ENVIRONMENTAL PRODUCT DECLARATION

as per /ISO 14025/ and /EN 15804/

Owner of the Declaration	**voestalpine AG**
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-VOE-20190094-IAC1-EN
ECO EPD Ref. No.	ECO-00000964
Issue date	14.08.2019
Valid to	13.08.2024

Rails for high-speed railways, mixed railways, heavy loads, urban public transportation, crane and construction rails

voestalpine Schienen GmbH

Institut Bauen und Umwelt e.V.

www.ibu-epd.com / https://epd-online.com

ECO PLATFORM EPD EN 15804 VERIFIED

1. General Information

voestalpine Schienen GmbH	Rails
Programme holder IBU - Institut Bauen und Umwelt e.V. Panoramastr. 1 10178 Berlin Germany	**Owner of the declaration** voestalpine AG voestalpine-Straße 3 4020 Linz Austria
Declaration number EPD-VOE-20190094-IAC1-EN	**Declared product / declared unit** 1 metric ton of average voestalpine rail
This declaration is based on the product category rules: Rails forming a track for vehicles, 06.2018 (PCR checked and approved by the SVR)	**Scope:** This EPD is based on a declared unit of 1 metric ton of average voestalpine rails produced at the production site in Donawitz (Austria).
Issue date 14.08.2019	The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.
Valid to 13.08.2024	**Verification** The standard /EN 15804/ serves as the core PCR Independent verification of the declaration and data according to /ISO 14025:2010/ ☐ internally ☒ externally
 Dipl. Ing. Hans Peters (President of Institut Bauen und Umwelt e.V.)	 Dr.-Ing. Wolfram Trinius (Independent verifier appointed by SVR)
 Dr. Alexander Röder (Managing Director IBU)	

2. Product

2.1 Product description / Product definition

The products of voestalpine Schienen GmbH are manufactured and delivered as roughly 120 different profiles and grades pursuant to applicable European and international standards, guidelines and specifications.

For the use and application of the product the respective national provisions at the place of use apply

2.2 Application

The products of voestalpine Schienen GmbH are used in railway systems, particularly in the following areas:

- High-speed railways
- Mixed railways (passenger and freight traffic)
- Heavy loads (including railways for ore transports)
- Urban public transportation (subways and trams)
- Railway switches (individual parts used in switch production)

2.3 Technical Data

This EPD refers to all products of voestalpine Schienen GmbH in a variety of different steel grades, dimensions, shapes and as-delivered conditions.

Constructional data

Name	Value	Unit
Density	7874	kg/m³
Tensile strength in accordance with TSI	>680	N/mm²
Hardness in accordance with TSI	>200	HBW
Elongation in accordance with EN 13674 and EN 14811	>9	%

Performance data of the product with respect to its characteristics in accordance with the relevant technical provision (no CE-marking).

2.4 Delivery status

The products of voestalpine Schienen GmbH are supplied in various profiles and customer-specified lengths of up to 120 meters. Customer supply can be just in time for every tariff station in Europe.

2.5 Base materials / Ancillary materials

The products of voestalpine Schienen GmbH consist of 100% continuously cast blooms (roughly 80% crude steel, 20% scrap and alloying elements) produced by voestalpine Stahl GmbH. The precise composition of the steel depends on the application and the steel grade specified by the customer.

The product contains substances in the Europaeische Chemikalien Agentur /(ECHA) candidate list/ (15 January 2019) above 0.1 mass %: no.
The product contains further carcinogenic, mutagenic, reprotoxic (CMR) substances of category 1A or 1B that are not in the candidate list, above 0.1 mass % in at least one sub-product: no.

Biocides have been added to the construction product, or the product has been treated with biocides (a treated product pursuant to the Biocidal Product Regulation (EU) No. 528/2012): no.

2.6 Manufacture

The starting material for the production of rails at voestalpine is crude steel made in the primary route (blast furnace, LD steelmaking plant) at the Donawitz site. The molten crude steel is cast into blooms using a continuous casting method. The blooms are temporarily stored in the bloom storage unit or in a holding pit and heated to rolling temperature in a controlled manner in the walking beam furnace. The rails are then pre-rolled in the reversing break-down mill (BDM). Final shaping of the rails takes place in the ultra-flexible rail mill (UFR). Depending on customer specifications, the rails are cooled naturally or heat-treated to achieve desired properties.

Further production stages:

- Vertical and horizontal straightening
- Non-destructive testing (visual testing, flatness testing, eddy current testing and ultrasonic testing)
- Final straightening
- Cutting
- Drilling
- Final acceptance
- Storage and shipping

2.7 Environment and health during manufacturing

The production site of voestalpine Schienen GmbH is certified pursuant to eco-management and audit scheme /EMAS200/, /ISO 9001/, /ISO 14001/, /ISO 50001/ and occupational health- and safety assessment series /OHSAS 18001/. In compliance with EMAS provisions, voestalpine continually publishes environment-related facts and figures pertaining to the production site. At the Donawitz site, investments are made on a regular basis in an effort to expand the environmental protection measures to reduce air and water emissions to a minimum. Compliance with all statutory emission limit values has been verified. All production systems approved in accordance with applicable environmental impact analyses are also inspected on a regular basis as part of environmental audits. voestalpine was the first steelmaking company to be awarded the Green Bands seal of approval for special commitment in the areas of global environmental protection and sustainability.

2.8 Product processing/Installation

The products of voestalpine Schienen GmbH are processed directly at the site of installation and in special welding plants in the region where they are to be used in the future. Installation is carried out in accordance with the applicable standards and directives in the respective place of use.

2.9 Packaging

The products of voestalpine Schienen GmbH are delivered unpacked to the customer (fastened for transport with Signode or steel straps).

2.10 Condition of use

No changes to the material grade are expected while the rails are in use. Maintenance and inspection requirements are dependent on the material design and the respective place of application.

2.11 Environment and health during use

No effects to the health of humans or animals, nor harmful air, soil or water emissions are expected during the use of rails.

2.12 Reference service life

With respect to rail products made by voestalpine Schienen GmbH, the specification of a reference service life is waived based on the variety of applications and stress (high-speed traffic, mixed traffic, heavy loads, passenger traffic, urban traffic, switch technologies). The service life of rails is affected by the installation radius and track conditions. The service life of the product is optimized by regular maintenance performed by the end user. Proper selection of the product can significantly increase the service life of rails.

2.13 Extraordinary effects

Fire

Rails are not flammable. No flammable gases or vapors are released.

Fire protection

Name	Value
Building material class	n.a.
Burning droplets	n.a.
Smoke gas development	n.a.

n.a. = not applicable

Water

No negative effects on the environment are expected from water (including flooding).

Mechanical destruction

Unforeseeable mechanical effects on the declared product would have no environmental impact because of the plasticity of steel.

2.14 Re-use phase

The declared products consist of 100% steel and can thus either be reused or used as a valuable secondary raw material in the steelmaking industry. Steel is a permanent material that can be recycled as many times as necessary.

2.15 Disposal

The declared product can be entirely recycled. The waste code is in accordance with the /European Waste Catalog (EWC), Waste Catalog Ordinance/): 17 04 05 (iron and steel). The type of waste is to be equated with the waste catalog code 35103 pursuant to the Waste Catalog Ordinance applicable in Austria.

2.16 Further information
Please find more information about the product on our homepage at https://www.voestalpine.com/railway-systems.

3. LCA: Calculation rules

3.1 Declared Unit
This environmental product declaration refers to a declared unit of 1 metric ton of average voestalpine rail.

Declared unit

Name	Value	Unit
Declared unit	1	t
Conversion factor to 1 kg	0.001	-

The analysed products represent naturally hardened and heat treated rails and do not differentiate with respect to their basic composition.
Depending on the client's specifications, the steel grade may vary. This EPD covers voestalpine rails referring to an average steel grade, which is considered representative for all voestalpine rail products.

3.2 System boundary
The life cycle assessment of voestalpine rails refers to a cradle-to-gate analysis with options. The following lifecycle phases are taken into consideration in the analysis:

Module A1-A3 | Production stage
The product stage includes upstream burdens of processed intermediates (mainly steel blooms) and raw materials including the corresponding transports to the production site in Donawitz. Material and energy flows needed for the integrated steel mill as well as the subsequent rolling, heat treatment and finishing of voestalpine rails were recorded on site. Electricity is provided at Donawitz in a power station where furnace gases are used as fuel. Since more energy is used than is supplied by the site's power station, natural gas and electricity is additionally supplied from the Austrian grid.
No packaging is needed for the delivery of the product.

Module C3 | Waste treatment
Product flows that reach Module D for recycling leave the product system in C3. Environmental impacts resulting from the grinding and sorting of steel scrap are not included.

Module C4 | Landfilling
Module C4 declares the environmental impacts incurred by landfilling (5% of the product).

Module D | Credits and loads beyond the system boundary
The potential for substituting primary steel with a recycling scenario (95% of the product) is set forth in Module D.

3.3 Estimates and assumptions
All assumptions are verified through detailed documentation and correspond to the best possible representation of reality based on the available data. Regional applicability of the used background data refers to average data under European or German conditions taken from the /GaBi database/. German data was used for the Austrian market whenever European or Austrian average data were not available.

3.4 Cut-off criteria
All inputs and outputs for which data are available are included in the LCA model. Data gaps are filled with conservative assumptions from average data (when available) or with generic data and are documented accordingly. Only data with a contribution of less than 1% were cut off. Ignoring such data is justified based on the insignificance of the expected effect. Processes, materials or emissions known to make a significant contribution to the environmental effects of the products under examination have not been neglected. Plausibility of data collection was further checked based on industry benchmarks. Data have been completely recorded and the overall total of ignored input flows do not amount to more than 5% of total energy and mass flows.
Environmental impacts of machines, plant and infrastructure were not included.

3.5 Background data
Secondary data are used to depict the background system in the LCA model. These data originate from the /GaBi database/ 2018.

3.6 Data quality
The foreground data collected at voestalpine Schienen GmbH and voestalpine Stahl Donawitz GmbH are based on the quantities used and volumes produced annually. All process data were collected by voestalpine and are also part of the group's reporting to official agencies. Data on material and energy use originate from material-specific throughput measurements of various processes as well as from controlling. Data were collected in compliance with the established worldsteel approach complemented by supplementary process specific plausibility checks. The technological, geographical and time-related representativeness of the database was kept in mind when selecting background data. Whenever specific data were missing, either generic datasets or representative average data were used instead. The implemented background datasets from the /GaBi database/ are not more than seven years old.

3.7 Period under review
Foreground data were collected in the 2017 production year. All data are based on the volumes produced on an annual basis.

3.8 Allocation
Primary data are allocated using the partitioning approach developed by /worldsteel 2014/ for calculating life cycle inventories of co-products in steel production, which is in line with the provisions of /EN 15804/. The so-called partitioning approach provides for the allocation of environmental effects to the steelmaking process and the emerging byproducts

based on physical relations. Material-inherent flow properties are thus taken into account.
Economic allocation is not considered as referring byproducts and co-products are not directly tradable goods. Furthermore, long-term contracts for the sale of the byproducts exist, and the negotiated prices are therefore not subject to market dynamics.
The process specific allocation of environmental impacts from electricity and steam production of the site's power plant is based on exergy.
The net flows are calculated by deducting the external steel scrap in A1-A3 from the overall mass of the product.

3.9 Comparability

Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to /EN 15804/ and the building context, respectively the product-specific characteristics of performance, are taken into account.

The background database from /GaBi database/ was used to calculate the LCA.

4. LCA: Scenarios and additional technical information

The end-of-life scenario used in this LCA study is based on the following assumptions and thus complies with the specifications published in /ökobaudat 2017/:

End-of-life (C1 - C4)

Name	Value	Unit
Collected separately (steel)	1000	kg
Recycling 95 %	950	kg
Landfilling 5 %	50	kg

Re-Use, recovery and recycling potential (D)

Name	Value	Unit
Net flow of steel scrap	797	kg

This scenario contains a recycling rate of 95%. Since voestalpine externally purchases scrap for steel production, this is offset against the steel scrap for recycling (net flow).

5. LCA: Results

The following table contains the LCA results for a declared unit of 1 metric ton of average voestalpine rails.

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE NOT DECLARED)

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	MND	MND	MND	MND	MNR	MNR	MNR	MND	MND	MND	MND	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 t voestalpine Schiene

Parameter	Unit	A1-A3	C3	C4	D
Global warming potential	[kg CO_2-Eq.]	2.63E+3	0.00E+0	2.42E+0	-1.28E+3
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	7.18E-9	0.00E+0	6.34E-13	7.12E-6
Acidification potential of land and water	[kg SO_2-Eq.]	6.73E+0	0.00E+0	6.74E-3	-2.51E+0
Eutrophication potential	[kg $(PO_4)^{3-}$-Eq.]	7.96E-1	0.00E+0	8.54E-4	-1.87E-1
Formation potential of tropospheric ozone photochemical oxidants	[kg ethene-Eq.]	1.17E+0	0.00E+0	5.99E-4	-5.89E-1
Abiotic depletion potential for non-fossil resources	[kg Sb-Eq.]	2.89E-2	0.00E+0	5.11E-7	-3.69E-3
Abiotic depletion potential for fossil resources	[MJ]	2.14E+4	0.00E+0	3.47E+1	-1.24E+4

RESULTS OF THE LCA - RESOURCE USE: 1 t voestalpine Schiene

Parameter	Unit	A1-A3	C3	C4	D
Renewable primary energy as energy carrier	[MJ]	1.05E+3	0.00E+0	2.66E+0	8.21E+2
Renewable primary energy resources as material utilization	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Total use of renewable primary energy resources	[MJ]	1.05E+3	0.00E+0	2.66E+0	8.21E+2
Non-renewable primary energy as energy carrier	[MJ]	2.18E+4	0.00E+0	3.60E+1	-1.19E+4
Non-renewable primary energy as material utilization	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Total use of non-renewable primary energy resources	[MJ]	2.18E+4	0.00E+0	3.60E+1	-1.19E+4
Use of secondary material	[kg]	1.56E+2	0.00E+0	0.00E+0	7.94E+2
Use of renewable secondary fuels	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of non-renewable secondary fuels	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of net fresh water	[m^3]	5.83E+0	0.00E+0	-1.69E-5	1.71E+0

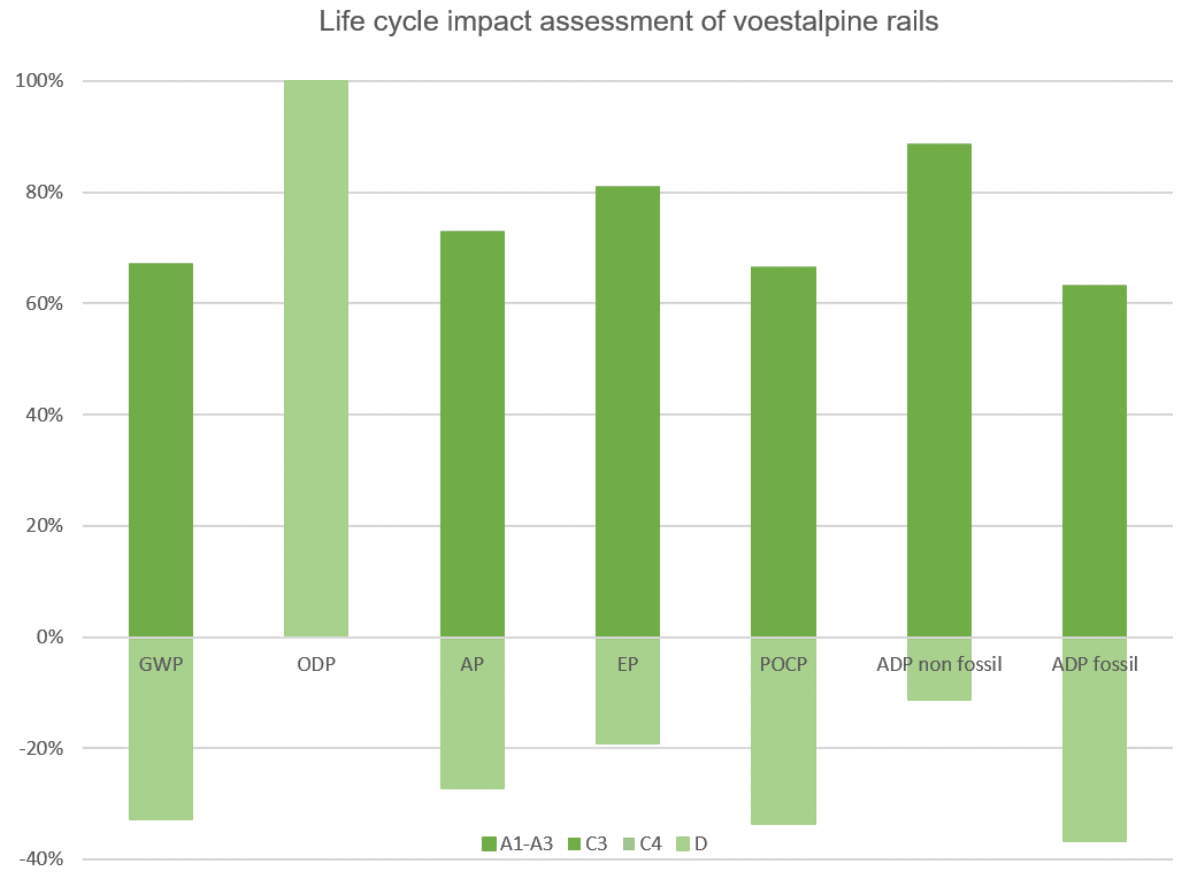
RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: 1 t voestalpine Schiene

Parameter	Unit	A1-A3	C3	C4	D
Hazardous waste disposed	[kg]	3.99E-4	0.00E+0	1.92E-7	-8.34E-4
Non-hazardous waste disposed	[kg]	1.99E+1	0.00E+0	5.01E+1	1.37E+2
Radioactive waste disposed	[kg]	1.76E-1	0.00E+0	5.01E-4	4.11E-4
Components for re-use	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Materials for recycling	[kg]	0.00E+0	9.50E+2	0.00E+0	0.00E+0
Materials for energy recovery	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Exported electrical energy	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Exported thermal energy	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0

6. LCA: Interpretation

The following interpretation contains a summary of the LCA results referenced to a declared unit of 1 metric ton of average voestalpine rail.

A comparison of the individual lifecycle phases results in a clear dominance of the production phase (Modules A1-A3). The environmental effects in the production phase are mainly dominated by the direct process emissions of steel production and the supply chain of purchased raw materials and energy carriers.



As a result of product recyclability, the material removed at the end of life can substitute primary steel. Module D shows the recycling potential of steel at the end of its product life. With the exception of the depletion potential of stratospheric ozone (**ODP**) as well as abiotic depletion of elementary resources (**ADP non fossil**), this results in credits from the substitution of primary steel for the impact categories investigated. Environmental burdens from the electricity use for the EAF-process account for the ODP results. The environmental impact of landfill disposal (C4) represents a minor contribution to the overall environmental impact of the product.

Environmental impacts from the production phase of rails (**modules A1-A3**) can largely be attributed to the raw materials and energy carriers needed in the blast furnaces, the basic oxygen furnace and the sinter plant including their emissions for primary steel making.

The greenhouse gases directly emitted from these processes, especially the blast furnaces, as well as the energetic treatment of the metallurgical gases contribute to a large share of potential global warming (**GWP**). When it comes to raw material supply, the upstream environmental burden for the production of alloys and coke contribute a major part to the product's global warming potential.
The potential global warming from further processing of blooms to rails is dominated by the emissions from natural gas used as energy carrier.

The main drivers of potential acidification (**AP**) and eutrophication (**EP**) also result from bloom production. Transports of main raw materials such as pellets and coke to the production site at Donawitz and resulting emissions from heavy fuel oil (HFO)-operated container ships thus contributes to potential acidification and eutrophication. Besides to direct process emissions at the production site, the upstream supply chain of pellets, coke and alloys represents a main driver for potential acidification and eutrophication.

Analysis shows that direct emissions at the production site are responsible for a large share of the potential formation of tropospheric ozone (**POCP**). Ship transports of pellets and lump ore for the blast furnaces also generate emissions that further contribute to the potential formation of summer smog.

The ozone depletion potential (**ODP**) mainly arises from pellets and iron ore used upstream in the blast furnaces and the alloying elements used in the steelmaking plant.

The upstream supply of the alloys plays a major role in the abiotic depletion potential of elementary resources (**ADP non fossil**).

The use of coke as well as coal to a minor extent represent main drivers of potential fossil resource depletion (**ADPf**) and the non-renewable primary energy use (**PENRE**). During rail processing, main amounts of non-renewable primary energy (**PENRE**) and fossil resource depletion (**ADPf**) are used for natural gas.

A majority of the renewable primary energy (**PERE**) is deployed in the upstream supply of the raw materials, electricity from the Austrian grid as well as for the production of alloys.

To sum up, raw material and energy input as well as direct process emissions for bloom production represent main drivers of the rail's environmental profile. Beyond that, potential acidification, eutrophication and formation of tropospheric ozone result from overseas transport to a large extent.

Processing of blooms to rails shows a minor contribution to the analysed environmental indicators. Natural gas input and resulting emissions represents a major factor for potential global warming and fossil resource depletion during rail processing.

7. Requisite evidence

Not relevant for this EPD.

8. References

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