Environmental Product Declaration

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

Environmental Product Declaration for Secondary Aluminum Alloy products produced by American Buffalo Metals at their facility in Crossville, Alabama

ADMINISTRATIVE INFORMATION

International Certified Environmental Product Declaration

Declared Product and Declared Unit:	This Environmental Product Declaration (EPD) covers secondary aluminum alloy products produced by American Buffalo Metals, declared unit: 1 (one) metric ton of secondary aluminum alloy product
Declaration Owner:	American Buffalo Metals 253 Greenway drive Crossville, Alabama, USA
Program Operator:	Labeling Sustainability 200 S.Rosemary West Palm Beach, FL https://www.labelingsustainability.com/
Product Category Rule:	Product Category Rules for Building-Related Products and Services Published by UL Environment Part A: Life Cycle Assessment Calculation Rules and Report Requirements, UL 10010 v4.0, and Part B: Aluminum Construction Product EPD Requirements, UL 10010 - 38 PCR Program Operator: UL PCR review was conducted by: Lindita Bushi, PhD, James Mellentine, and Nicholas Santero, PhD
ISO Standards	ISO 21930:2017 Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services ISO 14040:2006 Environmental Management - Life Cycle Assessment - Principles And Framework ISO 14044:2006 Environmental Management - Life Cycle Assessment - Requirements And Guidelines
Market of Applicability	North America
EPD Scope	A1-A3, C1-C4 and Module D
EPD Type	Manufacturer-Specific EPD
Independent LCA Reviewer and EPD Verifier:	This declaration was independently verified in accordance with ISO 14025:2006 Independent verification of the declaration, according to ISO 14025:2006 External X Third Party Verifier Hammad Ur Rehman, Certified 3rd Party Verifier under Labeling Sustainability Program (www.labelingsustainability.com)
Date of Issue:	07 May 2025
Period of Validity:	5 years: valid until 07 May 2030
EPD Number:	ABM2025050701

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COMPANY DESCRIPTION

American Buffalo Metals is a U.S.-based metal recycling and manufacturing company dedicated to the sustainable conversion of scrap aluminum into high-quality, reusable metal products. The company primarily sources recycled aluminum wheels, which are melted and refined into various forms, including sow, ingot, and cast cones. Through its operations, ABM contributes significantly to the circular economy by transforming aluminum waste into valuable raw materials for a range of industrial applications.

STUDY GOAL

The intended application of the background life cycle assessment (LCA) study was to comply with the procedures for creating a Type III environmental product declaration (EPD) and publish the EPD for public review on the website, https://www.labelingsustainability.com/. This level of study is in accordance with the product category rule (PCR) for building-related products and services published by UL Environment, Part A: Life Cycle Assessment Calculation Rules and Report Requirements, v4.0, Part B: Aluminum Construction Product EPD Requirements, UL 10010-38, ISO 21930:2017 Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services, ISO 14044:2006 Environmental management, Life cycle assessment- Requirements and guidelines; and ISO 14040:2006 Environmental management, Life cycle assessment-Principles and framework. The performance of this study and its subsequent publishing is in alignment with the business-to-business (B2B) communication requirements for the environmental assessment of building products. The study does not intend to support comparative assertions and is intended to be disclosed to the public.

This project report was commissioned to differentiate American Buffalo Metals from their competition for the following reasons: generate an advantage for the organization; offer customers information to help them make informed product decisions; improve the environmental performance of American Buffalo Metals by continuously measuring, controlling and reducing the environmental impacts of their products and to strengthen American Buffalo Metals' license to operate in the community. The intended audience for this EPD report is American Buffalo Metals' employees, their suppliers, project specifiers of their products, architects, and engineers. The EPD report is also available for policy makers, government officials interested in sustainability, academic professors, and LCA professionals. This EPD report does not include product comparisons from other facilities.

PRODUCT DESCRIPTION

The A356.1 Aluminum alloy products are produced from secondary aluminum. A356.1 is a well-regarded alloy known for its excellent casting properties, corrosion resistance, and reliable mechanical strength.

Table 1: **Description of the declared products.**

Name	Value		
Product Name	Aluminum Sow	Aluminum Ingot	Aluminum Cast cone
Product Description	Secondary aluminum alloy sow A356.1	Secondary aluminum alloy ingot A356.1	Secondary aluminum alloy cast cone A356.1
Classification	Cast Alloy - Aluminum Sow	Cast Alloy - Aluminum Ingot	Cast Alloy - Aluminum Cast Cone
Finishing	n/a	n/a	n/a
Alloy Group	A356.1 and A356.2	A356.1 and A356.2	A356.1 and A356.2

PRODUCT APPLICATIONS

These aluminum alloy products are ideal for re-melting or further processing into semi-fabricated aluminum products such as rolled coils, plates, or casted components.

MATERIAL COMPOSITION

The material composition of the secondary aluminum alloy products covered in this study is represented in the table below;

Table 2: **Primary and recycled material composition for declared products.**

Parameter	Value	Unit
Primary Material	0.25	% by mass
Post-Consumer Material	99.75	% by mass
Pre-Consumer Material	0.00	% by mass

Table 3: **A356.1 aluminum alloy chemical composition (% by mass) limits as per Pink Sheet (2018).**

	Si	Fe	Cu	Mn	Mg	Zn	Ti	Others (total)	Aluminum
Min	6.5	-	-	-	0.3	-	-	-	remainder
Max	7.5	0.15	0.2	0.1	0.45	0.1	0.2	0.15	remainder

TECHNICAL DATA

The following table outlines the technical data of the secondary aluminum alloy products covered in this study.

Table 4: **Technical data.**

Parameter	Value	Unit
Gross Density	2.64	g/cc
Melting Point	660.3	°C
Electrical Conductivity at 20°C	n/a	m/Ω mm2
Thermal Conductivity	n/a	W/mK
Coefficient of Thermal Expansion	n/a	$10^{-6}K^{-1}$
Modulus of Elasticity	n/a	N/mm2
Shear Modulus	n/a	N/mm2
Specific Heat Capacity	n/a	kJ/kg.K
Hardness	n/a	HB
Yield Strength RP 0.2 MIN	n/a	N/mm2
Yield Strength RM MIN	n/a	N/mm2
Tensile Stress at Break	n/a	%

DESIGN COMPOSITION

The following table provides mass breakdown (kg per declared unit) of the material composition of each secondary aluminum alloy product considered in this declaration.

Table 5: **Design composition of declared products.**

Materials	Value in kg	Value by %
Secondary Aluminum	997.84	99.78%
Magnesium metal	0.04	0.004%
Titanium, metal	1.42	0.14%
Strontium, metal	0.71	0.07%

The following tables provide a list of the secondary aluminum alloy products considered in this EPD, along with key performance parameters.

Table 6: **Declared products with all declared products considered in this environmental product declaration.**

Prod#	Unique name/ID	Short description	Declared Unit (DU)	Density, dry kg/DU	bio-carbon content, kg C/DU dry basis
1	Aluminum Ingot	24.25" x 3.25" x 3.25" aluminum bar, weight: ~20-24lbs	1 metric ton	1000	0.00
2	Aluminum Sow	45" x 52" x 13" aluminum block, weight: ~2000lbs	1 metric ton	1000	0.00
3	Aluminum Cast Cone	2" x 2" x 2" semi-pyramid, weight: ~8 oz	1 metric ton	1000	0.00

A1 RAW MATERIAL RECYCLED CONTENT AND MATERIAL LOSSES

The following table provides a list of the raw material inputs (module A1) across all products considered, their recyclability content, and assumed material losses.

Table 7: **Module A1 raw material inputs, the recyclability content and assumed material losses (dry basis).**

Product Name	Mix Category	Primary Content	Post Industrial Content	Post Consumer Content	Material Losses
Secondary Aluminum, Al wheels	scrap aluminum, new	0%	0%	100%	2%
Magnesium, metal	magnesium	100%	0%	0%	2%
Titanium, metal	titanium	100%	0%	0%	2%
Strontium, metal	strontium sulfate, 90% $SrSO_4$	100%	0%	0%	2%

MANUFACTURING PROCESS

The following figure illustrates the production of secondary aluminum alloy products at ABM.

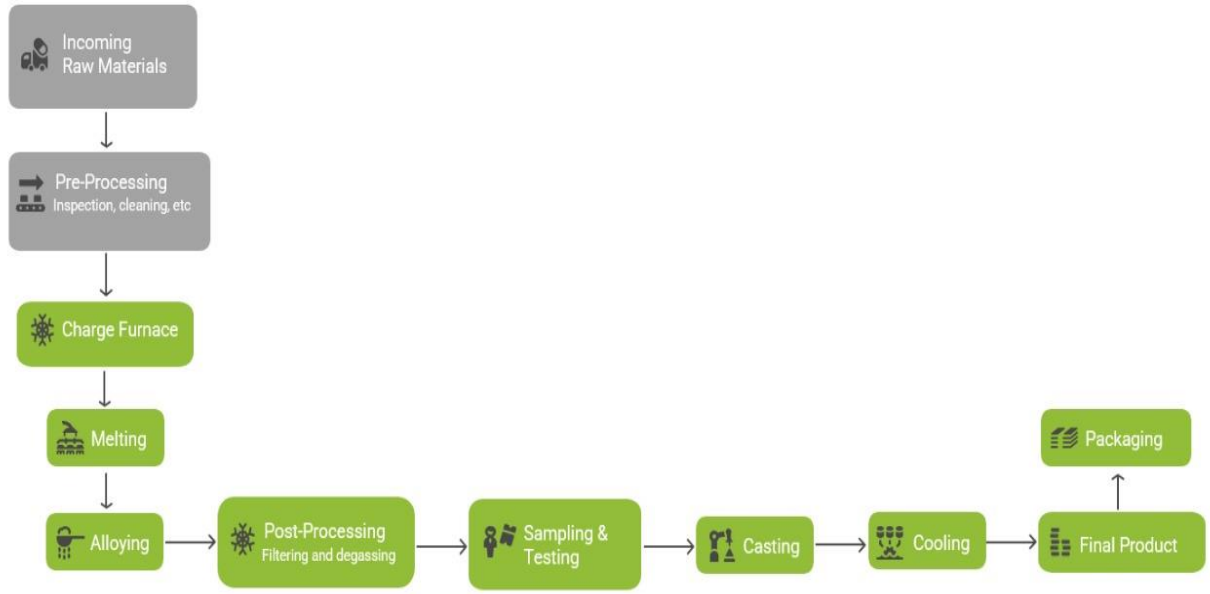

Figure 1: **Process flow diagram for the production of secondary aluminum alloy products.**

The production process begins with the on-site sorting of recycled wheels to identify those made of alloy A356.1. Selected wheels then undergo pre-processing steps, including cleaning, visual inspection, and the removal of non-metallic components. The prepared material is fed into a charge furnace for melting. During melting, the alloy's chemical composition is analyzed using a spectrometer to ensure it meets A356.1 specifications. If necessary, master alloys are added to adjust the composition to the required standard. Once the molten metal meets quality requirements, the molten metal is cast into ingot, sow, or cast cone forms and allowed to cool. The final product is ready for further processing or distribution.

SYSTEM BOUNDARIES

The following figure depicts the cradle-to-gate with required options (modules A1-A3, modules C1-C4, and module D) system boundary considered in this study:

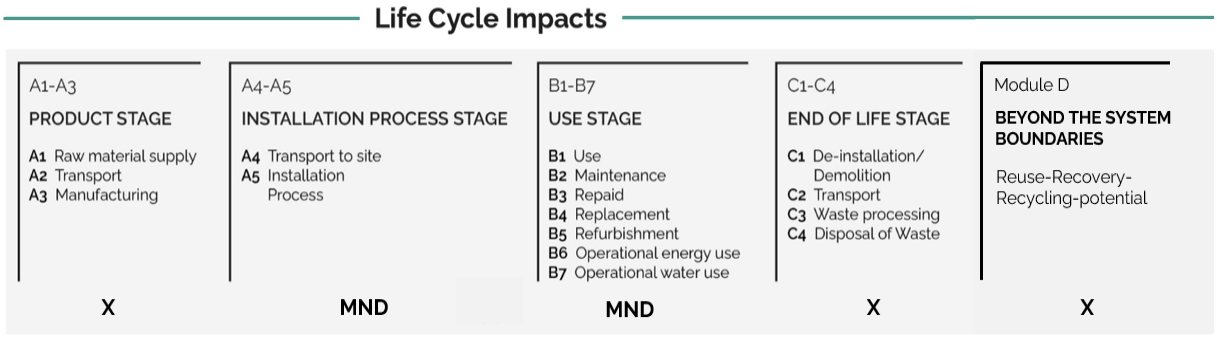

Figure 2: **General life cycle phases for consideration in a construction works system. (X = declared module, MND = module not declared).**

The following figure depicts the system boundary considered in this EPD and the general activities and input requirements for producing secondary aluminum alloy products, and it is not necessarily exhaustive.

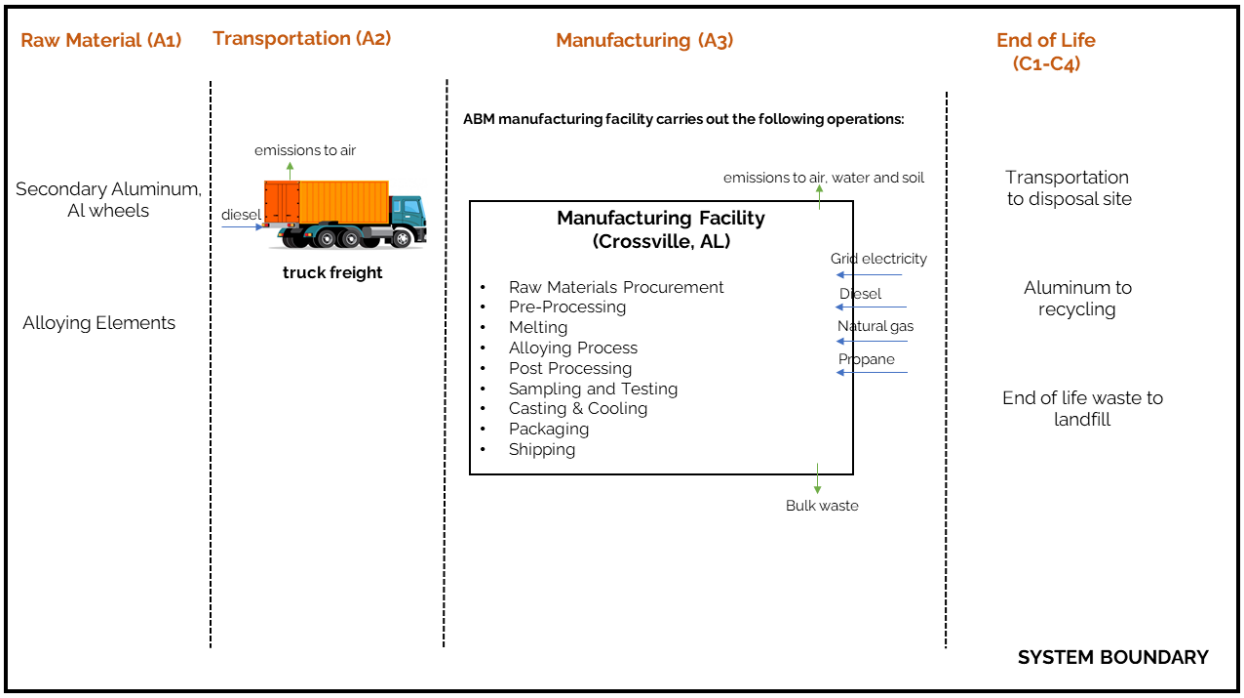

Figure 3: **General system inputs considered in the product system and categorized by modules in scope.**

The following life cycle stages are included in this EPD:

- A1: Raw material supply (upstream processes) - Extraction, handling, and processing of the materials used in the manufacturing of the declared products.
- A2: Transportation - Transportation of A1 materials from the supplier to the "gate" of the manufacturing facility (i.e. A3).
- A3: Manufacturing (core processes)- The energy and other utility inputs used to store, move, and manufacture the declared products and to operate the facility.
- C1-C4 – End-of-life scenarios, including demolition, transportation to disposal site, waste-processing, and disposal.
- Module D – reuse, recycling, and recycling potential of aluminum alloy products.

The life cycle stages not covered by this EPD include the construction stage (A4-A5) and the usage stage (B1-B7).

In addition, according to the relevant PCR, the following requirements are excluded from this study:

- Production, manufacture and construction of A3 building/capital goods and infrastructure;
- Personnel-related activities (travel, furniture, office supplies);
- Energy use related to company management and sales activities.
- Packaging of incoming raw materials (e.g, plastic strap, steel strap, etc.) is excluded as it accounts for less than 1% of the product's mass.

REPORTING PERIOD

This study represents the production data for 12 months from February 14, 2024, to February 14, 2025, for the American Buffalo manufacturing facility in Crossville, Alabama.

CUT-OFF CRITERIA

ISO 14044:2006 and the focus PCR requires the LCA model to contain a minimum of 95% of the total inflows (mass and energy) to the upstream and core modules be included in this study. The cut-off criteria were applied to all other processes unless otherwise noted above as follows. A 1% cut-off is considered for all renewable and non-renewable primary energy consumption and the total mass of inputs within a unit process where the total of the neglected inputs does not exceed 5%.

ALLOCATION

This EPD follows the allocation guidelines of ISO 14044, ISO 21930, and the reference PCR.

Where possible, allocation was avoided. When allocation was necessary, inputs and outputs were allocated on the basis of physical relationships, i.e., mass basis. As a default, secondary ecoinvent datasets use a physical mass basis for allocation. Secondary materials used adhere to the polluter pays

principle. Thus, the environmental impacts allocated to these materials are limited to the treatment and transportation required to use them as a material input.

COMPARABILITY

Environment declarations from different programs (Iso 14025) may not be comparable. EPDs are comparable only if prepared from cradle-to-grave life cycle results and based on the same function, quantified by the same functional unit, and taking account of replacement based on the product reference service life (RSL) relative to an assumed building service life, can be used to assist purchasers and users in making informed comparisons between products. This EPD is meant for B2B communication.

Third party verified ISO 14040/44 secondary LCI data sets contribute more than 80% of total impact (either at the unit process level or in aggregate) to any of the required impact categories identified by the applicable PCR.

No known flows are deliberately excluded from this EPD.

DATA SOURCES AND DATA QUALITY ASSESSMENT

No recovered on-site energy occurs at this facility.

The following statements explain how the above facility requirements/generation were derived:

Raw material transport:

American Buffalo Metals provided all primary information for the reporting year 2024, including comprehensive details on raw material consumption and logistics data for its Crossville, AL manufacturing facility. The transportation of these materials was determined based on the actual distance from the manufacturers or distributors. Logistics for A2 requirements relied on primary data to document transportation specifics, including the exact distance, mode of transport, and location details such as city, state, and country. All raw materials, including secondary aluminum, are sourced within the United States.

Electricity:

The reported electricity consumption is based on primary data from ABM's utility bills for the reporting period. The allocation of electricity was initially determined by normalizing the annual electricity consumption to the declared unit, i.e., 1 metric ton. Subsequently, this value was multiplied by the total production volume, measured in metric tons, for each product covered in this study.

National production mix from import, low voltage (production of transmission lines, in addition to direct emissions and losses in grid) of applied electricity for the manufacturing process (A3).

Electricity mix	Source	Amount	Unit
Electricity, United States (kwh) - US-SERC	Ecoinvent 3.10.1	506.66	g CO2-eq/kWh

Process/space heating:

The facility incorporates natural gas within its production processes. The reported natural gas consumption is based on ABM's primary information derived from utility bills for the reporting period. The allocation methodology for natural gas consumption follows the same approach as that of electricity.

The conversion factor used for mmBTU to MJ to represent the natural gas heating values in Mega joules (MJ) was 1 mmBTU equating to 1055.06 MJ.

Waste generation:

Waste calculations were calculated using primary information from ABM's records or vendor bills, which includes bulk waste only. All the scrap/waste generated during the manufacturing process, as every single material is consumable and can be reprocessed as a constituent in another manufacturing process. Transportation defaults were used because the driver's route and ultimate final destination are unknown. Therefore, the waste hauler could not confirm the exact mileage.

Packaging:

Packaging materials represent less than 1% of the mass of the main products per the declared unit. Common packaging materials include plastic strap, steel strap, and kraft paper.

Recovered energy:

No on-site energy is recovered on site.

Module A1 material losses:

Default material losses, 2%, were used.

Direct A3 emissions accounting:

Direct emissions were modeled with the best available ecoinvent processes.

Product packaging waste:

The table below provides the mass of packaging waste and its biogenic carbon content per the declared unit.

Table 8: **A5 (Installation) product packaging waste.**

A5 (Installation) packaging waste and bio-carbon content	Unit	Aluminum Ingot	Aluminum Sow	Aluminum Cast Cone
Plastic strap	kg	0.31	0.00	0.00
Steel strap	kg	0.09	0.00	0.00
Kraft paper	kg	0.01	0.00	0.00
Biogenic carbon content of packaging (kraft paper)	kg C	0.00402	0.00	0.00
Biogenic carbon content of packaging (plastic strap & steel strap)	kg C	0.00	0.00	0.00

Installation:

Outside the scope of this EPD.

Use stage:

Outside the scope of this EPD.

Reference service life:

This EPD does not cover product use stage and therefore, no claims regarding the product's service life are included in this study.

End-of-life scenarios:

In accordance with the Product Category Rules (PCR), the default assumptions for Module C were applied. As specified in the table below.

Table 9: **End-of-life (C1-C4) Scenarios.**

Name	Value
*Deconstruction	n/a
Transportation to the disposal site (truck)	100 km
*Waste processing	n/a
Disposal (landfill)	5%
Recycling rate of the product	95%
Removals of biogenic carbon	n/a

*The reference PCR reports the impacts of modules C1 and C3 as zero, since they are considered to be below the threshold criteria.

Preferred waste management:

At the end of the product service life, aluminum products should follow a sustainable cycle through responsible recycling wherever feasible. Aluminum is highly efficient sustainable building material and is 100% recyclable and can be recycled repeatedly . Components that can no longer be recycled must be handled through appropriate waste management practices. The disposal should follow industry-standard practices and regional waste management regulations. Waste materials may be directed to municipal landfills or commercial incineration facilities, ensuring full compliance with local, state, and federal requirements.

Module D:

According to the reference PCR, this EPD includes the reporting of Module D within its scope. Module D outlines the potential environmental benefits or burdens resulting from the substitution of primary materials and/or fuels through recycling and recovery processes at the end of a product's life.

A net scrap approach was used to account for the benefits associated with aluminum recycling, as reported in Module D. The following table outlines the relevant scenario information for Module D considered in this EPD.

Table 10: **Benefits and loads beyond the system boundary (Module D), relevant scenario information.**

Name	Value	Unit
Recycling rate of the product	95[1]	%
Recycled content of product	100	%

[1] Taken from International Aluminum Institute (IAI) Report: Aluminium Recyclability and Recycling – Towards Sustainable Cities, April 2015, p. 37 Table 2.4. Includes commercial and residential buildings.

Interpreting the results in Module D:

The values in Module D include a recognition of the benefits or impacts related to aluminum recycling which occur at the end of the product's service life. The rate of aluminum recycling and related processes will evolve over time. The results included in Module D attempt to capture future benefits, or impacts, but are based on a methodology that uses current industry-average data reflecting current processes.

DATA SOURCES

Specific data for the product composition are provided by the manufacturer. The data represents the production of the declared product and were collected for EPD development in the year of study. Background data is based on EPDs according to ISO 21930, EN 15804 and different LCA databases. The data quality of the raw materials in A1 is presented in the table below. There are no data gaps in the study, should any data gaps be identified, they are handled on an individual case basis

Table 11: **LCI inputs assumed for module A1 (i.e. raw material inputs).**

Materials	Source	Data Quality	Year
Chemical- Strontium	Ecoinvent 3.10.3	database	2023
Metal- Aluminum	Ecoinvent 3.10.1	database	2023
Metal- Titanium	Ecoinvent 3.10.1	database	2023
Metal- Magnesium	Ecoinvent 3.10.2	database	2023

DATA QUALITY ASSESSMENT

Data quality/variability requirements, as specified in the PCR, are applied. This section describes the achieved data quality relative to the ISO 14044:2006 requirements. Data quality is judged based on its precision (measured, calculated or estimated), completeness (e.g., unreported emissions), consistency (degree of uniformity of the methodology applied within a study serving as a data source) and representativeness (geographical, temporal, and technological).

Precision:

Through measurement and calculation, the manufacturers collected and provided primary data on their annual production. The product-specific data derived from specific production processes was used for modeling the life cycle of the declared products. For accuracy, the LCA practitioner and 3rd Party Verifier validated the plant gate-to-gate data.

Completeness:

All relevant specific processes, including inputs (raw materials, energy and ancillary materials) and outputs (emissions and production volume) were considered and modeled to represent the specified and declared products. The majority of relevant background materials and processes were taken from ecoinvent LCI datasets where relatively recent region-specific electricity inputs were utilized. The most relevant EPDs requiring key A1 inputs were also utilized where readily available.

Consistency:

To ensure consistency, the same modeling structure across the respective product systems was utilized for all inputs, which consisted of raw material inputs and ancillary material, energy flows, water resource inputs, product and co-products outputs, returned and recovered aluminum alloy materials, emissions to air, water and soil, and waste recycling and treatment. The same background LCI datasets

from the ecoinvent database were used across all product systems. Crosschecks concerning the plausibility of mass and energy flows were continuously conducted. The LCA team conducted mass and energy balances at the plant and selected process level to maintain a high level of consistency.

Reproducibility:

Internal reproducibility is possible since the data and the models are stored and available in a machine-readable project file for all foreground and background processes. A considerable level of transparency is provided throughout the detailed LCA report as the specifications and material quantity make-up for the declared products are presented, and key primary and secondary LCI data sources are summarized. The provision of more detailed publicly accessible data to allow full external reproducibility was not possible due to reasons of confidentiality.

Representativeness:

The representativeness of the data is summarized as follows**:**

- Time related coverage of the manufacturing processes' primary collected data from 2024-02-14 to 2025-02-14.
- Upstream (background) LCI data was either the PCR specified default (if applicable) or more appropriate LCI datasets as found in the country-adjusted ecoinvent database.
- Geographical coverage for inputs required by the A3 facility(ies) is representative of its region of focus; other upstream and background processes are based on US, North American, or global average data and adjusted to regional electricity mixes when relevant.
- Technological coverage is typical or average and specific to the participating facilities for all primary data.

Treatment of Missing Data:

In this study, missing data were not averaged as zeros; data gaps were addressed using default assumptions provided by the Product Category Rules (PCR), or through verified sources such as the ecoinvent database. Secondary sources such as LCA databases (e.g., ecoinvent) and industry-specific literature were consulted when primary data was unavailable. In cases where neither primary nor secondary data was accessible, analogous processes or materials were selected as proxies, ensuring that their selection was well-reasoned and appropriately justified. Missing data were minimized to the extent possible. Any remaining data gaps were filled with conservative estimates that do not significantly influence the overall LCA results.

Sources of Data:

All manufacturing processes were based on primary data. For raw materials, facility-specific supplier-provided data was utilized whenever it was accessible. In the absence of primary data, relevant secondary data from the ecoinvent database was used to represent raw material production.

Uncertainty:

Primary data was collected for over 95% of the processes involved. As such, uncertainty is considered low and does not significantly influence the overall LCA results. In instances where primary data was unavailable, representative datasets were employed that closely reflect the regional and temporal scope of the project.

ASSUMPTIONS AND ESTIMATES

All estimates and assumptions are within the requirements of ISO 14040/44. Certain assumptions made in this study may have influenced the results are:

- The selection of secondary datasets from the ecoinvent database plays a critical role in representing supply chain aspects for ABM products. Collaboration among LCA practitioners, American Buffalo Metals associates, and ecoinvent data experts was instrumental in identifying the most suitable datasets.
- The weights of each packaging material used were estimated based on industry averages.
- Region-specific electricity was used to model the electricity mix using the ecoinvent database v3.10.1.
- The allocation of inputs and outputs is based on physical characteristics, i.e., mass basis.

ENVIRONMENTAL INDICATORS AND INVENTORY METRICS

Per the PCR, this EPD supports the life cycle impact assessment indicators and inventory metrics as listed in the tables below. As specified in the PCR, the most recent US EPA Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI), impact categories were utilized as they provide a North American context for the mandatory category indicators to be included in the EPD. Additionally, the PCR requires a set of inventory metrics to be reported with the LCIA indicators (see tables below).

LCIA methods reported in this EPD are as follows:

- IPCC 2013 developed the Intergovernmental Panel on Climate Change based on Fifth Assessment Report (AR5).
- TRACI (Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts), developed by the U.S. EPA.
- CML-IA, developed at Leiden University.

Characterization factors were applied using established LCIA methods, including TRACI 2.1 (Bare et al., 2012), CML-IA (v4.8, 2016) (Guinée et al., 2016), and IPCC 2013 (AR5) to convert inventory data into potential environmental impacts.

Table 12: **Life cycle impact categories and life cycle inventory metrics.**

ID	LCIA indicators	Abbreviations	Units
1	Climate change: global warming potential	GWP100	kg CO2-eq
2	Ozone depletion: ozone depletion potential (ODP)	ODP	kg CFC-11-eq
3	Acidification: acidification potential (AP)	AP	kg SO2-eq
4	Eutrophication: eutrophication potential	EP	kg N-eq
5	Smog formation potential	SFP	kg O3-eq
6	Energy resources: non-renewable: abiotic depletion potential (ADP): fossil fuels	ADPfossil	MJ
Inventory metrics			
7	Inventory indicators ISO21930: Cumulative Energy Demand - renewable energy resources	RPRE	MJ
8	Inventory indicators ISO21930: Renewable primary resources with energy content used as material (i.e., PERM)	RPRM	MJ
9	Inventory indicators ISO21930: Cumulative Energy Demand - non-renewable energy resources	NRPRE	MJ
10	Inventory indicators ISO21930: Non-renewable primary resources with energy content used as material (i.e., PENRM)	NRPRM	MJ
11	Inventory indicators ISO21930: use of secondary material	SM	kg
12	Inventory indicators ISO21930: use of renewable secondary fuels	RSF	MJ
13	Inventory indicators ISO21930: use of non-renewable secondary fuels	NRSF	MJ
14	Inventory indicators ISO21930: recovered energy	RE	MJ
15	Inventory indicators ISO21930: use of net fresh water	FW	m3
16	Inventory indicators ISO21930: hazardous waste disposed	HWD	kg
17	Inventory indicators ISO21930: non-hazardous waste disposed	NHWD	kg
18	Inventory indicators ISO21930: radioactive waste disposed	RWD	kg
19	Inventory indicators ISO21930: materials for recycling	MR	kg
20	Inventory indicators ISO21930: materials for energy recovery	MER	kg
21	Inventory indicators ISO21930: exported energy - electricity	EEel	MJ
22	Inventory indicators ISO21930: exported energy - heat	EEheat	MJ

It should be noted that emerging LCA impact categories and inventory items are still under development and can have high levels of uncertainty that preclude international acceptance pending further development. Use caution when interpreting data in any of the following categories.

- Renewable primary energy resources as energy (fuel);
- Renewable primary resources as material;
- Non-renewable primary resources as energy (fuel);
- Non-renewable primary resources as material;
- Secondary Materials;
- Renewable secondary fuels;
- Non-renewable secondary fuels;
- Recovered energy;
- Abiotic depletion potential for non-fossil mineral resources.
- Land use related impacts, for example on biodiversity and/or soil fertility;
- Toxicological aspects;
- Emissions from land use change [GWP 100 (land-use change)];
- Hazardous waste disposed;
- Non-hazardous waste disposed;
- High-level radioactive waste;
- Intermediate and low-level radioactive waste;
- Components for reuse;
- Materials for recycling;
- Materials for energy recovery;
- Recovered energy exported from the product system

TOTAL IMPACT SUMMARY

The following table reports the total LCA results for each secondary aluminum alloy product produced at a given facility per declared unit basis.

The LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.

These six impact categories 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. Toxicity impacts shall be reported under “Additional Environmental Information”.

Table 13: **Total life cycle (across modules in scope) impact results for all declared products, on a per 1 metric ton basis.**

a) Midpoint Impact Categories:

Indicator/LCI Metric	***GWP100 (kg CO2-eq)					
Product	**A1-A3**	**C1**	**C2**	**C3**	**C4**	**D**
Aluminum Sow	7.08E+02	0.00E+00	2.42E+01	0.00E+00	1.25E+00	-2.11E+01
Aluminum Cast Cone	7.08E+02	0.00E+00	2.42E+01	0.00E+00	1.25E+00	-2.11E+01
Aluminum Ingot	7.09E+02	0.00E+00	2.42E+01	0.00E+00	1.25E+00	-2.16E+01
	ODP (kg CFC-11-eq)					
Aluminum Sow	1.22E-05	0.00E+00	4.00E-07	0.00E+00	2.45E-08	-1.78E-06
Aluminum Cast Cone	1.22E-05	0.00E+00	4.00E-07	0.00E+00	2.45E-08	-1.78E-06
Aluminum Ingot	1.22E-05	0.00E+00	4.00E-07	0.00E+00	2.45E-08	-1.78E-06
	AP (kg SO2-eq)					
Aluminum Sow	1.45E+00	0.00E+00	4.72E-02	0.00E+00	9.49E-03	-4.26E-02
Aluminum Cast Cone	1.45E+00	0.00E+00	4.72E-02	0.00E+00	9.49E-03	-4.26E-02
Aluminum Ingot	1.45E+00	0.00E+00	4.72E-02	0.00E+00	9.49E-03	-4.26E-02
	EP (kg N-eq)					
Aluminum Sow	9.36E-01	0.00E+00	2.36E-02	0.00E+00	4.92E-03	-2.75E-02
Aluminum Cast Cone	9.36E-01	0.00E+00	2.36E-02	0.00E+00	4.92E-03	-2.75E-02
Aluminum Ingot	9.38E-01	0.00E+00	2.36E-02	0.00E+00	4.92E-03	-2.76E-02
	SFP (kg O3-eq)					
Aluminum Sow	2.75E+01	0.00E+00	8.97E-01	0.00E+00	1.55E-01	-8.09E-01
Aluminum Cast Cone	2.75E+01	0.00E+00	8.97E-01	0.00E+00	1.55E-01	-8.09E-01
Aluminum Ingot	2.75E+01	0.00E+00	8.97E-01	0.00E+00	1.55E-01	-8.09E-01
	****ADPfossil (MJ)**					
Aluminum Sow	1.02E+04	0.00E+00	3.39E+02	0.00E+00	2.15E+01	-2.68E+02
Aluminum Cast Cone	1.02E+04	0.00E+00	3.39E+02	0.00E+00	2.15E+01	-2.68E+02
Aluminum Ingot	1.03E+04	0.00E+00	3.39E+02	0.00E+00	2.15E+01	-2.68E+02

***The LCI indicator (GWP 100) did not include biogenic carbon removal(s) & emissions and emissions from land use change [GWP100 (land-use-change)].

*** GWP100 was reported using the IPCC 2013 (AR5) LCIA methodology.

**ADPfossil was reported using the most recent version of the CML method (CML v4.8, 2016) along with updated characterization factors.

b) Resource Inventory Metrics:

Indicator/LCI Metric	RPRE (MJ)					
Module	**A1-A3**	**C1**	**C2**	**C3**	**C4**	**D**
Aluminum Sow	1.56E+02	0.00E+00	4.89E+00	0.00E+00	6.72E-01	-9.71E+01
Aluminum Cast Cone	1.56E+02	0.00E+00	4.89E+00	0.00E+00	6.72E-01	-9.71E+01
Aluminum Ingot	1.57E+02	0.00E+00	4.89E+00	0.00E+00	6.72E-01	-9.71E+01
	RPRM (MJ)					
Aluminum Sow	4.93E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aluminum Cast Cone	4.93E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aluminum Ingot	4.94E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NRPRE (MJ)					
Aluminum Sow	1.02E+04	0.00E+00	3.39E+02	0.00E+00	2.15E+01	-2.68E+02
Aluminum Cast Cone	1.02E+04	0.00E+00	3.39E+02	0.00E+00	2.15E+01	-2.68E+02
Aluminum Ingot	1.02E+04	0.00E+00	3.39E+02	0.00E+00	2.15E+01	-2.68E+02
	NRPRM (MJ)					
Aluminum Sow	3.22E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aluminum Cast Cone	3.22E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aluminum Ingot	3.23E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	SM (kg)					
Aluminum Sow	1.02E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aluminum Cast Cone	1.02E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aluminum Ingot	1.02E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	RSF (MJ)					
Aluminum Sow	4.85E-02	0.00E+00	1.74E-03	0.00E+00	1.19E-04	-3.97E-02
Aluminum Cast Cone	4.85E-02	0.00E+00	1.74E-03	0.00E+00	1.19E-04	-3.97E-02
Aluminum Ingot	5.97E-02	0.00E+00	1.74E-03	0.00E+00	1.19E-04	-3.97E-02
	NRSF (MJ)					
Aluminum Sow	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aluminum Cast Cone	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aluminum Ingot	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	FW (m3)					
Aluminum Sow	1.57E+00	0.00E+00	4.40E-02	0.00E+00	0.00E+00	-5.30E-01
Aluminum Cast Cone	1.57E+00	0.00E+00	4.40E-02	0.00E+00	0.00E+00	-5.30E-01
Aluminum Ingot	1.58E+00	0.00E+00	4.40E-02	0.00E+00	0.00E+00	-5.30E-01

c) Waste/output Inventory Metrics:

Indicator/LCI Metric	HWD (kg)					
Module	**A1-A3**	**C1**	**C2**	**C3**	**C4**	**D**
Aluminum Sow	3.18E+01	0.00E+00	5.79E-01	0.00E+00	1.62E-01	-8.89E-02
Aluminum Cast Cone	3.18E+01	0.00E+00	5.79E-01	0.00E+00	1.62E-01	-8.89E-02
Aluminum Ingot	3.19E+01	0.00E+00	5.79E-01	0.00E+00	3.35E-05	-8.89E-02
	NHWD (kg)					
Aluminum Sow	5.54E+02	0.00E+00	1.11E+01	0.00E+00	2.73E+02	-6.13E+00
Aluminum Cast Cone	5.54E+02	0.00E+00	1.11E+01	0.00E+00	2.73E+02	-6.13E+00
Aluminum Ingot	5.56E+02	0.00E+00	1.11E+01	0.00E+00	2.73E+02	-6.13E+00
	RWD (kg)					
Aluminum Sow	2.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-1.10E-03
Aluminum Cast Cone	2.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-1.10E-03
Aluminum Ingot	2.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-1.10E-03
	MR (kg)					
Aluminum Sow	3.35E-05	0.00E+00	0.00E+00	9.50E+02	3.62E-04	0.00E+00
Aluminum Cast Cone	3.35E-05	0.00E+00	0.00E+00	9.50E+02	3.62E-04	0.00E+00
Aluminum Ingot	3.35E-05	0.00E+00	0.00E+00	9.50E+02	3.62E-04	0.00E+00
	MER (kg)					
Aluminum Sow	1.16E-07	0.00E+00	0.00E+00	0.00E+00	1.56E-06	0.00E+00
Aluminum Cast Cone	1.16E-07	0.00E+00	0.00E+00	0.00E+00	1.56E-06	0.00E+00
Aluminum Ingot	1.16E-07	0.00E+00	0.00E+00	0.00E+00	1.56E-06	0.00E+00
	CRU (kg)					
Aluminum Sow	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aluminum Cast Cone	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aluminum Ingot	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	EEel (MJ)					
Aluminum Sow	3.96E-04	0.00E+00	0.00E+00	0.00E+00	1.09E-01	0.00E+00
Aluminum Cast Cone	3.96E-04	0.00E+00	0.00E+00	0.00E+00	1.09E-01	0.00E+00
Aluminum Ingot	3.96E-04	0.00E+00	0.00E+00	0.00E+00	1.09E-01	0.00E+00
	EEheat (MJ)					
Aluminum Sow	1.98E-04	0.00E+00	0.00E+00	0.00E+00	8.70E-03	0.00E+00
Aluminum Cast Cone	1.98E-04	0.00E+00	0.00E+00	0.00E+00	8.70E-03	0.00E+00
Aluminum Ingot	1.98E-04	0.00E+00	0.00E+00	0.00E+00	8.70E-03	0.00E+00

Comparisons cannot be made between product-specific or industry average EPDs at the design stage of a project, before a building has been specified. Comparisons may be made between product-specific or industry average EPDs at the time of product purchase when product performance and specifications have been established and serve as a functional unit for comparison. Environmental impact results shall be converted to a functional unit basis before any comparison is attempted.

Any comparison of EPDs shall be subject to the requirements of ISO 21930. EPDs are not comparative assertions and are either not comparable or have limited comparability when they have different system boundaries, are based on different product category rules or are missing relevant environmental impacts. Such comparison can be inaccurate, and could lead to erroneous selection of materials or products which are higher-impact, at least in some impact categories.

Interpretation:

This study represents the environmental impacts of 1 (one) metric ton of secondary aluminum alloy products. The study revealed specific key contributors or environmental hotspots that significantly contribute to the products' carbon footprint. The findings are as follows:

The most significant contributor to the secondary aluminum alloy products' carbon footprint, measured in kg CO_2 eq, stems from module A2 (Raw Material Transportation), primarily attributed to the procurement and logistical handling of secondary (scrap) aluminum sourced from a wide network of suppliers across the United States. This decentralized supply chain results in increased transportation distances and less optimized freight movements. Following this, the A3 (manufacturing stage), in particular, has a significant influence due to the energy-intensive process of melting aluminum scrap in a charge furnace, which substantially raises the overall Global Warming Potential (GWP). Other stages, including C2 (Transport to Disposal Site) and C4 (Disposal), contribute to the overall global warming potential (GWP), their impact is comparatively smaller.

However, Module D significantly affects the results, with the 95% recycling rate for aluminum considered a conservative and justifiable estimate. Higher recycling rates would reduce life-cycle impacts, while lower rates would increase them.

ADDITIONAL ENVIRONMENTAL INFO

- The products contain no hazardous substances.
- No substances required to be reported as hazardous are associated with the production of these products.
- The products are free from indoor air emissions, gamma or ionizing radiation, and the release of chemicals into the air, water, or soil.

REFERENCES

- ISO 21930:2017 Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services.
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- ISO 14040:2006 Environmental Management - Life Cycle Assessment - Principles and Framework.
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- UL Environment (2022). Product Category Rules for Building-Related Products and Services. Part A: Life Cycle Assessment Calculation Rules and Report Requirements, UL 10010 v4.0.
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