



sustainable mineral recovery

Environmental Product Declaration



Product: Colloidal Silica 1430NA



In accordance with ISO 14025:2006

An EPD should provide current information, and may be updated if conditions change. The stated validity is therefore subject to the continued registration and publication at www.environdec.com.

Programme:	EPD Australasia, https://epd-australasia.com/
Programme operator:	EPD Australasia Limited
EPD registration number:	S-P-09358
Version:	1.1
Version date:	31 October 2023
Publication date:	31 October 2023
Valid to:	31 October 2028
Version history:	Includes minor wording updates
Geographical scope of EPD:	Worldwide

What is an

ENVIRONMENTAL PRODUCT DECLARATION?

An Environmental Product Declaration (EPD) tells the environmental story of a product over its life cycle. It is science-based, independently verified, and globally recognised. It is a good way to demonstrate a company's commitment to environmental sustainability.

Our EPD covers the environmental performance of our unique Geo40 product:

1430Na

An EPD transparently communicates the environmental impacts of a product. This EPD is based on a Life Cycle Assessment (LCA) covering cradle to customer gate, including packaging end of life.

The information included in an EPD is useful for a variety of applications, especially as environmental issues and viable solutions are often misunderstood by the market. Having an EPD enables sustainable decision-making that can be backed up by credible data.

An EPD can be used for any type of product or service to:



describe its functional properties and material composition



provide science-based information on the resources and energy used during manufacture and use



illustrate the relevant environmental impacts, such as the carbon footprint



give comparable information within the same product group

Based on an open and transparent framework, an EPD discloses its registration number, the product category rules that it qualified under, and the third-party verifier. The validity of the EPD is also stated, which is normally five years.

Geo40 Limited as the EPD owner has the sole ownership, liability, and responsibility for the EPD.

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EPDs within the same product category but from different programmes may not be comparable.

The EPD owner has the sole ownership, liability and responsibility of the EPD.

Declaration owner:



Geo40 Limited

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Geographical Scope

International

Reference Year for Data

2022

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PCR:

PCR 2021:03 Basic chemicals
(version 1.1)

PCR review was
conducted by:

The Technical Committee of the
International EPD® System

Independent third-party
EPD verification of the
declaration and data,
according to
ISO 14025:2006:

EPD process certification (Internal)
 EPD verification (External)

Third party verifier:

Claudia A. Peña
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Approved by:

EPD Australasia

Procedure for follow-up
of data during EPD validity
involved third-party verifier

Yes
 No

Version History

v1.0
v1.1 Includes minor wording updates

ABOUT GEO40

A sustainable future relies on sustainable future minerals. This is what we do.

Geo40 is an innovative technology development and operating company based in New Zealand. We target sustainable, low-carbon recovery of valuable minerals from subterranean fluids.

Our team of diverse experts are committed to solving global sustainability challenges within strong environmental, social and governance principles.

We believe that the imperative for decarbonisation is acute. We know we can leverage our technology to play a meaningful role here.

Our focus to date has been on recovering silica, commonly the most abundant and problematic element for geothermal plant operators. Removing the silica first can open the gateway to recovering the other valuable elements (including Critical Minerals), which are generally present in lower concentrations.

With the commercialisation of Geo40's silica-recovery technology (Ohaaki Northern Plant), the company's technology-development focus has been increasingly directed onto lithium, with some early stage work on other valuable elements.

Our process

Key

- Geo40 Team
- Geo40 Process





Sustainability in our business

OUR POLICIES AND COMMITMENTS

Geo40 is grounded in the three Māori principles of kaitiakitanga, auaha and kotahitanga.

- Kaitiakitanga is a broad term that describes our role in being good guardians of the natural environment – we must individually and collectively act as strong kaitiaki.
- Auaha describes the spirit of innovation that we bring to all we do.
- We know that we are always stronger with great partners, and kotahitanga reflects more than a simple partnership, speaking to unity and togetherness.



Innovative mineral recovery

Geo40 is a diverse collection of industry professionals, with proven expertise in the development of new and innovative mineral recovery technologies, recovering silica and lithium. Technologies to recover boron, caesium and antimony are in early development.

Environmental conduct

We seek always to adhere to the highest standards of environmental care conduct. This extends throughout the project lifecycle, from initial concept through to design and we incorporate environmental outcomes into our build and operations.

We operate within the consent conditions of the geothermal power generators. As a result, we are acutely aware of the imperative for high levels of environmental performance. Our environmental performance record is strong, and we have the systems, processes and disciplines in place to keep it that way.



Environmental, Social, and Governance (ESG)

We are committed to the highest standards of environmental, social and governance performance. We publish our ESG sustainability performance report annually, reporting on the ESG disclosures of the 21 Stakeholder Capitalism Metrics (SCM) of the World Economic Forum (WEF). ESG reports are available on our website.

We are committed to the welfare of our staff, partners, and all stakeholders we engage with. We seek opportunities to have a positive impact on our environment and the climate globally.

Geo40's ESG focus areas for the year ended 31 March 2023

This diagram illustrates the focus metrics initially reported on in 2022, which are now attached to the inner pillar circle. The new focus areas for 2023 are shown most peripherally. The remaining focus metrics not yet reported on are shown slightly disconnected from the inner circle.



Local partnerships

We operate in New Zealand in partnership with the Ngāti Tahu Tribal Lands Trust. Our Ohaaki Northern Plant and Ngāwhā Demonstration Plant are located on their lands, where the Trust holds mana whenua, or rights over the land, but they are much more than our landlords.

We operate these plants with their blessing, and we are proud to have their people on our team. We recognise the role, opportunity, and responsibility we have in creating economic opportunities for our indigenous partners through our technologies.

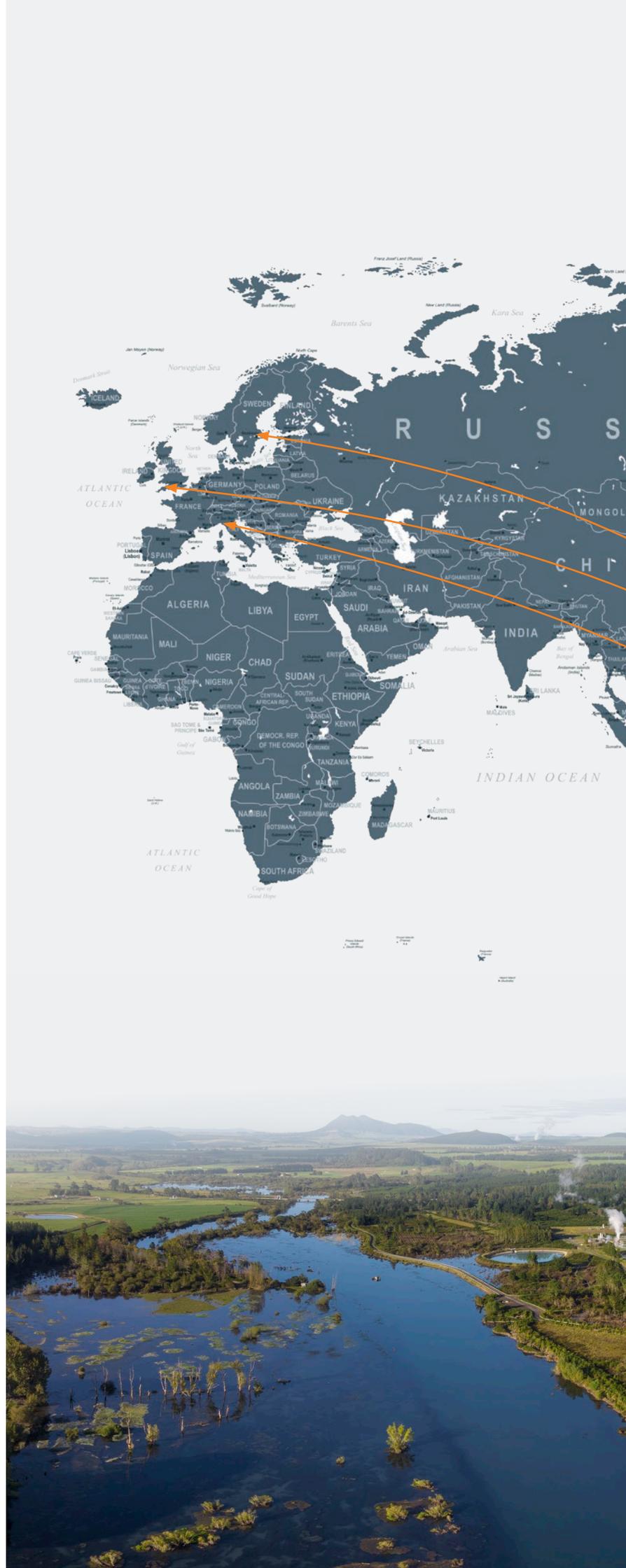
Our

LOCATION AND REACH

Geo40's first commercial-size plant was commissioned in New Zealand in early 2021, producing around 3,000 metric tonnes of high-quality, customisable colloidal silica annually.

We are looking to scale production with new sites around the world.

Geo40 products are produced for world-wide distribution.





Geo40 Limited. Northern Steam Field,
 Contact Energy, 391 Ohaaki Road,
 Ohaaki 3083, New Zealand

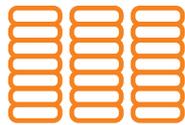


Colloidal **SILICA MARKETS**

Geo40 colloidal silicas are being delivered globally to a growing number of traditional and emerging colloidal silica markets, including:



Permeation Grouting



Precision Investment Casting



Refractory



Coatings



Pulp and Paper



Rubber and Latex



Ready-mix Concrete



Catalyst



Product

INFORMATION

Product covered by this EPD

This EPD covers Geo40's 1430Na which is recovered from geothermal brines pre-reinjection within Contact Energy's Ohaaki steam field, Taupo, New Zealand.

Our unique colloidal silicas are an aqueous dispersion of amorphous silicon dioxide nanoparticles. The alkaline dispersions contain customisable small-sized colloidal silica particles at 10-40% SiO₂ concentration in water. The particles have a negatively charged surface (anionic) which is stabilized by sodium hydroxide.

These silica dispersions are utilised globally in many traditional and emerging markets where industry partners are looking to decarbonise their supply chain and capture any potential performance benefits that are available.

Table 1: Industry classification

Product	Classification	Code	Category
Product name/type	UN CPC Ver.2	3427	Cyanides, cyanide oxides and complex cyanides: fulminates, cyanates, and thiocyanates: silicates: borates: perborates
	ANZSIC 2006	1813	Basic Inorganic Chemical Manufacturing
	CPV	24311400-1	Hydrogen chloride, inorganic acids, silicon dioxide and sulphur dioxide
	UNSPSC	12352309	Silica
	NACE	20.13	Manufacture of other inorganic basic chemicals

Declared Unit

The declared unit for the EPD is 1 kilogramme (kg) of colloidal silica plus its packaging ready for delivery.

Content Declaration

Table 2: Composition of 1430Na product (per 1 kilogramme)

Product components	Weight, kg	Post-consumer recycled material, weight-%	Biogenic material, weight-% and kg C/kg
Colloidal silica	0.3	0	0
Biocide	0.00222	0	0
Water	0.698	0	0
Total	1.00	0	0

The biocide used as a component of the product is Rocima BT NV2. The safety data sheet for this product identifies hazardous properties as:

- Acute toxicity - Category E - Oral
- Skin irritation - Category A
- Serious eye damage - Category A
- Skin sensitisation - Category B

Amorphous forms of silica are considered to have low human hazard potential. See for example the Crystalline silica: Human health tier II assessment (National Industrial Chemicals Notification and Assessment Scheme, 2020).

Table 3: Composition (of) 1430Na distribution packaging (per 1kg product)

Product materials	Weight, kg	Weight-% (versus the product)	Post-consumer recycled material, weight-%	Weight biogenic carbon, kg C/kg
Polyethylene HD Plastic	0.0142	1.4	0	0
Galvanised Steel	0.0358	3.6	0	0
Total	0.0500	5.0	0	0





Product

PROPERTIES

The properties of 1430Na are provided in the table below. All are available both in bulk and packaged quantities.

Table 4: 1430Na properties

Product	1430Na
Concentration (wt% solids)	30.0
pH	9.6
Stabilizing ion	Sodium
Surface charge	Anionic
Surface modification	Nil
Appearance	Clear to Opaque
Density (g/cm ³)	1.201
Viscosity (cP)	5.0

LCA

INFORMATION

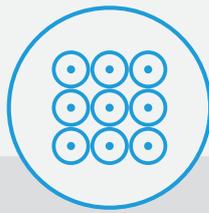
Database and LCA software used

All data in the background system were from the Managed LCA Content Database 2022 (fka GaBi, Sphera, 2022). Most datasets have a reference year between 2018 and 2021 and all fall within the 10-year limit.

System diagram



Geothermal liquid piped to Geo40 Plant



Processing



Packaging



Distribution



Packaging EOL

CRADLE

GRAVE



Description of system boundaries

The system boundary for this EPD is cradle to customer gate, including packaging end of life.

Upstream processes

- Raw material supply, including water supply, chemicals and electricity
- Transport of raw materials
- Production of IBC packaging

Core processes

- Production of product
- Use of raw materials, including water, chemicals, and electricity
- Fuel use
- Steam emissions
- Waste treatment

Downstream processes

- Transport to customer. Including maritime shipping as required, and weighted on market share and measured distances
- Packaging end of life

Excluded lifecycle stages

Colloidal silica has a wide variety of uses and many specific applications, each with significantly different environmental impacts. As such, the use phase has not been declared. Similarly, end-of-life treatment of the chemical product has been excluded as all of the following criteria have been fulfilled (PCR 2021:03 v 1.1.1):

- Colloidal silica is physically integrated with other products in subsequent life-cycle process and cannot be physically separated from these products at end-of-life;
- Colloidal silica is no longer identifiable at end-of-life because of a physical or chemical transformation process;
- Colloidal silica does not contain biogenic carbon; and
- Colloidal silica is a business-to-business product, hence the EPD will not be used in business-to-consumer communication.





LIFE CYCLE INVENTORY (LCI) DATA AND ASSUMPTION

Primary data was used for all manufacturing operations up to the factory gate, including upstream data for Geo40. Primary data for Geo40 operations was sourced from the period 2022-04-01 to 2022-09-30. The data collection period for this study covers six months of steady-state production, as Geo40 had not been operating at 100% output capacity for a full year at this time. The products are manufactured in batches and are not impacted by seasonality. The EPD will be updated when data for 12 months of operation becomes available. Background data was used for input materials sourced from other suppliers.

All data in the background system was from the GaBi Life Cycle Inventory Database 2021 (Sphera 2021). Most datasets have a reference year between 2017 and 2020. The most representative industry-average data for all background processes was used when available. Whenever such data were not available, best-available proxy data were employed. The impact of proxy data is less than 10% of the overall environmental impact from the product system.

Electricity

- Electricity is received directly from Contact Energy's Ohaaki Geothermal Power Plant nearby.

Transport

- Measured and calculated transport distances were primarily used. If distances were unknown then default distances as specified by the PCR were used.

Cut-off criteria

Environmental impacts relating to manufacturing of production equipment, buildings and other capital goods, business travel of personnel, travel to and from work by personnel, research and development activities, and energy use (heating and electricity) of office spaces are excluded from the system boundary as per the PCR. All other reported data were incorporated and modelled using the best available life cycle inventory data.

Assessment Indicators

The results tables describe the different environmental indicators for each product per declared unit, for each declared module. EPD International specifies the use of its default indicators for this EPD. The core environmental impact indicators of EN 15804:2012+A2:2019/AC:2021 are used as mandatory indicators.

The reference package used for characterisation factors is EF 3.0.

For colloidal silica, the following indicators are not relevant, hence result in zero values:

- Components for re-use (CRU) is zero since there are none produced
- Materials for energy recovery (MER) is zero since no credits are claimed for any incinerated wastes, applying the cut-off approach
- Exported electrical energy (EEE) is zero since there is none produced
- Exported thermal energy (EET) is zero since there is none produced



Environmental

IMPACT INDICATORS

An introduction to the core environmental impact indicators is provided below. The best-known effect of each indicator is listed in the descriptions and the abbreviations, in brackets, correspond to the labels in the following results tables.

The reference package used for characterisation factors is EF 3.0.



Climate change (Global Warming Potential)

(GWP-total, GWPf, GWPb, GWPluc)

A measure of greenhouse gas emissions, such as CO₂ and methane. These emissions are causing an increase in the absorption of radiation emitted by the earth, increasing the natural greenhouse effect. This may in turn have adverse impacts on ecosystem health, human health, and material welfare. The Global Warming Potential (GWP) is split into three sub indicators: total (GWPt), fossil (GWPf), biogenic (GWPb), and land-use and land-use change (GWPluc).



Ozone Depletion Potential

(ODP)

Depletion of the ozone leads to higher levels of UVB ultraviolet rays reaching the earth's surface with detrimental effects on humans and plants. The Ozone Depletion Potential is a measure of air emissions that contribute to the depletion of the stratospheric ozone layer.



Acidification potential

(AP)

Acidification Potential is a measure of emissions that cause acidifying effects to the environment. A molecule's acidification potential indicates its capacity to increase the hydrogen ion (H⁺) concentration in the presence of water, thus decreasing the pH value. Potential effects include fish mortality, forest decline, and the deterioration of building materials.



Eutrophication Potential

(EP-fw, EP-fm, EP-tr)

Eutrophication covers all potential impacts of excessively high levels of macronutrients, the most important of which are nitrogen (N) and phosphorus (P). In aquatic ecosystems where this term is mostly applied, this typically describes a degradation in water quality. Eutrophication can result in an undesirable change in the type of species that flourish and an increase in the production of biomass. As the decomposition of biomass consumes oxygen, eutrophication may decrease the available oxygen level in the water column and threaten fish in their ability to respire.



Photochemical Ozone Formation Potential (POFP)

Photochemical Ozone Formation Potential gives an indication of the emissions from precursors that contribute to ground level smog formation, mainly ozone (O₃). Ground level ozone may be harmful to human health and ecosystems and may also damage crops. These emissions are produced by the reaction of volatile organic compounds (VOCs) and carbon monoxide in the presence of nitrogen oxides and UV light.



Abiotic Resource Depletion (ADP-mm, ADPf)

The consumption of non-renewable resources decreases the availability of these resources and their associated functions in the future. Depletion of mineral resources and non-renewable energy resources are reported separately. Depletion of mineral resources is assessed based on total reserves.



Water use (WDP)

Water scarcity (water deprivation) is a measure of the stress on a region due to water consumption.



Environmental PERFORMANCE

The estimated impact results are only relative statements which do not indicate the end points of the impact categories, exceeding threshold values, safety margins or risks.

430Na with packaging

Table 5: Environmental Impacts for one kilogramme of 1430Na with packaging

INDICATOR	PARAMETER	UNIT	Upstream	Core	Downstream	Total
Global Warming Potential – total	GWP-t	kg CO ₂ -eq.	0.0297	0.097	0.104	0.231
Global Warming Potential - fossil	GWP-f	kg CO ₂ -eq.	0.0296	0.0818	0.103	0.215
Global Warming Potential - biogenic	GWP-b	kg CO ₂ -eq.	7.00E-05	0.0153	7.53E-04	0.0161
Global Warming Potential - land use and land use change	GWP-luluc	kg CO ₂ -eq.	9.97E-06	9.10E-06	4.24E-06	2.33E-05
Ozone depletion potential	ODP	kg CFC11-eq.	7.52E-17	5.05E-16	1.41E-17	5.95E-16
Acidification	AP	Mole of H ⁺ eq.	8.90E-05	3.34E-05	0.00313	0.00326
Eutrophication aquatic freshwater	EP-fw	kg P eq.	2.53E-08	4.20E-07	5.94E-08	5.04E-07
Eutrophication aquatic marine	EP-fm	kg N eq.	2.02E-05	1.70E-05	8.44E-04	8.81E-04
Eutrophication terrestrial	EP-tr	Mole of N eq.	2.19E-04	1.62E-04	0.00924	0.00962
Photochemical ozone formation	POCP	kg NMVOC eq.	6.67E-05	5.36E-05	0.00233	0.00245
Depletion of abiotic resources - minerals and metals*	ADP-mm	kg Sb-eq.	6.67E-07	1.16E-09	1.62E-08	6.84E-07
Depletion of abiotic resources - fossil fuels*	ADP-f	MJ	0.51	0.0718	1.29	1.87
Water deprivation potential*	WDP	m ³ world equiv.	8.94	-8.73	5.98E-04	0.212

* Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.

Table 6: Use of Resources for one kilogramme of 1430Na with packaging

INDICATOR	PARAMETER	UNIT	Upstream	Core	Downstream	Total
Renewable primary energy as energy carrier	PERE	MJ, net calorific value	0.0261	13.6	0.00771	13.7
Renewable primary energy resources as material utilization	PERM	MJ, net calorific value	0	0	0	0
Total use of renewable primary energy resources	PERT	MJ, net calorific value	0.0261	13.6	0.00771	13.7
Non-renewable primary energy as energy carrier	PENRE	MJ, net calorific value	0.511	0.0718	1.33	1.91
Non-renewable primary energy as material utilization	PENRM	MJ, net calorific value	0	0	0	0
Total use of non-renewable primary energy resources	PENRT	MJ, net calorific value	0.511	0.0718	1.33	1.91
Use of secondary material	SM	kg	0	0	0	0
Use of renewable secondary fuels	RSF	MJ, net calorific value	0	0	0	0
Use of non-renewable secondary fuels	NRSF	MJ, net calorific value	0	0	0	0
Use of net fresh water	FW	m ³	0.938	-0.937	1.96E-05	7.17E-04

Table 7: Waste and output flows for one kilogramme of 1430Na with packaging

INDICATOR	PARAMETER	UNIT	Upstream	Core	Downstream	Total
Hazardous waste disposed	HWD	kg	3.16E-11	1.74E-11	4.08E-11	8.98E-11
Non-hazardous waste disposed	NHWD	kg	2.99E-04	1.50E-02	1.06E-02	0.0258
Radioactive waste disposed	RWD	kg	3.50E-06	3.81E-07	2.09E-06	5.97E-06
Components for re-use	CRU	kg	0.00E+00	0.00E+00	0.00E+00	0
Materials for recycling	MFR	kg	0	0	0	0
Materials for energy recovery	MER	kg	0	0	0	0
Exported electrical energy	EEE	MJ	0	0	0	0
Exported thermal energy	EET	MJ	0	0	0	0

Table 8: Additional indicators for one kilogramme of ¹⁴³⁰Na with packaging

INDICATOR	PARAMETER	UNIT	Upstream	Core	Downstream	Total
IPCC AR5 GWP (excluding biogenic carbon)	GWP-GHG	kg CO ₂ -eq.	0.0295	0.0937	0.103	0.226
Respiratory inorganics	PM	Disease incidences	1.01E-09	2.21E-10	5.29E-08	5.41E-08
Ionizing radiation - human health [^]	IR	kBq U235 eq.	4.13E-04	5.25E-05	1.73E-04	6.38E-04
Ecotoxicity freshwater*	ETf	CTUe	0.192	74	1.2	75.4
Human toxicity, cancer*	HTc	CTUh	2.58E-11	1.22E-11	1.92E-11	5.73E-11
Human toxicity, non-canc.*	HTnc	CTUh	3.29E-10	2.74E-10	6.80E-10	1.28E-09
Land use*	SQP	Pt	0.0212	0.682	0.00569	0.709

* Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator

[^] This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

1430Na only

Table 9: Environmental Impacts for one kilogramme of 1430Na excluding packaging

INDICATOR	PARAMETER	UNIT	Upstream	Core	Downstream	Total
Global Warming Potential – total	GWP-t	kg CO ₂ -eq.	0.00239	0.097	0.103	0.203
Global Warming Potential - fossil	GWP-f	kg CO ₂ -eq.	0.00237	0.0818	0.102	0.186
Global Warming Potential - biogenic	GWP-b	kg CO ₂ -eq.	3.58E-06	1.53E-02	7.53E-04	0.0161
Global Warming Potential - land use and land use change	GWP-luluc	kg CO ₂ -eq.	3.04E-07	9.10E-06	3.84E-06	1.32E-05
Ozone depletion potential	ODP	kg CFC11-eq.	4.03E-18	5.05E-16	1.27E-17	5.22E-16
Acidification	AP	Mole of H ⁺ eq.	1.56E-05	3.34E-05	3.13E-03	0.00318
Eutrophication aquatic freshwater	EP-fw	kg P eq.	1.42E-09	4.20E-07	1.90E-08	4.40E-07
Eutrophication aquatic marine	EP-fm	kg N eq.	3.08E-06	1.70E-05	8.43E-04	0.000863
Eutrophication terrestrial	EP-tr	Mole of N eq.	3.40E-05	1.62E-04	9.23E-03	0.00943
Photochemical ozone formation	POCP	kg NMVOC eq.	9.71E-06	5.36E-05	2.33E-03	0.00239
Depletion of abiotic resources - minerals and metals*	ADP-mm	kg Sb-eq.	3.86E-10	1.16E-09	1.61E-08	1.76E-08
Depletion of abiotic resources - fossil fuels*	ADP-f	MJ	0.0842	0.0718	1.28	1.44
Water deprivation potential*	WDP	m ³ world equiv.	8.94	-8.73	0.00058	0.208

* The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator

Table 10: Use of Resources for one kilogramme of 1430Na excluding packaging

INDICATOR	PARAMETER	UNIT	Upstream	Core	Downstream	Total
Renewable primary energy as energy carrier	PERE	MJ, net calorific value	0.0013	13.6	0.00705	13.6
Renewable primary energy resources as material utilization	PERM	MJ, net calorific value	0	0	0	0
Total use of renewable primary energy resources	PERT	MJ, net calorific value	0.0013	13.6	0.00705	13.6
Non-renewable primary energy as energy carrier	PENRE	MJ, net calorific value	0.0839	0.0718	1.32	1.48
Non-renewable primary energy as material utilization	PENRM	MJ, net calorific value	0	0	0	0
Total use of non-renewable primary energy resources	PENRT	MJ, net calorific value	0.0839	0.0718	1.32	1.48
Use of secondary material	SM	kg	0	0	0	0
Use of renewable secondary fuels	RSF	MJ, net calorific value	0	0	0	0
Use of non-renewable secondary fuels	NRSF	MJ, net calorific value	0	0	0	0
Use of net fresh water	FW	m ³	0.938	-0.937	1.88E-05	9.59E-04

Table 11: Waste and output flows for one kilogramme of 1430Na excluding packaging

INDICATOR	PARAMETER	UNIT	Upstream	Core	Downstream	Total
Hazardous waste disposed	HWD	kg	2.91E-12	1.74E-11	3.97E-11	6.00E-11
Non-hazardous waste disposed	NHWD	kg	1.15E-05	0.015	9.55E-05	0.0151
Radioactive waste disposed	RWD	kg	3.42E-08	3.81E-07	2.01E-06	2.42E-06
Components for re-use	CRU	kg	0	0	0	0
Materials for recycling	MFR	kg	0	0	0	0
Materials for energy recovery	MER	kg	0	0	0	0
Exported electrical energy	EEE	MJ	0	0	0	0
Exported thermal energy	EET	MJ	0	0	0	0

Table 12: Additional indicators for one kilogramme of 1430Na excluding packaging

INDICATOR	PARAMETER	UNIT	Upstream	Core	Downstream	Total
IPCC AR5 GWP (excluding biogenic carbon)	GWP-GHG	kg CO ₂ -eq.	0.00241	0.0937	0.102	0.198
Respiratory inorganics	PM	Disease incidences	1.44E-10	2.21E-10	5.29E-08	5.32E-08
Ionizing radiation - human health [^]	IR	kBq U235 eq.	2.88E-06	5.25E-05	1.64E-04	2.19E-04
Ecotoxicity freshwater*	ETf	CTUe	0.035	74.0	1.19	75.2
Human toxicity, cancer*	HTc	CTUh	7.01E-13	1.22E-11	1.88E-11	3.18E-11
Human toxicity, non-canc.*	HTnc	CTUh	1.91E-11	2.74E-10	6.42E-10	9.32E-10
Land use*	SQP	Pt	0.000771	0.682	0.00492	0.688

* Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator

[^] This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

Packaging only

Table 13: Environmental Impacts for packaging associated with one kilogramme of 1430Na

INDICATOR	PARAMETER	UNIT	Upstream	Core	Downstream	Total
Global Warming Potential – total	GWP-t	kg CO ₂ -eq.	0.0273	0	0.00068	0.028
Global Warming Potential - fossil	GWP-f	kg CO ₂ -eq.	0.0272	0	0.00068	0.0279
Global Warming Potential - biogenic	GWP-b	kg CO ₂ -eq.	6.64E-05	0	1.89E-07	6.66E-05
Global Warming Potential - land use and land use change	GWP-luluc	kg CO ₂ -eq.	9.67E-06	0	3.99E-07	1.01E-05
Ozone depletion potential	ODP	kg CFC11-eq.	7.12E-17	0	1.36E-18	7.25E-17
Acidification	AP	Mole of H ⁺ eq.	7.34E-05	0	2.73E-06	7.62E-05
Eutrophication aquatic freshwater	EP-fw	kg P eq.	2.39E-08	0	4.04E-08	6.43E-08
Eutrophication aquatic marine	EP-fm	kg N eq.	1.71E-05	0	8.11E-07	1.79E-05
Eutrophication terrestrial	EP-tr	Mole of N eq.	0.000185	0	8.91E-06	0.000194
Photochemical ozone formation	POCP	kg NMVOC eq.	5.70E-05	0	2.12E-06	5.91E-05
Depletion of abiotic resources - minerals and metals*	ADP-mm	kg Sb-eq.	6.67E-07	0	1.23E-10	6.67E-07
Depletion of abiotic resources - fossil fuels*	ADP-f	MJ	0.426	0	0.00986	0.436
Water deprivation potential*	WDP	m ³ world equiv.	0.00224	0	1.77E-05	0.00226

*The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator

Table 14: Use of Resources for packaging associated with one kilogramme of 1430Na

INDICATOR	PARAMETER	UNIT	Upstream	Core	Downstream	Total
Renewable primary energy as energy carrier	PERE	MJ, net calorific value	0.0248	0	0.000658	0.0255
Renewable primary energy resources as material utilization	PERM	MJ, net calorific value	0	0	0	0
Total use of renewable primary energy resources	PERT	MJ, net calorific value	0.0248	0	0.000658	0.0255
Non-renewable primary energy as energy carrier	PENRE	MJ, net calorific value	0.427	0	0.0101	0.437
Non-renewable primary energy as material utilization	PENRM	MJ, net calorific value	0	0	0	0
Total use of non-renewable primary energy resources	PENRT	MJ, net calorific value	0.427	0	0.0101	0.437
Use of secondary material	SM	kg	0	0	0	0
Use of renewable secondary fuels	RSF	MJ, net calorific value	0	0	0	0
Use of non-renewable secondary fuels	NRSF	MJ, net calorific value	0	0	0	0
Use of net fresh water	FW	m ³	5.95E-05	0	7.50E-07	6.02E-05

Table 15: Waste and output flows for packaging associated with one kilogramme of 1430Na

INDICATOR	PARAMETER	UNIT	Upstream	Core	Downstream	Total
Hazardous waste disposed	HWD	kg	2.87E-11	0	1.10E-12	2.98E-11
Non-hazardous waste disposed	NHWD	kg	0.000288	0	0.0105	0.0108
Radioactive waste disposed	RWD	kg	3.47E-06	0	8.12E-08	3.55E-06
Components for re-use	CRU	kg	0	0	0	0
Materials for recycling	MFR	kg	0	0	0	0
Materials for energy recovery	MER	kg	0	0	0	0
Exported electrical energy	EEE	MJ	0	0	0	0
Exported thermal energy	EET	MJ	0	0	0	0

Table 16: Additional indicators for packaging associated with one kilogramme of 1430Na

INDICATOR	PARAMETER	UNIT	Upstream	Core	Downstream	Total
IPCC AR5 GWP (excluding biogenic carbon)	GWP-GHG	kg CO ₂ -eq.	0.0271	0	6.77E-04	0.0278
Respiratory inorganics	PM	Disease incidences	8.66E-10	0	2.60E-11	8.92E-10
Ionizing radiation - human health [^]	IR	kBq U235 eq.	4.10E-04	0	9.13E-06	4.19E-04
Ecotoxicity freshwater*	ETf	CTUe	0.157	0	0.00676	0.164
Human toxicity, cancer*	HTc	CTUh	2.51E-11	0	4.04E-13	2.55E-11
Human toxicity, non-canc.*	HTnc	CTUh	3.10E-10	0	3.84E-11	3.48E-10
Land use*	SQP	Pt	0.0204	0	7.70E-04	0.0212

* Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator

[^] This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.



List of

ACRONYMS AND GLOSSARY

Acronyms

GaBi Ganzheitliche Bilanzierung (German for holistic balancing)

Glossary

Life cycle

A view of a product system as 'consecutive and interlinked stages ... from raw material acquisition or generation from natural resources to final disposal' (ISO 14040:2006, section 3.1). This includes all material and energy inputs as well as emissions to air, land, and water.

Life Cycle Assessment (LCA)

Compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle (ISO 14040:2006, section 3.2)

Life Cycle Inventory (LCI)

Phase of life cycle assessment involving the compilation and quantification of inputs and outputs for a product throughout its life cycle (ISO 14040:2006, section 3.3)

Environmental Product Declaration (EPD)

Independently verified and registered document that communicates transparent and comparable information about the life-cycle environmental impact of products.

Product Category Rule (PCR)

Defines the rules and requirements for EPDs of a certain product category.

Declared unit

Quantified performance of a product system for use as a reference unit. (ISO 14040:2006, section 3.20). The EPD is not based on a full 'cradle to grave' LCA. It includes the average transport to a customer and end-of-life packaging but excludes the product use phase.

Allocation

Partitioning the input or output flows of a process or a product system between the product system under study and one or more other product systems (ISO 14040:2006, section 3.17)

Background system

'Those processes, where due to the averaging effect across the suppliers, a homogenous market with average (or equivalent, generic data) can be assumed to appropriately represent the respective process ... and/or those processes that are operated as part of the system but that are not under direct control or decisive influence of the producer of the good...' (JRC, 2010, pp. 97-98) As a general rule, secondary data are appropriate for the background system, particularly where primary data are difficult to collect.



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