Declaration Owner:
Cascade Steel Rolling Mills, Inc.
Daniel Lee
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Products
Fabricated Reinforcing Bar
(ASTM A615, A706, A1035)

Declared Unit
The declared unit is one metric ton of fabricated reinforcing bar.
Results are reported using SI units.

Facility
Cascade Steel Rolling Mills, Inc.
3200 NE Highway 99W
McMinnville, OR 97128

This EPD has been prepared using data from 19 representative North American fabrication facilities. For simplicity, the addresses have not been included here.

EPD Number and Period of Validity
SCS-EPD-04335
EPD Valid January 19, 2017 through January 18, 2022

Product Category Rule
North American Product Category Rule for Designated Steel Construction Products

Program Operator
SCS Global Services
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PCR review, was conducted by	Tom Gloria, PhD, Industrial Ecology Consultants (Review Chair) Email: t.gloria@industrial-ecology.com
Approved Date: January 19, 2017 - End Date: January 18, 2022	
Independent verification of the declaration and data, according to ISO 14025:2006 and ISO 21930:2007.	☐ internal ☑ external
Third party verifier	Tom Gloria, PhD, Industrial Ecology Consultants

ABOUT CASCADE STEEL

For over 40 years, Cascade Steel Rolling Mills has been providing the Western U.S. and Canada with high quality steel products produced from recycled scrap metal at our state-of-the-art electric arc furnace steel mill. Our products include reinforcing bar (rebar), coiled reinforcing bar, wire rod, merchant bar and specialty products. As a Schnitzer subsidiary and part of our parent company's vertical integration, we purchase all of the processed scrap metal we use through Schnitzer. Being part of a Fortune 1000 company has enabled us to grow stronger and introduce cost efficiencies and state-of-the art environmental controls into our operations.

Sustainability starts with our business model. Recycling metal instead of using virgin ore to create new steel products saves energy and natural resources. However, sustainability doesn't end with our business model. Like our parent company and its other subsidiaries, we are constantly working on reducing our environmental footprint. Over the years, we've improved our processes and controls, invested capital to increase our efficiency and decrease our energy use, and fostered a culture of resourcefulness and accountability. For over 40 years, we've shown that it is possible to operate profitably while maintaining a focus on sustainability and being responsible stewards of our environment.

PRODUCT DESCRIPTION

This EPD is for reinforcing bar produced by Cascade Steel mill located in McMinnville, Oregon. Fabricated reinforcing bar is a steel bar used in the reinforcement of concrete. The rebar surface is rolled with a deformed pattern in order to form an improved mechanical bond with the concrete. Mechanical properties, sizes, and deformation dimensions are specified by ASTM standards A615, A706, and A1035. Fabricated rebar is rebar that has been cut and bent as necessary to form shapes according to the needs of a particular project. Rebar sizes range from #3 through #18. In accordance with the PCR, the declared unit and product density is shown in Table 1.

Table 1. *Declared unit for fabricated reinforcing bar and the approximate density.*

Parameter	Value
Declared Unit	1 metric ton
Density	7,850 kg/m^3

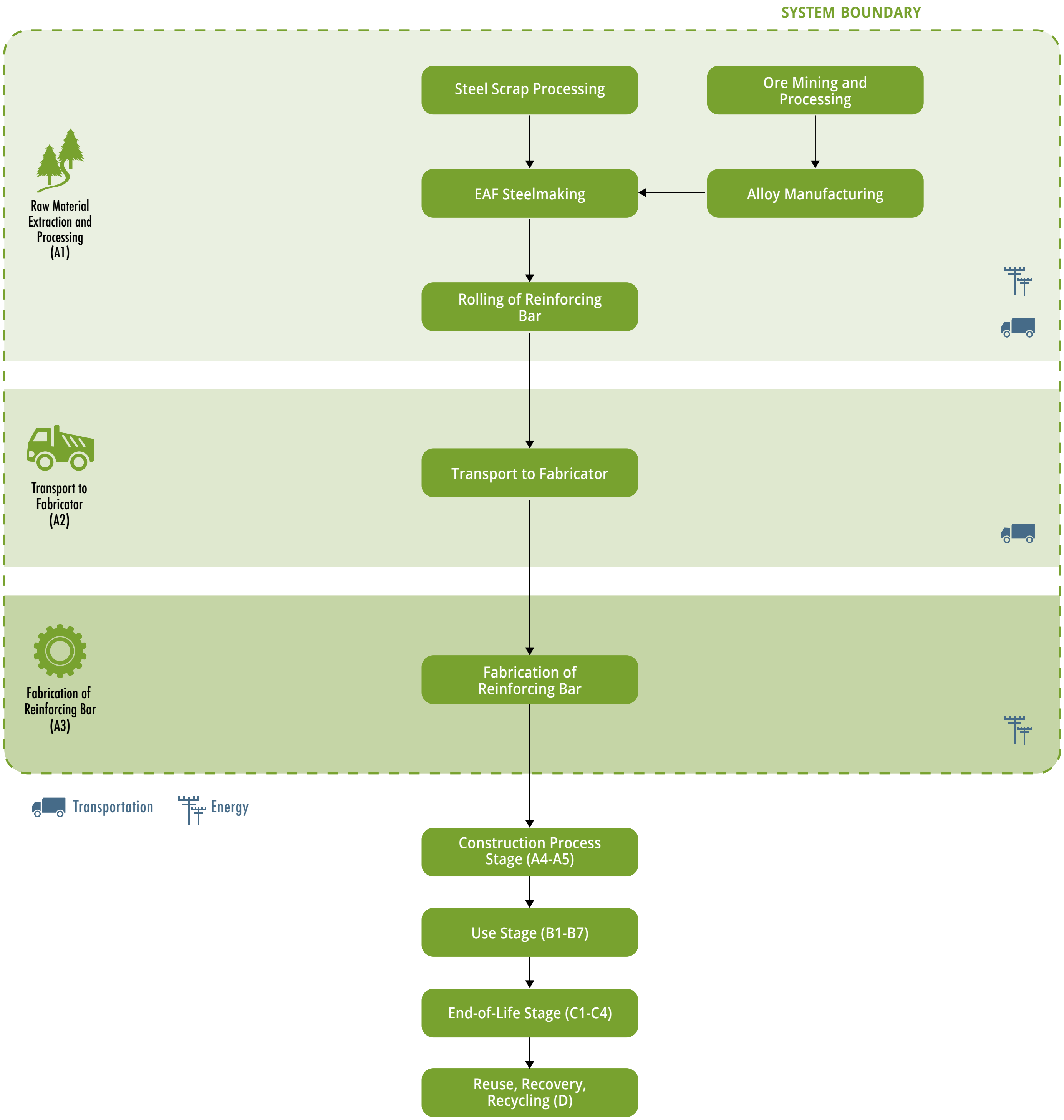
MATERIAL CONTENT

Cascade Steel's products contain approximately 95.4% recycled scrap steel content with 4.5% alloys and additives. In general, ASTM A615 and A706 reinforcing bar will contain 95-99% recycled iron, < 2% Manganese, < 1% Carbon, < 1% Chromium, <1% Silicon, and a total of < 1.5% Nickel, Sulfur, Vanadium, Phosphorous, Molybdenum, and other alloying elements. Similarly, ASTM A1035 reinforcing bar will generally contain 80-90% recycled iron, < 11% Chromium, < 2% Manganese, < 1% Carbon, < 1% Silicon, and a total of < 4% Nickel, Sulfur, Phosphorous, Molybdenum, and Copper.

Reinforcing bar products under normal conditions do not present inhalation, ingestion, or contact health hazards. These products, when used inside the building envelope, do not include materials or substances that have a potential route of exposure to humans or flora/fauna in the environment.

PRODUCT LIFE CYCLE FLOW DIAGRAM

The diagram below is a representation of the most significant contributions to the production of fabricated reinforcing bar. This includes resource extraction, steelmaking, transport to fabrication shops, and product fabrication. The cradle-to-gate (A1-A3) system boundaries are shown in the diagram.



LIFE CYCLE ASSESSMENT STAGES AND REPORTED INFORMATION

In accordance with the PCR, the life cycle stages included in this EPD are as shown below (X = included, MND = module not declared).

Product			Construction Process		Use							End-of-life				Benefits & loads beyond the system boundary
A1	A2	A3	A4	A5	B1	B1	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Raw Material Extraction and Processing	Transport to the Reinforcing Bar Fabricator	Fabrication of Reinforcement	Transport	Construction - Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction demolition	Transport	Waste processing	Disposal	Reuse, recovery and/or recycling potential
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

X = included, MND = module not declared

The following life cycle stages are included in the EPD:

Raw Material Extraction and Processing (A1): Includes all activities necessary for the production of reinforcing bar. This includes recovery and processing of scrap blend, and extraction and processing of alloys, fluxes, EAF consumables, and refractory consumables. The transportation from the supplier of materials to the steel mill is included. Lastly, this stage includes furnace and related process operation at the melt shop, creation of the billet, and the rolling of the final product. All upstream activities related to fuel use and electricity generation are included in this stage.

Transport to the Reinforcing Bar Fabricator (A2): Includes the transport of reinforcing bar from mill to fabricator by truck, rail, or ship.

Fabrication of Reinforcement (A3): Includes all activities necessary for the fabrication of reinforcing bar, which includes production of all ancillary materials, pre-products, products, and packaging.

The Reference Service Life (RSL) of the products is not specified.

The construction process stage, use stage, end-of-life stage, and Module D of the product are excluded from the system boundaries of this study. Additional elements that are excluded from the study are:

- Construction activities, capital equipment and infrastructure
- Maintenance and operation of equipment
- Personnel travel and resource use

The deletion of these inputs or outputs is permitted since it is not expected to significantly change the overall conclusions of the study.

LIFE CYCLE IMPACT ASSESSMENT

Results are reported in Table 4 and 5 according to the LCIA methodologies of Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI version 2.1) and CML-IA version 4.1.

Table 4. *LCIA results for 1 metric ton of ASTM A615 and A706 fabricated reinforcing bar produced in McMinnville, OR.*

			A1	A2	A3
Impact Category	Units	Total (A1-A3)	Unfabricated Reinforcing Bar Production	Transport to the Fabricator	Fabrication
Global Warming Potential	Metric ton CO_2 eq	$5.8x10^{-1}$	$5.2x10^{-1}$	$3.8x10^{-2}$	$1.8x10^{-2}$
Ozone Depletion Potential	Metric ton CFC-11 eq	$2.5x10^{-8}$	$1.6x10^{-8}$	$6.9x10^{-9}$	$1.7x10^{-9}$
Acidification Potential	Metric ton SO_2 eq	$3.0x10^{-3}$	$2.7x10^{-3}$	$2.4x10^{-4}$	$1.1x10^{-4}$
Eutrophication Potential	Metric ton N eq	$1.5x10^{-3}$	$1.4x10^{-3}$	$4.8x10^{-5}$	$4.5x10^{-5}$
Photochemical Ozone Creation Potential	Metric ton O_3 eq	$4.0x10^{-2}$	$3.4x10^{-2}$	$5.3x10^{-3}$	$1.0x10^{-3}$
Depletion of Abiotic Resources (Elements)*	Metric ton Sb eq	$-2.5x10^{-5}$	$-2.5x10^{-5}$	$1.0x10^{-7}$	$3.4x10^{-8}$
Depletion of Abiotic Resources (Fossil)	MJ, net calorific value	$5.1x10^{3}$	$4.7x10^{3}$	$6.0x10^{-1}$	$3.9x10^{2}$

*Negative results for abiotic depletion potential (elements) are due to the credit for avoided zinc production from recovered EAF baghouse dust. This credit is applied using the system expansion approach. This indicator is based on assumptions regarding current reserves estimates. Users should use caution when interpreting results because there is insufficient information on which indicator is best for assessing the depletion of abiotic resources.

Table 5. *LCIA results for 1 metric ton of ASTM A1035 reinforcing bar produced in McMinnville, OR.*

			A1	A2	A3
Impact Category	Units	Total (A1-A3)	Unfabricated Reinforcing Bar Production	Transport to the Fabricator	Fabrication
Global Warming Potential	Metric ton CO_2 eq	$9.9x10^{-1}$	$9.3x10^{-1}$	$3.8x10^{-2}$	$1.8x10^{-2}$
Ozone Depletion Potential	Metric ton CFC-11 eq	$4.0x10^{-8}$	$3.2x10^{-8}$	$6.9x10^{-9}$	$1.7x10^{-9}$
Acidification Potential	Metric ton SO_2 eq	$6.4x10^{-3}$	$6.0x10^{-3}$	$2.4x10^{-4}$	$1.1x10^{-4}$
Eutrophication Potential	Metric ton N eq	$2.9x10^{-3}$	$2.8x10^{-3}$	$4.8x10^{-5}$	$4.5x10^{-5}$
Photochemical Ozone Creation Potential	Metric ton O_3 eq	$8.6x10^{-2}$	$8.0x10^{-2}$	$5.3x10^{-3}$	$1.0x10^{-3}$
Depletion of Abiotic Resources (Elements)*	Metric ton Sb eq	$3.4x10^{-5}$	$3.4x10^{-5}$	$1.0x10^{-7}$	$3.4x10^{-8}$
Depletion of Abiotic Resources (Fossil)	MJ, net calorific value	$9.4x10^{3}$	$9.0x10^{3}$	$6.0x10^{-1}$	$3.9x10^{2}$

*Negative results for abiotic depletion potential (elements) are due to the credit for avoided zinc production from recovered EAF baghouse dust. This credit is applied using the system expansion approach. This indicator is based on assumptions regarding current reserves estimates. Users should use caution when interpreting results because there is insufficient information on which indicator is best for assessing the depletion of abiotic resources.

Resource Use:

The PCR requires that several parameters be reported in the EPD, including resource use, waste categories and output flows, and other environmental information. The results for these parameters per declared unit are shown in Table 6 and 7.

Table 6. *Resource use and wastes results for 1 metric ton of ASTM A615 and A706 fabricated reinforcing bar produced in McMinnvile, OR.*

Impact Category	Unit	Total (A1-A3)	A1	A2	A3
			Unfabricated Reinforcing Bar Production	Transport to the Fabricator	Fabrication
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ, net calorific value	$1.7x10^3$	$1.7x10^3$	4.7	34
Use of renewable primary energy resources used as raw materials	MJ, net calorific value	0.0	0.0	0.0	0.0
Total use of renewable primary energy resources	MJ, net calorific value	$1.7x10^3$	$1.7x10^3$	4.7	34
Use of nonrenewable primary energy excluding nonrenewable primary energy resources used as raw materials	MJ, net calorific value	$8.4x10^3$	$7.4x10^3$	$5.8x10^2$	$4.5x10^2$
Use of nonrenewable primary energy resources used as raw materials	MJ, net calorific value	$3.4x10^2$	$3.4x10^2$	0.0	0.0
Total use of nonrenewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ, net calorific value	$8.7x10^3$	$7.7x10^3$	$5.8x10^2$	$4.5x10^2$
Use of secondary materials	Metric ton	1.1	1.1	0.0	0.0
Use of renewable secondary fuels	MJ, net calorific value	0.0	0.0	0.0	0.0
Use of nonrenewable secondary fuels	MJ, net calorific value	0.0	0.0	0.0	0.0
Net use of fresh water	m^3	8.0	7.7	0.0	$3.1x10^{-1}$
Nonhazardous waste disposed	Metric ton	$1.1x10^{-1}$	$8.7x10^{-2}$	$2.4x10^{-2}$	$1.5x10^{-3}$
Hazardous waste disposed	Metric ton	0.0	0.0	0.0	0.0
Radioactive Waste disposed	Metric ton	$2.5x10^{-6}$	$1.7x10^{-6}$	$6.5x10^{-7}$	$1.4x10^{-7}$
Components for re-use	Metric ton	0.0	0.0	0.0	0.0
Materials for recycling	Metric ton	$6.0x10^{-1}$	$1.5x10^{-1}$	0.0	$4.5x10^{-1}$
Materials for energy recovery	Metric ton	0.0	0.0	0.0	0.0
Exported energy	MJ per energy carrier	0.0	0.0	0.0	0.0

Table 7. *Resource use and wastes results for 1 metric ton of ASTM A1035 reinforcing bar produced in McMinnville, OR.*

Impact Category	Unit	Total (A1-A3)	A1	A2	A3
			Unfabricated Reinforcing Bar Production	Transport to the Fabricator	Fabrication
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ, net calorific value	$3.0x10^{3}$	$3.0x10^{3}$	4.7	34
Use of renewable primary energy resources used as raw materials	MJ, net calorific value	0.0	0.0	0.0	0.0
Total use of renewable primary energy resources	MJ, net calorific value	$3.0x10^{3}$	$3.0x10^{3}$	4.7	34
Use of nonrenewable primary energy excluding nonrenewable primary energy resources used as raw materials	MJ, net calorific value	$1.6x10^{4}$	$1.5x10^{4}$	$5.8x10^{2}$	$4.5x10^{2}$
Use of nonrenewable primary energy resources used as raw materials	MJ, net calorific value	$3.4x10^{2}$	$3.4x10^{2}$	0.0	0.0
Total use of nonrenewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ, net calorific value	$1.6x10^{4}$	$1.5x10^{4}$	$5.8x10^{2}$	$4.5x10^{2}$
Use of secondary materials	Metric ton	1.0	1.0	0.0	0.0
Use of renewable secondary fuels	MJ, net calorific value	0.0	0.0	0.0	0.0
Use of nonrenewable secondary fuels	MJ, net calorific value	0.0	0.0	0.0	0.0
Net use of fresh water	m^3	8.0	7.7	0.0	$3.1x10^{-1}$
Nonhazardous waste disposed	Metric ton	$6.6x10^{-1}$	$6.4x10^{1}$	$2.4x10^{-2}$	$1.5x10^{-3}$
Hazardous waste disposed	Metric ton	0.0	0.0	0.0	0.0
Radioactive Waste disposed	Metric ton	$4.2x10^{-6}$	$3.4x10^{-6}$	$6.5x10^{-7}$	$1.4x10^{-7}$
Components for re-use	Metric ton	0.0	0.0	0.0	0.0
Materials for recycling	Metric ton	$6.0x10^{-1}$	$1.5x10^{-1}$	0.0	$4.5x10^{-1}$
Materials for energy recovery	Metric ton	0.0	0.0	0.0	0.0
Exported energy	MJ per energy carrier	0.0	0.0	0.0	0.0

Disclaimer:
This Environmental Product Declaration (EPD) conforms to ISO 14025, 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.*

SUPPORTING TECHNICAL INFORMATION

Data Sources

All primary data for Cascade Steel's manufacturing processes in module A1 were collected from the McMinnville mill for the calendar year 2015. Similarly, all primary data for the transportation of reinforcing bar to fabricator in module A2 and fabrication processes in module A3 were collected from 19 representative North American fabrication facilities for the calendar year 2015. See Table 7 for a description of data sources used for the LCA.

Table 8. *Data sources used for the LCA study.*

Module	Scope	Technology Source	Data Source	Region	Year
A1	Yes	SimaPro 8.1	Cascade Steel	US	2015
A2	Yes	SimaPro 8.1	19 Fabrication Facilities	Global	2015
A3	Yes	SimaPro 8.1	19 Fabrication Facilities	North America	2015
D	No	N/A	N/A	N/A	N/A
Other Processes	Yes	SimaPro 8.1	Ecoinvent	North America, European, Global, and "Rest-of-World"	2015

Data Quality

Data Quality Parameter	Data Quality Discussion
Time-Related Coverage: Age of data and the minimum length of time over which data is collected	Manufacturer and fabricator data (primary data) are based on 2015 annual production. Representative datasets (secondary data) used for upstream and background processes are generally less than 10 years old. All of the data used represented an average of at least one year's worth of data collection.
Geographical Coverage: Geographical area from which data for unit processes is collected to satisfy the goal of the study	The data used in the analysis provide the best possible representation available with current data. Actual processes for upstream operations are primarily North American. Surrogate data used in the assessment are representative of US, European, Global, or "Rest-of-World" (average for all countries in the world with uncertainty adjusted). Datasets chosen are considered sufficiently similar to actual processes.
Technology Coverage: Specific technology or technology mix	For the most part, data are representative of the actual technologies used for processing, transportation, and manufacturing operations.
Precision: Measure of the variability of the data values for each data expressed	Precision of results are not quantified due to a lack of data. Data collected for operations were typically averaged for one year and over multiple operations, which is expected to reduce the variability of results.
Completeness: Percentage of flow that is measured or estimated	The LCA model included all known mass and energy flows for the production of fabricated reinforcing bar products. In some instances, surrogate data used to represent upstream operations may be missing some data which is propagated in the model. No known processes or activities contributing to more than 1% of the total environmental impact for each indicator are excluded. In total, these missing data represent less than 5% of the mass or energy flows.
Representativeness: Qualitative assessment of the degree to which the data set reflects the true population of interest	Data used in the assessment represent typical or average processes as currently reported from multiple data sources, and are therefore generally representative of the range of actual processes and technologies for production of these materials. Considerable deviation may exist among actual processes on a site-specific basis; however, such a determination would require detailed data collection throughout the supply chain back to resource extraction. Some proxy datasets are used to represent some of the alloy materials due to the lack of data available.
Consistency: Qualitative assessment of whether the study methodology is applied uniformly to the various components of the analysis	The consistency of the assessment is considered to be high. Data sources of similar quality and age are used; with a bias towards Ecoinvent data where available. Different portions of the product life cycle are equally considered.
Reproducibility: Qualitative assessment of the extent to which information about the methodology and data values would allow an independent practitioner to reproduce the results reported in the study	Based on the description of data and assumptions used, this assessment would be reproducible by other practitioners. All assumptions, models, and data sources are documented.
Sources of the Data: Description of all primary and secondary data sources	Data representing energy use at the mill and fabrication facilities represent an annual average and are considered of high quality due to the length of time over which these data are collected, as compared to a snapshot that may not accurately reflect fluctuations in production. Secondary LCI datasets are primarily sources from Ecoinvent. Data representing mode and distance of freight for the transport of reinforcing bar to the fabricator and the fabrication of reinforcing bar is an average of 19 fabrication facilities.
Uncertainty of the Information: Uncertainty related to data, models, and assumptions	Uncertainty related to the product materials and packaging is low. Data for upstream operations relied upon use of existing representative datasets. These datasets contained relatively recent data (<10 years), but lacked geographical representativeness. Uncertainty related to the impact assessment methods used in the study are high. The impact methods required by the PCR include impact potentials, which lack characterization of providing and receiving environments or tipping points.

Allocation

The LCA followed the allocation guidelines of ISO 14044 and the PCR. Co-products from steelmaking were treated using system expansion, as described in the World Steel Association LCA Methodology Report (2011). The Cascade Steel mill produces three valuable co-products; slag, baghouse dust, and mill scale. In Table 9 the systems expansion assumptions for these co-products are shown.

Table 9. *System expansion assumptions for co-products at the steel mill.*

Product	Co-product function	Avoided production
Slag	9.0% Cement	0.9 metric ton slag/metric ton cement production
	91% Gravel	Gravel production
Baghouse dust	Zinc production	Zinc production; 0.205 metric ton zinc/metric ton dust
Millscale	Metallurgical input to steelmaking	Iron ore production

Limitations

- The LCIA indicators prescribed by the PCR do not represent all categories of potential environmental impacts, such as terrestrial ecosystem impacts.
- Emissions provided for the McMinnville, OR steel mill were aggregated and therefore the contribution for each major process at the facility is unavailable.
- Representative datasets were used to reflect the eGRID energy mix for electricity use at the McMinnville, OR steel mill and each fabrication facility.
- Primary data of material components (i.e. alloys, refractory materials) and the transportation of those materials could not be modeled with actual process information.
- Where primary data were unavailable, representative secondary data taken from Ecoinvent were used.

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