ENVIRONMENTAL PRODUCT DECLARATION

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

Owner of the Declaration	Stahlwerk Thüringen
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-STH-20230471-IAB1-EN
Issue date	11/03/2024
Valid to	10/03/2029

Structural Steel Sections

Stahlwerk Thüringen GmbH

Institut Bauen und Umwelt e.V.

ECO PLATFORM EPD VERIFIED

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

1. General Information

Stahlwerk Thüringen GmbH

Programme holder

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

Declaration number

EPD-STH-20230471-IAB1-EN

This declaration is based on the product category rules:

Structural steels, 01/08/2021
(PCR checked and approved by the SVR)

Issue date

11/03/2024

Valid to

10/03/2029

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

Florian Pronold
(Managing Director Institut Bauen und Umwelt e.V.)

Structural Steel Sections

Owner of the declaration

Stahlwerk Thüringen
Kronacher Straße 6
07333 Unterwellenborn
Germany

Declared product / declared unit

The declared unit is 1 ton of average structural steel sections

Scope:

This environmental product declaration covers steel products rolled out to structural sections and steel sleepers, intended for bolted, welded or otherwise connected constructions of buildings, bridges, rail constructions and other structures.

This EPD is valid for the product SWT Stahlwerk Thueringen Green Steel®, for hot-rolled steel sections and -sleepers, produced with renewably generated and not EEG-subsidized electricity proven by Stahlwerk Thüringen GmbH through guarantees of origin.
The production shares in this EPD are 100 % secondary route (Electric Arc Furnace steel production) based on 100 % green energy purchased with GoO. The EPD does not consider any mass balance allocation.
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

Therese Daxner,
(Independent verifier)

2. Product

2.1 Product description/Product definition

This EPD applies to 1 ton of structural steel sections. It covers steel products of grades S235 to S460 rolled out to structural sections.
For the placing on the market of the product in the European Union/European Free Trade Association (EU/EFTA) (with the exception of Switzerland) Regulation (EU) No. 305/2011 (CPR) applies. The product needs a declaration of performance taking into consideration EN 10025-1 Hot rolled products of structural steels – Part 1: General technical delivery conditions and the CE- or UKCA-marking.

For the application and use the respective national provisions apply.

2.2 Application

Structural steels are intended for bolted, welded or otherwise connected constructions of buildings, bridges and other structures, or in composite steel and concrete structures. Examples are:

- single-storey buildings (industrial and storage halls, etc.)
- multi-storey buildings (offices, residential buildings, shops, car parks, high rise, etc.)
- bridges (railway bridge, road bridge, pedestrian bridge, etc.)
- railway construction, track structure
- other structures (stadiums, convention centres, airports, stations, public constructions, etc.)

2.3 Technical Data

This EPD is valid for sections, channels and steel sleepers of varied grades and different dimensions.
Specific information on dimension tolerances, constructional data as well as mechanical and chemical properties can be found in the relevant literature and/or the standards.

Constructional data

Name	Value	Unit
Density	7850	kg/m^3
Modulus of elasticity	210000	N/mm^2
Coefficient of thermal expansion	12	$10^{-6}K^{-1}$
Thermal conductivity	48	W/(mK)
Melting point depending on the alloy proportions up to	1536	°C
Share Modulus	81000	N/mm^2

Stahlwerk Thüringen GmbH supplies to customers all over the world and produces therefore steel sections according to harmonized European standards with or without CE- or UK Conformity Assessed (UKCA)-marking as well as international standards (American Society for Testing and Materials, ASTM standards) with the following performance data (no CE- or UKCA-marking).

- Performance data of the product in accordance with the declaration of performance with respect to its essential characteristics according to *EN 10025-1*, Hot rolled products of structural steels
- Performance data of the product according to the harmonised standards, based on provisions for harmonization: *EN 10225-2*, Weldable structural steels for fixed offshore structures
- Performance data of the product with respect to its characteristics in accordance with the relevant technical provision (no CE-marking): *ASTM A36*, *ASTM A572*, *ASTM A992* and *ASTM A709*.

2.4 Delivery status

The dimensions of the declared products may vary according to the intended application.

2.5 Base materials/Ancillary materials

Structural steels are non-or low-alloy steel products whose carbon content is between 0 and 0.6 %. Iron is the main component of steel sections. The content of other elements is significantly less. The exact chemical composition varies depending on the steel grade.

Auxiliary materials and alloys:

The rates of these additives depend on the steel grade and are on average: 0,7 % silicomanganese, 0,3 % ferromanganese, 0,1% ferrosilicon and < 0,1 % other alloys (ferroniobium, ferrovanadium, ferrotitanium, aluminium). The considered products do not contain substances listed in the '*Candidate List of Substances of Very High Concern for Authorisation*' (SVHC) (19.01.2021) exceeding 0.1 % by mass.

The product for authorization contains substances on the ECHA list of substances of very high concern (SVHC) (14 July2021) above 0.1 % by mass: **No**.

The product contains further carcinogenic, mutagenic, reprotoxic (CMR) substances of category 1A or 1B that not in the candidate list, above 0.1 mass % in at least one subproduct: **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

In the electric steel production route, scrap is molten in an electric arc furnace to obtain liquid steel.

Refining (lowering of sulfur, phosphorous and other tramp elements) and alloying (e.g. about 1 % Mn, 0.2% Si) and/or micro-alloying (e.g. about 0.04 % Nb) is applied to give the requested characteristics to the steel.
At the end of the steelmaking process, the liquid steel is transformed into a semi-finished product in a continuous casting machine.
The semi-product (beam-blank) is hot-rolled into the final product dimensions (H-shape, I-shape, U-shape, steel sleepers, SWT designed special sections).

Quality control: *ISO 9001* Monitoring according to the product standards, e.g. *EN 10025*.

2.7 Environment and health during manufacturing

No measures relating to safety, health and environmental protection during the manufacturing process extending beyond national guidelines are required.

2.8 Product processing/Installation

Processing recommendations:

Planning, processing, implementation and intended use of section constructions have to be carried out depending on the respective applications according to the generally recognized rules of engineering and manufacturer's recommendations.

The standards of *EN 1993* and *EN 1994* (Eurocode EC3 and EC4) apply to the design of steel structures and composite steel and concrete structures. They include the requirements regarding serviceability, bearing capacity, durability and fire resistance of steel structures EC3 and composite steel and concrete structures EC4.

The standard Parts 1+2 of *EN 1090* apply to the execution of steel structures and include the requirements for factory production control.

In addition, the European Standards will work in connection with national amendments, national instructions, guidelines and publications, as well as legal provisions.

Regarding transport and storage of sections, the generally accepted requirements for securing loads have to be observed.

Instruction details of the manufacturer based on verified standards and guidelines regarding welding, galvanizing as well as hot and cold forming are to be observed in every case.

Occupational safety/Environmental protection:

When processing/using steel sections according to the generally recognized rules of engineering there are no measures to be taken which are going beyond public occupational health and safety.

Residual material:

During processing, residual pieces as well as turnings are to be collected separately.
This scrap steel can be entirely recycled by melting and producing new steel products.

2.9 Packaging

Structural steels are delivered bundled with steel straps. Packaging is not considered within the LCA.

2.10 Condition of use

Structural steels are non-/low-alloyed steel products generated by alloying iron with other metals and non-metals (esp. carbon). Iron is the main component of steel sections. The components are listed under chapter 2.5 'Base materials'. During usage, no changes in material composition shall occur.

2.11 Environment and health during use

The intended use of sections does not endanger health or the environment in any known way.

2.12 Reference service life

The reference service life is not relevant for consideration of the LCA. As construction products with many different applications, a reference service life for structural steel as sections is not declared here.

The purpose, possible corrosion protection and adequate maintenance are decisive for service life.

2.13 Extraordinary effects

Fire

The material is class A1, i.e. not flammable per *EN 13501*.
The material does not emit fumes or fire gases.

Fire safety

Name	Value
Building material class acc. EN 13501-1	A1

Water

Steel is stable in water, insoluble and does not emit substances in water. In case of flooding, no impacts are to be expected. Steel can corrode in the presence of oxygen in the water (= slow oxidation).

Mechanical destruction

Due to the ductility of steel, steel structures react resiliently in the event of unforeseeable mechanical destruction: In the case of tensile load, necking will occur before cracking. In case of a lasting high compression load, components of steel may buckle or bulge. No splintering or breaking edges should result.

2.14 Re-use phase

General:

Sections of steel are recyclable by 100 %. Due to the magnetic properties of steel, 97 % of the used steel is regained after dismantling European Commission Technical Steel Research.

Re-use:

Sections can be re-used. It is expected that around 14 % of the products are re-used after dismantling.

Recycling:

Sections can be recycled without any problems after dismantling. It is expected that around 83 % of the products are used for closed-loop recycling.

Data from industry estimates based on the following sources:
European Commission Technical Steel Research

2.15 Disposal

Due to its high value as a resource, steel scrap is not disposed of but instead fed into a well-stablished cycle of reuse or recycling. However, in the case of dumping due to collection loss, no environmental impacts are expected.

Waste code according to European Waste Catalogue *EWC*: 17 04 05 - iron and steel

2.16 Further information

Additional information on constructing with steel can be obtained from bauforumstahl.de.

3. LCA: Calculation rules

3.1 Declared Unit

The reference unit is 1 ton of structural steel sections. Foreground data for production are integrated into the software model for the considered production site/company. LCI is assessed as per the annual production data (100 %) of Stahlwerk Thüringen GmbH at the site Unterwellenborn.

The EPD covers steel products of the grades S235 to S460 rolled out to structural sections in different shape/size. The annual production data is representative for all steel products covered by the declared unit. In addition, for the modelling and calculation of the EPD results a conservative approach was followed.

Declared unit

Name	Value	Unit
Declared unit	1	t

For the calculation of the declared average, all grades produced were included in the form of an annual average. Input

and production quantities for the entire calendar year 2018 were taken into account. The calculated results can thus be considered representative for the entire product portfolio structural steel sections of Stahlwerk Thüringen.

3.2 System boundary

Type of the EPD: cradle-to-gate - with options: Module A1-A3, Modules C1-C4 and Module D were considered.

Modules A1-A3 covers the production stage including the upstream burdens of purchased raw materials (ferroalloys, lime, dolomite, etc.), their transports and the manufacturing at the production site in Unterwellenborn. Material and energy flows for the electric arc furnace and the hot strip mill are considered. All electricity consumed to produce the structural steel sections is produced from 100 % hydropower in Europe, with 0,0062 kg CO_2e/kWh, purchased with GoO.
The study did not consider the packaging of the product (SWT deliveries are without packaging materials).

Modules C1-C4 consider the dismantling of the considered product (C1), the transportation of the dismantled components to their final End-of-Life (EoL) destination (C2), the waste processing for reuse, recovery or recycling (C3) as well as the disposal (C4). It is assumed that the product is not connected with other materials and can therefore be dismantled. Associated efforts are negligible, no environmental impacts from the deconstruction of the products are declared (Module C1).

Module D refers to the End-of-Life, including recycling and/or reuse.

3.3 Estimates and assumptions

Due to the lack of available datasets for some alloying elements (e.g. ferrovanadium), South-African data sets were used instead of local data. However, amounts of these elements are very low – except for silicomanganese – and the use of South-African data sets would be the 'worst-case' assumption for European production, so the set-up scenario is considered a conservative approach. The proxy for silicomanganese was considered 75 % ferromanganese and 25 % ferrosilicon.

3.4 Cut-off criteria

All information from the data collection process has been considered; covering all used materials, thermal energy, and electrical energy. etc. Measurement of emissions took place and was considered.
No processes, materials or emissions that are known to contribute significantly to the environmental impact of the products under study have been omitted. All input or outputs contributing more than 1 % to the overall mass or energy of the system were considered.
It can be assumed, that the sum of all excluded inputs and outputs contribute less than 5 % to the impact assessment categories.

The manufacturing of required machinery and other infrastructure is not considered in the LCA.

3.5 Background data

For the life cycle modelling of the product under study, the *LCA FE (GaBi) Software* System for Life Cycle Engineering, content version 2022.2, is used (*LCA FE Software)*. The *LCA FE (GaBi) database* contains consistent and documented datasets which can be viewed in the online documentation (*LCA FE Documentation)*.

3.6 Data quality

The foreground data collected by the manufacturer are based on yearly production amounts and extrapolations of measurements on specific machines and plants. The production data refers to the year 2018.
All relevant background datasets are taken from the *LCA FE (GaBi) Software* database and are representative of the years 2017-2021.

The study is based on high-quality data.

3.7 Period under review

The foreground data collected by Stahlwerk Thüringen are based on annual production amounts referring to the year 2018.

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: Europe

3.9 Allocation

Steel production via the electric arc furnace (EAF) generates EAF slag and scales as co-products. The EAF process that produces these co-products cannot be further sub-divided into sub- processes related to each co-product, so allocation is required.
The allocation method used here for EAF slag was developed by the *World Steel Association and EUROFER* to be in line with *EN 15804*. The methodology is based on physical allocation taking into account how changes in inputs and outputs affect the production of co-products.

Scales generated during steelmaking are sold for interieur application in the automotive industry. To address the use of scales within other industry applications economic allocation is applied.

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 LCA FE (GaBi) background database (content version 2022.2) was used to calculate the LCA.

4. LCA: Scenarios and additional technical information

Characteristic product properties of biogenic carbon

The declared product does not include biogenic carbon. There is no packaging considered within the given study.
The annexe to the EPD covers four End of Life scenarios (SteelConstruction-info; Sansom, M./ Meijer, J.):

- Scenario 0: 100 % Recycling
- Scenario 1: 100 % Reuse
- Scenario 2: 100 % Loss / Landfilled
- Scenario 3: 88 % Recycling, 11 % Reuse and 1 % Loss

Metals are assumed to reach the end of waste status directly at construction site. The treatment as well as net benefits and loads of reuse or recycling potentials (for the net scrap amount only) are grouped to module D.

End of life (C1 - C4)

Steel scrap lost at End-of-Life is modelled via landfill of inert material.

Name	Value	Unit
Landfilling - Scenario 0	0	kg
Landfilling - Scenario 1	0	kg
Landfilling - Scenario 2	1000	kg
Landfilling - Scenario 3	10	kg

Reuse, recovery and/or recycling potentials (D), relevant scenario information

Steel scrap being recycled at End-of-Life is modelled via the "value of scrap" approach in accordance with the *worldsteel* methodology. Structural steel sections being reused are credited via module A1-A3 of the product under study.

Name	Value	Unit
Recycling - Scenario 0	1000	kg
Recycling - Scenario 1	0	kg
Recycling - Scenario 2	0	kg
Recycling - Scenario 3	880	kg
Reuse - Scenario 0	0	kg
Reuse - Scenario 1	1000	kg
Reuse - Scenario 2	0	kg
Reuse - Scenario 3	110	kg

5. LCA: Results

The following table contains the LCA results for a declared unit of 1 ton structural steel sections.

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = 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 Structural Steel: Section

Parameter	Unit	A1-A3	C1	C2	C3	C3/1	C3/2	C3/3	C4	C4/1	C4/2	C4/3	D	D/1	D/2	D/3
GWP-total	kg CO_2 eq	3.35E+02	0	2.51E+00	0	0	0	0	0	0	1.45E+01	1.45E-01	1.41E+02	-3.34E+02	1.87E+03	1.06E+02
GWP-fossil	kg CO_2 eq	3.34E+02	0	2.49E+00	0	0	0	0	0	0	1.49E+01	1.49E-01	1.41E+02	-3.33E+02	1.87E+03	1.06E+02
GWP-biogenic	kg CO_2 eq	3.53E-01	0	-3.44E-03	0	0	0	0	0	0	-4.42E-01	-4.42E-03	-7.18E-02	-3.52E-01	-9.56E-01	-1.11E-01
GWP-luluc	kg CO_2 eq	3.64E-02	0	1.39E-02	0	0	0	0	0	0	2.75E-02	2.75E-04	2.9E-03	-3.32E-02	3.86E-02	-7.16E-04
ODP	kg CFC11 eq	2.39E-10	0	1.49E-13	0	0	0	0	0	0	3.51E-11	3.51E-13	3.08E-13	-2.35E-10	4.09E-12	-2.55E-11
AP	mol H^+ eq	1.12E+00	0	2.25E-03	0	0	0	0	0	0	1.06E-01	1.06E-03	3.02E-01	-1.12E+00	4.02E+00	1.83E-01
EP-freshwater	kg P eq	1.22E-04	0	7.43E-06	0	0	0	0	0	0	2.53E-05	2.53E-07	2.55E-05	-1.19E-04	3.4E-04	1.28E-05
EP-marine	kg N eq	2E-01	0	6.75E-04	0	0	0	0	0	0	2.71E-02	2.71E-04	5.31E-02	-1.99E-01	7.07E-01	3.2E-02
EP-terrestrial	mol N eq	2.18E+00	0	8.17E-03	0	0	0	0	0	0	2.97E-01	2.97E-03	4.67E-01	-2.17E+00	6.21E+00	2.34E-01
POCP	kg NMVOC eq	6.54E-01	0	1.94E-03	0	0	0	0	0	0	8.22E-02	8.22E-04	2.16E-01	-6.51E-01	2.87E+00	1.47E-01
ADPE	kg Sb eq	1.04E-04	0	2.08E-07	0	0	0	0	0	0	1.53E-06	1.53E-08	3.51E-04	-1.03E-04	4.67E-03	3.44E-04
ADPF	MJ	3.59E+03	0	3.32E+01	0	0	0	0	0	0	1.95E+02	1.95E+00	1.29E+03	-3.58E+03	1.72E+04	9.15E+02
WDP	m^3 world eq deprived	4.13E+01	0	2.23E-02	0	0	0	0	0	0	1.64E+00	1.64E-02	2.61E+01	-4.12E+01	3.48E+02	2.2E+01

GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources; WDP = Water (user) deprivation potential)

RESULTS OF THE LCA - INDICATORS TO DESCRIBE RESOURCE USE according to EN 15804+A2: 1 ton Structural Steel: Section

Parameter	Unit	A1-A3	C1	C2	C3	C3/1	C3/2	C3/3	C4	C4/1	C4/2	C4/3	D	D/1	D/2	D/3
PERE	MJ	2.44E+03	0	1.89E+00	0	0	0	0	0	0	2.93E+01	2.93E-01	-8.14E+01	-2.44E+03	-1.08E+03	-3.51E+02
PERM	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PERT	MJ	2.44E+03	0	1.89E+00	0	0	0	0	0	0	2.93E+01	2.93E-01	-8.14E+01	-2.44E+03	-1.08E+03	-3.51E+02
PENRE	MJ	3.59E+03	0	3.33E+01	0	0	0	0	0	0	1.96E+02	1.96E+00	1.29E+03	-3.58E+03	1.72E+04	9.15E+02
PENRM	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PENRT	MJ	3.59E+03	0	3.33E+01	0	0	0	0	0	0	1.96E+02	1.96E+00	1.29E+03	-3.58E+03	1.72E+04	9.15E+02
SM	kg	1.08E+03	0	0	0	0	0	0	0	0	0	0	-8.12E+01	0	-1.08E+03	-8.23E+01
RSF	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FW	m^3	2.24E+00	0	2.14E-03	0	0	0	0	0	0	4.97E-02	4.97E-04	5.9E-01	-2.24E+00	7.86E+00	3.52E-01

PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy

excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water

RESULTS OF THE LCA – WASTE CATEGORIES AND OUTPUT FLOWS according to EN 15804+A2:
1 ton Structural Steel: Section

Parameter	Unit	A1-A3	C1	C2	C3	C3/1	C3/2	C3/3	C4	C4/1	C4/2	C4/3	D	D/1	D/2	D/3
HWD	kg	5.35E-07	0	1.6E-10	0	0	0	0	0	0	1E-08	1E-10	9.98E-09	-5.34E-07	1.33E-07	-4.87E-08
NHWD	kg	1.78E +00	0	4.78E-03	0	0	0	0	0	0	1E+03	1E+01	-1.96E +01	-1.78E +00	-2.61E +02	-2E+01
RWD	kg	2.66E-02	0	4.1E-05	0	0	0	0	0	0	2.17E-03	2.17E-05	-1.61E-04	-2.57E-02	-2.14E-03	-2.99E-03
CRU	kg	0	0	0	0	1E+03	0	1.1E+02	0	0	0	0	0	0	0	0
MFR	kg	0	0	0	1E+03	0	0	8.8E+02	0	0	0	0	0	0	0	0
MER	kg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EEE	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EET	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy; EET = Exported thermal energy

RESULTS OF THE LCA – additional impact categories according to EN 15804+A2-optional:
1 ton Structural Steel: Section

Parameter	Unit	A1-A3	C1	C2	C3	C3/1	C3/2	C3/3	C4	C4/1	C4/2	C4/3	D	D/1	D/2	D/3
PM	Disease incidence	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IR	kBq U235 eq	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ETP-fw	CTUe	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
HTP-c	CTUh	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
HTP-nc	CTUh	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SQP	SQP	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

PM = Potential incidence of disease due to PM emissions; IR = Potential Human exposure efficiency relative to U235; ETP-fw = Potential comparative Toxic Unit for ecosystems; HTP-c = Potential comparative Toxic Unit for humans (cancerogenic); HTP-nc = Potential comparative Toxic Unit for humans (not cancerogenic); SQP = Potential soil quality index

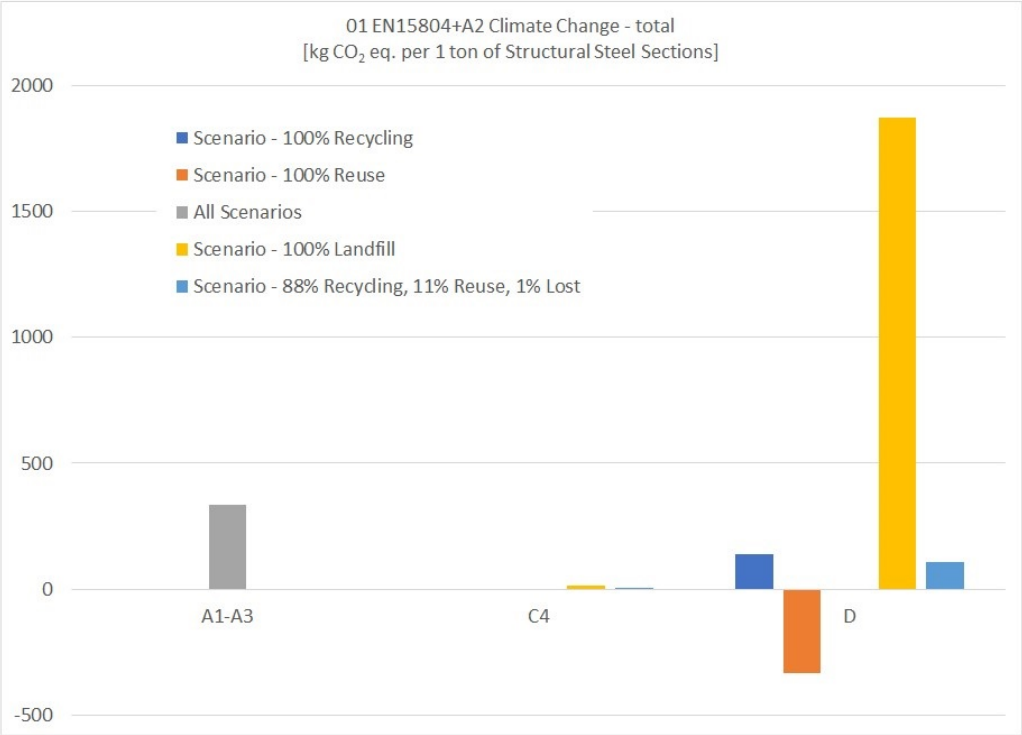
Disclaimer 1 – for the indicator 'Potential Human exposure efficiency relative to U235'. This impact category deals mainly with the eventual impact of low-dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure or radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, 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', 'potential comparative toxic unit for ecosystems', '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 as there is limited experience with the indicator.

All electricity consumed for the production of the structural steel sections is produced from 100% hydropower in Europe.

6. LCA: Interpretation

The following figure shows the results of the individual modules for all considered End-of-Life scenarios using the example of climate change:



It is visible that module D varies significantly depending on the considered End-of-Life scenario. The manufacturing phase (module A1-3) dominates the product system for all scenarios, except the scenario 100% Landfill.

The following table gives a detailed evaluation of all LCIA results of the production phase (Module A1-A3):

	On-Site (EAF, Hot Rolling)	**Alloys** (e.g. ferro-manganese)	**Energy** (electricity, natural gas, ...)	**Auxiliaries** (e.g. lime, dolomite, ...)
1. Environmental impact indicators				
01 EN15804+A2 Climate Change - total [kg CO2 eq.]	>40%	>35%	~5%	~15%
02 EN15804+A2 Climate Change, fossil [kg CO2 eq.]	>40%	>35%	~5%	~15%
03 EN15804+A2 Climate Change, biogenic [kg CO2 eq.]		>-5%	>75%	<30%
04 EN15804+A2 Climate Change, land use and land use change [kg CO2 eq.]		>65%	~15%	<20%
05 EN15804+A2 Ozone depletion [kg CFC-11 eq.]		~70%	<5%	~25%
06 EN15804+A2 Acidification [Mole of H+ eq.]	~25%	~70%	<5%	<5%
07 EN15804+A2 Eutrophication, freshwater [kg P eq.]		>15%	<10%	<75%
08 EN15804+A2 Eutrophication, marine [kg N eq.]	~35%	~55%	~5%	~5%
09 EN15804+A2 Eutrophication, terrestrial [Mole of N eq.]	~35%	~55%	~5%	~5%
10 EN15804+A2 Photochemical ozone formation, human health [kg NMVOC eq.]	<40%	~50%	~5%	>5%
11 EN15804+A2 Resource use, mineral and metals [kg Sb eq.]		~80%	<20%	<<5%
12 EN15804+A2 Resource use, fossils [MJ]		~35%	>50%	<15%
13 EN15804+A2 Water use [m^3 world equiv.]	>125%	<55%	<45%	>-120%
2. Ressource use indicators				
01 EN15804+A2 Use of renewable primary energy (PERE) [MJ]		~5%	<95%	<<5%
03 EN15804+A2 Total use of renewable primary energy resources (PERT) [MJ]		~5%	<95%	<<5%
04 EN15804+A2 Use of non-renewable primary energy (PENRE) [MJ]		~35%	>50%	<15%
06 EN15804+A2 Total use of non-renewable primary energy resources (PENRT) [MJ]		~35%	>50%	<15%
10 EN15804+A2 Use of net fresh water (FW) [m3]	~55%	>25%	<20%	<<5%
3. Output flows and waste categories				
01 EN15804+A2 Hazardous waste disposed (HWD) [kg]		<10%	>75%	~15%
02 EN15804+A2 Non-hazardous waste disposed (NHWD) [kg]		~25%	~45%	~30%
03 EN15804+A2 Radioactive waste disposed (RWD) [kg]		>80%	<5%	~15%
5. Optional indicators				
01 EN15804+A2 Particulate matter [Disease incidences]	>35%	<55%	<<5%	<10%
02 EN15804+A2 Ionising radiation, human health [kBq U235 eq.]		>75%	~5%	<20%
03 EN15804+A2 Ecotoxicity, freshwater [CTUe]	<5%	~60%	~5%	>30%
04 EN15804+A2 Human toxicity, cancer [CTUh]	~15%	~15%	~65%	~5%
05 EN15804+A2 Human toxicity, non-cancer [CTUh]	~65%	<10%	<15%	>10%
06 EN15804+A2 Land Use [Pt]		<95%	<<5%	~5%

Climate Change, Acidification Potential, Eutrophication Potential (marine, terrestrial) and Photochemical Ozone Creation Potential are mostly caused by onsite emissions as well as the extraction and processing of raw materials.

Eutrophication Potential (freshwater) is driven by the use of water.
Ozone Depletion Potential is mostly caused by emissions from the pre-chains of alloying materials.
Resource Use (mineral and metals) relates to the use of non-renewable elements in the production of alloying materials e.g., ferro-manganese. Resource Use (fossils) is dominated by the

extraction and processing of raw materials (alloys, auxiliaries) and the generation of natural gas.
The total use of renewable primary energy carrier (PERT) is dominated by the generation of electricity from hydropower. The total use of non-renewable primary energy (PENRT) is dominated by the extraction and processing of raw materials and the generation of natural gas.
Radioactive waste comes from the extraction and processing of raw materials. Non-hazardous wastes include overburden and tailings. Hazardous waste for deposition is mainly produced during the generation of natural gas.

In the declared average of this EPD all grades produced were included in the form the annual production. The analysis of different grade specifications identifies a variation of the product-related carbon footprint, the resource use (fossils) and the water scarcity of << 10 %. For eutrophication marine, eutrophication terrestrial and photochemical ozone formation, this interval amounts to a maximum of 15%, for acidification and resource use (mineral and metals), to a maximum of 30 %. No relevant variation is given for eutrophication fresh water.

7. Requisite evidence

This EPD covers semi-finished structural steel of hot-rolled construction products. Further processing and fabrication depend on the intended application. Therefore, further documentation is not applicable.

7.1 Weathering performance

The rusting rate of unalloyed steel depends on the position of the component and the conditions of the surrounding atmosphere (corrosivity categories according to *ISO 12944-2*. If required, the surfaces of fabricated structural components are usually protected with anticorrosion material in order to prevent any direct contact with the atmosphere. The weathering of this protection depends on the applied protection system.

8. References

ASTM A 36
Standard specification for carbon structural steel

ASTM A572
Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

ASTM A709
Standard Specification for Structural Steel for Bridges

ASTM A992
Standard specification for structural steel shapes

Candidate List of Substances of Very High Concern for Authorisation
Candidate List of substances of very high concern for Authorisation, 2021, ECHA, echa.europa.eu

EN 1090
Execution of steel structures and aluminium structures

EN 10025-1
Hot rolled products of structural steels
General technical delivery conditions

EN 10025-2
Hot rolled products of structural steels
Technical delivery conditions for non-alloy structural steels

EN 10025-3
Hot rolled products of structural steels.
Technical delivery conditions for normalized/normalized rolled weldable fine grain structural steels

EN 10025-4
Hot rolled products of structural steels
Technical delivery conditions for thermomechanical rolled weldable fine grain structural steels

EN 10225-2
Weldable structural steels for fixed offshore structures
Technical delivery conditions for sections

EN 13501
Fire classification of construction products and building elements

EN 15804
EN 15804+A1:2013, Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products

EN 1993
Eurocode 3, Design of steel structures

EN 1994
Eurocode 4, Design of composite steel and concrete structures

European Commission Technical Steel Research
Sansom, M. and Meijer, J.: Life-cycle assessment (LCA) for steel construction, European Commission technical steel research, 2001-12

EWC
European Waste Catalogue, European Commission

ISO 9001
Quality management systems – Requirements

ISO 12944-2
Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 2: Classification of environments

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

IBU 2021
IBU 2021, General Instructions for the EPD programme of Institut Bauen und Umwelt e.V. Version 2.0, Berlin: Institut Bauen und Umwelt e.V., 2021www.ibu-epd.de

CPR
Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC Text with EEA relevance

LCA FE (GaBi)
LCA for Experts Software System and Database for Life Cycle Engineering, Sphera Solution GmbH, Leinfelden-Echterdingen,

2022 (https://www.gabi-software.com/support/gabi)

PCR, Part A
Product Category Rules for Building-Related Products and Services, Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report. Institut Bauen und Umwelt e.V. (IBU) November 2021 www.bau-umwelt.de

PCR, Part B
PCR – Part B: Requirements of the EPD for Structural Steel, Institut Bauen und Umwelt e.V., www.bau-umwelt.com, 2023

SANSOM, M. / MEIJER, J.
Sansom, M. / Meijer, J., Life-cycle assessment (LCA) for steel construction, Ascot, Culemborg. 2002

STEELCONSTRUCTION-INFO
https://www.steelconstruction.info/The_recycling_and_reuse_survey

worldsteel
https://worldsteel.org/wp-content/uploads/Life-cycle-inventory-methodology-report.pdf

World Steel Association and EUROFER
Methodology to determine the LCI of steel industry co-products, 2011

Publisher

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

+49 (0)30 3087748- 0
info@ibu-epd.com
www.ibu-epd.com

Programme holder

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

+49 (0)30 3087748- 0
info@ibu-epd.com
www.ibu-epd.com

Author of the Life Cycle Assessment

Sphera Solutions GmbH
Hauptstraße 111- 113
70771 Leinfelden-Echterdingen
Germany

+49 711 341817-0
info@sphera.com
www.sphera.com

Owner of the Declaration

Stahlwerk Thüringen
Kronacher Straße 6
07333 Unterwellenborn
Germany

+49 3671 4550 0
info@stahlwerk-thueringen.de
www.stahlwerk-thueringen.de