ENVIRONMENTAL PRODUCT DECLARATION

as per *ISO 14025* and *EN 15804+A2*

Owner of the Declaration	voestalpine AG
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-VOE-20230092-IBA1-EN
Issue date	22.05.2023
Valid to	21.05.2028

Electrical steel strip - fully processed

voestalpine Stahl GmbH

Institut Bauen und Umwelt e.V.

ECO PLATFORM EPD VERIFIED

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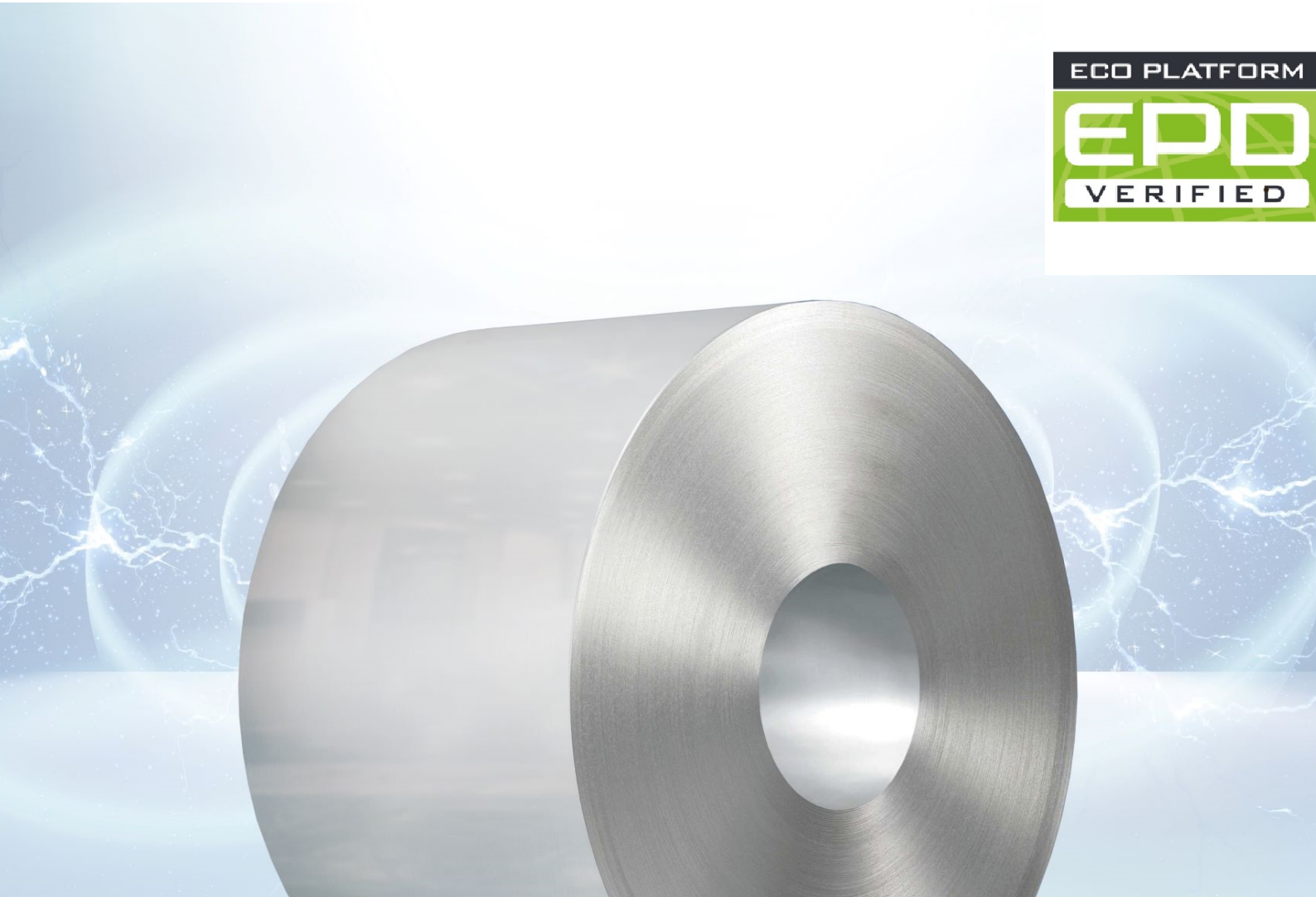


1. General Information

voestalpine Stahl GmbH

Programme holder

IBU – Institut Bauen und Umwelt e.V.
Hegelplatz 1
10117 Berlin
Germany

Declaration number

EPD-VOE-20230092-IBA1-EN

This declaration is based on the product category rules:

Structural steels, 01.09.2022
(PCR checked and approved by the SVR)

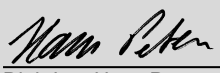
Issue date

22.05.2023

Valid to

21.05.2028

Dipl.-Ing. Hans Peters
(Chairman of Institut Bauen und Umwelt e.V.)



Dipl.-Ing. Hans Peters
(Managing Director Institut Bauen und Umwelt e.V.)

Electrical steel strip - fully processed

Owner of the declaration

voestalpine AG
voestalpine-Straße 3
4020 Linz
Austria

Declared product / declared unit

1 ton average non-grain-oriented electrical steel in fully processed condition

Scope:

This Environmental Product Declaration refers to a declared unit of 1 ton of average fully processed electrical steel produced at the Linz site.

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.

The EPD was created according to the specifications of EN 15804+A2. In the following, the standard will be simplified as *EN 15804*.

Verification

The standard EN 15804 serves as the core PCR
Independent verification of the declaration and data according to ISO 14025:2011
☐ internally ☒ externally

Dr.-Ing. Andreas Ciroth,
(Independent verifier)

2. Product

2.1 Product description/Product definition

The declared product is non-grain-oriented electrical steel in fully processed condition and is sold under the brand name isovac®. The technological properties (magnetic, mechanical, physical) in this product (fully processed electrical steel) are fully finalized following the final production stage at the steelmaker. The product is often supplied with an insulating coating. Fully processed electrical steel can be stamped and stacked by the customer.
The following characteristics, among others, can be cited as special material properties:

- State-of-the-art production (continuous lines) ensure excellent homogeneity of the material with respect to mechanical, geometric and magnetic qualities.
- This leads to excellent processability at the customer.
- Thanks to excellent magnetic properties in as-delivered condition, it is possible to manufacture electrical machinery with the highest energy efficiency.

Applicable national regulations regulate product use at any given site. In Austria, for example, the building regulations of individual provinces and the technical stipulations based on these regulations are applicable.

2.2 Application

Typical applications of isovac® electrical steel in fully processed condition are electrical machinery:

- Electric motors
- Generators
- Transformers
- Static machines

2.3 Technical Data

The data listed in the declaration of performance are authoritative:

Technical data

Name	Value	Unit
Thickness	0.25 - 1.0	mm
Surface weight	1.90 - 7.85	kg/m²
Coating thickness per side	1 - 8	µm

Performance values of the product according to the declaration of performance in relation to essential characteristics in accordance with the following norms:

Product standard

- *EN 10106:2016-03, Cold rolled non-oriented electrical steel strip and sheet delivered in the fully processed state.*
- *EN 10303:2016-02, Thin magnetic steel strip and sheet for use at medium frequencies.*

2.4 Delivery status

isovac® electrical steel in fully processed condition is supplied in coils with strip widths ranging between 1000 and 1620 mm. The steel strip thickness ranges between 0.25 and 1.0 mm, depending on the intended application and customer specifications.

2.5 Base materials/Ancillary materials

isovac® electrical steel in fully processed condition is in the form of cold-rolled steel strip produced at the voestalpine Stahl GmbH site in Linz. The basic material is produced of crude steel comprising roughly 75 % crude iron and 25 % scrap.

Auxiliary materials and additives:
Coating: Insulating coating systems with a layer thickness of 1 to 8 µm per side.

The product contains substances in the ECHA candidate list (16 January 2020) above 0.1 mass %: **No.**

The product contains further carcinogenic, mutagenic, reprotoxic (CMR) substances of category 1A or 1B that are not found 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.**

Respective national regulations shall apply to the use of the products.

2.6 Manufacture

The liquid crude steel produced in primary metallurgy (blast furnace, LD steelmaking plant) is further treated (alloyed) in secondary metallurgy and is cast into slabs in a continuous casting process. After being reheated (in pusher-type or walking-beam furnaces), the slabs are rolled into hot-rolled steel strip in several rolling steps. After removal of the oxide layer (pickling) formed in this process step and an intermediate annealing step (hood annealing) as required depending on the isovac® grade, the strips are rolled to the desired final thickness (continuous cold rolling). The isovac® electrical steel strips are then final-annealed in a continuous process. This heat treatment of isovac® electrical steel strip in fully processed condition is carried out primarily in Continuous Annealing Line 2 (some grades in Continuous Annealing Line 1). Final annealing is followed by coating with an insulating varnish applied directly following Continuous Annealing Line 2 (horizontal annealing furnace, coater, drying furnace). Surface finishing with insulating varnish ensures optimum product properties.

2.7 Environment and health during manufacturing

voestalpine Stahl GmbH is certified pursuant to *EMAS 2009*, *ISO 9001* und *ISO 14001*. In compliance with EMAS provisions, voestalpine continually publishes environment-related facts and figures pertaining to the production site. Investments are being made continually in the expansion of environmental protection measures at the Linz site in an effort to reduce air and water emissions to a minimum. All production systems approved in accordance with applicable environmental impact analyses are inspected on a regular basis as part of environmental audits in accordance with the state of the art.

2.8 Product processing/Installation

isovac® electrical steel in fully finished condition can be further processed by standard sheet processing methods such as stamping, cutting, stacking and bonding. Emissions or other harmful effects are not produced during the processing of the declared product.

2.9 Packaging

The declared product is supplied in the form of coils. Packaging consists of paper (coated), steel straps (circumferential and axle hole straps) and wooden frames and varies depending on the type of transport. All packaging can be recycled in its entirety.

2.10 Condition of use
The declared product is a high-quality fully processed electrical steel strip. Material changes are not expected in the intended application.

2.11 Environment and health during use
No adverse effects are expected on human health or the environment during use, nor do any harmful emissions arise from the declared product.

2.12 Reference service life
The referenced useful life depends on the respective application and generally lasts between 15 and 50 years.

2.13 Extraordinary effects
Fire
Not relevant.

Water
No negative effects are to be expected on the environment under the influence of water.

Mechanical destruction
Due to the plasticity of steel, no negative environmental impacts are to be expected from any, also unforeseeable, mechanical impacts on the declared product.

2.14 Re-use phase
Fully processed isovac® electrical steel can either be reused, introduced to a recycling process or reintroduced to the steelmaking industry as a valuable secondary raw material.

2.15 Disposal
The declared product can be entirely recycled. The waste code is in accordance with European Waste Catalog (EWC): 17 04 05. The type of waste is to be equated with waste catalog code 35103 pursuant to the Waste Catalog Ordinance applicable on a national level.

2.16 Further information
Please find more information about the product on our web site at https://www.voestalpine.com/isovac/

3. LCA: Calculation rules

3.1 Declared Unit
This environmental product declaration refers to a declared unit of 1 ton of fully processed electrical steel strip.

Declared unit

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

For the calculation of the declared average, all grades produced were included, calculating an annual average. Input and production quantities for the entire calendar year 2019 were taken into account. The calculated results can thus be considered representative for the entire product portfolio of fully processed electrical steel strips of voestalpine Stahl GmbH.

3.2 System boundary
The life cycle assessment of average fully processed electrical steel strips refers to a cradle-to-gate analysis with modules C1–C4 and module D (A1–A3 + C + D). The following life cycle phases are part of the analysis:

Module A1–A3 | Production stage
The production stage includes the upstream burdens of purchased raw materials (coal, iron ore, pellets etc.), their transports and the manufacturing at the production site in Linz. Material and energy flows for the sinter plant, the coking plant, the blast furnaces, the steelworks, the hot strip mill, the pickling, the cold rolling and the continuous annealing lines are considered. Electricity is provided at Linz from a power station where process gases are used as fuel. Since more energy is used than is supplied by this company-owned power station, natural gas and electricity is additionally procured from Austrian networks. Module A1–A3 also includes the production of the product packaging.

Module C1 | Deconstruction and demolition
It is assumed that the product is not connected with other materials and can therefore be dismantled. Dismantling efforts are considered negligible, thus no environmental impacts from the deconstruction of the products are declared.

Module C2 | Transport to disposal
For the transport to the disposal of the material, a distance of 50 km to the waste processing is assumed.

Module C3 | Waste processing
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 since the expected environmental impact is considered negligible.

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 outlined 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 were used for the Austrian market whenever European or Austrian average data were not available.

The composition of the coating of the steel strip reflects the majority of the systems used and can thus be considered representative. Due to the large number of coating systems used, simplifying assumptions were made.

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 irrelevance 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. Data were collected from the models and recommendations developed by *worldsteel 2017* and tested using available comparable values. It is assumed that the 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

This study uses generic background data for the evaluation of upstream environmental impacts from *GaBi*-database 2021.1 and is modelled in *GaBi*-software version 10.

3.6 Data quality

The foreground data collected at voestalpine Stahl GmbH are based on the quantities used and volumes produced annually. All process data were collected by voestalpine in the course of 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 *worldsteel 2017* provisions and were subjected to a supplementary plausibility check using material flow analyses of individual process steps. The technological, geographical and time-related representativeness of the data base 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 *GaBi* background datasets are not more than ten years old.

3.7 Period under review

Foreground data were collected in the 2019 production year, and the data are based on the volumes produced on an annual basis.

3.8 Geographic Representativeness

Land or region, in which the declared product system is manufactured, used or handled at the end of the product´s lifespan: Austria

3.9 Allocation

The 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 on the steelmaking process and the emerging byproducts based on physical relations. Material-inherent flow properties are thus taken into account.

The pickling byproducts iron sulphate and iron oxide were cut off as a result of their low contribution to company revenue. Economic allocation is not considered suitable since the 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.

3.10 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 *GaBi* background database was used to calculate the LCA (*GaBi* 10; 2021.1).

4. LCA: Scenarios and additional technical information

Characteristic product properties biogenic carbon

The declared product does not contain any biogenic carbon.

Installation in building (A5)

The end-of-life of the packaging materials is not declared in Module A5.

Name	Value	Unit
Packaging (Paper)	0.0012	kg
Packaging (Steel strips)	0.0002	kg

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 2022*:

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), relevant scenario information

Name	Value	Unit
Net flow of steel scrap	802	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 ton fully processed electrical steel strip.

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; ND = MODULE OR INDICATOR NOT DECLARED; MNR = MODULE NOT RELEVANT)

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	X	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: 1 ton fully processed electrical steel strip

Parameter	Unit	A1-A3	C1	C2	C3	C4	D
Global Warming Potential total (GWP-total)	kg CO_2 eq	2.52E+03	0	3.02E+00	0	2.42E+00	-1.36E+03
Global Warming Potential fossil fuels (GWP-fossil)	kg CO_2 eq	2.51E+03	0	3E+00	0	2.44E+00	-1.36E+03
Global Warming Potential biogenic (GWP-biogenic)	kg CO_2 eq	5.15E+00	0	-3.56E-03	0	-2.5E-02	-8.81E-01
Global Warming Potential luluc (GWP-luluc)	kg CO_2 eq	8.29E-01	0	2.44E-02	0	2.44E-03	1.97E-01
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC11 eq	6.41E-11	0	5.9E-16	0	5.77E-15	-2.27E-12
Acidification potential of land and water (AP)	mol H^+ eq	5.24E+00	0	9.92E-03	0	7.78E-03	-2.44E+00
Eutrophication potential aquatic freshwater (EP-freshwater)	kg P eq	2.53E-03	0	8.88E-06	0	1.86E-06	-2.78E-04
Eutrophication potential aquatic marine (EP-marine)	kg N eq	1.14E+00	0	4.55E-03	0	1.93E-03	-3.64E-01
Eutrophication potential terrestrial (EP-terrestrial)	mol N eq	1.24E+01	0	5.08E-02	0	2.12E-02	-3.55E+00
Formation potential of tropospheric ozone photochemical oxidants (POCP)	kg NMVOC eq	3.92E+00	0	8.94E-03	0	6.08E-03	-1.86E+00
Abiotic depletion potential for non fossil resources (ADPE)	kg Sb eq	2.08E-03	0	2.65E-07	0	1.68E-07	-2.96E-03
Abiotic depletion potential for fossil resources (ADPF)	MJ	2.25E+04	0	3.98E+01	0	3.56E+01	-1.18E+04
Water use (WDP)	m^3 world eq deprived	7.45E+01	0	2.77E-02	0	-2.89E-02	-2.67E+02

RESULTS OF THE LCA - INDICATORS TO DESCRIBE RESOURCE USE according to EN 15804+A2: 1 ton fully processed electrical steel strip

Parameter	Unit	A1-A3	C1	C2	C3	C4	D
Renewable primary energy as energy carrier (PERE)	MJ	1.2E+03	0	2.29E+00	0	2.57E+00	1.09E+03
Renewable primary energy resources as material utilization (PERM)	MJ	1.68E+01	0	0	0	0	0
Total use of renewable primary energy resources (PERT)	MJ	1.22E+03	0	2.29E+00	0	2.57E+00	1.09E+03
Non renewable primary energy as energy carrier (PENRE)	MJ	2.26E+04	0	4E+01	0	3.56E+01	-1.18E+04
Non renewable primary energy as material utilization (PENRM)	MJ	0	0	0	0	0	0
Total use of non renewable primary energy resources (PENRT)	MJ	2.26E+04	0	4E+01	0	3.56E+01	-1.18E+04
Use of secondary material (SM)	kg	1.49E+02	0	0	0	0	8.02E+02
Use of renewable secondary fuels (RSF)	MJ	0	0	0	0	0	0
Use of non renewable secondary fuels (NRSF)	MJ	0	0	0	0	0	0
Use of net fresh water (FW)	m^3	5.77E+00	0	2.62E-03	0	3.67E-04	-5.99E+00

RESULTS OF THE LCA – WASTE CATEGORIES AND OUTPUT FLOWS according to EN 15804+A2: 1 ton fully processed electrical steel strip

Parameter	Unit	A1-A3	C1	C2	C3	C4	D
Hazardous waste disposed (HWD)	kg	6.84E-06	0	2.11E-09	0	6.3E-09	3.3E-06
Non hazardous waste disposed (NHWD)	kg	2.82E+01	0	6.27E-03	0	5.01E+01	1.42E+02
Radioactive waste disposed (RWD)	kg	1.45E-01	0	7.25E-05	0	4.05E-04	4.29E-04
Components for re-use (CRU)	kg	0	0	0	0	0	0
Materials for recycling (MFR)	kg	0	0	0	9.5E+02	0	0
Materials for energy recovery (MER)	kg	0	0	0	0	0	0
Exported electrical energy (EEE)	MJ	0	0	0	0	0	0
Exported thermal energy (EET)	MJ	0	0	0	0	0	0

RESULTS OF THE LCA – additional impact categories according to EN 15804+A2-optional: 1 ton fully processed electrical steel strip

Parameter	Unit	A1-A3	C1	C2	C3	C4	D
Incidence of disease due to PM emissions (PM)	Disease incidence	ND	ND	ND	ND	ND	ND

Human exposure efficiency relative to U235 (IR)	kBq U235 eq	ND	ND	ND	ND	ND	ND
Comparative toxic unit for ecosystems (ETP-fw)	CTUe	ND	ND	ND	ND	ND	ND
Comparative toxic unit for humans (carcinogenic) (HTP-c)	CTUh	ND	ND	ND	ND	ND	ND
Comparative toxic unit for humans (noncarcinogenic) (HTP-nc)	CTUh	ND	ND	ND	ND	ND	ND
Soil quality index (SQP)	SQP	ND	ND	ND	ND	ND	ND

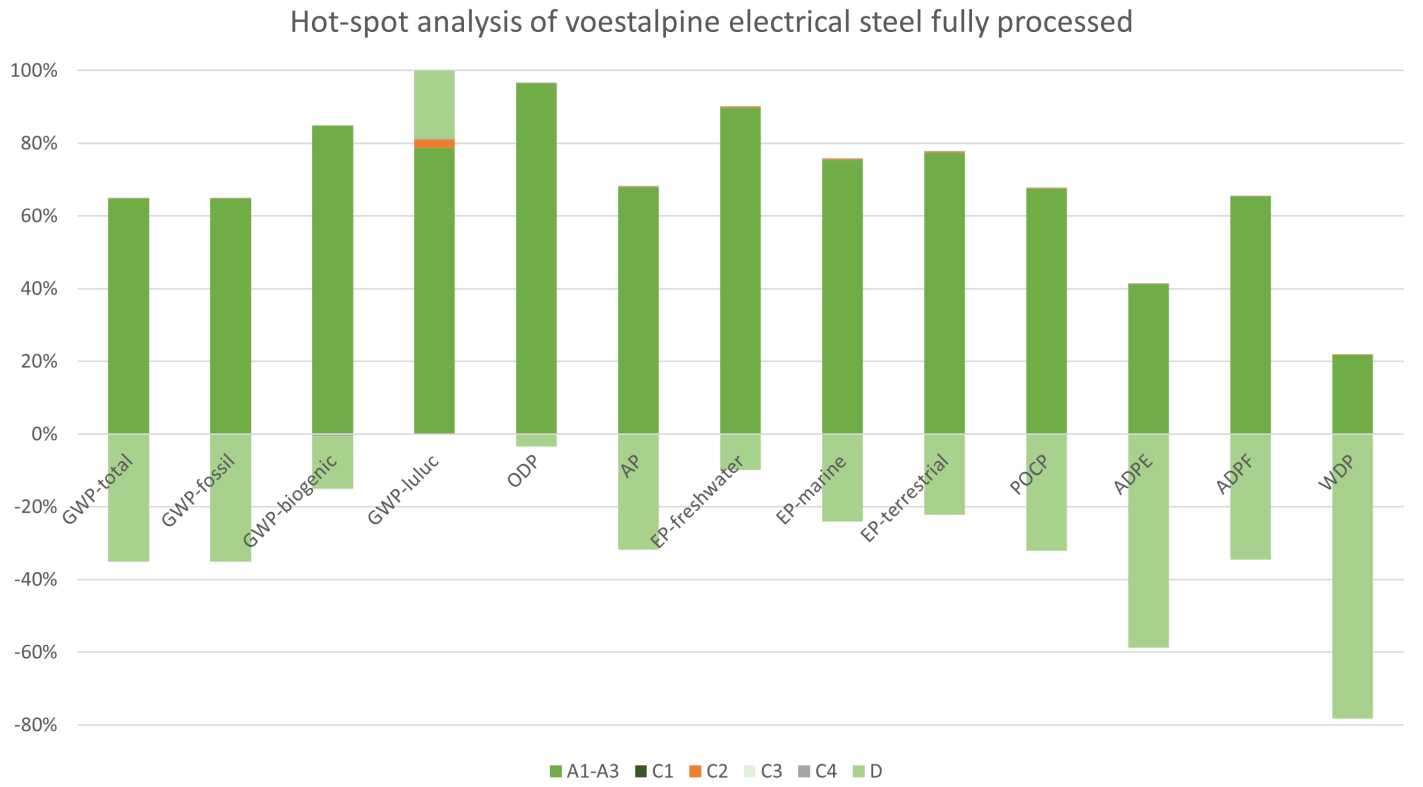
The additional and optional impact categories according to *EN 15804+*A2 are not declared, as the uncertainty of these indicators is to be classified as high.

Disclaimer 1 – for the indicator potential human exposure efficiency relative to U235:
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 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.

Disclaimer 2 – for the indicators abiotic depletion potential for non-fossil resources, abiotic depletion potential for fossil resources, water (user) deprivation potential, deprivation-weighted water consumption, eutrophication - fraction of nutrients reaching freshwater end compartment, potential comparative toxic unit for humans -cancerogenic, potential comparative toxic unit for humans - not cancerogenic, potential soil quality index: 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.

6. LCA: Interpretation

The following interpretation contains a summary of the LCA results referenced to a declared unit of 1 ton fully processed electrical steel strip.



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. This results in credits from the substitution of primary steel.

The environmental impact of the transport of the products to recycling (C2) as well as landfilling of the losses at the end of life (C4) represents a minor contribution to the overall environmental impact of the product.

In summary, raw material input and energy carriers required in the production phase as well as direct emissions at the site can be identified as important factors in the environmental impact of electrical steel strip. The greenhouse gases directly emitted from the processes at the Linz production site, especially from the blast furnaces and the energetic treatment of the metallurgical gases in the network, contribute to a large share to potential global warming. In the environmental profile of the continuous annealing lines, the direct emissions from the natural gas input play a major role.

Continuous annealing line 2 contributes about 5 % to the carbon footprint (GWP), the potential acidification (AP) and

freshwater eutrophication (EP-freshwater) of the fully processed electrical steel strip. The potential marine and terrestrial eutrophication (EP-marine & EP-terrestrial) as well as the formation potential of tropospheric ozone photochemical oxidants (POCP) are related to about 8 % to the activities of continuous annealing line 2. 10 % of the potential fossil fuel resource depletion (ADPF) are based on the energy input in the continuous annealing process.

In the declared average of this EPD, all produced grades were included declaring arepresentative average. The analysis of different specifications of fully processed electrical steel strips identifies a variation of the product-related carbon footprint of ± 3 %. For potential acidification, eutrophication and formation potential of tropospheric ozone photochemical oxidants, this interval amounts up to ± 0-7 %.

Due to the homogeneous structure of the products, the environmental impact of the products correlates directly with their mass. This implies a slight imprecision for the coating as these layers are not scalable linearly but surface-related and are dependent on the variation of their thickness on the respective product. A sensitivity analysis has shown that the impact of different coating thicknesses on the overall result is very small.

The results of the previous EPD (EPD-VOE-20200055-IAC1-DE) are not directly comparable with the present updated version due to the update of the underlying methodology according to *EN 15804*+A2.

7. Requisite evidence

Not relevant for this EPD.

8. References

Standards

EN 10106
EN 10106:2016-03, Cold rolled non-oriented electrical steel strip and sheet delivered in the fully processed state.

EN 10303
EN 10303:2016-02, Thin magnetic steel strip and sheet for use at medium frequencies.

EN 15804
DIN EN 15804:2012+A2:2019+AC:2021, Sustainability of construction works - Environmental Product Declarations - Core rules for the product category of construction products.

ISO 9001
DIN EN ISO 9001:2015, Quality management systems - Requirements.

ISO 14001
DIN EN ISO 14001:2015, Environmental management systems Requirements with guidance for use.

ISO 14025
DIN EN ISO 14025:2011-10, Environmental labels and declarations - Type III environmental declarations - Principles and procedures.

ISO 14044
DIN EN ISO 14044:2006-10. Environmental management - Life cycle assessment - Requirements and guidelines.

Further references

Candidate List
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World Steel Association, 14. Februar 2014: A methodology to determine the LCI of steel industry co-products.

worldsteel 2017
World Steel Association, 2017: Life cycle inventory methodology report.

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