NETL Life Cycle Inventory Data
Process Documentation File

Process Name:	Uranium, Production with US Enrichment
Reference Flow:	1 kg of Uranium Fuel Assemblies
Brief Description:	This process includes all inputs for the raw material acquisition for 1 kg of uranium fuel assemblies enriched in the U.S.

Section I: Meta Data

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

Year Data Best Represents: 2010

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:

Africa	*The percent of African mined uranium enriched in the U.S. and used in American reactors*
Australia	*The percent of Australian mined uranium enriched in the U.S. and used in American reactors*
Canada	*The percent of Canadian mined uranium enriched in the U.S. and used in American reactors*
Russia	*The percent of Russian mined uranium enriched in the U.S. and used in American reactors*

US	*The percent of American mined uranium enriched in the U.S. and used in American reactors*

Transportation Distances By Truck, Train, and Ocean Freighter for each of the following:

Mine to Conversion Facility	*The distances to transport from the port to the conversion facility by each mode of transportation*
Conversion Facility to Enrichment Facility	*The distances to transport from the conversion facility to the enrichment facility by each mode of transportation*
Enrichment Facility to Fuel Assembly	*The distances to transport from the enrichment facility to the fuel assembly facility by each mode of transportation*

Tracked Input Flows:

Yellowcake (U_3O_8)	*The quantity of yellowcake that is produced at the mines and goes to the conversion facility*
Uranium Hexafluoride (UF_6)	*The output from the conversion facility that enters the enrichment facility*
Enriched Uranium Hexafluoride (UF_6)	*The output from the enrichment facility that enters the fuel assembly facility*

Tracked Output Flows:

Fuel Assembly	*Assembled enriched uranium for insertion into the nuclear reactor*

Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_RMA_Uranium_US_Enrich_2011.02.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 uranium fuel assembly is delivered to the life cycle (LC) Stage #2 boundary.

Boundary and Description

LC Stage #1, RMA of uranium, includes extraction (open pit, in situ, and underground mining) and processing of yellowcake, conversion of yellowcake to uranium hexafluoride, enrichment of the concentration uranium hexafluoride, and the assembly of the enriched uranium hexafluoride into fuel assemblies. The enrichment occurs in the United States, using gaseous diffusion enrichment technology exclusively.

Each of the steps of the RMA processing includes the construction and operations of the step. The transportation between the steps is considered part of RMA and the modes are discussed in detail below. With the machinery and facility construction, upstream processes (for example, steel or concrete) are included. The plans for U.S. and European RMA of Uranium use the same unit processes; however, include different parameters applicable to each scenario. The U.S. plan is provided in **Figure 1**. The overall plans are the same for U.S. and European RMA, but the transportation distances and type of enrichment are specific to the supply chain.

There are transportation steps between each of the processing steps, but the product of each step undergoes more processing before it reaches the energy conversion facility, hence why it is still considered part of the RMA stage instead of raw material transportation. The same transportation plan is repeated for each transportation location. The uranium is transported by three modes: truck, ocean freighter, or truck. Each mode has operating emissions. The plan for the transportation of uranium is provided in **Figure 2.**

The construction processes for both machinery and facilities were created. The machinery includes:

- Underground Uranium Mine
  (DS/DF_Stage1_C_Underground_Uranium_Mine_2010.01.doc)
- Open Pit Uranium Mine, Construction
  (DS/DF_DF_Stage1_C_Open_Pit_Uranium_Mine_2010.01.doc)
- Uranium Milling, Construction
  (DS/DF_DS_Stage1_C_Milling_Facility_2010.01.xls)
- In Situ Uranium Mine, Construction
  (DS/ DF_DF_Stage1_C_In_Situ_Uranium_Extraction_2010 01.doc)
- Uranium Conversion Facility, Construction
  (DS/DF_Stage1_C_Conversion_Facility_UF6_2010.01.doc)

Figure 1: Plan for RMA of Uranium, Including Extraction, Conversion, Enrichment, and Fuel Assembly

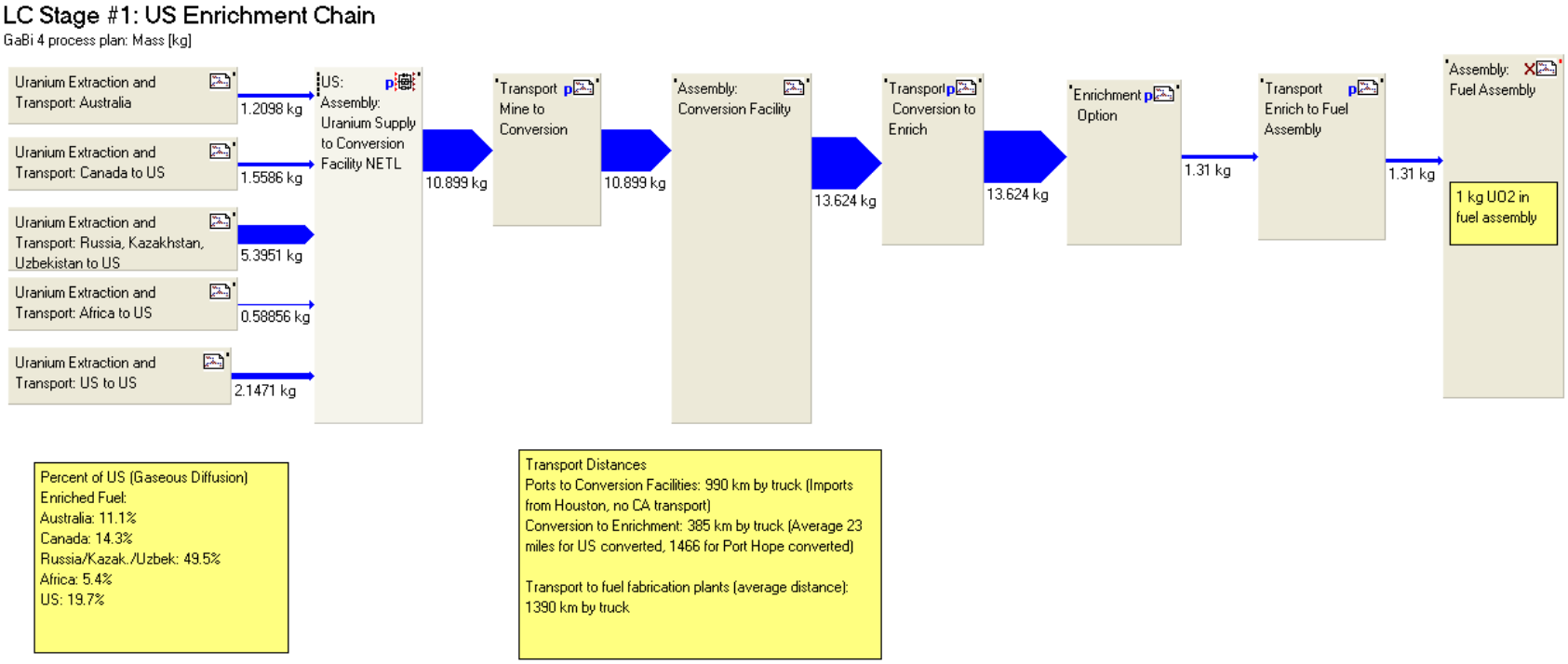
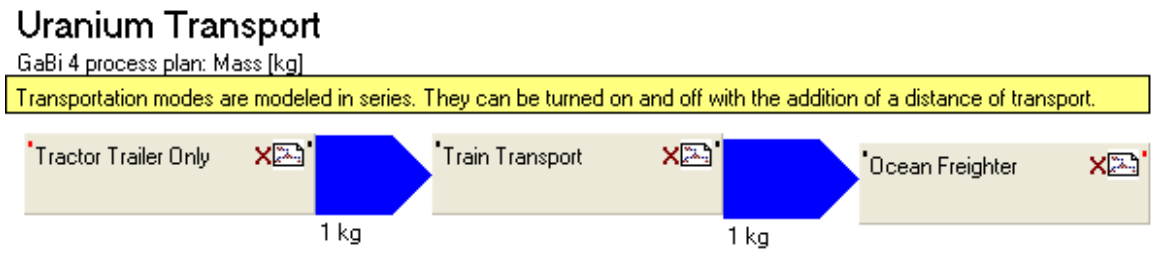


Figure 2: Plan for Transportation of Uranium, including Construction and Operation of Profiles for Transport



- US Enrichment Facility, Construction
  (DS/DF_Stage1_C_Nuclear_Enrichment_Facility_2010 01.doc)
- Enrichment, Decommissioning
  (DS/DF_Stage1_C_GasDiffusion_Decommissioning_2010.01.doc)
- Fuel Assembly, Construction
  (DS/DF_Stage1_C_Fuel_Fabrication_Facility_2010.01.doc)

Each piece of equipment or facility is scaled to the production of one kilogram of fuel assembly. 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 Uranium, US Enrichment

LC Stage #1: US Enrichment Chain
- Assembly: Conversion Facility
  - Conversion, Construction
    - DE: Cast iron part PE <p-agg>
    - DE: Copper mix PE
    - DE: Steel cold rolled PE
    - North American Average Electricity Mix, 2007 070111 NETL
    - RER: Aluminum ingot mix PE
    - RER: Aluminum sheet PE <p-agg>
    - US: Concrete, ready mixed, R-5-0 (100% Portland Cement) NETL <u-so>
    - US: Thermal energy from heavy fuel oil PE
    - US: Uranium Conversion Facility, Construction NETL
  - Conversion, Operation
    - CA: Uranium Conversion Facility, Operation NETL
    - North American Average Electricity Mix, 2007 070111 NETL
    - US: Industrial Boiler, Natural Gas Fired, Over 100 Million BTU/hr NETL
    - US: Natural Gas RMA/RMT, Mix Nominal, 060911 NETL
  - US: Assembly: Conversion Facility NETL
- Assembly: Fuel Assembly
  - Fuel Assembly, Construction
    - DE: Cast iron part PE <p-agg>
    - DE: Copper mix PE
    - DE: Steel cold rolled PE
    - North American Average Electricity Mix, 2007 070111 NETL
    - RER: Aluminum ingot mix PE
    - RER: Aluminum sheet PE <p-agg>
    - US: Concrete, ready mixed, R-5-0 (100% Portland Cement) NETL <u-so>
    - US: Fuel Assembly, Construction NETL
    - US: Thermal energy from heavy fuel oil PE
  - Fuel Assembly, Operation

North American Average Electricity Mix, 2007 070111 NETL
US: Fuel Assembly, Operation NETL
US: Natural Gas RMA/RMT, Mix Nominal, 060911 NETL
US: Assembly: Fuel Assembly NETL
Enrichment Option
Assembly: Centrifuge Enrichment in US
Centrifuge Enrichment in US, Operation
DE: Chlorine mix PE
EU-15: Lubricants PE
North American Average Electricity Mix, 2007 070111 NETL
US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
US: Gas Centrifuge Uranium Enrichment, Operation NETL
US: Industrial Boiler, Natural Gas Fired, Over 100 Million BTU/hr NETL
US: Natural Gas RMA/RMT, Mix Nominal, 060911 NETL
Enrichment Facility, Construction
DE: Copper mix PE
EU-15: Bitumen at refinery PE
EU-15: Diesel ELCD/PE-GaBi
FR: Power grid mix ELCD/PE-GaBi
RER: Aluminum ingot mix PE
RER: Aluminum sheet PE <p-agg>
US: Concrete, ready mixed, R-5-0 (100% Portland Cement) NETL <u-so>
US: Enrichment Facility, Construction NETL
WOR: Steel Pipe, Welded, BF, Manufacture NETL <u-so>
WOR: Steel Plate, BF, Manufacture NETL <u-so>
Enrichment, Decommissioning
North American Average Electricity Mix, 2007 070111 NETL
US: Assembly: Enrichment Facility Centrifuge
US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
US: UF6 Storage Container, Construction NETL
WOR: Steel Plate, BF, Manufacture NETL <u-so>
Assembly: Diffusion Enrichment
Enrichment Facility, Construction
DE: Copper mix PE
EU-15: Bitumen at refinery PE
EU-15: Diesel ELCD/PE-GaBi
FR: Power grid mix ELCD/PE-GaBi
RER: Aluminum ingot mix PE
RER: Aluminum sheet PE <p-agg>
US: Concrete, ready mixed, R-5-0 (100% Portland Cement) NETL <u-so>
US: Enrichment Facility, Construction NETL
WOR: Steel Pipe, Welded, BF, Manufacture NETL <u-so>
WOR: Steel Plate, BF, Manufacture NETL <u-so>

- Gaseous Diffusion Enrichment Operations
  - US: Gaseous Diffusion Enrichment Operation NETL
  - US: Power from hard coal PE
- Enrichment, Decommissioning
- North American Average Electricity Mix, 2007 070111 NETL
- US: Assembly: Enrichment Facility Gaseous
- US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
- US: UF6 Storage Container, Construction NETL
- WOR: Steel Plate, BF, Manufacture NETL <u-so>

US: Assembly: Enrichment 2 NETL

US: Assembly: Enrichment NETL

Transport Conversion to Enrich

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

US: Ocean Freighter Transport, Operation NETL

US: Tractor-trailer Transport, Operation NETL

US: Train Transport, Operation NETL

Transport Enrich to Fuel Assembly

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

US: Ocean Freighter Transport, Operation NETL

US: Tractor-trailer Transport, Operation NETL

US: Train Transport, Operation NETL

Transport Mine to Conversion

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

US: Ocean Freighter Transport, Operation NETL

US: Tractor-trailer Transport, Operation NETL

US: Train Transport, Operation NETL

Uranium Extraction and Transport: Africa to US

- Transport Africa Mine to Port
  - US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
  - US: Ocean Freighter Transport, Operation NETL
  - US: Tractor-trailer Transport, Operation NETL
  - US: Train Transport, Operation NETL
- Uranium Mining Mixer: Africa
  - ASSEMBLY: In Situ Uranium Mine
    - In Situ Mine, Construction
      - North American Average Electricity Mix, 2007 070111 NETL
      - North American Average Electricity Mix, 2007 070111 NETL
      - RER: Polyvinylchloride pipe (PVC) PlasticsEurope
      - US: Concrete, ready mixed, R-5-0 (100% Portland Cement) NETL <u-so>
      - US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
      - US: In Situ Uranium Mine, Construction NETL
    - In Situ Mining, Operation
      - DE: Carbon dioxide PE

DE: Soda (Na2CO3) PE
DE: Sodium chloride (rock salt) PE
FR: Hydrogen peroxide PE
GB: Chlorine mix PE
GB: Oxygen PE
North American Average Electricity Mix, 2007 070111 NETL
US: In Situ Leach Mining Operation NETL
US: Natural Gas RMA/RMT, Mix Nominal, 060911 NETL
US: Assembly: In Situ Uranium Mine
ASSEMBLY: Open Pit Uranium Mine
Uranium Milling, Construction
DE: Copper mix PE
DE: Pine log with bark ELCD/PE-GaBi
DE: Steel cold rolled PE
North American Average Electricity Mix, 2007 070111 NETL
RER: Aluminum ingot mix PE
RER: Aluminum sheet PE <p-agg>
RER: Polyvinylchloride pipe (PVC) PlasticsEurope
US: Concrete, ready mixed, R-5-0 (100% Portland Cement) NETL <u-so>
US: Diesel Fired Construction Equipment, Variable Horsepower NETL
US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
US: Uranium Milling, Construction NETL
Uranium Open Pit Mine, Construction
DE: Cast iron part PE <p-agg>
DE: Copper mix PE
DE: Steel cold rolled PE
DE: Styrene-butadiene rubber mix (SBR) PE
North American Average Electricity Mix, 2007 070111 NETL
RER: Aluminum ingot mix PE
RER: Aluminum sheet PE <p-agg>
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: Uranium Open Pit Mine, Construction NETL
WOR: Rebar Wire Rod, BF Manufactures NETL
Uranium Open Pit Mining, Operation
DE: Fuel oil light at refinery PE
DE: Limestone hydrate (Ca(OH)2) PE
DE: Soda (Na2CO3) PE
DE: Sulphuric acid (96%) PE
GB: Ammonia (NH3) PE
North American Average Electricity Mix, 2007 070111 NETL
RER: Ammonium nitrate PE

US: Diesel Fired Construction Equipment, Variable Horsepower NETL
US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
US: Industrial Boiler, Natural Gas Fired, Over 100 Million BTU/hr NETL
US: Natural Gas RMA/RMT, Mix Nominal, 060911 NETL
US: Uranium Open Pit Mining and Milling Operations NETL
US: Assembly: Open Pit Uranium Mine
US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
US: Surface Mine Commissioning / Decommissioning NETL
STAGE #1: I6 RMA
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 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 070111 NETL
US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
US: Natural Gas RMA/RMT, Mix Nominal, 060911 NETL
BF: Hot-dip Galvanized NETL
DE: Cast iron part PE <p-agg>
DE: Copper mix PE
DE: Stainless steel cold roll PE
DE: Steel cold rolled PE
DE: Styrene-butadiene rubber mix (SBR) PE
North American Average Electricity Mix, 2007 070111 NETL
RER: Polyvinylchloride pipe (PVC) PlasticsEurope
US: COAL MINE, CONSTRUCTION NETL
US: Concrete, ready mixed, R-5-0 (100% Portland Cement) NETL <u-so>
US: Thermal energy from heavy fuel oil PE
WOR: Rebar Wire Rod, BF Manufactures NETL
WOR: Steel Plate, BF, Manufacture NETL <u-so>
WOR: Steel, Stainless, 316 2B, 80% Recycled NETL <u-so>
Coal Mine, Operation
North American Average Electricity Mix, 2007 070111 NETL
US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
US: Underground Mine, Illinois No. 6 Bituminous Coal, Operation <u-so>
US: ASSEMBLY: COAL MINE CONSTRUCTION & OPERATION NETL
US: Uranium Mining Mixer: Africa NETL
Uranium Extraction and Transport: Australia
Transport Australia Mine to Port

US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
US: Ocean Freighter Transport, Operation NETL
US: Tractor-trailer Transport, Operation NETL
US: Train Transport, Operation NETL
Uranium Mining Mixer: Australia
ASSEMBLY: In Situ Uranium Mine
In Situ Mine, Construction
North American Average Electricity Mix, 2007 070111 NETL
North American Average Electricity Mix, 2007 070111 NETL
RER: Polyvinylchloride pipe (PVC) PlasticsEurope
US: Concrete, ready mixed, R-5-0 (100% Portland Cement) NETL <u-so>
US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
US: In Situ Uranium Mine, Construction NETL
In Situ Mining, Operation
DE: Carbon dioxide PE
DE: Soda (Na2CO3) PE
DE: Sodium chloride (rock salt) PE
FR: Hydrogen peroxide PE
GB: Chlorine mix PE
GB: Oxygen PE
North American Average Electricity Mix, 2007 070111 NETL
US: In Situ Leach Mining Operation NETL
US: Natural Gas RMA/RMT, Mix Nominal, 060911 NETL
US: Assembly: In Situ Uranium Mine
ASSEMBLY: Open Pit Uranium Mine
Uranium Milling, Construction
DE: Copper mix PE
DE: Pine log with bark ELCD/PE-GaBi
DE: Steel cold rolled PE
North American Average Electricity Mix, 2007 070111 NETL
RER: Aluminum ingot mix PE
RER: Aluminum sheet PE <p-agg>
RER: Polyvinylchloride pipe (PVC) PlasticsEurope
US: Concrete, ready mixed, R-5-0 (100% Portland Cement) NETL <u-so>
US: Diesel Fired Construction Equipment, Variable Horsepower NETL
US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
US: Uranium Milling, Construction NETL
Uranium Open Pit Mine, Construction
DE: Cast iron part PE <p-agg>
DE: Copper mix PE
DE: Steel cold rolled PE
DE: Styrene-butadiene rubber mix (SBR) PE
North American Average Electricity Mix, 2007 070111 NETL

RER: Aluminum ingot mix PE
RER: Aluminum sheet PE <p-agg>
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: Uranium Open Pit Mine, Construction NETL
WOR: Rebar Wire Rod, BF Manufactures NETL
Uranium Open Pit Mining, Operation
DE: Fuel oil light at refinery PE
DE: Limestone hydrate (Ca(OH)2) PE
DE: Soda (Na2CO3) PE
DE: Sulphuric acid (96%) PE
GB: Ammonia (NH3) PE
North American Average Electricity Mix, 2007 070111 NETL
RER: Ammonium nitrate PE
US: Diesel Fired Construction Equipment, Variable Horsepower NETL
US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
US: Industrial Boiler, Natural Gas Fired, Over 100 Million BTU/hr NETL
US: Natural Gas RMA/RMT, Mix Nominal, 060911 NETL
US: Uranium Open Pit Mining and Milling Operations NETL
US: Assembly: Open Pit Uranium Mine
US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
US: Surface Mine Commissioning / Decommissioning NETL
STAGE #1: I6 RMA
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 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 070111 NETL
US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
US: Natural Gas RMA/RMT, Mix Nominal, 060911 NETL
BF: Hot-dip Galvanized NETL
DE: Cast iron part PE <p-agg>
DE: Copper mix PE
DE: Stainless steel cold roll PE
DE: Steel cold rolled PE
DE: Styrene-butadiene rubber mix (SBR) PE
North American Average Electricity Mix, 2007 070111 NETL

- RER: Polyvinylchloride pipe (PVC) PlasticsEurope
- US: COAL MINE, CONSTRUCTION NETL
- US: Concrete, ready mixed, R-5-0 (100% Portland Cement) NETL <u-so>
- US: Thermal energy from heavy fuel oil PE
- WOR: Rebar Wire Rod, BF Manufactures NETL
- WOR: Steel Plate, BF, Manufacture NETL <u-so>
- WOR: Steel, Stainless, 316 2B, 80% Recycled NETL <u-so>

Coal Mine, Operation

- North American Average Electricity Mix, 2007 070111 NETL
- US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
- US: Underground Mine, Illinois No. 6 Bituminous Coal, Operation <u-so>

US: ASSEMBLY: COAL MINE CONSTRUCTION & OPERATION NETL

US: Uranium Mining Mixer: Australia NETL

Uranium Extraction and Transport: Canada to US

Transport Canada Mine to Port

- US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
- US: Ocean Freighter Transport, Operation NETL
- US: Tractor-trailer Transport, Operation NETL
- US: Train Transport, Operation NETL

Uranium Mining Mixer: Canada

ASSEMBLY: In Situ Uranium Mine

In Situ Mine, Construction

- North American Average Electricity Mix, 2007 070111 NETL
- North American Average Electricity Mix, 2007 070111 NETL
- RER: Polyvinylchloride pipe (PVC) PlasticsEurope
- US: Concrete, ready mixed, R-5-0 (100% Portland Cement) NETL <u-so>
- US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
- US: In Situ Uranium Mine, Construction NETL

In Situ Mining, Operation

- DE: Carbon dioxide PE
- DE: Soda (Na2CO3) PE
- DE: Sodium chloride (rock salt) PE
- FR: Hydrogen peroxide PE
- GB: Chlorine mix PE
- GB: Oxygen PE
- North American Average Electricity Mix, 2007 070111 NETL
- US: In Situ Leach Mining Operation NETL
- US: Natural Gas RMA/RMT, Mix Nominal, 060911 NETL

US: Assembly: In Situ Uranium Mine

ASSEMBLY: Open Pit Uranium Mine

Uranium Milling, Construction

- DE: Copper mix PE
- DE: Pine log with bark ELCD/PE-GaBi

DE: Steel cold rolled PE
North American Average Electricity Mix, 2007 070111 NETL
RER: Aluminum ingot mix PE
RER: Aluminum sheet PE <p-agg>
RER: Polyvinylchloride pipe (PVC) PlasticsEurope
US: Concrete, ready mixed, R-5-0 (100% Portland Cement) NETL <u-so>
US: Diesel Fired Construction Equipment, Variable Horsepower NETL
US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
US: Uranium Milling, Construction NETL
Uranium Open Pit Mine, Construction
DE: Cast iron part PE <p-agg>
DE: Copper mix PE
DE: Steel cold rolled PE
DE: Styrene-butadiene rubber mix (SBR) PE
North American Average Electricity Mix, 2007 070111 NETL
RER: Aluminum ingot mix PE
RER: Aluminum sheet PE <p-agg>
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: Uranium Open Pit Mine, Construction NETL
WOR: Rebar Wire Rod, BF Manufactures NETL
Uranium Open Pit Mining, Operation
DE: Fuel oil light at refinery PE
DE: Limestone hydrate (Ca(OH)2) PE
DE: Soda (Na2CO3) PE
DE: Sulphuric acid (96%) PE
GB: Ammonia (NH3) PE
North American Average Electricity Mix, 2007 070111 NETL
RER: Ammonium nitrate PE
US: Diesel Fired Construction Equipment, Variable Horsepower NETL
US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
US: Industrial Boiler, Natural Gas Fired, Over 100 Million BTU/hr NETL
US: Natural Gas RMA/RMT, Mix Nominal, 060911 NETL
US: Uranium Open Pit Mining and Milling Operations NETL
US: Assembly: Open Pit Uranium Mine
US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
US: Surface Mine Commissioning / Decommissioning NETL
STAGE #1: I6 RMA
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 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 070111 NETL
US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
US: Natural Gas RMA/RMT, Mix Nominal, 060911 NETL
BF: Hot-dip Galvanized NETL
DE: Cast iron part PE <p-agg>
DE: Copper mix PE
DE: Stainless steel cold roll PE
DE: Steel cold rolled PE
DE: Styrene-butadiene rubber mix (SBR) PE
North American Average Electricity Mix, 2007 070111 NETL
RER: Polyvinylchloride pipe (PVC) PlasticsEurope
US: COAL MINE, CONSTRUCTION NETL
US: Concrete, ready mixed, R-5-0 (100% Portland Cement) NETL <u-so>
US: Thermal energy from heavy fuel oil PE
WOR: Rebar Wire Rod, BF Manufactures NETL
WOR: Steel Plate, BF, Manufacture NETL <u-so>
WOR: Steel, Stainless, 316 2B, 80% Recycled NETL <u-so>
Coal Mine, Operation
North American Average Electricity Mix, 2007 070111 NETL
US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
US: Underground Mine, Illinois No. 6 Bituminous Coal, Operation <u-so>
US: ASSEMBLY: COAL MINE CONSTRUCTION & OPERATION NETL
US: Uranium Mining Mixer: Canada NETL
Uranium Extraction and Transport: Russia, Kazakhstan, Uzbekistan to US
Transport Russia Mine to Port
US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
US: Ocean Freighter Transport, Operation NETL
US: Tractor-trailer Transport, Operation NETL
US: Train Transport, Operation NETL
Uranium Mining Mixer: Russia
ASSEMBLY: In Situ Uranium Mine
In Situ Mine, Construction
North American Average Electricity Mix, 2007 070111 NETL
North American Average Electricity Mix, 2007 070111 NETL
RER: Polyvinylchloride pipe (PVC) PlasticsEurope
US: Concrete, ready mixed, R-5-0 (100% Portland Cement) NETL <u-so>
US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
US: In Situ Uranium Mine, Construction NETL

- In Situ Mining, Operation
  - DE: Carbon dioxide PE
  - DE: Soda (Na2CO3) PE
  - DE: Sodium chloride (rock salt) PE
  - FR: Hydrogen peroxide PE
  - GB: Chlorine mix PE
  - GB: Oxygen PE
  - North American Average Electricity Mix, 2007 070111 NETL
  - US: In Situ Leach Mining Operation NETL
  - US: Natural Gas RMA/RMT, Mix Nominal, 060911 NETL
- US: Assembly: In Situ Uranium Mine

ASSEMBLY: Open Pit Uranium Mine

- Uranium Milling, Construction
  - DE: Copper mix PE
  - DE: Pine log with bark ELCD/PE-GaBi
  - DE: Steel cold rolled PE
  - North American Average Electricity Mix, 2007 070111 NETL
  - RER: Aluminum ingot mix PE
  - RER: Aluminum sheet PE <p-agg>
  - RER: Polyvinylchloride pipe (PVC) PlasticsEurope
  - US: Concrete, ready mixed, R-5-0 (100% Portland Cement) NETL <u-so>
  - US: Diesel Fired Construction Equipment, Variable Horsepower NETL
  - US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
  - US: Uranium Milling, Construction NETL
- Uranium Open Pit Mine, Construction
  - DE: Cast iron part PE <p-agg>
  - DE: Copper mix PE
  - DE: Steel cold rolled PE
  - DE: Styrene-butadiene rubber mix (SBR) PE
  - North American Average Electricity Mix, 2007 070111 NETL
  - RER: Aluminum ingot mix PE
  - RER: Aluminum sheet PE <p-agg>
  - 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: Uranium Open Pit Mine, Construction NETL
  - WOR: Rebar Wire Rod, BF Manufactures NETL
- Uranium Open Pit Mining, Operation
  - DE: Fuel oil light at refinery PE
  - DE: Limestone hydrate (Ca(OH)2) PE
  - DE: Soda (Na2CO3) PE
  - DE: Sulphuric acid (96%) PE
  - GB: Ammonia (NH3) PE

North American Average Electricity Mix, 2007 070111 NETL
RER: Ammonium nitrate PE
US: Diesel Fired Construction Equipment, Variable Horsepower NETL
US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
US: Industrial Boiler, Natural Gas Fired, Over 100 Million BTU/hr NETL
US: Natural Gas RMA/RMT, Mix Nominal, 060911 NETL
US: Uranium Open Pit Mining and Milling Operations NETL
US: Assembly: Open Pit Uranium Mine
US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
US: Surface Mine Commissioning / Decommissioning NETL
STAGE #1: I6 RMA
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 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 070111 NETL
US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
US: Natural Gas RMA/RMT, Mix Nominal, 060911 NETL
BF: Hot-dip Galvanized NETL
DE: Cast iron part PE <p-agg>
DE: Copper mix PE
DE: Stainless steel cold roll PE
DE: Steel cold rolled PE
DE: Styrene-butadiene rubber mix (SBR) PE
North American Average Electricity Mix, 2007 070111 NETL
RER: Polyvinylchloride pipe (PVC) PlasticsEurope
US: COAL MINE, CONSTRUCTION NETL
US: Concrete, ready mixed, R-5-0 (100% Portland Cement) NETL <u-so>
US: Thermal energy from heavy fuel oil PE
WOR: Rebar Wire Rod, BF Manufactures NETL
WOR: Steel Plate, BF, Manufacture NETL <u-so>
WOR: Steel, Stainless, 316 2B, 80% Recycled NETL <u-so>
Coal Mine, Operation
North American Average Electricity Mix, 2007 070111 NETL
US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
US: Underground Mine, Illinois No. 6 Bituminous Coal, Operation <u-so>
US: ASSEMBLY: COAL MINE CONSTRUCTION & OPERATION NETL
US: Uranium Mining Mixer: Russia NETL

- Uranium Extraction and Transport: US to US
  - Transport US Mine to Port
    - US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
    - US: Ocean Freighter Transport, Operation NETL
    - US: Tractor-trailer Transport, Operation NETL
    - US: Train Transport, Operation NETL
  - Uranium Mining Mixer:US
    - ASSEMBLY: In Situ Uranium Mine
      - In Situ Mine, Construction
        - North American Average Electricity Mix, 2007 070111 NETL
        - North American Average Electricity Mix, 2007 070111 NETL
        - RER: Polyvinylchloride pipe (PVC) PlasticsEurope
        - US: Concrete, ready mixed, R-5-0 (100% Portland Cement) NETL <u-so>
        - US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
        - US: In Situ Uranium Mine, Construction NETL
      - In Situ Mining, Operation
        - DE: Carbon dioxide PE
        - DE: Soda (Na2CO3) PE
        - DE: Sodium chloride (rock salt) PE
        - FR: Hydrogen peroxide PE
        - GB: Chlorine mix PE
        - GB: Oxygen PE
        - North American Average Electricity Mix, 2007 070111 NETL
        - US: In Situ Leach Mining Operation NETL
        - US: Natural Gas RMA/RMT, Mix Nominal, 060911 NETL
      - US: Assembly: In Situ Uranium Mine
    - ASSEMBLY: Open Pit Uranium Mine
      - Uranium Milling, Construction
        - DE: Copper mix PE
        - DE: Pine log with bark ELCD/PE-GaBi
        - DE: Steel cold rolled PE
        - North American Average Electricity Mix, 2007 070111 NETL
        - RER: Aluminum ingot mix PE
        - RER: Aluminum sheet PE <p-agg>
        - RER: Polyvinylchloride pipe (PVC) PlasticsEurope
        - US: Concrete, ready mixed, R-5-0 (100% Portland Cement) NETL <u-so>
        - US: Diesel Fired Construction Equipment, Variable Horsepower NETL
        - US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
        - US: Uranium Milling, Construction NETL
      - Uranium Open Pit Mine, Construction
        - DE: Cast iron part PE <p-agg>
        - DE: Copper mix PE
        - DE: Steel cold rolled PE

DE: Styrene-butadiene rubber mix (SBR) PE
North American Average Electricity Mix, 2007 070111 NETL
RER: Aluminum ingot mix PE
RER: Aluminum sheet PE <p-agg>
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: Uranium Open Pit Mine, Construction NETL
WOR: Rebar Wire Rod, BF Manufactures NETL
Uranium Open Pit Mining, Operation
DE: Fuel oil light at refinery PE
DE: Limestone hydrate (Ca(OH)2) PE
DE: Soda (Na2CO3) PE
DE: Sulphuric acid (96%) PE
GB: Ammonia (NH3) PE
North American Average Electricity Mix, 2007 070111 NETL
RER: Ammonium nitrate PE
US: Diesel Fired Construction Equipment, Variable Horsepower NETL
US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
US: Industrial Boiler, Natural Gas Fired, Over 100 Million BTU/hr NETL
US: Natural Gas RMA/RMT, Mix Nominal, 060911 NETL
US: Uranium Open Pit Mining and Milling Operations NETL
US: Assembly: Open Pit Uranium Mine
US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
US: Surface Mine Commissioning / Decommissioning NETL
STAGE #1: I6 RMA
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 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 070111 NETL
US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
US: Natural Gas RMA/RMT, Mix Nominal, 060911 NETL
BF: Hot-dip Galvanized NETL
DE: Cast iron part PE <p-agg>
DE: Copper mix PE
DE: Stainless steel cold roll PE
DE: Steel cold rolled PE

DE: Styrene-butadiene rubber mix (SBR) PE
North American Average Electricity Mix, 2007 070111 NETL
RER: Polyvinylchloride pipe (PVC) PlasticsEurope
US: COAL MINE, CONSTRUCTION NETL
US: Concrete, ready mixed, R-5-0 (100% Portland Cement) NETL <u-so>
US: Thermal energy from heavy fuel oil PE
WOR: Rebar Wire Rod, BF Manufactures NETL
WOR: Steel Plate, BF, Manufacture NETL <u-so>
WOR: Steel, Stainless, 316 2B, 80% Recycled NETL <u-so>
Coal Mine, Operation
North American Average Electricity Mix, 2007 070111 NETL
US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
US: Underground Mine, Illinois No. 6 Bituminous Coal, Operation <u-so>
US: ASSEMBLY: COAL MINE CONSTRUCTION & OPERATION NETL
US: Uranium Mining Mixer: US NETL
US: Assembly: Uranium Supply to Conversion Facility NETL

Parameters and Balances

The parameters for the highest level modeling plans for RMA of uranium 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 Uranium

Plan	Parameter	Value	Comment
US: Assembly: Uranium Supply to Conversion Facility NETL	Africa	0.054	[unitless] Adjustable parameter; portion of uranium extracted in Africa.
US: Assembly: Uranium Supply to Conversion Facility NETL	Australia	0.111	[unitless] Adjustable parameter; portion of uranium extracted in Australia.
US: Assembly: Uranium Supply to Conversion Facility NETL	Canada	0.143	[unitless] Adjustable parameter; portion of uranium extracted in Canada.
US: Assembly: Uranium Supply to Conversion Facility NETL	Russia	0.495	[unitless] Adjustable parameter; portion of uranium extracted in Russia.
US: Assembly: Uranium Supply to Conversion Facility NETL	US	0.197	[unitless] Adjustable parameter; portion of uranium extracted in US.
Fraction of Enrichment in US	US_Enrichment	1	[unitless] Adjustable parameter; portion of the uranium enriched by gaseous diffusion in the US.
Fraction of Enrichment in Europe	Europe	0	[unitless]. Adjustable parameter; portion of the uranium which is enriched in Europe.
Transport Mine/Port to Conversion	MC_truck_dist	385	[km] distance from the mine to conversion facility by truck.
Transport Mine/Port to Conversion	MC_train_dist	0	[km] distance from the mine to conversion facility by train.
Transport Mine/Port to Conversion	MC_ocean_dist	0	[km] distance from the mine to conversion facility by ocean freighter.
Transport Conversion to Enrich	CE_truck_dist	990	[km] distance from the conversion facility to enrichment facility by truck.
Transport Conversion to Enrich	CE_train_dist	0	[km] distance from the conversion facility to enrichment facility by train.
Transport Conversion to Enrich	CE_ocean_dist	0	[km] distance from the conversion facility to enrichment facility by ocean freighter.
Transport Enrich to Fuel Assembly	EF_truck_dist	1390	[km] distance from the enrichment facility to fuel assembly by truck.
Transport Enrich to Fuel Assembly	EF_train_dist	0	[km] distance from the enrichment facility to fuel assembly by train.
Transport Enrich to Fuel Assembly	EF_ocean_dist	0	[km] distance from the enrichment facility to fuel assembly by ocean freighter.
Transport Enrich to Fuel Assembly	Africa	0.054	[unitless] Adjustable parameter; portion of uranium extracted in Africa.

Table 3: Inputs and Output Balances for RMA of Uranium, U.S. Enrichment (kg/kg delivered)

Process or Category	Cradle to Gate (RMA)
Inputs	
Flows	2.269E+05
Resources	2.265E+05

Process or Category	Cradle to Gate (RMA)
Energy resources	8.532E+03
Non renewable energy resources	8.532E+03
Crude oil (resource)	1.060E+02
Crude oil	4.257E-01
Crude oil Algeria	2.765E+00
Crude oil Angola	1.970E+00
Crude oil Argentina	6.717E-02
Crude oil Australia	1.704E-01
Crude oil Austria	7.522E-02
Crude oil Bolivia	1.799E-06
Crude oil Brazil	2.447E-01
Crude oil Brunei	9.278E-08
Crude oil Bulgaria	1.093E-05
Crude oil Cameroon	3.203E-01
Crude oil Canada	5.993E+00
Crude oil Central Africa	0.000E+00
Crude oil Central America	0.000E+00
Crude oil Chile	5.068E-05
Crude oil China	1.906E-02
Crude oil CIS	1.529E+01
Crude oil Colombia	1.971E-01
Crude oil Czech Republic	5.596E-03
Crude oil Denmark	2.527E+00
Crude oil Ecuador	8.116E-01
Crude oil Egypt	3.023E-01
Crude oil France	1.056E-01
Crude oil Gabon	1.552E-01
Crude oil Germany	7.588E-01
Crude oil Greece	1.489E-02
Crude oil Hungary	1.433E-03
Crude oil India	1.850E-07
Crude oil Indonesia	8.696E-02
Crude oil Iran	2.134E+00
Crude oil Iraq	2.731E+00
Crude oil Ireland	6.055E-07
Crude oil Italy	4.884E-01

Process or Category	Cradle to Gate (RMA)
Crude oil Japan	7.673E-10
Crude oil Kuwait	1.391E+00
Crude oil Libya	4.262E+00
Crude oil Malaysia	5.467E-08
Crude oil Mexico	4.493E+00
Crude oil Middle East	0.000E+00
Crude oil Netherlands	3.532E-01
Crude oil New Zealand	8.647E-03
Crude oil Nigeria	4.623E+00
Crude oil North Africa	0.000E+00
Crude oil Norway	1.167E+01
Crude oil Oman	2.793E-02
Crude oil Poland	3.184E-02
Crude oil Qatar	1.531E-02
Crude oil Romania	3.018E-02
Crude oil Saudi Arabia	8.378E+00
Crude oil Slovakia	1.060E-05
Crude oil South Africa	4.491E-08
Crude oil Spain	2.462E-02
Crude oil Syria	5.910E-05
Crude oil Trinidad and Tobago	5.354E-02
Crude oil Tunisia	1.669E-01
Crude oil Turkey	2.489E-09
Crude oil United Arab Emirates	3.248E-02
Crude oil United Kingdom	1.407E+01
Crude oil USA	1.435E+01
Crude oil Venezuela	4.359E+00
Hard coal (resource)	4.269E+03
Hard coal	3.215E-02
Hard Coal (Illinois No 6)	5.383E+01
Hard coal Australia	1.048E+01
Hard coal Belgium	7.295E-05
Hard coal Bosnia and Herzegovina	2.578E-02
Hard coal Brazil	2.816E-03
Hard coal Canada	1.287E+01
Hard coal Chile	5.283E-03

Process or Category	Cradle to Gate (RMA)
Hard coal China	6.906E-01
Hard coal CIS	1.557E+00
Hard coal Colombia	3.945E+01
Hard coal Czech Republic	4.626E-01
Hard coal France	1.701E-02
Hard coal Germany	1.121E+01
Hard coal India	1.351E-05
Hard coal Indonesia	8.177E+00
Hard coal Italy	3.876E-04
Hard coal Japan	2.563E-08
Hard coal Malaysia	2.335E-09
Hard coal Mexico	7.310E-04
Hard coal New Zealand	4.325E-03
Hard coal Poland	3.859E+00
Hard coal Portugal	2.286E-07
Hard coal South Africa	4.071E+00
Hard coal Spain	3.020E-02
Hard coal Turkey	1.074E-05
Hard coal United Kingdom	3.615E-01
Hard coal USA	4.108E+03
Hard coal Venezuela	1.401E+01
Hard coal Vietnam	6.248E-02
Hard Coal, Pure, Fuel	5.705E-04
Hard Coal, Raw, Fuel	4.468E-03
Lignite (resource)	1.723E+01
Lignite	1.215E-04
Lignite Australia	1.508E-01
Lignite Austria	3.803E-03
Lignite Bosnia and Herzegovina	5.955E-02
Lignite Bulgaria	1.038E-02
Lignite Canada	8.200E-02
Lignite CIS	2.988E-02
Lignite Czech Republic	2.112E-01
Lignite France	5.974E-03
Lignite Germany	8.409E-03
Lignite Germany (Central Germany)	2.153E+00

Process or Category	Cradle to Gate (RMA)
Lignite Germany (Lausitz)	4.289E+00
Lignite Germany (Rheinisch)	8.752E+00
Lignite Greece	3.086E-01
Lignite Hungary	8.030E-03
Lignite India	2.703E-06
Lignite Macedonia	6.891E-03
Lignite Poland	1.686E-01
Lignite Romania	4.118E-04
Lignite Serbia and Montenegro	1.549E-02
Lignite Slovakia	1.049E-02
Lignite Slovenia	7.608E-02
Lignite Spain	6.353E-02
Lignite Turkey	3.086E-07
Lignite USA	8.112E-01
Natural gas (resource)	4.140E+03
Natural gas	6.386E-02
Natural gas Algeria	6.548E-01
Natural gas Angola	2.448E-01
Natural gas Argentina	3.456E-02
Natural gas Australia	2.702E-02
Natural gas Austria	8.539E-03
Natural gas Bolivia	3.615E-03
Natural gas Brazil	3.237E-02
Natural gas Brunei	8.433E-04
Natural gas Bulgaria	2.378E-06
Natural gas Cameroon	7.979E-02
Natural gas Canada	1.352E+00
Natural gas Chile	1.188E-02
Natural gas China	1.838E-03
Natural gas CIS	6.490E+00
Natural gas Colombia	2.080E-02
Natural gas Czech Republic	4.921E-04
Natural gas Denmark	4.759E-01
Natural gas Ecuador	5.303E-02
Natural gas Egypt	2.689E-02
Natural gas France	4.675E-02

Process or Category	Cradle to Gate (RMA)
Natural gas Gabon	2.287E-02
Natural gas Germany	3.638E+00
Natural gas Greece	9.989E-04
Natural gas Hungary	1.743E-03
Natural gas India	1.035E-06
Natural gas Indonesia	9.794E-03
Natural gas Iran	2.201E-01
Natural gas Iraq	1.887E-01
Natural gas Ireland	1.377E-03
Natural gas Italy	8.453E-02
Natural gas Japan	2.657E-06
Natural gas Kuwait	8.393E-02
Natural gas Libyan	1.334E-01
Natural gas Malaysia	7.627E-04
Natural gas Mexico	3.316E-01
Natural gas Netherlands	3.658E+00
Natural gas New Zealand	5.713E-04
Natural gas Nigeria	8.442E-01
Natural gas Norway	4.151E+00
Natural gas Oman	5.689E-03
Natural gas Poland	3.370E-03
Natural gas Qatar	1.538E-02
Natural gas Romania	1.719E-03
Natural gas Saudi Arabia	5.631E-01
Natural gas Slovakia	1.713E-04
Natural gas South Africa	1.283E-05
Natural gas Spain	2.409E-03
Natural gas Syria	6.351E-06
Natural gas Trinidad and Tobago	4.698E-02
Natural gas Tunisia	2.010E-02
Natural gas Turkey	2.517E-10
Natural gas United Arab Emirates	4.255E-03
Natural gas United Kingdom	1.959E+00
Natural gas USA	3.760E+03
Natural gas Venezuela	2.966E-01
Natural Gas, Fuel	1.782E-03

Process or Category	Cradle to Gate (RMA)
Natural gas, Raw Material	3.376E+02
Pit gas	1.244E-04
Pit Methane	1.599E+01
Uranium (resource)	8.600E-04
Nuclear energy	0.000E+00
Uranium natural	8.600E-04
Renewable energy resources	3.165E-02
Biomass	1.101E-03
Energy, gross calorific value, in biomass, primary forest	0.000E+00
Primary energy from geothermics	0.000E+00
Primary energy from hydro power	0.000E+00
Primary energy from solar energy	0.000E+00
Primary energy from waves	0.000E+00
Primary energy from wind power	0.000E+00
Renewable fuels	4.823E-06
Wood	3.055E-02
Unspecified	0.000E+00
Energy unspecified (APME)	0.000E+00
Thermal Energy from Diesel Fuel	0.000E+00
Material resources	2.179E+05
Non renewable elements	2.041E+00
Aluminum	1.805E-06
Chromium	3.069E-07
Copper	1.079E-05
Iron	2.030E+00
Lead	3.176E-07
Magnesium	1.588E-12
Mercury	3.081E-07
Nickel	4.710E-09
Phosphorus	2.147E-07
Sulphur	-4.561E-05
Zinc	1.130E-02
Non renewable resources	2.137E+04
Barium sulphate	8.965E-12
Basalt	7.954E-02
Bauxite	2.127E+00

Process or Category	Cradle to Gate (RMA)
Bentonite	3.254E-01
Calcium carbonate (CaCO3)	1.175E-02
Calcium chloride	9.179E-10
Chalk (Calciumcarbonate)	3.099E-32
Chromium ore (39%)	7.439E-04
Clay	2.306E-01
Colemanite ore	1.221E-04
Copper - Gold - Silver - ore (1,0% Cu; 0,4 g/t Au; 66 g/t Ag)	7.878E+00
Copper - Gold - Silver - ore (1,1% Cu; 0,01 g/t Au; 2,86 g/t Ag)	4.799E+00
Copper - Gold - Silver - ore (1,16% Cu; 0,002 g/t Au; 1,06 g/t Ag)	2.709E+00
Copper - Molybdenum - Gold - Silver - ore (1,13% Cu; 0,02% Mo; 0,01 g/t Au; 2,86 g/t Ag)	1.215E-03
Copper ore (0.14%)	2.353E-02
Copper ore (1.2%)	8.169E-01
Copper ore (4%)	1.474E-12
Copper ore (sulphidic, 1.1%)	8.057E-04
Dolomite	1.220E-01
Feldspar (aluminum silicates)	7.473E-08
Ferro manganese	1.638E-07
Fluorspar (calcium fluoride; fluorite)	1.582E-02
Granite	2.318E-14
Gravel	6.139E-02
Gypsum (natural gypsum)	1.446E-01
Heavy spar (BaSO4)	7.780E-01
Ilmenite (titanium ore)	5.336E-04
Inert rock	2.079E+04
Iron ore (56,86%)	7.208E+00
Iron ore (65%)	7.051E-04
Kaolin ore	2.182E-04
Lead - zinc ore (4.6%-0.6%)	6.083E-02
Limestone (calcium carbonate)	2.685E+02
Magnesit (Magnesium carbonate)	2.827E-06
Magnesium chloride leach (40%)	6.319E-02
Manganese ore	1.449E-04
Manganese ore (R.O.M.)	5.187E-02
Molybdenite (Mo 0,24%)	7.452E-04
Molybdenum ore (0.1%)	8.355E-06

Process or Category	Cradle to Gate (RMA)
Natural Aggregate	2.638E+01
Nickel ore (1,5%)	1.392E-05
Nickel ore (1.6%)	1.801E-01
Olivine	1.692E-06
Peat	1.463E-02
Phosphate ore	1.031E-06
Phosphorus minerals	4.338E-06
Phosphorus ore (29% P2O5)	1.217E-08
Potassium chloride	1.181E-04
Precious metal ore (R.O.M)	4.785E-05
Quartz sand (silica sand; silicon dioxide)	4.195E-01
Raw pumice	1.915E-05
Rutile (titanium ore)	2.504E-09
sand	6.245E-05
Slate	8.124E-07
Sodium chloride (rock salt)	2.492E+02
Sodium nitrate	1.582E-12
Sodium sulphate	2.660E-05
Soil	6.329E+00
Sulphur (bonded)	6.916E-08
Talc	4.451E-06
Tin ore	7.775E-13
Titanium ore	1.018E-02
Zinc - copper ore (4.07%-2.59%)	1.806E+00
Zinc - lead - copper ore (12%-3%-2%)	1.351E+00
Zinc - lead ore (4.21%-4.96%)	5.031E-13
Zinc ore (4%)	-8.017E-03
Zinc ore (sulphidic, 4%)	2.495E-12
Renewable resources	1.966E+05
Water	1.415E+05
Water	7.429E+01
Water (feed water)	1.651E-01
Water (ground water)	8.477E+03
Water (lake water)	4.108E+02
Water (municipal)	5.226E-02
Water (municipal)	3.660E+02

Process or Category	Cradle to Gate (RMA)
Water (river water)	0.000E+00
Water (sea water)	0.000E+00
Water (surface water)	1.322E+05
Water (well water)	9.505E-02
Water (well-produced water)	9.687E-01
Water (with river silt)	1.950E-10
Water,turbine use, unspecified natural origin	0.000E+00
Air	5.507E+04
Carbon dioxide	7.673E+00
Nitrogen	8.540E-03
Oxygen	0.000E+00
Unspecified	5.180E-04
Unspecified minerals	1.179E-04
Unspecified resources	4.002E-04
Others	1.819E-10
Cargo	1.819E-10
Cargo (Foreign)	0.000E+00
Production residues in life cycle	4.787E-01
Hazardous waste for recovery	2.601E-12
Carcass meal	2.601E-12
Waste for recovery	4.787E-01
Cast iron scrap	4.036E-02
Industrial waste (incineration)	0.000E+00
Steel scrap (alloyed)	2.644E-06
Steel scrap (St)	4.378E-01
Steel Scrap, Carbon	2.482E-04
Steel Scrap, Stainless (304 from external supply)	0.000E+00
Steel Scrap, Stainless (316 from external supply)	2.416E-04
Steel Scrap, Stainless (430 from external supply)	0.000E+00
Deposited goods	5.185E-03
Consumer waste	5.185E-03
Municipal waste	5.185E-03
Stockpile goods	0.000E+00
Overburden (deposited)	0.000E+00
Tailings - Depleted UF6	0.000E+00
Output	

Process or Category	Cradle to Gate (RMA)
Flows	2.209E+05
Resources	1.107E+05
Energy resources	0.000E+00
Land use	0.000E+00
Hemeroby	0.000E+00
Occup. as Forest land	0.000E+00
Material resources	1.107E+05
Renewable resources	1.107E+05
Water	1.107E+05
Water	0.000E+00
Water (Evaporated)	9.914E+00
Water (feed water)	0.000E+00
Water (ground water)	0.000E+00
Water (lake water)	0.000E+00
Water (river water)	1.045E+05
Water (sea water)	7.344E+00
Water (wastewater)	5.672E+03
Water (wastewater)	4.478E+02
Nitrogen	0.000E+00
Oxygen	5.746E-02
Others	8.984E-01
Cargo	0.000E+00
Cargo (Foreign)	8.984E-01
Production residues in life cycle	6.639E+00
Hazardous waste for disposal	6.131E-01
Chromium containing slag	7.952E-07
Dross (Fines)	4.041E-03
Natrium oxide	6.925E-03
Red mud (dry)	6.016E-01
Soil and sand containing heavy metals	4.063E-05
Toxic chemicals (unspecified)	4.282E-04
Hazardous waste for recovery	2.694E+00
Used oil	1.091E-03
Waste water processing residue	2.693E+00
Waste for disposal	2.743E+00
Incineration good	4.679E-04

Process or Category	Cradle to Gate (RMA)
Sludge from water works (6% dry matter-content)	9.951E-06
Waste (solid)	1.334E+00
Waste for disposal (unspecified)	1.199E-02
Waste from steel works	1.397E+00
Waste for recovery	5.886E-01
Aluminum scrap	9.425E-12
Boiler ash (unspecified)	0.000E+00
Chemicals (unspecified)	5.128E-04
Cooling water	7.956E-04
Cryolite	1.884E-03
Dross	1.409E-06
Filter dust	1.262E-07
Fly ash (unspecified)	0.000E+00
Furnace clinker	3.155E-08
Gypsum	0.000E+00
Gypsum (contaminated)	5.033E-12
Gypsum (FDI)	4.537E-04
Plastic (unspecified)	5.625E-04
Production residues (unspecified)	7.323E-05
Rolling gravel	1.257E-02
Rolling tinder	1.767E-08
Slag	9.794E-02
Slag (containing precious metal)	1.167E-08
Slag (Iron plate production)	4.482E-01
Slag (Mn 6,5%)	2.539E-02
Waste paper	1.037E-04
Wood	1.039E-04
Wooden pallet (EURO)	5.521E-12
Mixed Waste (Hazardous or Radioactive)	6.593E-04
Neutralized residues	8.594E-05
Deposited goods	2.081E+04
Consumer waste	9.486E-02
Bulky waste	1.186E-03
Bulky waste from steel production	1.240E-04
Industrial waste for municipal disposal	-1.427E-04
inert chemical waste	0.000E+00

Process or Category	Cradle to Gate (RMA)
Liquid waste	2.768E-06
Mineral waste	1.747E-02
Municipal waste	0.000E+00
Organic waste	4.184E-03
Packaging waste (metal)	1.343E-05
Packaging waste (plastic)	1.020E-12
Paper (unspecified)	7.184E-05
Rubber	1.291E-04
Waste (unspecified)	7.182E-02
Hazardous waste	3.996E+00
Carbon (unspecified)	4.412E-03
Carbon filter dust	1.037E-03
Dust containing heavy metals	2.621E-05
Dust containing zinc	1.146E-04
Ferriferous furnace slags	9.432E-04
Filter dust	1.043E-03
Filter tar	1.862E-04
Furnace clinker	2.792E-03
Glass fibres	4.132E-05
Hazardous waste (underground deposit)	5.647E-03
Hazardous waste (unspec.)	3.005E-02
Hazardous waste from steel production	7.417E-05
Heavy metal sludge	1.871E-05
Inert chemical waste	5.458E-04
Liquid hazardous waste	0.000E+00
Oxalate (Alumina production)	2.788E-03
Refractory	7.566E-03
Slag	5.974E-02
Sludge	3.878E+00
Soot	5.514E-04
Radioactive waste	1.285E+01
CaF2 (low radioactice)	8.007E-05
Highly radioactive waste	2.389E-04
Highly-active fission product solution	0.000E+00
Jacket and body material	0.000E+00
Medium and low radioactive liquid waste	0.000E+00

Process or Category	Cradle to Gate (RMA)
Medium and low radioactive wastes	2.836E-04
Plutonium as residual product	4.754E-07
Radioactive tailings	1.285E+01
Slag (Uranium conversion)	5.303E-04
Uranium depleted	5.486E-04
Uranium spent as residue	0.000E+00
Volatile fission products (inert gases;iodine;C14)	0.000E+00
Waste radioactive	4.755E-04
Stockpile goods	2.079E+04
Ash	0.000E+00
Demolition waste (deposited)	3.094E+01
Overburden (deposited)	2.074E+04
Sand (Alumina production)	4.586E-02
Slag (deposited)	4.679E+00
Spoil (deposited)	8.323E-01
Tailings	1.334E+01
Tailings - Depleted UF6	0.000E+00
Treatment residue (mineral, deposited)	1.610E+00
Waste from Steel Manufacturing	2.359E+00
Solid Waste (crystal)	0.000E+00
Emissions to air	7.714E+04
Heavy metals to air	1.094E-02
Antimony	1.183E-04
Arsenic (+V)	1.327E-03
Arsenic trioxide	4.581E-11
Cadmium (+II)	7.458E-05
Chromium (+III)	1.126E-07
Chromium (+VI)	1.875E-11
Chromium (unspecified)	1.424E-03
Cobalt	4.969E-05
Copper (+II)	1.793E-04
Heavy metals to air (unspecified)	5.067E-08
Hydrogen arsenic (arsine)	3.802E-09
Iron	2.436E-05
Lanthanides	2.933E-09
Lead (+II)	5.554E-04

Process or Category	Cradle to Gate (RMA)
Manganese (+II)	2.796E-04
Mercury (+II)	1.298E-04
Molybdenum	7.910E-07
Nickel (+II)	1.213E-04
Palladium	2.541E-14
Rhodium	2.453E-14
Selenium	3.427E-03
Silver	5.903E-11
Tellurium	1.499E-08
Thallium	1.792E-07
Tin (+IV)	1.315E-03
Titanium	4.401E-07
Vanadium (+III)	2.398E-04
Zinc (+II)	1.675E-03
Inorganic emissions to air	3.122E+04
Ammonia	1.001E-01
Ammonium	3.124E-09
Ammonium nitrate	3.549E-10
Argon	3.532E-08
Barium	2.597E-03
Beryllium	1.437E-05
Boron compounds (unspecified)	2.307E-02
Bromine	1.005E-02
Carbon dioxide	1.185E+04
Carbon dioxide (biotic)	1.992E-05
Carbon dioxide (biotic)	6.753E+00
Carbon disulphide	9.919E-09
Carbon monoxide	7.037E+00
Carbon monoxide (biotic)	1.456E-08
Chloride (unspecified)	1.423E-04
Chlorine	1.740E-05
Cyanide (unspecified)	3.438E-06
Fluoride	3.854E-04
Fluorides	2.121E-07
Fluorine	8.833E-09
Helium	8.215E-06

Process or Category	Cradle to Gate (RMA)
Hydrogen	1.926E-03
Hydrogen bromine (hydrobromic acid)	2.000E-07
Hydrogen chloride	3.749E-02
Hydrogen cyanide (prussic acid)	8.393E-07
Hydrogen fluoride	1.234E-02
Hydrogen iodide	2.117E-10
Hydrogen phosphorous	9.961E-09
Hydrogen sulphide	2.214E-03
Lead dioxide	2.630E-08
Nitrogen (atmospheric nitrogen)	2.828E+00
Nitrogen (N-compounds)	6.909E-09
Nitrogen dioxide	1.116E-02
Nitrogen monoxide	2.458E-08
Nitrogen oxides	2.646E+01
Nitrous oxide (laughing gas)	1.717E-01
Oxygen	6.441E-01
Scandium	4.008E-10
Steam	1.925E+04
Strontium	3.673E-08
Sulphur dioxide	7.447E+01
Sulphur hexafluoride	4.450E-05
sulphur oxide	2.483E-02
Sulphuric acid	3.259E-06
Tin oxide	6.116E-12
Unspecified Particles	9.645E-04
Zinc oxide	1.223E-11
Zinc sulphate	9.046E-08
Organic emissions to air (group VOC)	2.739E+01
Group NMVOC to air	2.259E+00
Group PAH to air	2.523E-04
Anthracene	9.610E-09
Benzo{a}anthracene	4.835E-09
Benzo{a}pyrene	4.275E-06
Benzo{ghi}perylene	4.314E-09
Benzofluoranthene	8.628E-09
Chrysene	1.188E-08

Process or Category	Cradle to Gate (RMA)
Dibenz(a)anthracene	2.688E-09
Indeno[1,2,3-cd]pyrene	3.210E-09
Naphthalene	1.009E-06
Phenanthrene	3.170E-07
Polycyclic aromatic hydrocarbons (PAH)	2.467E-04
Halogenated organic emissions to air	1.054E-04
Dichloroethane (ethylene dichloride)	5.393E-06
Dichloromethane (methylene chloride)	3.487E-08
Dioxins (unspec.)	2.862E-11
Halogenated hydrocarbons (unspecified)	1.656E-06
Halon (1301)	0.000E+00
Polychlorinated biphenyls (PCB unspecified)	8.907E-09
Polychlorinated dibenzo-p-dioxins (2,3,7,8 - TCDD)	5.986E-10
R 11 (trichlorofluoromethane)	5.886E-06
R 114 (dichlorotetrafluoroethane)	6.028E-06
R 116 (hexafluoroethane)	7.353E-06
R 12 (dichlorodifluoromethane)	1.265E-06
R 13 (chlorotrifluoromethane)	7.946E-07
R 22 (chlorodifluoromethane)	1.383E-06
Tetrafluoromethane	6.623E-05
Vinyl chloride (VCM; chloroethene)	9.350E-06
Acetaldehyde (Ethanal)	3.833E-05
Acetic acid	1.511E-04
Acetone (dimethylcetone)	3.729E-05
Acrolein	6.781E-08
Aldehyde (unspecified)	3.562E-06
Alkane (unspecified)	5.489E-02
Alkene (unspecified)	5.477E-02
Aromatic hydrocarbons (unspecified)	1.466E-05
Benzene	2.908E-04
Butadiene	2.623E-09
Butane	8.848E-03
Butane (n-butane)	5.185E-03
Caprolactam	5.593E-11
Cumene (isopropylbenzene)	1.120E-15
Cyclohexane (hexahydro benzene)	2.169E-07

Process or Category	Cradle to Gate (RMA)
Diethylamine	6.689E-14
Ethane	3.549E-02
Ethanol	6.595E-05
Ethene (ethylene)	3.787E-06
Ethyl benzene	5.477E-02
Fluoranthene	3.130E-08
Fluorene	9.932E-08
Formaldehyde (methanal)	1.522E-02
Heptane (isomers)	2.562E-04
Hexamethylene diamine (HMDA)	1.543E-10
Hexane (isomers)	3.820E-04
Mercaptan (unspecified)	8.018E-06
Methanethiol	2.453E-05
Methanol	7.711E-05
NMVOC (unspecified)	1.681E+00
Octane	1.410E-04
Pentane (n-pentane)	3.830E-02
Phenol (hydroxy benzene)	3.108E-09
Propane	5.040E-02
Propene (propylene)	4.979E-03
Propionic acid (propane acid)	6.402E-09
Styrene	2.407E-10
Toluene (methyl benzene)	2.490E-02
Trimethylbenzene	5.958E-11
Xylene (dimethyl benzene)	2.290E-01
Hydrocarbons (unspecified)	3.427E-04
Methane	2.512E+01
Methane (biotic)	5.316E-04
Organic chlorine compounds	1.153E-06
Unspecified Organic Compounds	6.704E-10
VOC (unspecified)	7.095E-03
Other emissions to air	4.589E+04
Aldehydes, unspecified	3.352E-10
Exhaust	4.573E+04
non used primary energy from wind power	0.000E+00
Particulate Matter, unspecified	1.885E-03

Process or Category	Cradle to Gate (RMA)
Sand (Silica) (SiO2)	6.391E-06
Unused primary energy from solar energy	0.000E+00
Used air	1.593E+02
Waste heat	0.000E+00
Particles to air	2.704E+00
Dust (PM10)	2.347E-01
Dust (PM2,5 - PM10)	1.638E-03
Dust (PM2.5)	6.340E-01
Dust (Portland cement kiln)	3.296E-01
Dust (unspecified)	1.505E+00
Metals (unspecified)	4.259E-07
Unspecified Organic Chlorine Compounds	4.423E-09
Wood (dust)	2.257E-09
Radioactive emissions to air	6.672E-05
Antimony (Sb124)	0.000E+00
Argon (Ar41)	0.000E+00
Carbon (C14)	0.000E+00
Cesium (Cs134)	0.000E+00
Cesium (Cs137)	0.000E+00
Cobalt (Co58)	0.000E+00
Cobalt (Co60)	0.000E+00
Hydrogen (H3)	0.000E+00
Iodine (I129)	0.000E+00
Iodine (I131)	0.000E+00
Krypton (Kr85)	0.000E+00
Krypton (Kr85m)	0.000E+00
Plutonium (Pu alpha)	0.000E+00
radionuclides	0.000E+00
Radon (Rn222)	0.000E+00
Uranium (total)	6.672E-05
Uranium (U234)	0.000E+00
Uranium (U235)	0.000E+00
Uranium (U238)	0.000E+00
Xenon (Xe131m)	0.000E+00
Xenon (Xe133)	0.000E+00
Xenon (Xe133m)	0.000E+00

Process or Category	Cradle to Gate (RMA)
Xenon (Xe135)	0.000E+00
Xenon (Xe135m)	0.000E+00
Xenon (Xe137)	0.000E+00
Xenon (Xe138)	0.000E+00
Unspecified Heavy Metals	3.454E-13
Emissions to fresh water	6.709E+02
Analytical measures to fresh water	7.627E+00
Adsorbable organic halogen compounds (AOX)	8.096E-05
Biological oxygen demand (BOD)	8.969E-02
Chemical oxygen demand (COD)	4.411E+00
Nitrogenous Matter (unspecified, as N)	2.073E-04
Solids (dissolved)	6.879E-01
Total Biochemical Oxygen Demand	0.000E+00
Total dissolved organic bounded carbon	2.547E-02
Total Dissolved Solids	2.385E+00
Total organic bounded carbon	2.803E-02
Total Suspended Solids	0.000E+00
Heavy metals to fresh water	2.646E+02
Aluminium	1.515E-03
Antimony	1.424E-04
Arsenic (+V)	1.929E-03
Cadmium (+II)	2.523E-04
Chromium (+III)	2.055E-06
Chromium (+VI)	6.667E-07
Chromium (unspecified)	1.271E-03
Cobalt	3.083E-08
Copper (+II)	1.331E-03
Heavy metals to water (unspecified)	1.386E-01
Iron	9.514E-02
Lead (+II)	1.619E-03
Manganese (+II)	6.288E-02
Mercury (+II)	3.138E-05
Molybdenum	2.506E-04
Nickel (+II)	6.614E+01
Selenium	4.781E-04
Silver	1.389E-04

Process or Category	Cradle to Gate (RMA)
Strontium	2.135E-02
Thallium	1.689E-09
Tin (+IV)	7.137E-08
Titanium	2.823E-06
Unspecified Substance	2.988E-09
Uranium	1.981E+02
Vanadium (+III)	6.670E-06
Zinc (+II)	2.598E-02
Inorganic emissions to fresh water	3.875E+02
Acid (calculated as H+)	4.257E-04
Acidity	0.000E+00
Aluminum (+III)	1.968E-02
Aluminum ion (+III)	6.380E-12
Ammonia	4.466E-01
Ammonia, as N	7.935E-09
Ammonium (total N)	1.641E-02
Ammonium / ammonia	1.527E+02
Barium	1.058E+00
Beryllium	2.084E-08
Bicarbonate	6.783E+00
Boron	3.175E-02
Bromate	4.633E-08
Bromine	2.035E-08
Calcium (+II)	3.487E+01
Carbonate	7.057E-01
Chlorate	2.688E-05
Chloride	1.120E+02
Chlorine (dissolved)	1.517E-03
Copper ion (+II/+III)	3.772E-10
Cyanide	1.293E-03
Fluoride	1.184E+01
Fluorine	5.327E-06
Hydrogen chloride	4.912E-07
Hydrogen fluoride (hydrofluoric acid)	2.865E-08
Hydrogen Ions (H+)	6.671E-07
Hydroxide	1.303E-03

Process or Category	Cradle to Gate (RMA)
Inorganic salts and acids (unspecified)	2.989E-13
Iron ion (+II/+III)	4.844E-08
Magnesium (+III)	7.899E-01
Magnesium chloride	6.911E-09
Magnesium ion (+II)	6.074E-02
Metal ions (unspecific)	6.607E-08
Neutral salts	5.426E-07
Nickel ion (+III)	2.180E-09
Nitrate	1.103E+00
Nitrate (as total N)	1.071E-08
Nitrogen	9.122E-01
Nitrogen (as total N)	3.720E-03
Nitrogen organic bounded	8.575E-04
Phosphate	1.589E-03
Phosphorus	1.551E-02
Potassium	1.837E-05
Salinity (dissolved salts)	1.953E+00
Silicate particles	2.905E-04
Sodium (+I)	1.807E+01
Sodium chloride (rock salt)	1.966E+00
Sodium hypochlorite	1.274E-06
Sulfates	1.566E-01
Sulphate	1.552E+01
Sulphide	1.171E-03
Sulphite	7.801E-03
Sulphur	1.987E-06
Sulphur dioxide	0.000E+00
Sulphuric acid	6.333E-05
Total Dissolved Solids	2.650E+01
Unspecified Iron Oxides	7.651E-09
Unspecified Oil	2.711E-08
Unspecified Organic Chlorine compounds	6.143E-11
Unspecified Salt	2.458E-07
Unspecified Solids (Suspended)	9.542E-07
Organic emissions to fresh water	2.027E-01
Halogenated organic emissions to fresh water	4.964E-05

Process or Category	Cradle to Gate (RMA)
1,2-Dibromoethane	5.094E-11
Chlorinated hydrocarbons (unspecified)	4.808E-05
Chloromethane (methyl chloride)	2.612E-07
Dichloroethane (ethylene dichloride)	2.259E-07
Dichloropropane	1.239E-13
Polychlorinated dibenzo-p-dioxins (2,3,7,8 - TCDD)	7.355E-10
Vinyl chloride (VCM; chloroethene)	1.066E-06
Hydrocarbons to fresh water	2.019E-01
Acenaphthene	1.784E-08
Acenaphthylene	7.488E-09
Acetic acid	5.112E-05
Acrylonitrile	9.057E-09
Anthracene	2.856E-08
Aromatic hydrocarbons (unspecified)	9.573E-06
Benzene	3.875E-05
Benzo{a}anthracene	2.359E-09
Benzofluoranthene	9.563E-10
Chrysene	9.977E-09
Cresol (methyl phenol)	5.118E-08
Ethyl benzene	2.318E-06
Fluoranthene	2.827E-09
Hexane (isomers)	5.592E-09
Hydrocarbons (unspecified)	8.423E-02
Methanol	6.549E-02
Oil (unspecified)	5.193E-02
Phenol (hydroxy benzene)	5.377E-05
Polycyclic aromatic hydrocarbons (PAH, unspec.)	2.173E-05
Toluene (methyl benzene)	2.363E-05
Xylene (isomers; dimethyl benzene)	2.247E-05
Carbon, organically bound	6.857E-04
Naphthalene	1.133E-06
N-unspecified (N)	2.121E-08
Organic chlorine compounds (unspecified)	7.018E-08
Organic compounds (dissolved)	2.191E-06
Organic compounds (unspecified)	1.759E-05
Unspecified wastewater	1.604E-05

Process or Category	Cradle to Gate (RMA)
Other emissions to fresh water	0.000E+00
Detergent (unspecified)	0.000E+00
non used primary energy from water power	0.000E+00
Unused primary energy from geothermal	0.000E+00
Waste heat	0.000E+00
Waste water	0.000E+00
Particles to fresh water	1.095E+01
Metals (unspecified)	4.646E-06
Silicon dioxide (silica)	1.156E-07
Soil loss by erosion into water	2.755E-07
Solids (suspended)	1.095E+01
Suspended solids, unspecified	2.544E-04
Unspecified Oxides	6.361E-09
Radioactive emissions to fresh water	0.000E+00
Americium (Am241)	0.000E+00
Antimony (Sb124)	0.000E+00
Antimony (Sb125)	0.000E+00
Carbon (C14)	0.000E+00
Cesium (Cs134)	0.000E+00
Cesium (Cs137)	0.000E+00
Cobalt (Co58)	0.000E+00
Cobalt (Co60)	0.000E+00
Curium (Cm alpha)	0.000E+00
Hydrogen (H3)	0.000E+00
Iodine (I129)	0.000E+00
Iodine (I131)	0.000E+00
Manganese (Mn54)	0.000E+00
Plutonium (Pu alpha)	0.000E+00
Radionuclides	0.000E+00
Radium (Ra226)	0.000E+00
Ruthenium (Ru106)	0.000E+00
Silver (Ag110m)	0.000E+00
Strontium (Sr90)	0.000E+00
Thorium (Th234)	0.000E+00
Uranium	0.000E+00
Bromide	0.000E+00

Process or Category	Cradle to Gate (RMA)
Radionuclide	0.000E+00
Sulfite	0.000E+00
Unspecified Solids (Dissolved)	1.839E-06
Uranium (total)	2.872E-05
Emissions to sea water	3.680E+00
Analytical measures to sea water	7.410E-03
Adsorbable organic halogen compounds (AOX)	3.194E-10
Biological oxygen demand (BOD)	3.524E-04
Chemical oxygen demand (COD)	6.705E-03
Total organic bounded carbon	3.524E-04
Heavy metals to sea water	2.747E-02
Arsenic (+V)	1.543E-05
Cadmium (+II)	3.368E-05
Chromium (unspecified)	2.465E-05
Cobalt	1.519E-05
Copper (+II)	4.163E-05
Iron	2.307E-04
Lead (+II)	1.058E-05
Manganese (+II)	2.386E-05
Mercury (+II)	2.164E-07
Molybdenum	2.592E-02
Nickel (+II)	1.936E-05
Silver	1.018E-06
Strontium	8.256E-04
Tin (+IV)	1.219E-06
Titanium	1.242E-07
Vanadium (+III)	1.057E-05
Zinc (+II)	3.020E-04
Inorganic emissions to sea water	3.362E+00
Aluminum (+III)	3.997E-06
Ammonia	1.188E-04
Barium	6.588E-04
Beryllium	8.488E-07
Boron	6.464E-05
Calcium (+II)	7.059E-03
Carbonate	4.143E-02

Process or Category	Cradle to Gate (RMA)
Chloride	3.279E+00
Magnesium	1.765E-03
Nitrate	5.372E-05
Sodium (+I)	7.037E-03
Sulphate	1.751E-02
Sulphide	7.532E-03
Sulphur	3.459E-05
Organic emissions to sea water	1.968E-03
Hydrocarbons to sea water	1.946E-03
Acenaphthene	6.824E-07
Acenaphthylene	2.601E-07
Acetic acid	1.960E-06
Anthracene	1.837E-07
Aromatic hydrocarbons (unspecified)	3.524E-06
Benzene	1.513E-04
Benzo{a}anthracene	1.527E-07
Benzofluoranthene	1.692E-07
Chrysene	8.616E-07
Cresol (methyl phenol)	8.959E-07
Ethyl benzene	1.611E-05
Fluoranthene	1.780E-07
Hexane (isomers)	9.781E-08
Oil (unspecified)	1.317E-03
Phenol (hydroxy benzene)	2.821E-04
Toluene (methyl benzene)	8.917E-05
Xylene (isomers; dimethyl benzene)	8.155E-05
Naphthalene	2.247E-05
Particles to sea water	2.804E-01
Solids (suspended)	2.804E-01
Emissions to industrial soil	6.247E+03
Heavy metals to industrial soil	6.247E+03
Antimony	1.546E-15
Arsenic (+V)	3.463E+00
Cadmium (+II)	6.809E-08
Chromium (+III)	1.145E-09
Chromium (+VI)	5.601E-15

Process or Category	Cradle to Gate (RMA)
Chromium (unspecified)	1.075E-05
Cobalt	1.898E-07
Copper (+II)	1.092E-07
Iron	6.196E+03
Lead (+II)	2.476E+01
Manganese (+II)	2.379E-06
Mercury (+II)	6.404E-02
Nickel (+II)	3.591E-06
Selenium	4.113E-01
Strontium	3.542E-03
Thallium	2.994E+00
Vanadium (+III)	1.890E+01
Zinc (+II)	1.205E-06
Inorganic emissions to industrial soil	1.085E-02
Aluminum (+III)	1.215E-05
Ammonia	5.588E-03
Bromide	1.627E-06
Calcium (+II)	7.231E-05
Chloride	1.902E-03
Chlorine	1.307E-12
Fluoride	5.422E-05
Magnesium (+III)	1.001E-05
Phosphorus	5.760E-04
Potassium (+I)	1.380E-03
Sodium (+I)	6.323E-06
Sulphate	1.779E-04
Sulphide	1.067E-03
Organic emissions to industrial soil	6.775E-05
Oil (unspecified)	6.775E-05
Radioactive emissions to industrial soil	0.000E+00
Uranium	0.000E+00
Calcium Fluoride	7.490E-01
Radionuclide	0.000E+00
Waste Flow	5.051E+03
Slag and Ashes from Energy Production	2.032E-04
Slag and Ashes from Waste Incineration	5.785E-04

Process or Category	Cradle to Gate (RMA)
Slags Containing Manganese	4.054E-08
Unspecified Furnace Slag	3.586E-04
Uranium Tailings	5.051E+03

Embedded Unit Processes

NETL (2010). *NETL Life Cycle Inventory Data – Unit Process: Conversion Facility, UF_6, Construction.* U.S. Department of Energy, National Energy Technology Laboratory. Last Updated: November 2010 (version 01). www.netl.doe.gov/energy-analyses (http://www.netl.doe.gov/energy-analyses)

NETL (2010). *NETL Life Cycle Inventory Data – Unit Process: Fuel Fabrication Facility, Construction.* U.S. Department of Energy, National Energy Technology Laboratory. Last Updated: November 2010 (version 01). www.netl.doe.gov/energy-analyses (http://www.netl.doe.gov/energy-analyses)

NETL (2010). *NETL Life Cycle Inventory Data – Unit Process: Gaseous Diffusion Enrichment Facility, Decommissioning.* U.S. Department of Energy, National Energy Technology Laboratory. Last Updated: November 2010 (version 01). www.netl.doe.gov/energy-analyses (http://www.netl.doe.gov/energy-analyses)

NETL (2010). NETL Life Cycle Inventory Data – Process Data Sheet File: *In Situ Uranium Extraction, Construction*. U.S. Department of Energy, National Energy Technology Laboratory. Last Updated: October 2010 (version 01). www.netl.doe.gov/energy-analyses (http://www.netl.doe.gov/energy-analyses)

NETL (2010). *NETL Life Cycle Inventory Data – Unit Process: Underground Uranium Mine, Construction.* U.S. Department of Energy, National Energy Technology Laboratory. Last Updated: November 2010 (version 01). www.netl.doe.gov/energy-analyses (http://www.netl.doe.gov/energy-analyses)

NETL (2010). *NETL Life Cycle Inventory Data – Unit Process: Open Pit Uranium Mine, Construction.* U.S. Department of Energy, National Energy Technology Laboratory. Last Updated: November 2010 (version 01). www.netl.doe.gov/energy-analyses (http://www.netl.doe.gov/energy-analyses)

NETL (2010). *NETL Life Cycle Inventory Data – Unit Process: Nuclear Enrichment Facility, Construction.* U.S. Department of Energy, National Energy Technology Laboratory. Last Updated: October 2010 (version 01). www.netl.doe.gov/energy-analyses (http://www.netl.doe.gov/energy-analyses)

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

NETL (2010). NETL Life Cycle Inventory Data – Process Documentation File: *Diffusion Enrichment, Operation*. U.S. Department of Energy, National Energy Technology Laboratory. Last Updated: November 2010 (version 01). www.netl.doe.gov/energy-analyses (http://www.netl.doe.gov/energy-analyses)

NETL (2010). *NETL Life Cycle Inventory Data – Unit Process: Fuel Assembly Facility, Operation.* U.S. Department of Energy, National Energy Technology Laboratory. Last Updated: November 2010 (version 01). www.netl.doe.gov/energy-analyses (http://www.netl.doe.gov/energy-analyses)

NETL (2010). *NETL Life Cycle Inventory Data – Unit Process: In-Situ Leach Mining and Processing: Uranium.* U.S. Department of Energy, National Energy Technology Laboratory. Last Updated: November 2010 (version 01). www.netl.doe.gov/energy-analyses (http://www.netl.doe.gov/energy-analyses)

NETL (2010). *NETL Life Cycle Inventory Data – Unit Process: Open Pit Uranium Mine, Operation*. U.S. Department of Energy, National Energy Technology Laboratory. Last Updated: October 2010 (version 01). www.netl.doe.gov/energy-analyses (http://www.netl.doe.gov/energy-analyses)

NETL (2010). *NETL Life Cycle Inventory Data – Unit Process: Uranium Conversion Facility, Operation.* U.S. Department of Energy, National Energy Technology Laboratory. Last Updated: November 2010 (version 01). www.netl.doe.gov/energy-analyses (http://www.netl.doe.gov/energy-analyses)

NETL (2010). *NETL Life Cycle Inventory Data – Unit Process: Tractor Trailer Biomass Transport – Class 8B, Operations*. U.S. Department of Energy, National Energy Technology Laboratory. Last Updated: January 2010 (version 01). www.netl.doe.gov/energy-analyses (http://www.netl.doe.gov/energy-analyses)

NETL (2009). NETL Life Cycle Inventory Data – Process Documentation File: Train Transport, Operations. U.S. Department of Energy, National Energy Technology Laboratory. Last Updated: February 2010 (version 01). www.netl.doe.gov/energy-analyses (http://www.netl.doe.gov/energy-analyses)

NETL (2010). NETL Life Cycle Inventory Data – Process Documentation File: *Ocean Freighter Transport, Operations*. U.S. Department of Energy, National Energy Technology Laboratory. Last Updated: July 2010 (version 01). www.netl.doe.gov/energy-analyses (http://www.netl.doe.gov/energy-analyses)

References

None.

Section III: Document Control Information

Date Created: September 12, 2011

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

Revision History:

[31MAY2012] Revised values based on updated model runs.

How to Cite This Document: This document should be cited as:

NETL (2011). *NETL Life Cycle Inventory Data – Unit Process: Uranium, Production with U.S. Enrichment.* U.S. Department of Energy, National Energy Technology Laboratory. Last Updated: May 2012 (version 02). www.netl.doe.gov/energy-analyses (http://www.netl.doe.gov/energy-analyses)

Section IV: Disclaimer

Neither the U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL) nor any person acting on behalf of these organizations:

A. Makes any warranty or representation, express or implied, with respect to the accuracy, completeness, or usefulness of the information contained in this document, or that the use of any information, apparatus, method, or process disclosed in this document may not infringe on privately owned rights; or

B. Assumes any liability with this report as to its use, or damages resulting from the use of any information, apparatus, method, or process disclosed in this document.

Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by NETL. The views and opinions of the authors expressed herein do not necessarily state or reflect those of NETL.