# Environmental Product Declaration

EPD®

S-P-02316

## FOR ALUMINIUM EXTRUSION BILLET PRODUCED BY HYDRO ALUMINIUM EXTRUSION PORTUGAL HAEP S.A. AVINTES

In accordance with ISO 14025 and EN 15804:2012+A1:2013

Hydro

| | |
|---|---|
| EPD Program | The International EPD® System |
| Programme operator | EPD International AB |
| CPC Code | 415 Semi-finished products of copper, nickel, aluminium, lead, zinc and tin or their alloys |
| Based on | PCR 2012:01 v2.3 Construction products and construction services |
| Declaration number | S-P-02316 |
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| Valid until | 2025-12-10 |
| Market coverage | Europe |

# Hydro

Hydro is a fully integrated aluminium company with 35,000 employees in 40 countries on all continents, combining local expertise, worldwide reach and unmatched capabilities in R&D. Hydro is present within all market segments for aluminium, with sales and trading activities throughout the value chain serving more than 30,000 customers.

**Our purpose and core values**
The *Hydro Way* is our way of doing what we do; it expresses who we are and aspire to be. It has been forged and shaped through more than 100 years of continually finding new and better ways of working. And this is how we will continue to develop innovative products and solutions that benefit our customers and society, now and in the future. We are constantly evolving. But the essence of everything we do remains the same, even though the way we express it may change.

Our purpose is to create a more viable society by developing natural resources into products and solutions in innovative and efficient ways. And these are the values we build on:

- Care: we act with respect for people and the environment and place safety at the heart of our operations.

- Courage: we break new ground and take measured risks with agility, accountability and foresight.

- Collaboration: we work as partners internally and externally to unite competencies and create win-win opportunities.

**Products and services**
Hydro produces primary aluminium, rolled and extruded products and recycling. In addition, Hydro extracts bauxite, refines alumina and generates energy also offer a variety of services to be the only 360° company of the global aluminium industry.

Hydro provides products and services in industries such as the automobile, transportation, building & construction, infrastructure, industrial design, electronics, Heating, Ventilation, Air Conditioning, and Refrigeration (HVAC), solar and energy or general engineering.

**Extruded solutions**
In the area of extrusion, Hydro performes both custom high-quality extrusions and ready-made aluminium products and systems.

For the first one, we provide custom extrusion design and manufacturing including:

- Product development support
- Solutions that are energy-efficient
- Solutions that meet environmental requirements and reduce environmental impact
- Solutions that utilize the strengths of aluminium
- Solutions that satisfy and surpass your expectations

For the last one, we offer all kinds of finished products, from pedestrian bridges and window profiles to conduit products and wheelchair ramps.

For all cases, our products can be delivered with several surface treatment that strengthen the advantages of aluminium and add a beautiful finish to products.

**Hydro Aluminium Extrusion Portugal**
In Portugal, Hydro manufactures and markets extruded aluminium profiles, and offers surface treatment and added-value operations to transform the profiles into the solutions that meet customer specifications.

Founded in 1982 and with more than 130 employees, the Avintes plant brings all its resources and more than 30 years of experience in aluminum solutions supply.

The production processes occurring in the site include the production of billets in aluminium alloys and the production of profiles through the extrusion of billets, including eventual additional manufacturing steps and treatment such as the such the profile aging processes and the thermal break.

Facilities in Avintes are certified ISO 9001, ISO 14001, ISO 50001, IATF 16949, Alu+C- label and ASI Performance Standard that covers critical issues for the entire aluminum value chain, including greenhouse gas emissions, waste management, material stewardship, biodiversity and human rights.

# Product information

**Product description**
This EPD covers a wide range of aluminum extrusion billets that are intermediate products which feed other processing steps for the production of other products.

The production process includes the remelting of process and post-consumer scrap and primary ingots and the following casting process. During the process, impurities are removed and alloying elements are added, if needed, to adjust the chemical composition and to reach the quality standard. Billets are stored to be sold externally or to be used internally as input in the extrusion process for profiles production.

The results declared in this EPD are an average representative of all aluminium billets produced for Hydro in Portugal. Averages are obtained through the production and total consumption in Avintes facilities.

Aluminium billet is a semi-finished product (UN CPC Code: 415) used to produce extrusion profiles mainly for the building & construction sector but also in sectors such as automobile, transportation, infrastructure, industrial design, electronics, HVAC, solar and energy or general engineering. Tailored and finished produtcs are applied in windows, doors, curtain walls, electronics, transportation and thousands of product areas in between.

**Composition**
6000 series aluminium alloys is the predominant production at Hydro. Composition are reported in the table below. The product does not contain any substance included in the list of Substances of Very High Concern with concentrations higher than 0.1% in weight.

**Packaging**
Billets are binded together by means of plastic straps and wood bars. All packaging materials are recyclable or reusable following delivery to the customer. Packaging materials for billets are included in the scope of this EPD. The disposal of raw materials packaging is also included.

**Reference service life and use phase**
Service life for products will vary depending on the final application, but is typically long due to aluminium´s high corrosion resistance. For construction sector can be accepted a service life of 50 years according to bibliography.

**Recycling and disposal**
Aluminium products are highly recyclable. During aluminium profile production, all process scrap (extrusion drop-offs from cutting, unfit material and discards, etc.) is fed back into the billet production process.

When an aluminium product reaches the end of its life (post-consumer scrap), it is systematically and selectively collected and sent to recycling facilities for secondary billet production. For example a collection rate for aluminium products next to 95% is well documented in construction sector.

Hence, aluminium supply at the beginning of the product system has a content of recycled material with the consequent reduction of environmental burdens. In module D are reported only the net benefits of recycling, i.e. the recycling benefits at the end of life minus the benefits already considered in the module A1 due to post-consumer scrap content. In this EPD, the scrap not collected at the end of life is sent to landfill.

| Alloy | Mg | Mn | Fe | Si | Cu | Zn | Cr | Ti | Other | Al |
|---|---|---|---|---|---|---|---|---|---|---|
| 6005A | 0.4-0.7 | ≤0.50 | ≤0.35 | 0.5-0.9 | ≤0.30 | ≤0.20 | ≤0.30 | ≤0.10 | ≤0.05 | Rest |
| 6060 | 0.35-0.6 | ≤0.10 | 0.10-0.30 | 0.3-0.6 | ≤0.10 | ≤0.15 | ≤0.05 | ≤0.10 | ≤0.05 | Rest |
| 6061 | 0.8-1.2 | ≤0.15 | ≤0.7 | 0.4-0.8 | 0.15-0.40 | ≤0.25 | 0.04-0.35 | ≤0.15 | ≤0.05 | Rest |
| 6063 | 0.45-0.9 | ≤0.10 | ≤0.35 | 0.2-0.40 | ≤0.10 | ≤0.10 | ≤0.10 | ≤0.10 | ≤0.05 | Rest |
| 6082 | 0.6-1.2 | 0.4-1.0 | ≤0.50 | 0.7-1.3 | ≤0.10 | ≤0.20 | ≤0.25 | ≤0.10 | ≤0.05 | Rest |
| 6106 | 0.4-0.8 | 0.05-0.2 | ≤0.35 | 0.3-0.6 | ≤0.25 | ≤0.15 | ≤0.20 | ≤0.10 | ≤0.05 | Rest |

| **Aluminium Billet** | **1 kg** |
|---|---|
| Primary aluminium ingot | 24.8 % |
| Process scrap (pre-consumer) | 45.4 % |
| Post-consumer scrap | 29.4 % |
| Alloying | 0.47 % |
| **Packaging** | **0.024 kg** |
| Wood | 0.022 kg |
| Polyester strap | 0.002 kg |

# LCA Information

**Declared unit**
The declared unit is the production of 1 kg of aluminium billet and its packaging.

**Goal and scope**
This EPD evaluates the environmental impacts of 1 kg aluminium billet from cradle to gate with option (disposal). This EPD is the basis for B2B communication. Intended use clients and relevant stakeholders within several sectors.

**System boundaries**
This EPD provides information on the production stage of the aluminium billets (raw material supply, transport to plants and manufacturing) and their end-of-life. Recycling potential of aluminium with burdens saving due to use in a second product systems is also reported. The information is presented in a modular way separated in the following stages.

A1-3 - Cradle to gate
This module represents the extraction and processing of raw materials and aluminium scrap, the transport to production site and the manufacture of billets. The billets are delivered with a diameter between 6 and 10 inches, and long, from 6 m to 7.4 m. Wood and plastic strap are adjusted to the quantity of billet delivery.

The aggregation of the modules A1, A2 and A3 is allowed by EN 15804. This rule is applied in this EPD and denoted by A1-3.

A4 - Transport to clients
For the transport towards clients a weighted distance, based on Hydro's clients location, has been considered.

C1 - Dismantling
No information was found in the life cycle databases consulted for the dismantling operations of elements such as windows, external doors or curtain walls, nor was there a bibliography regarding the inputs or residues generated during these operations in building sector or in any other. Then, no contribution on impact categories of this module is declared.

C2 - Transport to waste processing
A distance of 200 km has been assumed for the transport to scrap dealers. Transport is calculated on the basis of a scenario with the parameters described in the attached table.

C3 - Waste processing for reuse, recovery and/or recycling
It has been assumed that during the scrapping operations the same electricity is consumed as during the assembly of a window of 1.23 m x 1.48 m with a profile thickness between 45 and 70 mm.

C4 - Final disposal
Recovery rates for aluminium during building dismantling are modelled based on figures reported by the European Aluminium Association (see references). It was assumed a 95% for recovery rate while the remaining 5% goes to landfill. Similar or even higher figures can be achieved in other sectors.

D - Allocation by reuse, recovery or recycling
In order to obtain the net post-consumer scrap output from the product system, the input of post-consumer scrap is subtracted from post-consumer scrap to be recycled at end of life. Module D reports the burdens and benefits of the recycling of this remaining net scrap. Benefits are assessed at the point of functional equivalence, i.e. where the substitution of primary aluminium takes place. In the recycling process, smelting yield for post-consumer scrap was also taken into account.

In order to make the results tables lighter, will be shown only declared modules with a non-zero contribution to the impact categories declared in this EPD.

| **Stage** | Production | | | Construction | | Use | | | | | | | End-of-life | | | | Resource recovery |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A1 | A2 | A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D |
| **Module** | Raw materials supply | Transport | Manufacturing | Transport | Installation | Use | Maintenance | Repair | Replacement | Refurbishment | Operational energy use | Operational water use | Dismantling | Transport | Waste processing | Disposal | Reuse, recovery or recycling potentials |
| **Declared module** | X | X | X | X | ND | ND | ND | ND | ND | ND | ND | ND | X | X | X | X | X |
| **Geography** | EU | EU | EU | EU | - | - | - | - | - | - | - | - | EU | EU | EU | EU | EU |
| **Specific data (*)** | 92.28% | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

(*) For Climatic change - kg $CO_2$ eq. ND - Not declared

### Time representativeness
All primary data used in this EPD are based on the 2019 production data for aluminium profiles manufactured by Hydro in their facilities in Avintes.

### Database(s) and LCA software used
The data for primary aluminium consumed in Europe and for post-consumer scrap remelting are based on LCI dataset published by European Aluminium in february 2018 and are the best available. These dataset have been used to characterize the average of environmental burdens for process scrap and for processess involved in module D. Ecoinvent v3.3 database has been consulted for primary aluminium consumed in Avintes plant. Data were adapted to specific aluminium provider of Hydro. For transport processes the ELCD 3.2 database was consulted. Other LCI datasets were also sourced from Ecoinvent v3.3.

The LCA study was performed using an excel-based model. The impact assessment results were calculated using characterization factors published by the University of Leiden's Centre of Environmental Sciences (CML 2001) obtained from Simapro software.

### Data Quality
In order to achieve precision, consistency and representativeness and to ensure reliable results, first-hand industry data were used. All foreground data were collected from Hydro for its facility in Avintes using customized data collection templates. It was created representative production inventories. These inventories are intended to represent average of aluminium billets production by Hydro in Avintes. The age of these data is less than three years. As for bibliographic data, none has been used with a year of publication lower than 2011.

Regionally specific datasets were used to model the energy consumption (electricity, natural gas or diesel). For the processes of transport, production of raw materials or end-of-life, datasets were chosen according to their technological and geographical representation of the actual process. The technological and geographical representativeness of the processes included in the LCA is guaranteed among which are the most contributing to final results (for example, 92.23% of climate change impact is obtained by specific data). For the rest of the processes, proxy datasets were used to address the lack of data for a specific process or for a specific geographical region.

### Estimates and Assumptions
Post-consumer scrap was modeled as burden free when entering the system althought it was included transport to plant. Process scrap is considered as aluminium that has never fullfilled its purpose as a product and is remelted once more. So that process scrap is given the same burdens of aluminium mix consumed in Europe. In order to calculate them, LCI dataset published by European Aluminium for primary (European production and imports) and secondary aluminium have been used.

In module D are reported only the burdens and benefits of the net output flow of post-consumer scrap. These figures are based on LCI dataset published by European Aluminium for remelting scrap and the sustitution of aluminium consumed in Europe

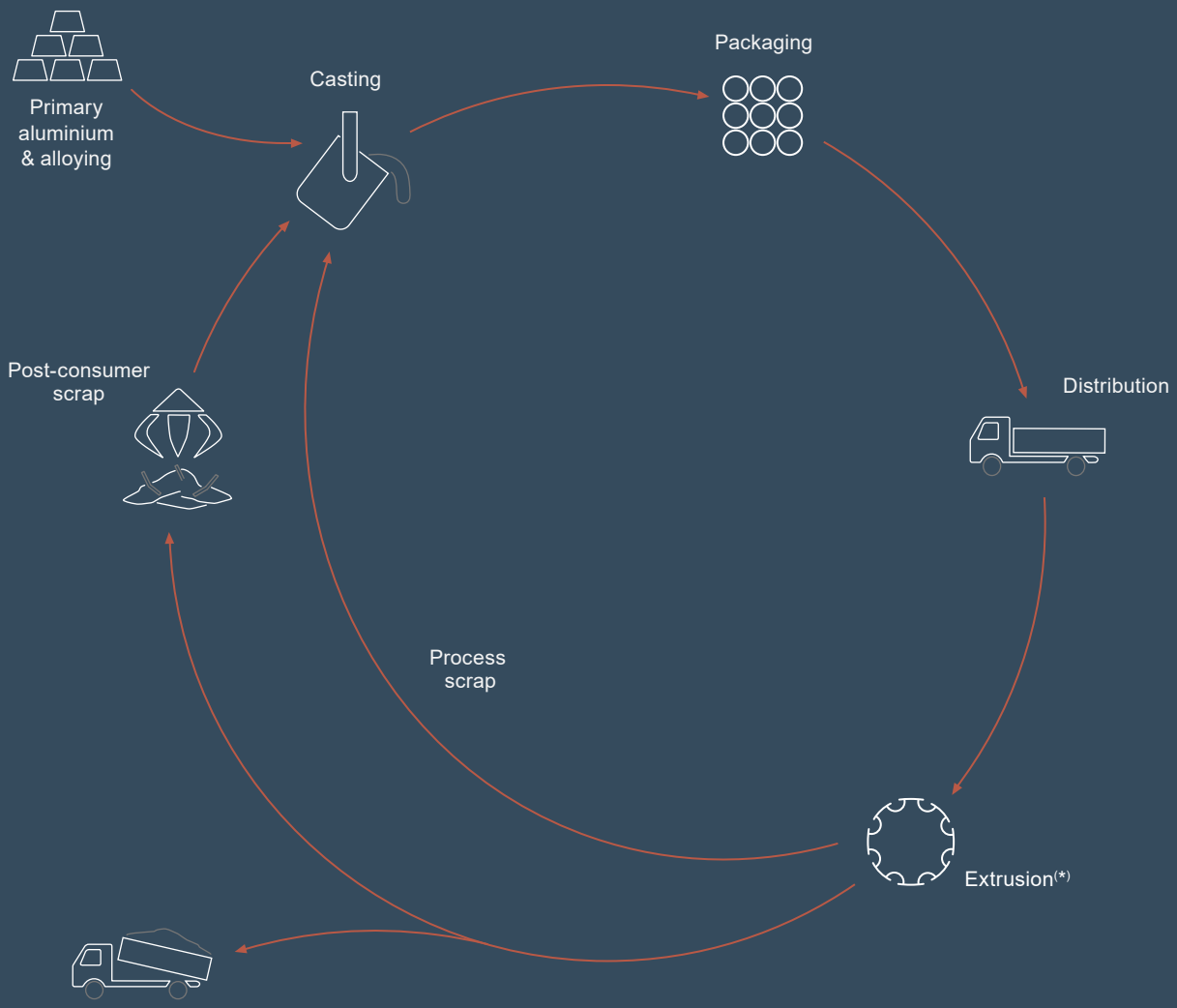
Disposal and recovery rates are modelled based on figures reported by the European Aluminium (see references) for building & construction sector. It was assumed a 95% for recovery rate while the remaining 5% goes to landfill.

### Allocation
It was not possible to distinguish the consumption of electricity and natural gas between the production stages developed in Avintes (billets, extrusion, etc.). Based on the total energy consumption in the plant, electricity and natural gas used in billet manifacturing was estimated according to the ISO 50001 energy management system implemented in Avintes facilities.

Once the energy consumption was attributed to billet production, it was allocated to total production thus using a mass-based criterion. It has proceeded in the same way for raw materials and waste generation.

### Cut-off criteria
All raw materials and packaging are included in the analysis as well as the energy for manufacturing. In the same way, all manufacturing waste (including hazardous waste) and air emissions are accounted for.

The construction of the manufacturing site (capital goods) in not included. The modules A4, A5, and from B1 to B7 are excluded as they are dependent of the specific product application.




| A4 module parameters | |
|---|---|
| Transport by road (1) | Articulated lorry, 27 t max payload |
| Diesel consumption (l/km) | 0.35 |
| Weighted distance (km) | 650 |
| Mass capacity utilisation | 68% |

| C2 module parameters | |
|---|---|
| Transport by road (1) | Lorry, 17.3 t max payload |
| Diesel consumption (l/km) | 0.221 |
| Distance (km) | 200 |
| Mass capacity utilisation | 67% |

| C3 module parameters | |
|---|---|
| Energy carrier | Electricity, low voltage {ES} |
| Consumption (kWh/kg) | 0.0245 |
| Waste (landfill) | 0.05 kg |

(*) Not included (1) Technology mix, Euro 0, 1, 2, 3, 4

# Results

| Environmental Impacts | Units | A1-3 | A4 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|
| CC | kg $CO_2$ eq | 5.11 | 3.31E-02 | 1.31E-02 | 1.10E-02 | 8.88E-04 | -4.67 |
| OD | kg CFC-11 eq | 1.73E-07 | 6.71E-11 | 2.66E-11 | 1.45E-09 | 1.58E-11 | -2.31E-06 |
| A | kg $SO_2$ eq | 2.94E-02 | 1.49E-04 | 6.22E-05 | 7.58E-05 | 3.20E-06 | -2.38E-02 |
| Eu | kg $PO_4^{-3}$ eq | 3.14E-03 | 3.40E-05 | 1.43E-05 | 5.21E-06 | 2.02E-05 | -1.57E-03 |
| POF | kg $C_2H_2$ eq | 2.18E-03 | 1.06E-05 | 4.48E-06 | 2.98E-06 | 2.81E-07 | -1.26E-03 |
| AD-non fossil | kg Sb eq | 4.64E-06 | 1.32E-09 | 5.24E-10 | 2.32E-08 | 4.04E-11 | -2.31E-06 |
| AD-fossil | MJ | 53.1 | 4.68E-01 | 1.86E-01 | 2.60E-01 | 1.01E-02 | -48.7 |
| **Resource use** | | | | | | | |
| PERE | MJ | 33.1 | 6.24E-04 | 0.248 | 2.92E-02 | 3.26E-03 | -26.2 |
| PERM | MJ | 0 | 0 | 0 | 0 | 0 | 0 |
| PERT | MJ | 33.1 | 6.24E-04 | 0.248 | 2.92E-02 | 3.26E-03 | -26.2 |
| PENRE | MJ | 175 | 4.68E-01 | 186 | 0.264 | 2.33 | -57.6 |
| PENRM | MJ | 0 | 0 | 0 | 0 | 0 | 0 |
| PENRT | MJ | 175 | 4.68E-01 | 186 | 0.264 | 2.33 | -57.6 |
| SM | kg | 0.420 | 0 | 0 | 0 | 0 | 0 |
| RSF | MJ | 0 | 0 | 0 | 0 | 0 | 0 |
| NRSF | MJ | 0 | 0 | 0 | 0 | 0 | 0 |
| FW | $m^3$ eq | 2.32 | 0 | 0 | 1.03E-02 | 0 | -0.204 |
| **Waste categories** | | | | | | | |
| HWD | kg | 0.197 | 4.11E-08 | 1.63E-05 | 0 | 2.24E-07 | -0.303 |
| NHWD | kg | 0.923 | 1.86E-05 | 7.37E-03 | 0 | 1.79E-04 | -1.41 |
| RWD | kg | 2.33E-03 | 0 | 0 | 0 | 0 | -3.44E-03 |
| **Output Flows** | | | | | | | |
| CRU | kg | 0 | 0 | 0 | 0 | 0 | 0 |
| MFR | kg | 0.174 | 0 | 0 | 0 | 0 | 0 |
| MER | kg | 0 | 0 | 0 | 0 | 0 | 0 |
| EE | MJ | 0 | 0 | 0 | 0 | 0 | 0 |

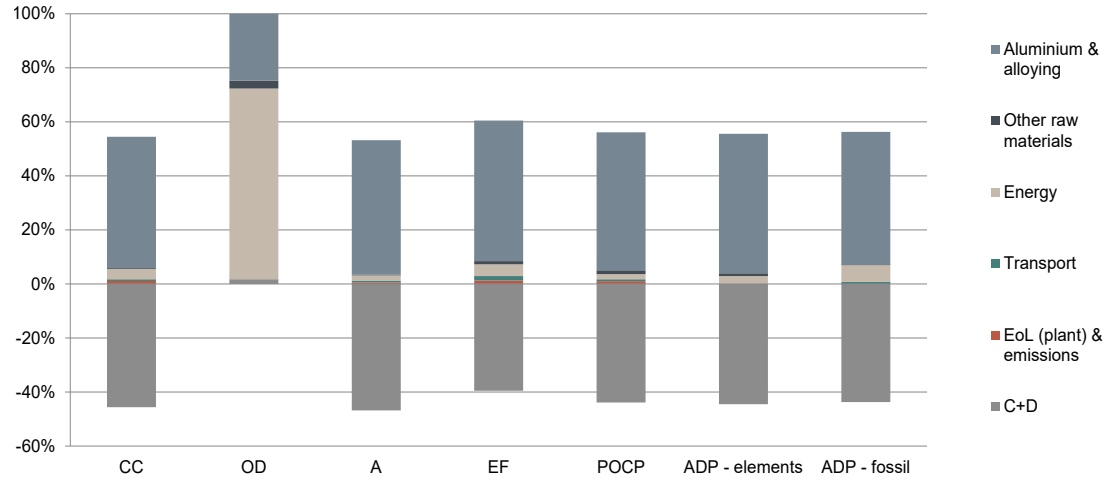
**ENVIRONMENTAL IMPACTS** - CC: Climatic Change; OD: Ozone depletion; A: Acidification ; Eu: Eutrophication; POF: Photochemical ozone formation; AD- non fossil: Abiotic resource depletion - minerals and metals; AD-fossil: Abiotic resource depletion - fossils.

**RESOURCE USE** - PERE: Renewable primary energy as energy carrier; PERM: Renewable primary energy resource as material utilization; PERT: Total use of renewable primary energy resources; PENRE: Non-renewable primary energy as energy carrier; PENRM: Non-renewable primary energy as material utilization; PENRT: 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; FW: Use of net fresh water.

**WASTE CATEGORIES** - HWD: Hazardous waste disposed; NHWD: Non-hazardous waste disposed; RWD: Radioactive waste disposed;

**OUTPUT FLOWS** - CRU: Components for re-use. MFR: Materials for recycling. MER: Materials for energy recovery; EE Exported energy per energy carrier.

# Supplement information




The graph shows the contribution that impacts sources included in the study have on the results.
It can be seen that aluminum inputs have a strong influence on the results followed by the energy used during the process. The avoided impacts declared in module D offset those generated during the first useful life of the aluminium

**Additional relevant information**
Processed scrap and post-consumer scrap are not matched in this EPD. Process scrap arises during processing of aluminium billets (such as e.g. extruded profiles, cullets, etc.) and it is considered as an aluminium flow that has never fulfilled its purpose as a product, and thus carries the same burdens of the original aluminium billet from which it is produced. Post-consumer scrap, on the other hand, has fulfilled its purpose in its first life cycle, is starting its second life cycle, and has thus no historical burdens attached to it.

# Contacts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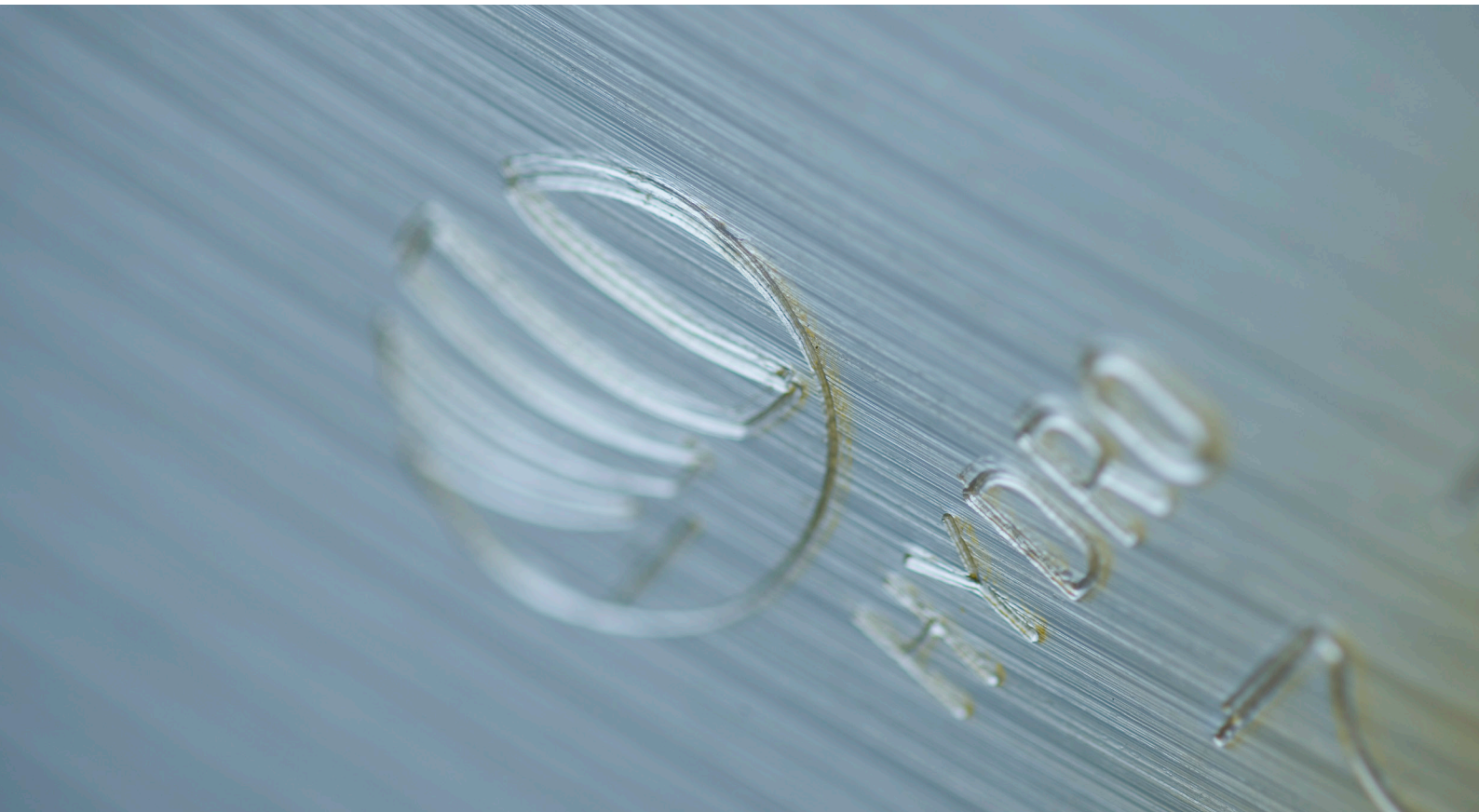

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# Verification

This declaration is an environmental product declaration (EPD) in accordance with ISO 14025 and the requirements given in the product category rules document for Construction Products and Construction Services (EN 15804) and the general program guidelines by The International EPD® System. The results shown in this EPD are based on the LCA for Hydro products according to standard 14044.

This EPD is not comparative assertions and are either not comparable or have limited comparability when they cover different life cycle stages or are based on different Product Category Rules. EPDs of construction products may not be comparable if they do not comply with EN 15804. The EPD owner is responsible for its content, as well as to preserve supporting documentation during the period of validity that justifies the data and statements that are included.

| | |
|---|---|
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| EPD registration number | S-P-02316 |
| EPD owner | Hydro Aluminium Extrusion Portugal HAEP S.A. |
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| System boundaries | Cradle to gate with options |
| Published | 2020-12-10 |
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| Reference year for data | 2019 |
| Geographical scope | Worldwide |
| Product group classification | UN CPC Code: 415 Semi-finished products of copper, nickel, aluminium, lead, zinc and tin or their alloys |
| Product Category Rules | PCR 2012:01 Construction products and Construction services. Version 2.3. 2017-05-30. Based on CEN standard EN 15804 |
| PCR review was conducted by | Technical Committee of The International EPD® System<br>www.environdec.com info@environdec.com |
| Independent verification of the declaration and data, according to ISO 14025:2006 | X External Internal EPD Process |
| Third-party verifier | Eva Martinez Herrero<br>Centro Tecnológico de Miranda de Ebro<br>www. ctme.es<br>evamtz@ctme.es |

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Hydro is a fully integrated aluminium company with 35,000 employees in 40 countries on all continents, combining local expertise, worldwide reach and unmatched capabilities in R&D. In addition to production of primary aluminium, rolled and extruded products and recycling, Hydro also extracts bauxite, refines alumina and generates energy to be the only 360° company of the global aluminium industry. Hydro is present within all market segments for aluminium, with sales and trading activities throughout the value chain serving more than 30,000 customers. Based in Norway and rooted in more than a century of experience in renewable energy, technology and innovation, Hydro is committed to strengthening the viability of its customers and communities, shaping a sustainable future through innovative aluminium solutions.