ENVIRONMENTAL PRODUCT DECLARATION

FABRICATED CONCRETE REINFORCING STEEL

CMC is a global metals company with a commitment to protecting our environment that is as strong as our steel.

CMC Commercial Metals

COMMITMENT
YOU CAN COUNT ON

Commercial Metals Company is a global, low-cost metals recycling, manufacturing, fabricating and trading enterprise. We are committed to minimizing our impact on the environment and protecting our natural resources. CMC is one of the world's largest metal recyclers, and our micro- and mini-mill steelmaking processes consume significantly less natural resources and release fewer emissions than blast furnace steelmaking. With corporate headquarters in Irving, Texas, CMC operates locations in the United States and in strategic international markets.

EPD IMPACT SUMMARY

Company Name	Commercial Metals Company (CMC)
Product Type	Construction steel
Product Name	Fabricated concrete reinforcing steel
Product Definition	Carbon steel used as reinforcement in concrete.
Product Category Rule (PCR)	North American Product Category Rule for Designated Steel Construction Products
Certification Period	5 years
Declared Unit	1 metric ton
ASTM Declaration Number	EPD-013

LIFECYCLE IMPACT CATEGORIES

CATEGORY INDICATOR	PER METRIC TON		PER SHORT TON	
	PRODUCT STAGE A1-A3	UNIT	PRODUCT STAGE A1-A3	UNIT
Global warming potential	0.934	metric ton CO_2 eq	0.934	short ton CO_2 eq
Acidification potential	2.55E-03	metric ton SO_2 eq	2.55E-03	short ton SO_2 eq
Eutrophication potential	1.11E-04	metric ton N eq	1.11E-04	short ton N eq
Photochemical ozone creation potential	3.60E-02	metric ton O_3 eq	3.60E-02	short ton O_3 eq
Ozone depletion potential	1.86E-10	metric ton CFC-11 eq	1.86E-10	short ton CFC-11 eq
Abiotic depletion potential, non-fossil resources	-1.32E-05	metric ton Sb eq	-1.32E-05	short ton Sb eq
Abiotic depletion potential, fossil resources	1.00E+04	MJ, net calorific value	8.62E+06	BTU, net calorific value

This document is a Type III environmental product declaration by the Commercial Metals Company (CMC) 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 in accordance with the instructions listed in the product category rules cited below. 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.

EPD INFORMATION			
Program Operator		ASTM International	
Declaration Holder		Commercial Metals Company 6565 North MacArthur Blvd., Suite 800 Irving, TX 75039 214.689.4300 www.cmc.com	
Product group Construction steel	**Date of Issue** September 1, 2015	**Period of Validity** 5 years	**Declaration Number** EPD-013
Declaration Type A "cradle-to-gate" EPD for steel reinforcement bars, including modules A1-A3.			
Applicable Countries United States			
This EPD was independently verified by ASTM in accordance with ISO 14025: ☐ Internal ☒ External		Timothy Brooke • tbrooke@astm.org 100 Barr Harbor Drive, West Conshohocken, PA 19428 • www.astm.org/EPDs.htm	
This EPD was critically reviewed in accordance with ISO 14044 and the reference PCR:		Matt Bowick • Matt.Bowick@athenasmi.org Athena Sustainable Materials Institute • www.athenasmi.org	
LCA INFORMATION			
Basis LCA (Available upon request: cert@astm.org)		Cradle-to-Gate Study of Fabricated Steel Products	
LCA Preparer		Maggie Wildnauer • Maggie.Wildnauer@thinkstep.com thinkstep, Inc. 170 Milk Street, 3rd Floor, Boston, MA 02109 • www.thinkstep.com	
This life cycle assessment was critically reviewed in accordance with ISO 14044 by:		Matt Bowick • Matt.Bowick@athenasmi.org Athena Sustainable Materials Institute • www.athenasmi.org	
PCR INFORMATION			
Program Operator		SCS Global Services	
Reference PCR		North American Product Category Rule for Designated Steel Construction Products	
Date of Issue		May 2015	
PCR review was conducted by:		Dr. Thomas Gloria, Ph.D. (Chairperson) • t.gloria@industrial-ecology.com Industrial Ecology Consultants	

PRODUCT DEFINITION

Fabricated concrete reinforcing bar (rebar) refers to carbon steel used as reinforcement in concrete. Rebar's surface is often patterned to form a better bond with the concrete, and can be epoxy-coated to mitigate corrosion. This document refers only to uncoated rebar. Fabricated rebar is reinforcing steel which has been bent, cut, or otherwise modified for a specific installation. The reference service life of each product is not specified, as only modules A1-A3 are included.

TABLE 1: TECHNICAL CHARACTERISTICS

NAME	VALUE	UNIT
Density	7,833	kg/m^3
Modulus of elasticity	199,900	N/mm^2
Coefficient of thermal expansion	11.8	$10^{-6}K^{-1}$

TABLE 1: TECHNICAL CHARACTERISTICS *(CONT.)*

NAME	VALUE	UNIT
Thermal conductivity	80.4	W/(mK)
Melting point	1,504	°C
Electrical conductivity at 20°C	10,000,000	$\Omega^{-1}m^{-1}$
Minimum yield strength	By grade	N/mm^2
Minimum tensile strength	By grade	N/mm^2
Minimum elongation	By grade	%
Tensile strength	By grade	N/mm^2
ASTM Specification	A615, A706, A1035 CL, A1035 CM, A1035 CS	-

MATERIAL CONTENT

The exact chemical composition of CMC's steel is declared on a mill test report, which is provided with each shipment and for each heat. In general, the steel will be >97% recycled iron and a total of 2% or less of the following elements: Carbon, Manganese, Silicon, Chromium, Nickel, Molybdenum, Vanadium, Copper, Tin, Sulfur, and Phosphorus. The combined total of Molybdenum, Sulfur, and Phosphorus is generally less than 0.1%. Elements exist in steel in their natural, unoxidized states, so any concerns over elements that are toxic only in certain valence states are mitigated.

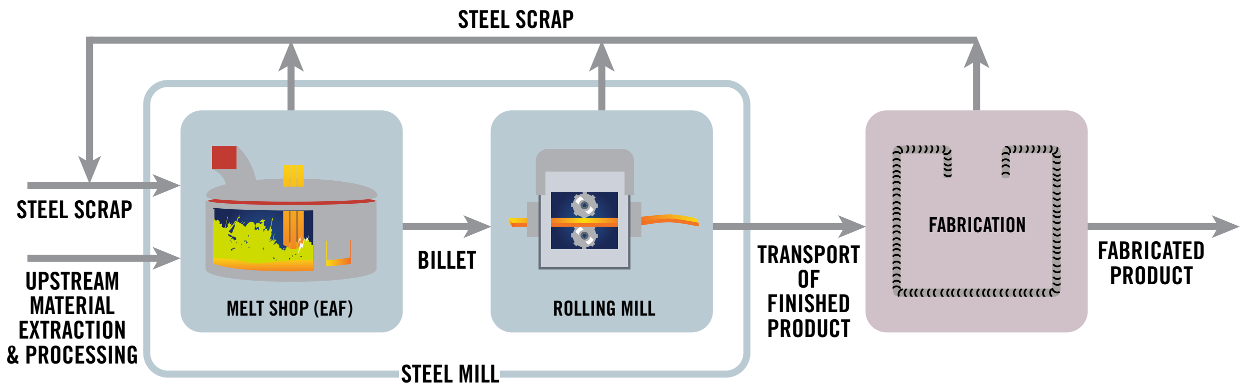
All CMC rebar is manufactured from 100% recycled scrap steel sourced within the United States.

MANUFACTURING

Scrap steel is melted in an electric arc furnace (EAF) which uses a combination of electrical energy and chemical energy in the form of carbon and oxygen injections into the steel. When the scrap has melted and reached approximately 3,000°F, the molten steel is poured (tapped) into a vessel called a ladle. During tapping, the majority of the alloys and fluxes are added to the steel to serve as deoxidizers and strengthening agents. The ladle is transported to the ladle metallurgical station, where the steel chemistry is refined to meet the chemical specifications. The ladle is then transported to a continuous caster where the steel is solidified into a solid, basic shape called a billet. In the minimill process, billets are then reheated and transferred into the rolling mill for processing. In the micromill process, the caster produces one continuous strand that is run directly into the rolling mill for processing. There is minimal reheating from an induction furnace unlike the minimill process where billets are reheated in a gas furnace from ambient temperature. In the rolling mill, billets are rolled into the final shape and emerge onto a cooling bed. The mill markings for source mill, material grade, and specification are rolled into the rebar products on the final finishing stand.

The micromill and minimill technology is the cleanest and most energy efficient steelmaking process available today. By using recycled scrap as raw material rather than virgin natural resources, CMC is reducing the need for mining of natural resources and reducing CO_2 emissions by 58%. For every ton of steel produced, CMC conserves 2,500 pounds of iron ore, 1,400 pounds of coal, and 120 pounds of limestone.

FIGURE 1: PRODUCTION FLOW DIAGRAM



After cooling, finished steel products are placed in storage bays before being transported to their final destination. Most of CMC's merchant and light structural shape products are transported to third-party fabricators, distribution centers, and job sites. Similarly, the majority of rebar produced in CMC mills is consumed in CMC-owned fabrication facilities but a portion of the rebar production is transported to third-party rebar fabricators.

The average transportation distance from CMC's steel mills to a CMC-owned rebar fabrication facility is a combined 277 miles by truck and 178 miles by rail. Fabrication of rebar consists of bending, cutting, and assembling of specific pieces of rebar for installation in a concrete structure. The fabricated steel is packaged into bundles, which range from 1.5 to 3 tons. The bundles are secured with steel banding that is wrapped around the bundles. The piece count, length, weight, size, heat, and grade information are declared on a tag that is stud-welded or wire-tied to one of the products in the bundle.

UNDERLYING LIFE CYCLE ASSESSMENT

Declared Unit

As can be seen in Table 2, both a declared unit of 1 metric ton and the optional unit of 1 short ton are used.

TABLE 2: DECLARED UNIT TABLE

NAME	QUANTITY	REQUIRED UNIT	QUANTITY	OPTIONAL UNIT
Declared Unit	1	metric ton	1	short ton
Density	7,833	kg/m^3	489	lb/ft^3

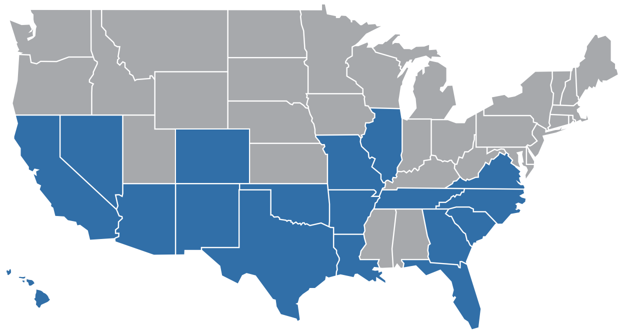
System Boundaries

The LCA was conducted for the product stage only, modules A1-A3. Construction, use, and end-of-life are excluded from the scope of the PCR and thus from the LCA. Module D, which is optional to include, was also excluded.

TABLE 3: SYSTEM BOUNDARIES

PRODUCT STAGE			CONSTRUCTION STAGE		USE STAGE					END-OF-LIFE STAGE				BENEFITS AND LOADS BEYOND SYSTEM BOUNDARY
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	D
Raw materials supply	Transport	Manufacturing	Transport	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	De-construction	Transport	Waste processing	Disposal	Reuse, recovery, and recycling potential
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

MND = module not declared



Geographic Relevance

Rebar is manufactured in: Mesa, AZ; Magnolia, AR; Durant, OK; Cayce, SC and Seguin, TX. Fabrication occurs in 43 different CMC facilities, located in:

- Mesa, AZ
- Etiwanda, CA
- Fontana, CA
- Fresno, CA
- San Diego, CA
- Tracy, CA
- Brighton, CO
- Denver, CO
- Fort Myers, FL
- Kissimmee, FL
- Lawrenceville, GA
- Kapolei, HI
- Kankakee, IL
- Baton Rouge, LA (2)
- Bossier City, LA
- Pearl River, LA
- Polo, MO
- Gastonia, NC
- Albuquerque, NM
- Las Vegas, NV
- Columbia, SC
  Nashville, TN
- Buda, TX
- College Station, TX
- Conroe, TX
- Corpus Christi, TX
- Dallas, TX
- El Paso, TX
- Harlingen, TX
- Houston, TX (2)
- Laredo, TX
- Lubbock, TX
- Melissa, TX
- San Antonio, TX
- Seguin, TX
- Texas City, TX
- Waco, TX
- Waxahachie, TX (2)
- Farmville, VA
- Fredericksburg, VA

Temporal Relevance

Data was collected for the 2014 fiscal year.

Technological Relevance

Rebar is manufactured using an electric arc furnace (EAF). Rebar fabrication consists of bending, cutting and assembling pieces of rebar for installation in a concrete structure.

Assumptions And Limitations

No additional assumptions were necessary.

Cutoff Criteria

The cut-off rules, as specified in the PCR, did not have to be applied as none of the reported data was excluded.

Data Quality

Background Data: All background data were obtained from the 2014 GaBi 6 database. Where appropriate LCI data was not available proxy datasets had to be used, as documented in the background report.

Foreground Data: All primary data were collected by the manufacturer for annual production during the 2014 fiscal year.

Representativeness:

Temporal: All primary data were collected for the year 2014. All secondary data come from the GaBi 2014 databases and are representative of the years 2010-2013. As the study intended to compare the product systems for the reference year 2014, temporal representativeness is warranted.

Geographical: All primary and secondary data were collected specific to the countries or regions under study. Where country-specific or region-specific data were unavailable, proxy data were used. Geographical representativeness is considered to be high.

Technological: All primary and secondary data were modeled to be specific to the technologies or technology mixes under study. Where technology-specific data were unavailable, proxy data were used. Technological representativeness is considered to be high.

Consistency: To ensure data consistency, all primary data were collected with the same level of detail, while all background data were sourced from the GaBi databases.

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

Uncertainty: Given the consistency within the data and the representativeness of the data, uncertainty associated with the model and results is low.

Data quality meets the requirements of the PCR.

Allocation:

Steel scrap: Scrap generated during manufacturing is modeled as a closed-loop system. Scrap burden includes inbound transportation only. Upstream processing, e.g. shredding and sorting, is excluded as it would instead fall under module C3 of the previous life cycle in which the scrap is generated.

Multi-product output: Where multiple finished products are produced, allocation sometimes had to be applied. While the melt shop knows exact formulations and energy requirements for each billet produced, the data for the rolling mill had to be allocated by total production time. In cases where melt shop and rolling mill water, waste, and emissions could not be separated, impacts were allocated by product mass.

Co-products: The avoided burden method is applied for co-products in accordance with the PCR. Using system expansion, credit is given for the end use of the co-products of the steel manufacturing process. Avoided production products and rates for EAF slag and mill scale are based on the worldsteel LCA Methodology Report (World Steel Association, 2011).

TABLE 4: SYSTEM EXPANSION OF CO-PRODUCTS

CO-PRODUCT	RECOVERY RATE	AVOIDED PRODUCTION
EAF SLAG	100%	Cement**, 9% Roadstone**, 91%
EAF Dust	99%	Zinc*, 25%
Mill scale	100%	Iron-ore**, 100%

*Based on zinc-content of dust. After zinc is removed, remaining material is sent to hazardous waste treatment. Energy for recovery is included.

**Energy for recovery unavailable and therefore not included. Credit is given assuming 100% recovery, i.e. for every 1 kg EAF slag recovered, the avoided production of cement is 0.09 kg and roadstone is 0.91 kg.

LIFE CYCLE ASSESSMENT RESULTS

LCA results are presented as an aggregated product stage total, both per metric ton and per short ton of rebar. Net negative results can be seen for the abiotic depletion potential, non-fossil resources. This is a consequence of the avoided burden approach to end-of-life allocation and shall not be interpreted in a way that an increase in consumption of the products under study will lead to any 'reversal' of environmental burden elsewhere. It is specifically due to the credit given for the EAF dust in combination with the fact that the rebar is made from 100% scrap and thus has no direct abiotic depletion potential associated with it.

TABLE 5: LCA RESULTS, PER 1 METRIC TON AND 1 SHORT TON

CATEGORY INDICATOR	PER METRIC TON		PER SHORT TON	
	PRODUCT STAGE A1-A3	UNIT	PRODUCT STAGE A1-A3	UNIT
Global warming potential	0.934	metric ton CO_2 eq	0.934	short ton CO_2 eq
Acidification potential	2.55E-03	metric ton SO_2 eq	2.55E-03	short ton SO_2 eq
Eutrophication potential	1.11E-04	metric ton N eq	1.11E-04	short ton N eq
Photochemical ozone creation potential	3.60E-02	metric ton O_3 eq	3.60E-02	short ton O_3 eq
Ozone depletion potential	1.86E-10	metric ton CFC-11 eq	1.86E-10	short ton CFC-11 eq
Abiotic depletion potential, non-fossil resources	-1.32E-05	metric ton Sb eq	-1.32E-05	short ton Sb eq
Abiotic depletion potential, fossil resources	1.00E+04	MJ, net calorific value	8.62E+06	BTU, net calorific value

Primary energy resources, secondary material, and water consumption are presented below as an aggregated product stage total. Secondary material use accounts both for the material that ends up in the final rebar product and that which gets recycled either internally or externally at the steel mill or fabrication facility.

TABLE 6: ENERGY AND MATERIAL RESOURCE USE CONSUMPTION RESULTS, PER 1 METRIC TON AND 1 SHORT TON

CATEGORY INDICATOR	PER METRIC TON		PER SHORT TON	
	PRODUCT STAGE A1-A3	UNIT	PRODUCT STAGE A1-A3	UNIT
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	511	MJ, net calorific value	4.39E+05	BTU, net calorific value
Use of renewable primary energy resources used as raw materials	2.87E-04	MJ, net calorific value	2.47E-01	BTU, net calorific value
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)	511	MJ, net calorific value	4.39E+05	BTU, net calorific value

TABLE 6: ENERGY AND MATERIAL RESOURCE USE CONSUMPTION RESULTS, PER 1 METRIC TON AND 1 SHORT TON *(CONT.)*

CATEGORY INDICATOR	PER METRIC TON		PER SHORT TON	
	PRODUCT STAGE A1-A3	UNIT	PRODUCT STAGE A1-A3	UNIT
Use of nonrenewable primary energy excluding nonrenewable primary energy resources used as raw materials	1.10E+04	MJ, net calorific value	9.42E+06	BTU, net calorific value
Use of nonrenewable primary energy resources used as raw materials	556	MJ, net calorific value	4.78E+05	BTU, net calorific value
Total use of nonrenewable primary energy resources (primary energy and primary energy resources used as raw materials)	1.15E+04	MJ, net calorific value	9.90E+06	BTU, net calorific value
Use of secondary material	1.16	metric ton	1.16	short ton
Use of renewable secondary fuels	-	MJ, net calorific value	-	BTU, net calorific value
Use of nonrenewable secondary fuels	-	MJ, net calorific value	-	BTU, net calorific value
Net use of fresh water	3.58	m^3	858	gallons

Waste generation results are presented below as an aggregated product stage total.

TABLE 7: WASTE GENERATION RESULTS, PER 1 METRIC TON AND 1 SHORT TON

CATEGORY INDICATOR	PER METRIC TON		PER SHORT TON	
	PRODUCT STAGE A1-A3	UNIT	PRODUCT STAGE A1-A3	UNIT
Hazardous waste disposed	2.29E-06	metric ton	2.29E-06	short ton
Nonhazardous waste disposed	1.33E-02	metric ton	1.33E-02	short ton
Radioactive waste disposed	5.82E-04	metric ton	5.82E-04	short ton

Other environmental indicators are presented below as an aggregated product stage total. Materials for recycling accounts for the steel scrap, slag, mill scale, and dust collected at the steel mill and fabrication facilities.

TABLE 8: OTHER ENVIRONMENTAL OUTPUT RESULTS, PER 1 METRIC TON AND 1 SHORT TON

CATEGORY INDICATOR	PER METRIC TON		PER SHORT TON	
	PRODUCT STAGE A1-A3	UNIT	PRODUCT STAGE A1-A3	UNIT
Components for re-use	-	metric ton	-	short ton
Materials for recycling	0.293	metric ton	0.293	short ton
Materials for energy recovery	-	metric ton	-	short ton
Exported energy	-	MJ per energy carrier	-	BTU per energy carrier

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 14025, ISO 14040, ISO 14044, 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

SCS Global Services. (2015). *North American Product Category Rule for Designated Steel Construction Products.* Retrieved from: http://www.scsglobalservices.com/files/standards/scs_pcr_steel-products_050515_final.pdf

thinkstep. (2015). *Cradle-to-Gate Study of Mill and Fabricated Steel Products: Background report in support of Environmental Product Declarations (EPDs) for three mill and two fabricated steel products.*

World Steel Association. (2011). *Life Cycle assessment methodology report.* Retrieved from: http://www.worldsteel.org/dms/internetDocumentList/bookshop/LCA-Methodology-Report/document/LCA%20Methodology%20Report.pdf