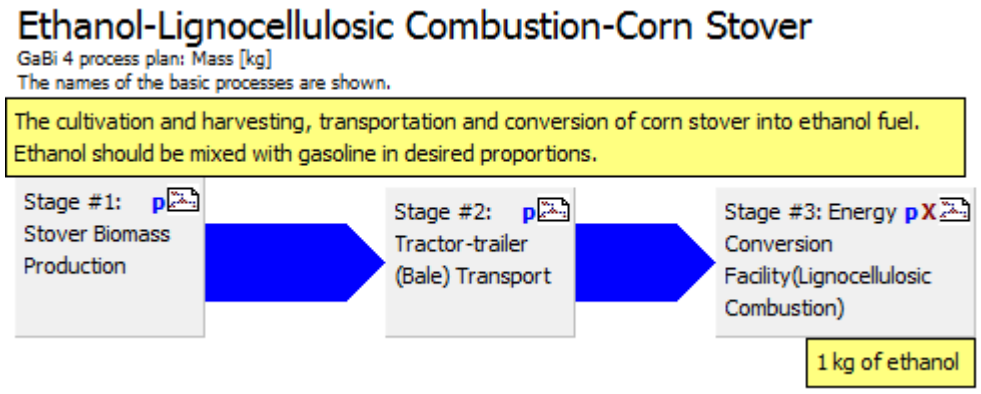
Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_CTG_Ethanol_LignocellulosicCombustion_CornStover_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), raw material transportation (RMT), and the energy conversion facility (ECF) for the production of ethanol (E95) via lignocellulosic combustion of corn stover, as shown in **Figure 1**. At the downstream boundary of this unit process, one kilogram finished ethanol (E95) is delivered to the upstream boundary of finished fuels transport (LC Stage #4). The RMA, RMT, and ECF are discussed separately below.

Figure 1: Plan for RMA, RMT, and ECF for Lignocellulosic Combustion



Boundary and Description

LC Stage #1, raw material acquisition of corn stover, includes land preparation for corn and corn stover production, cultivation of the corn and corn stover, and the harvesting and storing of the corn stover. Most of the data used in the formation of the operation processes are from states in the U.S. Midwest.

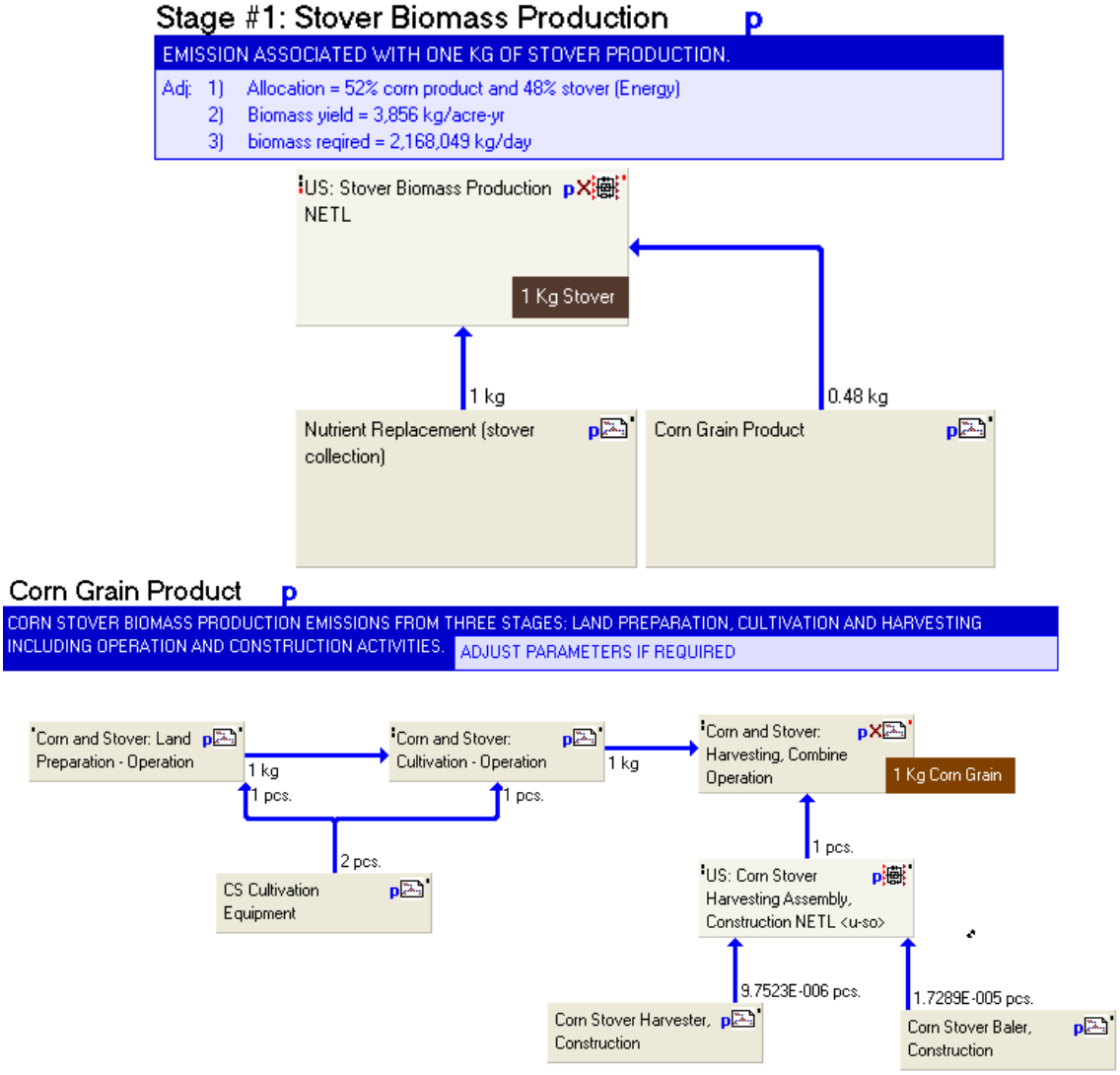
The RMA of corn stover includes the construction of machinery needed for RMA operation processes. Within the machinery construction, upstream processes (for example, steel or rubber) are included. The plan for RMA of corn stover is provided in **Figure 2**.

The biomass processes discussed here are set up slightly differently than some of the other feedstocks. Unlike other RMA pathways, biomass has a set order of operations for its production. The product from one process is the input to another process, which then lends itself to assembly of the model in series. Each of the operations uses a distinct set of machinery, and each piece is constructed as many times as needed during the study period. For the operation processes, each requires diesel fuel and calculates the emissions based on the diesel consumed. The cultivation process also includes the production and application of different fertilizers (potassium, nitrogen, and phosphorus). Agricultural production of corn grain is considered concurrently to corn stover, as shown in **Figure 2**.

The construction processes for machinery contain all of the machinery needed for the initial clearing of the site, cultivation, and harvesting of the corn stover. The machinery includes:

- Tiller
  (DS/DF_Stage1_C_Tiller_5015_lbs_TractorPropelled_2009.01.doc)
- Tractor
  (DS/DF_Stage1_C_Diesel_Tractor_165_HP_2009.01.doc)
- Seeder
  (DS/DF_Stage1_C_Diesel_Forage_Harvester_615_HP_2010.01.doc)
- Harvester
  (DS/ DF_Stage1_C_Harvester_300_ Bushel_Capacity_2009.01.doc)
- Baler
  (DS/ DF_Stage1_C_Baler_3110_lbs_TractorPropelled_2009.01.doc)

Figure 2: Plan for RMA of Corn Stover, Including Land Preparation, Cultivation and Harvesting and Storage



Each piece of equipment is scaled to the production of one kilogram of corn stover, 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 of Corn Stover

Ethanol-Lignocellulosic Combustion-Corn Stover
Stage #1: Stover Biomass Production
Corn Grain Product
Corn and Stover: Cultivation - Operation
Average K Fertilizer
EU-15: Average K Fertilizer NETL

US: North American Average Electricity Mix, 2007 080811 NETL

Average N Fertilizer

DE: Ammonia (NH3) PE

DE: Nitric acid (98%) PE

EU-15: Average N Fertilizer NETL

US: North American Average Electricity Mix, 2007 080811 NETL

Average P Fertilizer

DE: Sulphuric acid (96%) PE

EU-15: Average P Fertilizer NETL

US: North American Average Electricity Mix, 2007 080811 NETL

US: Phosphate NETL

US: Corn Stover Cultivation, Operation NETL <u-so>

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

Corn and Stover: Harvesting, Combine Operation

US: Corn Stover Harvesting & Storage, Operation NETL <u-so>

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

Corn and Stover: Land Preparation - Operation

US: Corn Stover Land Preparation, Operation NETL <u-so>

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

Corn Stover Baler, Construction

US: Baler, 3110 lbs, Tractor-Propelled, Construction NETL <u-so>

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

Corn Stover Harvester, Construction

US: Harvester, 300-Bushel Capacity, 6 Cylinder, Construction NETL <u-so>

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

CS Cultivation Equipment

Seeder, Construction

US: Seeder, 21900 lbs, Tractor-Propelled, Construction NETL <u-so>

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

Tiller, Construction

US: Tiller, 5015 lbs, Tractor-Propelled, Construction NETL <u-so>

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

Tractor, Construction

US: Diesel Tractor, 165 Horsepower, Construction NETL <u-so>

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

US: Corn Stover Cultivation Assembly, Construction NETL <u-so>

US: Corn Stover Harvesting Assembly, Construction NETL <u-so>

Nutrient Replacement (stover collection)

Average K Fertilizer

EU-15: Average K Fertilizer NETL

US: North American Average Electricity Mix, 2007 080811 NETL

Average N Fertilizer

DE: Ammonia (NH3) PE

DE: Nitric acid (98%) PE

EU-15: Average N Fertilizer NETL

US: North American Average Electricity Mix, 2007 080811 NETL

Average P Fertilizer

DE: Sulphuric acid (96%) PE

EU-15: Average P Fertilizer NETL

US: North American Average Electricity Mix, 2007 080811 NETL

US: Phosphate NETL

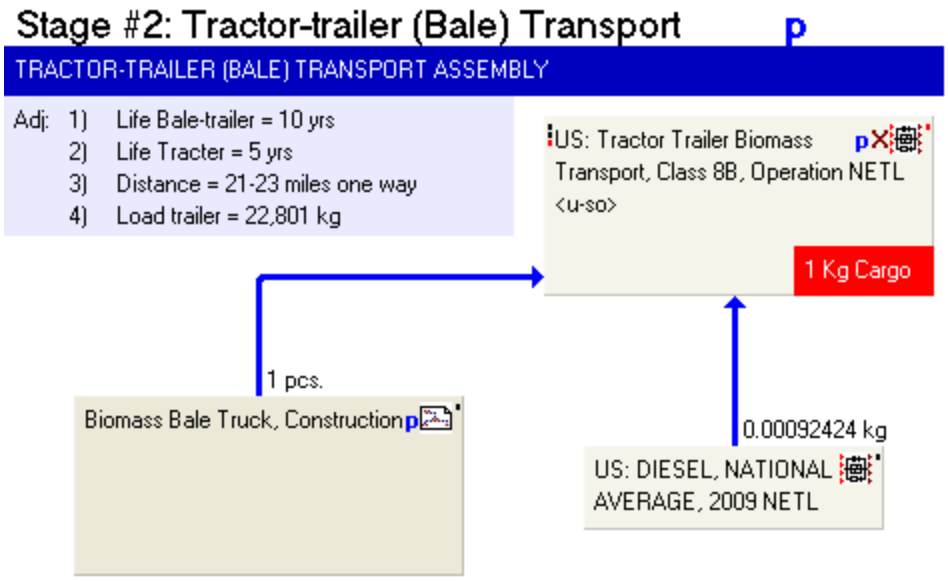
US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>

US: NPK Nutrients Replacement, Operation NETL <u-so>

US: Stover Biomass Production NETL

LC Stage #2 (RMT) includes the transport of the harvested corn stover from the farm to the energy conversion facility (LC Stage #3). The construction of equipment used to transport corn stover and the operation of that equipment are the two processes within RMT. Corn stover transport takes place via tractor-trailer (i.e., semi truck) that is diesel-powered and suitable for the transport of corn stover. The transport distance is an adjustable parameter for RMT. The plan for RMT of corn stover is provided in **Figure 3.**

Figure 3: Plan for RMT of Corn Stover, Including Construction and Operation of Profiles for Transport



Construction of the truck for RMT includes the materials required to construct the piece of equipment, shown below, for transport. A bale truck is used as a proxy transport vehicle for corn stover transport because it is presumed to represent a suitable transport vehicle for corn stover.

- Bale Truck
  (DS/ DF_Stage2_C_Bale_Truck_Biomass_Transport_2010.01.doc)

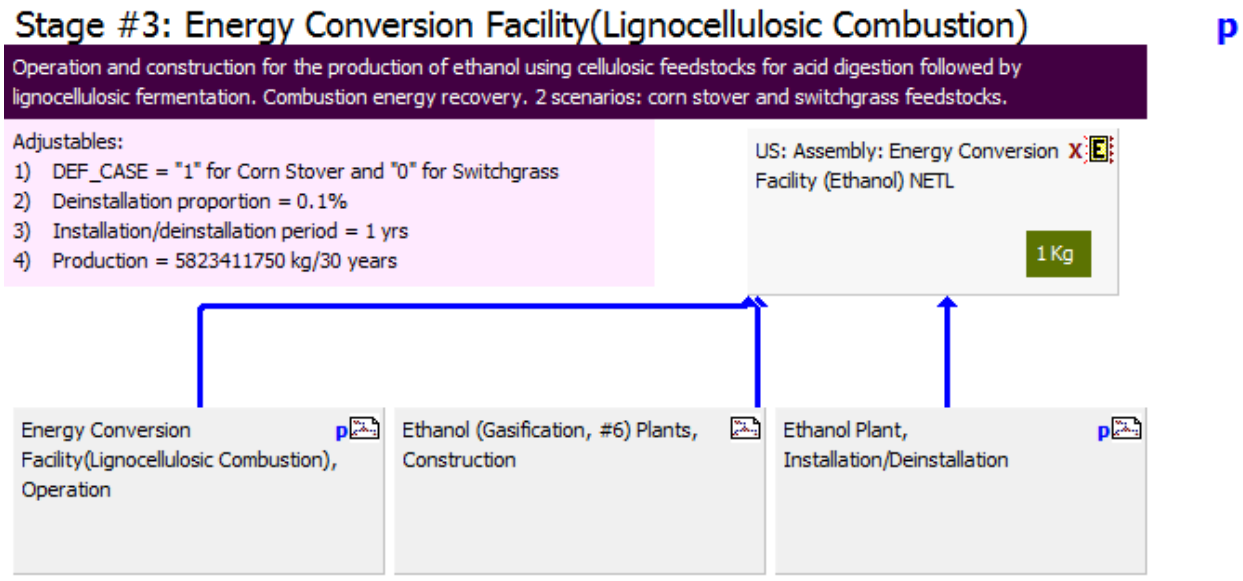
The profiles and processes included in RMT are provided in **Table 2**. Those shown in bold face were developed by NETL.

Table 2: Profiles and Processes Included in RMT for Corn Stover

Stage #2: Tractor-trailer (Bale) Transport
Biomass Bale Truck, Construction
DE: Lead (99,995%) PE
DE: Styrene-butadiene rubber mix (SBR) PE
RER: Aluminum sheet mix PE
RER: Nylon 6.6 granulate (PA 6.6) ELCD/PlasticsEurope <p-agg>
RER: Polyurethane flexible foam (PU) PlasticsEurope
US: Bale Truck, Biomass Transport, Construction NETL <u-so>
WOR: Steel Plate, BF, Manufacture NETL <u-so>
US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
US: Tractor Trailer Biomass Transport, Class 8B, Operation NETL <u-so>

LC Stage #3 (ECF) includes the conversion of corn stover to fuel grade ethanol (E95) via a lignocellulosic combustion. This process can use either corn stover or switchgrass as the cellulosic feedstock in the production of ethanol. Finished ethanol from the ECF process is delivered to the upstream boundary of LC Stage #4, finished fuels transport. The plan for the corn stover/ethanol ECF (lignocellulosic combustion) is provided in **Figure 4**.

Figure 4: Plan for ECF of Corn Stover to Ethanol (E95) Finished Fuel



The profiles and processes included in the ECF are provided in **Table 3**. Those shown in bold face were developed by NETL.

Table 3: Profiles and Processes Included in ECF for Corn Stover

Stage #3: Energy Conversion Facility (Lignocellulosic Combustion)
- Energy Conversion Facility(Lignocellulosic Combustion), Operation
  - US: MROW Grid Power Mix, 2005 (eGRID2007)
    - EU-15: Power from biomass - Energy Quality EDIP
    - GLO: Power from nuclear power plant PE
    - GLO: Power from wind power PE
    - **US: MROW Power grid mix, 2005 (eGRID2007) NETL**
    - US: Power from hard coal PE
    - US: Power from heavy fuel oil PE
    - US: Power from hydropower PE
    - US: Power from lignite PE
    - US: Power from natural gas PE
  - DE: Limestone flour (CaCO3; dried) PE
  - RER: Sulphuric acid (96%) PE
  - **US: Biochemical Ethanol Plant with Boiler Cogen NETL <u-so>**
  - **US: Electricity, System Expansion NETL**
- Ethanol (Gasification, #6) Plants, Construction
  - US: MROW Grid Power Mix, 2005 (eGRID2007)
    - EU-15: Power from biomass - Energy Quality EDIP
    - GLO: Power from nuclear power plant PE
    - GLO: Power from wind power PE
    - **US: MROW Power grid mix, 2005 (eGRID2007) NETL**
    - US: Power from hard coal PE
    - US: Power from heavy fuel oil PE
    - US: Power from hydropower PE
    - US: Power from lignite PE
    - US: Power from natural gas PE
  - **US: Concrete, ready mixed, R-5-0 (100% Portland Cement) NETL <u-so>**
  - **US: Ethanol Plant, Thermochemical, Construction NETL <u-so>**
  - **WOR: Steel Plate, BF, Manufacture NETL <u-so>**
  - **WOR: Steel, Stainless, 316 2B, 80% Recycled NETL <u-so>**
- Ethanol Plant, Installation/Deinstallation
  - **US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>**
  - **US: Fischer-Tropsch Diesel (FTD) Energy Conversion Facility Commissioning/Decommissioning NETL <u-so>**
- **US: Assembly: Energy Conversion Facility (Ethanol) NETL**

Parameters and Balances

The parameters for the highest level modeling plans for RMA, RMT, and ECF for corn stover to ethanol production are shown in **Table 4**. These parameters may or may not include the adjustable parameters shown previously, depending on how the model was created.

Table 5 presents the input and output balances for resources and emissions of interest for the cradle-to-gate plan as well as each of the RMA, RMT, and ECF plans.

Table 4: Adjustable Parameters for RMA, RMT, and ECF for Corn Stover Ethanol

Plan	Parameter	Value	Comment
LC Stage #1			
Stage #1: Stover Biomass Production	BIO_YIELD	3.87E+03	[kg/acre-year] Adjustable parameter. Represents weight of stover. All other parameters are derived
Stage #1: Stover Biomass Production	CBTL_bio_day	3.63E+06	[kg biomass/day] Adjustable parameter; Kg of biomass used per day for the ECF
Stage #1: Stover Biomass Production	CF	0.96	[unitless proportion] Adjustable parameter. Capacity factor of ECF plant, weighs into the required
Stage #1: Stover Biomass Production	CORN_ALLOCATION	52	[%] Percentage of corn grain from the corn stover production system
Stage #1: Stover Biomass Production	yield_corn	7.73E-01	[kg/kg] Kg of corn grain produced per kg of corn stover production.
LC Stage #2			
Stage #2: Tractor-trailer (Bale) Transport	Load_Trailer	2.28E+04	[kg] Maximum weight of corn stover transported by 1 trailer load.
Stage #2: Tractor-trailer (Bale) Transport	S2_TRK_DIST	2.20E+01	[miles] adjustable parameter for distance from Origin to Destination. Calculated in "Biomass distance
LC Stage #3			
Stage #3: Energy Conversion Facility (Lignocellulosic Combustion)	ETHANOL_PROD	5.82E+09	[kg/Study Period] Ethanol production from refinery, per 30-year study period; see 'Calcs_FD' for ref

Table 5: Inputs and Output Balances for Cradle-to-Gate, RMA, RMT, and ECF for Ethanol Production via Lignocellulosic Combustion of Corn Stover (kg/kg produced)

Process or Category	Cradle to Gate	Cradle to Gate (RMA)	Gate to Gate (RMT)	Gate to Gate (ECF)
Inputs				
Flows	3.828E+01	4.821E+01	3.514E-02	-5.156E+00
Resources	3.828E+01	4.821E+01	3.514E-02	-5.156E+00
Energy resources	5.979E-01	7.842E-01	2.264E-03	-1.886E-01
Non renewable energy resources	5.979E-01	7.842E-01	2.262E-03	-1.886E-01
Crude oil (resource)	1.332E-01	9.293E-02	1.369E-03	3.890E-02
Hard coal (resource)	3.093E-01	5.335E-01	3.964E-04	-2.246E-01

Process or Category	Cradle to Gate	Cradle to Gate (RMA)	Gate to Gate (RMT)	Gate to Gate (ECF)
Lignite (resource)	9.776E-03	9.286E-03	7.061E-05	4.198E-04
Natural gas (resource)	1.456E-01	1.484E-01	4.265E-04	-3.236E-03
Uranium (resource)	-2.442E-06	2.487E-07	3.687E-09	-2.694E-06
Renewable energy resources	-1.168E-06	3.437E-07	1.524E-06	-3.036E-06
Biomass	1.504E-06	4.723E-09	1.506E-06	-7.087E-09
Renewable fuels	6.703E-10	4.490E-10	8.482E-13	2.205E-10
Wood	-2.672E-06	3.385E-07	1.829E-08	-3.029E-06
Unspecified	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Land use	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Material resources	3.768E+01	4.743E+01	3.288E-02	-4.967E+00
Non renewable elements	8.254E-06	4.538E-06	5.663E-07	3.149E-06
Aluminum	-2.318E-09	1.199E-10	1.122E-12	-2.438E-09
Chromium	9.735E-11	2.984E-13	9.628E-11	7.712E-13
Copper	2.312E-11	1.437E-13	2.292E-11	6.030E-14
Iron	7.941E-06	4.513E-06	2.948E-07	3.134E-06
Lead	9.339E-11	1.781E-13	9.274E-11	4.755E-13
Magnesium	1.150E-13	3.482E-16	1.137E-13	9.108E-16
Mercury	2.922E-11	9.013E-14	2.891E-11	2.268E-13
Nickel	3.609E-13	1.146E-15	3.569E-13	2.855E-15
Phosphorus	1.149E-08	3.480E-11	1.136E-08	9.102E-11
Sulphur	2.592E-07	3.107E-10	2.580E-07	8.519E-10
Zinc	4.438E-08	2.507E-08	1.869E-09	1.744E-08
Non renewable resources	1.611E-01	1.161E+00	2.128E-03	-1.002E+00
Barium sulphate	3.281E-16	5.363E-17	9.650E-17	1.779E-16
Basalt	8.173E-06	6.155E-07	1.421E-06	6.136E-06
Bauxite	9.576E-05	5.255E-06	8.154E-05	8.965E-06
Bentonite	1.278E-04	1.115E-04	5.520E-06	1.074E-05
Calcium carbonate (CaCO3)	2.530E-02	2.531E-02	7.299E-09	-1.587E-05
Calcium chloride	3.359E-14	5.491E-15	9.880E-15	1.822E-14
Chalk (Calciumcarbonate)	1.993E-37	6.591E-40	1.978E-37	8.453E-40
Chromium ore (39%)	2.430E-04	1.468E-07	1.557E-09	2.429E-04
Clay	9.338E-06	1.830E-05	4.990E-07	-9.465E-06
Colemanite ore	-3.810E-07	2.788E-08	6.019E-10	-4.095E-07
Copper - Gold - Silver - ore (1,0% Cu; 0,4 g/t Au; 66 g/t Ag)	-1.039E-06	4.618E-07	7.494E-09	-1.509E-06
Copper - Gold - Silver - ore (1,1% Cu; 0,01 g/t Au; 2,86 g/t Ag)	-6.331E-07	2.813E-07	4.565E-09	-9.190E-07
Copper - Gold - Silver - ore (1,16% Cu; 0,002 g/t Au; 1,06 g/t Ag)	-3.573E-07	1.588E-07	2.577E-09	-5.187E-07
Copper - Molybdenum - Gold - Silver - ore (1,13% Cu; 0,02% Mo; 0,01 g/t Au; 2,86 g/t Ag)	-1.134E-06	1.234E-07	6.278E-09	-1.264E-06

Process or Category	Cradle to Gate	Cradle to Gate (RMA)	Gate to Gate (RMT)	Gate to Gate (ECF)
Copper ore (0.14%)	-7.103E-05	5.438E-06	4.581E-08	-7.651E-05
Copper ore (1.2%)	-1.078E-07	4.789E-08	7.771E-10	-1.564E-07
Copper ore (4%)	-9.134E-17	5.149E-17	2.677E-18	-1.455E-16
Copper ore (sulphidic, 1.1%)	-1.034E-06	5.349E-08	5.006E-10	-1.088E-06
Dolomite	6.657E-03	6.495E-03	3.731E-06	1.580E-04
Feldspar (aluminum silicates)	8.103E-09	2.454E-11	8.014E-09	6.419E-11
Ferro manganese	2.349E-11	5.427E-14	2.330E-11	1.403E-13
Fluorspar (calcium fluoride; fluorite)	7.179E-07	3.824E-08	6.125E-07	6.712E-08
Granite	2.533E-18	6.841E-21	2.509E-18	1.739E-20
Gravel	4.159E-06	4.159E-06	0.000E+00	0.000E+00
Gypsum (natural gypsum)	-5.802E-06	4.732E-06	2.184E-07	-1.075E-05
Heavy spar (BaSO4)	3.100E-04	2.697E-04	1.330E-05	2.703E-05
Ilmenite (titanium ore)	8.021E-11	7.710E-12	1.379E-16	7.250E-11
Inert rock	-9.754E-01	1.275E-01	1.496E-03	-1.104E+00
Iron ore (56,86%)	5.544E-01	5.532E-01	3.206E-04	9.198E-04
Iron ore (65%)	8.405E-09	3.218E-08	2.283E-09	-2.606E-08
Kaolin ore	-6.840E-07	5.002E-08	1.079E-09	-7.351E-07
Lead - zinc ore (4.6%-0.6%)	8.728E-05	2.214E-05	6.274E-05	2.401E-06
Limestone (calcium carbonate)	2.210E-01	1.252E-01	9.998E-05	9.569E-02
Magnesit (Magnesium carbonate)	7.716E-08	9.534E-11	4.715E-12	7.706E-08
Magnesium chloride leach (40%)	3.941E-05	3.116E-05	3.486E-07	7.903E-06
Manganese ore	5.820E-05	2.836E-08	3.154E-10	5.817E-05
Manganese ore (R.O.M.)	1.026E-06	8.769E-07	5.151E-08	9.723E-08
Molybdenite (Mo 0,24%)	-6.923E-07	7.538E-08	3.871E-09	-7.715E-07
Molybdenum ore (0.1%)	8.397E-05	5.420E-10	0.000E+00	8.397E-05
Natural Aggregate	-2.000E-03	1.818E-04	4.981E-06	-2.187E-03
Nickel ore (1,5%)	5.955E-05	9.824E-10	4.104E-13	5.955E-05
Nickel ore (1.6%)	3.189E-06	3.105E-06	1.581E-07	-7.447E-08
Olivine	2.443E-10	5.656E-13	2.423E-10	1.463E-12
Peat	5.497E-05	1.687E-07	8.872E-08	5.471E-05
Phosphate ore	4.639E-03	4.637E-03	1.467E-11	1.953E-06
Phosphorus minerals	5.136E-05	5.032E-05	1.034E-06	7.924E-09
Phosphorus ore (29% P2O5)	1.385E-08	2.607E-14	1.065E-11	1.384E-08
Potassium chloride	3.215E-01	3.215E-01	1.446E-07	3.038E-08
Precious metal ore (R.O.M)	-2.476E-08	4.328E-09	2.010E-10	-2.929E-08
Quartz sand (silica sand; silicon dioxide)	4.087E-05	3.793E-05	3.651E-07	2.571E-06
Raw pumice	-6.654E-08	4.854E-09	2.566E-11	-7.142E-08
Rutile (titanium ore)	1.241E-08	8.730E-12	1.238E-08	2.796E-11

Process or Category	Cradle to Gate	Cradle to Gate (RMA)	Gate to Gate (RMT)	Gate to Gate (ECF)
sand	2.928E-08	8.298E-11	2.898E-08	2.163E-10
Slate	5.801E-10	1.191E-12	5.757E-10	3.193E-12
Sodium chloride (rock salt)	3.270E-04	2.233E-04	2.474E-05	7.897E-05
Sodium nitrate	6.150E-18	3.672E-20	6.065E-18	4.849E-20
Sodium sulphate	2.978E-09	2.125E-09	7.099E-11	7.820E-10
Soil	7.680E-03	5.766E-05	1.738E-06	7.620E-03
Sulphur (bonded)	-2.301E-12	6.106E-12	4.092E-13	-8.816E-12
Talc	-1.146E-08	8.718E-10	6.317E-12	-1.234E-08
Tin ore	2.845E-17	4.651E-18	8.368E-18	1.543E-17
Titanium ore	-6.991E-07	3.534E-07	1.561E-08	-1.068E-06
Zinc - copper ore (4.07%-2.59%)	1.274E-06	4.113E-06	1.618E-06	-4.457E-06
Zinc - lead - copper ore (12%-3%-2%)	7.773E-06	1.807E-06	8.604E-06	-2.638E-06
Zinc - lead ore (4.21%-4.96%)	-3.119E-17	1.758E-17	9.141E-19	-4.968E-17
Zinc ore (4%)	-4.168E-03	-4.163E-03	-2.380E-06	-2.820E-06
Zinc ore (sulphidic, 4%)	-7.644E-16	4.201E-16	3.383E-17	-1.218E-15
Renewable resources	3.752E+01	4.627E+01	3.075E-02	-3.966E+00
Water	3.970E+01	4.542E+01	2.486E-02	-9.343E-01
Water	1.094E-01	1.999E-02	9.166E-03	8.027E-02
Water (feed water)	9.994E-04	0.000E+00	8.281E-04	1.771E-04
Water (ground water)	2.635E+01	2.646E+01	5.404E-03	-1.196E-01
Water (lake water)	3.803E-06	3.803E-06	0.000E+00	2.193E-18
Water (municipal)	3.388E-06	3.388E-06	0.000E+00	0.000E+00
Water (river water)	0.000E+00	0.000E+00	5.609E-03	4.804E+00
Water (sea water)	2.481E-03	9.545E-05	3.360E-04	2.049E-03
Water (surface water)	1.323E+01	1.893E+01	3.434E-03	-5.702E+00
Water (well water)	8.163E-05	2.468E-07	8.074E-05	6.430E-07
Water (well-produced water)	1.682E-03	1.682E-03	0.000E+00	0.000E+00
Water (with river silt)	5.523E-12	1.815E-14	3.685E-16	5.504E-12
Air	-2.174E+00	8.513E-01	5.878E-03	-3.031E+00
Carbon dioxide	-1.685E-04	5.613E-05	6.025E-06	-2.307E-04
Nitrogen	4.487E-06	7.810E-09	4.458E-06	2.115E-08
Oxygen	0.000E+00	0.000E+00	6.711E-08	0.000E+00
Unspecified	-6.650E-07	3.440E-08	3.218E-10	-6.997E-07
Unspecified minerals	-1.513E-07	7.825E-09	7.322E-11	-1.592E-07
Unspecified resources	-5.137E-07	2.657E-08	2.486E-10	-5.405E-07
Area of Production Land	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Output				

Process or Category	Cradle to Gate	Cradle to Gate (RMA)	Gate to Gate (RMT)	Gate to Gate (ECF)
Flows	-4.692E+00	5.986E-01	1.337E-02	-4.936E-01
Resources	-4.090E+00	7.199E-01	3.835E-05	5.172E-04
Energy resources	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Land use	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Material resources	-4.090E+00	7.199E-01	3.835E-05	5.172E-04
Renewable resources	-4.090E+00	7.199E-01	3.835E-05	5.172E-04
Water	-4.090E+00	7.198E-01	3.835E-05	4.045E-04
Water (feed water)	0.000E+00	5.807E-06	0.000E+00	0.000E+00
Water (river water)	-4.099E+00	7.106E-01	0.000E+00	0.000E+00
Water (wastewater)	2.249E-03	1.806E-03	3.835E-05	4.045E-04
Water (wastewater)	7.464E-03	7.464E-03	0.000E+00	0.000E+00
Nitrogen	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Oxygen	1.413E-04	2.874E-05	0.000E+00	1.126E-04
Ecoinvent	8.911E-06	8.911E-06	1.330E-14	-2.891E-11
Long-term emission	8.911E-06	8.911E-06	1.330E-14	-2.891E-11
Fresh water	8.911E-06	8.911E-06	1.330E-14	-2.891E-11
Chloride	8.911E-06	8.911E-06	0.000E+00	0.000E+00
Dissolved organic carbon, DOC (Ecoinvent)	-2.748E-11	1.421E-12	1.330E-14	-2.891E-11
Production residues in life cycle	1.170E+00	7.253E-01	9.320E-04	4.438E-01
Hazardous waste for disposal	2.896E-05	1.399E-06	2.409E-05	3.470E-06
Chromium containing slag	2.832E-10	5.387E-11	0.000E+00	2.293E-10
Dross (Fines)	1.891E-07	9.276E-09	1.564E-07	2.340E-08
Natrium oxide	3.215E-07	1.577E-08	2.659E-07	3.979E-08
Red mud (dry)	2.793E-05	1.370E-06	2.310E-05	3.457E-06
Soil and sand containing heavy metals	-5.216E-08	2.698E-09	2.524E-11	-5.488E-08
Toxic chemicals (unspecified)	5.710E-07	1.599E-09	5.652E-07	4.194E-09
Hazardous waste for recovery	3.471E-04	2.529E-04	4.981E-07	9.371E-05
Used oil	5.133E-08	2.938E-09	4.207E-08	6.327E-09
Waste water processing residue	3.470E-04	2.528E-04	4.561E-07	9.370E-05
Waste for disposal	1.169E+00	7.251E-01	4.152E-04	4.437E-01
Incineration good	2.889E-07	8.803E-10	2.857E-07	2.288E-09
Sludge from water works (6% dry matter-content)	1.339E-09	4.452E-11	1.272E-11	1.282E-09
Waste (solid)	4.427E-01	1.837E-06	5.025E-07	4.427E-01
Waste for disposal (unspecified)	2.756E-09	5.280E-10	0.000E+00	2.228E-09
Waste from steel works	7.265E-01	7.251E-01	4.144E-04	9.706E-04
Waste for recovery	4.981E-04	1.284E-06	4.922E-04	4.567E-06
Aluminum scrap	3.051E-11	1.674E-14	6.561E-12	2.393E-11

Process or Category	Cradle to Gate	Cradle to Gate (RMA)	Gate to Gate (RMT)	Gate to Gate (ECF)
Chemicals (unspecified)	2.165E-07	4.738E-10	2.148E-07	1.257E-09
Cooling water	4.920E-04	1.224E-06	4.864E-04	4.311E-06
Cryolite	8.817E-08	4.324E-09	7.294E-08	1.091E-08
Dross	9.909E-07	2.501E-09	9.805E-07	7.857E-09
Filter dust	5.422E-11	8.551E-12	0.000E+00	4.567E-11
Furnace clinker	3.340E-08	2.138E-12	0.000E+00	3.340E-08
Gypsum	2.132E-08	0.000E+00	0.000E+00	2.132E-08
Gypsum (contaminated)	7.735E-14	3.410E-16	0.000E+00	7.701E-14
Gypsum (FDI)	6.982E-11	6.811E-12	1.173E-16	6.301E-11
Plastic (unspecified)	3.003E-07	9.228E-10	2.969E-07	2.497E-09
Production residues (unspecified)	2.200E-09	7.502E-12	2.175E-09	1.742E-11
Rolling gravel	8.776E-09	5.654E-10	0.000E+00	8.210E-09
Rolling tinder	7.591E-12	1.197E-12	2.062E-23	6.393E-12
Slag	4.396E-06	2.412E-08	4.219E-06	1.528E-07
Slag (containing precious metal)	2.222E-11	7.908E-13	0.000E+00	2.143E-11
Slag (Iron plate production)	1.810E-08	1.792E-08	0.000E+00	1.827E-10
Slag (Mn 6,5%)	2.588E-08	9.305E-09	0.000E+00	1.658E-08
Waste paper	0.000E+00	1.325E-12	4.332E-11	0.000E+00
Wood	2.871E-10	1.672E-12	2.841E-10	1.318E-12
Wooden pallet (EURO)	1.230E-15	2.669E-18	1.220E-15	7.014E-18
Mixed Waste (Hazardous or Radioactive)	4.274E-08	4.274E-08	0.000E+00	0.000E+00
Neutralized residues	1.242E-12	1.242E-12	2.222E-17	2.302E-16
Emissions to air	-1.817E+00	-8.938E-01	1.230E-02	-9.358E-01
Heavy metals to air	2.387E-05	2.373E-05	1.607E-08	1.297E-07
Antimony	-6.258E-09	1.231E-10	3.754E-12	-6.385E-09
Arsenic (+V)	-7.066E-08	8.074E-10	5.006E-11	-7.152E-08
Arsenic trioxide	1.678E-14	1.498E-14	7.722E-16	1.032E-15
Cadmium (+II)	6.860E-08	7.221E-08	5.155E-11	-3.665E-09
Chromium (+III)	-4.439E-12	3.675E-12	1.696E-13	-8.284E-12
Chromium (+VI)	1.884E-10	1.216E-15	0.000E+00	1.884E-10
Chromium (unspecified)	1.388E-06	1.063E-06	6.454E-10	3.241E-07
Cobalt	-6.771E-10	3.188E-10	9.305E-12	-1.005E-09
Copper (+II)	-4.277E-09	7.083E-10	4.267E-11	-5.028E-09
Heavy metals to air (unspecified)	-1.504E-10	1.111E-11	6.438E-14	-1.616E-10
Hydrogen arsenic (arsine)	1.393E-12	1.243E-12	6.410E-14	8.576E-14
Iron	1.205E-08	1.525E-09	3.805E-11	1.048E-08
Lanthanides	-1.072E-13	4.491E-14	1.692E-15	-1.538E-13
Lead (+II)	2.981E-06	2.999E-06	2.119E-09	-2.046E-08

Process or Category	Cradle to Gate	Cradle to Gate (RMA)	Gate to Gate (RMT)	Gate to Gate (ECF)
Manganese (+II)	-1.198E-08	2.071E-09	3.395E-11	-1.408E-08
Mercury (+II)	1.827E-07	1.889E-07	1.183E-10	-6.318E-09
Molybdenum	4.242E-08	1.143E-10	2.794E-12	4.230E-08
Nickel (+II)	1.065E-07	2.218E-09	2.516E-10	1.040E-07
Palladium	9.297E-19	1.520E-19	2.735E-19	5.043E-19
Rhodium	8.975E-19	1.467E-19	2.640E-19	4.868E-19
Selenium	-1.829E-07	2.531E-09	7.822E-11	-1.855E-07
Silver	1.198E-16	1.421E-18	1.241E-16	-5.670E-18
Tellurium	-5.920E-13	4.900E-13	2.262E-14	-1.105E-12
Thallium	-3.422E-12	3.719E-12	4.738E-13	-7.615E-12
Tin (+IV)	-7.037E-08	7.668E-10	3.690E-11	-7.117E-08
Titanium	-1.458E-11	2.938E-12	1.086E-13	-1.763E-11
Vanadium (+III)	1.155E-07	1.801E-08	1.075E-09	9.645E-08
Zinc (+II)	1.932E-05	1.938E-05	1.151E-08	-6.254E-08
Inorganic emissions to air	-1.940E-02	-1.668E+00	7.434E-03	1.641E+00
Ammonia	3.054E-04	3.082E-04	3.668E-08	-2.862E-06
Ammonium	-9.035E-12	7.064E-13	3.621E-15	-9.745E-12
Ammonium nitrate	-1.546E-14	3.588E-14	5.253E-16	-5.186E-14
Argon	2.290E-12	2.290E-12	0.000E+00	2.760E-21
Barium	8.574E-08	1.740E-07	8.464E-09	-9.676E-08
Beryllium	-7.669E-10	1.648E-11	8.372E-13	-7.842E-10
Boron compounds (unspecified)	-1.205E-06	4.788E-08	8.171E-10	-1.254E-06
Bromine	-5.356E-07	1.138E-08	2.781E-10	-5.473E-07
Carbon dioxide	1.247E+00	1.804E+00	5.775E-03	-5.625E-01
Carbon dioxide (biotic)	1.619E-10	1.619E-10	0.000E+00	0.000E+00
Carbon dioxide (biotic)	-2.323E-01	-3.703E+00	8.584E-07	3.470E+00
Carbon disulphide	1.891E-11	3.197E-13	1.972E-11	-1.131E-12
Carbon monoxide	1.279E-02	1.296E-02	1.564E-05	-1.877E-04
Carbon monoxide (biotic)	2.739E-04	4.832E-05	0.000E+00	2.256E-04
Chloride (unspecified)	2.301E-07	1.518E-08	6.055E-10	2.143E-07
Chlorine	5.012E-09	3.067E-10	4.564E-09	1.410E-10
Cyanide (unspecified)	4.647E-09	3.779E-10	1.161E-11	4.257E-09
Fluoride	6.631E-08	1.453E-08	1.181E-08	3.996E-08
Fluorides	9.233E-11	1.745E-11	5.392E-12	6.949E-11
Fluorine	-1.206E-11	1.535E-12	6.436E-13	-1.424E-11
Helium	-3.483E-10	2.344E-10	9.201E-12	-5.919E-10
Hydrogen	2.448E-07	1.748E-07	3.602E-08	3.402E-08
Hydrogen bromine (hydrobromic acid)	1.165E-10	9.274E-11	1.972E-12	2.181E-11

Process or Category	Cradle to Gate	Cradle to Gate (RMA)	Gate to Gate (RMT)	Gate to Gate (ECF)
Hydrogen chloride	7.767E-05	8.088E-05	6.598E-08	-3.275E-06
Hydrogen cyanide (prussic acid)	-4.135E-12	6.783E-12	9.470E-12	-2.039E-11
Hydrogen fluoride	-3.632E-07	4.913E-08	1.258E-08	-4.249E-07
Hydrogen iodide	1.253E-13	9.913E-14	2.020E-15	2.415E-14
Hydrogen phosphorous	3.914E-13	3.052E-14	3.834E-13	-2.259E-14
Hydrogen sulphide	4.451E-05	4.428E-05	4.686E-08	1.767E-07
Lead dioxide	-3.372E-11	1.748E-12	1.663E-14	-3.549E-11
Nitrogen (atmospheric nitrogen)	-1.361E-04	8.396E-06	5.153E-06	-1.497E-04
Nitrogen (N-compounds)	4.479E-13	4.479E-13	0.000E+00	0.000E+00
Nitrogen dioxide	2.405E-04	1.295E-05	4.580E-07	2.270E-04
Nitrogen monoxide	6.862E-09	1.586E-11	5.976E-09	8.701E-10
Nitrogen oxides	2.179E-03	3.297E-03	4.913E-06	-1.124E-03
Nitrous oxide (laughing gas)	1.754E-03	1.696E-03	1.596E-07	5.728E-05
Oxygen	-4.570E-05	1.259E-05	7.911E-07	-5.908E-05
Scandium	-1.964E-14	2.111E-14	8.457E-16	-4.159E-14
Steam	-1.054E+00	2.084E-01	1.623E-03	-1.264E+00
Strontium	-1.453E-12	8.440E-13	3.203E-14	-2.329E-12
Sulphur dioxide	2.005E-03	3.878E-03	7.741E-06	-1.881E-03
Sulphur hexafluoride	2.864E-09	2.868E-09	2.354E-14	-4.252E-12
sulphur oxide	6.483E-11	6.483E-11	0.000E+00	0.000E+00
Sulphuric acid	7.851E-11	8.779E-11	1.398E-11	-2.326E-11
Tin oxide	-4.840E-15	5.783E-16	2.935E-17	-5.448E-15
Unspecified Particles	-1.238E-06	6.404E-08	5.993E-10	-1.303E-06
Zinc oxide	-9.681E-15	1.157E-15	5.871E-17	-1.090E-14
Zinc sulphate	3.553E-11	3.131E-11	1.614E-12	2.603E-12
Organic emissions to air (group VOC)	1.507E-01	1.511E-01	1.444E-05	-4.613E-04
Group NMVOC to air	1.494E-01	1.494E-01	2.973E-06	2.647E-05
Group PAH to air	6.154E-08	4.365E-08	1.546E-09	1.635E-08
Anthracene	4.283E-12	3.357E-12	1.852E-13	7.408E-13
Benzo{a}anthracene	2.155E-12	1.689E-12	9.317E-14	3.729E-13
Benzo{a}pyrene	-3.338E-09	1.792E-10	1.885E-11	-3.536E-09
Benzo{ghi}perylene	1.922E-12	1.507E-12	8.312E-14	3.327E-13
Benzofluoranthene	3.845E-12	3.013E-12	1.663E-13	6.655E-13
Chrysene	5.294E-12	4.149E-12	2.289E-13	9.161E-13
Dibenz(a)anthracene	1.198E-12	9.390E-13	5.179E-14	2.071E-13
Indeno[1,2,3-cd]pyrene	1.430E-12	1.121E-12	6.184E-14	2.474E-13
Naphthalene	4.498E-10	3.525E-10	1.945E-11	7.787E-11
Phenanthrene	1.413E-10	1.107E-10	6.109E-12	2.446E-11

Process or Category	Cradle to Gate	Cradle to Gate (RMA)	Gate to Gate (RMT)	Gate to Gate (ECF)
Polycyclic aromatic hydrocarbons (PAH)	6.427E-08	4.299E-08	1.501E-09	1.978E-08
Halogenated organic emissions to air	-4.289E-08	5.234E-09	3.071E-09	-5.120E-08
Dichloroethane (ethylene dichloride)	9.626E-14	6.209E-14	3.392E-14	2.466E-16
Dichloromethane (methylene chloride)	1.249E-12	4.174E-15	1.235E-12	9.872E-15
Dioxins (unspec.)	-5.904E-12	-5.865E-12	-3.334E-15	-3.635E-14
Halogenated hydrocarbons (unspecified)	1.489E-10	4.699E-13	1.473E-10	1.179E-12
Halon (1301)	2.006E-19	0.000E+00	0.000E+00	2.006E-19
Polychlorinated biphenyls (PCB unspecified)	3.086E-12	2.732E-12	1.346E-13	2.200E-13
Polychlorinated dibenzo-p-dioxins (2,3,7,8 - TCDD)	-3.151E-14	1.667E-15	2.223E-16	-3.340E-14
R 11 (trichlorofluoromethane)	-1.794E-08	1.815E-09	2.694E-11	-1.978E-08
R 114 (dichlorotetrafluoroethane)	-1.837E-08	1.859E-09	2.759E-11	-2.026E-08
R 116 (hexafluoroethane)	3.441E-10	1.688E-11	2.846E-10	4.258E-11
R 12 (dichlorodifluoromethane)	-3.857E-09	3.903E-10	5.792E-12	-4.254E-09
R 13 (chlorotrifluoromethane)	-2.422E-09	2.451E-10	3.637E-12	-2.671E-09
R 22 (chlorodifluoromethane)	-4.216E-09	4.266E-10	6.331E-12	-4.649E-09
Tetrafluoromethane	2.958E-09	1.642E-10	2.562E-09	2.320E-10
Vinyl chloride (VCM; chloroethene)	4.706E-10	3.191E-10	5.198E-12	1.463E-10
Acetaldehyde (Ethanal)	7.689E-10	4.979E-09	4.863E-10	-4.697E-09
Acetic acid	-1.456E-08	2.019E-08	2.005E-09	-3.675E-08
Acetone (dimethylcetone)	3.095E-11	4.422E-09	4.770E-10	-4.868E-09
Acrolein	3.022E-11	2.369E-11	1.307E-12	5.230E-12
Aldehyde (unspecified)	-1.668E-09	3.403E-10	1.947E-11	-2.027E-09
Alkane (unspecified)	-2.947E-06	5.082E-08	2.837E-09	-3.000E-06
Alkene (unspecified)	-2.927E-06	4.651E-08	1.225E-09	-2.975E-06
Aromatic hydrocarbons (unspecified)	-5.564E-10	4.563E-10	1.617E-09	-2.629E-09
Benzene	1.555E-07	5.770E-08	1.562E-09	9.620E-08
Butadiene	-9.112E-12	6.648E-13	3.514E-15	-9.781E-12
Butane	5.754E-06	3.171E-06	1.207E-07	2.463E-06
Butane (n-butane)	-2.233E-07	1.243E-07	2.457E-09	-3.500E-07
Caprolactam	9.478E-13	2.101E-13	6.491E-14	6.728E-13
Cumene (isopropylbenzene)	4.812E-19	7.589E-20	0.000E+00	4.053E-19
Cyclohexane (hexahydro benzene)	-2.233E-11	5.948E-12	1.246E-12	-2.953E-11
Diethylamine	-2.307E-16	1.690E-17	9.054E-20	-2.477E-16
Ethane	1.738E-05	1.126E-05	3.419E-07	5.776E-06
Ethanol	-2.175E-08	3.453E-09	8.662E-10	-2.607E-08
Ethene (ethylene)	1.080E-09	1.087E-09	8.917E-11	-9.628E-11
Ethyl benzene	-2.925E-06	4.689E-08	1.157E-09	-2.974E-06
Fluoranthene	1.395E-11	1.093E-11	6.031E-13	2.414E-12

Process or Category	Cradle to Gate	Cradle to Gate (RMA)	Gate to Gate (RMT)	Gate to Gate (ECF)
Fluorene	4.427E-11	3.469E-11	1.914E-12	7.664E-12
Formaldehyde (methanal)	1.493E-01	1.493E-01	3.747E-09	-9.034E-07
Heptane (isomers)	1.194E-07	1.885E-08	3.664E-09	9.690E-08
Hexamethylene diamine (HMDA)	-5.360E-13	3.911E-14	2.067E-16	-5.753E-13
Hexane (isomers)	2.348E-07	2.860E-08	6.529E-08	1.409E-07
Mercaptan (unspecified)	6.511E-09	4.219E-09	6.796E-11	2.224E-09
Methanethiol	-3.148E-08	1.628E-09	1.524E-11	-3.313E-08
Methanol	-1.009E-08	2.268E-09	8.488E-10	-1.321E-08
NMVOC (unspecified)	4.451E-05	1.135E-05	1.800E-06	3.136E-05
Octane	6.569E-08	1.037E-08	2.016E-09	5.330E-08
Pentane (n-pentane)	4.112E-07	1.582E-06	4.662E-08	-1.218E-06
Phenol (hydroxy benzene)	-1.456E-13	4.645E-14	3.158E-14	-2.236E-13
Propane	2.071E-05	8.028E-06	5.636E-07	1.212E-05
Propene (propylene)	-2.660E-07	4.208E-09	1.557E-10	-2.704E-07
Propionic acid (propane acid)	-8.604E-14	2.483E-13	6.878E-14	-4.031E-13
Styrene	1.128E-12	7.483E-15	1.151E-12	-2.989E-14
Toluene (methyl benzene)	-1.328E-06	2.267E-08	6.009E-10	-1.351E-06
Trimethylbenzene	-4.695E-14	5.633E-15	2.859E-16	-5.287E-14
Xylene (dimethyl benzene)	-1.224E-05	1.949E-07	4.826E-09	-1.244E-05
Hydrocarbons (unspecified)	-9.157E-09	6.293E-09	1.082E-07	-1.237E-07
Methane	1.020E-03	1.501E-03	9.897E-06	-4.916E-04
Methane (biotic)	5.630E-09	6.417E-11	0.000E+00	5.565E-09
Organic chlorine compounds	1.854E-10	5.925E-13	1.833E-10	1.442E-12
Unspecified Organic Compounds	-8.606E-13	4.451E-14	4.165E-16	-9.056E-13
VOC (unspecified)	2.456E-04	2.402E-04	1.460E-06	3.944E-06
Other emissions to air	-1.950E+00	6.211E-01	4.855E-03	-2.576E+00
Aldehydes, unspecified	-4.303E-13	2.226E-14	2.083E-16	-4.528E-13
Exhaust	-2.380E+00	1.975E-01	4.102E-03	-2.582E+00
Particulate Matter, unspecified	6.874E-07	1.246E-07	3.812E-08	5.247E-07
Sand (Silica) (SiO2)	-8.204E-09	4.243E-10	3.970E-12	-8.632E-09
Used air	4.298E-01	4.235E-01	7.528E-04	5.520E-03
Particles to air	1.764E-03	1.811E-03	8.242E-07	-4.817E-05
Dust (PM10)	-1.801E-06	3.322E-07	1.409E-07	-2.274E-06
Dust (PM2,5 - PM10)	1.145E-12	1.145E-12	0.000E+00	0.000E+00
Dust (PM2.5)	-3.230E-05	1.008E-06	5.574E-08	-3.337E-05
Dust (Portland cement kiln)	3.490E-06	3.979E-08	0.000E+00	3.451E-06
Dust (unspecified)	1.794E-03	1.810E-03	6.273E-07	-1.598E-05
Metals (unspecified)	2.445E-10	1.787E-12	2.703E-10	-2.763E-11

Process or Category	Cradle to Gate	Cradle to Gate (RMA)	Gate to Gate (RMT)	Gate to Gate (ECF)
Unspecified Organic Chlorine Compounds	-5.678E-12	2.937E-13	2.748E-15	-5.975E-12
Wood (dust)	-1.779E-12	2.134E-13	1.083E-14	-2.003E-12
Radioactive emissions to air	-2.102E-08	2.111E-09	3.160E-11	-2.316E-08
Uranium (total)	-2.102E-08	2.111E-09	3.160E-11	-2.316E-08
Unspecified Heavy Metals	-4.434E-16	2.294E-17	2.146E-19	-4.666E-16
Emissions to fresh water	4.343E-02	4.684E-02	6.882E-05	-3.481E-03
Analytical measures to fresh water	-2.406E-05	2.054E-04	1.077E-06	-2.305E-04
Adsorbable organic halogen compounds (AOX)	6.261E-08	3.443E-08	9.729E-10	2.721E-08
Biological oxygen demand (BOD)	1.374E-06	1.144E-06	8.297E-08	1.470E-07
Chemical oxygen demand (COD)	-1.620E-04	6.682E-05	6.330E-07	-2.294E-04
Nitrogenous Matter (unspecified, as N)	7.573E-05	7.505E-05	4.291E-08	6.315E-07
Solids (dissolved)	4.747E-05	5.066E-05	1.891E-07	-3.379E-06
Total dissolved organic bounded carbon	1.892E-07	1.204E-07	6.864E-08	2.007E-10
Total Dissolved Solids	1.115E-05	1.115E-05	0.000E+00	0.000E+00
Total organic bounded carbon	1.933E-06	4.180E-07	5.925E-08	1.455E-06
Heavy metals to fresh water	1.750E-04	9.962E-05	8.643E-06	6.678E-05
Aluminium	2.706E-05	4.989E-06	1.542E-06	2.053E-05
Antimony	2.390E-07	4.420E-08	1.366E-08	1.811E-07
Arsenic (+V)	8.300E-07	2.242E-07	4.384E-08	5.619E-07
Cadmium (+II)	1.375E-07	8.879E-08	4.349E-09	4.437E-08
Chromium (+III)	-5.678E-09	5.507E-10	1.034E-11	-6.239E-09
Chromium (+VI)	3.231E-08	2.228E-13	1.867E-12	3.231E-08
Chromium (unspecified)	1.806E-06	6.915E-07	7.589E-08	1.038E-06
Cobalt	2.299E-11	9.766E-12	1.198E-12	1.203E-11
Copper (+II)	1.433E-06	5.407E-07	6.394E-08	8.281E-07
Heavy metals to water (unspecified)	2.835E-10	7.225E-10	1.005E-12	-4.400E-10
Iron	7.949E-05	7.545E-05	3.527E-06	5.177E-07
Lead (+II)	3.423E-06	1.362E-06	1.484E-07	1.912E-06
Manganese (+II)	-3.518E-07	5.358E-08	3.699E-10	-4.058E-07
Mercury (+II)	5.696E-07	5.602E-07	7.462E-10	8.593E-09
Molybdenum	-4.012E-08	5.429E-09	8.135E-11	-4.563E-08
Nickel (+II)	2.175E-05	5.071E-06	1.172E-06	1.550E-05
Selenium	-8.437E-09	1.132E-09	1.692E-11	-9.586E-09
Silver	2.333E-07	4.317E-08	1.334E-08	1.768E-07
Strontium	-9.133E-07	7.052E-08	4.718E-09	-9.885E-07
Thallium	5.935E-13	5.329E-13	2.774E-14	3.293E-14
Tin (+IV)	1.006E-09	1.381E-11	4.005E-12	9.885E-10
Titanium	-5.400E-09	5.584E-10	8.902E-12	-5.968E-09

Process or Category	Cradle to Gate	Cradle to Gate (RMA)	Gate to Gate (RMT)	Gate to Gate (ECF)
Unspecified Substance	-3.836E-12	1.984E-13	1.856E-15	-4.036E-12
Uranium	2.861E-06	2.861E-06	0.000E+00	0.000E+00
Vanadium (+III)	-1.419E-08	1.772E-09	2.967E-11	-1.599E-08
Zinc (+II)	3.651E-05	7.563E-06	2.033E-06	2.692E-05
Inorganic emissions to fresh water	4.288E-02	4.606E-02	4.933E-05	-3.222E-03
Acid (calculated as H+)	2.432E-07	2.895E-09	1.654E-08	2.238E-07
Aluminum (+III)	-1.818E-06	1.720E-07	2.522E-09	-1.992E-06
Ammonia	4.787E-05	4.752E-05	2.756E-08	3.317E-07
Ammonia, as N	5.244E-13	5.244E-13	0.000E+00	0.000E+00
Ammonium (total N)	2.920E-04	5.400E-05	1.669E-05	2.213E-04
Ammonium / ammonia	8.791E-05	8.983E-05	4.573E-08	-1.966E-06
Barium	5.058E-07	4.755E-07	1.133E-09	2.918E-08
Beryllium	-6.286E-11	6.401E-12	9.487E-14	-6.936E-11
Boron	-1.333E-06	5.870E-08	8.886E-10	-1.392E-06
Bromate	1.668E-12	5.538E-15	1.649E-12	1.310E-14
Bromine	1.640E-11	1.038E-11	1.865E-13	5.833E-12
Calcium (+II)	1.742E-02	1.763E-02	1.895E-06	-2.110E-04
Carbonate	2.642E-02	2.642E-02	9.991E-08	2.074E-06
Chlorate	1.668E-09	5.087E-12	1.650E-09	1.254E-11
Chloride	-1.639E-03	2.664E-04	2.004E-05	-1.926E-03
Chlorine (dissolved)	-2.194E-06	2.796E-07	3.464E-09	-2.477E-06
Copper ion (+II/+III)	7.585E-10	2.493E-14	1.874E-16	7.585E-10
Cyanide	2.173E-06	4.016E-07	1.244E-07	1.647E-06
Fluoride	3.725E-04	1.006E-03	3.080E-07	-6.341E-04
Fluorine	-5.109E-10	2.186E-10	9.363E-12	-7.389E-10
Hydrogen chloride	-7.912E-12	3.999E-12	1.725E-13	-1.208E-11
Hydrogen fluoride (hydrofluoric acid)	1.955E-11	1.304E-11	2.108E-13	6.302E-12
Hydrogen Ions (H+)	-8.564E-10	4.429E-11	4.145E-13	-9.011E-10
Hydroxide	6.003E-08	3.080E-09	4.991E-08	7.037E-09
Inorganic salts and acids (unspecified)	7.424E-16	2.797E-17	5.114E-20	7.144E-16
Iron ion (+II/+III)	3.466E-07	3.172E-12	0.000E+00	3.466E-07
Magnesium (+III)	-4.061E-05	1.878E-06	3.063E-08	-4.252E-05
Magnesium chloride	2.513E-13	4.134E-14	7.439E-14	1.356E-13
Metal ions (unspecific)	7.495E-08	1.866E-10	7.417E-08	5.941E-10
Neutral salts	7.480E-11	5.037E-11	1.616E-13	2.427E-11
Nickel ion (+III)	2.191E-08	1.414E-13	0.000E+00	2.191E-08
Nitrate	-1.189E-05	9.120E-07	6.882E-07	-1.349E-05
Nitrate (as total N)	-1.375E-11	7.114E-13	6.657E-15	-1.447E-11

Process or Category	Cradle to Gate	Cradle to Gate (RMA)	Gate to Gate (RMT)	Gate to Gate (ECF)
Nitrogen	9.265E-05	9.259E-05	3.236E-08	2.446E-08
Nitrogen (as total N)	8.813E-09	8.813E-09	0.000E+00	0.000E+00
Nitrogen organic bounded	1.482E-06	8.219E-08	5.654E-09	1.394E-06
Phosphate	2.388E-07	1.434E-07	9.289E-10	9.442E-08
Phosphorus	2.954E-04	2.744E-04	1.497E-06	1.954E-05
Potassium	2.691E-08	5.104E-09	6.110E-09	1.570E-08
Silicate particles	5.370E-10	5.382E-10	4.007E-14	-1.241E-12
Sodium (+I)	4.264E-05	7.699E-05	6.797E-06	-4.115E-05
Sodium chloride (rock salt)	9.287E-06	9.287E-06	1.504E-13	-3.018E-11
Sodium hypochlorite	1.594E-10	1.174E-10	7.418E-13	4.127E-11
Sulfates	6.968E-07	6.968E-07	0.000E+00	0.000E+00
Sulphate	-5.057E-04	8.664E-05	8.829E-07	-5.932E-04
Sulphide	5.575E-07	9.789E-08	1.311E-08	4.465E-07
Sulphite	-4.050E-07	1.731E-08	2.408E-10	-4.225E-07
Sulphur	1.400E-09	3.866E-10	1.136E-10	8.999E-10
Sulphuric acid	-1.020E-09	5.155E-10	2.224E-11	-1.558E-09
Unspecified Iron Oxides	-9.823E-12	5.080E-13	4.754E-15	-1.034E-11
Unspecified Oil	-3.480E-11	1.800E-12	1.684E-14	-3.662E-11
Unspecified Organic Chlorine compounds	-7.886E-14	4.079E-15	3.817E-17	-8.298E-14
Unspecified Salt	-3.155E-10	1.632E-11	1.527E-13	-3.320E-10
Unspecified Solids (Suspended)	-1.225E-09	6.336E-11	5.928E-13	-1.289E-09
Organic emissions to fresh water	8.555E-05	8.568E-05	6.649E-08	-1.961E-07
Halogenated organic emissions to fresh water	-3.216E-12	1.509E-11	4.456E-13	-1.875E-11
1,2-Dibromoethane	-5.246E-15	1.397E-15	2.927E-16	-6.936E-15
Chlorinated hydrocarbons (unspecified)	2.401E-13	2.401E-13	2.046E-19	4.984E-18
Chloromethane (methyl chloride)	-3.427E-12	1.483E-11	4.433E-13	-1.870E-11
Dichloroethane (ethylene dichloride)	2.735E-15	2.598E-15	1.365E-16	6.614E-19
Dichloropropane	-4.302E-16	3.139E-17	1.659E-19	-4.618E-16
Polychlorinated dibenzo-p-dioxins (2,3,7,8 - TCDD)	1.409E-17	8.466E-18	5.590E-18	3.120E-20
Vinyl chloride (VCM; chloroethene)	-2.663E-14	1.669E-14	1.885E-15	-4.521E-14
Hydrocarbons to fresh water	8.509E-05	8.534E-05	1.092E-08	-2.634E-07
Acenaphthene	7.985E-12	1.598E-12	2.182E-13	6.169E-12
Acenaphthylene	3.332E-12	6.480E-13	9.060E-14	2.594E-12
Acetic acid	1.981E-08	6.848E-09	3.800E-10	1.258E-08
Acrylonitrile	-3.146E-11	2.295E-12	1.213E-14	-3.377E-11
Anthracene	1.269E-11	2.261E-12	3.137E-13	1.012E-11
Aromatic hydrocarbons (unspecified)	8.397E-09	3.409E-09	1.232E-10	4.864E-09
Benzene	1.785E-08	4.786E-09	4.338E-10	1.263E-08

Process or Category	Cradle to Gate	Cradle to Gate (RMA)	Gate to Gate (RMT)	Gate to Gate (ECF)
Benzo{a}anthracene	1.055E-12	2.262E-13	3.130E-14	7.976E-13
Benzofluoranthene	4.435E-13	1.315E-13	1.688E-14	2.951E-13
Chrysene	4.491E-12	1.034E-12	1.409E-13	3.316E-12
Cresol (methyl phenol)	3.626E-11	1.001E-11	2.942E-12	2.331E-11
Ethyl benzene	8.577E-10	1.683E-10	2.220E-11	6.672E-10
Fluoranthene	1.325E-12	3.219E-13	3.724E-14	9.663E-13
Hexane (isomers)	3.956E-12	1.094E-12	3.212E-13	2.541E-12
Hydrocarbons (unspecified)	2.319E-07	1.425E-08	5.057E-09	2.126E-07
Methanol	8.133E-05	8.192E-05	8.869E-10	-5.908E-07
Oil (unspecified)	3.443E-06	3.379E-06	2.913E-09	6.148E-08
Phenol (hydroxy benzene)	3.347E-08	2.969E-09	6.262E-10	2.988E-08
Polycyclic aromatic hydrocarbons (PAH, unspec.)	-1.505E-08	1.892E-09	9.443E-11	-1.704E-08
Toluene (methyl benzene)	1.031E-08	2.397E-09	2.705E-10	7.644E-09
Xylene (isomers; dimethyl benzene)	3.764E-09	1.541E-09	1.109E-10	2.112E-09
Carbon, organically bound	4.450E-07	3.398E-07	1.672E-08	8.844E-08
Naphthalene	5.107E-10	9.780E-11	1.349E-11	3.994E-10
N-unspecified (N)	-2.723E-11	1.409E-12	1.318E-14	-2.866E-11
Organic chlorine compounds (unspecified)	3.289E-11	1.017E-13	3.259E-11	1.939E-13
Organic compounds (dissolved)	3.560E-08	3.104E-11	3.548E-08	9.444E-11
Organic compounds (unspecified)	3.346E-09	1.033E-11	3.309E-09	2.650E-11
Unspecified wastewater	-2.059E-08	1.065E-09	9.967E-12	-2.167E-08
Other emissions to fresh water	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Particles to fresh water	3.044E-04	3.895E-04	9.694E-06	-9.477E-05
Metals (unspecified)	1.182E-09	1.157E-11	1.313E-09	-1.425E-10
Silicon dioxide (silica)	1.161E-06	7.496E-12	4.290E-15	1.161E-06
Soil loss by erosion into water	3.119E-07	2.487E-10	3.955E-12	3.116E-07
Solids (suspended)	1.708E-04	2.575E-04	9.618E-06	-9.634E-05
Suspended solids, unspecified	1.322E-04	1.320E-04	7.545E-08	8.940E-08
Unspecified Oxides	-8.166E-12	4.223E-13	3.952E-15	-8.592E-12
Radioactive emissions to fresh water	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Bromide	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Radionuclide	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sulfite	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Unspecified Solids (Dissolved)	-2.361E-09	1.221E-10	1.143E-12	-2.484E-09
Uranium (total)	2.658E-13	2.658E-13	0.000E+00	0.000E+00
Emissions to sea water	1.656E-03	1.801E-04	2.521E-05	1.450E-03
Analytical measures to sea water	2.598E-06	5.312E-07	8.724E-08	1.979E-06
Adsorbable organic halogen compounds (AOX)	8.285E-14	2.897E-14	5.137E-15	4.874E-14

Process or Category	Cradle to Gate	Cradle to Gate (RMA)	Gate to Gate (RMT)	Gate to Gate (ECF)
Biological oxygen demand (BOD)	9.139E-08	3.196E-08	5.667E-09	5.376E-08
Chemical oxygen demand (COD)	2.415E-06	4.673E-07	7.590E-08	1.872E-06
Total organic bounded carbon	9.139E-08	3.196E-08	5.667E-09	5.376E-08
Heavy metals to sea water	5.385E-07	7.991E-08	1.830E-08	4.403E-07
Arsenic (+V)	7.644E-09	8.228E-10	1.950E-10	6.627E-09
Cadmium (+II)	1.709E-09	5.078E-10	9.772E-11	1.103E-09
Chromium (unspecified)	1.231E-08	1.244E-09	3.129E-10	1.076E-08
Cobalt	7.178E-09	6.811E-10	5.948E-11	6.437E-09
Copper (+II)	1.603E-08	2.899E-09	5.912E-10	1.254E-08
Iron	1.000E-07	1.079E-08	1.472E-09	8.774E-08
Lead (+II)	3.799E-09	7.179E-10	1.565E-10	2.925E-09
Manganese (+II)	1.039E-08	1.113E-09	1.493E-10	9.127E-09
Mercury (+II)	8.138E-11	1.466E-11	2.366E-12	6.435E-11
Molybdenum	2.712E-10	1.981E-10	5.765E-12	6.734E-11
Nickel (+II)	8.272E-09	1.150E-09	2.097E-10	6.912E-09
Silver	2.727E-10	5.578E-11	1.710E-11	1.998E-10
Strontium	2.221E-07	4.550E-08	1.381E-08	1.628E-07
Tin (+IV)	3.266E-10	6.681E-11	2.049E-11	2.393E-10
Titanium	3.327E-11	6.806E-12	2.087E-12	2.438E-11
Vanadium (+III)	4.963E-09	4.756E-10	4.340E-11	4.444E-09
Zinc (+II)	1.431E-07	1.367E-08	1.159E-09	1.283E-07
Inorganic emissions to sea water	1.579E-03	1.539E-04	2.058E-05	1.404E-03
Aluminum (+III)	1.071E-09	2.191E-10	6.717E-11	7.847E-10
Ammonia	3.183E-08	6.511E-09	1.996E-09	2.332E-08
Barium	3.109E-07	3.058E-08	3.983E-09	2.763E-07
Beryllium	4.051E-10	3.788E-11	3.080E-12	3.641E-10
Boron	1.732E-08	3.543E-09	1.086E-09	1.269E-08
Calcium (+II)	1.891E-06	3.869E-07	1.186E-07	1.386E-06
Carbonate	1.952E-05	1.894E-06	2.504E-07	1.738E-05
Chloride	1.543E-03	1.496E-04	1.991E-05	1.373E-03
Magnesium	4.724E-07	9.896E-08	2.962E-08	3.439E-07
Nitrate	2.535E-08	2.496E-09	3.248E-10	2.253E-08
Sodium (+I)	1.825E-06	6.382E-07	1.132E-07	1.074E-06
Sulphate	8.341E-06	9.097E-07	1.061E-07	7.325E-06
Sulphide	3.532E-06	3.225E-07	4.550E-08	3.164E-06
Sulphur	9.267E-09	1.896E-09	5.812E-10	6.790E-09
Organic emissions to sea water	9.182E-07	1.124E-07	1.274E-08	7.931E-07
Hydrocarbons to sea water	9.080E-07	1.112E-07	1.263E-08	7.842E-07

Process or Category	Cradle to Gate	Cradle to Gate (RMA)	Gate to Gate (RMT)	Gate to Gate (ECF)
Acenaphthene	3.081E-10	3.858E-11	3.308E-12	2.662E-10
Acenaphthylene	1.175E-10	1.470E-11	1.269E-12	1.015E-10
Acetic acid	9.303E-10	1.042E-10	7.601E-12	8.186E-10
Anthracene	8.477E-11	1.019E-11	1.162E-12	7.342E-11
Aromatic hydrocarbons (unspecified)	9.139E-10	3.196E-10	5.667E-11	5.377E-10
Benzene	7.271E-08	1.135E-08	1.209E-09	6.014E-08
Benzo{a}anthracene	6.880E-11	8.645E-12	7.215E-13	5.944E-11
Benzofluoranthene	7.610E-11	9.592E-12	7.804E-13	6.573E-11
Chrysene	3.880E-10	4.881E-11	4.034E-12	3.352E-10
Cresol (methyl phenol)	2.400E-10	4.910E-11	1.505E-11	1.759E-10
Ethyl benzene	9.354E-09	2.653E-09	8.862E-11	6.612E-09
Fluoranthene	8.020E-11	1.008E-11	8.413E-13	6.928E-11
Hexane (isomers)	2.620E-11	5.361E-12	1.644E-12	1.920E-11
Oil (unspecified)	6.047E-07	6.956E-08	8.536E-09	5.266E-07
Phenol (hydroxy benzene)	1.351E-07	1.540E-08	1.549E-09	1.182E-07
Toluene (methyl benzene)	4.344E-08	8.459E-09	7.738E-10	3.421E-08
Xylene (isomers; dimethyl benzene)	3.950E-08	3.108E-09	3.767E-10	3.601E-08
Naphthalene	1.020E-08	1.223E-09	1.156E-10	8.866E-09
Particles to sea water	7.273E-05	2.543E-05	4.510E-06	4.279E-05
Solids (suspended)	7.273E-05	2.543E-05	4.510E-06	4.279E-05
Emissions to agricultural soil	5.302E-05	5.302E-05	0.000E+00	5.157E-12
Heavy metals to agricultural soil	5.302E-05	5.302E-05	0.000E+00	5.157E-12
Cadmium (+II)	7.752E-07	7.751E-07	0.000E+00	3.770E-12
Chromium (unspecified)	3.689E-05	3.689E-05	0.000E+00	0.000E+00
Copper (+II)	2.104E-06	2.104E-06	0.000E+00	1.978E-13
Lead (+II)	3.911E-07	3.911E-07	0.000E+00	2.967E-13
Mercury (+II)	6.432E-09	6.432E-09	0.000E+00	1.978E-15
Nickel (+II)	1.266E-06	1.266E-06	0.000E+00	9.892E-14
Zinc (+II)	1.159E-05	1.159E-05	0.000E+00	7.913E-13
Emissions to industrial soil	1.017E-04	9.774E-05	1.240E-07	3.811E-06
Heavy metals to industrial soil	9.309E-05	9.209E-05	3.170E-08	9.716E-07
Antimony	8.085E-19	1.047E-19	0.000E+00	7.038E-19
Arsenic (+V)	5.001E-08	5.001E-08	3.676E-14	1.097E-12
Cadmium (+II)	3.429E-11	2.064E-11	4.092E-12	9.557E-12
Chromium (+III)	8.656E-11	2.531E-13	8.572E-11	5.823E-13
Chromium (+VI)	2.406E-18	3.794E-19	0.000E+00	2.026E-18
Chromium (unspecified)	8.588E-09	5.619E-09	9.011E-11	2.879E-09
Cobalt	1.549E-10	1.001E-10	1.599E-12	5.318E-11

Process or Category	Cradle to Gate	Cradle to Gate (RMA)	Gate to Gate (RMT)	Gate to Gate (ECF)
Copper (+II)	1.749E-10	5.735E-11	8.662E-11	3.097E-11
Iron	8.950E-05	8.950E-05	1.297E-10	4.307E-09
Lead (+II)	3.577E-07	3.576E-07	1.286E-10	1.644E-12
Manganese (+II)	1.682E-09	1.185E-09	1.945E-11	4.775E-10
Mercury (+II)	9.260E-10	9.251E-10	8.590E-13	6.622E-14
Nickel (+II)	2.096E-09	1.658E-09	7.091E-11	3.668E-10
Selenium	5.941E-09	5.941E-09	0.000E+00	5.772E-18
Strontium	2.845E-06	1.851E-06	3.073E-08	9.631E-07
Thallium	4.324E-08	4.324E-08	0.000E+00	0.000E+00
Vanadium (+III)	2.730E-07	2.730E-07	0.000E+00	0.000E+00
Zinc (+II)	1.285E-09	6.236E-10	3.528E-10	3.083E-10
Inorganic emissions to industrial soil	8.566E-06	5.638E-06	9.211E-08	2.836E-06
Aluminum (+III)	9.523E-09	6.307E-09	1.005E-10	3.116E-09
Ammonia	4.499E-06	2.925E-06	4.822E-08	1.526E-06
Bromide	1.327E-09	8.580E-10	1.370E-11	4.558E-10
Calcium (+II)	-5.693E-08	6.853E-09	3.472E-10	-6.413E-08
Chloride	1.545E-06	1.001E-06	1.601E-08	5.280E-07
Chlorine	5.614E-16	8.854E-17	0.000E+00	4.728E-16
Fluoride	4.425E-08	2.860E-08	4.568E-10	1.519E-08
Magnesium (+III)	-7.852E-09	9.563E-10	4.813E-11	-8.856E-09
Phosphorus	4.626E-07	3.010E-07	4.998E-09	1.566E-07
Potassium (+I)	1.100E-06	7.216E-07	1.139E-08	3.669E-07
Sodium (+I)	-4.982E-09	5.979E-10	3.034E-11	-5.610E-09
Sulphate	1.391E-07	9.211E-08	1.500E-09	4.549E-08
Sulphide	8.346E-07	5.527E-07	9.002E-09	2.729E-07
Organic emissions to industrial soil	6.927E-09	3.219E-09	1.718E-10	3.536E-09
Oil (unspecified)	6.927E-09	3.219E-09	1.718E-10	3.536E-09
Radioactive emissions to industrial soil	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Calcium Fluoride	6.830E-09	6.830E-09	0.000E+00	0.000E+00
Radionuclide	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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