ENVIRONMENTAL PRODUCT DECLARATION

STEEL CONCRETE REINFORCING BAR AND MERCHANT BAR PRODUCTS

NUCOR STEEL SEATTLE, INC.
2424 SW ANDOVER ST. SEATTLE, WA 98106

Nucor Steel Seattle, Inc. is the state of Washington's largest recycler, with the capacity to process over a million tons of scrap steel each year. Using an electric arc furnace, a steel recycling technology we helped to pioneer, we produce high-quality steel with over 98 percent recycled content.

We recognize our role in protecting the environment and have demonstrated a long-standing commitment to do so. We have invested tens of millions of dollars in our Seattle facility to make it among the most efficient and environmentally responsible steel plants in the world.

In addition to being ISO14001 certified, we operate on an electric grid that is nearly carbon free.

UL CERTIFIED
ENVIRONMENTAL PRODUCT DECLARATION
UL.COM/EPD

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STEEL CONCRETE REINFORCING AND MERCHANT BAR
NUCOR STEEL SEATTLE, INC.

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 Environment
DECLARATION HOLDER	Nucor Steel Seattle, Inc.
DECLARATION NUMBER	4787940707.101.1
DECLARED PRODUCT	Steel concrete reinforcing and merchant bar
REFERENCE PCR	North American PCR for Designated Steel Construction Products, SCS Global Services
DATE OF ISSUE	6/02/2017
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:	Review Panel Chair: Thomas Gloria
This declaration was independently verified in accordance with ISO 14025 by Underwriters Laboratories ☐ INTERNAL ☒ EXTERNAL	Wade Stout, UL Environment
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Thomas P. Gloria, Industrial Ecology Consultants

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Product Definition

Manufacturer Description

We aim to lead our industry in embracing environmental responsibility in all aspects of our business. For us, taking care of the environment is more than a corporate policy, it is a cultural responsibility shared by all of our teammates from the front line to management. And while this commitment is good for our business, it is even better for the communities where we live and work.

Nucor Steel Seattle operates a steel mill, founded in 1904, that is located in West Seattle. It currently produces predominantly rebar and merchant bar quality (MBQ) and employs approximately 330 teammates. We recognize our role in protecting the environment and have demonstrated a long-standing commitment to its welfare. We are Washington's largest recycler, recycling over 700,000 tons of scrap steel in 2016. Using an electric arc furnace steel recycling technology, we produce high-quality steel with 99.4 percent recycled content.

We have invested tens of millions of dollars into our Seattle facility to make it among the most efficient and environmentally friendly steel plants in the world.

This environmental product declaration (EPD) represents steel rebar and MBQ produced via an electric arc furnace (EAF) from Nucor Corporation's mill in Seattle, Washington.

Product Description

Nucor has 13 bar mills that produce concrete reinforcing bars, hot-rolled bars, rod, light shapes, structural angles, structural channels and guardrails in carbon and alloy steel. These products have a wide usage serving primarily the agricultural, automotive, construction, energy, furniture, machinery, metal building, railroad, recreational equipment, shipbuilding, heavy truck and trailer market segments. Steel bar products are used as reinforcement in concrete or masonry structures. The bar can be fabricated (i.e., cut, bent, or otherwise modified) by a fabricator or shipped directly to a job site.

Application and Codes of Practice

Steel rebar and MBQ produced by Nucor's Seattle mill are defined by the following ASTM standards:

- **ASTM A36/A36M-14** Standard Specification for Carbon Structural Steel
- **ASTM A529/A529-14** Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality [Grades 50, 55]
- **ASTM A709/A709M-16a** Standard Specification for Structural Steel for Bridges [Grades 36, 50]
- **ASTM A572/A572M-15** Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel [Grades 50, 55]
- **ASTM A615/A615M-16** Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement [Grades 40, 60, 75, 80, 100]
- **ASTM A706/A706M-16** Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement [Grades 60, 80]
- **ASTM F1554-15e1** Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength [Grade 55]

- **ASTM A588/A588M-15** Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi [345 MPa] Minimum Yield Point, with Atmospheric Corrosion Resistance [Grade B]
- **ASTM A29/A29M-15** Standard Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought [Grades 1006, 1008, 1010, 1012, 1015, 1018, 1022, 1045, 1527, 4140]
- **CSA G40.20-13/G40.21-13** General Requirements for rolled or welded structural quality steel / Structural quality steel [Grades 44W, 50W, 55W]
- **CSA G30.18M-09 (R2014)** Carbon steel bars for concrete reinforcement [Grades 400R, 500R, 400W, 500W]

Life Cycle Stages

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

Raw Materials

Steel rebar and MBQ are manufactured entirely from carbon steel. They do 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.

Inbound Transportation

Inbound transportation distances and modes for scrap steel were collected from Nucor.

Manufacturing

Nucor's Seattle facility manufacturers rebar and MBQ from secondary steel (i.e., from steel scrap) via an electric arc furnace (EAF). Steel scrap is loaded into a refractory-lined vessel and melted via electric energy supplied through graphite electrodes. Oxy-fuel burners and other means of generating heat through chemical reactions are also employed. The chemistry of the molten steel is adjusted at this stage by adding material to attain a specific alloy composition and by removing impurities, which migrate to the slag. Once the desired chemical composition is attained, the molten steel is then cast into billets for eventual processing in the rolling mill located in the same facility.

At the rolling mill, the billets are reheated in a natural gas furnace and run through rollers to shape their profile into bar products. Any steel scrap generated is recycled internally (i.e., put back into the EAF). The finished products are packaged and loaded onto trucks for distribution to fabricators or job sites.

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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 and followed LCA principles, requirements and guidelines laid out in the ISO 14040/14044 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 steel construction product. Note that comparison of EPD results on a mass basis, alone, is insufficient and should consider the technical performance of the product.

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 from primary energy resources, including upstream processes; production of all ancillary materials, pre-products, products, and co-products, including any packaging; emissions from on-site fuel combustion.

This EPD represents 2015 steel rebar and MBQ production in Nucor’s Seattle, Washington mill.

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 materials supply	**Transport**	**Manufacturing**	Transport	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Building energy use	Building water use	De-construction	Transport	Waste processing	Disposal	Reuse, recovery, recycling potential

Assumptions

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.

Allocation

System expansion is used to address the recovery and use of co-products such as slag, baghouse dust, and mill scale. 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.

Life Cycle Assessment Results and Analysis

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

Primary Energy	Results per metric ton		Results per short ton	
Use of renewable primary energy resources excluding those used as raw materials	2.95E+03	MJ LHV	2.54E+06	BTU
Use of renewable primary energy resources as raw materials	0	MJ LHV	0	BTU
Total use of renewable primary energy resources	***2.95E+03***	**MJ LHV**	**2.54E+06**	**BTU**
Use of non-renewable primary energy resources excluding those used as raw materials	5.56E+03	MJ LHV	4.78E+06	BTU
Use of non-renewable primary energy resources as raw materials	0	MJ LHV	0	BTU
Total use of non-renewable primary energy resources	**5.56E+03**	MJ LHV	**4.78E+06**	**BTU**

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Material Resource Use	Results per metric ton		Results per short ton	
Use of secondary material	1.06+00	metric ton	1.06+00	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*	1.58E+01	m^3	3.79E+03	gallons

* Evaporative losses from reservoirs used in hydroelectric power generation represent around 75% of net fresh water use.

Life Cycle Impact Assessment

Parameter	Results per metric ton		Results per short ton	
Impact Assessment Method: TRACI 2.1				
Global warming potential (GWP)	4.99E-01	metric ton CO_2 eq	4.99E-01	short ton CO_2 eq
Depletion potential of the stratospheric ozone layer (ODP)	5.12E-11	metric ton CFC-11 eq	5.12E-11	short ton CFC-11 eq
Acidification potential of soil and water (AP)	1.71E-03	metric ton SO_2 eq	1.71E-03	short ton SO_2 eq
Eutrophication potential (EP)	7.22E-05	metric ton N eq	7.22E-05	short ton N eq
Formation potential of tropospheric ozone (POCP)	2.73E-02	metric ton O_3 eq	2.73E-02	short ton O_3 eq
Impact Assessment Method: CML2001 (version v4.1)				
Abiotic depletion potential (ADP-elements)*	-2.31E-05	metric ton Sb eq	-2.31E-05	short ton Sb eq
Abiotic depletion potential (ADP-fossil)	5.11E+03	MJ	4.39E+06	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.

Other Environmental Information

Parameter	Results per metric ton		Results per short ton	
Hazardous waste disposed	6.44E-08	metric ton	6.44E-08	short ton
Non-hazardous waste disposed	3.49E-02	metric ton	3.49E-02	short ton
Radioactive waste disposed	1.74E-04	metric ton	1.74E-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 per energy carrier	0	BTU per energy carrier

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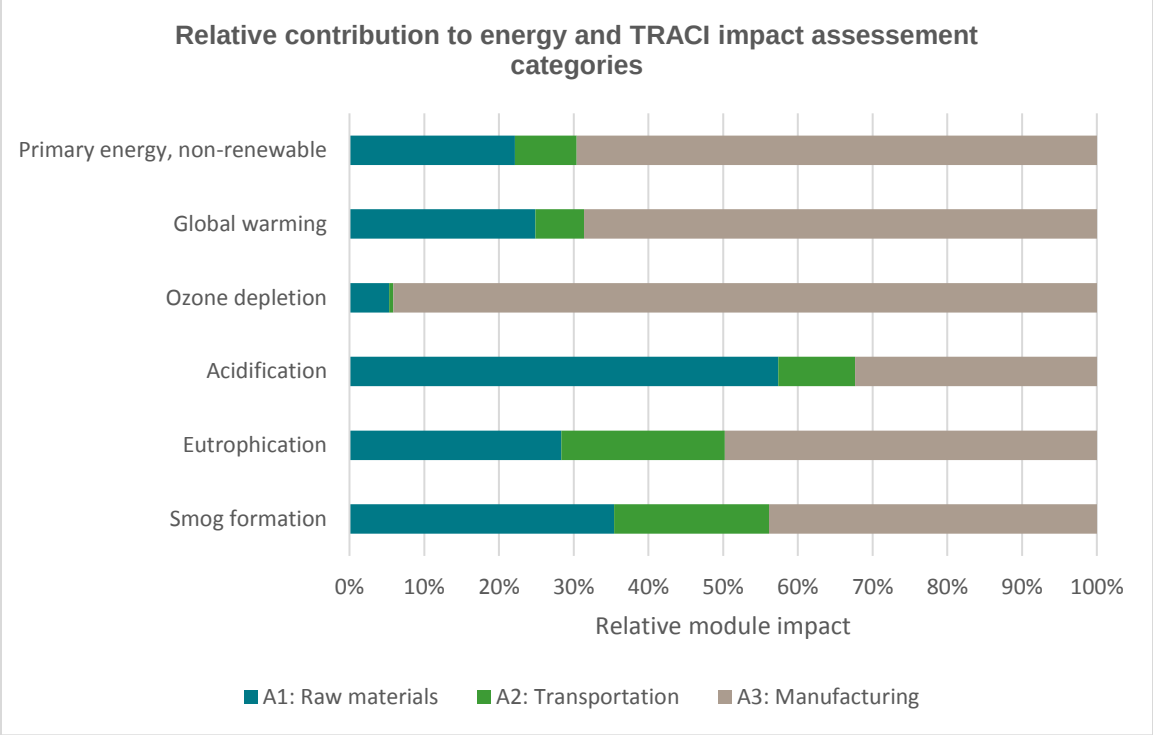
Visualization of Life Cycle Impact Assessment

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



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.

Data Quality Assessment

- **Temporal representativeness:** Primary data for production were collected for the year 2015 and for transportation for the year 2014. All secondary data come from the GaBi 2016 databases and are representative of the years 2010-2015. As the intent is to represent Nucor production in 2015, temporal representativeness is warranted.
- **Geographical representativeness:** All primary and secondary data were collected specific to the region under study. Whenever region- or country-specific background data were not readily available (e.g., for some alloy materials), European, global, or other regional data were used as proxies based on the technology required. Geographical representativeness is considered to be high.
- **Technological representativeness:** Primary data were collected for the production of steel rebar and MBQ by Nucor and represent the manufacturing technologies in use. Secondary data were chosen to be specific to the technologies or technology mixes under study. Where technology-specific data were unavailable, proxy data were used (e.g., for alloy materials). 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 (http://www.gabi-software.com/international/support/gabi/).
- **Completeness:** Each unit process was checked for mass balance and completeness of the emissions inventory. No foreground data were knowingly omitted. Completeness of foreground unit process data is considered to be high. All background data are sourced from GaBi databases with the documented completeness.
- **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 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 and MBQ production were provided by Nucor. Secondary data were obtained from the GaBi 2016 databases. Data were cross-checked for completeness and plausibility and, when possible, benchmarked against existing numbers.
- **Uncertainty:** Nucor provided complete facility data that were cross-checked and benchmarked against existing numbers. Some proxy data were used for alloy materials—for instance, aluminum to represent ferro-aluminum and ferro-manganese to represent silico-manganese. In general, technological routes of material production are similar so representativeness is warranted.

Additional Environmental Information

Nucor Steel Seattle's environmental management system has been accredited to the ISO 14001 standard since 2009. In terms of safety, Nucor has attained Voluntary Protection Program certification from OSHA to demonstrate our commitment to leading the industry by example.

As Seattle City Light's largest customer, Nucor is involved in the HPEM program, which helps industries best mark

practices and technology with the goal of identifying projects that could reduce electricity usage.

Nucor also participates in the Network for Business Innovation and Sustainability (NBIS) By-Product Synergy Group. This NBIS group brings together environmental experts from a wide variety of industries to allow them to compare waste streams and find ways to divert materials from landfills.

Contact Information

Study Commissioner

Nucor Steel Seattle, Inc.
(206) 933-2238
patrick.jablonski@nucor.com
http://www.nucor.com

LCA Practitioner

thinkstep, Inc.
+1 (617) 247-4477
info@thinkstep.com
http://www.thinkstep.com