ecoinvent

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ecoinvent 3.8 Dataset Documentation

'chromite ore concentrate production - KZ - chromite ore concentrate'

Note: This document contains only an extract of the information in the dataset. Additional data about properties of exchanges, mathematical relations, parameters, and contact information for authors and reviewers are available within the dataset, i.e. in ecoSpold format.

Link to the dataset on ecoquery website

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Dataset Identification

Activity name	chromite ore concentrate production
Geography	Kazakhstan
Time period	1994-01-01 to 2021-12-31 - Valid for the entire period
ISIC rev.4 ecoinvent	0729:Mining of other non-ferrous metal ores
Reference product	chromite ore concentrate
CPC classification	14290: Other non-ferrous metal ores and concentrates (other than uranium or thorium ores and concentrates)
Dataset type	Production mix
Technology level	New
Version - system model	3.8 - Allocation, cut-off

Dataset Authorship

Data entry	Eleonora Crenna,
Data generator	Eleonora Crenna,

Exchange Summary

Reference product	Byproduct classification	Amount
chromite ore concentrate	allocatable product	1 kg

Inputs from technosphere, wastes	Amount
non-sulfidic overburden, off-site	-1.77 kg
non-sulfidic tailing, off-site	-0.486 kg

Inputs from technosphere	Amount
aluminium hydroxide factory	3.12e-15 unit
blasting	0.00149 kg
conveyor belt	6.42e-08 m
diesel, burned in building machine	0.0807 MJ
electricity, medium voltage	0.048 kWh
mine infrastructure, open cast, non-ferrous metal	3.76e-12 unit
mine infrastructure, underground, non-ferrous metal	5e-11 unit
steel, chromium steel 18/8, hot rolled	0.000446 kg

Inputs from environment	Amount
Chromium, in ground	0.307 kg
Gangue, in ground	2.85 kg
Iron, in ground	0.0959 kg
Occupation, mineral extraction site	5.25e-06 m2*year
Transformation, from unspecified	1.75e-07 m2
Transformation, to mineral extraction site	1.75e-07 m2
Water, river	0.00269 m3

Emissions to air	Amount
Aluminium	8.57e-09 kg
Chromium	5.36e-08 kg
Iron	8.13e-06 kg
Magnesium	1.74e-08 kg
Particulates, < 2.5 um	8.24e-09 kg
Particulates, > 10 um	8.52e-08 kg
Particulates, > 2.5 um, and < 10um	7.41e-08 kg
Silicon	5.63e-09 kg
Water	0.000403 m3

Emissions to water	Amount

BOD5, Biological Oxygen Demand	1.2e-07 kg
COD, Chemical Oxygen Demand	1.8e-07 kg
Calcium, ion	1.43e-07 kg
Chromium, ion	5.93e-11 kg
DOC, Dissolved Organic Carbon	7.04e-08 kg
Dissolved solids	6e-08 kg
Iron, ion	8.25e-09 kg
Oils, unspecified	1.2e-08 kg
TOC, Total Organic Carbon	7.04e-08 kg
Water	0.00229 m3

Dataset Description

General comment
This dataset describes the production of 1 kg of chromite ore concentrate in Kazakhstan. It is designed for the use of chromite as intermediary product in the production of ferrochromium, dichromate and refractories. This data set is adapted from the existing global dataset of chromite ore concentrate production, in which process data is taken mainly from a material flow analysis for the consumption of chromium compounds in Germany. Electricity consumption is estimated from the feasibility study made in 2006 for the Voskhod mine in Kazakhstan using sublevel caving (SLC) and selective mining of metallurgical grade chromite ore (Bleiwas, 2011). Reference: Bleiwas, D. I. (2011). Estimates of electricity requirements for the recovery of mineral commodities, with examples applied to sub-Saharan Africa. US Department of the Interior, US Geological Survey. [This dataset is meant to replace the following datasets:]

Included activities start
Mining process starting from chromite ore, in ground.

Included activities end
The activity ends with the gravity concentration of the material, at the beneficiation facility. The dataset includes the crushing, grounding and screening of mined ore, the production infrastructure for mining and beneficiation,and the disposal of overburden and tailings.

Sampling procedure
Data come from "chromite ore concentrate production, GLO" data set, except for the information on electricity consumption and mine infrastructure which are taken from Bleiwas 2011 and Kazchrome 2019/USGS 2017 respectively. The amount of iron in ground and gangue were added to the original dataset for the sake of mass balance. Reference: Bleiwas, D. I. (2011). Estimates of electricity requirements for the recovery of mineral commodities, with examples applied to sub-Saharan Africa. US Department of the Interior, US Geological Survey. Hilbrans H. and Hinrichs W. (1999) Stoffmengenflüsse und Energiebedarf bei der Gewinnung ausgewählter mineralischer Rohstoffe; Teilstudie Nickel. In: Geologisches Jahrbuch, Vol. Sonderhefte SH 7. Bundesanstalt für Geowissenschaften und Rohstoffe, Hannover. ISBN 3-510-95829-2. Kazchrome, 2019. Annual report 2018. Available at: https://www-aix-kz.s3.eu-central-1.amazonaws.com/uploads/2019/07/Kazchrome_AR2018_28062019-KFO.pdf (accessed March 2021) USGS 2017. Minerals Yearbook - Chromium.

Extrapolations
This dataset has been extrapolated from year 2017 to the year of the calculation (2021). The uncertainty has been adjusted accordingly.

Technology comment
Mining is done both open pit and underground, followed by a benefication of the ore trough classification. Overburden and tailings are disposed near the mining site. MINING: Chromite ores are usually mined underground. An estimated share of 93% underground mining has been reported for activities in the mine production in Donskoy mine operation site (leader in chromite ore production in Kazakhstan), while the remaining 7% is open pit (Kaplunov et al. 2018). Emissions and waste: The major emissions are due to mineral born pollutants in the effluents. Open cut mining generates large quantities of dust, which contains elevated contents of metals. Rain percolates through overburden and leads to metal emissions to groundwater. Overburden is deposed close to the mine. BENEFICIATION: After mining, the ore is first crushed in several stages with jaw and / or cone crushers, and then subsequently ground with rod and or ball mills and finally screened for classification. In a second step the classified material is subjected to gravity concentration to separate the metal-bearing particles from the unwanted minerals. For this drum separators and de-watering screens for lumps are used and cone separators and a high-gradient magnetic separator for fine material. No flotation is done. The separated gangue is disposed in tailings ponds, the concentrated ore is fed to the metallurgy, which is on-site. Chromite yields vary in a range from 65% to 85%. There's no treatment of wastewater. Emissions and waste: Ore handling and processing produce large amounts of dust, containing PM10 and several metals from the ore itself. Tailings are deposed as piles and in ponds. Since the tailings are not sulphidic, no acid rock drainage (ARD) occurs. In the tailings material the most significant contents are Cr and Ni, which occur as insoluble compounds and are considered not to cause any negative effects. References: Adelhardt W. and Antrekowitsch H. (1998) Stoffmengenflüsse und Energie-bedarf bei der Gewinnung ausgewählter mineralischer Rohstoffe; Teilstudie Chrom. In: Geologisches Jahrbuch, Vol. Sonderhefte SH 3. Bundesanstalt für Geowissenschaften und Rohstoffe, Hannover. ISBN 3-510-95831-4. IPPC (2002) Integrated Pollution Prevention and Control (IPPC); Draft Refer-ence Document on Best Available Techniques for Management of Tailings and Waste-Rock in Mining Activities. European Commission. Retrieved at 01.03.2003 from http://www.jrc.es/pub/english.cgi/0/733169 Kaplunov, D., Bekbergenov, D., & Djangulova, G. (2018). Particularities of solving the problem of sustainable development of chromite underground mining at deep horizons by means of combined geotechnology. In E3S Web of Conferences (Vol. 56, p. 01015). EDP Sciences.

Geography comment
This dataset relates to the Kazakhstan situation and it is adapted from the existing global dataset.

Time period comment
Data are considered valid from 1994 to 2017 (year of the production volume)

Detailed Information For Exchanges

Reference product	Annual prod.vol.	Amount
chromite ore concentrate	6.69e+9 kg	1 kg

Comment: EcoSpold01Location=GLO
The world-wide average calculated chromite (25.5% Cr) content of raw ores is 37.3%. Chromite ore rarely contains more than 50 % Cr2O3; other minerals such as SiO2 can also be present.Chromite is a spinel FeO · Cr2O3. It contains 44.9% Chromium. Uses: Chromite ore is the central intermediary product in the chromium industry. From it the three main product groups are made: ferrochromium, chromium chemicals and refractories. Chromite is used directly in the refractory industry to make bricks, mortar, and ramming and gunning mixes. Chromite enhances thermal shock and slag resistance, volume stability, strength and is used mainly in the ferrous and non-ferrous industry, cement industry and glass manufacturing. In foundries for certain applications chromite is used as moulding sand, for which chromite sand with more specific properties is applied.
Production volume: 6.69e+9 kg
Production volume comment: According to USGS (2021), 6'688'800 metric tons of chromite ore were produced in Kazakhstan in 2018.
Reference:
USGS (2021). Chromium Statistics and Information, Advance Data Release of the 2019 Annual Tables. https://prd-wret.s3.us-west-2.amazonaws.com/assets/palladium/production/atoms/files/myb1-2019-chrom-adv.xlsx
Source: Adelhardt W. (1998)

Inputs from technosphere	Amount
aluminium hydroxide factory	3.12e-15 unit

Comment: EcoSpold01Location=RER
Estimation from dataset author.
Proxy: "aluminium hydroxide factory" is used as a proxy for the infrastructure for chromite ore beneficiation.
Uncertainty distribution: lognormal; **GSD2:** 1.88; **Pedigree matrix:** [5, 5, 3, 1, 1]
Uncertainty comment: rough estimate

blasting	0.00149 kg

Comment: EcoSpold01Location=RER
Literature value.
Uncertainty distribution: lognormal; **GSD2:** 1.10; **Pedigree matrix:** [2, 2, 4, 1, 1]
Source: Adelhardt W. (1998)

conveyor belt	6.42e-08 m

Comment: Estimation from dataset author.
Modelled, based on “ISIC 0729” - pdf-document on the dedicated talk page of ecoinvent (www.ecoinvent.org/documentation). See part Regarding “chromite ore concentrate production, GLO 2003” dataset.
EcoSpold01Location=RER
Uncertainty distribution: lognormal; **GSD2:** 1.88; **Pedigree matrix:** [5, 5, 3, 1, 1]
Uncertainty comment: rough estimate

diesel, burned in building machine	0.0807 MJ

Comment: Estimation: Diesel consumption for functioning of mobile equipment used for exploration like drilling machines, scoop trams and underground trucks.
EcoSpold01Location=GLO
Uncertainty distribution: lognormal; **GSD2:** 1.10; **Pedigree matrix:** [2, 2, 4, 1, 1]
Source: Adelhardt W. (1998)

electricity, medium voltage	0.048 kWh

Comment: EcoSpold01Location=UCTE
Estimation. Original value of 0.048 kWh/kg chromite ore is taken from Bleiwas 2011.
Reference:
Bleiwas, D. I. (2011). Estimates of electricity requirements for the recovery of mineral commodities, with examples applied to sub-Saharan Africa. US Department of the Interior, US Geological Survey.

Hilbrans H. and Hinrichs W. (1999) Stoffmengenflüsse und Energiebedarf bei der Gewinnung ausgewählter mineralischer Rohstoffe; Teilstudie Nickel. In: Geologisches Jahrbuch, Vol. Sonderhefte SH 7. Bundesanstalt für Geowissenschaften und Rohstoffe, Hannover. ISBN 3-510-95829-2.
Uncertainty distribution: lognormal; **GSD2:** 1.10; **Pedigree matrix:** [2, 2, 4, 1, 1]

mine infrastructure, open cast, non-ferrous metal	3.76e-12 unit

Comment: EcoSpold01Location=GLO
Estimation based on literature. Donskoy mine operation site is the leader in chromite ore production in Kazakhstan. The mine has a lifetime of 62 years (open in 1997, it is estimated to provide resources until 2059 under current extraction practice - Kazchrome report 2019). Production at the mine was estimated to be 300,000 t/yr of ore (USGS 2017). 93% of ore deposit is mined underground, while the remaining is open pit
Uncertainty distribution: lognormal; **GSD2:** 1.88; **Pedigree matrix:** [5, 5, 3, 1, 1]
Uncertainty comment: rough estimate

mine infrastructure, underground, non-ferrous metal	5e-11 unit

Comment: EcoSpold01Location=GLO
Estimation based on literature. Donskoy mine operation site is the leader in chromite ore production in Kazakhstan. The mine has a lifetime of 62 years (open in 1997, it is estimated to provide resources until 2059 under current extraction practice - Kazchrome report 2019). Production at the mine was estimated to be 300,000 t/yr of ore (USGS 2017). 93% of ore deposit is mined underground, while the remaining is open pit
Uncertainty distribution: lognormal; **GSD2:** 1.88; **Pedigree matrix:** [5, 5, 3, 1, 1]
Uncertainty comment: rough estimate

non-sulfidic overburden, off-site	-1.77 kg

Comment: EcoSpold01Location=GLO
Estimation: The overburden is disposed in piles near the mine. No overburden is refilled.
Production volume: 1.18e+10 kg
Production volume comment: Calculated from the production volume of chromite ore concentrate in proportion to the respective output amounts.
Uncertainty distribution: lognormal; **GSD2:** 1.11; **Pedigree matrix:** [3, 2, 4, 1, 1]
Source: Adelhardt W. (1998)

non-sulfidic tailing, off-site	-0.486 kg

Comment: Estimation: No tailings are refilled.
EcoSpold01Location=GLO
Production volume: 3.25e+9 kg
Production volume comment: Calculated from the production volume of chromite ore concentrate in proportion to the respective output amounts.
Uncertainty distribution: lognormal; **GSD2:** 1.11; **Pedigree matrix:** [3, 2, 4, 1, 1]
Uncertainty comment: reported values
Source: Adelhardt W. (1998)

steel, chromium steel 18/8, hot rolled	0.000446 kg

Comment: Estimation: The steel input (abrasion) for milling is documented for a single Finnish chromite mine (Kula) and amounts to 300 g / t ground ore.
Proxy: The mill (jaws, balls, etc.) consists of special austenitic manganese steel of Hadfield grade, which is approximated with chromium steel in the inventory.
EcoSpold01Location=RER
Uncertainty distribution: lognormal; **GSD2:** 1.12; **Pedigree matrix:** [2, 3, 3, 3, 1]
Source: IPPC (2002)

Inputs from environment	Subcompartment	Amount
Chromium, in ground	in ground	0.307 kg

Comment: 25.5% Cr in chromite; 11.6% in ore; Estimation: The world average chromium content after beneficiation amounts to 30.7% (44.9% Cr2O3), a yield from mining and beneficiation of 81% can be calculated. 1.48 kg of ore and 1.77 kg of overburden are extracted per kg of chromite.
Uncertainty distribution: lognormal; **GSD2:** 1.10; **Pedigree matrix:** [2, 2, 4, 1, 1]

Gangue, in ground	in ground	2.85 kg

Comment: Calculated to obtain mass balance considering 1.48 kg of ore and 1.74 kg of overburden per kg of chromite. See comment to "Chromium, in ground" exchange
Uncertainty distribution: lognormal; **GSD2:** 1.11; **Pedigree matrix:** [3, 2, 4, 1, 1]

Iron, in ground	in ground	0.0959 kg

Comment: Calculated based on the ratio Cr/Fe in chromite, according to Table 3.1, Part IV - Chromium in Classen et al. (2009). The ratio from Zimbabwe chromite is used as a proxy for Kazakhstan due to the similarity in chromite composition. Reference: Classen, M., Althaus, H.-J., Blaser, S., Tuchschmid, M., Jungbluth, N., Doka, G., Faist Emmenegger, M., Scharnhorst, W. (2009). Life Cycle Inventories of Metals. Final report ecoinvent data v2.1, No 10. EMPA Dübendorf, Swiss Centre for Life Cycle Inventories, Dübendorf, CH, Online-Version under: www.ecoinvent.ch
Uncertainty distribution: lognormal; **GSD2:** 1.10; **Pedigree matrix:** [2, 2, 4, 2, 1]

Occupation, mineral extraction site	land	5.25e-06 m2*year

Comment: Estimation: No direct land use for underground mining (93%) is inventoried. Land use for open pit mining (7%) per tonne of ore is assessed with 0.0025m2/t. A occupation of 30 years is assumed.
Uncertainty distribution: lognormal; **GSD2:** 1.25; **Pedigree matrix:** [3, 2, 4, 1, 1]
Uncertainty comment: calculation based on reported value

Transformation, from unspecified	land	1.75e-07 m2

Comment: Estimation: No direct land use for underground mining (93%) is inventoried. Land use for open pit mining (7%) per tonne of ore is assessed with 0.0025m2/t.
Uncertainty distribution: lognormal; **GSD2:** 1.43; **Pedigree matrix:** [3, 2, 4, 1, 1]
Uncertainty comment: calculation based on reported value

Transformation, to mineral extraction site	land	1.75e-07 m2

Comment: Estimation: No direct land use for underground mining (93%) is inventoried. Land use for open pit mining (7%) per tonne of ore is assessed with 0.0025m2/t.
Uncertainty distribution: lognormal; **GSD2:** 1.43; **Pedigree matrix:** [3, 2, 4, 1, 1]
Uncertainty comment: calculation based on reported value

Water, river	in water	0.00269 m3

Comment: Estimation: In the beneficiation step, water is inventoried as originating from river without pumping activities.
Uncertainty distribution: lognormal; **GSD2:** 1.10; **Pedigree matrix:** [2, 2, 4, 1, 1]

Emissions to air	Subcompartment	Amount
Aluminium	non-urban air or from high stacks	8.57e-09 kg

Comment: Modelled. Details are reported in Classen M., Althaus H.-J., Blaser S., Doka G., Jungbluth N. and Tuchschmid M. (2009) Life Cycle Inventories of Metals. Final report ecoinvent data v2.1 No.10. Swiss Centre for Life Cycle Inventories, Dübendorf, CH.
Uncertainty distribution: lognormal; **GSD2:** 1.42; **Pedigree matrix:** [5, 2, 3, 1, 1]

Chromium	non-urban air or from high stacks	5.36e-08 kg

Comment: Modelled. Details are reported in Classen M., Althaus H.-J., Blaser S., Doka G., Jungbluth N. and Tuchschmid M. (2009) Life Cycle Inventories of Metals. Final report ecoinvent data v2.1 No.10. Swiss Centre for Life Cycle Inventories, Dübendorf, CH.
Uncertainty distribution: lognormal; **GSD2:** 2.35; **Pedigree matrix:** [5, 2, 3, 1, 1]

Iron	non-urban air or from high stacks	8.13e-06 kg

Comment: Modelled. Details are reported in Classen M., Althaus H.-J., Blaser S., Doka G., Jungbluth N. and Tuchschmid M. (2009) Life Cycle Inventories of Metals. Final report ecoinvent data v2.1 No.10. Swiss Centre for Life Cycle Inventories, Dübendorf, CH.
Uncertainty distribution: lognormal; **GSD2:** 1.42; **Pedigree matrix:** [5, 2, 3, 1, 1]

Magnesium	non-urban air or from high stacks	1.74e-08 kg

Comment: Modelled. Details are reported in Classen M., Althaus H.-J., Blaser S., Doka G., Jungbluth N. and Tuchschmid M. (2009) Life Cycle Inventories of Metals. Final report ecoinvent data v2.1 No.10. Swiss Centre for Life Cycle Inventories, Dübendorf, CH.
Uncertainty distribution: lognormal; **GSD2:** 1.42; **Pedigree matrix:** [5, 2, 3, 1, 1]

Particulates, < 2.5 um	non-urban air or from high stacks	8.24e-09 kg

Comment: Modelled. Details are reported in Classen M., Althaus H.-J., Blaser S., Doka G., Jungbluth N. and Tuchschmid M. (2009) Life Cycle Inventories of Metals. Final report ecoinvent data v2.1 No.10. Swiss Centre for Life Cycle Inventories, Dübendorf, CH.
Uncertainty distribution: lognormal; **GSD2:** 1.86; **Pedigree matrix:** [5, 2, 3, 1, 1]

Particulates, > 10 um	non-urban air or from high stacks	8.52e-08 kg

Comment: Modelled. Details are reported in Classen M., Althaus H.-J., Blaser S., Doka G., Jungbluth N. and Tuchschmid M. (2009) Life Cycle Inventories of Metals. Final report ecoinvent data v2.1 No.10. Swiss Centre for Life Cycle Inventories, Dübendorf, CH.
Uncertainty distribution: lognormal; **GSD2:** 1.42; **Pedigree matrix:** [5, 2, 3, 1, 1]

Particulates, > 2.5 um, and < 10um	non-urban air or from high stacks	7.41e-08 kg

Comment: Modelled. Details are reported in Classen M., Althaus H.-J., Blaser S., Doka G., Jungbluth N. and Tuchschmid M. (2009) Life Cycle Inventories of Metals. Final report ecoinvent data v2.1 No.10. Swiss Centre for Life Cycle Inventories, Dübendorf, CH.
Uncertainty distribution: lognormal; **GSD2:** 1.57; **Pedigree matrix:** [5, 2, 3, 1, 1]

Silicon	non-urban air or from high stacks	5.63e-09 kg

Comment: Modelled. Details are reported in Classen M., Althaus H.-J., Blaser S., Doka G., Jungbluth N. and Tuchschmid M. (2009) Life Cycle Inventories of Metals. Final report ecoinvent data v2.1 No.10. Swiss Centre for Life Cycle Inventories, Dübendorf, CH.
Uncertainty distribution: lognormal; **GSD2:** 1.42; **Pedigree matrix:** [5, 2, 3, 1, 1]

Water	unspecified	0.000403 m3

Comment: Calculated value based on literature values and expert opinion. See comments in the parametres' comment field.
Uncertainty distribution: lognormal; **GSD2:** 1.23; **Pedigree matrix:** [2, 2, 3, 1, 1]

Emissions to water	Subcompartment	Amount
BOD5, Biological Oxygen Demand	surface water	1.2e-07 kg

Comment: Estimation: 150 mg / l COD is assumed to amount to 150% of BOD.
Uncertainty distribution: lognormal; **GSD2:** 3.17; **Pedigree matrix:** [1, 1, 3, 1, 1]

COD, Chemical Oxygen Demand	surface water	1.8e-07 kg

Comment: Modelled. Details are reported in Classen M., Althaus H.-J., Blaser S., Doka G., Jungbluth N. and Tuchschmid M. (2009) Life Cycle Inventories of Metals. Final report ecoinvent data v2.1 No.10. Swiss Centre for Life Cycle Inventories, Dübendorf, CH.
Uncertainty distribution: lognormal; **GSD2:** 3.17; **Pedigree matrix:** [1, 1, 3, 1, 1]

Calcium, ion	surface water	1.43e-07 kg

Comment: Modelled. Details are reported in Classen M., Althaus H.-J., Blaser S., Doka G., Jungbluth N. and Tuchschmid M. (2009) Life Cycle Inventories of Metals. Final report ecoinvent data v2.1 No.10. Swiss Centre for Life Cycle Inventories, Dübendorf, CH.
Uncertainty distribution: lognormal; **GSD2:** 3.17; **Pedigree matrix:** [1, 1, 3, 1, 1]

Chromium, ion	surface water	5.93e-11 kg

Comment: Modelled. Details are reported in Classen M., Althaus H.-J., Blaser S., Doka G., Jungbluth N. and Tuchschmid M. (2009) Life Cycle Inventories of Metals. Final report ecoinvent data v2.1 No.10. Swiss Centre for Life Cycle Inventories, Dübendorf, CH.
Uncertainty distribution: lognormal; **GSD2:** 3.17; **Pedigree matrix:** [1, 1, 3, 1, 1]

DOC, Dissolved Organic Carbon	surface water	7.04e-08 kg

Comment: Calculated value: Values for TOC are calculated by approximating the unknown organic matter with the simplified formula for organic matter C6H12O6. This gives 58.7 mg / l TOC and DOC respectively.
Uncertainty distribution: lognormal; **GSD2:** 3.17; **Pedigree matrix:** [1, 1, 3, 1, 1]

Dissolved solids	surface water	6e-08 kg

Comment: Modelled. Details are reported in Classen M., Althaus H.-J., Blaser S., Doka G., Jungbluth N. and Tuchschmid M. (2009) Life Cycle Inventories of Metals. Final report ecoinvent data v2.1 No.10. Swiss Centre for Life Cycle Inventories, Dübendorf, CH.
Uncertainty distribution: lognormal; **GSD2:** 3.17; **Pedigree matrix:** [1, 1, 3, 1, 1]

Iron, ion	surface water	8.25e-09 kg

Comment: Modelled. Details are reported in Classen M., Althaus H.-J., Blaser S., Doka G., Jungbluth N. and Tuchschmid M. (2009) Life Cycle Inventories of Metals. Final report ecoinvent data v2.1 No.10. Swiss Centre for Life Cycle Inventories, Dübendorf, CH.
Uncertainty distribution: lognormal; **GSD2:** 3.17; **Pedigree matrix:** [1, 1, 3, 1, 1]

Oils, unspecified	surface water	1.2e-08 kg

Comment: Modelled. Details are reported in Classen M., Althaus H.-J., Blaser S., Doka G., Jungbluth N. and Tuchschmid M. (2009) Life Cycle Inventories of Metals. Final report ecoinvent data v2.1 No.10. Swiss Centre for Life Cycle Inventories, Dübendorf, CH.
Uncertainty distribution: lognormal; **GSD2:** 3.17; **Pedigree matrix:** [1, 1, 3, 1, 1]

TOC, Total Organic Carbon	surface water	7.04e-08 kg

Comment: Calculated value: Values for TOC are calculated by approximating the unknown organic matter with the simplified formula for organic matter C6H12O6. This gives 58.7 mg / l TOC and DOC respectively.
Uncertainty distribution: lognormal; **GSD2:** 3.17; **Pedigree matrix:** [1, 1, 3, 1, 1]

Water	unspecified	0.00229 m3

Comment: Calculated value based on literature values and expert opinion. See comments in the parametres' comment field.
Uncertainty distribution: lognormal; **GSD2:** 1.23; **Pedigree matrix:** [2, 2, 3, 1, 1]

Selected Impact Assessment Results

Method	Category	Indicator	Score
ecological scarcity 2013	total	total	1.60e+3 UBP
EF v3.0	material resources: metals/minerals	abiotic depletion potential (ADP): elements (ultimate reserves)	0.000138 kg Sb-Eq
IPCC 2013	climate change	GWP 100a	0.0701 kg CO2-Eq

Direct impact contributions

ecological scarcity 2013, total, total: 1.60e+3 UBP

Exchange	Amount	Impact (UBP)	Impact %
Chromium, in ground natural resource - in ground	0.307 kg	1.47e+3	91.93%
market for electricity, medium voltage KZ - electricity, medium voltage	0.048 kWh	40.5	2.53%
market for blasting GLO - blasting	0.00149 kg	36.2	2.26%
market for mine infrastructure, underground, non-ferrous metal GLO - mine infrastructure, underground, non-ferrous metal	5e-11 unit	28.4	1.77%
market for diesel, burned in building machine GLO - diesel, burned in building machine	0.0807 MJ	10	0.63%
market for steel, chromium steel 18/8, hot rolled GLO - steel, chromium steel 18/8, hot rolled	0.000446 kg	6.41	0.4%
market for non-sulfidic overburden, off-site GLO - non-sulfidic overburden, off-site	-1.77 kg	3.52	0.22%
market for mine infrastructure, open cast, non-ferrous metal GLO - mine infrastructure, open cast, non-ferrous metal	3.76e-12 unit	2.19	0.14%
market for non-sulfidic tailing, off-site GLO - non-sulfidic tailing, off-site	-0.486 kg	0.967	0.06%
Iron, in ground natural resource - in ground	0.0959 kg	0.806	0.05%
Water air - unspecified	0.000403 m3	0.246	0.02%
market for conveyor belt GLO - conveyor belt	6.42e-08 m	0.181	0.01%
Particulates, > 2.5 um, and < 10um air - non-urban air or from high stacks	7.41e-08 kg	0.0104	0.0%
Occupation, mineral extraction site natural resource - land	5.25e-06 m2*year	0.00158	0.0%
COD, Chemical Oxygen Demand water - surface water	1.8e-07 kg	0.00122	0.0%

3 minor direct contributors have been omitted for clarity

EF v3.0, material resources: metals/minerals, abiotic depletion potential (ADP): elements (ultimate reserves): 0.000138 kg Sb-Eq

Exchange	Amount	Impact (kg Sb-Eq)	Impact %
Chromium, in ground natural resource - in ground	0.307 kg	0.000136	98.6%
market for mine infrastructure, underground, non-ferrous metal GLO - mine infrastructure, underground, non-ferrous metal	5e-11 unit	1.6e-06	1.16%
market for mine infrastructure, open cast, non-ferrous metal GLO - mine infrastructure, open cast, non-ferrous metal	3.76e-12 unit	1.21e-07	0.09%
market for blasting GLO - blasting	0.00149 kg	8.92e-08	0.06%
market for steel, chromium steel 18/8, hot rolled GLO - steel, chromium steel 18/8, hot rolled	0.000446 kg	6.23e-08	0.05%
market for electricity, medium voltage KZ - electricity, medium voltage	0.048 kWh	4.57e-08	0.03%
Iron, in ground natural resource - in ground	0.0959 kg	5.03e-09	0.0%
market for diesel, burned in building machine GLO - diesel, burned in building machine	0.0807 MJ	3.87e-09	0.0%
market for conveyor belt GLO - conveyor belt	6.42e-08 m	9.91e-10	0.0%
market for aluminium hydroxide factory GLO - aluminium hydroxide factory	3.12e-15 unit	1.02e-11	0.0%

IPCC 2013, climate change, GWP 100a: 0.0701 kg CO2-Eq

Exchange	Amount	Impact (kg CO2-Eq)	Impact %
market for electricity, medium voltage KZ - electricity, medium voltage	0.048 kWh	0.0481	68.68%
market for diesel, burned in building machine GLO - diesel, burned in building machine	0.0807 MJ	0.00745	10.63%
market for blasting GLO - blasting	0.00149 kg	0.00705	10.06%
market for mine infrastructure, underground, non-ferrous metal GLO - mine infrastructure, underground, non-ferrous metal	5e-11 unit	0.00467	6.66%
market for steel, chromium steel 18/8, hot rolled GLO - steel, chromium steel 18/8, hot rolled	0.000446 kg	0.0023	3.29%
market for mine infrastructure, open cast, non-ferrous metal GLO - mine infrastructure, open cast, non-ferrous metal	3.76e-12 unit	0.000381	0.54%
market for conveyor belt GLO - conveyor belt	6.42e-08 m	8.87e-05	0.13%
market for aluminium hydroxide factory GLO - aluminium hydroxide factory	3.12e-15 unit	8.24e-08	0.0%

Source

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Additional author(s)	Ruhrberg M., Mistry M.
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Year	2002
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Issue number	55

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Additional author(s)	Et al.
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First author	IPPC
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