ENVIRONMENTAL PRODUCT DECLARATION

HOT-ROLLED SHEET

NUCOR CORPORATION

NUCOR®

The Nucor Sheet Mill Group produces recycled steel sheet products at scrap-based mills strategically located across the United States. These mills produce a range of steel products, including hot-rolled sheet, floor plate, cold-rolled sheet, galvanized sheet, and galvannealed sheet. Nucor's sheet products contain 59.4% recycled content, and the capacity of Nucor's sheet mills is estimated at approximately 12.1 million tons per year. The Nucor Sheet Mill Group produces flat-rolled steel for a variety of industrial and consumer applications, including automotive, appliance, construction, pipe, and tube.

Nucor is North America's largest recycler, turning approximately 21.4 million net tons of scrap steel in 2021 into new steel. Nucor uses Electric Arc Furnace (EAF) technology at each of its steel recycling facilities.

EAFs use post-consumer scrap as its major feedstock, unlike traditional blast furnace steelmaking, which produces more than 70% of the world's steel using mined iron ore and metallurgical coal as feedstock. Through its use of EAFs, Nucor's steelmaking energy intensity is approximately one-quarter the global average and one-fifth the average integrated (BF/BOF) steel producer.

ASTM INTERNATIONAL
Helping our world work better

ENVIRONMENTAL PRODUCT DECLARATION

NUCOR®

ASTM INTERNATIONAL
Helping our world work better

Hot-Rolled Sheet
Designated Steel Construction Product

According to ISO 14025, and ISO 21930:2017

EPD PROGRAM AND PROGRAM OPERATOR NAME, ADDRESS, LOGO, AND WEBSITE	ASTM INTERNATIONAL 100 BARR HARBOR DRIVE P.O. BOX C700 WEST CONSHOHOCKEN, PA 19428-2959, USA HTTPS://WWW.ASTM.ORG/
GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER	ASTM Program Operator for Product Category Rules (PCR) and Environmental Product Declarations (EPDs), General Program Instructions, Version: 8.0, Revised 04/29/20.
MANUFACTURER NAME AND ADDRESS	Nucor Corporation, 1915 Rexford Road, Charlotte, North Carolina 28211
DECLARATION NUMBER	**EPD 449**
DECLARED PRODUCT & FUNCTIONAL UNIT OR DECLARED UNIT	Hot-Rolled Sheet, 1 metric ton
REFERENCE PCR AND VERSION NUMBER	Part A: Life Cycle Assessment Calculation Rules and Report Requirements (UL Environment, V3.2, 12.12.2018) and Part B: Designated Steel Construction Product EPD Requirements (UL Environment, V2.0, 08.26.2020).
DESCRIPTION OF PRODUCT APPLICATION/USE	Hot rolled sheet used in automotive, appliance, and construction.
PRODUCT RSL DESCRIPTION (IF APPL.)	N/A
MARKETS OF APPLICABILITY	North America
DATE OF ISSUE	**4/21/2023**
PERIOD OF VALIDITY	**5 years**
EPD TYPE	Product-Specific
EPD SCOPE	Cradle to Gate
YEAR(S) OF REPORTED PRIMARY DATA	2021
LCA SOFTWARE & VERSION NUMBER	GaBi v10.6.2.9
LCI DATABASE(S) & VERSION NUMBER	GaBi 2022.2
LCIA METHODOLOGY & VERSION NUMBER	TRACI 2.1

The PCR review was conducted by:	**Dr. Tom Gloria, Chair, Industrial Ecology Associates**
This declaration was independently verified in accordance with ISO 14025: 2006. ☐ INTERNAL ☒EXTERNAL	**Timothy S. Brooke, ASTM International**
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	**Trinity Consultants**
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	**Lindita Bushi, Ph.D., Athena Sustainable Materials Institute)**

NUCOR®

ASTM INTERNATIONAL
Helping our world work better

Hot-Rolled Sheet
Designated Steel Construction Product

According to ISO 14025, and ISO 21930:2017

LIMITATIONS
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. Environmental declarations from different programs (ISO 14025) may not be comparable.

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; the level of accuracy in estimation of effect differs for any particular product line and reported impact.

Comparability: EPDs from different programs may not be comparable. Full conformance with a PCR allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible". Example of variations: Different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared.

This declaration was independently verified in accordance with ISO 14025: 2006. The UL Environment "Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report," v3.2 (December 2018), in conformance with ISO 21930:2017, serves as the core PCR, with additional considerations from the USGBC/UL Environment Part A Enhancement (2017).

ENVIRONMENTAL PRODUCT DECLARATION

NUCOR®

ASTM INTERNATIONAL
Helping our world work better

Hot-Rolled Sheet
Designated Steel Construction Product

According to ISO 14025, and ISO 21930:2017

1. PRODUCT DEFINITION AND INFORMATION

Description of Organization

This environmental product declaration (EPD) represents hot-rolled sheet produced via an electric arc furnace (EAF) from Nucor Steel-Berkeley (Huger, SC), Nucor Steel-Gallatin (Ghent, KY), Nucor Steel-Indiana (Crawfordsville, IN), Nucor Steel-Decatur (Trinity, AL), and Nucor Steel-Arkansas (Blytheville, AR). As a vertically integrated company, Nucor controls a large and growing part of its supply chain from scrap recycling to raw steelmaking to steel products and distribution. All of the steel produced by Nucor is 100% recyclable at the end of its useful life.

For production of the hot-rolled sheets in Nucor's sheet mills, Nucor uses scrap as its primary feedstock, which is largely provided by its wholly-owned subsidiary, the David J. Joseph Company (DJJ). DJJ operates more than 60 scrap recycling facilities within close proximity to Nucor steel mills, processing approximately 5,000,000 tons of ferrous scrap annually and providing an abundant supply of scrap to the steel mills. Having an abundant and reliable supply of recycled scrap with close proximity not only gives Nucor's steel mills a logistical and economic advantage over their competitors, but also a carbon footprint that is a fraction of the average steel producer.

Product Description

Hot-rolled sheet steel are used in automotive, appliance, construction, pipe and tube and many other industrial and consumer applications. These products are flat-rolled to their final thickness by rolling at high temperatures on a hot-rolling mill. Hot-rolled sheet steel can then either be packaged and transported off site for distribution or be further processed in cold mills. Hot-rolled sheet in this EPD represent product manufactured in North America from steel product produced in North America.

Hot-rolled sheet steel produced by Nucor are defined by the following steel standards:

- American Society for Testing and Materials (ASTM) grades for:
  - Carbon Structural Steel (A36)
  - Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over) (A139)
  - Electric-Resistance-Welded Carbon Steel and Carbon-Manganese Steel Boiler and Superheater Tubes (A178)
  - Welded and Seamless Steel Pipe Piles (A252); Steel, Sheet, Carbon, and High-Strength, Low-Alloy for Pressure Vessels (A414)
  - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes (A500)
  - High-Strength Low-Alloy Columbian-Vanadium Structural Steel (A572)
  - High-Strength Low-Alloy Structural Steel, up to 50 ksi [345 MPa] Minimum Yield Point, with Atmospheric Corrosion Resistance (A588)
  - Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance (A606); Structural Steel for Bridges (A709)
  - Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates (A786)
  - High-Strength Low-Alloy Structural Steel Plate With Atmospheric Corrosion Resistance (A871)
  - Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength (A1011)
  - Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength (A1018)
- Coils for conversion to ASTM grades for Structural Quality plates (A6) and Pressure Vessel Quality plates (A20)
- Coils for conversion to CSA G40.21 plates (CSA grades 38W, 38WT, 44W, 44WT, 50W, 50WT, 50A, 50AT, 60W, 60WT, 70W, 70WT)
- Coils for conversion to API 5L Linepipe and API 5CT Casing
- European Normative coil products covered by EN 10025 and EN 10149

The United Nations Standard Products and Service Code (UNSPSC) and the Construction Specifications Institute (CSI) / Constructions Specifications Canadian (CSC) classification identified for hot-rolled sheet products are:

- CSI MasterFormat Code: 07 60 00 Flashing and Sheet Metal
- UNSPSC Code: 30264001 Carbon steel SAE 1000 series hot rolled sheet

Product Average

The 2021 production data used in this EPD considers hot-rolled sheet steel produced by Nucor during the year. The products are manufactured at five locations in the US. Results are weighted according to production totals at all locations. Facility-specific global warming potential results are provided in a separate table.

Application

Hot-rolled sheet steel is used in construction, automotive, appliance, and many other industrial applications.

Declaration of Methodological Framework

The scope of the EPD is cradle-to-gate, including raw material extraction and processing, upstream transportation, and product manufacture (Modules A1, A2, and A3).

Technical Requirement

Technical data for the studied product can be found in the table below.

Table 1. Technical data for steel product

NAME	VALUE	UNIT
Density	7,800	kg/m^3
Melting point	1425-1450	°C
Electrical conductivity at 20°C	NA	% of IAC[8]
Thermal conductivity	NA	W/(m-K)
Coefficient of thermal expansion	NA	m/m-ºC
Modulus of elasticity	NA	N/mm^2
Shear modulus	NA	N/mm^2
Specific heat capacity	NA	J/kg-ºC
Hardness, Brinell Number	80-100	HB
Yield strength	250-550	N/mm^2
Ultimate tensile strength	410-655	N/mm^2
Breaking elongation	13-20	%
Chemical composition	Varies by ASTM Specification/Grade	% by mass

Properties of Declared Product as Delivered

Hot-rolled sheet steels can either be transported off site for distribution to fabricators or be further processed in cold mills prior to being distributed to fabricators.

Material Composition

Hot-rolled sheet steels are manufactured from recycled scrap (59.4%), direct reduced iron and pig iron. 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. The products do not contain any hazardous substances according to the Resource Conservation and Recovery Act (RCRA), Subtitle 3. The products do not release dangerous substances to the environment, including indoor air emissions, gamma or ionizing radiation, or chemicals released to air or leached to water and soil.

Manufacturing

The Nucor Sheet Mills use EAF technology to produce steel from recycled scrap metal or scrap substitutes. Scrap metal or scrap substitutes are received via rail, truck and/or barge and are inspected and sorted into piles located within the on-site scrapyard. Scrap or scrap substitutes are moved from the scrapyard via trucks to the scrap buckets located in the melt shop. Scrap buckets are picked up using an overhead charging crane and dumped into the top of the EAFs. Once the EAFs are charged with scrap, electric current is applied via large electrodes made of graphite or other high carbon material to melt the raw materials. Other raw materials are introduced to assist the melting process. Once the ideal melt conditions have been reached, ladles are placed at the tapping side of the EAFs, the furnaces are de-energized, and the molten steel is poured into the ladles. The ladles transport the molten steel to a ladle metallurgical furnace (LMF) which promote a more homogeneous mixture. Additional additives may include various metal alloys to achieve the desired composition and steel grade of the final steel product. The molten steel is then transported to the casters where the steel begins to cool and solidify into slabs. The steel slabs then enter the tunnel furnaces, coiler and bander, from which they are outputted as hot-rolled sheet steel. Metal scrap generated during manufacturing is recycled externally.

The life cycle phases included in this study are illustrated in Figure 1.

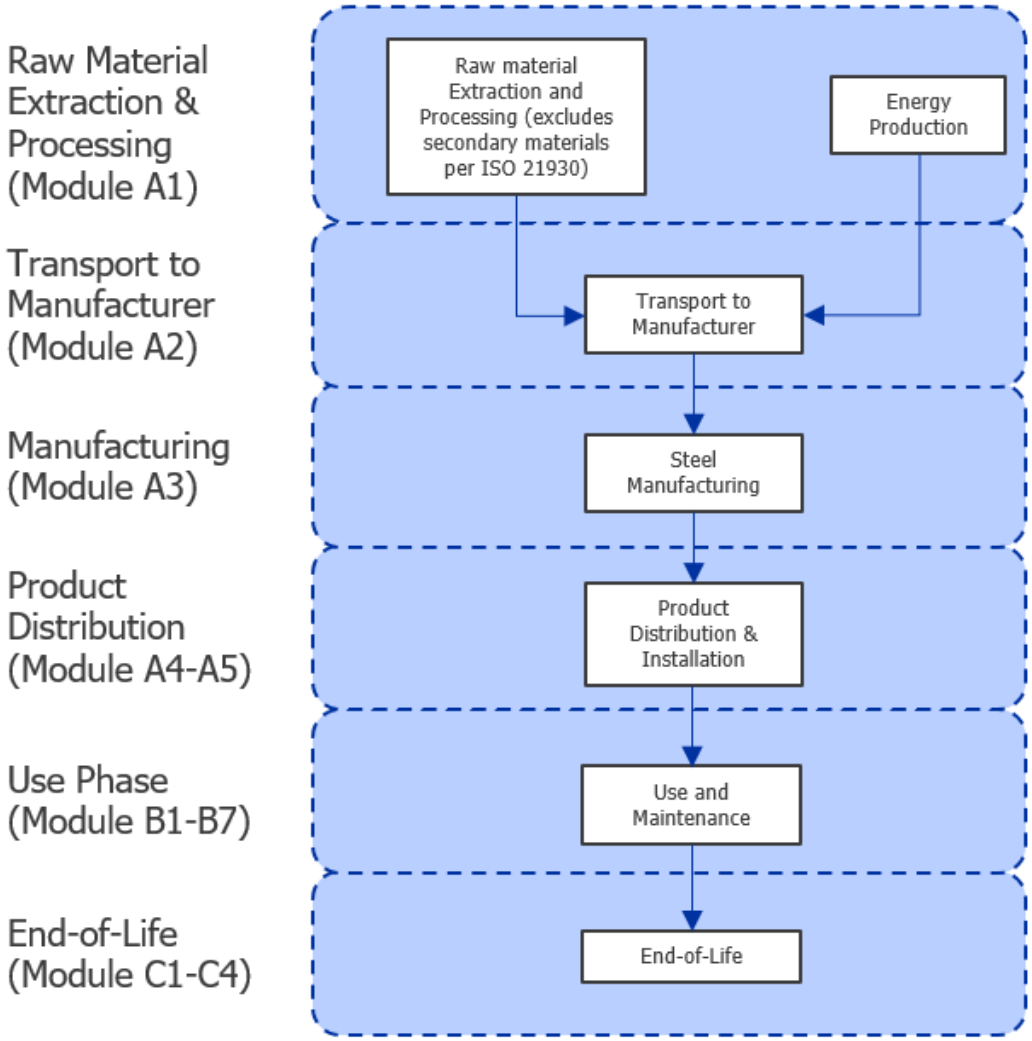

Figure 1: Flow chart for product system

Packaging

Packaging at Nucor's Sheet Mills facilities falls below the cut-off criteria and therefore it is not included in the LCA for this EPD.

2. LCA CALCULATION RULES

Declared Unit

The declared unit is one (1) metric ton of steel product.

System Boundary

Per the PCR, this cradle-to-gate analysis provides information on the Product Stage of the steel product life cycle, including modules A1, A2, and A3. Product delivery, installation and use, and product disposal (modules A4 – A5, B1 – B7, C1 – C4, and D) have not been included.

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARY
Raw material supply	Transport	Manufacturing	Transport	Construction/Install	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	Deconstruction & Demolition	Transport	Waste Processing	Disposal	Reuse, Recovery, Recycling Potential
A1	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

X = Module declared
MND = Module not declared

Cut-off Rules

According to the PCR, processes contributing greater than 1% of the total environmental impact indicator for each impact are included in the inventory. In cases where no matching life cycle inventories were available to represent a flow, proxy data were applied based on conservative assumptions regarding environmental impacts. No data gaps were allowed which were expected to significantly affect the outcome of the indicator results. No other known flows are deliberately excluded from this EPD.

The mass input of each omitted stream is less than 1% of the total mass input streams into the system and the cumulative mass input of all omitted streams is less than 5% of the total mass input streams. Therefore, no data gaps were allowed which were expected to significantly affect the outcome of the indicator results.

Data Sources

The LCA model was created using the GaBi Software system for life cycle engineering, version 10.6.2.9, developed by Sphera (Sphera, 2021). Background life cycle inventory data for raw materials and processes were obtained from the GaBi 2022.2 database. Primary manufacturing data and fabrication data were provided by Nucor.

NUCOR®

ASTM INTERNATIONAL
Helping our world work better

Hot-Rolled Sheet
Designated Steel Construction Product

According to ISO 14025, and ISO 21930:2017

Data Quality

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

Production data has been collected by Nucor directly from the production sites and are average values for the year 2021 (12 consecutive months of averaged data as required for manufacturer specific data sets). The data has been measured and verified internally. The data is assumed to be the most relevant according to current conditions and production practices. Based on availability of data, natural gas and electricity usage for the operation of administrative offices was included in the system boundary for some facilities.

Time-related coverage, geographical coverage, technological coverage, precision, completeness, representativeness, consistency, reproducibility, sources of data, and uncertainty have each been analyzed as part of this LCA. All inputs and data sources meet the requirements set forth in the PCR and there is no reason to believe that any of the employed material, data, or inputs are not representative of the product under study.

Geographical Coverage

Primary data represents production in the United States at the following Nucor facilities:

- Nucor Steel Berkeley – Huger, SC
- Nucor Steel Gallatin – Ghent, KY
- Nucor Steel Indiana – Crawfordsville, IN
- Nucor Steel Decatur – Trinity, AL
- Nucor Steel Arkansas – Blytheville, AR

Regionally specific datasets, where available, were used to represent each manufacturing location's energy consumption. Proxy datasets were used as needed for raw material inputs to address lack of data for a specific material or for a specific geographical region. These proxy datasets were chosen for their technological representativeness of the actual materials.

Period under Review

Primary data collected represent production during the 2021 calendar year. This analysis is intended to represent production in 2021.

Allocation

Per ISO 21930 and the PCR, this is an attributional LCA and as such, no allocation using system expansion was performed. Allocation of background data (energy and materials) taken from the GaBi 2021 databases is documented online at http://www.gabi-software.com/international/support/gabi/.

The Nucor Sheet Mills EAFs produce steel slabs and slag. All slag is sold as-is. Steel slabs continue onto the rolling mill to be rolled into sheet steel. The slag and steel slabs are considered co-products of the product system resulting from a joint co-production process. Therefore, this study allocated the environmental burden upstream of the rolling mill between the slag and sheet steel.

Performing an energy balance around the EAFs showed that 93.3% of overall production's energy is used to bring the steel (including steel billet and steel product) to the required temperature in the steelmaking vessel, while the remaining 6.7% of the energy is used to form the molten slag. Therefore, for most flows into and out of the EAFs, 93.3% of environmental impacts were allocated to steel (including steel billet and steel product), and 6.7% of impacts were allocated to slag.

Per ISO 21930 7.2.5.2, the life cycle inventory of joint co-production processes "should be allocated between the products and co-products in a way that reflects the underlying physical relationships between them, i.e. they should reflect the way in which the inputs and outputs are changed by quantitative changes in the products or functions delivered by the system." The World Steel Association has developed a methodology to allocate life cycle impact for slag from the steel-making process that applies to the EAF route [1]; this methodology was used to partition impacts between the slag and steel.

[1] Report available at: https://worldsteel.org/wp-content/uploads/A-methodology-to-determine-the-LCI-of-steel-industry-co-products.pdf..

Estimates and Assumptions

The underlying study was conducted in accordance with the PCR. While this EPD has been developed by industry experts to best represent the product system, real life environmental impacts of unfabricated steel products may extend beyond those defined in this document.

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.

Raw Material procurement and upstream transport to Nucor Sheet Mills facilities are included for all raw materials above the cut-off thresholds. For each raw material, a representative dataset was selected to represent the geographic region of origin. Distances by truck and rail were estimated using Google Maps. Distances by ship were estimated using sea-distances.org.[2] In some cases, the Nucor Sheet Mills facilities sourced a single raw material from multiple distributors, in which case the transport from every distributor was modeled. Only travel to the facility is accounted for (i.e., return truck and rail trips are considered out of scope).

[2] https://sea-distances.org/

3. LCA RESULTS

North American life cycle impact assessment (LCIA) results are declared using TRACI 2.1 methodology, with the exception of GWP which uses the IPCC AR5 methodology. LCIA results are relative expressions and do not predict actual impacts, the exceeding of thresholds, safety margins or risks.

The six impact categories reported in the LCIA tables below are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development. However, the EPD users shall not use additional measures for comparative purposes.

Table 2. LCIA results, per 1 metric ton of unfabricated product [a]

PARAMETER	UNIT	A1	A2	A3	TOTAL
GWP 100	kg CO_2 eq.	7.21E+02	3.99E+01	4.83E+02	1.24E+03
ODP	kg CFC 11 eq.	2.71E-08	4.14E-13	3.01E-06	3.04E-06
AP	kg SO_2 eq.	2.52E+00	7.07E-01	9.95E-01	4.22E+00
EP	kg N eq.	8.74E-02	3.11E-02	7.65E-02	1.95E-01
SFP	kg O_3 eq.	3.86E+01	1.57E+01	1.48E+01	6.92E+01
ADP_{FOSSIL}	MJ surplus LHV	8.01E+02	6.90E+01	3.31E+02	1.20E+03

a. Results represent a production-weighted average of the five Nucor Sheet Mill facilities.

Table 3. Resource use results, per 1 metric ton of unfabricated product [a,b]

PARAMETER	UNIT	A1	A2	A3	TOTAL
RPR_E	MJ LHV	3.88E+02	2.33E+01	4.16E+02	8.27E+02
RPR_M	MJ LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	MJ LHV	1.01E+04	5.44E+02	5.95E+03	1.66E+04
$NRPR_M$	MJ LHV	4.25E+02	0.00E+00	0.00E+00	4.25E+02
SM	kg	7.55E+02	0.00E+00	0.00E+00	7.55E+02
RSF	MJ LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE	MJ LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	1.59E+00	5.86E-02	2.76E+00	4.41E+00

a. Lower calorific values (LHV) of fuels are used for energy parameters.
b. Results represent a production-weighted average of the five Nucor Sheet Mill facilities.

Table 4. Output flows and waste categories results, per 1 metric ton of unfabricated product [a,b]

PARAMETER	UNIT	A1	A2	A3	Total
HWD	kg	1.97E-05	4.05E-09	1.11E+01	1.11E+01
NHWD	kg	1.18E+01	4.42E-02	2.66E+01	3.84E+01
HLRW	kg	4.54E-05	7.52E-06	8.03E-04	8.56E-04
ILLRW	kg	4.01E-02	6.29E-03	6.71E-01	7.18E-01
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	kg	0.00E+00	0.00E+00	7.81E+02	7.81E+02
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00

a. Lower calorific values (LHV) of fuels are used for energy parameters.
b. Results represent a production-weighted average of the five Nucor Steel Mill facilities.

Any comparison of EPDs shall be subject to the requirements of ISO 21930. Environmental impact results shall be converted to a functional unit basis before any comparison is attempted. 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.

To align with the PCR, “product specific EPDs which include averaging shall report the range of results for all IPCC AR5 and TRACI indicators for products included in the average.” Averaging across manufacturing facilities was used in this EPD, so Table 5 reports the range of results for the six impact categories included in Table 2.

Table 5. LCIA results, variation per 1 metric ton of unfabricated product [a]

PARAMETER	UNIT	A1 (MIN)	A1 (MAX)	A2 (MIN)	A2 (MAX)	A3 (MIN)	A3 (MIN)	TOTAL (MIN)	TOTAL (MAX)
GWP 100	kg CO_2 eq.	5.56E+02	9.82E+02	2.54E+01	4.90E+01	3.91E+02	5.58E+02	1.03E+03	1.58E+03
ODP	kg CFC 11 eq.	1.98E-08	3.60E-08	1.32E-13	7.96E-13	9.20E-11	1.24E-05	2.50E-08	1.24E-05
AP	kg SO_2 eq.	1.79E+00	3.34E+00	1.83E-01	1.14E+00	5.23E-01	1.36E+00	2.93E+00	5.60E+00
EP	kg N eq.	5.90E-02	1.15E-01	1.45E-02	4.20E-02	5.91E-02	9.90E-02	1.60E-01	2.56E-01
SFP	kg O_3 eq.	2.53E+01	5.16E+01	6.17E+00	2.30E+01	9.96E+00	2.07E+01	5.09E+01	8.98E+01
ADP_{FOSSIL}	MJ surplus	2.63E+02	9.86E+02	4.71E+01	8.23E+01	2.28E+02	4.80E+02	7.37E+02	1.47E+03

a. Results compared based on 1 metric ton of unfabricated product produced by each facility.

4. LCA INTERPRETATION

To facilitate a more detailed understanding of the contributions from different mill processes, an analysis is included in this section which details the contribution from Modules A1, A2, and A3. The results in Figure 3 are shown below for sheet steel products to facilitate a better understanding of which categories contribute most to which impacts.

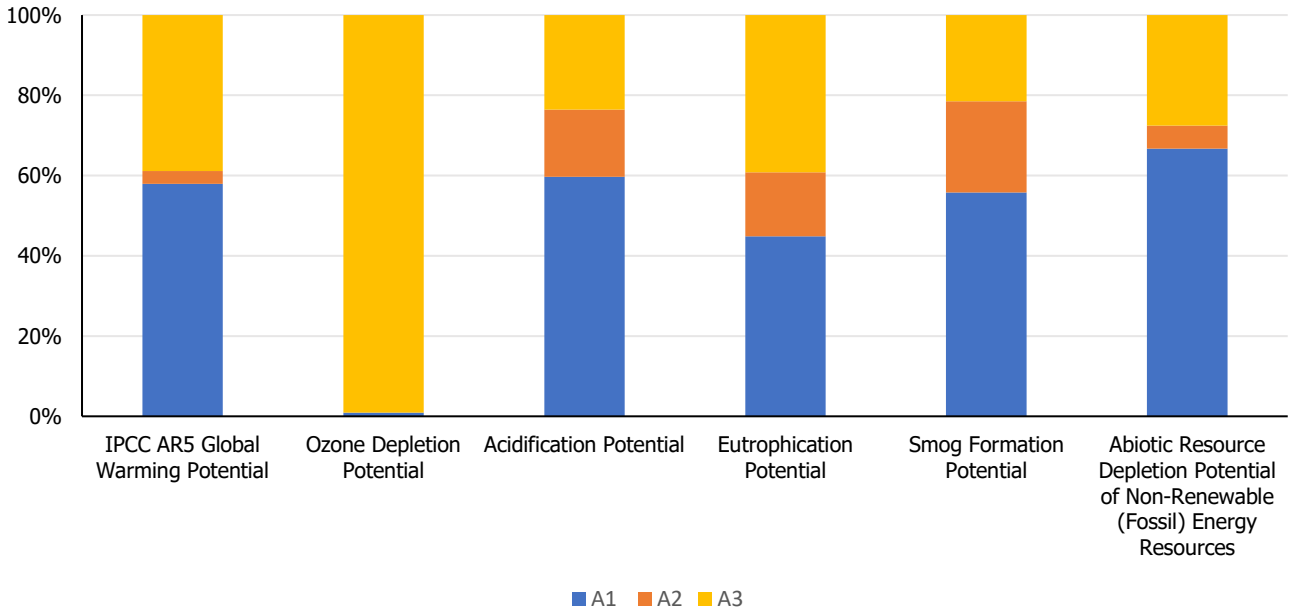

Figure 3: Relative contributions by module, IPCC AR5 + TRACI 2.1 impact categories

The impact assessment results indicate that Module A3, i.e. manufacturing, which includes purchased electricity generation, on-site natural gas and diesel combustion, and facility emissions is the key contributor to the potential environmental impact for ozone depletion potential. Module 1, i.e. raw material procurement, is a key contributor to global warming potential, acidification, eutrophication, smog formation, and abiotic resource depletion of fossil energy resources. Module A2, i.e. transport to manufacturer, is not the most significant contributor to any impact category.

Facility-Specific GWP 100 Results

Nucor's hot-rolled steel products are manufactured at five different facilities. The results presented in the LCA Results section above represent a production-weighted average of these facilities. To understand how the GWP may vary between sites, facility specific GWP 100 results are presented below, per metric ton, in Table 6.

Table 6. Facility-specific GWP 100 results, per 1 metric ton of unfabricated product

GWP 100 (kg CO_2 eq.)	A1	A2	A3	TOTAL
Berkeley (Huger, SC)	982.01	43.53	558.22	1583.76
Indiana (Crawfordsville, IN)	556.02	49.05	458.06	1063.13
Arkansas (Blytheville, AR)	701.46	37.35	557.30	1296.11
Decatur (Trinity, AL)	596.81	39.27	390.71	1026.80
Gallatin (Ghent, KY)	751.43	25.39	432.89	1209.71

5. ADDITIONAL ENVIRONMENTAL INFORMATION

Health and Safety

Health: Refer to the specific Nucor product SDS for health, safety, and proper handling information.[3]

Safety: Since 2005, Nucor has partnered with the Occupational Safety and Health Administration (OSHA) through its Voluntary Protection Program (VPP), which recognizes companies that voluntarily go the extra mile to meet rigorous safety standards. The Voluntary Protection Program (VPP) recognizes employers and workers in private industry and federal agencies who have implemented effective safety and health management systems and maintain injury and illness rates below national Bureau of Labor Statistics averages for their respective industries. An important aspect of VPP is the Special Government Employee (SGE) Program, which allows industry employees to work alongside OSHA and of which approximately 640 Nucor employees are active participants as of September 2018.

Four Nucor divisions employ the American National Standards Institute (ANSI) Z-10 Occupational Health and Safety Management System. And four others participate in the OSHA Series (OSHAS) 45001 Divisions. ANSI Z-10 is audited to best practices and in safety and health. OHSAS 45001 is an international safety and health system that provides a framework to promote better safety and health systems.

Environmental Activities and Certifications

ISO 14001:2015 Environmental Management System: The environmental performance of Nucor's steel mills focuses on continuous improvement through internal and external training, application of new technologies and how data and results are communicated. To provide a framework for Nucor teammates to follow, Nucor utilizes ISO 14001, which is the international standard that establishes specific requirements for an effective environmental management system (EMS). The Nucor Sheet Mills' environmental management system are accredited to the ISO 14001 standard.

Sustainability: Through recycling, Nucor has made the United States the cleanest place in the world to make steel. We are producing the sustainable steel that will build our modern 21st century economy. For more than 50 years, Nucor has been making steel using an EAF that melts recycled scrap and turns it into new steel. EAFs are far less energy intensive and more energy efficient than traditional blast furnace steel making. Electric arc furnaces allow Nucor to produce less emissions than competitors who often make steel by melting iron ore and coking coal.

By recycling scrap in EAFs, Nucor's energy intensity (average gigajoules per metric ton of steel produced) is 74% lower than the global average, and its greenhouse gas intensity (metric tons CO2 per ton of steel produced) is less than one-third the global average, and nearly one-fifth of the average integrated (BF/BOF) steel producer. Today, Nucor's greenhouse gas emissions intensity is less than one-third of the Paris Climate Agreement's most aggressive 2030 target for the global steel sector, the below 2 degrees Celsius benchmark compared to pre-industrial levels.

Today, Nucor accounts for more than 25% of the United States' steel production, but only accounts for 8% of the domestic steel industry's greenhouse gas emissions. However, Nucor realizes that being one of America's cleanest and most efficient steelmakers is not enough. That is why Nucor is committing to a 35% combined reduction in its steel mill Scope 1 and Scope 2 greenhouse gas intensity by 2030, measured against a 2015 baseline. This goal will take Nucor's steel mill CO2 emissions down to 77% less than today's global steelmaking average, and 82% less than today's integrated steelmaking average. Beyond 2030, Nucor is committed to further reducing its greenhouse emissions to a goal of net zero emission steel at scale.

Nucor also recently launched its Econiq™ product line, which is the world's first net-zero steel available at scale. Econiq is not a single product; it is a net-zero certification, which can be applied to any product from Nucor's steel mills by balancing the CO2 produced by our activities by an equivalent amount being removed. We

[3] https://www.theboralroofing.com/wp-content/uploads/boral-resource/Steel-NUCOR-SDS-sheet.pdf

achieve net-zero on Econiq products by eliminating all remaining Scope 2 emissions (by using 100% renewable electricity certificates) and by offsetting all Scope 1 emissions (through the purchase of carbon offsets). Per the requirements of the Product Category Rule for Building-Related Products and Services in North America, Part A, Renewable Electricity Certificates are not included in this LCA. Nucor shipped its first Econiq steel to a commercial customer in January 2022.

Recycled Materials Content: Nucor proudly uses recycled scrap to make high-quality steel with low emissions, using one of the cleanest and most energy efficient steel-making processes available. Steel can be infinitely recycled and reused without any quality loss. Nationwide, Nucor steel products are made from an average of 75.4% recycled content, with some products containing as almost 100% recycled content. Nucor Sheet Products use an average of 59.4% recycled scrap to produce new sheet steel products that are 100% recyclable at the end of their useful life.

Globally, only 26.3% of the more than 2 billion net tons of steel produced in 2020 was made by recycling scrap in EAFs – and EAFs only accounted 9.2% of the 1.17 billion net tons of steel made in China. Scrap inputs for the total crude steel production globally have remained at around 35% since 2013. To effectively address the goals set by the Paris Climate Agreement, the International Energy Agency recommends that the global market share needs to reach over 40% by 2030 – less than half the percentage that Nucor Sheet Mills use in their day-to-day production today.

Waste and Water Recycling: Nucor's EAFs, including the ones at its steel mills, emit less than 1% of the particulate matter of a traditional steel blast furnace – and the company recycles 99 percent of the EAF dust it collects in its baghouses. Nucor also recognizes that water is a critical natural resource and is essential to our business and the communities in which it operates. Nucor has worked extensively to improve water use efficiency in its processes. One hundred percent of the process water from Nucor's steelmaking operations is recycled multiple times at its steel mills. Currently there are no Nucor steel mill division located in a High or Extremely High Water Stress Area.

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.

Clean Energy: As America's cleanest and most efficient steel company, Nucor is increasing its utilization of renewable energy and supporting the continued growth of clean power generation in the United States.

In November 2020 and March 2021, Nucor entered two Virtual Power Purchase Agreements (VPPAs) which support the development of more than 350 megawatts of new clean energy infrastructure, making Nucor the 7th largest corporate buyer of renewable energy in America, and the largest of any steel producer.

The VPPAs enable the construction of 250MW of new solar energy and 100MW of new wind energy in Texas. Together, these two projects are equal to the electricity usage of nearly 70,000 Texas homes, and have the potential to supply renewable power to the regional electric grid 24-hours a day.

Environmental Training: In 2015, Nucor established Nucor Environmental University (NEU), an online training platform for Nucor teammates with environmental responsibilities and others looking to expand their involvement with the environmental team. From the beginning, Nucor designed this program to help teammates develop a thorough and meaningful understanding of environmental compliance. NEU has had over 1,000 active users since its inception and Nucor teammates have completed at least 10,000 environmental training courses, passed over 6,600 training exams, and helped develop dozens of courses. Because of NEU, Nucor's teammates are better prepared to meet the demands of environmental compliance and achieve Nucor's goal of being a sustainable organization.

Living Building Challenge: Nucor's Sheet Mills are compliant with the Living Building Challenge (LBC)'s I-13 Red List. LBC is a green building standard with a goal to create "Living Buildings" that incorporate sustainable design solutions that actually improve the local environment rather than focusing on environmental impact reduction. LBC's I-13 Red List represents the "worst in class" materials, chemicals, and elements known to pose serious risks to human health ecosystems that are common in the building products industry. The International Living Future Institute (ILFI) believes that these materials should be phased out of production due to human and/or environmental health and toxicity concerns. ILFI, based in Berkeley and Portland, is an

environmental NGO committed to catalyzing the transformation toward communities that are socially just, culturally rich and ecologically restorative.

6. REFERENCES

- ISO. (2006). *ISO 14044:2006/Amd.1:2017/Amd.2:2020: Environmental management - Life cycle assessment - Requirements and guidelines.*
- ISO. (2006). *ISO 14040/Amd.1:2020: Environmental management - Life cycle assessment - principles and frameworks.*
- ISO. (2006). *ISO 14025: Environmental labels and declarations - Type III environmental declarations - principles and procedures.*
- ISO. (2017). *ISO 21930: Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services.*
- Nucor. (2022). *2021 Recycled Content Averages for Nucor Steel Mill Products.*
- Sphera. (2021). *GaBi LCA Database Documentation. Retrieved from Sphera Solutions, Inc.:* http://www.gabi-software.com/america/support/gabi/
- UL Environment. (2018). *Product Category Rules for Building-Related Products and Services - Part A: Life Cycle Assessment Calculation Rules and Report Requirements, v3.2.*
- UL Environment. (2020). *Part B: Designated Steel Construction Product EPD Requirements, v2.0.*
- World Steel Association. (2014). *A methodology to determine the LCI of steel industry co-products.*

6. CONTACT INFORMATION

Study Commissioner

NUCOR®

NUCOR CORPORATION
1915 Rexford Road
Charlotte, NC 28211
Ph: 704.366.7000
www.nucor.com

LCA Practitioner

Trinity Consultants

TRINITY CONSULTANTS, INC.
12700 Park Central Drive, Suite 2100
Dallas, TX 75251
https://www.trinityconsultants.com/