ENVIRONMENTAL PRODUCT DECLARATION FOR

THE LOW CARBON ALUMINIUM EXTRUSION BILLET

PRODUCED BY HYDRO EXTRUSION SWEDEN AB

We are aluminium

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EPD in accordance with ISO 14025 and EN 15804:2012+A2:2019

SUMMARY

1 PROGRAMME RELATED INFORMATION

This EPD is developed under the program The International EPD ® System, in compliance with the General Program Instruction version 3.1 for the EPD development and the Product Category Rules PCR "Construction products" 2019:14 version 1.1.

More information about the International EPD ® System is available on the website:
https://www.environdec.com/

2 PRODUCT RELATED INFORMATION

2.1 THE COMPANY

Hydro Extrusion Sweden AB is a company of Hydro group manufacturing aluminium billets from remelting and aluminium profiles by extrusion. More in detail, the company has manufacturing plants in Finspång and Vetlanda (extrusion) and an aluminium casthouse in Sjunnen. The Sjunnen casthouse (smelter unit) produces billets in 203, 228 and 317-mm diameter.

2.2 THE PRODUCT

The low carbon aluminium billet is a forthcoming product (not yet into the market). The low carbon billet is an intermediate product which feed other processing steps for the production of other products, mainly profiles for the building sector. Aluminium scraps and primary ingots are melted, alloying elements added, and billets produced through a casting process.

The production process, represented in Figure 1, is the same of the traditional billets produced in Sjunnen, occurring in the same furnace and using the same raw materials in input, in different percentage. The process includes the remelting of aluminium scrap and aluminium primary ingots, the following casting process. During the process impurities are removed, and alloys are added, to adjust the chemical composition and to reach the quality standard. Casted billets are bound together by means of plastic straps and wood bars and are stored to be sold externally or to be used internally as input in the extrusion process (profiles production).

Hydro has planned the production of the low carbon billet with an aim to reach a carbon target (4 $kgCO_2eq$ per Kg of billet). To this aim the amount of post-consumer scrap in input is increased and the pre-consumer scrap in input is better selected. The used pre-consumer scrap is retrieved only in the European market.

The reference CPC code is 415 "Semi-finished products of copper, nickel, aluminium, lead, zinc and tin or their alloys".

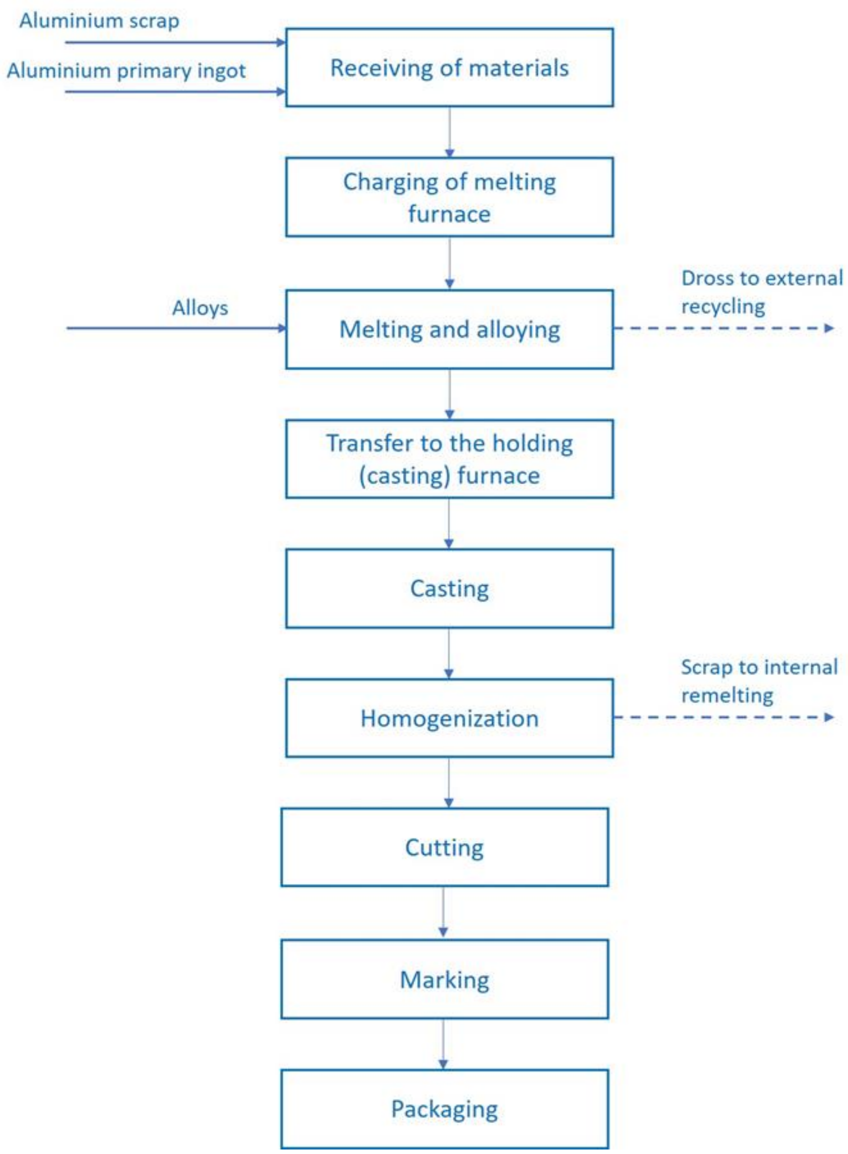


Figure 1: Production process of the low carbon aluminium billet occurring in Sjunnen's site.

2.2.1 TECHNICAL CHARACTERISTICS OF THE PRODUCT

All products are produced according to European standards specific for each casthouse products. The products are variants within the 6000 alloys. For more detailed information about shapes, dimensions, and tolerances: www.hydro.com/en/products/casthouse-products/ .

2.2.2 PRODUCT COMPOSITION

The composition of the product is reported in Table 1. The content of SVHC does not exceed 0,1 % of the total weight.

Table 1: BoM of the low carbon aluminium billet by Hydro Extrusion Sweden AB

BoM of the aluminium billet	
Material contribution (% in weight) to 1 kg of aluminium billet	
Aluminium scrap, of which	**88,45**
Process scrap (from Europe)	*38,45*
Post-consumer	*50,00*
Aluminium primary ingot	**10**
Alloys	**1,55**
Packaging per kg of aluminium billet	
Plastic strap	**0,0001**
Wood	**0,0015**

2.2.3 PRODUCT REFERENCE SERVICE LIFE

The Product Reference Service Life depends on the specific application.

2.2.4 MARKET

The reference market is Europe. Application sector is mainly Building and Construction, but also Automotive and Transport, Consumer Goods, General Engineering.

3 ENVIRONMENTAL PRODUCT DECLARATION

3.1 METHODOLOGY

The study behind the present EPD has been performed according to the state of art of the LCA methodology, with specific reference to the construction sector, in accordance with the following standard and guidelines:

- EN ISO 14040: 2006 Environmental management -- Life cycle assessment -- Principles and framework
- EN ISO 14044:2006 Environmental management -- Life cycle assessment -- Requirements and guidelines
- EN 15804:2012+A2:2019 Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products.
- EN 15804:2012+A1:2013 Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products.
- General Programme Instructions (GPI) for the International EPD® VERSION 3.1
- The International EPD® System Product Category Rules (PCRs) for construction products, 2019:14 version 1.1.

The goal of the study is the evaluation of the potential environmental impacts of the low carbon aluminium billet.

The EPD is mainly addressed to the business-to-business communication. The data elaboration has been performed with the Gabi software, version 10.5.1.124. The database used are the most updated ones implemented in Gabi software. More in detail, main database used is Sphera, European Aluminium and IAI. The LCIA method used is EF3.

3.2 DECLARED UNIT

The declared unit is 1 kg of aluminium billet, plus its packaging.

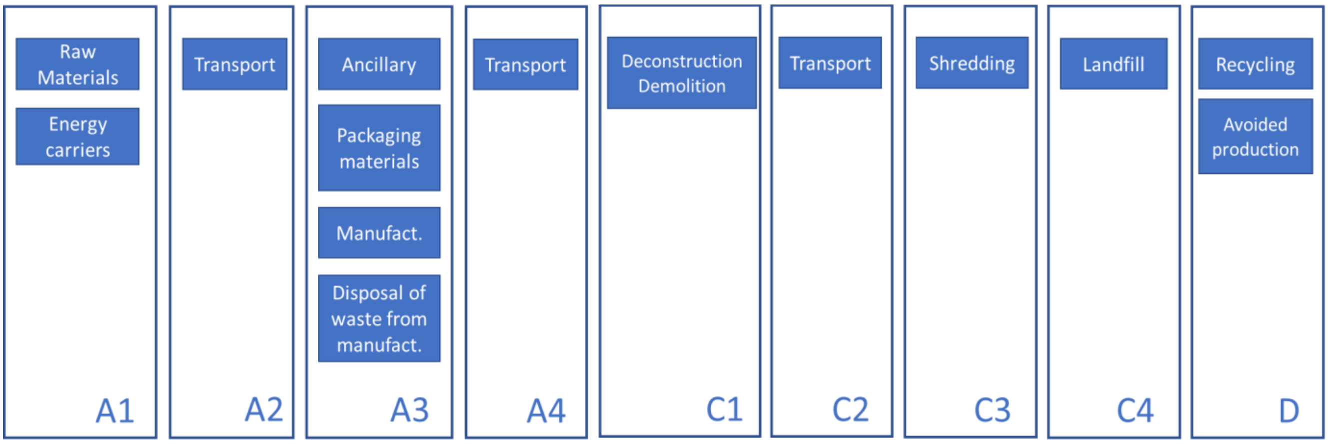
3.3 SYSTEM BOUNDARY

The EPD is a "Cradle to Gate with modules C1-C4 and D and optional modules" (as represented in Table 2 and in showed in Figure 2). Modules A5 and B1 to B7 are excluded as they are strongly dependent on the specific application within the reference market.

Table 2: Life cycle stages included in the study for the low carbon aluminium billet by Hydro Extrusion Sweden AB

<table>
<tr><th></th><th colspan="3">PRODUCT STAGE</th><th colspan="2">CONSTRUCTION PROCESS STAGE</th><th>USE STAGE</th><th colspan="4">END-OF-LIFE STAGE</th><th>BENEFITS and LOADS BEYOND SYSTEM BOUNDARY</th></tr>
<tr><th></th><th>A1</th><th>A2</th><th>A3</th><th>A4</th><th>A5</th><th>B1 to B7</th><th>C1</th><th>C2</th><th>C3</th><th>C4</th><th>D</th></tr>
<tr><td></td><td>Raw Material Supply</td><td>Transport</td><td>Manufacturing</td><td>Transport</td><td>Construction/Installation</td><td>Use, Maintenance, Repair, Replacement, Refurbishment, Operational energy use, Operational water use</td><td>Deconstruction/Demolition</td><td>Transport</td><td>Waste processing</td><td>Disposal</td><td>Reuse, Recycling potential</td></tr>
<tr><td>Modules declared</td><td>X</td><td>X</td><td>X</td><td>X</td><td>NA</td><td>NA</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Geography</td><td>EU, extra-EU, GLO</td><td>EU, extra-EU, GLO</td><td>EU, SE</td><td>GLO, EU</td><td>-</td><td>-</td><td>EU</td><td>GLO, EU</td><td>EU</td><td>EU</td><td>EU, GLO</td></tr>
<tr><td>Specific data</td><td colspan="5">>90%</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Variation – products</td><td colspan="5">Not relevant</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Variation – sites</td><td colspan="5">Not relevant</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
</table>

Figure 2: System boundaries for the study of the low carbon aluminium billet by Hydro Extrusion Sweden AB



The following stages are included in the study:

Raw Materials supply (A1). Production of raw materials used in the products, of as well as the production of energy carriers used in the production process.

Transport of raw materials to the factory (A2)

Manufacturing of the Hydro aluminium billet (A3). It includes the following production phases:

- Remelting and casting
- Cutting and homogenization
- Cooling and binding (packaging) for final storage

Moreover, in module A3, the production of primary packaging and of the ancillary materials and the treatment of waste generated from the manufacturing processes are accounted for.

Transport to the user (A4)

De-construction, demolition processes (C1): deconstruction and demolition

Transport from collection to waste processing and disposal site (C2)

Waste processing (C3): shredding

Disposal (C4): landfill of material fractions not entering the recycling treatment

Module D: transport to recycling treatment site (remelter), remelting process and benefit due to the avoided production of primary aluminium.

3.4 MAIN ASSUMPTIONS, CUT-OFFS, BACKGROUND DATA INFORMATION AND SCENARIOS

3.4.1 DATA QUALITY

Specific data are used for all of Hydro's processes based on the reference production period from October 2020 to April 2021. All background data used in the study are from LCI database and are not older than 5 years. Background data on, for instance, transport and energy production, are from Sphera. In addition, with specific reference to the electricity used in the manufacturing processes, the specific mix purchased by the company is used.

3.4.2 ALLOCATION

The allocation is made in accordance with the provisions of EN 15804. Energy and resources (water and ancillary) in input and waste and emissions in output from the foundry are allocated to the billet production based on the mass. The production of aluminium included in process scrap is allocated to the main product in which the material is used. The recycling process and transportation of the material is allocated to this analysis.

3.4.3 CUT-OFFS CRITERIA

Raw and packaging materials are fully included 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) is not included. Minor auxiliaries (e.g. filter nettings), chemicals and general waste (e.g. WEEE) are not considered, being marginal in terms of impacts and accounting for <0,01% in terms of mass compared to the total amount of raw materials used in the process.

3.4.4 BACKGROUND DATA INFORMATION

For most of the raw materials as well as for the packaging for the finished products a European production is considered. Process scrap in input to the production is given the impact of average aluminium consumed in Europe, that come 100% from the European market.

Raw materials road transport is assumed on a truck Euro 4 (> 32 t) with a utilisation ratio of 61%.

3.4.5 SCENARIOS FOR OPTIONAL MODULES

For the transport towards clients an average distance, based on Hydro's client's location, is considered (Table 3).

Table 3: Distance and transport mean considered for module A4.

Transport information for module A4		
Transport mean	**Utilisation ratio - %**	**Distance travelled - km**
Diesel truck, Euro IV, > 32 t	61	157

As one of the main reference markets, building sector is considered for the End-of-life modules. The end-of-life scenario takes place in Europe.

Profiles are assumed to be manually dismantled. In light of this, no impacts are accounted for in module C1.

After collection, aluminium is shredded, sorted, and sent to remelting. Material lost at the collection and waste treatment sites is sent to landfill. Collection and waste processing efficiency are reported in Table 4, whereas Table 5 reports transport information.

Table 4: Applied collection and waste processing efficiency for the End-of-life.

End-of-life - collection and processing efficiency	
Collection efficiency - %	
Aluminium collected	**96**
Aluminium lost at the collection site	**4**
Processing efficiency (shredding) - %	
Aluminium sent to recycling after shredding	**95**
Aluminium lost in the shredding	**5**

Table 5: Distance and transport means applied for the End-of-life.

End-of-life – transport information for modules C and D		
Transport mean	**Utilisation ratio - %**	**Distance travelled - km**
Materials not collected and sent to landfill (module C2)		
Diesel truck, Euro IV, > 32 t	61	200
Material collected and sent to waste processing (module C2)		
Diesel truck, Euro IV, > 32 t	61	200*
Materials from waste processing to remelter (module D)		
Diesel truck, Euro IV, > 32 t	61	200

*no additional transport is assumed for material which is landfilled after waste processing.

Module D environmental impacts address burden and benefit from net output flows leaving the product system, i.e. from flows leaving the product system, lowered of the recycled content % initially included in the product. The primary aluminium ingot consumed in Europe is considered for the accounting of benefits from remelted aluminium.

3.5 PARAMETERS DESCRIBING THE ENVIRONMENTAL IMPACT

The estimated impact results are only relative statements which do not indicate the end points of the impact categories, exceeding threshold values, safety margins or risks.

Table 6: Environmental profile of the low carbon aluminium billet per declared unit (1 kg) produced in Sjunnen by Hydro Extrusion Sweden AB according to EN 15804:2012+A2:2019 plus additional GWP-GHG Indicator required by PCRs.

Results according EN 15804:2012+A2:2019							
Impact category – core indicators	**A1-A3**	**A4**	**C1**	**C2**	**C3**	**C4**	**D**
Climate Change (GWPtot) [kg CO2 eq.]	3,39E+00	1,05E-02	0,00E+00	1,34E-02	2,06E-02	1,30E-03	-3,06E+00
Climate Change (fossil) (GWPf) [kg CO2 eq.]	3,38E+00	1,04E-02	0,00E+00	1,33E-02	2,03E-02	1,33E-03	-3,05E+00
Climate Change (biogenic) (GWPb) [kg CO2 eq.]	5,02E-03	-1,35E-05	0,00E+00	-1,72E-05	1,73E-04	-3,87E-05	-6,35E-03
Climate Change (land use change) (GWPluc) [kg CO2 eq.]	9,40E-04	8,65E-05	0,00E+00	1,10E-04	2,90E-05	3,91E-06	-5,23E-04
Ozone depletion (ODP) [kg CFC-11 eq.]	9,13E-11	1,35E-18	0,00E+00	1,72E-18	4,88E-16	5,18E-18	-2,29E-11
Acidification terrestrial and freshwater (AP) [Mole of H+ eq.]	1,68E-02	6,19E-05	0,00E+00	7,88E-05	4,23E-05	9,48E-06	-1,78E-02
Eutrophication freshwater (EPfr) [kg P eq.]*	1,99E-06	3,14E-08	0,00E+00	4,00E-08	5,49E-08	2,23E-09	-1,36E-06
Eutrophication marine (EPmar) [kg N eq.]	2,76E-03	3,03E-05	0,00E+00	3,87E-05	1,00E-05	2,46E-06	-2,56E-03
Eutrophication terrestrial (EPter) [Mole of N eq.]	3,02E-02	3,36E-04	0,00E+00	4,28E-04	1,05E-04	2,70E-05	-2,79E-02
Photochemical ozone formation - human health (POCP) [kg NMVOC eq.]	8,30E-03	5,84E-05	0,00E+00	7,43E-05	2,73E-05	7,46E-06	-7,72E-03
Resource use, mineral and metals (ADPe) [kg Sb eq.] **	2,00E-06	8,04E-10	0,00E+00	1,02E-09	6,00E-09	1,26E-10	-6,86E-07
Resource use, energy carriers (ADPf) [MJ] **	3,97E+01	1,41E-01	0,00E+00	1,79E-01	3,61E-01	1,77E-02	-3,74E+01
Water scarcity (WS) [m³ world equiv.] **	6,80E-01	9,18E-05	0,00E+00	1,17E-04	3,23E-03	1,43E-04	-4,53E-01
Additional GWP-GHG indicator required by PCRs							
Climate change - GWP-GHG [kg CO2 eq.]***	3,34E+00	1,04E-02	0,00E+00	1,32E-02	2,02E-02	1,31E-03	-3,03E+00

*The results in kg P eq. can be obtained by dividing the results in kg PO4 eq. by a factor of 3,07.
** The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.
***The indicator includes all greenhouse gases included in GWP-total but excludes biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product.

Table 7: Environmental profile of the low carbon aluminium billet per declared unit (1 kg) produced in Sjunnen by Hydro Extrusion Sweden AB EN 15804:2012+A1:2013.

	Results according EN 15804:2012+A1:2013						
Impact category	**A1-A3**	**A4**	**C1**	**C2**	**C3**	**C4**	**D**
Global warming potential (GWP) [kg CO2 eq.]	3,34E+00	1,03E-02	0,00E+00	1,31E-02	2,01E-02	1,26E-03	-3,03E+00
Ozone Depletion Potential (ODP) [kg R11 eq.]	1,01E-10	1,80E-18	0,00E+00	2,29E-18	6,51E-16	6,90E-18	-4,22E-11
Acidification potential (AP) [kg SO2 eq.]	1,41E-02	4,22E-05	0,00E+00	5,37E-05	3,40E-05	7,54E-06	-1,51E-02
Eutrophication potential (EP) [kg Phosphate eq.]	9,62E-04	1,06E-05	0,00E+00	1,35E-05	4,49E-06	8,55E-07	-8,90E-04
Photochemical Ozone Creation Potential (POCP) [kg Ethene eq.]*	8,41E-04	-1,63E-05	0,00E+00	-2,07E-05	2,86E-06	5,79E-07	-8,27E-04
Abiotic depletion potential for non-fossil resources (ADPe) [kg Sb eq.]	2,01E-06	8,05E-10	0,00E+00	1,03E-09	6,33E-09	1,27E-10	-7,00E-07
Abiotic depletion potential for fossil resources (ADPf) [MJ]	3,32E+01	1,40E-01	0,00E+00	1,78E-01	2,24E-01	1,71E-02	-3,16E+01

* Negative impact for Photochemical Ozone Creation Potential (POCP) in modules A4 and C2, D is due to the NO emissions from truck.

3.6 INDICATORS OF RESOURCES USE

Table 8: Indicators of resources of the low carbon aluminium billet per declared unit (1 kg) by Hydro Extrusion Sweden AB

Indicators on resources use	A1-A3	A4	C1	C2	C3	C4	D
Use of renewable primary energy resources excluding renewable primary energy resources used as raw materials (PERE) [MJ]	2,26E+01	7,85E-03	0,00E+00	1,00E-02	1,67E-01	2,38E-03	-1,70E+01
Use of renewable primary energy resources used as raw materials (PERM) [MJ]*	1,83E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Total use of renewable primary energy resources (PERT) [MJ]	2,26E+01	7,85E-03	0,00E+00	1,00E-02	1,67E-01	2,38E-03	-1,70E+01
Use of non-renewable primary energy resources excluding non-renewable primary energy resources used as raw materials (PENRE) [MJ]	3,98E+01	1,41E-01	0,00E+00	1,79E-01	3,61E-01	1,77E-02	-3,75E+01
Non-renewable primary energy resources used as raw materials (PENRM) [MJ]	1,32E-09	9,99E-16	0,00E+00	9,99E-16	1,40E-14	2,98E-16	0,00E+00
Total use of non-renewable primary energy resources (PENRT) [MJ]	3,98E+01	1,41E-01	0,00E+00	1,79E-01	3,61E-01	1,77E-02	-3,75E+01
Use of secondary materials (SM) [kg]	9,00E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Use of renewable secondary fuels (RSF) [MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Use of non-renewable secondary fuels (NRSF) [MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Use of net fresh water (FW) [m3]	6,02E-02	8,98E-06	0,00E+00	1,14E-05	1,62E-04	4,36E-06	-4,30E-02

* The calorific value of the wood bar used for the packaging was considered as 12,2 MJ/kg (AIEL 2009)

3.7 INDICATORS OF WASTE AND OUTPUT FLOWS

Table 9: Indicators on output flows and waste of the low carbon aluminium billet per declared unit (1 kg) produced by Hydro Extrusion Sweden AB

Indicators on output flows and waste categories	A1-A3	A4	C1	C2	C3	C4	D
Hazardous waste disposed (HWD) [kg]	9,73E-07	7,10E-12	0,00E+00	9,04E-12	9,59E-11	1,88E-12	-2,64E-08
Non-hazardous waste disposed (NHWD) [kg]	1,22E+00	2,09E-05	0,00E+00	2,67E-05	2,57E-04	8,81E-02	-9,15E-01
Radioactive waste disposed (RWD) [kg]	2,28E-03	1,70E-07	0,00E+00	2,17E-07	5,37E-05	1,86E-07	-2,23E-03
Materials for Recycling (MFR) [kg]	3,35E-02	0,00E+00	0,00E+00	0,00E+00	9,12E-01	0,00E+00	0,00E+00
Material for Energy Recovery (MER) [kg]	3,39E-04	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Exported electrical energy (EEE) [MJ]	6,08E-04	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Exported thermal energy (EET) [MJ]	1,19E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Components for reuse [kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00

3.8 INFORMATION ON BIOGENIC CARBON CONTENT

The mass of biogenic carbon containing materials in the products is less than 5%.

Table 10: Indicators on biogenic carbon content for the packaging of the low carbon aluminium billet per declared unit (1 kg) produced by Hydro Extrusion Sweden AB

Indicators on biogenic carbon content	A1-A3	A4	C1	C2	C3	C4	D
Biogenic carbon content in packaging [kg]*	1,22E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00

* 1 kg biogenic carbon is equivalent to 44/12 kg C

4 REFERENCE

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5 ADDITIONAL INFORMATION

5.1 ADDITIONAL INFORMATION CONCERNING THE PROGRAMME AND THE EPD

EPDs within the same product category but from different program may not be comparable.
EPDs of construction products may not be comparable if they do not comply with EN 15804. Environmental product declarations within the same product category from different programs may not be comparable. This EPD and the PCR 2019:14 “Construction products” are available on the website of The International EPD® System (www.environdec.com).
The verifier and the Program Operator do not make any claim nor have any responsibility of the legality of the products included in the present EPD. The LCA study and the present EPD have been issued with the technical scientific support of Ecoinnovazione S.r.l., spin-off ENEA (http://ecoinnovazione.it/?lang=en).

5.2 ADDITIONAL INFORMATION ON THE PRODUCT AND ON THE COMPANY

Aluminium billet covered by the present EPD are produced in Sjunnen.

For further information on product characteristics, typical applications, technical datasheet and case histories, please visit our website www.hydro.com or contact us to anna.linden@hydro.com.

6 VERIFICATION AND REGISTRATION

CEN standard EN 15804 served as core PCR	
EPD Programme:	The International EPD® System For more information – www.environdec.it
PCR:	PCR 2019:14 Construction products version 1.1
PCR review was conducted by:	The Technical Committee of the International EPD® System. Chair of the TC: Massimo Marino Contact: info@environdec.com
EPD Registration n°:	S-P-04642
EPD validity:	5 years
EPD valid within the following geographical area:	Global
Technical support:	Ecoinnovazione S.r.l. – spin-off ENEA Via della Liberazione 6, 40128 Bologna ecoinnovazione spin off ENEA www.ecoinnovazione.it
Independent verification of the declaration and data according to ISO 14025:	EPD verification (external)
Third party verifier:	David Althoff Palm, Ramboll Sweden AB
Accredited by:	The International EPD-system