ENVIRONMENTAL PRODUCT DECLARATION

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

Owner of the Declaration	bauforumstahl e.V.
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-BFS-20230270-IBG1-EN
Issue date	06.10.2023
Valid to	05.10.2028

Structural Steel: Heavy Plates

bauforumstahl e.V.

Institut Bauen und Umwelt e.V.

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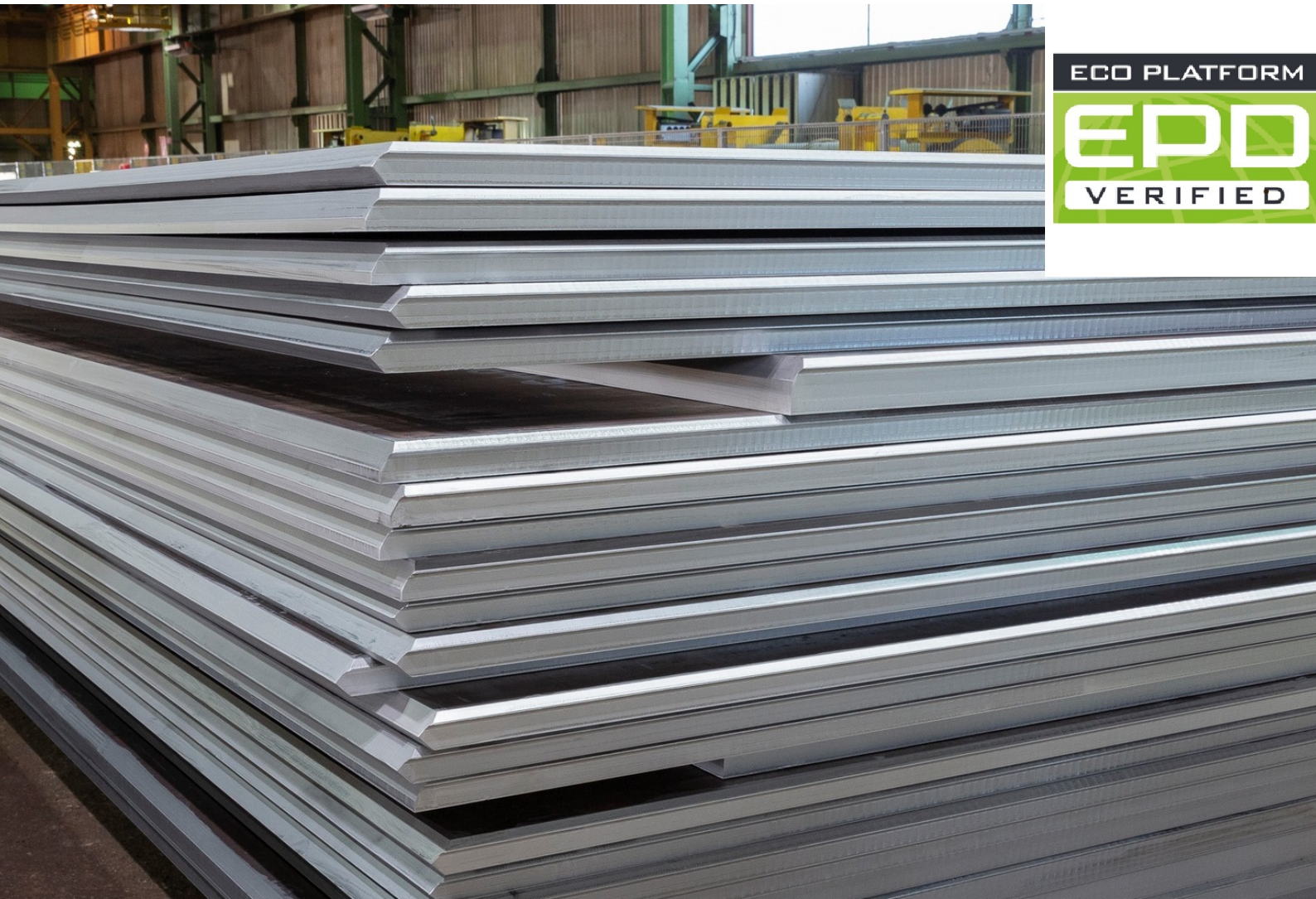


1. General Information

bauforumstahl e.V.

Programme holder

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

Declaration number

EPD-BFS-20230270-IBG1-EN

This declaration is based on the product category rules:

Structural steels, 01.08.2021
(PCR checked and approved by the SVR)

Issue date

06.10.2023

Valid to

05.10.2028

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

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

Structural Steel: Heavy Plates

Owner of the declaration

bauforumstahl e.V.
Sohnstraße 65
40237 Düsseldorf
Germany

Declared product / declared unit

1 metric ton of structural steel heavy plates

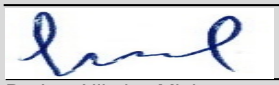
Scope:

This environmental product declaration (EPD) covers structural steel heavy plates and refers to a specific product.
The Life Cycle Assessment is based on data collected from the following plants of bauforumstahl e.V. member companies:
- Dillinger with the sites in Dillingen (Germany) and Dunkirk (France)
The data used represent >95 % of the annual production of heavy plates from bauforumstahl e.V. member companies.
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. Nikolay Minkov,
(Independent verifier)

2. Product

2.1 Product description/Product definition

This EPD refers to heavy plates, hot rolled products produced on dedicated quarto plate mills. The declaration covers various steel grades in various delivery conditions (grades S235 to S960). The mean steel grades are structural steel grades, like low alloy structural steels, including weathering steels. Mean thickness value is at 20 mm but the declaration covers the whole range from 5 mm up to 510 mm. Width range is from 1000 mm up to 5200 mm. Weathering steels offer improved resistance to corrosion thanks to the addition of elements, like copper, chromium and nickel during manufacture. Additional alloying elements can be added to increase the steel's tensile strength or make forming processes easier. For the placing of the product on the market in the European Union/European Free Trade Association
(EU/EFTA) (with the exception of Switzerland) Regulation (EU) No. 305/2011 (CPR) applies. This product has a declaration of performance taking into consideration EN 10025-1:2004 - Hot rolled products of structural steels - Part 1: General technical delivery conditions. 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.)
- other structures (power plants, stadiums, convention centres, airports, stations, etc.)

When weathering steel is exposed to the ambient atmosphere it develops an initial layer of iron oxide in the same way as carbon steel. The rate of oxidisation depends on how much oxygen, moisture, and atmospheric contaminants can access the surface of the metal. In the initial stages, a complex mix of iron oxides covers the surface to create a layer of rust. As the process progresses, the rust layer forms a barrier against the corrosive agents and the rate of corrosion slows.

2.3 Technical Data

This EPD is valid for plates of varied grades and different forms of delivery. 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 at 20°C λ	48	W/(mK)
Melting point depending on the alloy proportions up to	1536	°C
Shear modulus	81000	N/mm^2

Performance data of the product in accordance with the declaration of performance with respect to its essential characteristics according to *EN 10025*, Hot rolled products of structural steels. Further product standards can be: *EN 10225*, *ASTM A36*, *A572*, *A514*, *A709* and *A1066*.

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 plates. The content of other elements is less than 2 %. The exact chemical composition varies depending on the steel grade.

Auxiliary materials:
For the production route 'blast furnace with basic oxygen furnace': coking coal, coal,
lime, aluminium, ferroalloys (ferro silicon, ferro manganese, ferro nickel, ferro niobium, ferro vanadium, ferro titanium)
The rates of these additives depend on the steel grade.

The product for authorization contains substances on the ECHA list of substances of very high concern (SVHC) (14 July 2021) 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 integrated steel production route iron ore, (typical mix based on ferro-oxides $Fe2O_3$) coke breeze, circulating components and other additives are mixed and sintered in preparation for being fed into the blast furnace together with coking coke, which is the reducing agent. Also pellets and/or lump may be used.
The pig iron produced in the blast furnace is transferred into the basic oxygen furnace. In this vessel, the iron is converted into steel by lowering the carbon content of the iron by blowing oxygen into the melt (exothermic reaction). For temperature control, steel scrap (up to 35 %) is added to the melt.

At the end of the steelmaking process, the liquid steel is mainly transformed into a semi-finished product in a continuous casting machine.
The semi-product (slab) is hot-rolled into the final product dimensions (heavy plate)

Quality control: ISO 9001 Monitoring according to the product standards, e.g. EN 10025, Part 1.

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 and plate 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 heavy plates, 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 plates according to the generally recognized rules of engineering there are no measures to be taken which are going beyond the public occupational health and safety.
The processing/using of steel plates pursuant to the generally recognized rules of engineering does not release substantial environmental pollutants. Particular measures to protect the environment are not required.

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

2.9 Packaging
Structural steels are delivered unpacked.

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 plates. 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 steel plates does not pose a hazard to health or the environment in any known way.

2.12 Reference service life
A reference service life for heavy steel plates is not declared. Heavy steel plates are construction products with many different application purposes. The lifetime therefore will be limited by the application as well as the service life of the work. Bridges using heavy plates are designed and calculated according to Eurocodes to ensure more than 100 years of durability. First structural steel projects using weathering steel were completed 50 years ago in Europe and have demonstrated a very low maintenance level and no need for painting. At the end of life, weathering steel products are recovered, reused or recycled as well. 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 to 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 resilient in the event of unforeseeable mechanical destruction: In 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 shall result.

2.14 Re-use phase
General:
After the service life of structural steel constructions the material is collected as secondary material for recycling or reuse.
Recycling:
Structural steel is 100 % recyclable to new products of similar or higher quality. Due to the magnetic properties, even small amounts are regained after dismantling. Possible coatings (metallic, organic or intumescent) do not limit the recyclability. On the European market 88 % of the products are used for closed-loop recycling.
Reuse:
Structural steel elements can be reused. On the European market 11 % of the products are reused after dismantling. Data from industry estimates based on the following sources: European Commission Technical Steel Research

2.15 Disposal
Due to its high value, steel scrap is not disposed, but fed into a well-established endless cycle of reuse and recycling. However, in 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 www.bauforumstahl.de.

3. LCA: Calculation rules

3.1 Declared Unit
The reference unit is 1 ton of structural steel heavy plates.

Foreground data describing the on-site production are integrated into the *LCA FE Software* model for all sites under study. The LCI is assessed based on annual production data. Background data are taken from the *LCA FE Database*.

Declared unit

Name	Value	Unit
Declared unit	1	t
Density	7850	kg/m^3
Conversion factor to 1 kg	0.001	-

The EPD is representative for all steel products covered by the declared unit.

3.2 System boundary

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

Modules A1-A3 cover the production stage including the upstream burdens of purchased raw materials (iron ore, ferro-alloys, lime, dolomite, etc.), their transports and the integrated steel production at the production site under study. Material and energy flows for coke making, the sinter plant, the blast furnace, the basic oxygen furnace and the hot strip mills are considered.

Modules C1-C4 consider the dismantling of the considered product (C1), the transportation of the dismantled components to their final EoL destination (C2), the waste processing for reuse, recovery or recycling (C3) as well as the disposal (C4).

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

3.3 Estimates and assumptions

All assumptions are documented in detail and represent the reality best possible based on available data.
Due to lack of available datasets for some alloying elements (e.g. ferro vanadium) South-African datasets were used instead of local data. The use of South-African data sets represents a 'worst case' assumption for European production so the set-up scenario is considered conservative approach. Based on the LCA practitioner's knowledge working with the respective industries, the proxy for silico-manganese was considered as 75 % ferro manganese and 25 % ferro silicon.

3.4 Cut-off criteria

No cut-off criteria are applied in this study. All reported data were incorporated and modelled using the best available LCI data.
Packaging materials and their transportation, or the steel straps used to bundle the considered steel products for delivery, are neglected due to low contribution to the overall life cycle results.

3.5 Background data

Secondary data from the *LCA FE Database* (former GaBi) were used to model the background system in the LCA model.

3.6 Data quality

Technological: All primary and secondary data are modelled to be specific to the technologies or technology mixes under study. Where technology-specific data are unavailable, proxy data are used. The overall technological representativeness is considered to be good.

Geographical: All primary and secondary data are collected specific to the country /region under study. Where country/region-specific data are unavailable, proxy data are used. The overall geographical representativeness is considered to be good.

Temporal: All primary data are collected for a representative year (2021). All secondary data come from the Sphera *LCA FE Databases* and are representative of the years 2017-2022. As the study intended to compare the product systems for the reference year 2021, temporal representativeness is good.

3.7 Period under review

The foreground data collected by the manufacturer are based on yearly production amounts and refer to 2021.

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: Western Europe

3.9 Allocation

Primary data are allocated using the partitioning approach developed by *worldsteel/EUROFER* for calculating life cycle inventories of co-products in steel production. The so-called coproduct methodology allocates environmental effects to the steelmaking process and the emerging co-products based on physical relations. Material-inherent flow properties are thus taken into account.

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 Database* (CUP 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.

End-of-Life Scenarios
The EPD covers three End-of-Life scenarios (*SteelConstruction-info;* European Commission Technical Steel Research):

- Scenario 1: 100 % Recycling
- Scenario 2: 100 % Reuse
- Scenario 3: European average 88 % Recycling, 11 % Reuse and 1 % Loss

End of life (C1-C4)

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

Re-use, recovery- and recycling potential (D)

Name	Value	Unit
Recycling - Scenario 1	1000	kg
Recycling - Scenario 2	0	kg
Recycling - Scenario 3	880	kg
Reuse - Scenario 1	0	kg
Reuse - Scenario 2	1000	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 heavy plates.

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 structural steel

Parameter	Unit	A1-A3	C1	C2	C3/1	C3/2	C3/3	C4/1	C4/2	C4/3	D/1	D/2	D/3
GWP-total	kg CO_2 eq	2.53E+03	2.19E+00	2.51E+00	0	0	0	0	0	1.45E-01	-1.36E+03	-2.53E+03	-1.47E+03
GWP-fossil	kg CO_2 eq	2.53E+03	2.86E+00	2.52E+00	0	0	0	0	0	1.49E-01	-1.36E+03	-2.53E+03	-1.47E+03
GWP-biogenic	kg CO_2 eq	4.03E-01	-7.61E-01	-2.47E-02	0	0	0	0	0	-4.42E-03	6.93E-01	-4.08E-01	5.63E-01
GWP-luluc	kg CO_2 eq	9.07E-01	9.32E-02	1.7E-02	0	0	0	0	0	2.75E-04	-2.8E-02	-9.03E-01	-1.24E-01
ODP	kg CFC11 eq	5.5E-10	5.72E-12	2.48E-13	0	0	0	0	0	3.51E-13	-2.97E-12	-5.5E-10	-6.31E-11
AP	mol H^+ eq	5.37E+00	1.1E-02	2.65E-03	0	0	0	0	0	1.06E-03	-2.91E+00	-5.37E+00	-3.15E+00
EP-freshwater	kg P eq	1.1E-03	5.1E-05	9.03E-06	0	0	0	0	0	2.53E-07	-2.46E-04	-1.09E-03	-3.36E-04
EP-marine	kg N eq	1.33E+00	2.17E-03	8.17E-04	0	0	0	0	0	2.71E-04	-5.12E-01	-1.33E+00	-5.95E-01
EP-terrestrial	mol N eq	1.45E+01	2.83E-02	9.87E-03	0	0	0	0	0	2.97E-03	-4.5E+00	-1.45E+01	-5.54E+00
POCP	kg NMVOC eq	5.67E+00	8.5E-03	2.25E-03	0	0	0	0	0	8.22E-04	-2.08E+00	-5.67E+00	-2.45E+00
ADPE	kg Sb eq	3.63E-03	1.52E-06	2.55E-07	0	0	0	0	0	1.53E-08	-3.38E-03	-3.63E-03	-3.36E-03
ADPF	MJ	2.4E+04	2.4E+02	3.32E+01	0	0	0	0	0	1.95E+00	-1.25E+04	-2.4E+04	-1.36E+04
WDP	m^3 world eq deprived	1.4E+02	2.3E-01	2.83E-02	0	0	0	0	0	1.64E-02	-2.52E+02	-1.4E+02	-2.36E+02

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

Parameter	Unit	A1-A3	C1	C2	C3/1	C3/2	C3/3	C4/1	C4/2	C4/3	D/1	D/2	D/3
PERE	MJ	8.26E+02	1.6E+01	2.3E+00	0	0	0	0	0	2.93E-01	7.85E+02	-8.25E+02	5.98E+02
PERM	MJ	0	0	0	0	0	0	0	0	0	0	0	0
PERT	MJ	8.26E+02	1.6E+01	2.3E+00	0	0	0	0	0	2.93E-01	7.85E+02	-8.25E+02	5.98E+02
PENRE	MJ	2.4E+04	2.41E+02	3.33E+01	0	0	0	0	0	1.96E+00	-1.25E+04	-2.4E+04	-1.36E+04
PENRM	MJ	0	0	0	0	0	0	0	0	0	0	0	0
PENRT	MJ	2.4E+04	2.41E+02	3.33E+01	0	0	0	0	0	1.96E+00	-1.25E+04	-2.4E+04	-1.36E+04
SM	kg	2.17E+02	0	0	0	0	0	0	0	0	0	0	0
RSF	MJ	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
FW	m^3	4.68E+00	1.76E-02	2.66E-03	0	0	0	0	0	4.97E-04	-5.69E+00	-4.68E+00	-5.51E+00

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

Parameter	Unit	A1-A3	C1	C2	C3/1	C3/2	C3/3	C4/1	C4/2	C4/3	D/1	D/2	D/3
HWD	kg	3.17E-07	1.62E-09	1.76E-10	0	0	0	0	0	1E-10	-9.62E-08	-3.17E-07	-1.19E-07
NHWD	kg	5.3E+00	3.75E-02	5.43E-03	0	0	0	0	0	1E+01	1.89E+02	-5.3E+00	1.65E+02
RWD	kg	1.88E-01	1.21E-03	6.18E-05	0	0	0	0	0	2.17E-05	1.55E-03	-1.88E-01	-1.94E-02
CRU	kg	0	0	0	0	1E+03	1.1E+02	0	0	0	0	0	0
MFR	kg	0	0	0	1E+03	0	8.8E+02	0	0	0	0	0	0

MER	kg	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
EET	MJ	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

Parameter	Unit	A1-A3	C1	C2	C3/1	C3/2	C3/3	C4/1	C4/2	C4/3	D/1	D/2	D/3
PM	Disease incidence	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
ETP-fw	CTUe	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
HTP-nc	CTUh	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

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

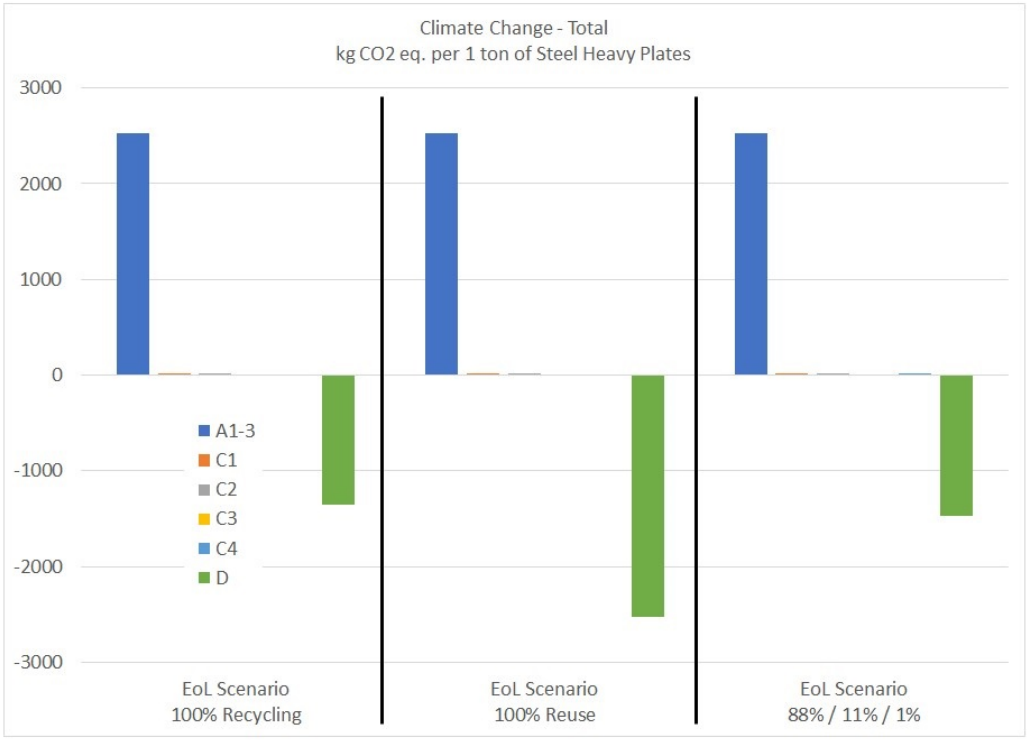
The additional and optional impact categories according to EN15804+A2 are not declared as this is not required according to PCR Part A.

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 experienced with the indicator.

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 represents a credit within all considered scenarios and varies significantly depending on the considered End-of-Life scenario. The manufacturing phase

(module A1-3) dominates the product system for all scenarios.

The following tables give a detailed evaluation of all LCIA results of the production phase (A1-A3):

	On-Site	Alloys	Energy	Coal & Coke	Lime, ...	Iron	Auxiliaries
1. Environmental impact indicators							
01 EN15804+A2 Climate Change - total [kg CO2 eq.]	~80%	<10%	>-5%	~10%		<5%	<<5%
02 EN15804+A2 Climate Change, fossil [kg CO2 eq.]	~80%	<10%	>-5%	~10%		<5%	<<5%
03 EN15804+A2 Climate Change, biogenic [kg CO2 eq.]		<-300%	~-525%	<-225%	<-25%	>860%	~320%
04 EN15804+A2 Climate Change, land use and land use change [kg CO2 eq.]		<15%		~25%		>60%	<<5%
05 EN15804+A2 Ozone depletion [kg CFC-11 eq.]		~460%	~-1230%	~90%	~10%		~770%
06 EN15804+A2 Acidification [Mole of H+ eq.]	~30%	>20%		<20%		>30%	
07 EN15804+A2 Eutrophication, freshwater [kg P eq.]		>5%	~-20%	~15%		~85%	>10%
08 EN15804+A2 Eutrophication, marine [kg N eq.]	>20%	>10%		>30%		~35%	<<5%
09 EN15804+A2 Eutrophication, terrestrial [Mole of N eq.]	>20%	>10%		>30%		~35%	
10 EN15804+A2 Photochemical ozone formation, human health [kg NMVOC eq.]	<50%	<10%		~20%		<25%	
11 EN15804+A2 Resource use, mineral and metals [kg Sb eq.]		<100%				<<5%	
12 EN15804+A2 Resource use, fossils [MJ]		~10%		>85%		~5%	<<5%
13 EN15804+A2 Water use [m³ world equiv.]	~45%	~45%		<5%		~5%	
2. Ressource use indicators							
01 EN15804+A2 Use of renewable primary energy (PERE) [MJ]		~60%	<-70%	<15%		<50%	<50%
03 EN15804+A2 Total use of renewable primary energy resources (PERT) [MJ]		~60%	<-70%	<15%		<50%	<50%
04 EN15804+A2 Use of non-renewable primary energy (PENRE) [MJ]		~10%		>85%		~5%	<<5%
06 EN15804+A2 Total use of non-renewable primary energy resources (PENRT) [MJ]		~10%		>85%		~5%	<<5%
10 EN15804+A2 Use of net fresh water (FW) [m3]	>30%	~40%		>5%		~20%	<5%
3. Output flows and waste categories							
01 EN15804+A2 Hazardous waste disposed (HWD) [kg]		>40%	~-25%	~15%		>50%	~15%
02 EN15804+A2 Non-hazardous waste disposed (NHWD) [kg]		~75%	<-10%	~5%		~25%	>5%
03 EN15804+A2 Radioactive waste disposed (RWD) [kg]		~30%	<5%	>10%		>20%	>30%

As can be seen from the table, direct process emissions of steel production (coke making, sinter plant, blast furnace, basic oxygen furnace, hot rolling, and boiler/on-site power plant) and the supply chain of purchased raw materials and energy carriers (e.g. coal for coke making, pellet feed and iron ore consumed within the sinter plant and blast furnace, ferro-alloys consumed in the basic oxygen furnace, natural gas consumed within most of the on-site processes) dominate the environmental effects across all selected impact categories. The environmental impact of the products correlates directly with their mass.

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 *EN 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

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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 (0)711 341817-0
info@sphera.com
www.sphera.com

Owner of the Declaration

bauforumstahl e.V.
Sohnstraße 65
40237 Düsseldorf
Germany

0211-54012080
zentrale@bauforumstahl.de
www.bauforumstahl.de

Dillinger
Werkstraße 1
66763 Dillingen/Saar
Germany

+49 6831 470
info@dillinger.biz
www.dillinger.de