Environmental Product Declaration

According to ISO 14025

Steel Reinforcing Bar (Rebar)

Steel Dynamics, Inc.®
Long Products Group
Structural and Rail Division

Issue Date: December 20, 2019

Valid Until: December 19, 2024

Declaration Number: 123

Declaration Information

Declaration

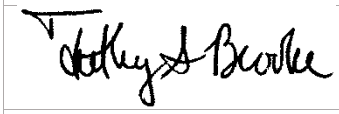
Program Operator: ASTM International	www.astm.org	www.steeldynamics.com
Company: Steel Dynamics, Inc. (SDI)		

Product Information	Validity / Applicability
Product Name: Steel reinforcing bar (rebar)	**Period of Validity:** This declaration is valid for a period of 5 years from the date of publication
Product Definition: Reinforcing bar or rebar is used to strengthen concrete or other masonry structures	
Declaration Type: Business to business	**Geographic Scope:** This declaration is valid for steel reinforcement milled by SDI in Columbia City, IN (USA) and sold in North America
PCR Reference: North American Product Category Rule for Designated Steel Construction Products	

Product Application and / or Characteristics

This declaration covers steel reinforcing bar (rebar) for use in concrete and masonry structures.

Technical Drawing or Product Visual	Content of the Declaration
	• Rebar milled at single steel mill owned and operated by SDI • Steel made from 98% recycled steel scrap via electric arc furnace (EAF) technology • Cradle-to-gate assessment results

Product Information		Validity / Applicability	
This declaration and the rules on which this EPD is based have been examined by an independent verifier in accordance with ISO 14025.			
			
Name: Timothy S. Brooke	**Date: Dec. 20, 2019**	**Name: Thomas P. Gloria**	**Date: Dec. 20, 2019**

EPD Summary

This document is a Type III environmental product declaration by Steel Dynamics, Inc. (SDI) that is certified by ASTM International (ASTM) as conforming to the requirements of ISO 14025. ASTM has assessed that the Life Cycle Assessment (LCA) information fulfills the requirements of ISO 14040 and ISO 14044 in accordance with the instructions listed in the referenced product category rules. The intent of this document is to further the development of environmentally compatible and sustainable construction methods by providing comprehensive environmental information related to potential impacts in accordance with international standards.

This EPD was not written to support any comparative assertions. Even for similar products, differences in declared unit, use and end-of-life assumptions, and data quality may produce incomparable results. It is not recommended to compare EPDs with another organization as there may be differences in assumptions, methodology, allocation methods, and data quality such as variability in datasets and results of variability in assessment software tools.

Scope and Boundaries of the Life Cycle Assessment

The Life Cycle Assessment (LCA) was performed according to ISO 14040 (ISO, 2006) and ISO 14044 (ISO, 2006) following the requirements of the ASTM EPD Program Instructions and referenced PCR (SCS Global Services, 2015).

System Boundary: Cradle-to-gate
Allocation Method: Cut-off approach
Declared Unit: One metric ton (1,000 kg) of steel reinforcing bar

EVALUATION VARIABLE	UNIT PER METRIC TON	TOTAL	UNIT PER SHORT TON	TOTAL
Primary Energy, non-renewable	MJ	14,700	BTU	1.21E+07
Primary Energy, renewable	MJ	644	BTU	5.53E+05
Global Warming Potential	metric ton CO_2 eq.	1.05	short ton CO_2 eq.	1.05
Ozone Depletion Potential	metric ton R11 eq.	1.95E-12	short ton R11 eq.	1.95E-12
Acidification Potential	metric ton SO_2 eq.	2.69E-03	short ton SO_2 eq.	2.69E-03
Eutrophication Potential	metric ton N eq.	1.24E-04	short ton N eq.	1.24E-04
Smog Formation Potential	metric ton O_3 eq.	3.51E-02	short ton O_3 eq.	3.51E-02

Additional Information

The vast majority of reinforcing steel (ASTM A615 and A706) has recycled material content typically greater than 98%. Specialty reinforcing steel products have a recycled material content typically greater than 75%.

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Product Description

Steel rebar is used as reinforcement in concrete or masonry structures. We produce coiled rebar as well as cut-to-length rebar in several grades that vary in yield and tensile strength – ASTM A615 certified from GR60-GR100, as well as A706. Available lengths include our standard 20', 30', 40' and 60' pieces.

Delivered Product Configurations

Our compact spooled coils provide a change-out downtime reduction, thus increasing production rates and improving material yield and safety. Unlike loose coils, our twist-free spooled coils create a more efficient bar, fewer rejects, and fewer returns on your fabricated product. Safety is optimized with compact spooled coils, offering more stability and tighter stacking. This allows for easier storage, staging, loading and transportation. Our coils give an advantage to fabricators through tangle-free de-coiling and decreased downtime, increasing your production rates compared to loose coils.

Product Applicability and Technical Characteristics

Steel rebar is defined by the following standards:

- ASTM A615/A615M-18e1 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- ASTM A706/A706M-16 Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement
- AASHTO M31-19 Deformed and Plain Carbon and Low-Alloy Steel Bars for Concrete Reinforcement

Additional information can be found on SDI's website at www.stld-cci.com.

Life Cycle Stages

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

Figure 1: Life cycle modules included in analysis

Raw materials extraction and processing (A1)

Steel rebar is manufactured from carbon steel. Incoming raw materials include steel scrap and alloys, as well as process materials such as those used for slag. The declared product 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 at levels exceeding safe health thresholds.

Inbound and internal transportation (A2)

Inbound truck transportation distance for steel scrap was calculated using SDI data. Internal transport was included via reported fuel consumption.

Rebar production (A3)

The study represents steel rebar manufactured at SDI's electric arc furnace and rolling mill in Columbia City, IN. The data included electricity and fuel consumption, steel rebar output, as well as emissions and wastes.

Underlying Life Cycle Assessment

Declared Unit

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

Declared Unit

Name	Required unit	Optional unit
Declared unit	1 metric ton	1 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: steel scrap transportation to the factory gate and all internal transport;
- A3: generation of rolling mill electricity from primary energy resources, including upstream processes; production of all ancillary materials, pre-products, products, and co-products.

Declared Unit (MND = Module Not Declared)

Product Stage			Construction Stage		Use Stage							End-of-Life Stage				Benefits & Loads
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
			EXCLUDED FROM THIS STUDY													
Raw material supply	Transport	Manufacturing	Transport	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction	Transport	Waste processing	Disposal	Reuse, recovery, recycling potential
x	x	x	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

This EPD represents average SDI rebar production during the 2017 reference year.

Assumptions

This study describes an annual average rebar product manufactured by SDI. Modules A1 and A3 include primary data from the steel mill. Module A2 represents the incoming transportation of steel scrap with an average distance as well as the internal transport via fuel consumption. Module A3 accounts for energy consumption and emissions from SDI's Indiana facility.

Cut-off Criteria

All available energy and material flow data were included in the model for the processes identified within the system boundary of this study. The PCR's cut-off criteria were applied only in the case of packaging. Based on a check of packaging data, packaging was shown to represent less than 1% of steel output mass and is, therefore, excluded under the cut-off criteria provided by the PCR. In cases where life cycle inventory data were not available to represent a flow, proxy data were applied based on conservative assumptions regarding environmental impacts.

Data Quality

A variety of tests and checks were performed throughout the project to ensure high quality of the completed LCA. Checks included an extensive review of the LCA model as well as the background data used.

Temporal Representativeness

Primary data represent twelve months of continuous operation in the 2017 calendar years. All secondary data came from the GaBi 2019 databases and are representative of the years 2016 to 2018—except for copper and aluminum inputs which were modeled with 2013 and 2010 data, respectively. As the study is intended to represent rebar produced in 2017, temporal representativeness is considered to be high.

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, U.S., European, or global data were used as proxies. Geographical representativeness is considered to be high.

Technological Representativeness

The majority of primary data and all secondary data were modeled to be specific to the technologies or technology mixes under study. Rebar production data represent manufacturing via electric arc furnace. Overall, 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).

Completeness

Each unit process was checked for mass balance and completeness of the emission inventory. No foreground data were omitted in this study, except for packaging which was sufficiently small and not anticipated to significantly impact results. This approach is in line with the cut-off criteria in the PCR.

Consistency

To ensure consistency, all primary data were collected with the same level of detail (i.e., using consistent data collection templates), while background data were sourced from the GaBi 2019 databases. Allocation and other methodological choices were made consistently throughout the model.

Reproducibility

Reproducibility is supported as much as possible through the disclosure of input-output data, dataset choices, and modeling approaches. Based on information provided in the background LCA report, any third party should be able to approximate the results of this study using the same data and modeling approaches.

Sources of Data

Primary data for rebar manufacturing were provided by SDI. Secondary data were obtained from GaBi 2019 databases.

Uncertainty

SDI provided complete facility data.

Allocation

Regarding co-products from rebar production—system expansion is used to address these co-products from the steel mill. As such, zinc content in the baghouse dust (on average, 18% by weight) is credited with the production of primary zinc; slag is repurposed as embankment and credited with gravel production; and mill scale is credited with primary iron. Where manufacturing inputs, such as electricity use, were not sub-metered, they were allocated by mass.

Allocation of background data (energy and materials) taken from the GaBi 2019 databases is documented online at http://www.gabi-software.com/international/databases/gabi-databases/.

LCA: Results

Results

Life cycle assessment results are presented per metric ton of steel product (required reporting unit) and per short ton of steel product (optional reporting unit). The product stage (modules A1-A3) has been aggregated into a single number for each metric. Primary energy use represents lower heating value.

Table 1: Product stage energy results per 1 metric and 1 short ton

Primary energy	Results per metric ton		Results per short ton	
Use of renewable primary energy resources excluding those used as raw materials	644	MJ	5.53E+05	BTU
Use of renewable primary energy as raw materials	0	MJ	0	BTU
Total use of renewable primary energy resources	**644**	**MJ**	**5.53E+05**	**BTU**
Use of non-renewable primary energy resources excluding those used as raw materials	1.41E+04	MJ	1.21E+07	BTU
Use of non-renewable primary energy resources as raw materials	0	MJ	0	BTU
Total use of non-renewable primary energy resources	**1.41E+04**	**MJ**	**1.21E+07**	**BTU**

Table 2: Product stage material resource results per 1 metric and 1 short ton

Material resource use	Results per metric ton		Results per short ton	
Use of secondary material	1.32	metric ton	1.32	short ton
Use of renewable secondary fuels	0	MJ	0	BTU
Use of non-renewable secondary fuels	0	MJ	0	BTU
Net use of fresh water	5.3	m^3	1.27E+03	gallon

Table 3: Product stage life cycle impact assessment results per 1 metric and 1 short ton

Impact category	Results per metric ton		Results per short ton	
Impact Assessment Method: TRACI 2.1				
Global warming potential (GWP100)	1.05	metric ton CO_2 eq.	1.05	short ton CO_2 eq.
Depletion potential of the stratospheric ozone layer (ODP)	1.95E-12	metric ton CFC-11 eq.	1.95E-12	short ton CFC-11 eq.
Acidification potential of soil and water (AP)	2.69E-03	metric ton SO_2 eq.	2.69E-03	short ton SO_2 eq.
Eutrophication potential (EP)	1.24E-04	metric ton N eq.	1.24E-04	short ton N eq.
Smog formation potential (SFP)	3.51E-02	metric ton O_3 eq.	3.51E-02	short ton O_3 eq.
Impact Assessment Method: CML 2001 (version April 2013)				
Abiotic depletion potential (ADP-elements)†	-4.07E-06	metric ton Sb eq.	-4.07E-06	short ton Sb eq.
Abiotic depletion potential (ADP-fossil)	1.18E+04	MJ	1.01E+07	BTU

† 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.

Table 4: Product stage waste and other environmental output results per 1 metric and 1 short ton

Waste or environmental output	Results per metric ton		Results per short ton	
Hazardous waste disposed	2.03E-06	metric ton	2.03E-06	short ton
Non-hazardous waste disposed	4.49E-02	metric ton	4.49E-02	short ton
Radioactive waste disposed	8.90E-04	metric ton	8.90E-04	short ton
Components for re-use	0	metric ton	0	short ton
Materials for recycling	0	metric ton	0	short ton
Materials for energy recovery	0	metric ton	0	short ton
Exported energy	0	MJ	0	BTU

LCA: Interpretation

Visualization of Life Cycle Impact Assessment

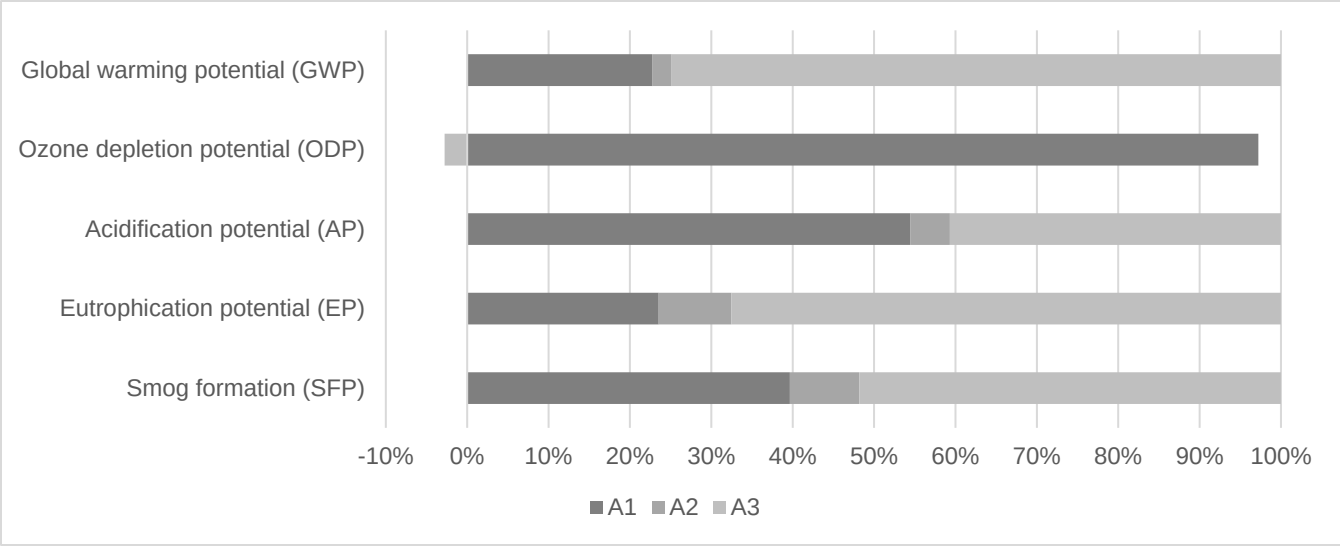

Figure 2: Relative contribution to life cycle modules to product stage impact assessment results

Disclaimer

This Environmental Product Declaration (EPD) conforms to ISO 14025, ISO 14040, ISO 14044, and ISO 21930 (ISO, 2007).

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.

References

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thinkstep. (2019). GaBi LCA Database Documentation. Retrieved from thinkstep AG: http://www.gabi-software.com/international/databases/gabi-databases/.

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