ENVIRONMENTAL PRODUCT DECLARATION

HIGH-CARBON STEEL PLATE

ARKANSAS STEEL ASSOCIATES, LLC

Arkansas Steel Associates, LLC (ASA) is North America's leading producer of railroad tie-plates. Tie-plate is one of the railroad components that is used to fix rail to the railroad tie and keep the rail stable. ASA has the ability to produce approximately 145,000 metric tons of high-carbon tie-plates each year.

This report provides the results of a cradle-to-gate life cycle assessment (LCA) for the Environmental Product Declaration (EPD) of the high-carbon tie-plate product (herein referred to as "HCTP") produced at Arkansas Steel Associates in Newport, Arkansas. ASA produces tie-plates to meet both American Railway Engineering and Maintenance-of-Way Association (AREMA) and customer specifications.

ASA uses Electric Arc Furnace (EAF) technology its steel manufacturing facility. 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.

ENVIRONMENTAL PRODUCT DECLARATION

Arkansas Steel Associates, LLC

High-Carbon Steel Plate
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 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	Arkansas Steel Associates, LLC, 2803 Van Dyke Rd, Newport, AR 72112
DECLARATION NUMBER	EPD 991
DECLARED PRODUCT & FUNCTIONAL UNIT OR DECLARED UNIT	High-Carbon Tie-Plate (HCTP), 1 metric ton
REFERENCE PCR AND VERSION NUMBER	ISO 21930:2017 serves as the core PCR and UL Part A: UL Environment (2018). PCR for Building-Related Products and Services - Part A: Calculation Rules for the LCA and Requirements, UL 10010 v.3.2 and UL Part B: Designated Steel Construction Product EPD Requirements (UL Environment, V2.0, 2020).
ACLCA PCR GUIDANCE CONFORMANCE LEVEL	N/A
ACLCA PCR GUIDANCE VERSION	N/A
DESCRIPTION OF PRODUCT APPLICATION/USE	High-Carbon Tie-Plate used in railroad construction
PRODUCT RSL DESCRIPTION (IF APPL.)	N/A
MARKETS OF APPLICABILITY	North America
DATE OF ISSUE	**May 20, 2025**
PERIOD OF VALIDITY	5 years
EPD TYPE	Product-Specific, Facility-Specific
EPD SCOPE	Cradle to Gate
YEAR(S) OF REPORTED PRIMARY DATA	January 2023 to December 2023
LCA SOFTWARE & VERSION NUMBER	LCA for Experts v10.9.0.20
LCI DATABASE(S) & VERSION NUMBER	LCA for Experts 2024.2
LCIA METHODOLOGY & VERSION NUMBER	TRACI 2.2, IPCC 2013 (AR5), CML-baseline v4.7 August 2016

The PCR Part A review was conducted by:	**Dr. Lindita Bush, Chair, Athena Sustainable Materials Institute**
	Hugues Imbeault-Tétreault, Eng., M.A.Sc., Groupe AGÉCO
	Jack Geibig, Ecoform
The PCR Part B review was conducted by:	**Dr. Tom Gloria, Chair, Industrial Ecology Associates**
	Brandie Sebastian, JBE Consultants
	James Littlefield, Independent Consultant
This declaration was independently verified in accordance with ISO 14025: 2006, ISO 14044:2006, ISO 21930:2017, and the reference PCRs. ☐ INTERNAL ☒EXTERNAL	

ENVIRONMENTAL PRODUCT DECLARATION

High-Carbon Tie-Plate
Designated Steel Construction Product

According to ISO 14025, and ISO 21930:2017

	Dr. Tom Gloria, Chair, Industrial Ecology Associates
This life cycle assessment was conducted in accordance with ISO 14025:2006, ISO 14044:2006, ISO 21930:2017, and the reference PCRs by:	
	Trinity Consultants

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. The EPD owner has sole ownership, liability, and responsibility for the EPD.

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: Comparisons of the environmental performance of steel products using EPD information shall be based on the product's use and impacts at the construction works level, and therefore EPDs may not be used for comparability purposes when not considering the construction works energy use phase as instructed under this PCR. 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.

EPDs from different programs may not be comparable. Full conformance with a PCR for steel products allows EPD comparability only when all stages of a life cycle have been considered, when they comply with all referenced standards, use the same sub-category Part B PCR, and use equivalent scenarios with respect to construction works. 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," v4.0 (March 2022), in conformance with ISO 21930:2017, serves as the core PCR, with additional considerations from the USGBC/UL Environment Part A Enhancement (2017). EPDs are only comparable if they comply with this document, use the same sub-category PCR where applicable, include all relevant information modules and are based on equivalent scenarios with respect to the context of construction works.

ENVIRONMENTAL PRODUCT DECLARATION

High-Carbon Tie-Plate
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 high-carbon tie-plate (HCTP) produced by Arkansas Steel Associates (ASA) located in Newport, Arkansas. ASA is well-established in the steel industry and manufactures a wide variety of tie-plate sections, grader blades, wide flats, semi-finished products for the railroad industry and various grades of market billets. All steel produced by ASA is 100% recyclable at the end of its useful life.

This EPD represents the high-carbon tie-plate products produced by the EPD owner, Arkansas Steel Associates.

Product Description

ASA products can be provided in a range of sizes, thicknesses, and shapes. ASA's primary product is railroad tie-plates. Specifically, ASA offers hot-rolled double shoulder railroad tie-plates with lengths of 13" to 18" for use with rail having a 5.5" or 6" base. Further, ASA's tie-plates meet AREMA specifications and can accommodate rail sizes from 115RE to 140RE. Tie-plates also meet the Federal Transit Administration's (FTA) Buy America requirements.

HCTP products produced by ASA are defined by the following standards:

- AISI 1018
- AISI 1030
- AISI 1040
- AISI 1045
- AR 657

The United Nations Standard Products and Service Code (UNSPSC) and the Construction Specifications Institute (CSI) / Constructions Specifications Canadian (CSC) classification identified for high-carbon tie-plate products are:

CSI MasterFormat Code: 05 58 00 Formed Metal Fabrications
UNSPSC Code: 30260000 Structural materials

This EPD reports the LCA results of the product's fabricated impacts.

Product Composition

Steel is an alloy of iron containing small amounts of trace alloys. These alloying elements improve the chemical and physical properties of steel, such as strength, ductility, durability, and corrosion resistance. There are many different grades of steel with many different physical, chemical, and environmental properties. Composition data for the studied product can be found in the table below, which outlines all materials that constitute the final product. Ancillary materials do not constitute any part of the final product. Various grades of steel will contain different combinations of these elements and/or trace materials. Exact specifications may be found by calling the manufacturer and asking for a specifications sheet. No substances required to be reported as hazardous are associated with the production of this product.

ENVIRONMENTAL PRODUCT DECLARATION

High-Carbon Tie-Plate
Designated Steel Construction Product

According to ISO 14025, and ISO 21930:2017

Table 1. Composition Data for Steel Product

NAME	VALUE	UNIT
Iron Oxide	99	% by mass
Manganese	1.5	% by mass
Sulfur Dioxide	1	% by mass
Silica Dioxide	1	% by mass
Phosphorous	1	% by mass
Chromium III	1	% by mass
Nickel	1	% by mass
Vanadium	1	% by mass
Copper	1	% by mass
Molybdenum	5	% by mass
Boron Oxide	1	% by mass

Product Average
The production data used in this EPD considers high-carbon tie-plate produced during the 2023 calendar year. The product is manufactured at the Newport location. Results are based on the production totals at the Newport facility.

Application
High-carbon tie-plate is one of the railroad components that is used to fix a rail to a railroad tie and ensure the railway functions as intended.

Railroad tie-plate, including high-carbon plate, is a railroad component used in track construction by being installed between the rail and underlying wood tie with a purpose to promote load distribution, tie protection and helps maintain proper rail alignment.

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.

ENVIRONMENTAL PRODUCT DECLARATION

High-Carbon Tie-Plate
Designated Steel Construction Product

According to ISO 14025, and ISO 21930:2017

Table 2. Technical data for steel product

NAME	VALUE	UNIT
Density	N/A	kg/m^3
Melting point	2600-2800	°F
Electrical conductivity at 20°C	NA	% of IAC
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/mm2
Specific heat capacity	NA	J/kg-ºC
Yield strength	NA	N/mm^2
Ultimate tensile strength	NA	N/mm^2
Breaking elongation	NA	%
Chemical composition	Varies by Specification/Grade	% by mass
Surface Area	Varies by Specification/Grade	m^2
Thickness	Varies by Specification/Grade	Mm

Properties of Declared Product as Delivered

Fabricated HCTP is packaged onsite and shipped directly to a job site or end user by ASA.

Material Composition

ASA HCTP is manufactured entirely from carbon steel, which is produced through an electric arc furnace whose largest component is scrap steel being recycled. The product does not include materials or substances which may have any potential route of exposure to humans or flora/fauna in the environment. The product does not contain any hazardous substances in its final sold state, in accordance with the Resource Conservation and Recovery Act (RCRA), Subtitle C. However, the product contains components that are known to be toxic and hazardous according to the OSHA 29 CFR 1910 Subpart Z. The hazardous nature of the steel becomes a concern only during further processing. 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

Arkansas Steel Associates uses EAF technology to produce steel from recycled scrap metal or scrap substitutes. ASA receives steel scrap from various domestic brokers via truck and rail. Scrap, lime, and carbon are fed to an electric arc furnace (EAF). Oxygen is introduced into the charge through oxygen lances. Once the EAF is charged, electric current is applied via large electrodes made of graphite or other high-carbon material to melt the raw materials. The electrodes are consumed in the melting process.

Once the ideal melt conditions have been reached, a ladle is placed at the tapping side of the EAF, the furnace is de-energized, and the molten steel is poured into the ladle. The ladle transports the molten steel to a ladle metallurgy station (LMS) which

promotes a more homogeneous mixture. Additional additives may include various metal alloys to achieve the desired composition of the final steel product. The molten steel is then transported to the tundish which feeds molten steel to the caster. Special water-cooled molds in the caster form the molten steel into long, thick, cross-sectionally rectangular pieces of steel known as billets.

After leaving the caster, the steel billets are stored in a billet yard to be sold or further processed onsite. Sold billets are either forged or hot-rolled offsite. Billets that are further processed into HCTP onsite are sent through a natural gas-fired reheat furnace. The hot billets are then fed into the rolling mill, where they are pressed into desired shapes and sections by passing through a cascading series of mill stands. The mill stands hold opposing pairs of large, spool-like rolls with cylindrical surface geometries reflective of the desired cross-sectional shapes, then cut to desired lengths and set with slots or punched holes to customer specifications.

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

Packaging

Packaging at Arkansas Steel Associates is not included in the LCA for this EPD.

High-Carbon Tie-Plate
Designated Steel Construction Product

According to ISO 14025, and ISO 21930:2017

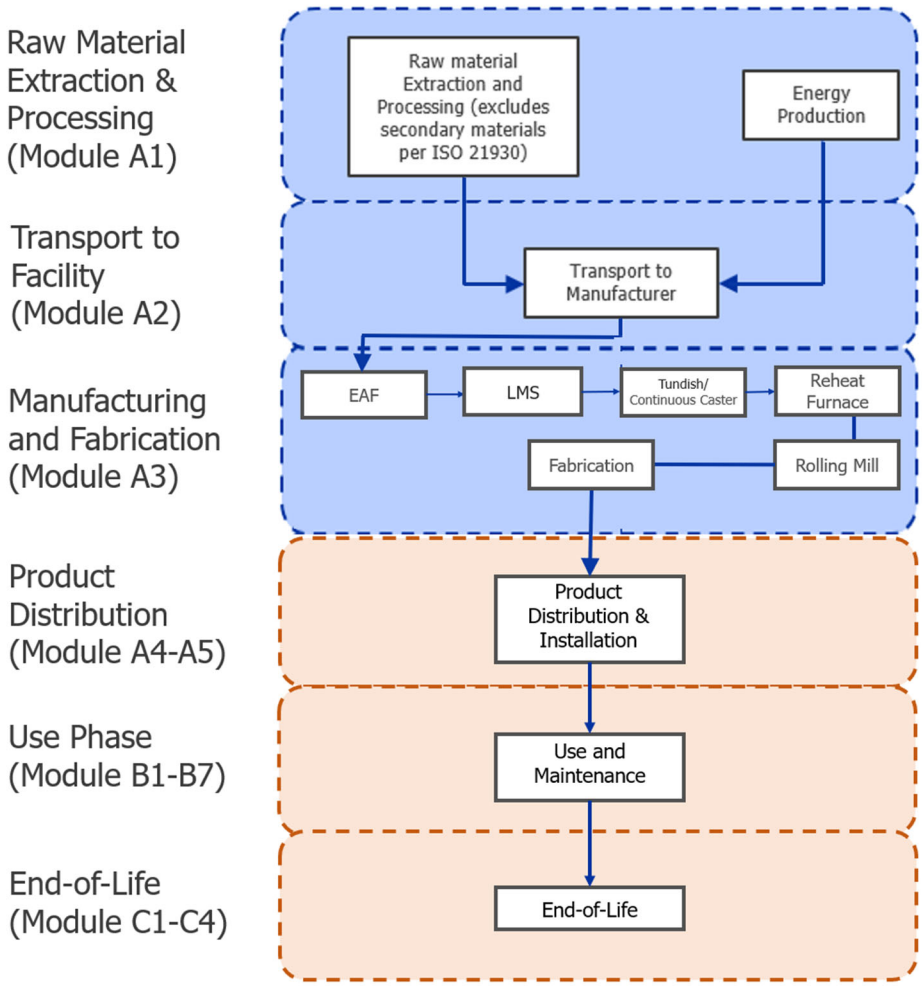

Figure 1. Flow Chart for Product System

High-Carbon Tie-Plate
Designated Steel Construction Product

According to ISO 14025, and ISO 21930:2017

2. LCA CALCULATION RULES

Declared Unit

The declared unit is one (1) metric ton of HCTP 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, 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 from gate to site	Assembly/Install	Use	Maintenance	Repair	Replacement	Refurbishment	Building Operational Energy Use During Product Use	Building Operational Water Use During Product Use	Deconstruction	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 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.

Biogenic Carbon and Land-Use Change

The production of HCTP at ASA does not include significant sources of biogenic carbon or GHG emissions occurring as a result of land-use change. The biogenic carbon emissions and removals were determined to be negligible for both products; therefore, the biogenic carbon emissions are considered zero in this analysis. Similarly, GHG emissions occurring as a result of land-use change were determined to be negligible and land-use change emissions considered zero in this analysis. The characterization

method for GWP100 includes both biogenic carbon and land-use change. Additional indicators on the uptake and emissions of CO_2 are not included or published in this EPD as they are not considered relevant.

Carbonation, Calcination, and Combustion of Waste

There is no carbonation, calcination or combustion of waste from renewable or non-renewable sources used in the production processes of high-carbon tie-plate products and the scope of this analysis did not include use and end-of-life stages. Accordingly, the environmental impacts do not account for any environmental benefits attributed to carbonation, calcination or combustion of waste from renewable or non-renewable sources.

Data Sources

The LCA model was created using the LCA for Experts (formerly GaBi) Software system for life cycle engineering, version 10.9.0.20, developed by Sphera. Background life cycle inventory data for raw materials and processes were obtained from LCA for Experts 2024.2 databases (formerly known as GaBi databases). Primary manufacturing data were provided by ASA. The datasets are listed below.

Table 3. Data Sources for the System Product

Material/ Process Category	Module	Material/ Process Name	Inventory Dataset Name	Location	Reporting Period	Reference
Material/Product	A1	Electrodes	Electrode	NO	2023	LCA For Experts 2024 Professional Database
Material/Product	A1	Dololime (Proxy), Quicklime, Sparlime Flux (Proxy)	Lime (CaO; quicklime lumpy)[a]	US	2023	LCA For Experts 2024 Professional Database
Material/Product	A1	Metallurgical Coke	Metallurgical coke	US	2023	LCA For Experts 2024 Professional Database
Material/Product	A1	Natural Gas	Natural gas mix	US	2023	LCA For Experts 2024 Professional Database
Material/Product	A1	Oxygen	Oxygen (gaseous)	US	2023	LCA For Experts 2024 Professional Database
Ancillary Material	A3	Refractories	Fireproof stones (alumina-rich)	EU-28	2023	LCA For Experts 2024 Professional Database
Material/Product	A1	Aluminum	Aluminum secondary ingot, at plant	RNA	2023	LCA For Experts 2024 Professional Database
Material/Product	A1	Argon	Argon (gaseous)	US	2023	LCA For Experts 2024 Professional Database
Material/Product	A1	Ferro-chromium	Ferro chrome high carbon, consumption mix	DE	2023	LCA For Experts 2024 Professional Database

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Material/Product	A1	Ferro-molybdenum	Ferromolybdenum (FeMo)	GLO	2023	LCA For Experts 2024 Professional Database
Material/Product	A1	Silicon Manganese (Proxy), Vanadium (Proxy), Ferro-niobium (Proxy)	Ferro-manganese, high-carbon (HC FeMn), 74 to 82 wt. % Mn, up to 7.5 wt % carbon[b]	GLO	2023	LCA For Experts 2024 Professional Database
Material/Product	A1	Ferro Silicon, Silicon Carbide (Proxy)	Ferro silicon mix (90 % Si)[c]	GLO	2023	LCA For Experts 2024 Professional Database
Material/Product	A1	Fluorspar	Fluorspar (extraction and processing)	US	2023	LCA For Experts 2024 Professional Database
Material/Product	A1	Nickel	Nickel (Class 1, >99.8% Nickel)	GLO	2023	LCA For Experts 2024 Professional Database
Material/Product	A1	Nitrogen	Nitrogen (gaseous)	US	2023	LCA For Experts 2024 Professional Database
Material/Product	A1	Silica Sand, Rice Hull (Proxy)	Silica sand (Excavation and processing)[d]	US	2023	LCA For Experts 2024 Professional Database
Transport	A2	Truck	Truck – Heavy Heavy-duty Diesel Truck / 53,333 lb payload – 8b	US	2023	LCA For Experts 2024 Professional Database
Transport	A2	Rail	Rail transport cargo – average, average train, gross tonne weight 1,000t / 726t payload capacity	GLO	2023	LCA For Experts 2024 Professional Database
Transport	A2	Barge	River freight ship, 4,000t payload capacity / upstream	GLO	2023	LCA For Experts 2024 Professional Database
Transport	A2	Ship	Container ship, 5,000 to 200,000 dwt payload capacity, deep sea	GLO	2023	LCA For Experts 2024 Professional Database
Transport	A2	Transport Fuel	Diesel mix at filling station	US	2023	LCA For Experts 2024 Professional Database
Transport	A2	Transport Fuel	Heavy fuel oil at refinery (2.5wt% S)	US	2023	LCA For Experts 2024 Professional Database
Energy	A3	Diesel Combustion	Diesel, combusted in industrial equipment[e]	US	2023	LCA For Experts 2024 Professional Database
Energy	A3	Gasoline Combustion	Gasoline, combusted in equipment[e]	US	2023	LCA For Experts 2024 Professional Database
Energy	A3	Propane Combustion	Thermal energy from propane[e]	US	2023	LCA For Experts 2024 Professional Database

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Waste	A3	Hazardous Waste Disposal	Municipal Solid Waste Incineration Plant (27.5% H2O content)	US	2023	LCA For Experts 2024 Professional Database
Waste	A3	Non-Hazardous Waste Disposal	Municipal Solid Waste on landfill	US	2023	LCA For Experts 2024 Professional Database
Wastewater	A3	Wastewater Disposal	Municipal Wastewater (EPA data, avoided burden, EPA Region 06)	US	2023	LCA For Experts 2024 Professional Database
Ancillary Material	A3	Groundwater	Process water from groundwater	US	2023	LCA For Experts 2024 Professional Database
Ancillary Material	A3	Tap Water	Tap water from surface water	US	2023	LCA For Experts 2024 Professional Database
Electricity	A3	Biomass Electricity	Electricity from biomass (solid)	US	2023	LCA For Experts 2024 Professional Database
Electricity	A3	Geothermal Electricity	Electricity from geothermal	US	2023	LCA For Experts 2024 Professional Database
Electricity	A3	Hard Coal Electricity	Electricity from hard coal	US	2023	LCA For Experts 2024 Professional Database
Electricity	A3	HFO Electricity	Electricity from heavy fuel oil (HFO)	US	2023	LCA For Experts 2024 Professional Database
Electricity	A3	Hydro Electricity	Electricity from hydro power	US	2023	LCA For Experts 2024 Professional Database
Electricity	A3	Natural Gas Electricity	Electricity from natural gas	US	2023	LCA For Experts 2024 Professional Database
Electricity	A3	Nuclear Electricity	Electricity from nuclear	US	2023	LCA For Experts 2024 Professional Database
Electricity	A3	Solar Electricity	Electricity from photovoltaic	US	2023	LCA For Experts 2024 Professional Database
Electricity	A3	Wind Electricity	Electricity from wind power	US	2023	LCA For Experts 2024 Professional Database
Electricity	A3	Eastern US Other Electricity	Electricity, at grid, Eastern US	US	2023	LCA For Experts 2024 Professional Database
Electricity	A3	Western US Other Electricity	Electricity, at grid, Western US	US	2023	LCA For Experts 2024 Professional Database

High-Carbon Tie-Plate
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 ASA directly for the 2023 calendar year. 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.

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 facility:

- Arkansas Steel Associates – Newport, AR

Regionally specific datasets, where available, were used to represent the 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 2023 calendar year. This analysis is intended to represent production in 2023.

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 Managed LCA Content (formerly known as GaBi databases) is documented online at https://sphera.com/life-cycle-assessment-lca-database/.

ASA uses external scrap and home scrap as raw materials for the EAF to produce HCTP. In accordance with ISO 21930's "polluter pays principle", where processes relevant to waste processing are assigned to the product system that generates the waste until the system boundary between product systems is reached, external scrap used by ASA carries no upstream material processing impact burden because the burden is associated with the producer of the steel scrap. Therefore, external scrap is modeled as a secondary material with only impacts associated with transportation from the steel scrap provider to ASA. Any home scrap processing conducted at ASA is assumed to be accounted for in the facility-wide material and energy usages. Therefore, home scrap is modeled as a secondary material with no additional impacts.

ASA melt shop produces steel billet and slag. All slag is sold as-is. Designated steel billet continues onto the rolling mill to be rolled into high-carbon tie-plate products. The slag and steel product are considered co-products of the product system resulting from a joint co-production process. Per Worldsteel Association methodology, the steel production process is a thermodynamic system requiring energy to drive production process; therefore, the energy associated with the mass flows and chemicals reactions of the co-products should be the basis for the partitioning of the flows between the co-products. ASA did not perform a slag-related energy analysis in accordance with this methodology, thus, literature thermodynamic values were used to determine slag allocation for applicable flows.

ASA also produces mill scale which is sold as a co-product from the facility. However, since allocation for mill scale will require system expansion, it is not considered in this LCA.

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According to ISO 14025, and ISO 21930:2017

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 fabricated steel products may extend beyond those defined in this document.

All 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 the reported material and energy flows have been accounted for.

Raw material procurement and upstream transport to ASA is 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 ports.com.[1] In some cases, ASA 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).

[1] http://ports.com/sea-route/

High-Carbon Tie-Plate
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According to ISO 14025, and ISO 21930:2017

3. LCA RESULTS

North American life cycle impact assessment (LCIA) results are declared using TRACI 2.2 methodology, with the exception of GWP and ADP_{fossil}. GWP 100 is reported using the IPCC 2013 (AR5) methodology, and ADP_{fossil} is reported using CML-baseline v4.7 August 2016. LCIA results are relative expressions and do not predict actual impacts, the exceeding of thresholds, safety margins or risks.

The 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.

All acronyms used in the following results tables are defined in Section 6 of this EPD.

The LCIA results below are relative expressions and do not predict impacts on category endpoints, the exceedance of thresholds, safety margins or risks. The six impact categories presented in the LCIA results 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 users of these results shall not use additional measures for comparative purposes. LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.

Fabricated HCTP Product Results

Table 9. LCIA results, per 1 metric ton of fabricated HCTP

PARAMETER	UNIT	A1	A2	A3	TOTAL
GWP-total	kg CO_2 eq.	2.02E+02	2.51E+01	4.58E+02	6.85E+02
GWP-fossil	kg CO_2 eq.	2.02E+02	2.51E+01	4.55E+02	6.83E+02
ODP	kg CFC 11 eq.	6.34E-10	6.05E-13	1.71E-10	8.05E-10
AP	kg SO_2 eq.	3.31E-01	1.71E-01	6.59E-01	1.16E+00
EP	kg N eq.	1.47E-02	9.96E-03	1.22E-01	1.47E-01
SFP	kg O_3 eq.	5.86E+00	3.59E+00	1.14E+01	2.08E+01

Table 10. Resource use results, per 1 metric ton of fabricated HCTP [a]

PARAMETER	UNIT	A1	A2	A3	TOTAL
RPR_E	MJ LHV	1.67E+02	2.97E+01	2.34E+02	4.31E+02
RPR_M	MJ LHV	0.00E+00	N/A	N/A	0.00E+00
RPR_T	MJ LHV	1.67E+02	2.97E+01	2.34E+02	4.31E+02
$NRPR_E$	MJ LHV	4.98E+03	3.45E+02	7.33E+03	1.27E+04
$NRPR_M$	MJ LHV	4.93E+02	N/A	N/A	4.93E+02
$NRPR_T$	MJ LHV	5.48E+03	3.45E+02	7.33E+03	1.31E+04
SM	kg	1.10E+03	N/A	0.00E+00	1.10E+03
RSF	MJ LHV	N/A	N/A	0.00E+00	0.00E+00

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PARAMETER	UNIT	A1	A2	A3	TOTAL
NRSF	MJ LHV	N/A	N/A	0.00E+00	0.00E+00
RE	MJ LHV	N/A	N/A	0.00E+00	0.00E+00
ADP_{FOSSIL}	MJ surplus	5.39E+03	3.20E+02	2.00E+03	7.72E+03
FW	m^3	4.40E-01	6.42E-02	1.19E+00	1.69E+00

a. Lower calorific values (LHV) of fuels are used for energy parameters.

Table 11. Output flows and waste categories results, per 1 metric ton of fabricated HCTP [a]

PARAMETER	UNIT	A1	A2	A3	Total
HWD	kg	N/A	N/A	0.00E+00	0.00E+00
NHWD	kg	N/A	N/A	5.88E+00	5.88E+00
HLRW	kg	3.55E-05	1.07E-05	2.25E-03	2.29E-03
ILLRW	kg	3.01E-02	8.95E-03	1.88E+00	1.92E+00
CRU	kg	N/A	N/A	N/A	N/A
MR	kg	N/A	N/A	3.28E+01	3.28E+01
MER	kg	N/A	N/A	0.00E+00	0.00E+00
EE	MJ LHV	N/A	N/A	0.00E+00	0.00E+00

a. Lower calorific values (LHV) of fuels are used for energy parameters.

Comparisons cannot be made between product-specific or industry average EPDs at the design stage of the project, before a building or construction works has been specified. Comparisons may be made between product-specific or industry average EPDs at the time of product purchase only when product or construction works 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 or EN 15804. 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 comparisons can be inaccurate and could lead to erroneous selection of materials or products that are higher-impact, at least in some impact categories.

4. LCA INTERPRETATION

In order 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 2 are for the fabricated HCTP. These facilitate a better understanding of which categories contribute most to which impacts.

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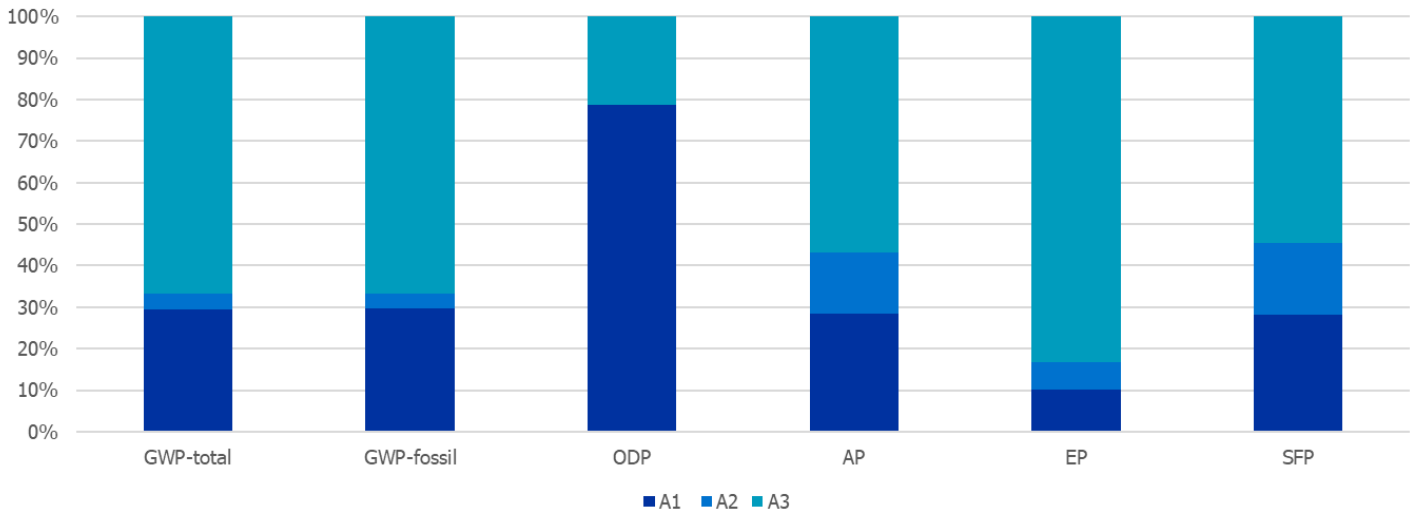

Figure 2. Fabricated HCTP Relative Contributions by Module and Impact Categories

For the high-carbon tie-plate products, the impact assessment results indicate that Module A3, i.e. manufacturing and fabricating HCTP product, direct emissions, transportation of waste and fuel and energy use is the key contributor to potential environmental impact categories for Global Warming Potential, Acidification Potential, Eutrophication Potential, and Smog Formation Potential. Module A1, i.e. raw material extraction and processing is the most significant contributor to Ozone Depletion Potential. Module A2, i.e. transport to manufacturer is not the most significant contributor to any impact category. Overall, the largest contributors for ASA's HCTP product GWP were direct emissions, purchased electricity, and the raw material procurement of metal alloys. This is representative of the module impact results for ASA HCTP product.

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5. ADDITIONAL ENVIRONMENTAL INFORMATION

Certain additional environmental activities and certifications are discussed in the following subsections. More information on ASA's certifications can be found at www.arkansassteel.com.

Health and Safety

Health: Refer to the specific ASA product SDS for health, safety, and proper handling information.

Safety: ASA is committed to controlling hazards and conditions that could lead to physical, psychological or material harm to preserve the health and well-being of all employees. The ASA Health and Safety Plan is a tool used to achieve this state within the workplace. Key elements to the Health and Safety Plan are Roles and Responsibilities, Accident Reporting, Accident/Injury Analysis, Safety Program Record Keeping, Training and Education, Safety and Environmental Inspections, Accident/Incident Investigation, Employee Communication, and Plan Review and Revision. The ASA Safety Policy communicates the concept of "Safety with Production" with commitments to subscribe to local, state, and Federal statutes, ordinances and regulations while providing a productive environment, resulting in economic stability. Employees are encouraged to "speak up" when witnessing an unsafe act, identifying a hazard, or suggesting a safer alternative to a task. All suggestions and comments are taken into consideration, and a line of communication is always maintained. This concerted effort is supported throughout the organization and is held in high regard.

Environmental Activities and Certifications

ISO 9001:2015 Quality Management System: ASA is an ISO 9001:2015 certified company. ISO 9001:2015 sets the framework that is globally recognized and helps organizations implement and maintain a QMS (Quality Management System). The standard's requirements are set by the ISO (International Organization for Standardization), a non-government body comprised of independent experts. It contains policies, processes, and technologies designed to meet quality objectives and enhance customer satisfaction. ASA's QMS policy aims to meet government requirements, achieve high Customer Satisfaction, and continually improve the QMS. https://amtivo.com/us/resources/insights/what-are-the-iso-9001-certification-requirements/

AAR M-1003 Quality Assurance Certificate: ASA has met the requirements of the Association of American Railroads Quality Assurance Program as specified in M-1003.

ISO 14001:2015 Environmental Management System: The environmental performance of ASA's facility 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 ASA employees to follow, ASA utilizes ISO 14001, which is the international standard that establishes specific requirements for an effective environmental management system (EMS).

Environmental Training: As part of ASA's Environmental Management System (EMS), all employees are trained in environmental awareness during orientation when hired. In addition, a training matrix has been developed to ensure affected employees are trained in areas needed to perform their job responsibilities. This training matrix is reviewed at least annually during the internal audit and updated as necessary or when compliance obligations change.

Sustainability

Recycled Materials Content: ASA has partnered with a regional recycler to perform periodic audits to identify materials for recycling to help reduce ASA's footprint on waste to landfill.

Water Recycling: Water is essential in the steel industry to cool equipment from high heat that is generated by its processes. ASA is always looking for ways to reduce or reuse water that circulates through its equipment. After water is used in processes where quality is most essential, the water is transferred to less critical cooling systems for reuse before its eventual discharge.

Waste Recycling: ASA has a Waste Minimization Program in place as part of the organizational policy. The electric arc furnace

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(EAF) process generates hazardous waste known as K061 (steel dust). Instead of landfilling this waste, ASA sends it to a recycling processing facility that separates the metals of the waste to be reused and make a wide range of products. The process produces marketable products without K061 waste.

Clean Energy: In December 2023, ASA entered into an agreement with Entergy Arkansas to participate in the Go Zero Emissions Resource Options Tariff Program (Go ZERO). The CY2024 agreement employs asset-backed renewable energy certificates (RECs) and zero-emission alternative energy certificates (AECs). This strategy is anticipated to reduce ASA's Scope 2 emissions to as low as 0 metric tons CO2e annually starting in 2024 (compared to 2023 base year, assuming all else equal). Details about this can be found at https://www.entergynewsroom.com/news/arkansas-steel-associates-go-zero-for-green-clean-energy-in-2024/.

Additional Information: Refer to ASA's website for additional information: Arkansas Steel Associates

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6. RESULTS ACRONYMS AND DEFINITIONS

Table 15. Results Acronyms and Definitions

ACRONYM	DEFINITION
ADP_{FOSSIL}	Abiotic Resource Depletion Potential of Non-Renewable (Fossil) Energy Resources
AP	Acidification Potential
CRU	Components for Reuse
EE	Recovered Energy Exported from the Product System
EP	Eutrophication Potential
FW	Use of Fresh Water Resources
GWP100 (excl. biogenic C and land-use)	Global Warming Potential, Excluding Biogenic Carbon and Land-Use
HLRW	High-Level Radioactive Waste, Conditioned, to Final Repository
HWD	Hazardous Waste Disposed
ILLRW	Intermediate and Low-Level Radioactive Waste, Conditioned, to Final Repository
MER	Materials for Energy Recovery
MR	Materials for Recycling
NHWD	Non-Hazardous Waste Disposed
$NRPR_E$	Non-Renewable Primary Resources Used as an Energy Carrier (Fuel)
$NRPR_M$	Non-Renewable Primary Resources with Energy Content Used as Material
NRSF	Non-Renewable Secondary Fuels
ODP	Ozone Depletion Potential
RE	Recovered Energy
RPR_E	Renewable Primary Resources Used as an Energy Carrier (Fuel)
RPR_M	Renewable Primary Resources with Energy Content Used as Material
RSF	Renewable Secondary Fuels
SFP	Smog Formation Potential
SM	Secondary Materials

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8. CONTACT INFORMATION

Study Commissioner

ARKANSAS STEEL ASSOCIATES, LLC.
2803 Van Dyke Rd
Newport, AR 72112
Arkansas Steel Associates

LCA Practitioner

TRINITY CONSULTANTS, INC.
12700 Park Central Drive, Suite 600
Dallas, TX 75251
https://www.trinityconsultants.com/

Program Operator

ASTM INTERNATIONAL
100 Barr Harbor Drive, P.O. Box C700
West Conshohocken, PA 19428
https://www.astm.org/