Environmental Product Declaration

In accordance with ISO 14025

Aluminium Recycled Foundry Alloy (RFA)

Owner of the declaration:
Alumetal S.A.
ul. Kościuszki 111, 32-650 Kęty, Poland
https://alumetal.pl/

Product name:
Aluminium Recycled Foundry Alloy

Declared unit:
1 kg Aluminium Recycled Foundry Alloy in solid (e.g. ingots) or liquid state manufactured by Alumetal

Product category /PCR:
PCR 2022:08 version 1.0 Basic Aluminium products and special alloys, EPD International

Program holder and publisher:
The Norwegian EPD foundation

Declaration number:
NEPD-7700-7063-EN

Registration Number:
NEPD-7700-7063-EN

Issue date: 03.10.2024

Valid to: 03.10.2029

The Norwegian
EPD Foundation

General information

Product:
Aluminium Recycled Foundry Alloy (RFA)

Program holder:
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Declaration Number:
NEPD-7700-7063-EN

This declaration is based on Product Category Rules:
PCR 2022:08 version 1.0 Basic Aluminium products and special alloys, EPD International

Statements:
The owner of the declaration shall be liable for the underlying information and evidence. EPD Norway shall not be liable with respect to manufacturer, life cycle assessment data and evidences.

Declared unit:
1 kg Aluminium Recycled Foundry Alloy in solid (e.g. ingots) or liquid form manufactured by Alumetal

Declared unit with option:
NA

Functional unit:
NA

Verification:
Independent verification of the declaration and data, according to ISO14025:2010

internal ☐ external ☒

Andreas Brekke, NORSUS AS
Independent verifier approved by EPD Norway

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Place of production:
Alumetal S.A., Poland (Kęty)

Management system:
ISO 9001, ISO 14001, ISO 45001

Organisation no:
[123456789MVA fill in]

Issue date:
03.10.2024

Valid to:
03.10.2029

Year of study:
2023

Comparability:
EPDs from other programmes than EPD Norge, EPD International may not be comparable.

The EPD has been worked out by:
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Approved

Håkon Hauan

Manager of EPD Norway

Product/Process

Aluminium Recycled Foundry Alloy manufactured by Alumetal

Alumetal Group produces secondary aluminium casting alloys and primary alloys. The production capacity of the Alumetal Group plants is 280 000 tons per year. Alumetal Group consists of:

- A holding company Alumetal S.A. with its principal place of business in Kęty;
- A production company – Alumetal Poland Sp. z o.o. with three plants located in Kęty, Gorzyce and Nowa Sól of total production capacity amounting to 220 thousand tons per year, which specializes in production of secondary aluminium casting alloys, master alloys and aluminium for steel deoxidation;
- A production company – Alumetal Group Hungary Kft. with production plant located in Komarom (Hungary) of total production capacity amounting to 60 thousand tons per year;
- Support production company (chemical division) – T+S Sp. z o.o. in Kęty of annual production capacity 7 thousand tons, which produces for non-ferrous metals market sector, steel industry and delivers chemical materials.

Alumetal Plants offer a full range of alloys manufactured from secondary raw materials and primary aluminium. The offer includes alloys produced compliant with the following standards:

- European standard: EN 1676,
- Polish standard: PN-76/h-88027, ZN-86/MN-260-14,
- Other standards: DIN 1725, JIS, ASTM, BS.

In an aluminium recycling plant producing Foundry Alloys, ingots are made from melting a mix of end-of-life scrap (post-consumer scrap), process scrap (pre-consumer scrap), master alloys and some smaller amounts of alloying materials. Ingots are used mainly in the automotive sector. Average raw material used for the production of Aluminium Recycled Foundry Alloy ingots are:

- Post-Consumer Scrap: 57 %
- Process Scrap (also denoted pre-consumer scrap): 37%
- Alloying Materials: 6%

This declaration covers the RFA alloy produced at Alumetal location in Kęty.

Climate footprint and allocation methods

Pre-consumer scrap comprises by-products from various downstream processing operations of aluminium and is modeled to reflect the climate impact of the actual scrap used. This is called the by-product (or co-product) allocation method, and the burden of pre-consumer scrap follows the physical metal when recycled. The main reason for using the by-product method is to reduce greenwashing risk, as well as clearly distinguish between post-consumer and pre-consumer scrap, as from an overall aluminium decarbonization perspective only post-consumer scrap leads to a real footprint reduction. Post-consumer scrap originates from products that have completed their useful life and are subsequently recovered for recycling. This type of scrap is modeled as waste, with no environmental impacts attributed to it except for the transportation between the site where the used aluminium is handled and the recycling facility.

This gives Aluminium Recycled Foundry Alloy (RFA) an average climate impact of 2.44 kg CO_2 eq./kg aluminium ingot. 87% of the climate impact is attributable to emissions generated during the upstream production of materials used in the manufacture of RFA. In contrast, only 13% of the impact is due to direct emissions and the energy sources utilized in the production process.

The upstream emissions, accounting for 42%, are attributed to the carbon footprint associated with the use of pre-consumer scrap in the production of RFA.

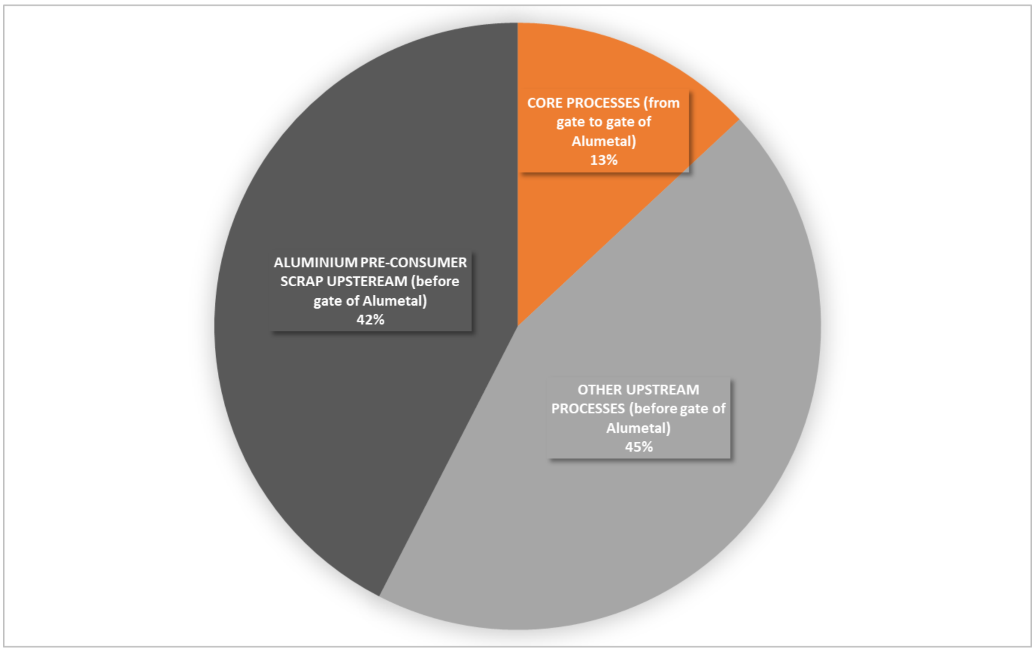

Fig. 1. Share of Upstream and Core Processes in the Carbon Footprint of the Declared Unit of Aluminium Recycled Foundry Alloy produced by Alumetal, with taking into account the Impact Resulting from Upstream Pre-Consumer Scrap Processes.

The alternative allocation method referred to as the cut-off method assumes that the burden of pre-consumer scrap is fully accounted for when generated and that the scrap, for calculation purposes, do not carry a footprint. Taking this approach, there are zero environmental burdens for both post-consumer scrap and pre-consumer scrap in environmental product declarations. Several EPDs developed in accordance with PCR 2022:08 version 1.0 “Basic Aluminium products and special alloys” are using this approach.
To address this challenge and enable full transparency the two different allocation methods were examined, and the results are presented below in Tab. 1.

Tab. 1. Carbon footprint calculation methods with different approaches to accounting for the environmental burden of Pre-Consumer Scrap of RFA at the Alumetal gate.

	RFA allocation method 1	RFA allocation method 2
	0% of primary aluminium	*0% of primary aluminium*
Climate Change [kg CO_2 eq.]	2.44	1.41

Method 1, by-product allocation method, includes the impact of pre-consumer scrap in the carbon footprint of RFA.
Method 2, cut-off allocation method includes a zero impact of pre-consumer scrap in the carbon footprint of RFA (as used in several comparable environmental product declarations developed according to PCR 2022:08).
When comparing the carbon footprints of products from different producers, it is important to pay attention to which allocation method has been used for the assessment.

Due to the conservative approach adopted by Alumetal, the results presented in this declaration refer only to method 1. This approach is adopted and recommended by Norsk Hydro ASA, of which Alumetal is a part.

Product specification:

Aluminium RFA is produced from pre- and post-consumer scrap and alloying materials.

Tab. 2. Material composition of RFA.

Materials	kg	%
Aluminium from recycling Pre-Consumer Scrap	0.366	36.63
Aluminium from recycling Post-Consumer Scrap	0.567	56.73
Aluminium primary	0.000	0.00
Silicon	0.046	4.64
Magnesium	0.001	0.14
Copper (from pre-treatment scrap)	0.013	1.29
Master alloys	0.005	0.49
Alloys purchased	0.001	0.08

Technical data:

Applications:

Aluminium Recycled Foundry Alloy is widely used in the automotive industry, particularly for manufacturing engine components, housings, and other parts requiring good castability, mechanical strength, and corrosion resistance. It is also used in various other industrial applications where these properties are critical.

Castability and Machinability:

- Castability: Excellent, making it suitable for complex shapes and thin-walled castings.
- Machinability: Good, with the potential for high precision.

Corrosion Resistance:

Alloy RFA offers good corrosion resistance, especially in automotive environments, due to the protective oxide layer formed on its surface.

Heat Treatment:

This alloy is usually used in the as-cast condition (F temper) but can also be heat treated to modify its mechanical properties.

Market:

The Aluminium Recycled Foundry Alloy covered in this EPD has all of Europe as its main market. The largest sector using the product is the automotive sector.

LCA: Calculation rules

Declared unit:

1 kg Aluminium Recycled Foundry Alloy in solid (e.g. ingots) or liquid state manufactured by Alumetal.

Cut-off criteria:

There were no deliberate exclusions apart from pre-treatment and post-consumer scrap preparation at its suppliers before the actual pre-treatment, which is not included due to the lack of available data. The actual pre-treatment processes carried out in Alumetal are included.

When applying the cut-off criteria for this EPD, mass and energy flows have been gathered for the entire production system and all processes in the foreground system including Upstream Processes.

The total exclusion of mass and energy flows is well below 5% per module and for the system in total.

Allocation:

The allocation is performed in accordance with the Allocation Rules of PCR 2022:08. Electricity, natural gas, heat, fuels, materials, water, and in-house waste production are allocated equally among all products through mass allocation.

In the manufacturing of RFA, salt slag is used during the melting phase. This salt slag is recycled at a facility which separates the salt and the aluminium in the slag. Mass allocation is used between salt and aluminium in this process.

The waste generated in the core process is allocated to the system under study using mass-based allocation.

The carbon footprint associated with the production of pre-consumer scrap is assigned to RFA.

Post-consumer scrap at the Alumetal gate is considered waste with a zero carbon footprint; only the recycling process and transportation of the material are allocated to RFA.

Data quality:

Data were collected in the first quarter of 2024 for the year 2023, and it is representative of that year.

Specific data, meaning data gathered from the actual manufacturing plant where product-specific processes are carried out, were collected. Site-specific data were also gathered from the salt slag treatment plant.

Generic data were applied to the upstream processes, sourced from the commercial database Ecoinvent 3.10 (2024) (Allocation – Cut-Off by classification).

SimaPro 9.6.0.1 (2024) was used to develop the model.

System boundary:

EPD system boundary is "cradle-to-gate".

As basic aluminium is a semi-finished/intermediate product that need to be further processed to obtain the final consumer product, it can be physically integrated with other products in subsequent life-cycle processes (i.e. no longer identifiable) and its final use/end-of life is unknown, system boundaries, according to PCR 2022:08, are limited to cradle-to-gate approach. Thereupon the life cycle of the RFA analyzed in this declaration, is divided into life cycle stages:

– Upstream processes (from cradle-to-gate);
– Core processes (from gate-to-gate);
– Transport to the customer is considered with an assumed distance of 500 km by a freight lorry with a load capacity of 16-32 metric tons, meeting the EURO5 standard requirements.

The key contributors in the Upstream phase include raw material suppliers, energy providers, and chemical manufacturers that supply the necessary inputs for aluminium alloy production. In this phase, it is also important to mention the salt slag recycler, which provides recycled salt. Alumetal's production facilities in Kęty, Gorzyce, and Nowa Sól are the key contributors in the Core phase, responsible for the manufacturing of aluminium alloys. Additionally, utility providers supply electricity, water, and fuel to support the production processes. Transport companies or suppliers also deliver the necessary products for the production process.

Figure below shows simplified flow of materials and processes in the life cycle of products manufactured by Alumetal.

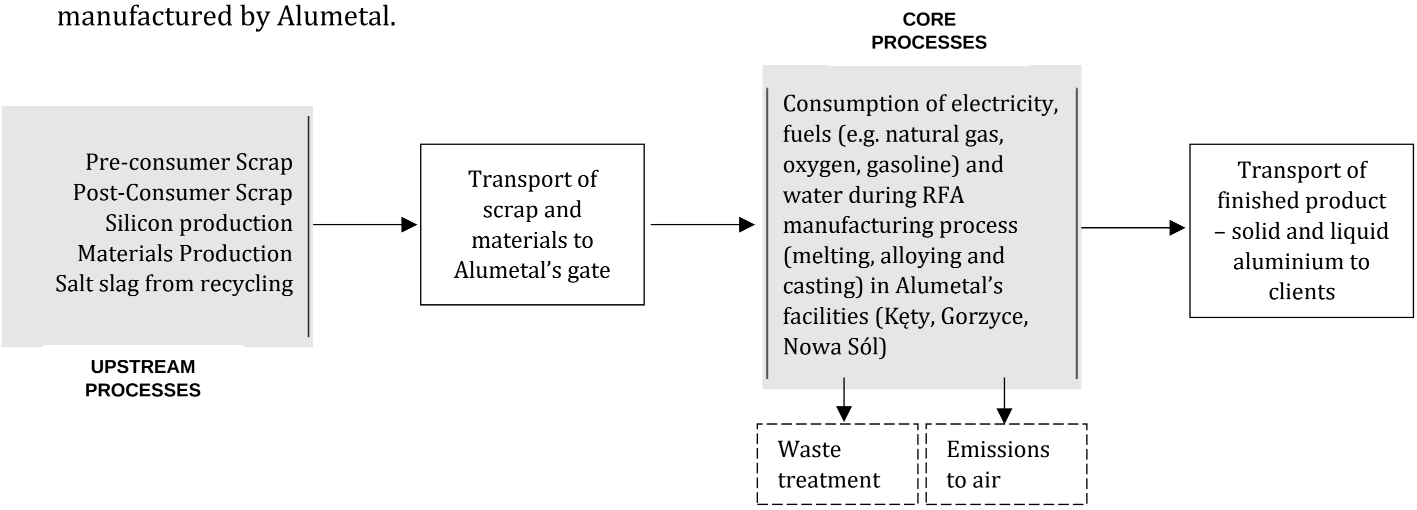

Fig. 2. Simplified flow of materials and processes in the life cycle of products manufactured by Alumetal.

Below is the detailed process assignment in the model.

Process assignment in the model
USPTREAM PROCESSES consist in the “from cradle to gate” set of processes that includes:
– production process of pre-consumer scrap – transport of scrap from suppliers to the manufacturing site in Kęty (including transport of scrap from external suppliers to Alumetal Nowa Sól, transport of copper and magnesium) – transport of scrap from suppliers to Alumetal Nowa Sól – transport of scraps from Alumetal Nowa Sól to the manufacturing site in Kęty – energy needed for pre-treatment of scrap (carried out internally in Kęty) – energy needed for pre-treatment of scrap (carried out internally in Nowa Sól) – production of pure alloying elements from raw materials (silicon, part of magnesium) – production of master alloys – production of alloys purchased – production of raw materials used (e.g. chemical products and auxiliaries, including packaging materials) – salt slags recycling through third party – production of spare parts (e.g. refractories, machinery tires) and all material needed for maintenance operations more frequent than every 3 years

CORE PROCESSES consist in processes within the production plant "from gate to gate" that includes:
– transport of pure alloying elements from raw materials (silicon, magnesium) to gate – transport of master alloys to gate – transport of alloys purchased to gate – transport of raw materials used (e.g. chemical products and auxiliaries) to gate – transport of recycled salt to gate – consumption of electricity, fuels (e.g. natural gas, oxygen, gasoline) and water in the company during manufacturing process (including their production) – direct air emissions in the production plant – treatment of water used during the production process – end-of-life treatment of waste and packaging materials of the products used in the plant – transport of waste (including salt slag) to third parties for disposal – transport of product to customer

Excluded processes are the following:

- post-consumer scrap production, i.e. processes from other previous lifecycles that generate scrap;
- construction of buildings and machineries;
- production and maintenance of machineries with more than 3 years estimated lifetime;
- activity and travels of employees;
- use and end of life of the product.

LCA: Results[1]

All results are calculated with the use of SimaPro v.9.6.0.1 (2024) and impact methods according to Environmental Footprint 3.1 (adapted) V1.01.

The LCIA results include the carbon footprint of pre-consumer scrap; they do not include the impact of pre-consumer scrap in the remaining impact categories.

Environmental impact

Parameter	Unit	Upstream	Core[2]	Transport to client	Total
GWP-total	kg CO_2 eq.	2.12E+00	3.20E-01	7.77E-02	2.52E+00
GWP-fossil	kg CO_2 eq.	2.11E+00	3.20E-01	7.77E-02	2.50E+00
GWP-biogenic	kg CO_2 eq.	1.42E-02	1.31E-04	2.65E-06	1.44E-02
GWP-LULUC	kg CO_2 eq.	6.25E-04	1.36E-04	1.91E-06	7.63E-04
ODP	kg CFC11 eq.	7.42E-08	1.55E-08	1.58E-09	9.12E-08
AP	mol H^+ eq.	1.13E-02	1.34E-03	1.93E-04	1.28E-02
EP freshwater	kg P eq.	1.30E-04	9.41E-06	6.51E-08	1.39E-04
EP-marine	kg N eq.	1.73E-03	2.99E-04	7.41E-05	2.10E-03
EP terrestrial	mol N eq.	1.91E-02	2.60E-03	8.11E-04	2.26E-02
POCP	kg NMVOC eq.	6.21E-03	1.39E-03	3.37E-04	7.93E-03
ADP-M&M	kg Sb eq.	2.49E+01	6.34E+00	1.02E+00	3.23E+01
ADP-fossil	MJ	6.67E-06	9.91E-09	2.56E-09	6.68E-06
WDP	m^3	7.21E+02	1.02E-01	4.35E-04	7.21E+02

GWP-total: Global Warming Potential; GWP-fossil: Global Warming Potential fossil fuels; GWP-biogenic: Global Warming Potential biogenic; GWP-LULUC: Global Warming Potential land use and land use change; ODP: Depletion potential of the stratospheric ozone layer; AP: Acidification potential, Accumulated Exceedance; EP-freshwater: Eutrophication potential, fraction of nutrients reaching freshwater end compartment; EP-marine: Eutrophication potential, fraction of nutrients

[1] *Reading example: 3.25E-01 = 3.25*10-1 = 0.325*

[2] *Using residual mix for electricity.*

reaching freshwater end compartment; EP-terrestrial: Eutrophication potential, Accumulated Exceedance; POCP: Formation potential of tropospheric ozone; ADP M&M: Abiotic depletion potential for non-fossil resources (minerals and metals); ADP-fossil: Abiotic depletion potential for fossil resources; WDP: Water deprivation potential, deprivation weighted water consumption

Analyzing the impact of Aluminium Recycled Foundry Alloy on climate change from cradle to gate (**Global Warming Potential** - GWP total category), upstream processes account for the largest share, contributing 84.2% of the total impact (2.12 kg CO2 eq.). This is primarily driven by the production of pre-consumer scrap and silicon, followed by material transport. The core processes contribute 12.7% (0.32 kg CO2 eq.), mainly due to natural gas and electricity consumption during the manufacturing phase. Transport contributes 3.1% (0.0777 kg CO2 eq.) of the total impact.

In the **Acidification Potential** (AP) category, upstream processes are responsible for 88% of the total impact (1.13E-02 mol H^+ eq.), driven largely by silicon production, material transport, and salt slag recycling. The core processes account for 10.5% (1.34E-03 mol H^+ eq.), primarily due to electricity and oxygen consumption during production, while transport adds 1.5% to the total impact.

In the **Eutrophication Potential (freshwater)** category, upstream processes contribute 93.2% of the total impact (1.30E-04 kg P eq.), with significant contributions from silicon and magnesium production, salt slag recycling, and energy consumption. The core processes contribute 6.7% (9.41E-06 kg P eq.), mainly due to electricity and waste management, while transport adds 0.1% to the overall impact.

For **Eutrophication Potential (marine)**, upstream processes account for 82.2% of the total impact (1.73E-03 kg N eq.), with key contributions from material production and transport. Core processes contribute 14.2% (2.99E-04 kg N eq.), and transport contributes 3.5% to the total.

In the **Photochemical Ozone Creation Potential** (POCP) category, upstream processes contribute 78.2% of the total impact (6.21E-03 kg NMVOC eq.), driven by alloying elements production (mainly silicon) and material transport. The core processes account for 17.5% (1.39E-03 kg NMVOC eq.), with transport adding 4.2% to the total.

Resource use

Parameter	Unit	Upstream	Core	Total
RPEE	MJ	2.87E+00	2.57E-01	3.13E+00
RPEM	MJ	5.89E-05	0.00E+00	5.89E-05
TPE	MJ	2.87E+00	2.57E-01	3.13E+00
NRPE	MJ	1.15E+01	6.34E+00	1.79E+01
NRPM	MJ	0.00E+00	0.00E+00	0.00E+00
TRPE	MJ	1.15E+01	6.34E+00	1.79E+01
SM	kg	1.00E+00	1.78E-02	1.02E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00
W	m^3	5.02E-02	9.27E-02	1.43E-01

RPEE Renewable primary energy resources used as energy carrier; RPEM Renewable primary energy resources used as raw materials; TPE Total use of renewable primary energy resources; NRPE Non renewable primary energy resources used as energy carrier; NRPM Non renewable primary energy resources used as materials; TRPE Total use of non renewable primary energy resources; SM Use of secondary materials; RSF Use of renewable secondary fuels; NRSF Use of non renewable secondary fuels; W Use of net fresh water

End of life - Waste

Parameter	Unit	Upstream	Core	Total
HW	kg	1.54E-05	3.58E-02	3.58E-02
NHW	kg	3.53E-09	2.29E-03	2.29E-03
RW	kg	2.23E-05	1.01E-05	3.24E-05

HW Hazardous waste disposed; NHW Non hazardous waste disposed; RW Radioactive waste disposed

End of life – output flow

Parameter	Unit	Upstream	Core	Total
CR	kg	0.00E+00	0.00E+00	0.00E+00
MR	kg	0.00E+00	2.32E-02	2.32E-02
MER	kg	0.00E+00	0.00E+00	0.00E+00
EEE	MJ	8.39E-03	4.75E-03	1.31E-02
ETE	MJ	1.61E-03	3.56E-03	5.17E-03

CR Components for reuse; MR Materials for recycling; MER Materials for energy recovery; EEE Exported electric energy; ETE Exported thermal energy

Additional requirements

Greenhous gas emission from the use of electricity in the manufacturing phase

The national residual mix for high voltage (including the production of transmission lines. along with direct emissions and grid losses) was applied to the electricity used in the manufacturing process:

Electricity mix	Data source	Amount	Unit
Electricity. high voltage {PL}| electricity. high voltage. residual mix | Cut-off. U	Ecoinvent 3.10 (March 2024)	1.08	kg CO_2 eq./kWh

The location-based electricity mix was also modelled using Ecoinvent 3.10 process:

Electricity – location-based	Data source	Amount	Unit
Electricity. high voltage {PL}| electricity. high voltage. production mix | Cut-off. U	Ecoinvent 3.10 (March 2024)	0.933	kg CO2 eq./kWh

The calculation results for the Core module. modeled using the residual mix and location-based indicators. are presented below. The calculations do not take into account guarantees of origin. as Alumetal has not used these contractual instruments at this time.

Parameter	Unit	Core (residual mix)	Core (location based)
GWP-total	kg CO_2 eq.	3.20E-01	3.11E-01
GWP-fossil	kg CO_2 eq.	3.20E-01	3.11E-01
GWP-biogenic	kg CO_2 eq.	1.31E-04	1.34E-04
GWP-LULUC	kg CO_2 eq.	1.36E-04	1.35E-04
ODP	kg CFC11 eq.	1.34E-03	1.27E-03
AP	mol H^+ eq.	9.41E-06	1.29E-05
EP freshwater	kg P eq.	2.99E-04	2.83E-04
EP-marine	kg N eq.	2.60E-03	2.42E-03
EP terrestrial	mol N eq.	1.55E-08	1.54E-08
POCP	kg NMVOC eq.	1.39E-03	1.34E-03
ADP-M&M	kg Sb eq.	6.34E+00	6.20E+00
ADP-fossil	MJ	9.91E-09	1.07E-08
WDP	m^3	1.02E-01	1.00E-01

Dangerous substances and indoor environment

For the Alumetal products covered by this study. We cannot provide information on the content of dangerous substances or impact on the indoor environment as it is not relevant. The product is intended for the automotive industry and does not have direct contact with humans. The product does not have any certifications or approvals in this regard.

Bibliography

ISO 14025:2010	Environmental labels and declarations - Type III environmental declarations - Principles and procedures
ISO 14044:2006	Environmental management - Life cycle assessment - Requirements and guidelines
ecoinvent version 3.10	Database published by ecoinvent
GPI/EPD Norge	General Programme Instructions for The Norwegian EPD Foundation/EPD-Norge (www.epd-norge.no) version 3:2019 updated 250523
PCR 2022:08	Basic aluminium products and special alloys. Version 1.0
SimaPro	LCA software by Pre Sustainability. ver. 9.6.0.1.

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