

Environmental Footprint Declaration

RETORTE Selenium Products



This document presents an environmental footprint declaration based on the results of a life cycle assessment (LCA) of RETORTE selenium products, developed in accordance with ISO 14040 and ISO 14044 standards and the principles of ISO 14025. No applicable Product Category Rules (PCR) were available at the time of publication.

1. General information

Product name	RETORTE selenium products
Declared unit	1 kg of selenium contained in selenium
Manufacturer	RETORTE GmbH, Aurubis subsidiary
Production site(s)	RETORTE site, Germany
LCA	Aurubis supported by Sphera
Publication date	13/10/2025
Time coverage	Reference calendar year 2024
Independent verifier	TÜV NORD CERT Prüf- und Umweltgutachtergesellschaft mbH
Review type	Critical review per ISO 14044 (Clause 6)

2. Methodology and scope

Applied standards/guidelines: The study was conducted in accordance with the ISO 14040 (ISO 14040:2021 Environmental management — Life cycle assessment — Principles and framework) and ISO 14044 (ISO 14044:2021 Environmental management — Life cycle assessment — Requirements and guidelines) LCA standards and the Environmental Footprint impact assessment method (3.1).

Functional unit: 1 kg of selenium contained in selenium products (zinc selenite; sodium selenite; high-purity selenium; selenous acid; selenium dioxide; selenium granules/powder) at plant gate.

System boundaries: Cradle-to-gate life cycle inventory from the extraction of raw materials to the production of selenium products at RETORTE, based on the allocated profile of crude selenium from precious metals refining. The final profile includes the processing of crude selenium into finished RETORTE selenium products. Excludes packaging, downstream use, and end-of-life.

Allocation procedures: Allocation applied to precious metal refining to allocate impacts between silver, gold, PGM concentrate, and crude selenium.

3. Product

Product description: RETORTE selenium products are high-purity materials produced by processing crude selenium. The crude selenium is refined by RETORTE GmbH, a subsidiary of Aurubis, into selenium pellets, powders and compounds. These products are known for their consistent quality and ultra-low iron content, with ultra-pure selenium reaching up to 99.999 % purity.

Technical properties/applications: RETORTE selenium exhibits semi-metallic properties making it suitable for applications such as glass coloring and decolorizing, digital X-ray detectors, infrared optics, and electroplating. Ultra-pure selenium (up to 99.999 %) is particularly ideal for high-performance uses such as CIS/CIGS solar cells, where material purity is essential for efficiency and long-term stability. Selenium compounds such as sodium and zinc selenite/selenate are also used in pharmaceuticals, animal feed additives, and various chemical industry processes.

Expected service life: Highly dependent on downstream application. Selenium used in solar panels or electronics may remain in use for decades, while applications in feed or pharmaceuticals involve short-term use.

4. Environmental performance — impact results (per 1 kg selenium contained in selenium products)

Impact category	Unit	Result
Climate change	kg CO ₂ eq	13.09
Ozone depletion	kg CFC-11 eq	0.0000000014
Human toxicity, cancer effects ¹	CTUh	0.000000008
Human toxicity, non-cancer effects ¹	CTUh	0.00000017
Particulate matter	Disease incidences	0.000001
Ionizing radiation	kBq U235 eq	0.74
Photochemical ozone formation	kg NMVOC eq	0.07
Acidification	mol H+ eq	0.103
Eutrophication (terrestrial)	mol N eq	0.276
Eutrophication (freshwater)	kg P eq	0.0001
Eutrophication (marine)	kg N eq	0.03
Ecotoxicity (freshwater) ¹	CTUe	67.29
Land use ¹	Pt	60.39
Water use	m ³ world eq	12.51
Resource use, energy carriers	MJ	162.55
Resource use, mineral and metals ¹	kg Sb eq	0.01

¹ Impacts are not sufficiently robust and accurate to be used for metals.

5. Environmental performance improvement and comparison with global average

The following graphs show the environmental improvements achieved by the company between 2023 and 2024 for RETORTE selenium product production.

No industry average data is available for comparison.

Carbon footprint

in kg CO₂ eq/kg Se



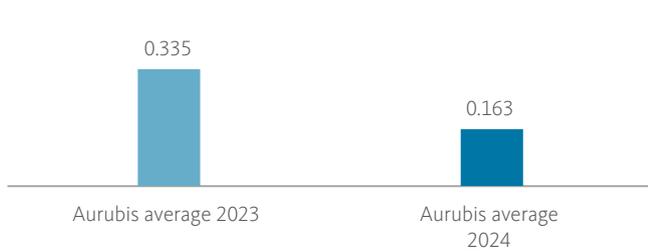
Eutrophication, marine

in kg N eq/kg Se



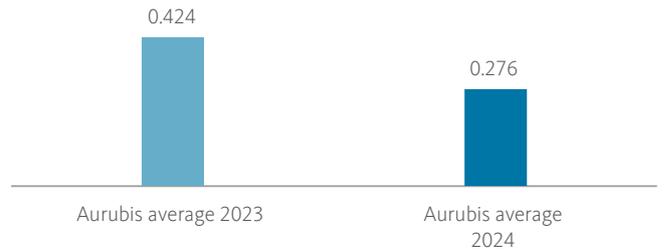
Resource use, fossils

in GJ/kg Se



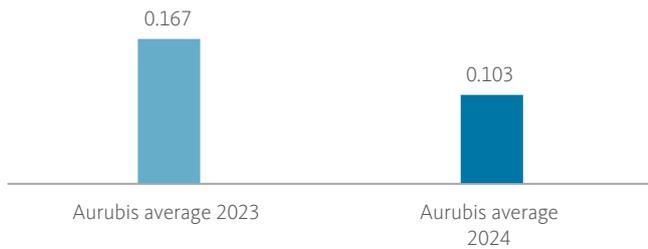
Eutrophication, terrestrial

in mole N eq/kg Se



Acidification

in mole of H⁺ eq/kg Se



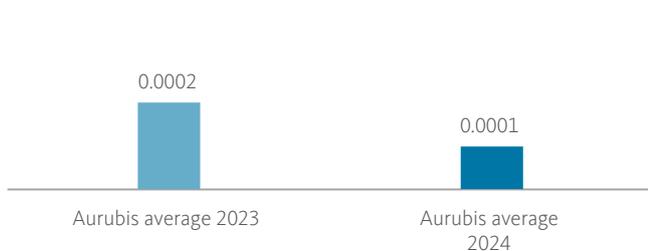
Summer smog

in kg NMVOC eq/kg Se



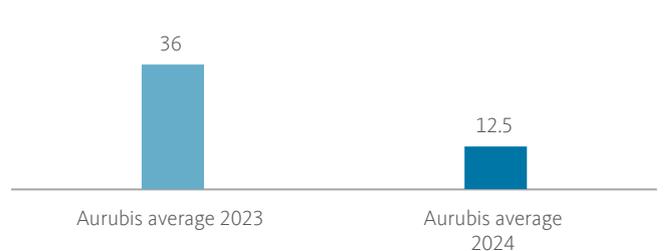
Eutrophication, freshwater

in kg P eq/kg Se



Water use

m³ world eq/kg Se



6. Additional environmental information

Environmental labels/Certifications: Aurubis RETORTE, the selenium products producing site, is certified to ISO 14001 and ISO 50001.

7. Interpretation and conclusions

The environmental impact of selenium product manufacturing is mainly driven by the production of crude selenium, with minor contributions from electricity use and auxiliary materials at the RETORTE site.

The updated environmental profile in 2024 is lower than in 2023 for all impact categories. This is mainly due to a lower share of impacts allocated to crude selenium in precious metals refining.

Aurubis' sustainability efforts — especially at the Hamburg site, the main supplier of crude selenium — play a key role in reducing the environmental footprint. Investments in energy-efficient and low-carbon technologies across the Aurubis Group have further improved performance.

8. Verification

Verification type	Critical review in accordance with ISO 14040 (2021) and ISO 14044 (2021)
Verifier name & organization	Dr. Winfried Hirtz, Michael Sommer TÜV NORD CERT Prüf- und Umweltgutachtergesellschaft mbH Am TÜV 1, 30519 Hannover, Germany Phone +49 (0) 511 986-1172 Email whirtz@tuev-nord.de; micsommer@tuev-nord.de
Date of verification	2/10/2025

The review confirmed that the LCA complies with the applicable standards and is scientifically and technically valid.

9. Disclaimer

This declaration has not been issued under a program operator and has not been verified in accordance with a PCR because none is available. The information is provided for transparency and B2B communication purposes.

10. Annexes

A. LCA Report

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