ENVIRONMENTAL PRODUCT DECLARATION

as per /ISO 14025/ and /EN 15804/

Owner of the Declaration	bauforumstahl e.V. & Industrieverband Feuerverzinken e.V.
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
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Valid to	20.12.2023

Hot-dip galvanized structural steel:
Hot rolled steel sections and heavy plates

bauforumstahl e.V. &
Industrieverband Feuerverzinken e.V.

Institut Bauen und Umwelt e.V.

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EN ISO 1461

1. General Information

bauforumstahl e. V. & Industrieverband Feuerverzinken e.V.	Hot-dip galvanized structural steel: Hot rolled steel sections and heavy plates
Programme holder IBU - Institut Bauen und Umwelt e.V. Panoramastr. 1, 10178 Berlin Germany	**Owner of the declaration** bauforumstahl e. V. Sohnstr. 65, 40237 Düsseldorf Germany -- Industrieverband Feuerverzinken e.V. Mörsenbroicher Weg 200, 40470 Düsseldorf Germany
Declaration number EPD-BFS-20180167-IBG1-DE	**Declared product / declared unit** The declared unit is 1 t of structural steel (sections and plates)
This declaration is based on the product category rules: Structural steels, 07.2014 (PCR checked and approved by SVR) **Issue date** 21.12.2018 **Valid to** 20.12.2023	**Scope:** This environmental product declaration covers hot-dip galvanized structural steel rolled out to structural sections, merchant bars and heavy plates, intended for bolted, welded or otherwise connected constructions in buildings, bridges and similar structures. The precursor products are heavy plates and rolled steel sections that are subsequently hot-dip galvanized. The heavy plates are produced by: - Dillinger, operating sites at Dillingen (Germany) and Dunkirk (France) The hot rolled sections are produced by: - ArcelorMittal, operating sites at Differdange (Luxembourg), Dabrowa (Poland), Esch-Belval (Luxembourg), Bergara (Spain), Hunedoara (Romania), Olaberria (Spain), Warsaw (Poland) and Rodange (Luxembourg) - Peiner Träger (Germany) - Stahlwerk Thüringen (Germany) The products are hot-dip galvanized under subcontracting agreements and by the member companies and partners of the German Association for Hot-Dip Galvanizing (Industrieverband Feuerverzinken e.V. IVF, see https://www.feuerverzinken.com/industrie/mitglieder-und-partner). For the selection of the hot-dip galvanizing contractors for the purpose of data collection, the plant size, galvanizing capacity and product range were taken into account. With regard to the scope of the EPD, the data thus covers a representative sample. The owner of the declaration shall be liable for the underlying information and evidence; IBU shall not be liable with respect to manufacturer information, life cycle assessment data and requisite evidence.
Prof. Dr.-Ing. Horst J. Bossenmayer (President of Institut Bauen und Umwelt e.V.)	**Verification** The standard /EN 15804/ serves as the core PCR Independent verification of the declaration and data according to /ISO 14025:2010/ ☐ internally ☒ externally
Dr. Alexander Röder (Managing Director IBU)	Dr.-Ing. Wolfram Trinius (Independent verifier appointed by SVR)

2. Product

2.1 Product description / Product definition

This EPD applies to 1 t of hot-dip galvanized structural steel (sections and plates). It covers steel products of grades S235 to S960 rolled out to structural sections, merchant bars and heavy plates.
The primary data relating to the production of the steel products is taken from EDP /Structural steel: Sections and Plates/ published by bauforumstahl e.V.
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 10025:2005-2 Hot rolled products of structural steels/ and a CE mark.

2.2 Application

Hot-dip galvanized structural steel is used for bolted, welded or otherwise connected constructions in buildings, bridges and similar structures, and in composite steel structures. Examples:
- Single-storey buildings (industrial and storage halls, etc.)
- Multi-storey buildings (office, residential buildings, shops, car parks, high rise, etc.)
- Bridges (railway, road and pedestrian bridges, etc.)
- Other structures (power plants, stadiums, convention centres, airports, train stations, etc.)
- Industrial plants.

2.3 Technical Data

This EPD applies to sheet metal and rolled sections of various steel grades and shipping formats that have been hot-dip galvanized according to /DIN EN ISO 1461/ and /DASt Guideline 022/.
For specific dimensional tolerances, construction and strength data as well as mechanical and chemical properties, refer to the relevant literature and/or standards, including /EN 1993/.

The performance data of the product correspond to the declaration of performance with regard to its characteristic properties according to /EN 10025 Hot rolled products of structural steels/.

Constructional data

Name	Value	Unit
Density	7850	kg/m3
Modulus of elasticity	210000	N/mm2
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/mm²
Emissivity up to 500 °C / from 500 °C	0,35 / 0,7	

Other product standards: /ASTM A36/, /A572/, /A992/, /A913/, /A283/, /A514/, /A573/, /A588/, /A633/, /A709/ and /A1066/.

2.4 Delivery status

The dimensions of the declared products may vary depending on 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 and plates. The content of other elements is significantly lower.

The chemical composition varies from steel grade to steel grade and is specified in the product standards listed below. The surfaces of hot-dip galvanized structural steels are covered by a zinc coating.

Auxiliary materials:
A. For production route "blast furnace with basic oxygen furnace": coking coal, coal, lime
B. For production route "electric arc furnace": lime
For both production routes: aluminium, ferro alloys (ferro silicon, ferro manganese, ferro nickel, ferro niobium, ferro vanadium, ferro titanium)
The content in weight percent of these additives depends on the steel grade.
C. For hot-dip galvanizing: degreasing agent, hydrochloric acid, zinc and ammonium chloride, zinc alloy

2.6 Manufacture

In the integrated steel production route "blast furnace with basic oxygen furnace" (integrated steel production), iron ore, (typical mix based on ferric oxide Fe_2O_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 ore may be used.
The pig iron produced in the blast furnace is transferred to 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, scrap (up to 35%) is added to the melt.

In the electric steel production route, scrap is molten in an electric arc furnace to obtain liquid steel. Refining (lowering of sulphur, phosphorous and other tramp elements) and alloying (e.g. about 1% Mn, 0.2% Si) and / or micro-alloying (e.g. about 0.01% V) are applied to give the steel the required characteristics.
At the end of the steelmaking process, the liquid steel is processed in a continuous casting machine to a semi-finished product. In exceptional cases, it is poured into ingot moulds to form blocks.

The semi-finished product (slab, beam blank, bloom or billet) is hot-rolled into the final product shape (heavy plate, wide flat, H-shape, I-shape, U-shape, L- shape and other merchant bars).

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

Subsequently, the products are hot-dip galvanized. For this purpose, they undergo a wet chemical surface cleaning, are covered by flux, dried and then dipped in a hot zinc bath and cooled /Peissker 2016/.
Quality assurance: /ISO 9001/ monitoring according to /DASt Guideline 022/.

2.7 Environment and health during manufacturing

No measures relating to safety, health and environment protection during the manufacturing process extending beyond statutory regulations 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, and according to the generally recognized rules of engineering and manufacturer recommendations. Standards /EN 1993/ and /EN 1994/ (/EUROCODE EC3/ and /EC4/) apply to the design of steel structures and composite steel and concrete structures.
They specify the requirements regarding serviceability, bearing capacity, durability and fire resistance of steel structures /EC3/ and composite steel and concrete structures /EC4/. Parts 1+2 of /EN 1090/ apply to the production of steel structures and include the requirements for factory production control.

The European standards are complemented by national appendices, instructions, guidelines and publications, as well as statutory regulations.
For the transport and storage of sections and plates, the generally accepted requirements for securing loads must be observed.

Instructions and recommendations of the manufacturer, based on relevant standards and guidelines for welding, galvanizing as well as hot and cold forming must always be observed.

Occupational safety / Environmental protection:
When processing/using steel sections and plates pursuant to the generally recognized rules of engineering, there is no need for measures that go beyond the statutory health and safety regulations.
The processing/use of steel sections and plates pursuant to the generally recognized rules of engineering does not lead to the release of substantial environmental pollutants.
Specific measures to protect the environment are not required.

Residual material:
During processing, cut-off and other waste as well as chips produced by cutting must be collected separately.
The steel scrap can be nearly 100% recycled by melting to produce new steel products, while the recovered zinc can be used again for hot-dip galvanizing.

2.9 Packaging

Hot-dip galvanized structural steels are normally shipped without packaging. To facilitate transportation, the material is generally made available in bundles.
For sea transport, special packaging to protect the goods while at sea might be used.

2.10 Condition of use

Chemical composition:
Hot-dip galvanized structural steels are non- or low-alloy steel products produced by alloying iron with other metals and non-metals (especially carbon). Iron is the main component of steel sections and heavy plates. During usage, the chemical composition remains the same as at the time of production (see chapter 2.6).

2.11 Environment and health during use

If used properly, there are no known negative impacts of hot-dip galvanized heavy plates and rolled steel sections on the environment or on the health of people.

2.12 Reference service life

Hot-dip galvanizing allows for durable corrosion protection of steel components under atmospheric corrosion conditions. The protection normally lasts for several decades without any need for maintenance or repair.

Life to first maintenance for zinc coating systems according to DIN EN ISO 1461 in a range of corrosivity categories
(excerpt from DIN EN ISO 14713-1, Table 2)

Minimum thickness [µm]	C3	C4
	Life min./max. (years) and durability class (VL, L, M, H, VH)	
85	40/>100; VH	20/40; VH
140	67/>100; VH	33/67; VH
200	95/>100; VH	48/95; VH

NOTE: The figures for life have been rounded to whole numbers. The allocation of the durability designation is based upon the average of the minimum and maximum of the calculated life to first maintenance, e.g. 85 µm zinc coating in corrosivity category C4 gives expected durability of 85/2.1 = 40.746 years (rounded to 40 years) and 85/4.2 = 20.238 years (rounded to 20 years). Average durability of (20 + 40)/2 = 30 years – designated "VH".
Abbreviations: VL = very low (life 0 to <2 years); L = low (life 2 to <5 years); M = medium (life 5 to <10 years); H = high (life 10 to <20 years); VH = very high (life ≥20 years)

Hot-dip galvanizing also provides adequate protection under maritime conditions and against deicing salts. For more information regarding the reference service life of hot-dip galvanized structural steel, see /DIN EN ISO 14713-1/.

2.13 Extraordinary effects

Fire
The product meets the requirements of building material safety class A1 (non-flammable according to /DIN EN 13501/).
Given the significantly lower emissivity of hot-dip galvanized structural steel, and depending on the form factor, fire resistance class R30 can be achieved by hot-dip galvanizing alone and without any additional protective measures.
At temperatures above 650°C, the thin zinc coating evaporates quickly as zinc oxide (ZnO), causing fumes.
When inhaled for a prolonged period of time, ZnO fumes can cause metal fume fever (diarrhoea, fever, dry throat), whereby these symptoms normally disappear within 1 to 2 days after inhalation.
The critical temperature (failure temperature of the component) depends primarily on the component load and the insulation of the component.

Fire safety

Designation	Value
Classification according to DIN EN 13501-1	A1

Water
Hot-dip galvanized steel is not soluble in water and does not release any substances when exposed to water.

Mechanical destruction
Due to the high ductility of steel, structures made from hot-dip galvanized steel react resilient in the event of unforeseeable mechanical destruction:

Under tensile load, structural steel is deformed by necking, with fracture at high loads.
Under constant high compressive load, components made from hot-dip galvanized steel might buckle. Splintering, chipping, etc. do not occur.

2.14 Re-use phase

General:
Sections and plates of hot-dip galvanized steel are recyclable by 100%.
Due to the magnetic properties of steel, 99% of the used steel is recovered after dismantling /*European Commission Technical Steel Research*/.

Recycling:
After dismantling, hot-dip galvanized sections and plates can be recycled without any problems. Currently, around 88% of the products are recycled as material.
Sources: /*European Commission Technical Steel Research*/ and /*German Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety*/. The remaining 11% (99 % - 88 %) is re-used.
Re-use:
Sections and plates can be re-used. Currently, around 11% of the products are re-used after dismantling.

2.15 Disposal

Due to its high value as a resource, steel scrap is not disposed of in landfill but enters a well-established cycle of re-use or recycling.
Should it however be disposed of in landfill, for instance due to collection loss, no environmental impacts are to be expected.
Waste code according to European Waste Catalogue /EWC/: (17 04 05 - iron and steel)

2.16 Further information

For more information on hot-dip galvanized structural steel and its use, visit www.bauforumstahl.de and www.feuerverzinken.com.

3. LCA: Calculation rules

3.1 Declared Unit

The declaration refers to the functional unit of 1 ton of hot-dip galvanized structural steel: rolled sections and heavy plates.
The LCA is calculated based on weighted average production volumes of representative plants.

Declared unit

Designation	Value	Unit
Declared unit	1	t
Specific weight	7850	kg/m³
Conversion factor for 1 kg	0.001	-

3.2 System boundary

EPD type: Cradle-to-gate - with options.
The following processes are included in product stage **A1–A3** of the hot-dip galvanized steel:

- Manufacturing processes involving raw materials/semi-finished goods (module A1) and auxiliary materials (module A3).
  The manufacturing process for structural steel is based on EPD "Structural steel – hot rolled steel sections and heavy plates" as revised in 2018.
- Transport of structural steel to galvanizing plant (module A2)
- Hot-dip galvanizing of structural steel (module A3), including energy generation, production of auxiliary materials, disposal of waste material (production waste, precursor packaging waste) and emissions produced by plant.

Module C3 takes into account the sorting and shredding of after-use steel that is recycled, as well as non-recovered scrap resulting from sorting loss, which is disposed of in landfill.
A conservative estimate of 1% landfill is assumed.

Module D refers to the end-of-life re-use and recycling of structural steel.

3.3 Estimates and assumptions

For the transport analysis, a transport distance of 100 km has been assumed, unless otherwise specified by the relevant companies.
The model is based on the general use of a degreasing agent (based on hydrochloric acid or sodium hydroxide) in all cases and thus represents the *worst case* scenario.
The heat generated by the incineration of the packaging of raw and auxiliary materials is used to generate electricity and thermal energy.
According to the /Product Category Rules PCR part A/, the generated energy is set off against the energy consumed in the production of structural steel (A1-A3).
Steel scrap from production is set off against the "recycling potential for sheet steel".
The spent iron pickling and zinc baths are partially recycled so that 30% of the input material can be set off. In order to assess the impact of the recycling rates on the environmental profile of the product, a sensitivity analysis was performed, using three scenarios with recycling rates of 0 %, 30 % and 70 % respectively. This analysis showed that the above assumptions are accurate.

3.4 Cut-off criteria

All data gathered during the production data acquisition, as well as the consumption data for thermal energy, electricity and diesel are taken into account.
All material flows that amount to more than 1 % of the total mass, the energy consumption or the environmental impact of the system have been taken into account in the analysis.
It can be assumed that the processes omitted from the analysis account for less than 5% of the impact within the relevant categories.
Impacts relating to the production of machines, plants and facilities required for production are outside the scope of this assessment.

3.5 Background data

For the life cycle modelling of the declared products, the "GaBi 8" software system for life cycle engineering was used (/GaBi ts Software/).

All relevant background datasets relating to the production of hot-dip galvanized structural steel were retrieved from the GaBi 8 database, or were made available by *bauforumstahl e.V.* and *Industrieverband Feuerverzinken e.V.*
The representative hot-dip galvanizing contractors were identified by Industrieverband Feuerverzinken /Hot-dip galvanized structural steel/.

3.6 Data quality

All relevant background datasets for the LCA were retrieved from the GaBi 8 database.
Primary data was made available by *bauforumstahl e.V. and Industrieverband Feuerverzinken e.V.*
The quality of the data is considered high.
The last revision of the used background and manufacturer data took place less than 5 years ago.

3.7 Period under review

The data used for this LCA is based on up-to-date primary data collected by *bauforumstahl e.V.* and *Industrieverband Feuerverzinken e.V.* in 2017.

3.8 Allocation

The spent pickling and flux baths are partially recycled. A recovery rate of the input material of 30% for set-off was assumed for the *worst case* scenario.
For the steel and zinc scrap generated in the production process, the relevant amounts of primary materials minus the impacts associated with the related preparation and melting processes have been credited.

3.9 Comparability

As a rule, a comparison or evaluation of EPD data is only possible, if all datasets to be compared are compiled according to /EN 15804/, and the building construction context or the product-specific characteristics of performance are taken into account.

4. LCA: Scenarios and additional technical information

The following end-of-life scenarios for re-use, recycling and waste disposal were assessed:

End of life (C3)

Designation	Value	Unit
Landfill disposal	1	%

Reuse, recovery and/or recycling potential (D)

Designation	Value	Unit
Recycling	88	%
Reuse	11	%

5. LCA: Results

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

PRODUCT STAGE			CONSTRUCTI ON 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: 1 ton structural steel

Parameter	Unit	A1-A3	C3	D
Global warming potential	[kg CO_2-Äq.]	1,32E+3	2,21E+0	-4,95E+2
Depletion potential of the stratospheric ozone layer	[kg CFC11-Äq.]	2,26E-9	6,99E-12	1,77E-6
Acidification potential of land and water	[kg SO_2-Äq.]	2,62E+0	6,33E-3	-1,02E+0
Eutrophication potential	[kg $(PO_4)^{3-}$-Äq.]	2,72E-1	7,26E-4	-8,56E-2
Formation potential of tropospheric ozone photochemical oxidants	[kg Ethen-Äq.]	4,18E-1	4,53E-4	-2,03E-1
Abiotic depletion potential for non-fossil resources	[kg Sb-Äq.]	1,38E-1	1,44E-6	-4,79E-2
Abiotic depletion potential for fossil resources	[MJ]	1,30E+4	2,58E+1	-4,84E+3

RESULTS OF THE LCA - RESOURCE USE: 1 ton structural steel

Parameter	Unit	A1-A3	C3	D
Renewable primary energy as energy carrier	[MJ]	2,43E+3	1,14E+1	-1,74E+2
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]	2,43E+3	1,14E+1	-1,74E+2
Non-renewable primary energy as energy carrier	[MJ]	1,48E+4	3,78E+1	-5,01E+3
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]	1,48E+4	3,78E+1	-5,01E+3
Use of secondary materia	[kg]	7,67E+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	[m³]	5,41E+0	1,47E-2	-4,14E-1

RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: 1 ton structural steel

Parameter	Unit	A1-A3	C3	D
Hazardous waste disposed	[kg]	1,31E-2	1,85E-7	-1,65E-3
Non-hazardous waste disposed	[kg]	1,97E+1	1,00E+1	3,16E+1
Radioactive waste disposed	[kg]	7,27E-1	4,78E-3	-1,11E-1
Components for re-use	[kg]	0,00E+0	1,10E+2	0,00E+0
Materials for recycling	[kg]	0,00E+0	8,80E+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

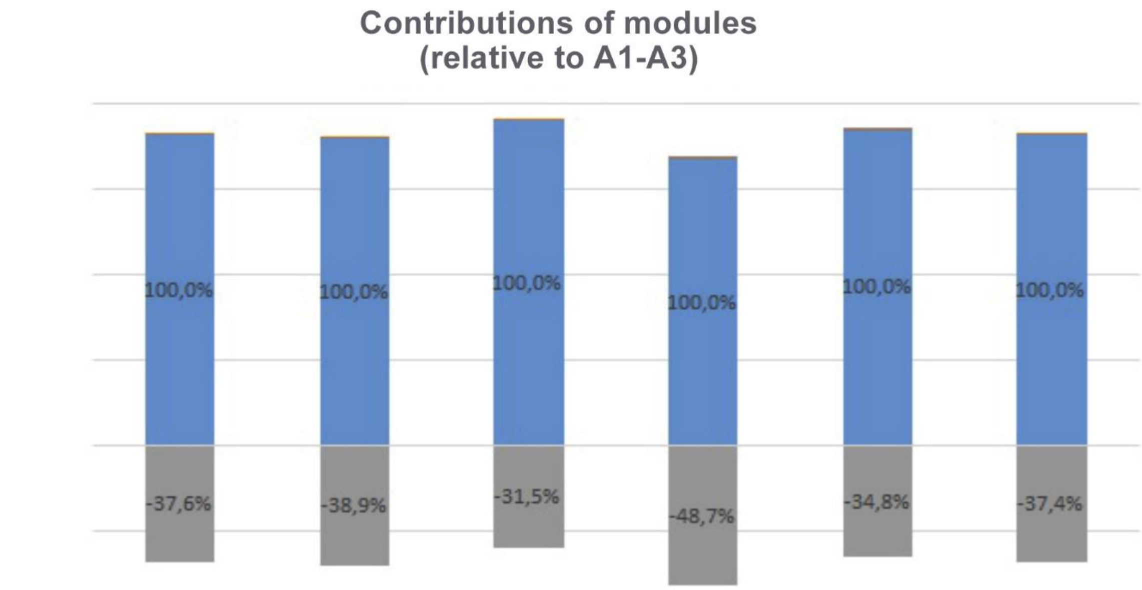
6. LCA: Interpretation

This chapter summarises the results of the LCA.

The production of the raw material (module A1) is the largest impact driver across all declared modules (with the exception of ODP, which is mainly caused by energy generation), followed by module A3.
The contributions of the transport of the structural steel (module A2) and waste treatment (module C3) are below 1.5% in all environmental impact categories.
The credits in module D arise from the recycling of steel scrap.

The credit is based on the substitution of primary steel by secondary steel from the electric arc furnace (EAF), with a 100% scrap utilisation along the EAF route.

The figure below illustrates the outcomes of the modules relative to modules A1-A3 for selected environmental criteria.



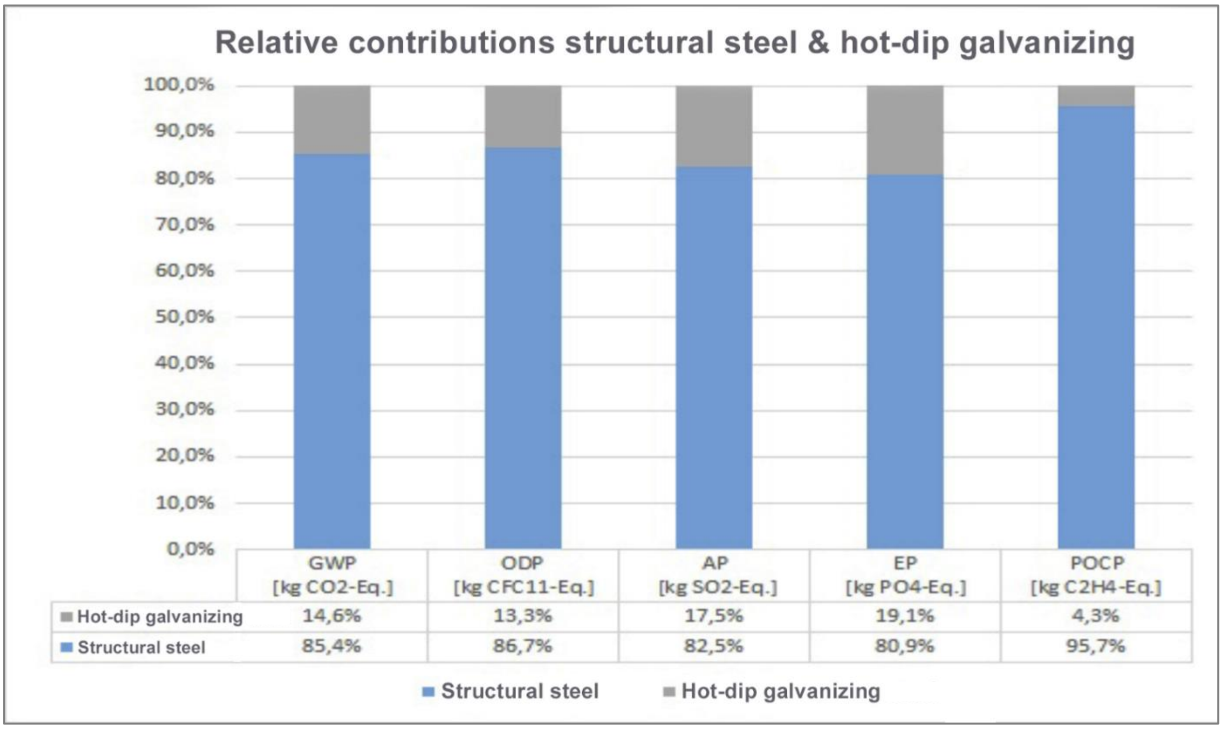
	GWP [kg CO2-Eq.]	AP [kg SO2-Eq.]	EP [kg PO4-Eq.]	POCP [kg C2H4-Eq.]	ADPE [kg Sb-Eq.]	ADPF [MJ]
D	-37,6%	-38,9%	-31,5%	-48,7%	-34,8%	-37,4%
C3	0,2%	0,2%	0,3%	0,1%	0,0%	0,2%
A1-A3	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%

Global Warming Potential (GWP), Acidification Potential (AP), Eutrophication Potential (EP), **Photochemical Ozone Creation Potential (POCP)** and **Abiotic Depletion Potential fossil fuel (ADPF)** are dominated by the emissions arising during steel production and the manufacture of auxiliary and precursor materials, as the steel production is an energy-intensive process. The second highest impact is caused by the mining and processing of the raw materials, and by the generation of steam and heat.

The provision of zinc is the main contributing factor to the **Abiotic Depletion Potential elementary (ADPe)**. The results for **Ozone Depletion Potential (ODP)** are mainly due to upstream energy generation processes, in particular the generation of nuclear energy.
In this EPD model, the share of nuclear energy for the generation of electric power for modules A1-A3 is very small, which is reflected in the low value for A1-A3.

In contrast, module D is based on the global average steel production mix, where the share of nuclear power is much higher. As a consequence, the ODP results are mainly due to module D.

The figure below compares the relative contributions of the production of structural steel on the one hand and of hot-dip galvanizing on the other. The values refer exclusively to modules A1-A3 and do not include credits. They show clearly that the hot-dip galvanizing process contributes only marginally to the environmental impact of the overall process.
When assessing the hot-dip galvanizing process in isolation, the processes for the provision of the zinc and the thermal and electrical energy are the main contributing factors.



7. Requisite evidence

7.1 Chemical weathering
When exposed to the elements, the surfaces of hot-dip galvanized steel components become naturally covered in a protective layer know as patina. Patina is extremely durable and thus provides for exceptionally effective protection against corrosion, lasting several decades.
At the same time, it protects the zinc coating, so that it remains intact for a long period of time.
The ever more stringent air quality improvement measures (in particular the desulphurisation of power plant and engine fuels) have a major positive impact on the reduction of chemical weathering of zinc coatings. /Schröder 2013/ reports of zinc coating depletion rates of up to 4.7 µm/a observed in the 1970s in hot-dip galvanized steel crash barriers.
For complete chemical weathering, recent publications (see /Hullmann 2003/) quote corrosion rates for zinc of 3.0 g/m²*a (corresponding to approx. 0.5 µm/a).
Recent studies (/BAST 2008/ and /Schröder 2013/) examined hot-dip galvanized steel crash barriers along the German Federal Motorway BAB 4 and detected no measurable loss of thickness of the zinc coating due to chemical weathering after 10 years of exposure to the elements.
Chemical weathering can thus be assumed to be minimal and therefore negligible, even over several years and under increased corrosion stress such as along motorways (where deicing salt is used during the winter months).

8. References

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