ENVIRONMENTAL PRODUCT DECLARATION

as per *ISO 14025* and *EN 15804+A1*

Owner of the Declaration	**ROOFINOX GmbH**
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-RFI-20210280-IBD1-EN
Issue date	07.10.2021
Valid to	27.06.2024

HFX Stainless Steel
ROOFINOX GmbH

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Like no other.

1. General Information

ROOFINOX	HFX Stainless Steel
Programme holder IBU – Institut Bauen und Umwelt e.V. Panoramastr. 1 10178 Berlin Germany	**Owner of the declaration** ROOFINOX GmbH Industriestrasse 11 6832 Sulz AUSTRIA
Declaration number EPD-RFI-20210280-IBD1-EN	**Declared product / declared unit** This EPD applies to 1 ton of HFX stainless steel product. It covers steel delivered as sheet or as coil for various applications for building and civil work.
This declaration is based on the product category rules: Structural steels, 07.2014 (PCR checked and approved by the SVR)	**Scope:** The declaration applies to 1 ton of HFX stainless steel product produced in Germany and Finland. The Life Cycle Assessment is based on data from production plants in Germany and Finland. Production has been modeled using annual production data from 2017. Where required averaging is based on production output from each site.
Issue date 07.10.2021	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+A1*. In the following, the standard will be simplified as *EN 15804*.
Valid to 27.06.2024	**Verification** The standard *EN 15804* serves as the core PCR Independent verification of the declaration and data according to *ISO 14025:2010* ☐ internally ☒ externally
 Dipl. Ing. Hans Peters (chairman of Institut Bauen und Umwelt e.V.)	
 Dr. Alexander Röder (Managing Director Institut Bauen und Umwelt e.V.))	 Dr.-Ing. Andreas Ciroth (Independent verifier)

2. Product

2.1 Product description/Product definition

This EPD describes HFX stainless steel products manufactured by ROOFINOX GmbH. HFX products are supplied as coil, sheet or panel. HFX stainless steel has excellent dimensional tolerances and high surface quality. A number of sheet widths and heights are available to meet the various design specifications and requirements. A multitude of surface finishes are also available, including brush-rolled, bead-blasted, electro-coloured, ribbed, or mirror-rolled. This EPD is applicable to homogeneous ROOFINOX HFX products which are used in the construction and building industry.

For the placing on the market of the product in the 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 10088-4:2009, Stainless steels. Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for construction purposes/, /Limiting dimension and shape tolerance: Tolerances according to ISO (EN) 9444-2/ 9445-2/ and the CE-marking. For the application and use the respective national provisions apply.

2.2 Application

HFX products are used in a wide range of applications in building and construction. Typical applications are building envelopes, rainwater drainage, interior cladding and paneling, heating, cooling and ventilation, lifts and elevators.

2.3 Technical Data

Constructional data

Name	Value	Unit
Density	7900	kg/m^3
Coefficient of thermal expansion	14	$10^{-6}K^{-1}$
Thermal conductivity	19	W/(mK)

Modulus of elasticity	205	GPa
Melting point	1450	°C
Proof strength Rp0.2	200-530	MPa
Tensile strength Rm	420-950	MPa
Elongation A	18-45	%
Weldability	covered by chemical composition	
Durability	covered by chemical composition	
Cold formability	covered by elongation	

performance data of the product in accordance with the declaration of performance with respect to its essential characteristics according to /EN 10088-1:2014/, /EN 10028-7:2016/, /ASTM A240/, /ASME IID 2017/, /EN 10204:2005/, (not part of CE-marking).

2.4 Delivery status

Delivered with a standard HFX finishing condition, (e.g. brush-rolled) according to /**EN 10088-1**/ and in accordance with /**EN 10204**/. The dimensions of the declared product may vary according to the final use.

The products are certified in accordance with product standards :
/EN 10088-1/
/EN 10028-7/
/ASTM A240/
/ASME IID/
/EN 10204/

2.5 Base materials/Ancillary materials

Manufacturing is based on recycling and ferrous scrap (predominantly stainless steel scrap) is used as a major raw material. Alloying elements are also added as ferroalloys or metals. The most common alloying elements are chromium, nickel, molybdenum, manganese and silicon. Other elements, for example nitrogen, niobium and titanium may also be present in the HFX stainless steel. The presence and rates of these alloying elements depend on the HFX stainless steel designation as set out in /**EN 10088-1**/. All HFX stainless steels contain at least 10.5 % chromium. Substances listed on the “Candidate List of Substances of Very High Concern for Authorisation” by the European Chemicals Agency are not contained in HFX stainless steel in declarable quantities.

2.6 Manufacture

The steel scrap is melted in an electric arc furnace to obtain a steel melt. The liquid steel is further refined (adjustment of sulphur, carbon and phosphorous) and alloyed to give HFX stainless steel the required characteristics. The molten steel is then cast into semi-finished steel products like slabs or billets. The semi-finished steel products are hot rolled and then annealed and pickled and cold rolled to a desired thickness. HFX cold rolling adds the desired design finish also referred to as brush-rolling.

2.7 Environment and health during manufacturing

Environmental, occupational health and safety and quality management are in accordance with /**ISO 14001**/, /**ISO 9001**/ and /**OHSAS 18001**/.

2.8 Product processing/Installation

Processing and installation of the HFX stainless coil or sheet has to be carried out according to generally recognized engineering rules and the manufacturer’s recommendation depending on the respective application.
Eurocodes /**EC3**/ and /**EC4**/ apply to the design and construction. They include the requirements regarding performance, durability and fire resistance of steel structures. During handling and use of the products, normal occupational safety measures should be applied. Instructions from the manufacturer concerning welding as well as cold forming are to be followed.
Under normal conditions no significant environmental impact to water, air or soil is known.
Residual material like steel scrap should be collected as it is 100% recyclable.

2.9 Packaging

HFX stainless coils and sheets are usually delivered with interleaving paper and/or a polyethylene plastic film to protect the surface. This paper/plastic has been included in the EPD. In most cases, wooden pallets may be used for truck transport, although these have not been included in the EPD.

2.10 Condition of use

The maintenance requirements depend on the specific design and application, but typically HFX stainless steel only requires a minimum of maintenance, for example, washing with mild detergents to maintain the product’s appearance.

2.11 Environment and health during use

Under normal conditions of use, no adverse health effects are known for HFX stainless steel products.
HFX stainless steel does not release volatile organic compounds (VOCs) to indoor air.
Similarly no significant environmental impact to water, air or soil is expected, due to the extremely low metal release from HFX stainless steel and the low maintenance need.

2.12 Reference service life

Service life is dependent upon physical and mechanical service conditions. Correct alloy designation choice can satisfy a required service life.

2.13 Extraordinary effects

Fire

Structural steel products meet the requirements of building material safety class A1 (i.e. non-flammable according to /**EN 13501-1**/).

Fire protection

Name	Value
Building material class	-
Burning droplets	-
Smoke gas development	-

Water
In the event of unforeseeable exposure to water caused by sudden flooding, no risks to the environment or human health are expected to occur.

Mechanical destruction
In the event of mechanical destruction, no risks to the environment or human health are expected to occur.

2.14 Re-use phase
HFX stainless steel structures are not generally reused at end-of-life. Reuse is possible and could take place providing that the reused component was able to meet the technical specifications required. HFX stainless steel is usually recycled and can be recycled to the same quality of steel without loss of properties.

2.15 Disposal
HFX stainless steel scrap is a valuable resource with well-established recycling routes. Disposal is not recommended, but no adverse environmental impact is known.
The /**European Waste Catalogue**/ code for iron and steel products is 17 04 05.

2.16 Further information
For further information on these products please refer to https://www.roofinox.com.

3. LCA: Calculation rules

3.1 Declared Unit
The declaration applies to one ton of HFX stainless steel product. The declared unit is the production and recycling of one ton of HFX stainless steel product.

Declared unit

Name	Value	Unit
Density	7900	kg/m^3
conversion factor [Mass/Declared Unit]	-	-
Conversion factor to 1 kg	1	-
Declared unit	1000	kg

3.2 System boundary
This EPD is cradle-to-gate with options, and includes the following process steps:

- Upstream production of raw materials, fuels and energy and all relevant upstream transport processes.
- Production/manufacturing of the HFX stainless steel product.
- Waste water and treatment of wastes generated on site including swarf, dusts, scrap, slag and waste water.
- End-of-life (recycling, remelting or disposal of steel scrap).

3.3 Estimates and assumptions
95 % of HFX structural steel products are assumed to be recycled at end-of-life. The average HFX product manufactured by ROOFINOX has a stainless steel scrap content of 65.2 % hence the net stainless steel scrap output is 29.8 % (95 % - 65.2 %). This stainless steel scrap is declared as a credit in module D. This means that for each 1000 kg of HFX stainless steel product produced, 297.8 kg stainless steel scrap is credited.
The carbon steel scrap used as input is not included in these numbers as carbon steel scrap is considered an open loop with own burden.

End-of-Life Scenario
At end-of-life, a 95 % recycling rate for the steel product is assumed. The remaining 5 % is assumed to remain uncollected or to go to disposal e.g. landfill.

3.4 Cut-off criteria
All reported data were incorporated and modelled i.e. all raw materials, water, thermal and electrical energy and production waste.
The principal material transport processes (such as alloys and scrap) are also considered. Thus, even minor material and energy flows of less than 1 % mass are included.
Data for the sites were cross-checked with one another to identify potential data gaps. No processes, materials or emissions that are known to make a significant contribution to the environmental impact of the products studied have been omitted.
It can be assumed, that all excluded flows contribute less than 5% to the impact assessment categories.
Packaging materials and its transportation are neglected due to low contribution to the overall life cycle results.
Machines, facilities and infrastructure required during manufacture are not taken into account.

3.5 Background data
Background data for upstream materials, fuels and energy production are taken from the /**GaBi Database**/.

3.6 Data quality
Production has been modeled using 2017 average production data provided by the production sites and has been quality-checked by the producer and thinkstep.

3.7 Period under review
Modelling is based on production data from 2017. Background data used are from the 2018 version of /**GaBi Database**/. Documentation related to all the processes used in the stainless steel production model can be found in the GaBi documentation /**GaBi Documentation**/.

3.8 Allocation
Slag generated as a by-product of electric arc furnace (EAF) steelmaking is used as an input to a variety of industries including as a constituent of cement, in road building or as fill material.

This study has adopted a conservative approach and has assumed that all the environmental burdens associated with the production of HFX stainless steel products and EAF slag are allocated to the production of steel, with slag included under the material for recycling (MFR) category.

Production losses of steel during the production process are recycled in a closed loop reducing the requirement for external scrap.

Specific information on allocation within the background data is given in the GaBi datasets documentation (/**GaBi Documentation/)**.

3.9 Comparability

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

4. LCA: Scenarios and additional technical information

For this steel product following average end of life scenarios were considered with the corresponding benefits and burdens:
Landfilling of 5%, a recycling rate of 95%.
The HFX stainless steel scrap input into Modul A is 652 kg; this results in a value of scrap benefit of 297,8kg.

Transport to the building site (A4)

Name	Value	Unit
Litres of fuel	-	l/100km
Transport distance	-	km
Capacity utilisation (including empty runs)	-	%
Gross density of products transported	-	kg/m³
Capacity utilisation volume factor	-	-

Installation into the building (A5)

Name	Value	Unit
Auxiliary	-	kg
Water consumption	-	m³
Other resources	-	kg
Electricity consumption	-	kWh
Other energy carriers	-	MJ
Material loss	-	kg
Output substances following waste treatment on site	-	kg
Dust in the air	-	kg
VOC in the air	-	kg

Use or application of the installed product (B1) see section 2.12 "Use"

Name	Value	Unit

Maintenance (B2)

Name	Value	Unit
Information on maintenance	-	-
Maintenance cycle	-	Number/ RSL
Water consumption	-	m³
Auxiliary	-	kg
Other resources	-	kg
Electricity consumption	-	kWh
Other energy carriers	-	MJ
Material loss	-	kg

Repair (B3)

Name	Value	Unit
Information on the repair process	-	-
Information on the inspection process	-	-
Repair cycle	-	Number/ RSL
Water consumption	-	m³
Auxiliary	-	kg
Other resources	-	kg
Electricity consumption	-	kWh
Other energy carriers	-	MJ
Material loss	-	kg

Replacement (B4) / Refurbishment (B5)

Name	Value	Unit
Replacement cycle	-	Number/ RSL
Electricity consumption	-	kWh
Litres of fuel	-	l/100km
Replacement of worn parts	-	kg

Reference service life

Name	Value	Unit
Reference service life	-	a
Life Span (according to BBSR)	-	a
Life Span according to the manufacturer	-	a
Declared product properties (at the gate) and finishes	-	-
Design application parameters (if instructed by the manufacturer), including the references to the appropriate practices and application codes	-	-
An assumed quality of work, when installed in accordance with the manufacturer's instructions	-	-
Outdoor environment, (for outdoor applications), e.g. weathering, pollutants, UV and wind exposure, building orientation, shading,	-	-

temperature		
Indoor environment (for indoor applications), e.g. temperature, moisture, chemical exposure	-	-
Usage conditions, e.g. frequency of use, mechanical exposure	-	-
Maintenance e.g. required frequency, type and quality and replacement of components	-	-

Operational energy use (B6) and Operational water use (B7)

Name	Value	Unit
Water consumption	-	m^3
Electricity consumption	-	kWh
Other energy carriers	-	MJ
Equipment output	-	kW

End of life (C3)

Name	Value	Unit
Landfilling	5	%

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

Name	Value	Unit
End-of-life recycling rate	95	%
Stainless steel scrap input (into module A)	65.2	%
Net stainless steel scrap credit	29.8	%
Equiv. Mass of stainless steel scrap credited per ton product	297.8	kg

5. LCA: Results

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE 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	MND	MND	X	MND	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A1: 1 t HFX stainless steel

Parameter	Unit	A1-A3	C3	D
Global warming potential	[kg CO_2-Eq.]	3.39E+3	2.48E+0	-1.50E+3
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	4.87E-9	7.00E-12	-1.16E-12
Acidification potential of land and water	[kg SO_2-Eq.]	1.66E+1	9.61E-3	-9.44E+0
Eutrophication potential	[kg $(PO_4)^3$-Eq.]	1.16E+0	1.19E-3	-5.22E-1
Formation potential of tropospheric ozone photochemical oxidants	[kg ethene-Eq.]	1.11E+0	6.99E-4	-5.64E-1
Abiotic depletion potential for non-fossil resources	[kg Sb-Eq.]	1.89E-1	1.14E-6	-8.23E-2
Abiotic depletion potential for fossil resources	[MJ]	5.03E+4	2.87E+1	-1.80E+4

RESULTS OF THE LCA - INDICATORS TO DESCRIBE RESOURCE USE according to EN 15804+A1: 1 t HFX stainless steel

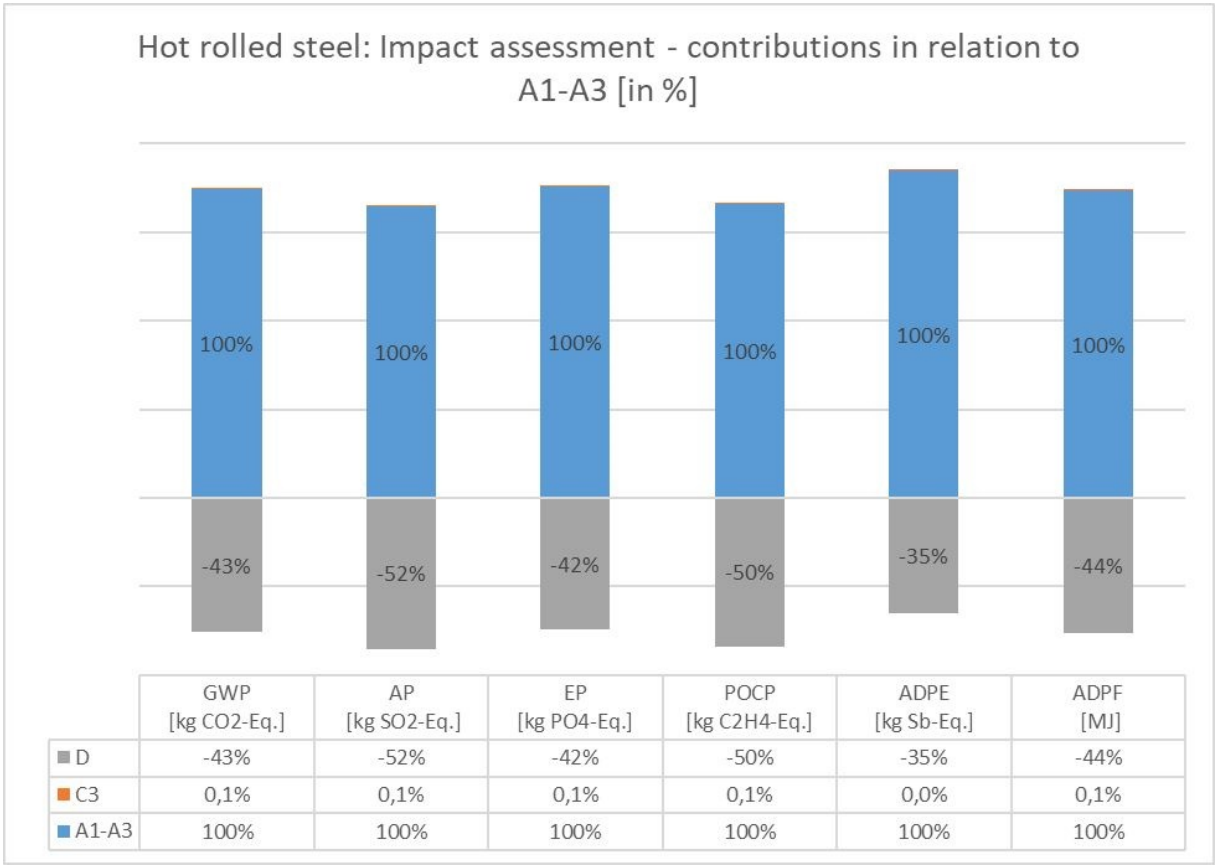
Parameter	Unit	A1-A3	C3	D
Renewable primary energy as energy carrier	[MJ]	8.79E+3	1.20E+1	-2.87E+3
Renewable primary energy resources as material utilization	[MJ]	0.00E+0	0.00E+0	0.00E+0
Total use of renewable primary energy resources	[MJ]	8.79E+3	1.20E+1	-2.87E+3
Non-renewable primary energy as energy carrier	[MJ]	5.59E+4	4.07E+1	-1.83E+4
Non-renewable primary energy as material utilization	[MJ]	0.00E+0	0.00E+0	0.00E+0
Total use of non-renewable primary energy resources	[MJ]	5.59E+4	4.07E+1	-1.83E+4
Use of secondary material	[kg]	6.52E+2	0.00E+0	0.00E+0
Use of renewable secondary fuels	[MJ]	0.00E+0	0.00E+0	0.00E+0
Use of non-renewable secondary fuels	[MJ]	0.00E+0	0.00E+0	0.00E+0
Use of net fresh water	[m^3]	3.82E+1	1.65E-2	-2.10E+1

RESULTS OF THE LCA – WASTE CATEGORIES AND OUTPUT FLOWS according to EN 15804+A1: 1 t HFX stainless steel

Parameter	Unit	A1-A3	C3	D
Hazardous waste disposed	[kg]	4.86E-2	3.28E-7	-1.89E-1
Non-hazardous waste disposed	[kg]	3.41E+2	5.01E+1	1.99E+1
Radioactive waste disposed	[kg]	2.31E+0	4.80E-3	-1.54E-1
Components for re-use	[kg]	0.00E+0	0.00E+0	0.00E+0
Materials for recycling	[kg]	0.00E+0	9.50E+2	0.00E+0
Materials for energy recovery	[kg]	0.00E+0	0.00E+0	0.00E+0
Exported electrical energy	[MJ]	0.00E+0	0.00E+0	0.00E+0
Exported thermal energy	[MJ]	0.00E+0	0.00E+0	0.00E+0

6. LCA: Interpretation

This chapter contains an interpretation of the Life Cycle Impact Assessment categories with regards to the functional unit – 1 ton of HFX stainless steel product. It focuses on the dominant contributions during the production process and recycling steel at its end of life.



	GWP [kg CO2-Eq.]	AP [kg SO2-Eq.]	EP [kg PO4-Eq.]	POCP [kg C2H4-Eq.]	ADPE [kg Sb-Eq.]	ADPF [MJ]
D	-43%	-52%	-42%	-50%	-35%	-44%
C3	0,1%	0,1%	0,1%	0,1%	0,0%	0,1%
A1-A3	100%	100%	100%	100%	100%	100%

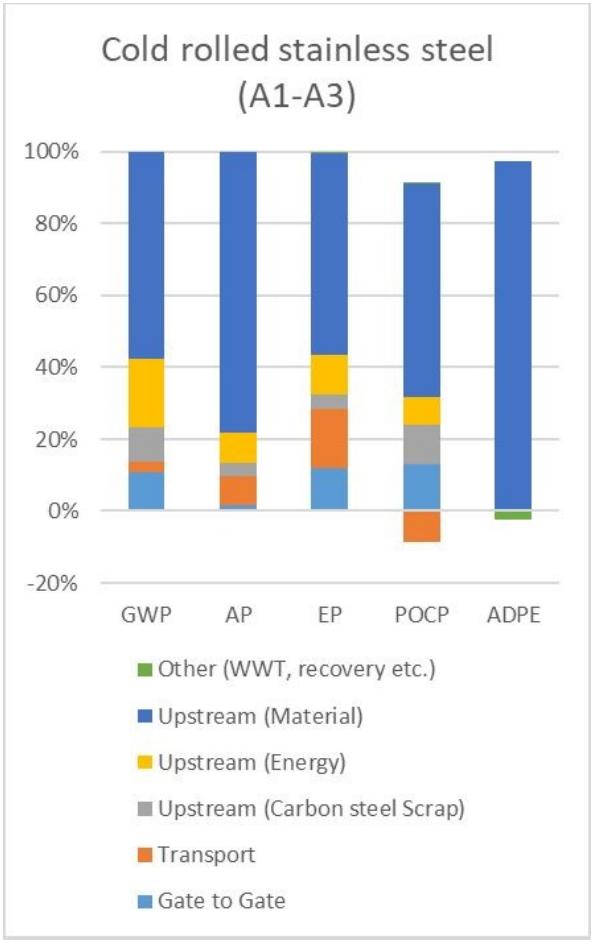
The figure above shows the relative contribution of the production stages (Module A1-A3), waste treatment (Module C3) and the benefits and loads beyond the product system boundary (Module D).
For all categories, the results for product stage (A1-3) contributes with the highest shares. Overall, C3 has a minimized contribution. The credits in Module D have a considerable share, thanks to the recycling.

The most relevant emissions on HFX stainless steel production:
for **Global Warming Potential (GWP**) are CO2, CH4
for **Acidication Potential** (**AP)** are SO2 and NOx;
for **Eutrophication Potential (EP**) are NOx
for **Photochemical Ozone Creation Potential (POCP)** are CO, SO2, NOx, and NMVOC.

The main contribution to A1-A3 is the production of upstream materials, which is dominated by the production of the Fe-alloys Fe-Cr, Fe-Ni, Fe-Si, and Fe-Mo. The production of the listed Fe-alloys is high in energy consumption on Primary Energy Demand and registers high emissions of carbon dioxide, nitrogen oxides and sulphur dioxide with the resulting effect on Global Warming Potential, Acidification Potential, Eutrophication Potential and Photochemical Ozone Creation Potential.

In addition to the upstream material production, a certain influence on the overall results is given by the upstream energy production related to the electricity and fuel consumption on-site. Depending on the location of the site this influence might vary related to the country specific energy supply.

The following figure summarises percentage contributions to selected impact category for each of the products (cradle-to-gate), showing the large contribution from upstream materials.



7. Requisite evidence

This EPD covers HFX products which are likely to be employed in a variety of applications including building envelopes, rainwater drainage, interior cladding and paneling, heating, cooling and ventilation, lifts and elevators, many of which will require further processing and fabrication related to the final application. Consequently, further documentation is not applicable.

7.1 Weathering performance

The majority of the applications described in section 2.2 relate to the interior of buildings. However, where HFX stainless steel is used in an external application, no corrosion shall occur as HFX stainless steel is inherently non-corrosive. For this reason, HFX stainless steel products are often applied where corrosion resistance is a key performance characteristic such as marine environments.

8. References

/PCR Part B/
Institut Bauen und Umwelt e.V., Berlin (pub.): PCR Guidance Texts for Building Related Products and Services, Part B: Requirements on the EPD for Structural Steels. 2017

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/EN 10088-4:2009/, Stainless steels. Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for construction purposes

/EN 10028-7/
EN 10028-7:2016: Flat products made of steels for pressure purposes - Stainless steels

/ASTM A240/
ASTM A240: Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

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/EN 10204/
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/ISO 9001/
ISO 9001:2015: Quality management systems - Requirements

/ISO 14001/
ISO 14001:2015: Environmental management

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/GaBi Documentation/
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