An Environmental Product Declaration

In accordance with ISO 14025:2006 and ISO 21930:2017

A Cradle-to-Gate EPD (A1 to A3 Modules) for
Fabricated Carbon-Steel and Low-Alloy Reinforcing Bar (Rebar) Manufactured by BC Supply, LLC

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ASTM International Certified Environmental Product Declaration

This document is a Type III environmental product declaration (EPD) for BC Supply Fabricated Carbon-Steel and Low-Alloy Uncoated Reinforcing Bar (rebar) products, as fabricated at BC Supply's facility in Chambersburg, PA.

This declaration has been prepared in accordance with ISO 14025 (1), ISO 21930 (2), ISO 14040/44 (3), (4), UL Environment's Product Category Rules (PCR) Part A: Life Cycle Assessment Calculation Rules and Report Requirements (5), Part B: Designated Steel Construction Products (6), and ASTM's General Program Instructions for Type III EPDs (7).

The intent of this document is to further the development of environmentally compatible and more sustainable construction methods by providing comprehensive environmental information related to the potential impacts of BC Supply's Fabricated Carbon-Steel and Low-Alloy Uncoated Reinforcing Bar (Rebar) products in accordance with international standards.

Environmental Product Declaration Summary

General Information	
Owner of the EPD	BC Supply LLC 1410 N. Franklin Street Chambersburg, PA 17202 Link (URL) https://bcsupplyllc.com/ Since 2008, BC Supply has been supplying both residential and commercial contractors with a wide variety of durable construction materials. BC Supply focuses on concrete related items, such as fabricated rebar, stock rebar, wire mesh, supports, trench drains, cures, sealers, and concrete repair and restoration products. *The owner of the declaration is liable for the underlying information and evidence.*
Manufacturing Sites	1410 N. Franklin Street Chambersburg, PA 17202
Product Group	Uncoated Concrete Reinforcing Bar

Product Definition	Uncoated fabricated rebar refers to carbon-steel and low-alloy steel bars that have undergone fabrication processes (such as bending, cutting, and threading) to prepare them for installation in concrete or masonry structures. These reinforcement steel bars can be coiled, plain, deformed, or smooth. CSI/CSC Specification Section: 03 21 00 UNSPSC Product Code: 30103623
Product Category Rule (PCR)	UL Environment, Product Category Rule for Building-Related Products and Services. Part A: Life Cycle Assessment Calculation Rules and Report Requirements, Version 4.0. March 2022 (5). Part B: Designated Steel Construction Product EPD Requirements (6). ISO 21930:2017 serves as the core PCR (2).
Certification Period	January 21st 2025 – 5-year validity
Declared Unit	Fabricated Carbon-Steel and Low-Alloy Uncoated Rebar, One metric ton
ASTM Declaration Number	EPD #872
EPD Information	
Program Operator	ASTM International 100 Barr Harbor Drive, PO Box C700 West Conshohocken, PA 19428-2959, USA https://www.astm.org/products-services/certification/environmental-product-declarations/epd-pcr.html

Declaration Type

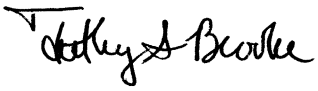
A “Cradle-to-gate” EPD for Fabricated Carbon-Steel and Low-Alloy Uncoated Rebar. The life cycle stages covered are the extraction and upstream production (A1), transportation to factory (A2), and manufacturing (A3). The declaration is intended for Business-to-Business (B-to-B) communication.

Applicable Countries

North America

Product Applicability

Rebar is used as a tension device in reinforced concrete and reinforced masonry structures to strengthen and hold the concrete in tension. Rebar’s surface is often patterned to form a better bond with the concrete.

This EPD was independently verified by ASTM in accordance with ISO 14025: **Internal** / **External** X	 Tim Brooke 100 Barr Harbor Drive, PO Box C700 West Conshohocken, PA 19428-2959, USA https://www.astm.org/
EPD Project Report Information	
EPD Project Report	A Cradle-to-Gate Life Cycle Assessment of Fabricated Carbon-Steel and Low-Alloy Uncoated Reinforcing Bar (Rebar) Manufactured by BC Supply LLC (8).
Prepared by Athena Sustainable Materials Institute	Athena Sustainable Materials Institute 280 Albert Street, Suite 404 Ottawa, Ontario. K1P 5G8 info@athenasmi.org
The EPD project report was independently verified by and in accordance with ISO 14025 and the reference PCR:	Thomas P. Gloria, Ph.D. Industrial Ecology Consultants 35 Bracebridge Rd. Newton, MA 02459-1728
PCR Information	
Program Operator	UL Environment
Reference Part B PCR	UL Environment, Product Category Rule for Building-Related Products and Services. Part B: Designated Steel Construction Product EPD Requirements (6)
Date of Issue	September 2020
PCR review was conducted by:	Dr. Tom Goria, Industrial Ecology Associates Brandie Sebastian, JBE Consultants James Littlefield, Independent Consultant
EPD Explanatory material	Please contact the program operator for any explanatory material regarding this EPD. ASTM International Environmental Product Declarations 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, http://www.astm.org

1 PRODUCT IDENTIFICATION

1.1 PRODUCT DEFINITION

Rebar is used as a tension device in reinforced concrete and reinforced masonry structures to strengthen and hold the concrete in tension. For applications where corrosion resistance is not required, uncoated rebar is commonly used.

Uncoated rebar is produced using carbon-steel or low-alloy steel and is manufactured to ASTM A695, A706, or A996 specifications.

Rebar's surface is often patterned to form a better bond with the concrete. There are a number of methods to identify rebar from the production mill to the fabrication shop to the jobsite.

Each individual reinforcing bar is manufactured with a series of individual markings (9):

- The first letter or symbol identifies the producing mill.
- The next marking is the bar size.
- The third marking symbol designates the type of reinforcing steel – usually either "S" for carbon-steel (ASTM A615) or "W" for low-alloy steel (ASTM A706).
- Finally, there will be a grade marking (60, 75, 80, 100, 120), or by the addition of one line (60), two lines (75), three lines (80, 100), or four lines (120) that must be at least five deformations long.

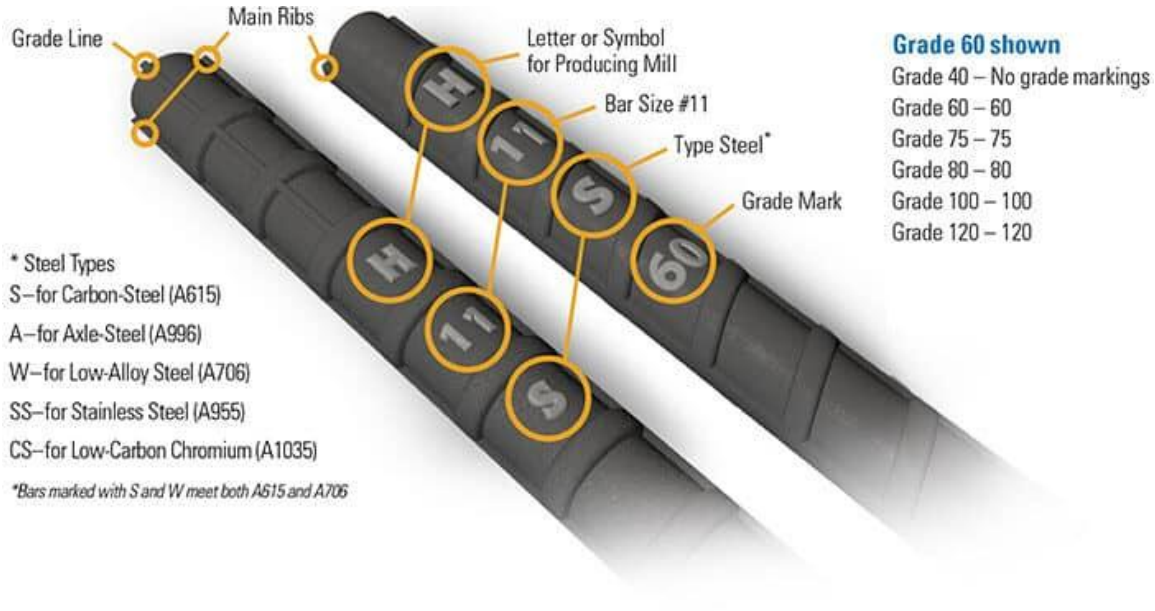


Figure 1: ASTM Bar Marking Sequence (9)

1.2 PRODUCT STANDARDS

Table 1 below summarizes key technical data for BC Supply's uncoated fabricated rebar products for the 2023 reference year.

Table 1 Percent Production of Carbon-Steel and Low-Alloy Uncoated Rebar

Declared Product	ASTM Steel Designation	Type	Grades and Sizes	Total Annual Production (%)
BC Supply Uncoated Fabricated Rebar	ASTM A615	Carbon-Steel Uncoated Rebar	Grade: 60 and 75 Size #: 3, 4, 5, 6, 7, 8, 9, 10, 11, 14, and 18	98.9%
	ASTM A706	Low-Alloy Uncoated Rebar	Grade: 60 Size #: 3, 4, 5, 6, 7, 8	1.1%

BC Supply's uncoated fabricated rebar meet the following standards ad requirements:

- ASTM A615/A615M-20 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement (10).
- ASTM A706/A706M-16 – Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement (11).

2 DECLARED UNIT

The declared unit is defined as one metric ton of fabricated carbon-steel and low-alloy uncoated rebar (6).

3 MATERIAL CONTENT

The material content of raw rebar stock will vary slightly from batch to batch and from supplier to supplier. In general, the steel will contain around 97% recycled iron, < 2% Manganese, <1.5% Copper, <0.9% Carbon, and a total of 1.5% or less of Nickel, Silicon, Sulfur, Tin, Phosphorus, and Vanadium. BC Supply only purchases raw rebar stock from domestic suppliers operating electric arc furnaces (EAF) using nearly 100% pre- and post-consumer scrap steel as feedstock sourced within the United States without the need for a pure iron source in the production of raw rebar stock.

4 SYSTEM BOUNDARY

Figure 2 shows the life-cycle stages and information modules that are included within the cradle-to-gate LCA system boundary of this EPD. The boundary is "cradle-to-gate", which consists of Extraction and Upstream Production (A1), Transportation to Factory (A2), and Manufacturing (A3).

Figure 3 provides a visual representation of the cradle-to-gate system boundary as applied to BC Supply's manufacturing facility.

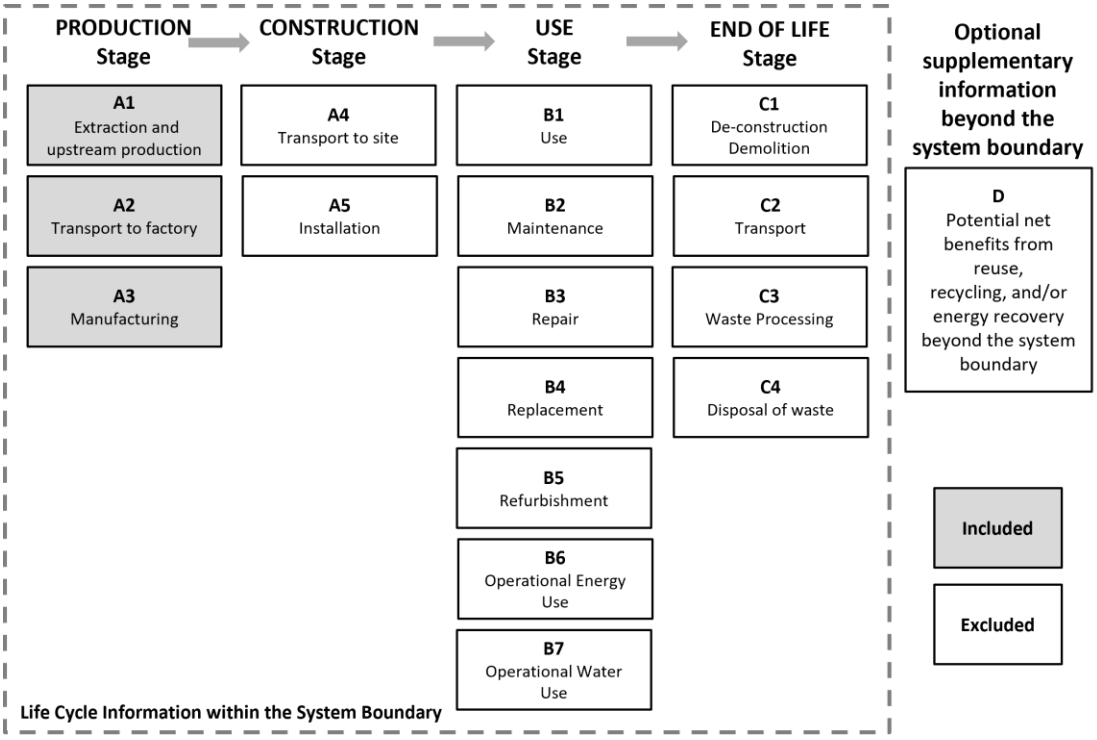


Figure 2: Life Cycle Stages and Modules

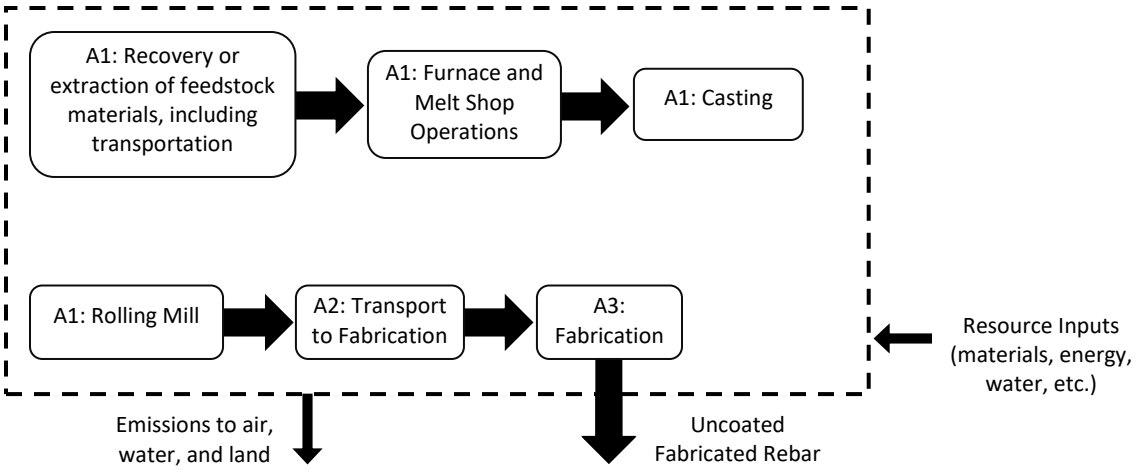


Figure 3: BC Supply Cradle-to-Gate System Boundary

5 LIFE CYCLE INVENTORY

5.1 DATA COLLECTION, SOURCES, AND CALCULATIONS

LCI data collection was based on a customized LCI survey. The LCI survey covered the primary data for BC Supply's manufacturing facility in Chambersburg, PA for the 2023 reference year (12 consecutive months). Data calculation procedures follow ISO 14044 (4), and UL Environment PCR for Designated Steel Construction Products (6).

Commercial Metals Company (CMC), Gerdau, and Steel Dynamics Inc. supplied unfabricated rebar used in the fabrication of BC Supply's rebar products in 2023. Both Gerdau and Steel Dynamics, Inc. have published facility-specific EPDs for their rebar products (12), (13). These EPDs include fabrication, and CMC has published a corporate average EPD for their unfabricated rebar products (14). These supply-chain specific EPDs were used to represent the unfabricated rebar input into BC Supply's fabrication facility.

The upstream EPDs from Gerdau and Steel Dynamics, Inc. include manufacturing of unfabricated rebar (A1), transport to fabricator (A2), and fabrication (A3). For these EPDs, the results for the A1 module have been used as background data for this study and the A2 and A3 modules have been excluded. Additionally, fabrication material scrap has been removed from the A1 impact to provide an environmental profile for 1 metric ton (1,000 kg) of unfabricated rebar. Module A2 and A3 including fabrication scrap are modelled based on BC Supply's foreground LCI data.

5.2 DATA QUALITY REQUIREMENTS AND ASSESSMENTS

The LCA project report provides a detailed description of the collected data and the data quality assessment regarding the UL Environment PCR requirements (5), (6) and ISO 14044 (5). Data quality is assessed based on its representativeness (technology coverage, geographic coverage, time coverage), completeness, consistency, reproducibility, transparency, and uncertainty (Table 2)

Table 2: Data Quality Requirements and Assessment

Data Quality Requirements	Description
Technology Coverage	Data represents the prevailing technology at BC Supply's facility in Chambersburg, PA. Whenever available, North American typical or average industry LCI datasets were utilized for all upstream and core materials and processes. *Technological representativeness is characterized as "high".*
Geographic Coverage	The geographic region considered is the U.S. *Geographical representativeness is characterized as "high".*

Data Quality Requirements	Description
Time Coverage	Activity (primary) data are representative of the 2023 calendar year (12 months) and include the following: - Rebar Fabrication – primary data collected for the 2023 reference year - Inbound and Outbound Transportation – primary data collected for the 2023 reference year - Upstream Raw Rebar Stock – Data provided by CMC, Gerdau, and Steel Dynamics Inc. The upstream EPDs have all been published within the last 5 years. - Generic Data: The most appropriate LCI datasets were used as found in the US LCI and ecoinvent 3.9.1 databases. *Temporal representativeness is characterized as "medium" to "high".*
Completeness	All relevant, specific processes were considered and modelled, including inputs (raw materials, energy, and ancillary materials) and outputs (emissions, waste, and production volume). The relevant background materials and processes were taken from the US LCI Database (adjusted for known data placeholders), ecoinvent v 3.9.1 LCI database for US, and third-party verified EPDs where applicable. The modelling has been completed in SimaPro v.9.5, 2024 (15). The completeness of the cradle-to-gate process chain in terms of process steps is rigorously assessed for fabricated rebar and documented in the project report.
Consistency	Crosschecks concerning the plausibility of mass and energy flows were continuously conducted. The LCA team conducted mass balance at the facility and product level to maintain a high level of consistency.
Reproducibility	Internal reproducibility is possible since the data and the models are stored and available in the *BC Supply LCI database* developed in SimaPro v.9.5, 2024 (15). A high level of transparency is provided throughout the critically reviewed LCA project report as the LCI profile is presented for the fabricated rebar product. The supporting LCA project report summarizes key primary (manufacturer-specific) and secondary (generic) LCI data sources.
Transparency	Activity and LCI datasets, including data sources, are transparently disclosed in the project report.
Uncertainty	A *sensitivity check* was conducted to assess the reliability of the EPD results and conclusions by determining how they are affected by uncertainties in the data or assumptions on the calculation of LCIA and energy indicator results. The LCA background report includes the results of the *sensitivity analysis.*

5.3 ALLOCATION RULES

This EPD follows the allocation guidelines of ISO 14044 (4) and the UL PCR (5), (6).

BC Supply manufactures a wide range of uncoated fabricated rebar sizes and grades. Inputs and outputs were allocated over the total outputs of uncoated fabricated rebar on a "mass" basis. LCI modelling accounts for the plant specific fabrication yields in accordance with ISO 14044, 4.3.4.2 (4).

Additionally, BC Supply fabricates epoxy coated rebar (co-product) in addition to the uncoated rebar declared in this EPD. Data for energy use (such as electricity usage, gasoline, diesel, etc.) and waste from manufacturing, were not provided separately for uncoated rebar. Energy and waste flows were allocated by mass and normalized against the total production (including uncoated and epoxy coated rebar) to provide reference energy and waste flows per metric ton of *total production.*

It is also noted that no burden or credit is allocated to the fabrication scrap (burden free) for the uncoated fabricated rebar product system. In addition, allocation related to transport is based on the mass of transported inputs and outputs.

5.4 CUT OFF RULES

The cut-off criteria were followed as specified in the UL PCR Part A, Section 2.9 (5) and ISO 21930, 7.1.8 (2). All input/output data reported by BC Supply's manufacturing facility were included in the model. None of the reported flow data were excluded based on the cut-off criteria. No substances with hazardous and toxic properties that concern human health and/or the environment were identified in the framework of this EPD.

This EPD excludes the following processes and activities:

- Capital goods and infrastructure, and
- Personnel-related activity (travel, furniture, office operations and supplies).

6 LIFE CYCLE ASSESSMENT RESULTS

Table 3 presents the "cradle-to-gate" LCA results for one metric ton of uncoated fabricated rebar. The EPD results for one short ton of fabricated rebar are shown in Table 4. As specified in the UL PCR, the US EPA Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI), version 2.1, 2012 (16) impact categories are used as they provide a North American context for the mandatory category indicators to be included in this EPD. *These are relative expressions only and do not predict category impact endpoints, the exceeding of thresholds, safety margins or risks* [4], [5].

Additional mandatory resource use, waste categories and output flows are also reported as specified in ISO 21930 (2). There are several emerging LCA impact categories and inventory metrics which are still under development and can have high levels of uncertainty that preclude international acceptance. These categories are noted with an asterisk (*) – use caution when interpreting data in these categories.

The environmental impact results of steel products in this document are based on a declared unit and therefore do not provide sufficient information to establish comparisons. The results shall not be used for comparisons without knowledge of how the physical properties of the steel product impact the precise function at the construction level. The environmental impact results shall be converted to a functional unit basis before any comparison is attempted. See Section 3.8 of the Part B Designated Steel Construction Product PCR (6) for additional EPD comparability guidelines.

Table 3 Production stage EPD Results (Total A1 to A3) – One metric ton of uncoated fabricated rebar

Impact category and inventory indicators	Unit	A1	A2	A3	A1-A3 Total
Global warming potential, GWP 100[1)]	kg CO_2 eq	6.54E+02	5.23E+01	1.24E+01	7.18E+02
Acidification potential, AP[1)]	kg SO_2 eq	1.80E+00	6.86E-01	4.11E-02	2.53E+00
Eutrophication potential, EP[1)]	kg N eq	9.53E-01	4.14E-02	2.15E-02	1.02E+00
Smog formation potential, SFP[1)]	kg O_3 eq	2.64E+01	1.78E+01	9.02E-01	4.51E+01
Ozone depletion potential, ODP[1)]	kg CFC-11 eq	3.80E-05	2.20E-09	1.61E-07	3.81E-05
Abiotic depletion potential for fossil resources, ADPf*[3)]	MJ, LHV	7.94E+03	7.45E+02	1.47E+02	8.83E+03
Renewable primary resources used as an energy carrier (fuel), RPRE*[4)]	MJ, LHV	5.75E+02	0	1.80E+01	5.93E+02
Renewable primary resources with energy content used as material, RPRM*[4)]	MJ, LHV	0	0	6.29E+01	6.29E+01
Non-renewable primary resources used as an energy carrier (fuel), NRPRE*[4)]	MJ, LHV	8.13E+03	7.53E+02	1.88E+02	9.07E+03
Non-renewable primary resources with energy content used as material, NRPRM*[4)]	MJ, LHV	3.48E+02	0	0	3.48E+02
Secondary materials, SM*[4)]	kg	1.14E+03	0	3.53E-01	1.14E+03
Renewable secondary fuels, RSF*[4)]	MJ, LHV	0	0	2.33E+00	2.33E+00
Non-renewable secondary fuels, NRSF*[4)]	MJ, LHV	0	0	0	0
Recovered energy, RE*[4)]	MJ, LHV	0	0	0	0
Consumption of freshwater, FW*[4)]	m^3	2.85E+00	0	7.19E-03	2.86E+00
Hazardous waste disposed, HWD*[4)]	kg	2.78E-01	0	1.30E-05	2.78E-01
Non-hazardous waste disposed, NHWD*[4)]	kg	5.60E+01	0	1.18E-01	5.61E+01
High-level radioactive waste, conditioned, to final repository, HLRW*[4) 5)]	m^3	1.08E-06	0	3.59E-08	1.11E-06
Intermediate- and low-level radioactive waste, conditioned, to final repository, ILLRW*[4) 5)]	m^3	7.86E-05	0	2.05E-05	9.91E-05
Components for re-use, CRU*[4)]	kg	0	0	0	0
Materials for recycling, MR*[4)]	kg	2.36E+01	0	2.04E+01	4.40E+01
Materials for energy recovery, MER*[4)]	kg	0	0	0	0
Recovered energy exported from the product system, EE*[4)]	MJ, LHV	1.69E-02	0	0	1.69E-02
Removals and emissions associated with carbon content of bio-based packaging[4)]	kg CO_2	0	0	-4.84E+00	-4.84E+00

Table 4 Production stage EPD Results (Total A1 to A3) – One short ton of uncoated fabricated rebar

Impact category and inventory indicators	Unit	A1	A2	A3	A1-A3 Total
Global warming potential, GWP 100[1) 2)]	kg CO_2 eq	5.93E+02	4.75E+01	1.13E+01	6.52E+02
Acidification potential, AP[1)]	kg SO_2 eq	1.63E+00	6.23E-01	3.73E-02	2.29E+00
Eutrophication potential, EP[1)]	kg N eq	8.65E-01	3.75E-02	1.95E-02	9.22E-01
Smog formation potential, SFP[1)]	kg O_3 eq	2.39E+01	1.61E+01	8.18E-01	4.09E+01
Ozone depletion potential, ODP[1)]	kg CFC-11 eq	3.44E-05	1.99E-09	1.46E-07	3.46E-05
Abiotic depletion potential for fossil resources, ADPf*[3)]	MJ, LHV	7.20E+03	6.76E+02	1.34E+02	8.01E+03
Renewable primary resources used as an energy carrier (fuel), RPRE*[4)]	MJ, LHV	5.22E+02	0	1.64E+01	5.38E+02
Renewable primary resources with energy content used as material, RPRM*[4)]	MJ, LHV	0	0	5.71E+01	5.71E+01
Non-renewable primary resources used as an energy carrier (fuel), NRPRE*[4)]	MJ, LHV	7.38E+03	6.83E+02	1.70E+02	8.23E+03
Non-renewable primary resources with energy content used as material, NRPRM*[4)]	MJ, LHV	3.16E+02	0	0	3.16E+02
Secondary materials, SM*[4)]	kg	1.03E+03	0	3.20E-01	1.03E+03
Renewable secondary fuels, RSF*[4)]	MJ, LHV	0	0	2.11E+00	2.11E+00
Non-renewable secondary fuels, NRSF*[4)]	MJ, LHV	0	0	0	0
Recovered energy, RE*[4)]	MJ, LHV	0	0	0	0
Consumption of freshwater, FW*[4)]	m^3	2.58E+00	0	6.52E-03	2.59E+00
Hazardous waste disposed, HWD*[4)]	kg	2.52E-01	0	1.18E-05	2.52E-01
Non-hazardous waste disposed, NHWD*[4)]	kg	5.08E+01	0	1.07E-01	5.09E+01
High-level radioactive waste, conditioned, to final repository, HLRW*[4) 5)]	m^3	9.79E-07	0	3.26E-08	1.01E-06
Intermediate- and low-level radioactive waste, conditioned, to final repository, ILLRW*[4) 5)]	m^3	7.13E-05	0	1.86E-05	8.99E-05
Components for re-use, CRU*[4)]	kg	0	0	0	0
Materials for recycling, MR*[4)]	kg	2.14E+01	0	1.85E+01	3.99E+01
Materials for energy recovery, MER*[4)]	kg	0	0	0	0
Recovered energy exported from the product system, EE*[4)]	MJ, LHV	1.54E-02	0	0	1.54E-02
Removals and emissions associated with carbon content of bio-based packaging[4)]	kg CO_2	0	0	-4.39E+00	-4.39E+00

Notes:

[1)] Calculated as per U.S EPA TRACI 2.1, v1.05, SimaPro v.9.5.0.2

[2)] GWP-100 excludes biogenic CO_2 removals and emissions associated with biobased products, including bio-based packaging. Biogenic carbon content of packaging materials is reported separately. CO_2 emissions from calcination and carbonation do not apply to the declared product; 100-year time horizon GWP factors are provided by the IPCC 2013 Fifth Assessment Report (AR5), TRACI 2.1, v1.05 (16).

[3)] Calculated as per CML-IA baseline, V4.7, SimaPro v.9.5.0.2. ADP_f is required in LEED v4.0/v4.1 MR2 Credit: Building Product Disclosure and Optimization – Environmental Product Declarations (17), (18).

[4)] Calculated as per ACLCA ISO 21930 Guidance (19).

[5)] It should be noted that the foreground system (A3 manufacturing process) does not generate any high-level radioactive waste or low/intermediate level radioactive waste. Radioactive waste is primarily generated from electricity production. High level radioactive waste consists mainly of spent fuel from reactors. Low/intermediate level radioactive waste is primarily generated from routine facility maintenance and operation (2).

7 EPD COMPARABILITY LIMITATION STATEMENT

As specified in the UL PCR (6), the following points apply to the comparability of environmental declarations:

- Environmental declarations from different programs may not be comparable.
- Comparison of the environmental performance of construction works and construction products using EPD information shall be based on the product's use and impacts at the construction works level. In general, EPDs may not be used for comparability purposes when not considered in a construction works context. Given this PCR ensures products meet the same functional requirements, comparability is permissible provided the information given for such comparison is transparent and the limitations of comparability explained.
- Comparisons cannot be made between product-specific or industry average EPDs at the design stage of a project, before a building has been specified. Comparisons may be made between product-specific or industry average EPDs at the time of product purchase when product performance and specifications have been established and serve as a functional unit for comparison. Environmental impact results shall be converted to a functional unit basis before any comparison is attempted.
- Any comparison of EPDs shall be subject to the requirements of ISO 21930. EPDs are not comparative assertions and are either not comparable or have limited comparability when they have different system boundaries, are based on different product category rules or are missing relevant environmental impacts. Such comparison can be inaccurate and could lead to erroneous selection of materials or products which are higher impact, at least in some impact categories.

8 INTERPRETATION

Module A1 Extraction and upstream production contributes the largest share of the LCIA category indicator results – accounting for between 59% to 94% of the *Production stage* (A1 to A3) potential environmental impacts. *Module A2 Transportation* is the second largest contributor to the overall potential environmental impacts.

Approximately 94% of the total primary energy is derived from *non-renewable primary energy reource* ($NRPR_E$).

Module A3 Manufacturing contributes less than 5% to the potential environmental impact.

9 DECLARATION TYPE

The "cradle-to-gate" EPD for BC Supply's uncoated fabricated rebar covers production stage, including the extraction and upstream production, transport to factory, and manufacturing (modules A1 to A3). The declarations are intended for use in Business-to-Business (B-to-B) communication.

BC Supply's EPD falls under the description:

- A product-specific EPD from one manufacturer.

11 REFERENCES

1. ISO 14025: 2006 Environmental labeling and declarations - Type III environmental declarations - Principles and procedures.

2. ISO 21930:2017 Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services.

3. ISO 14040/Amd1:2020 Environmental Management – Life Cycle Assessment – Principles and Framework, International Organization for Standardization, 2006.

4. ISO 14044/Amd1:2017/Amd2:2020 Environmental Management – Life Cycle Assessment – Requirements and guidelines, International Organization for Standardization, 2006.

5. UL Environment. Product Category Rules for Building-Related Products and Services. Part A: Life Cycle Assessment Calculation Rules and Report Requirements. Version 4.0. March 2022.

6. UL Environment. Product Category Rules (PCR) for Building-Related Products and Services. Part B: Designated Steel Construction Product EPD Requirements. Version 2.0. August 2020.

7. ASTM Program Operator for Product Category Rules (PCRs) and Environmental Product Declarations (EPDs), General Program Instructions, April 2020.

8. Athena Sustainable Materials Institute, A Cradle-to-Gate Life Cycle Assessment of Fabricated Carbon-Steel and Low-Alloy Uncoated Reinforcing Bar (Rebar) Manufactured by BC Supply LLC, November 2024.

9. Concrete Reinforcing Steel Institute. Reinforcing Basics - Bar Identification. [Online] https://www.crsi.org/reinforcing-basics/reinforcing-steel/bar-identification/.

10. *ASTM A615 / A615M-16 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.*

11. *ASTM A706 / A706M - 16 - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.*

12. Steel Dynamics, Inc. *Environmental Product Declaration Fabricated Steel Reinforcing Bar (Rebar).* s.l. : ASTM International, September 2022.

13. Gerdau. *Environmental Product Declaration Gerdau Rebar, Charlotte Steel Mill.* s.l. : SCS Global, August 2021.

14. Commercial Metals Company. *Environmental Product Declaration Concrete Reinforcing Steel.* s.l. : ASTM International, February 2021.

15. PRé 2021.SimaPro LCA Software v 9.5, 2024, https://simapro.com/.

16. Bare, J., TRACI 2.0: The Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts 2.0. Clean Technologies and Environmental Policy 2011, 13, (5), https://link.springer.com/article/10.1007/s10098-010-0338-9#page-1.

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18. LEED v4.1, MRc2: Building product disclosure and optimization, Environmental Product Declarations,. *https://leeduser.buildinggreen.com/credit/NC-v4.1/MRc2#tab-credit-language* .

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