ENVIRONMENTAL PRODUCT DECLARATION

HOT-DIP GALVANIZED STEEL AFTER FABRICATION

GALVANIZED HOT-ROLLED SECTIONS, PLATE, AND HOLLOW STRUCTURAL SECTIONS
AMERICAN GALVANIZERS ASSOCIATION

The San Diego Central Library façade and dome utilizes hot-dip galvanized hot-rolled sections, plate, and hollow structural steel sections.

Use of this EPD is limited to North American AGA members. Member names are available at www.galvanizeit.org/galvanizers.

American Galvanizers Association
Protecting Steel for a Sustainable Future

Hot-dip galvanizing is a proven corrosion protection system that transcends time with little economic or environmental impact. From artful sculptures and building facades to utilitarian bridges, utility poles, and other infrastructure, hot-dip galvanized steel is an important part of everyday life.

Not only does hot-dip galvanizing provide decades of maintenance-free longevity, its primary components, zinc and steel, are both 100% recyclable, making hot-dip galvanizing an infinitely renewable building material.

Sustainability and corrosion protection are intrinsic whenever hot-dip galvanized steel is used. Lower maintenance of installed HDG steel ensures less natural resources are consumed, less emissions are released, and less money is spent over the life of a project.

The American Galvanizers Association (AGA) is a not-for-profit trade association serving the after fabrication hot-dip galvanizing industry in North America.

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GALVANIZED HOT-ROLLED SECTIONS, PLATE, & HOLLOW STRUCTURAL SECTIONS

According to ISO 14025

This declaration is an environmental product declaration (EPD) in accordance with ISO 14025. EPDs rely on Life Cycle Assessment (LCA) to provide information on a number of environmental impacts of products over their life cycle. Exclusions: EPDs do not indicate that any environmental or social performance benchmarks are met, and there may be impacts that they do not encompass. LCAs do not typically address the site-specific environmental impacts of raw material extraction, nor are they meant to assess human health toxicity. EPDs can complement but cannot replace tools and certifications that are designed to address these impacts and/or set performance thresholds – e.g. Type 1 certifications, health assessments and declarations, environmental impact assessments, etc. Accuracy of Results: EPDs regularly rely on estimations of impacts, and the level of accuracy in estimation of effect differs for any particular product line and reported impact. Comparability: EPDs are not comparative assertions and are either not comparable or have limited comparability when they cover different life cycle stages, are based on different product category rules or are missing relevant environmental impacts. EPDs from different programs may not be comparable.

PROGRAM OPERATOR	UL
DECLARATION HOLDER	The American Galvanizers Association (AGA)
DECLARATION NUMBER	11345278.101.1
DECLARED PRODUCT	Hot-dip galvanized steel after fabrication
REFERENCE PCR	North American PCR for Designated Steel Construction Products, SCS, v1.0, 2015
DATE OF ISSUE	September 22, 2016
PERIOD OF VALIDITY	5 Years
CONTENTS OF THE DECLARATION	Product definition and information about building physics Information about basic material and the material's origin Description of the product's manufacture Indication of product processing Information about the in-use conditions Life cycle assessment results Testing results and verifications

The PCR review was conducted by:	PCR Review Panel Chair: Thomas P. Gloria info@scsglobalservices.com
This declaration was independently verified in accordance with ISO 14025 by Underwriters Laboratories ☐ INTERNAL ☒ EXTERNAL	Wade Stout, UL
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Thomas P. Gloria, Industrial Ecology Consultants

American Galvanizers Association
Protecting Steel for a Sustainable Future

HOT-DIP GALVANIZED STEEL AFTER FABRICATION
GALVANIZED HOT-ROLLED SECTIONS, PLATE, & HOLLOW STRUCTURAL SECTIONS

According to ISO 14025

Product Definition

Association Description

The American Galvanizers Association (AGA), headquartered in Centennial, CO, is a not-for-profit trade association dedicated to serving the needs of specifiers, architects, engineers, contractors, fabricators, and after-fabrication hot-dip galvanizers throughout North America. Since 1933, the AGA has provided information on the most innovative applications and state-of-the-art technological developments in hot-dip galvanizing for corrosion control. The AGA serves as the unified voice and representative of the North American hot-dip galvanizing industry and strives to deliver clear, objective messages about the environmental and economic benefits of utilizing hot-dip galvanized steel. The AGA maintains a large technical library, provides multimedia educational seminars, offers technical support, and preserves and expands galvanized steel's market position in existing and emerging markets.

Participating Members

This EPD represents hot-rolled structural steel sections, steel plate, and hollow structural steel sections that are hot-dip galvanized after fabrication by the AGA's membership. Galvanizing data were collected from appropriate AGA members to represent the industry average. Member names are available at www.galvanizeit.org/galvanizers/.

Product Description

Hot-rolled structural sections, plate, and hollow structural sections hot-dip galvanized after fabrication are used in building, bridge, and industrial applications where corrosion resistance is necessary. Hot-dip galvanizing after fabrication has been specified to combat steel corrosion in the harshest environments throughout various markets for more than 100 years. New technologies and creative chemistries continue to evolve the specification and use of hot-dip galvanized steel as new markets emerge. Once considered only as a means of corrosion protection, hot-dip galvanizing is now specified for an array of reasons including lower initial and life cycle costs, durability, longevity, availability, versatility, sustainability, and aesthetics.

Delivered Product Configurations

Structural steel consists of the elements of the structural frame that are shown and sized in the structural design documents, essential to support the design loads and described in the *Code of Standard Practice for Structural Steel Buildings and Bridges*, AISC 303-10. Hot-dip galvanizing coating for corrosion protection as described in ASTM A123/A123M.

Application and Codes of Practice

ANSI/AISC 360-10	Specification for Structural Steel Buildings
ANSI/AISC 341-10	Seismic Provisions for Structural Steel Buildings
AISC 303-10	Code of Standard Practice for Structural Steel Buildings
AASHTO LRFD Bridge Design Specifications, Customary U.S. Units, 7th Edition	
ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanizing) Coatings on Iron and Steel Products
ASTM B6	Standard Specification for Zinc

Additional information can be found on AGA's website at www.galvanizeit.org.

Life Cycle Stages

The life cycle stages for galvanized structural steel products are summarized in the flow diagram shown in the figure below. Only the cradle-to-gate performance is considered in the analysis.

Raw Materials

Galvanized structural steel is manufactured from fabricated structural steel. It does not contain any materials or substances for which there exists a route to exposure that leads to humans or flora/fauna in the environment being exposed to said materials or substances at levels exceeding safe health thresholds. Steel production was represented by background datasets for North American steel as published by worldsteel and AISC. Zinc production was represented by a background dataset for global zinc published by the International Zinc Association (IZA) and fabrication by primary data collected by the American Institute of Steel Construction (AISC).

Inbound Transportation

Inbound transportation distances and modes for steel and ancillary materials were collected from each galvanizer.

Manufacturing

The major inputs to galvanizing is the fabricated steel itself, along with the zinc used to produce the coating. Process materials such as acids, degreasers, caustic soda, and zinc ammonium chloride are used to prepare the steel prior to galvanizing. Once the surface is prepared, the steel is immersed in a bath of molten zinc to form the coating. Energy is needed to prepare and coat the steel as well as to move the materials. Acids and zinc byproducts (skimmings and dross) are reprocessed internally and recycled externally.

Requirements for Underlying Life Cycle Assessment

A “cradle-to-gate” analysis using life cycle assessment (LCA) methodology was conducted for this EPD. The analysis was done according to the product category rule (PCR) for Designated Steel Construction Products[1] and followed LCA principles, requirements and guidelines laid out in the ISO 14040/14044[2,3] standards. As such, EPDs of construction products may not be comparable if they do not comply with the same PCR. While the intent of the PCR is to increase comparability, there may still be differences among EPDs that comply with the same PCR (e.g., due to differences in system boundaries, background data, etc.).

Declared unit

The declared unit for this EPD is one metric ton of galvanized structural steel product. Note that comparison of EPD results on a mass basis, alone, is insufficient and should consider the technical performance of the product.

[1] SCS Global. North American Product Category Rule for Designated Steel Construction Products. v1.0, 2015.
[2] ISO 14040: Environmental Management – Life Cycle Assessment – Principles and Framework, 2006
[3] ISO 14044: Environmental management -- Life cycle assessment -- Requirements and guidelines, 2006

Name	Required Unit	Optional Unit
Declared Unit	metric ton	short ton
Density	7,800 kg / m^3	487 lbs. / $ft.^3$

System Boundaries

The “cradle-to-gate” life-cycle stages represent the product stage (information modules A1-A3) and include:

- A1: all extraction and processing of raw materials, any reuse of products or materials from a previous product system, processing of secondary materials, and any energy recovery or other recovery processes from secondary fuels;
- A2: all transportation to the factory gate and all internal transport;
- A3: generation of electricity used in galvanizing from primary energy resources, including upstream processes; production of all ancillary materials, pre-products, products, and co-products, including any packaging.
- D: potential benefit associated with the recovery of zinc scrap (in the form of skimmings and dross) from galvanizing and thus the potential displacement of primary zinc.

Product Stage			Construction Stage		Use Stage					End-of-Life Stage				Benefits & Loads
A1	**A2**	**A3**	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	D
			EXCLUDED FROM THIS STUDY											
Raw materials supply	**Transport**	**Manufacturing**	Transport	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	De-construction	Transport	Waste processing	Disposal	Reuse, recovery, recycling potential

This EPD represents 2013 galvanized structural steel products as produced by AGA member companies in the United States.

Assumptions

The ratio of zinc to steel mass will vary depending on the dimensions and surface area of the piece of steel coated. To ensure galvanizing data represent an average ratio while balancing time and effort spent by galvanizers in data provision, manufacturers who primarily coat medium structural sections were chosen to provide data.

All of the raw materials and energy inputs have been modeled using processes and flows that closely follow actual production data on raw materials and processes. All of the reported material and energy flows have been accounted for.

Zinc scrap (i.e., dross and skimmings) is recovered from galvanizing facilities. Since galvanizing scrap generated

exceeds the scrap content of incoming zinc, the product system is credited with the potential benefit from the displacement of primary zinc as the recovered scrap can be reused in another product. The potential benefit is calculated using value-corrected substitution, in which the ratios of scrap prices for dross and skimmings relative to the primary zinc price are used to "correct" for the zinc content in the scrap as well as for the additional effort of zinc recovery[4]. Once the correction is applied, credit representing the avoided production of primary zinc is calculated and reported under module D.

Allocation

No allocation was necessary at the galvanizing facility. Allocation of background data (energy and materials) taken from the GaBi 2016 databases is documented online at http://www.gabi-software.com/international/support/gabi/.

Cut-off Criteria

The cut-off criteria for including or excluding materials, energy and emissions data of the study are as follows:

- Mass: If a flow is less than 1% of the cumulative mass of the model it may be excluded, providing its environmental relevance is not a concern.
- Energy: If a flow is less than 1% of the cumulative energy of the model it may be excluded, providing its environmental relevance is not a concern.
- Environmental relevance: If a flow meets the above criteria for exclusion, yet is thought to potentially have a significant environmental impact, it was included.

Capital goods for the production processes (machines, buildings, etc.) were not taken into consideration.

[4] Koffler, C. & Florin, J. Koffler, C. & Florin, J. "Tackling the Downcycling Issue—A revised approach to value-corrected substitution in life cycle assessment of aluminum (VCS 2.0)", *Sustainability*, **5**, p. 4546. 2013.

Life Cycle Assessment Results and Analysis: Galvanized Structural Sections

Life cycle assessment results are presented per metric ton of steel product, the required reporting unit, and per short ton of steel product, the optional reporting unit. Primary energy use represents lower heating value (LHV).

Use of Energy and Material Resources: Galvanized Structural Sections

Primary Energy	Results per metric ton			Results per short ton		
	A1-A3	**D**	**Units**	**A1-A3**	**D**	**Units**
Use of renewable primary energy resources excluding those used as raw materials	1,010	-60.3	MJ	8.69E+05	-5.19E+04	BTU
Use of renewable primary energy resources as raw materials	0	0	MJ	0	0	BTU
Total use of renewable primary energy resources	**1,010**	**-60.3**	**MJ**	**8.69E+05**	**-5.19E+04**	**BTU**
Use of non-renewable primary energy resources excluding those used as raw materials	18,700	-162	MJ	1.61E+07	-1.39E+05	BTU
Use of non-renewable primary energy resources as raw materials	0	0	MJ	0	0	BTU
Total use of non-renewable primary energy resources	**18,700**	**-162**	**MJ**	**1.61E+07**	**-1.39E+05**	**BTU**

Material Resource Use	Results per metric ton			Results per short ton		
	A1-A3	**D**	**Units**	**A1-A3**	**D**	**Units**
Use of secondary material	1.02	0	metric ton	1.02	0	short ton
Use of renewable secondary fuels	0	0	MJ	0	0	BTU
Use of non-renewable secondary fuels	0	0	MJ	0	0	BTU
Net use of fresh water*	*(n/a)*	*(n/a)*	m^3	*(n/a)*	*(n/a)*	gallons

* Net use of fresh water is not reported in this EPD due to lack of consistent water data in worldsteel's datasets and for consistency with AISC's fabricated structural steel EPDs. worldsteel is currently working to update its data; once these data are published, net use of fresh water results can be calculated and reported.

Life Cycle Impact Assessment: Galvanized Structural Sections

Parameter	Results per metric ton			Results per short ton		
	A1-A3	D	Units	A1-A3	D	Units
Impact Assessment Method: TRACI 2.1						
Global warming potential (GWP)	1.48E+00	-1.56E-02	metric ton CO_2 eq	1.48E+00	-1.56E-02	short ton CO_2 eq
Depletion potential of the stratospheric ozone layer (ODP)*	*(n/a)*	*(n/a)*	metric ton CFC-11 eq	*(n/a)*	*(n/a)*	short ton CFC-11 eq
Acidification potential of soil and water (AP)	7.28E-03	-1.17E-04	metric ton SO_2 eq	7.28E-03	-1.17E-04	short ton SO_2 eq
Eutrophication potential (EP)	2.16E-04	-7.02E-06	metric ton N eq	2.16E-04	-7.02E-06	short ton N eq
Formation potential of tropospheric ozone (POCP)	5.86E-02	-2.66E-03	metric ton O_3 eq	5.86E-02	-2.66E-03	short ton O_3 eq
Impact Assessment Method: CML2001 (v4.1)						
Abiotic depletion potential (ADP-elements)†	*(n/a)*	*(n/a)*	metric ton Sb eq	*(n/a)*	*(n/a)*	short ton Sb eq
Abiotic depletion potential (ADP-fossil)	1.65E+04	-1.25E+02	MJ	1.42E+07	-1.07E+05	BTU

* Ozone depletion results are not reported in this EPD. Results are negative due to credit given within the zinc dataset.
† Results for this indicator are not reported. This indicator is based on assumptions regarding current reserves estimates; therefore, caution is necessary when interpreting results because there is insufficient information on which indicator is best for assessing the depletion of abiotic resources.

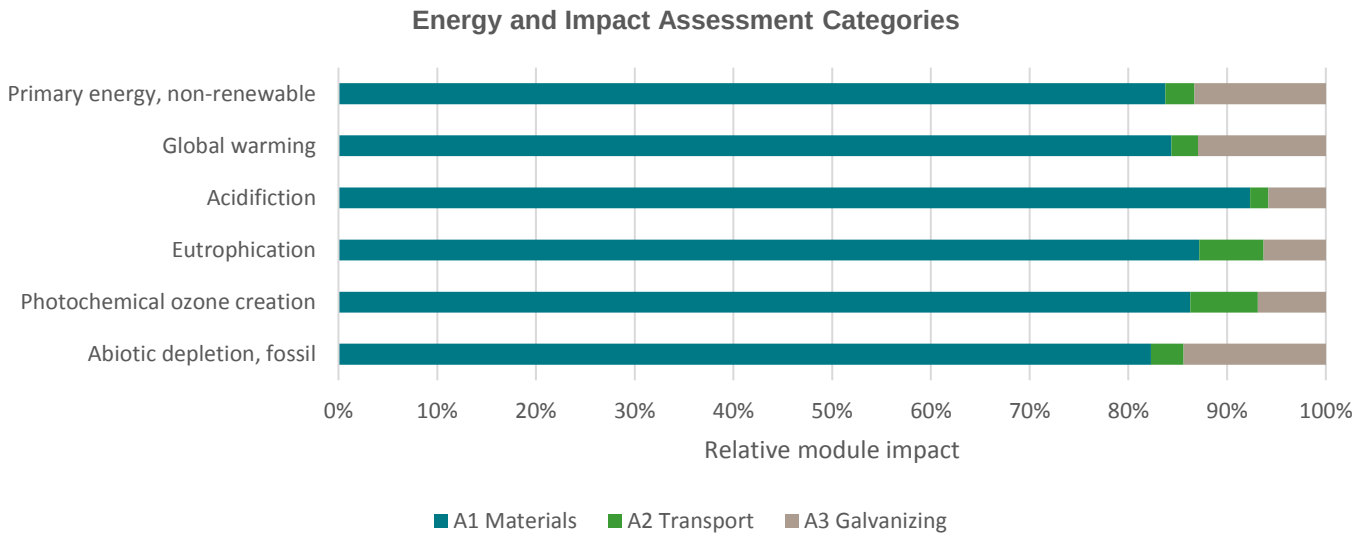
Other Environmental Information: Galvanized Structural Sections

Parameter	Results per metric ton			Results per short ton		
	A1-A3	D	Units	A1-A3	D	Units
Hazardous waste disposed*	*(n/a)*	*(n/a)*	metric ton	*(n/a)*	*(n/a)*	short ton
Non-hazardous waste disposed*	*(n/a)*	*(n/a)*	metric ton	*(n/a)*	*(n/a)*	short ton
Radioactive waste disposed	8.76E-04	-1.47E-05	metric ton	8.76E-04	-1.47E-05	short ton
Components for re-use	0	0	metric ton	0	0	short ton
Materials for recycling	2.05E-02	0	metric ton	2.05E-02	0	short ton
Materials for energy recovery	0	0	metric ton	0	0	short ton
Exported energy	0	0	MJ	0	0	BTU

* Hazardous and non-hazardous waste disposed are not reported in this EPD due to lack of waste inventory data in worldsteel's datasets.

Visualization of Life Cycle Impact Assessment: Galvanized Structural Sections

The diagram in this section illustrates the degree to which the modules drive energy demand and the major impact categories.



Life Cycle Assessment Results and Analysis: Galvanized Steel Plate

Life cycle assessment results are presented per metric ton of steel product, the required reporting unit, and per short ton of steel product, the optional reporting unit. Primary energy use represents lower heating value (LHV).

Use of Energy and Material Resources: Galvanized Steel Plate

Primary Energy	Results per metric ton			Results per short ton		
	A1-A3	**D**	**Units**	**A1-A3**	**D**	**Units**
Use of renewable primary energy resources excluding those used as raw materials	991	-60.3	MJ	8.52E+05	-5.19E+04	BTU
Use of renewable primary energy resources as raw materials	0	0	MJ	0	0	BTU
Total use of renewable primary energy resources	**991**	**-60.3**	**MJ**	**8.52E+05**	**-5.19E+04**	**BTU**
Use of non-renewable primary energy resources excluding those used as raw materials	22,200	-162	MJ	1.91E+07	-1.39E+05	BTU
Use of non-renewable primary energy resources as raw materials	0	0	MJ	0	0	BTU
Total use of non-renewable primary energy resources	**22,200**	**-162**	**MJ**	**1.91E+07**	**-1.39E+05**	**BTU**

Material Resource Use	Results per metric ton			Results per short ton		
	A1-A3	D	Units	A1-A3	D	Units
Use of secondary material	0.81	0	metric ton	0.81	0	short ton
Use of renewable secondary fuels	0	0	MJ	0	0	BTU
Use of non-renewable secondary fuels	0	0	MJ	0	0	BTU
Net use of fresh water*	*(n/a)*	*(n/a)*	m^3	*(n/a)*	*(n/a)*	gallons

* Net use of fresh water is not reported in this EPD due to lack of consistent water data in worldsteel's datasets and for consistency with AISC's fabricated structural steel EPDs. worldsteel is currently working to update its data; once these data are published, net use of fresh water results can be calculated and reported.

Life Cycle Impact Assessment: Galvanized Steel Plate

Parameter	Results per metric ton			Results per short ton		
	A1-A3	D	Units	A1-A3	D	Units
Impact Assessment Method: TRACI 2.1						
Global warming potential (GWP)	1.79E+00	-1.56E-02	metric ton CO_2 eq	1.79E+00	-1.56E-02	short ton CO_2 eq
Depletion potential of the stratospheric ozone layer (ODP)	4.66E-08	6.98E-11	metric ton CFC-11 eq	4.66E-08	6.98E-11	short ton CFC-11 eq
Acidification potential of soil and water (AP)	7.28E-03	-1.17E-04	metric ton SO_2 eq	7.28E-03	-1.17E-04	short ton SO_2 eq
Eutrophication potential (EP)	2.92E-04	-7.02E-06	metric ton N eq	2.92E-04	-7.02E-06	short ton N eq
Formation potential of tropospheric ozone (POCP)	8.92E-02	-2.66E-03	metric ton O_3 eq	8.92E-02	-2.66E-03	short ton O_3 eq
Impact Assessment Method: CML2001 (v4.1)						
Abiotic depletion potential (ADP-elements)†	*(n/a)*	*(n/a)*	metric ton Sb eq	*(n/a)*	*(n/a)*	short ton Sb eq
Abiotic depletion potential (ADP-fossil)	2.00E+04	-1.25E+02	MJ	1.72E+07	-1.07E+05	BTU

† Results for this indicator are not reported. This indicator is based on assumptions regarding current reserves estimates; therefore, caution is necessary when interpreting results because there is insufficient information on which indicator is best for assessing the depletion of abiotic resources.

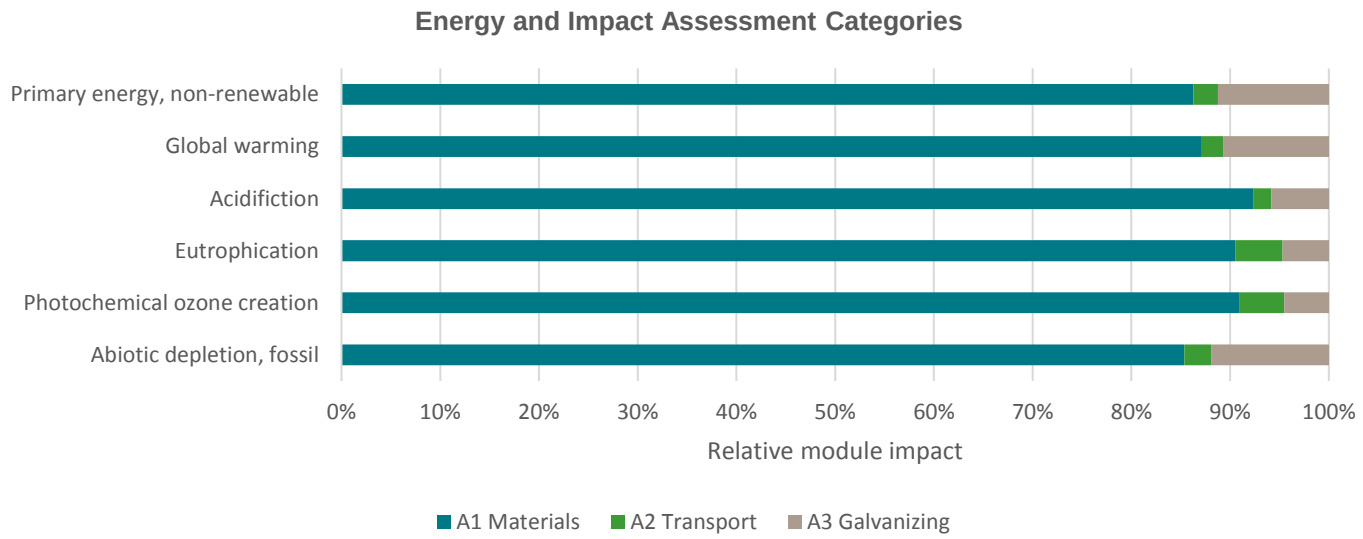
Other Environmental Information: Galvanized Steel Plate

Parameter	Results per metric ton			Results per short ton		
	A1-A3	D	Units	A1-A3	D	Units
Hazardous waste disposed*	*(n/a)*	*(n/a)*	metric ton	*(n/a)*	*(n/a)*	short ton
Non-hazardous waste disposed*	*(n/a)*	*(n/a)*	metric ton	*(n/a)*	*(n/a)*	short ton
Radioactive waste disposed	8.04E-04	-1.47E-05	metric ton	8.04E-04	-1.47E-05	short ton
Components for re-use	0	0	metric ton	0	0	short ton
Materials for recycling	2.05E-02	0	metric ton	2.05E-02	0	short ton
Materials for energy recovery	0	0	metric ton	0	0	short ton
Exported energy	0	0	MJ	0	0	BTU

* Hazardous and non-hazardous waste disposed are not reported in this EPD due to lack of waste inventory data in worldsteel's datasets.

Visualization of Life Cycle Impact Assessment: Galvanized Steel Plate

The diagram in this section illustrates the degree to which the modules drive energy demand and the major impact categories.



Life Cycle Assessment Results and Analysis: Galvanized Hollow Structural Sections

Life cycle assessment results are presented per metric ton of steel product, the required reporting unit, and per short ton of steel product, the optional reporting unit. Primary energy use represents lower heating value (LHV).

Use of Energy and Material Resources: Galvanized Hollow Structural Sections

Primary Energy	Results per metric ton			Results per short ton		
	A1-A3	**D**	**Units**	**A1-A3**	**D**	**Units**
Use of renewable primary energy resources excluding those used as raw materials	1,230	-60.3	MJ	1.06E+06	-5.19E+04	BTU
Use of renewable primary energy resources as raw materials	0	0	MJ	0	0	BTU
Total use of renewable primary energy resources	**1,230**	**-60.3**	**MJ**	**1.06E+06**	**-5.19E+04**	**BTU**
Use of non-renewable primary energy resources excluding those used as raw materials	31,200	-162	MJ	2.68E+07	-1.39E+05	BTU
Use of non-renewable primary energy resources as raw materials	0	0	MJ	0	0	BTU
Total use of non-renewable primary energy resources	**31,200**	**-162**	**MJ**	**2.68E+07**	**-1.39E+05**	**BTU**

Material Resource Use	Results per metric ton			Results per short ton		
	A1-A3	**D**	**Units**	**A1-A3**	**D**	**Units**
Use of secondary material	0.07	0	metric ton	0.07	0	short ton
Use of renewable secondary fuels	0	0	MJ	0	0	BTU
Use of non-renewable secondary fuels	0	0	MJ	0	0	BTU
Net use of fresh water*	*(n/a)*	*(n/a)*	m^3	*(n/a)*	*(n/a)*	gallons

* Net use of fresh water is not reported in this EPD due to lack of consistent water data in worldsteel's datasets and for consistency with AISC's fabricated structural steel EPDs. worldsteel is currently working to update its data; once these data are published, net use of fresh water results can be calculated and reported.

Life Cycle Impact Assessment: Galvanized Hollow Structural Sections

Parameter	Results per metric ton			Results per short ton		
	A1-A3	D	Units	A1-A3	D	Units
Impact Assessment Method: TRACI 2.1						
Global warming potential (GWP)	2.68E+00	-1.56E-02	metric ton CO_2 eq	2.68E+00	-1.56E-02	short ton CO_2 eq
Depletion potential of the stratospheric ozone layer (ODP)	2.13E-08	6.98E-11	metric ton CFC-11 eq	2.13E-08	6.98E-11	short ton CFC-11 eq
Acidification potential of soil and water (AP)	1.00E-02	-1.17E-04	metric ton SO_2 eq	1.00E-02	-1.17E-04	short ton SO_2 eq
Eutrophication potential (EP)	5.09E-04	-7.02E-06	metric ton N eq	5.09E-04	-7.02E-06	short ton N eq
Formation potential of tropospheric ozone (POCP)	1.43E-01	-2.66E-03	metric ton O_3 eq	1.43E-01	-2.66E-03	short ton O_3 eq
Impact Assessment Method: CML2001 (v4.1)						
Abiotic depletion potential (ADP-elements)†	*(n/a)*	*(n/a)*	metric ton Sb eq	*(n/a)*	*(n/a)*	short ton Sb eq
Abiotic depletion potential (ADP-fossil)	2.96E+04	-1.25E+02	MJ	2.55E+07	-1.07E+05	BTU

† Results for this indicator are not reported. This indicator is based on assumptions regarding current reserves estimates; therefore, caution is necessary when interpreting results because there is insufficient information on which indicator is best for assessing the depletion of abiotic resources.

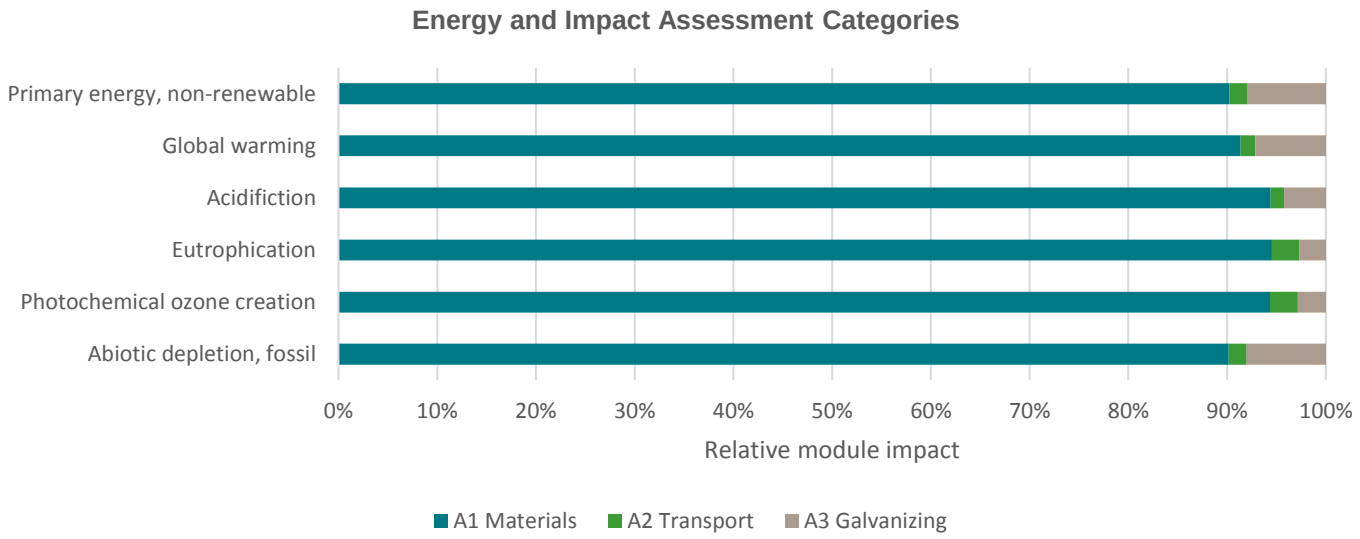
Other Environmental Information: Galvanized Hollow Structural Sections

Parameter	Results per metric ton			Results per short ton		
	A1-A3	D	Units	A1-A3	D	Units
Hazardous waste disposed*	*(n/a)*	*(n/a)*	metric ton	*(n/a)*	*(n/a)*	short ton
Non-hazardous waste disposed*	*(n/a)*	*(n/a)*	metric ton	*(n/a)*	*(n/a)*	short ton
Radioactive waste disposed	5.79E-04	-1.47E-05	metric ton	5.79E-04	-1.47E-05	short ton
Components for re-use	0	0	metric ton	0	0	short ton
Materials for recycling	2.05E-02	0	metric ton	2.05E-02	0	short ton
Materials for energy recovery	0	0	metric ton	0	0	short ton
Exported energy	0	0	MJ	0	0	BTU

* Hazardous and non-hazardous waste disposed are not reported in this EPD due to lack of waste inventory data in worldsteel's datasets.

Visualization of Life Cycle Impact Assessment: Galvanized Hollow Structural Sections

The diagram in this section illustrates the degree to which the modules drive energy demand and the major impact categories.



Data Quality Assessment

Temporal representativeness: All primary data were collected for the 2013 calendar years. All secondary data come from the GaBi 2016 databases and are representative of the years 2009-2015. Therefore, temporal representativeness is warranted. **Geographical representativeness:** All primary and secondary data were collected specific to the countries or regions under study. Whenever country-specific background data were not readily available, US, European, or global data were used as proxies. Geographical representativeness is considered to be high. **Technological representativeness:** Primary data were collected for the production of galvanized steel by AGA members and represent the manufacturing technologies in use. All other major contributors to results are either representative of North America (steel and fabrication inputs) or of the country-specific technology mix (electricity grid and other inputs). Where technology-specific secondary data were unavailable, proxy data were used. Technological representativeness is considered to be high. **Precision:** As the majority of the relevant foreground data are measured data or calculated based on primary information sources of the owner of the technology, precision is considered to be high. All background data are sourced from GaBi databases with the documented precision (www.gabi-software.com).

Note: worldsteel life cycle inventories for steel products do not include potential environmental impacts for certain alloying elements—in particular, silico-manganese. These elements were excluded from the analysis due to lack of available data at the time the worldsteel LCIs were conducted and, in order to achieve consistency, were accordingly excluded from AISC's LCI for structural sections. Thus EPDs based on worldsteel and AISC steel data cannot be compared with EPDs whose steel LCIs include the alloying elements due to differences in scope.

Disclaimer: This Environmental Product Declaration (EPD) conforms to ISO 14025, ISO 14040, ISO 14044, and ISO 21930.

Scope of Results Reported: The PCR requires the reporting of a limited set of LCA metrics; therefore, there may be relevant environmental impacts beyond those disclosed by this EPD. The EPD does not indicate that any environmental or social performance benchmarks are met nor thresholds exceeded.

Accuracy of Results: This EPD has been developed in accordance with the PCR applicable for the identified product following the principles, requirements and guidelines of the ISO 14040, ISO 14044, ISO 14025 and ISO 21930 standards. The results in this EPD are estimations of potential impacts. The accuracy of results in different EPDs may vary as a result of value choices, background data assumptions and quality of data collected.

Comparability: EPDs are not comparative assertions and are either not comparable or have limited comparability when they cover different life cycle stages, are based on different product category rules or are missing relevant environmental impacts. Such comparisons can be inaccurate, and could lead to the erroneous selection of materials or products which are higher-impact, at least in some impact categories. Any comparison of EPDs shall be subject to the requirements of ISO 21930. For comparison of EPDs which report different module scopes, such that one EPD includes Module D and the other does not, the comparison shall only be made on the basis of Modules A1, A2 and A3. Additionally, when Module D is included in the EPDs being compared, all EPDs must use the same methodology for calculation of Module D values.

Interpreting the Results in Module D: The values in Module D include a recognition of the benefits or impacts related to zinc scrap from galvanizing. The results included in Module D attempt to capture future benefits, or impacts, but are based on a methodology that uses current industry-average data reflecting current processes.

Contact Information

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