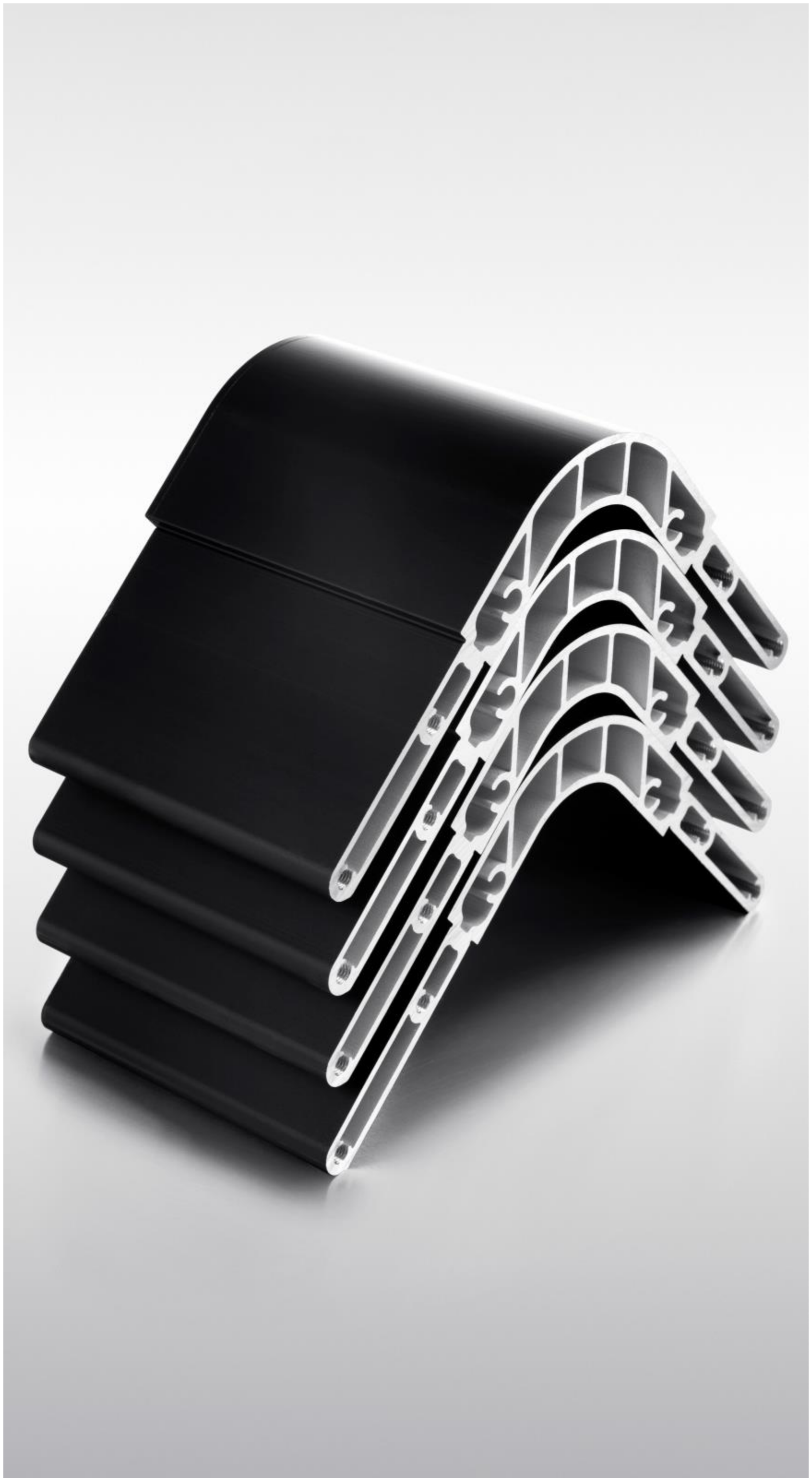
Environmental Product Declaration

Aluminum Extrusions

MILL FINISH, WET PAINT, FABRICATED, & ANODIZED – PORTLAND, OREGON



Hydro

Hydro is a leading aluminum and energy company that builds businesses and partnerships for a more sustainable future. We develop industries that matter to people and society.

Since 1905, Hydro has turned natural resources into valuable products for people and businesses, creating a safe and secure workplace for our 32,000 employees in more than 140 locations and 40 countries.

Today, we own and operate various businesses and have investments with a base in sustainable industries. Hydro is present in a broad range of market segments for aluminum and metal recycling, and energy and renewables. We offer a unique wealth of knowledge and competence.

Hydro is committed to leading the way towards a more sustainable future, creating more viable societies by developing natural resources into products and solutions in innovative and efficient ways.

UL CERTIFIED ENVIRONMENTAL PRODUCT DECLARATION UL.COM/EPD

Environmental Product Declaration

ALUMINUM EXTRUSIONS
MILL FINISH, WET PAINT, FABRICATED, & ANODIZED – PORTLAND, OREGON

According to ISO 14025, ISO 21930:2017

EPD PROGRAM AND PROGRAM OPERATOR NAME, ADDRESS, LOGO, AND WEBSITE	UL ENVIRONMENT 333 PFINGSTEN RD; NORTHBROOK, IL 60062-2096 USA WWW.UL.COM WWW.SPOT.UL.COM
GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER	Program Operator Rules v 2.7 2022
MANUFACTURER NAME AND ADDRESS	Hydro Extrusion North America 7933 NE 21st Avenue, Portland, OR 97211 USA
DECLARATION NUMBER	4790427057.126.2
DECLARED PRODUCT & FUNCTIONAL UNIT OR DECLARED UNIT	Aluminum extrusion products: mill finished, fabricated painted and anodized; declared unit: 1 kg of profiles plus primary packaging
REFERENCE PCR AND VERSION NUMBER	Product Category Rules (PCR) Guidance for Building Related Products and Services Part A: Life Cycle Assessment Calculation Rules and Report Requirements, UL 10010 v.4 March 2022 Product Category Rules (PCR) Guidance for Building Related Products and Services Part B: Aluminum Construction Product EPD Requirements, UL 10010 – 38 v.1 February 2022
DESCRIPTION OF PRODUCT APPLICATION/USE	Non thermally improved aluminum extrusion, including mill finished, fabricated, wet painted and anodized profiles, used in construction and/or other market sectors.
PRODUCT RSL DESCRIPTION (IF APPL.)	Not applicable
MARKETS OF APPLICABILITY	North America
DATE OF ISSUE	May 1, 2024
PERIOD OF VALIDITY	5 Years
EPD TYPE	Product-specific
EPD SCOPE	Cradle to gate with optional modules C1-C4, module D included
YEAR(S) OF REPORTED PRIMARY DATA	2022
LCA SOFTWARE & VERSION NUMBER	LCA for Experts 10.8.0.14
LCI DATABASE(S) & VERSION NUMBER	MLC 2023.2
LCIA METHODOLOGY & VERSION NUMBER	IPCC AR5 (GWP100), TRACI 2.1 and CML-IA v.4.8 August 2016 (ADPf)

The PCR review was conducted by:	UL Solutions PCR Review Panel epd@ul.com
This declaration was independently verified in accordance with ISO 14025: 2006. ☐ INTERNAL ☒ EXTERNAL	Cooper McCollum, UL Solutions
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	Ecoinnovazione
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Thomas P. Gloria, Industrial Ecology Consultants

LIMITATIONS

Exclusions: EPDs do not indicate that any environmental or social performance benchmarks are met, and there may be impacts that they do not encompass. LCAs do not typically address the site-specific environmental impacts of raw material extraction, nor are they meant to assess human health toxicity. EPDs can complement but cannot replace tools and certifications that are designed to address these impacts and/or set performance thresholds – e.g. Type 1 certifications, health assessments and declarations, environmental impact assessments, etc.

Accuracy of Results: EPDs regularly rely on estimations of impacts; the level of accuracy in estimation of effect differs for any particular product line and reported impact.

Comparability: EPDs from different programs may not be comparable. Full conformance with a PCR allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible. Example of variations: Different LCA software and background LCI datasets may lead to different results for upstream or downstream of the life cycle stages declared.

1. Product Definition and Information

Description of Company/Organization

Through our unique combination of local expertise, global network, and unmatched R&D capabilities, Hydro can offer everything from standard profiles to advanced development and manufacturing for most industries. Hydro is committed to leading the way in shaping a sustainable future and in doing so, creating more viable societies by developing natural resources into products and solutions in innovative and efficient ways.

Product Description

Product Identification

This EPD covers the production of mill finished, fabricated, wet painted and anodized profiles manufactured by Hydro Extrusion North America located in Portland, Oregon, USA. The results are representative of the average mill finished fabricated, wet painted and anodized profiles manufactured with the average billet purchased by the plant. The input billet mix includes primary billets (from smelters) and secondary billets (from remelters). Secondary billets are the average cast billets manufactured by Hydro Extrusion in Monett (Missouri, USA), The Dalles (Oregon, USA), Yankton (South Dakota, USA)[1], beyond other secondary billets manufactured in USA, outside Hydro Extrusions.

Table 1 reports the product description, whereas Figure 1 describes the production process.

Table 1. Product description

FIELD	VALUE
PRODUCT NAME	Aluminum profiles, including mill-finished, fabricated, wet painted and anodized profiles
PRODUCT DESCRIPTION	Mill finished profiles manufactured with the average billet purchased; fabricated profiles manufactured with the average billet purchased; wet painted profiles manufactured with the average billet purchased; anodized profiles manufactured with the average billet purchased
CLASSIFICATION	Semi-fabricated construction product
CLASSIFICATION (SEMI-FABRICATED PRODUCTS ONLY)	List the raw material inputs that apply: billet Output (one of): extruded profile
FINISHING	List the following processes that apply, if any: fabrication, anodizing, wet painting
ALLOY GROUP	6000 series

[1] Declaration number 4790427057.130.1 for Monett, number 4790427057.131.1 for The Dalles, number 4790427057.111.1 for Yankton

Flow Diagram

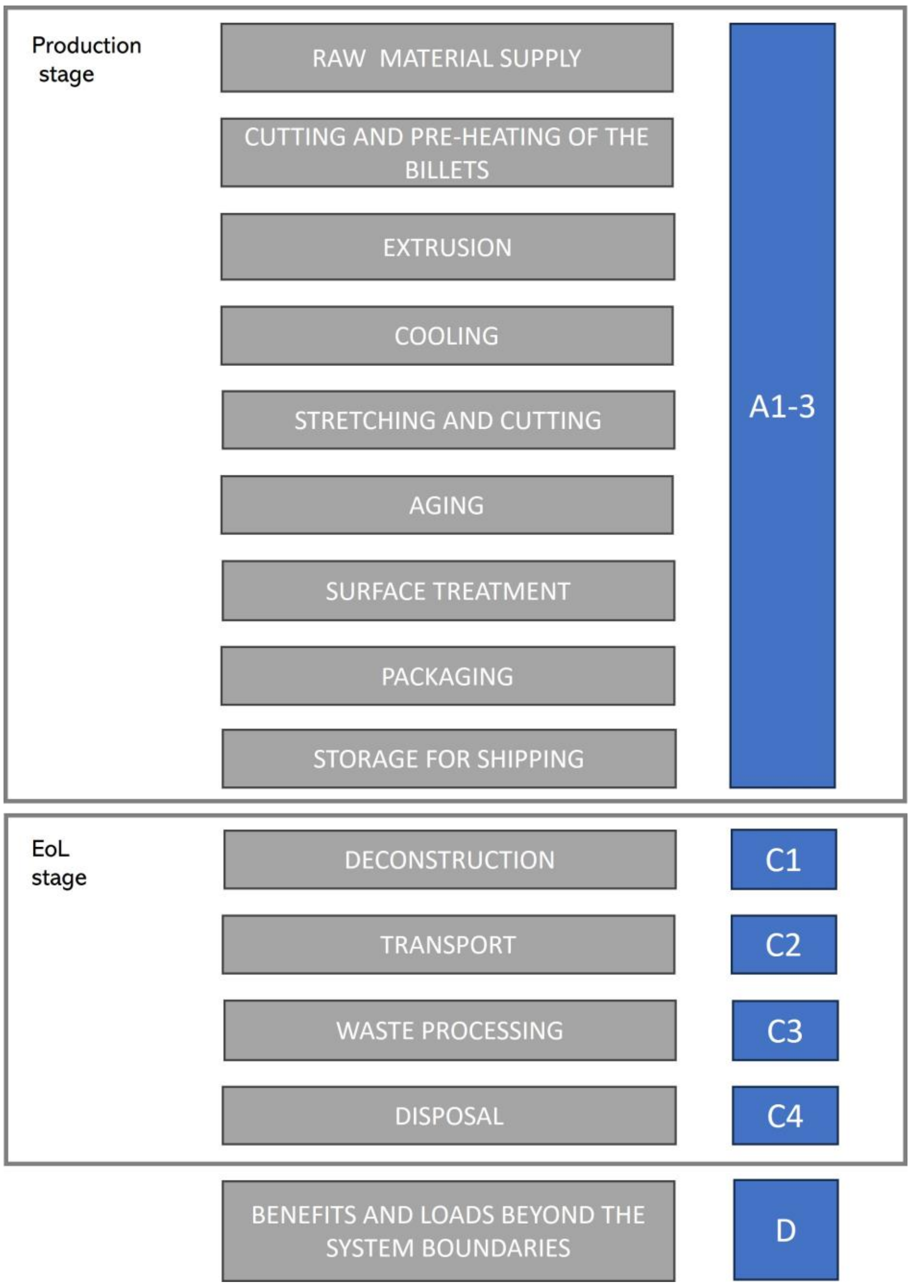


Figure 1. Scheme of the profiles manufacturing process occurring at Portland

Application

The studied aluminum profiles are used in a variety of market sectors, including building and construction, transportation, electrical, renewable energy, and consumer goods.

Declaration of Methodological Framework

This EPD is declared under "cradle to gate with options" system boundaries. As such, it includes A1-A3, C1-C4 and D modules.

Material Composition

The type of alumnium alloys and their chemical composition is reported in Table 2, whereas the main product materials that make up the product are described in Table 3. No substances required to be reported as hazardous are associated with the production of this product.

Table 2. Types of Aluminum, as per teal sheet

DESIGNATION AND CHEMICAL COMPOSITION LIMITS																	
	Si	*Fe*	*Cu*	*Mn*	*Mg*	*Cr*	*Ni*	*Zn*	*Ti*	*B*	*Bi*	*Pb*	*Sn*	*V*	*Zr*	*Others Each*	*Aluminum*
Min	0.2	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0		remainder
Max	4	1	1.2	1.4	3	0.4	0.2	1.5	0.25	0.06	1.5	2	2	0.3	0.2	0.05	remainder

Table 3. Primary and recycled material composition

MATERIAL INPUT		VALUE FOR ALL PRODUCTS (EXCEPT WET PAINTED)	VALUE FOR WET PAINTED
Primary material		89.80% mass	90.02% mass
Recycled material	Pre-consumer	9.35% mass	9.14% mass
	Post-consumer	0.85% mass	0.83% mass

Technical parameters

Table 4. Technical data

NAME	VALUE	UNIT
Gross density	2700	Kg/m^3
Melting point	582-652	°C
Electrical conductivity at 20°C	33.7	Ms/m
Coefficient of thermal expansion	NA	$10^{-6}K^{-1}$
Modulus of elasticity	68900	N/mm^2
Shear modulus	NA	N/mm^2

Specific heat capacity	900	J/(kg*K)
Hardness	95	HB
Yield Strength RP 0.2 Min	240	N/mm^2
Tensile strength RM min	260	N/mm^2
Tensile Stress at Break	12	%

Manufacturing

The extrusion process takes cast billet and produces extruded profiles by means of electricity driven presses. The preparation for extrusion begins with a calibrated furnace that preheats the temperature of the billet to a predetermined level depending on the alloy. During cut to length process, the billet is sheared and placed in a hydraulic press, which then forces the billet through a heated steel die to form the desired shape. The length of the resulting extrusion is dictated by the cut off process. Extrusions are air cooled, or water quenched, to specific quench parameters dependent on the alloy and desired properties. The extrusion is then secured and stretched to straighten the profile and relieve tension. Subsequently, the stretched profile is cut to length and then aged at elevated temperatures to achieve desired hardness properties.During the aging process, a restructuring of the atomic structure occurs to improve the mechanical strength of the product.
Upon completion of the aging process, profiles may be staged for shipment or be transfered for fabrication, wet painting and /or anodizing.
Fabrication includes mechanical based operations. Painting is manufactured with wet paint. On average, 0.035 kg of paint are used per each kg of painted profile.

Packaging

It was not possible for the facility to account for packaging materials used in the various production lines. To avoid double counting of packaging impacts, total amount of packaging materials entering the site is allocated to the total amount of products output from the production lines. Wood, plastic, cardboard and paper are used in the site.

Table 5 reports the amount allocated to 1 kg of aluminum product in output.

Table 5. Packaging type and weight used for the profiles per declared unit

TYPE OF PACKAGING	AMOUNT PER DECLARED UNIT (KG/KG)
Wood	3.31E-02
Plastic	1.56E-03
Cardboard	5.84E-03
Paper	1.95E-03

Recycling and disposal

Aluminum is 100% recyclable and can be recycled repeatedly. In the building and construction industry, aluminum has a recycling rate of 95% (UNEP, 2011), meaning that 95% of the collected aluminum is recycled, the remaining 5% is lost in the pretreatment process. Conservatively, it is assumed that only 94% of the aluminum reaching the end of life is collected. Aluminum not collected and aluminum lost in the pretreatment process is sent to landfill.

2. Life Cycle Assessment Background Information

Functional or Declared Unit

The declared unit of this EPD is 1 kg of alumium profile.

System Boundary

This EPD is cradle to gate with optional modules (as presented in Table 6). Modules A5 and B1 to B7 are excluded as they are strongly dependent on the specific application within the reference market.

The following stages are included in the study:

- **Raw Materials supply (A1).** Production of raw materials used in the products. A1 includes:
  - Production of billets
  - Production of wet paint (for painted profile)

  The production of energy carriers used in the production process is part of A1 as well.
- **Transport of materials (including ancillary) to the factory (A2)**
- **Manufacturing of the Hydro aluminum profiles (A3)**. It includes the following production phases:
  - Cutting of billets and pre-heating of billets and dies
  - Extrusion, including cooling, stretching and cutting and aging
  - Fabrication (if applied)
  - Painting (if applied)
  - Anodizing (if applied)
  - Packaging and storage for shipping

  In module A3, the production of primary packaging, the ancillary materials and the treatment of waste generated from the manufacturing processes are accounted for. Since module A5 is excluded, the CO2 stocked in the packaging has been balanced with an equal emission of CO2.
- **Deconstruction (C1) –** demolition processes
- **Transport (C2) –** Transport to waste processing and to disposal
- **Waste processing (C3) –** shredding and sorting of aluminum collected at deconstruction step
- **Disposal (C4) –** Landfill of fractions lost in C1 and C3
- **Reuse, recovery and recycling potential (D) –** transport to remelting site, remelting and avoided primary production.

Table 6. Description of system boundaries

DESCRIPTION OF THE SYSTEM BOUNDARIES																
Production			Construction		Use							End of life				Benefits and loads beyond system boundaries
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Raw material supply	Transport	Manufacturing	Transport to site	Assembly / Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	De-construction / Demolition	Transport	Waste processing	Disposal	Reuse, Recovery, Recyling potential
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	X	X	X	X	X

X= Module included in the EPD; MND= Module not declared

Estimates and Assumptions

All the raw materials and energy input have been modeled using processes and flows that closely follow actual production data on raw materials and processes. All reported raw materials and energy flows have been accounted for. No known raw materials and energy flows are deliberately excluded from the present EPD.

Cut-off Criteria

A few minor chemicals are excluded as well as the packaging of some specific chemicals (e.g. of cooling tower chemicals) The construction of the manufacturing site is excluded as well. In cases where no matching life cycle inventory are available to represent a flow, proxy data have been applied based on conservative assumptions.

Data Sources

The LCA model was created with the support of *LCA for Expertss v. 10.8.0.14 software and Database MLC 2023.2 version.*

Primary aluminum production datasets from the International Alumiunium Institute (IAI) have been used to represent the primary billets purchased in Australia (GLO – IAI), in East Middle East (RME – IAI) and Russia (RU – IAI). The resulting carbon intensity associated to the primary billets entering the plant is reported in

Table 7.

The aluminum datasets used in the study are the most recent released by the industry association (IAI).

Table 7. Data source, origin, and carbon intensity of primary billets

DATASETS USED IN THE CALCULATION	CARBON INTENSITY OF ELECTRICITY (KG CO_2/KWH)	WEIGHTED AVERAGE POWER MIX (%)	GEOGRAPHIC ORIGIN

GLO: Aluminum ingot mix IAI 2015 RME: Aluminum ingot mix IAI 2015 RU: Aluminum ingot mix IAI 2015	3.39E-01	Hydro 16.98% Coal 0.71% Natural gas 82.31% 0.01%	Australia East Middle East Russia

As far the secondary billets are concerned, those from Hydro Monett, The Dalles and Yankton do consider the information as declared in the related EPD[2], whereas secondary billets retrieved in USA do reflect the average aluminum consumed by Hydro Extrusion North America, with a scrap content of 37.2%.

Data Quality

Specific data for the modeling of the manufacturing phase were collected at the Hydro manufacturing site for the reference year.

The majority of the generic data used in the study comes from Sphera's database, which has updated all its processes to 2022 data. Therefore, the study is in line with the ISO 21930 requirements on the time representativeness of the selected generic data (not older than 10 years).

Period under Review

Primary data were collected for Hydro's manufacturing processes over the 12 months of the 2022 calendar year. Background data for upstream and downstream processes were obtained from the *LCA for Expert Database, MLC version 2023.2*.

Allocation

The allocation is made in accordance with the provisions of ISO 21930. Energy and resources (water and ancillary) inputs, waste and emissions outputs from the manufacturing processes are allocated to the final product based on mass.

[2] Declaration number 4790427057.130.1 for Monett, number 4790427057.131.1 for The Dalles, number 4790427057.111.1 for Yankton

3. Life Cycle Assessment Scenarios

Table 8. End of life scenario (C1-C4)

COLLECTION, RECOVERY AND DISPOSAL		VALUE	UNIT
Assumptions for scenario development (description of deconstruction, collection, recovery, disposal method and transportation) – see Recycling and Disposal in section 1			
Collection process (specified by type)	Collected separately	0.96	kg
	Collected with mixed construction waste	0.04	kg
Recovery (specified by type)	Reuse	-	kg
	Recycling	0.912	kg
	Landfill	0.088	kg
	Incineration	-	kg
	Incineration with energy recovery	-	kg
	Energy conversion efficiency rate	-	
Disposal (specified by type)	Product or material for final deposition	0.088	kg
Removals of biogenic carbon (excluding packaging)		-	kg CO2

The transport distance between the demolition site and the landfill is assumed to be 100 km. Similarly, the transport distance between the preprocessing site and the landfill and between the demolition site and the preprocessing site is assumed to be 100 km.

Benefits and loads beyond the system boundaries (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. Such recognition includes the transportation, where a distance of 100 km is assumed between the preprocessing site and the remelting site. The rate of aluminum recycling and related processes are expected to 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.

Values in Module D are calculated based on a net scrap approach, based on recycled content resulting from Table 3 and recycling rate resulting from Table 8, and re-called in Table 9. Datasets in Table 10 were used for the calculation.

Table 9. Recycling rate and recycled content of the products

NAME	VALUE FOR ALL PRODUCTS (EXCEPT WET PAINTED)	VALUE FOR WET PAINTED	UNIT
Recycling rate of the product	91.20%	91.20%	%
Recycled content of the product	10.20%	9.98%	%

Table 10. Background datasets used for Module D

BACKGROUND DATASETS	REFERENCE YEAR
RNA: Recycled aluminum ingot (100% recycled content)	2016
RNA: Primary aluminum ingot	2016

The net scrap approach is based on the perspective that the material recycled into secondary material at the end of life will replace an equivalent amount of virgin material. Hence, a credit is given to account for this material substitution.

However, this also means that a burden should be assigned to scrap used as input to the recycling process. This approach rewards the end of life recycling but does not reward the recycled content.

4. Life Cycle Assessment and Life Cycle Inventory Results

Comparability:

Environmental declarations from different programs based upon differing PCRs may not be comparable.

Comparison of the environmental performance of construction works and construction products using EPD information shall be based on the product’s use and impacts at the construction works level. In general, EPDs may not be used for comparability purposes when not considered in a construction works context. Given this PCR ensures products meet the same functional requirements, comparability is permissible provided the information given for such comparison is transparent and the limitations of comparability explained.

When comparing EPDs created using this PCR, variations and deviations are possible. Example of variations: Different LCA software and background LCI datasets may lead to different results for upstream or downstream of the life cycle stages declared.

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.

Life Cycle Impact Assessment Results

Table 11. Life Cycle Impact Assessment Results for the mill finished profile

Mill finished profile									
Impact category*	Unit	A1	A2	A3	C1	C2	C3	C4	D
Abiotic Resource Depletion Potential of Non-renewable (fossil) energy resources (ADPfossil)	[MJ, LHV]	1.77E+02	3.20E+00	2.38E+00	0.00E+00	1.30E-01	3.08E-01	1.71E-02	-5.95E+01
Global Warming Potential (GWP 100), IPCC 2013	[kg CO2 eq]	1.43E+01	2.49E-01	1.86E-01	0.00E+00	9.04E-03	2.48E-02	1.26E-03	-6.53E+00
Acidification Potential (AP)	[kg SO2 eq]	7.13E-02	3.96E-03	2.72E-04	0.00E+00	5.09E-05	3.71E-05	8.06E-06	-3.08E-02
Eutrophication Potential (EP)	[kg N eq]	2.05E-03	2.17E-04	3.21E-05	0.00E+00	4.31E-06	2.81E-06	3.56E-07	-6.82E-04
Ozone Depletion Potential (ODP)	[kg CFC 11 eq]	3.33E-14	5.35E-16	1.41E-14	0.00E+00	2.06E-17	2.54E-15	7.08E-17	-2.21E-15
Smog Formation Potential (SFP)	[kg O3 eq]	1.05E+00	1.17E-01	5.11E-03	0.00E+00	1.18E-03	5.23E-04	1.53E-04	-2.53E-01

*GWP 100 according to IPCC AR5; ADP fossil according to CML 2001 v4.8 (August 2016); all other indicators according to TRACI 2.1.

Table 12. Life Cycle Impact Assessment Results for the fabricated profile

Fabricated profile									
Impact category*	Unit	A1	A2	A3	C1	C2	C3	C4	D
Abiotic Resource Depletion Potential of Non-renewable (fossil) energy resources (ADPfossil)	[MJ, LHV]	1.79E+02	3.38E+00	5.16E+00	0.00E+00	1.30E-01	3.08E-01	1.71E-02	-5.95E+01
Global Warming Potential (GWP 100), IPCC 2013	[kg CO2 eq]	1.44E+01	2.63E-01	4.19E-01	0.00E+00	9.04E-03	2.48E-02	1.26E-03	-6.53E+00
Acidification Potential (AP)	[kg SO2 eq]	7.20E-02	4.08E-03	6.40E-04	0.00E+00	5.09E-05	3.71E-05	8.06E-06	-3.08E-02
Eutrophication Potential (EP)	[kg N eq]	2.07E-03	2.25E-04	6.66E-05	0.00E+00	4.31E-06	2.81E-06	3.56E-07	-6.82E-04
Ozone Depletion Potential (ODP)	[kg CFC 11 eq]	3.36E-14	5.71E-16	3.92E-14	0.00E+00	2.06E-17	2.54E-15	7.08E-17	-2.21E-15
Smog Formation Potential (SFP)	[kg O3 eq]	1.06E+00	1.20E-01	1.12E-02	0.00E+00	1.18E-03	5.23E-04	1.53E-04	-2.53E-01

Table 13. Life Cycle Impact Assessment Results for the wet painted profile

Wet painted profile									
Impact category*	Unit	A1	A2	A3	C1	C2	C3	C4	D
Abiotic Resource Depletion Potential of Non-renewable (fossil) energy resources (ADPfossil)	[MJ, LHV]	1.77E+02	3.33E+00	1.23E+01	0.00E+00	1.30E-01	3.08E-01	1.71E-02	-5.82E+01
Global Warming Potential (GWP 100), IPCC 2013	[kg CO2 eq]	1.42E+01	2.59E-01	8.65E-01	0.00E+00	9.04E-03	2.48E-02	1.26E-03	-6.39E+00
Acidification Potential (AP)	[kg SO2 eq]	7.14E-02	4.01E-03	9.37E-04	0.00E+00	5.09E-05	3.71E-05	8.06E-06	-3.02E-02
Eutrophication Potential (EP)	[kg N eq]	2.04E-03	2.22E-04	1.19E-04	0.00E+00	4.31E-06	2.81E-06	3.56E-07	-6.67E-04
Ozone Depletion Potential (ODP)	[kg CFC 11 eq]	3.61E-14	5.62E-16	4.03E-14	0.00E+00	2.06E-17	2.54E-15	7.08E-17	-2.17E-15

Smog Formation Potential (SFP)	[kg O3 eq]	1.05E+00	1.18E-01	1.69E-02	0.00E+00	1.18E-03	5.23E-04	1.53E-04	-2.48E-01

Table 14. Life Cycle Impact Assessment Results for the anodized

Anodized profile									
Impact category*	Unit	A1	A2	A3	C1	C2	C3	C4	D
Abiotic Resource Depletion Potential of Non-renewable (fossil) energy resources (ADPfossil)	[MJ, LHV]	1.80E+02	3.41E+00	1.73E+01	0.00E+00	1.30E-01	3.08E-01	1.71E-02	-5.95E+01
Global Warming Potential (GWP 100), IPCC 2013	[kg CO2 eq]	1.45E+01	2.65E-01	1.37E+00	0.00E+00	9.04E-03	2.48E-02	1.26E-03	-6.53E+00
Acidification Potential (AP)	[kg SO2 eq]	7.22E-02	4.10E-03	2.72E-03	0.00E+00	5.09E-05	3.71E-05	8.06E-06	-3.08E-02
Eutrophication Potential (EP)	[kg N eq]	2.07E-03	2.27E-04	3.01E-04	0.00E+00	4.31E-06	2.81E-06	3.56E-07	-6.82E-04
Ozone Depletion Potential (ODP)	[kg CFC 11 eq]	3.37E-14	5.76E-16	2.36E-13	0.00E+00	2.06E-17	2.54E-15	7.08E-17	-2.21E-15
Smog Formation Potential (SFP)	[kg O3 eq]	1.07E+00	1.21E-01	3.64E-02	0.00E+00	1.18E-03	5.23E-04	1.53E-04	-2.53E-01

Life Cycle Inventory Results

Table 15. Resource Use Indicators for mill finished profile

Mill finished profile									
Parameter	Unit	A1	A2	A3	C1	C2	C3	C4	D
RPRE: Renewable primary resources used as energy carrier (fuel)	[MJ]	2.78E+01	4.03E-02	1.32E+00	0.00E+00	5.08E-03	1.00E-01	2.87E-03	-4.28E+01
RPRM: Renewable primary resources with energy content used as material	[MJ]	0.00E+00	0.00E+00	5.21E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRPRE: Non-renewable primary resources used as an energy carrier (fuel)	[MJ]	1.79E+02	3.22E+00	2.47E+00	0.00E+00	1.30E-01	4.24E-01	1.76E-02	-6.06E+01
NRPRM: Non-renewable primary resources with energy content used as material	[MJ]	0.00E+00	0.00E+00	6.75E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SM: Secondary materials	[kg]	1.02E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF: Renewable secondary fuels	[MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF: Non-renewable secondary fuels	[MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE: Recovered energy	[MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW: Use of net freshwater resources	[m3]	9.11E-02	8.15E-05	4.46E-03	0.00E+00	1.76E-05	1.69E-04	4.45E-06	-1.42E-01
RPRT Total use of renewable primary resources with energy content	[MJ]	2.78E+01	4.03E-02	1.84E+00	0.00E+00	5.08E-03	1.00E-01	2.87E-03	-4.28E+01
NRPRT Total non-renewable primary resources with energy content	[MJ]	1.79E+02	3.22E+00	2.54E+00	0.00E+00	1.30E-01	4.24E-01	1.76E-02	-6.06E+01

Table 16. Output Flows and Waste Flows for mill finished profile

MILL FINISHED PROFILE									
Parameter	Unit	A1	A2	A3	C1	C2	C3	C4	D
HWD: Hazardous waste disposed	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD: Non-hazardous waste disposed	[kg]	0.00E+00	0.00E+00	8.03E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HLRW: High-level radioactive waste, conditioned, to final repository	[kg]	8.20E-07	9.86E-09	6.46E-08	0.00E+00	3.80E-10	4.91E-08	2.05E-10	-5.22E-07
ILLRW: Intermediate- and low-level radioactive waste, conditioned, to final repository	[kg]	5.66E-04	8.34E-06	5.76E-05	0.00E+00	3.20E-07	4.10E-05	2.01E-07	-4.18E-04
CRU: Components for re-use	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR: Materials for recycling	[kg]	0.00E+00	0.00E+00	5.21E-01	0.00E+00	0.00E+00	9.12E-01	0.00E+00	8.18E-01
MER: Materials for energy recovery	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE: Recovered energy exported from the product system	[MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 17. Carbon Emissions and Removals for mill finished profile

MILL FINISHED PROFILE									
Parameter	Unit	A1	A2	A3	C1	C2	C3	C4	D
BCRP: Biogenic Carbon Removal from Product	[kg CO2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEP: Biogenic Carbon Emission from Product	[kg CO2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCRK: Biogenic Carbon Removal from Packaging	[kg CO2]	0.00E+00	0.00E+00	6.32E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEK: Biogenic Carbon Emission from Packaging	[kg CO2]	0.00E+00	0.00E+00	6.32E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEW: Biogenic Carbon Emission from Combustion of Waste from Renewable Sources Used in Production Processes	[kg CO2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCE: Calcination Carbon Emissions	[kg CO2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCR: Carbonation Carbon Removals	[kg CO2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CWNR: Carbon Emissions from Combustion of Waste from Non-Renewable Sources used in Production Processes	[kg CO2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 18. Resource Use Indicators for fabricated profile

FABRICATED PROFILE									
Parameter	Unit	A1	A2	A3	C1	C2	C3	C4	D
RPRE: Renewable primary resources used as energy carrier (fuel)	[MJ]	2.81E+01	5.20E-02	3.64E+00	0.00E+00	5.08E-03	1.00E-01	2.87E-03	-4.28E+01
RPRM: Renewable primary resources with energy content used as material	[MJ]	0.00E+00	0.00E+00	1.05E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRPRE: Non-renewable primary resources used as an energy carrier (fuel)	[MJ]	1.80E+02	3.41E+00	5.46E+00	0.00E+00	1.30E-01	4.24E-01	1.76E-02	-6.06E+01

NRPRM: Non-renewable primary resources with energy content used as material	[MJ]	0.00E+00	0.00E+00	1.36E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SM: Secondary materials	[kg]	1.02E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF: Renewable secondary fuels	[MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF: Non-renewable secondary fuels	[MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE: Recovered energy	[MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW: Use of net freshwater resources	[m3]	9.20E-02	9.52E-05	1.07E-02	0.00E+00	1.76E-05	1.69E-04	4.45E-06	-1.42E-01
RPRT Total use of renewable primary resources with energy content	[MJ]	2.81E+01	5.20E-02	4.68E+00	0.00E+00	5.08E-03	1.00E-01	2.87E-03	-4.28E+01
NRPRT Total non-renewable primary resources with energy content	[MJ]	1.80E+02	3.41E+00	5.59E+00	0.00E+00	1.30E-01	4.24E-01	1.76E-02	-6.06E+01

Table 19. Output Flows and Waste Flows for fabricated profile

FABRICATED PROFILE									
Parameter	Unit	A1	A2	A3	C1	C2	C3	C4	D
HWD: Hazardous waste disposed	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD: Non-hazardous waste disposed	[kg]	0.00E+00	0.00E+00	8.15E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HLRW: High-level radioactive waste, conditioned, to final repository	[kg]	8.28E-07	1.02E-08	1.77E-07	0.00E+00	3.80E-10	4.91E-08	2.05E-10	-5.22E-07
ILLRW: Intermediate- and low-level radioactive waste, conditioned, to final repository	[kg]	5.72E-04	8.72E-06	1.54E-04	0.00E+00	3.20E-07	4.10E-05	2.01E-07	-4.18E-04
CRU: Components for re-use	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR: Materials for recycling	[kg]	0.00E+00	0.00E+00	5.47E-01	0.00E+00	0.00E+00	9.12E-01	0.00E+00	8.18E-01
MER: Materials for energy recovery	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE: Recovered energy exported from the product system	[MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 20. Carbon Emissions and Removals for fabricated profile

FABRICATED PROFILE									
Parameter	Unit	A1	A2	A3	C1	C2	C3	C4	D
BCRP: Biogenic Carbon Removal from Product	[kg CO2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEP: Biogenic Carbon Emission from Product	[kg CO2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCRK: Biogenic Carbon Removal from Packaging	[kg CO2]	0.00E+00	0.00E+00	1.27E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEK: Biogenic Carbon Emission from Packaging	[kg CO2]	0.00E+00	0.00E+00	1.27E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEW: Biogenic Carbon Emission from Combustion of Waste from Renewable Sources Used in Production Processes	[kg CO2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCE: Calcination Carbon Emissions	[kg CO2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCR: Carbonation Carbon Removals	[kg CO2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

CWNR: Carbon Emissions from Combustion of Waste from Non-Renewable Sources used in Production Processes	[kg CO2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 21. Resource Use Indicators for wet painted profile

WET PAINTED PROFILE									
Parameter	Unit	A1	A2	A3	C1	C2	C3	C4	D
RPRE: Renewable primary resources used as energy carrier (fuel)	[MJ]	2.77E+01	5.15E-02	3.64E+00	0.00E+00	5.08E-03	1.00E-01	2.87E-03	-4.19E+01
RPRM: Renewable primary resources with energy content used as material	[MJ]	0.00E+00	0.00E+00	1.04E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRPRE: Non-renewable primary resources used as an energy carrier (fuel)	[MJ]	1.79E+02	3.36E+00	1.26E+01	0.00E+00	1.30E-01	4.24E-01	1.76E-02	-5.93E+01
NRPRM: Non-renewable primary resources with energy content used as material	[MJ]	0.00E+00	0.00E+00	1.35E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SM: Secondary materials	[kg]	9.99E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF: Renewable secondary fuels	[MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF: Non-renewable secondary fuels	[MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE: Recovered energy	[MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW: Use of net freshwater resources	[m3]	9.06E-02	9.44E-05	9.14E-03	0.00E+00	1.76E-05	1.69E-04	4.45E-06	-1.39E-01
RPRT Total use of renewable primary resources with energy content	[MJ]	2.77E+01	5.15E-02	4.68E+00	0.00E+00	5.08E-03	1.00E-01	2.87E-03	-4.19E+01
NRPRT Total non-renewable primary resources with energy content	[MJ]	1.79E+02	3.36E+00	1.27E+01	0.00E+00	1.30E-01	4.24E-01	1.76E-02	-5.93E+01

Table 22. Output Flows and Waste Flows for wet painted profile

WET PAINTED PROFILE									
Parameter	Unit	A1	A2	A3	C1	C2	C3	C4	D
HWD: Hazardous waste disposed	[kg]	0.00E+00	0.00E+00	1.97E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD: Non-hazardous waste disposed	[kg]	0.00E+00	0.00E+00	8.02E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HLRW: High-level radioactive waste, conditioned, to final repository	[kg]	8.32E-07	1.01E-08	1.83E-07	0.00E+00	3.80E-10	4.91E-08	2.05E-10	-5.11E-07
ILLRW: Intermediate- and low-level radioactive waste, conditioned, to final repository	[kg]	5.84E-04	8.58E-06	1.60E-04	0.00E+00	3.20E-07	4.10E-05	2.01E-07	-4.09E-04
CRU: Components for re-use	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR: Materials for recycling	[kg]	0.00E+00	0.00E+00	5.58E-01	0.00E+00	0.00E+00	9.12E-01	0.00E+00	8.01E-01
MER: Materials for energy recovery	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE: Recovered energy exported from the product system	[MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 23. Carbon Emissions and Removals for wet painted profile

WET PAINTED PROFILE									
Parameter	Unit	A1	A2	A3	C1	C2	C3	C4	D
BCRP: Biogenic Carbon Removal from Product	[kg CO2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEP: Biogenic Carbon Emission from Product	[kg CO2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCRK: Biogenic Carbon Removal from Packaging	[kg CO2]	0.00E+00	0.00E+00	1.26E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEK: Biogenic Carbon Emission from Packaging	[kg CO2]	0.00E+00	0.00E+00	1.26E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEW: Biogenic Carbon Emission from Combustion of Waste from Renewable Sources Used in Production Processes	[kg CO2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCE: Calcination Carbon Emissions	[kg CO2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCR: Carbonation Carbon Removals	[kg CO2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CWNR: Carbon Emissions from Combustion of Waste from Non-Renewable Sources used in Production Processes	[kg CO2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 24. Resource Use Indicators for anodized profile

ANODIZED PROFILE									
Parameter	Unit	A1	A2	A3	C1	C2	C3	C4	D
RPRE: Renewable primary resources used as energy carrier (fuel)	[MJ]	2.82E+01	5.28E-02	1.32E+01	0.00E+00	5.08E-03	1.00E-01	2.87E-03	-4.28E+01
RPRM: Renewable primary resources with energy content used as material	[MJ]	0.00E+00	0.00E+00	1.05E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRPRE: Non-renewable primary resources used as an energy carrier (fuel)	[MJ]	1.81E+02	3.44E+00	1.91E+01	0.00E+00	1.30E-01	4.24E-01	1.76E-02	-6.06E+01
NRPRM: Non-renewable primary resources with energy content used as material	[MJ]	0.00E+00	0.00E+00	1.36E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SM: Secondary materials	[kg]	1.02E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF: Renewable secondary fuels	[MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF: Non-renewable secondary fuels	[MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE: Recovered energy	[MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW: Use of net freshwater resources	[m3]	9.23E-02	9.78E-05	3.90E-02	0.00E+00	1.76E-05	1.69E-04	4.45E-06	-1.42E-01
RPRT Total use of renewable primary resources with energy content	[MJ]	2.82E+01	5.28E-02	1.43E+01	0.00E+00	5.08E-03	1.00E-01	2.87E-03	-4.28E+01
NRPRT Total non-renewable primary resources with energy content	[MJ]	1.81E+02	3.44E+00	1.92E+01	0.00E+00	1.30E-01	4.24E-01	1.76E-02	-6.06E+01

Table 25. Output Flows and Waste Flows for anodized

ANODIZED PROFILE									
Parameter	Unit	A1	A2	A3	C1	C2	C3	C4	D
HWD: Hazardous waste disposed	[kg]	0.00E+00	0.00E+00	4.21E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD: Non-hazardous waste disposed	[kg]	0.00E+00	0.00E+00	8.19E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HLRW: High-level radioactive waste, conditioned, to final repository	[kg]	8.31E-07	1.03E-08	7.42E-07	0.00E+00	3.80E-10	4.91E-08	2.05E-10	-5.22E-07
ILLRW: Intermediate- and low-level radioactive waste, conditioned, to final repository	[kg]	5.74E-04	8.79E-06	6.67E-04	0.00E+00	3.20E-07	4.10E-05	2.01E-07	-4.18E-04
CRU: Components for re-use	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR: Materials for recycling	[kg]	0.00E+00	0.00E+00	5.56E-01	0.00E+00	0.00E+00	9.12E-01	0.00E+00	8.18E-01
MER: Materials for energy recovery	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE: Recovered energy exported from the product system	[MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 26. Carbon Emissions and Removals for anodized profile

ANODIZED PROFILE									
Parameter	Unit	A1	A2	A3	C1	C2	C3	C4	D
BCRP: Biogenic Carbon Removal from Product	[kg CO2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEP: Biogenic Carbon Emission from Product	[kg CO2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCRK: Biogenic Carbon Removal from Packaging	[kg CO2]	0.00E+00	0.00E+00	1.28E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEK: Biogenic Carbon Emission from Packaging	[kg CO2]	0.00E+00	0.00E+00	1.28E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEW: Biogenic Carbon Emission from Combustion of Waste from Renewable Sources Used in Production Processes	[kg CO2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCE: Calcination Carbon Emissions	[kg CO2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCR: Carbonation Carbon Removals	[kg CO2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CWNR: Carbon Emissions from Combustion of Waste from Non-Renewable Sources used in Production Processes	[kg CO2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Alternative Life Cycle Impact Assessment Results

The following section reports the calculated LCIA indicators when considering process scrap (industrial scrap) as a co-product. In this approach, the process scrap in output from the extrusion, fabrication, wet painting and anodizing takes the same material burden of the billet input to the extrusion. Similarly, the process scrap entering the billet production takes the same burden of the original billet used in the production process who generated the scrap. LCIA results are reported in Table 30.

Table 27 to Table 30.

Table 27. Alternative Life Cycle Impact Assessment Results (co-product approach for the modeling of pre-consumer scrap) for the mill finished profile

MILL FINISHED PROFILE									
Impact category*	Unit	A1	A2	A3	C1	C2	C3	C4	D
Abiotic Resource Depletion Potential of Non-renewable (fossil) energy resources (ADPfossil)	[MJ, LHV]	1.24E+02	2.17E+00	2.38E+00	0.00E+00	1.30E-01	3.08E-01	1.71E-02	-6.57E+01
Global Warming Potential (GWP 100), IPCC 2013	[kg CO2 eq]	1.01E+01	1.68E-01	1.86E-01	0.00E+00	9.04E-03	2.48E-02	1.26E-03	-7.21E+00
Acidification Potential (AP)	[kg SO2 eq]	5.03E-02	2.64E-03	2.72E-04	0.00E+00	5.09E-05	3.71E-05	8.06E-06	-3.41E-02
Eutrophication Potential (EP)	[kg N eq]	1.42E-03	1.46E-04	3.21E-05	0.00E+00	4.31E-06	2.81E-06	3.56E-07	-7.53E-04
Ozone Depletion Potential (ODP)	[kg CFC 11 eq]	1.83E-13	3.64E-16	1.41E-14	0.00E+00	2.06E-17	2.54E-15	7.08E-17	-2.45E-15
Smog Formation Potential (SFP)	[kg O3 eq]	7.28E-01	7.82E-02	5.11E-03	0.00E+00	1.18E-03	5.23E-04	1.53E-04	-2.79E-01

*GWP 100 according to IPCC AR5; ADP fossil according to CML 2001 v4.8 (August 2016); all other indicators according to TRACI 2.1.

Table 28. Alternative Life Cycle Impact Assessment Results (co-product approach for the modeling of pre-consumer scrap) for the fabricated profile

FABRICATED PROFILE									
Impact category*	Unit	A1	A2	A3	C1	C2	C3	C4	D
Abiotic Resource Depletion Potential of Non-renewable (fossil) energy resources (ADPfossil)	[MJ, LHV]	1.24E+02	2.32E+00	5.16E+00	0.00E+00	1.30E-01	3.08E-01	1.71E-02	-6.57E+01
Global Warming Potential (GWP 100), IPCC 2013	[kg CO2 eq]	1.01E+01	1.80E-01	4.19E-01	0.00E+00	9.04E-03	2.48E-02	1.26E-03	-7.21E+00
Acidification Potential (AP)	[kg SO2 eq]	5.03E-02	2.72E-03	6.40E-04	0.00E+00	5.09E-05	3.71E-05	8.06E-06	-3.41E-02
Eutrophication Potential (EP)	[kg N eq]	1.42E-03	1.52E-04	6.66E-05	0.00E+00	4.31E-06	2.81E-06	3.56E-07	-7.53E-04
Ozone Depletion Potential (ODP)	[kg CFC 11 eq]	1.83E-13	3.96E-16	3.92E-14	0.00E+00	2.06E-17	2.54E-15	7.08E-17	-2.45E-15
Smog Formation Potential (SFP)	[kg O3 eq]	7.28E-01	8.00E-02	1.12E-02	0.00E+00	1.18E-03	5.23E-04	1.53E-04	-2.79E-01

*GWP 100 according to IPCC AR5; ADP fossil according to CML 2001 v4.8 (August 2016); all other indicators according to TRACI 2.1.

Table 29. Alternative Life Cycle Impact Assessment Results (co-product approach for the modeling of pre-consumer scrap) for the wet painted profile

WET PAINTED PROFILE									
Impact category*	Unit	A1	A2	A3	C1	C2	C3	C4	D
Abiotic Resource Depletion Potential of Non-renewable (fossil) energy resources (ADPfossil)	[MJ, LHV]	1.23E+02	2.28E+00	1.23E+01	0.00E+00	1.30E-01	3.08E-01	1.71E-02	-6.43E+01
Global Warming Potential (GWP 100), IPCC 2013	[kg CO2 eq]	9.94E+00	1.77E-01	8.65E-01	0.00E+00	9.04E-03	2.48E-02	1.26E-03	-7.05E+00
Acidification Potential (AP)	[kg SO2 eq]	4.99E-02	2.67E-03	9.37E-04	0.00E+00	5.09E-05	3.71E-05	8.06E-06	-3.33E-02
Eutrophication Potential (EP)	[kg N eq]	1.40E-03	1.49E-04	1.19E-04	0.00E+00	4.31E-06	2.81E-06	3.56E-07	-7.37E-04
Ozone Depletion Potential (ODP)	[kg CFC 11 eq]	1.82E-13	3.89E-16	4.03E-14	0.00E+00	2.06E-17	2.54E-15	7.08E-17	-2.39E-15
Smog Formation Potential (SFP)	[kg O3 eq]	7.15E-01	7.84E-02	1.69E-02	0.00E+00	1.18E-03	5.23E-04	1.53E-04	-2.73E-01

*GWP 100 according to IPCC AR5; ADP fossil according to CML 2001 v4.8 (August 2016); all other indicators according to TRACI 2.1.

Table 30. Alternative Life Cycle Impact Assessment Results (co-product approach for the modeling of pre-consumer scrap) for the anodized profile

ANODIZED PROFILE									
Impact category*	Unit	A1	A2	A3	C1	C2	C3	C4	D
Abiotic Resource Depletion Potential of Non-renewable (fossil) energy resources (ADPfossil)	[MJ, LHV]	1.24E+02	2.34E+00	1.73E+01	0.00E+00	1.30E-01	3.08E-01	1.71E-02	-6.57E+01
Global Warming Potential (GWP 100), IPCC 2013	[kg CO2 eq]	1.01E+01	1.81E-01	1.37E+00	0.00E+00	9.04E-03	2.48E-02	1.26E-03	-7.21E+00
Acidification Potential (AP)	[kg SO2 eq]	5.03E-02	2.73E-03	2.72E-03	0.00E+00	5.09E-05	3.71E-05	8.06E-06	-3.41E-02
Eutrophication Potential (EP)	[kg N eq]	1.42E-03	1.52E-04	3.01E-04	0.00E+00	4.31E-06	2.81E-06	3.56E-07	-7.53E-04
Ozone Depletion Potential (ODP)	[kg CFC 11 eq]	1.83E-13	3.98E-16	2.36E-13	0.00E+00	2.06E-17	2.54E-15	7.08E-17	-2.45E-15
Smog Formation Potential (SFP)	[kg O3 eq]	7.28E-01	8.02E-02	3.64E-02	0.00E+00	1.18E-03	5.23E-04	1.53E-04	-2.79E-01

5. LCA Interpretation

The present interpretation is intended to provide futher information in support of results reported in Table 11, Table 12, Table 13 and Table 14. The LCA study shows that the higher contribution to the overall impacts comes from the manufacturing stage (more than 90% for analysed impact categories) whereas the downstream (C1-C4) is of minor relevance.

With regard to the upstream stages, impacts are driven by billets for all impact categories, with the exception of the ODP for anodized and painted profiles where the first contributor is the anodizing and the painting respectively due to the electricity used in the process. The relative contribution of the different processes to the upstream stage (A1-A3) are reported in Figure 2 to Figure 5.

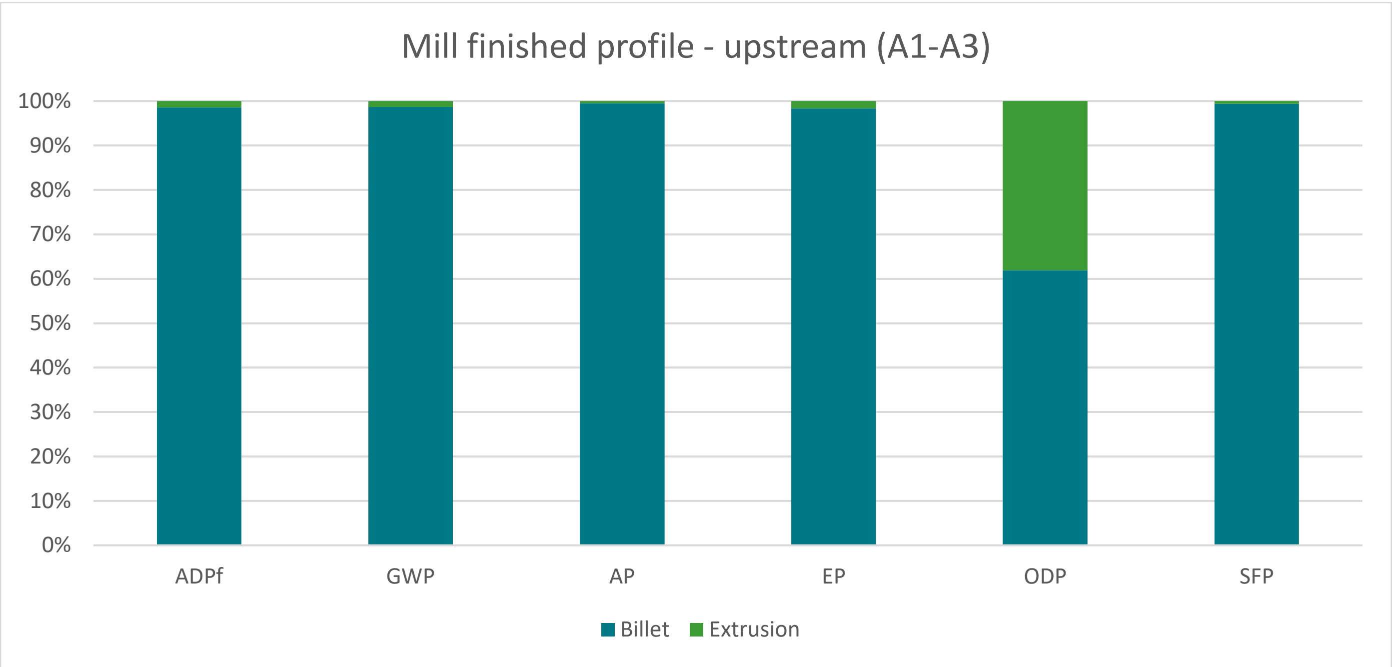


Figure 2. Relative contribution to upstream process of mill finished profile

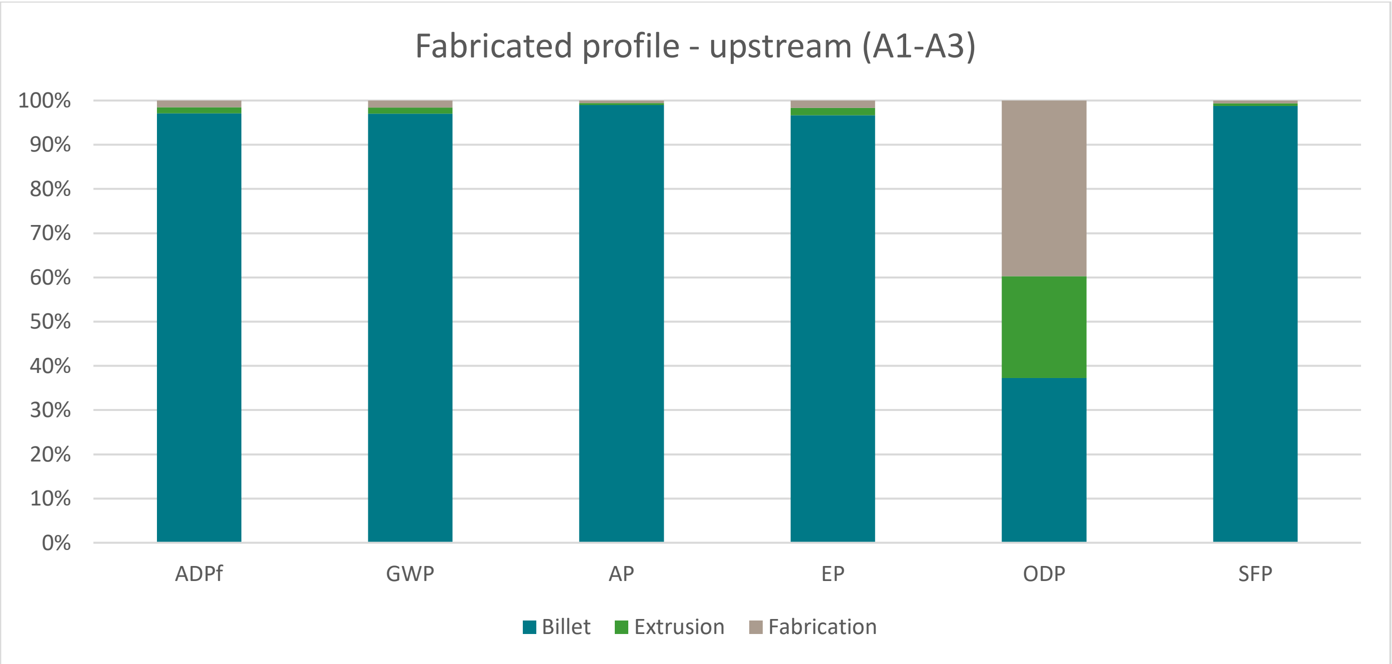


Figure 3. Relative contribution to upstream process of fabricated profile

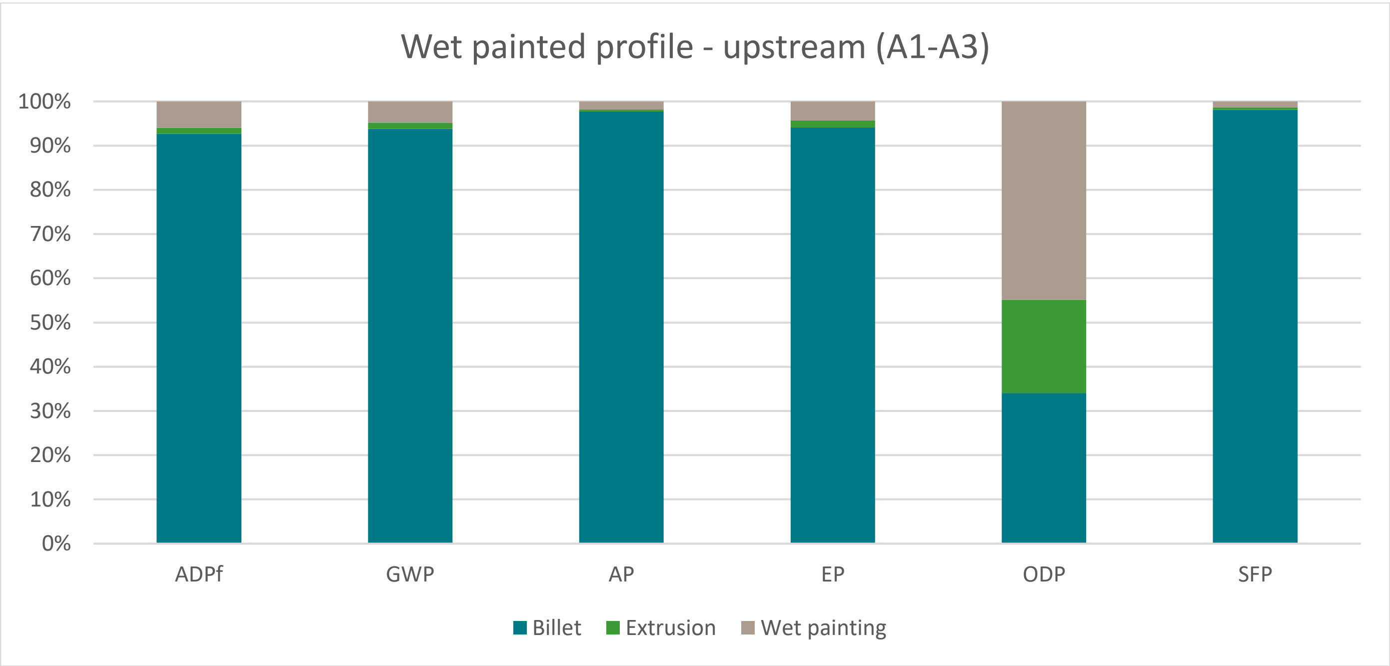


Figure 4. Relative contribution to upstream process of wet painted profile

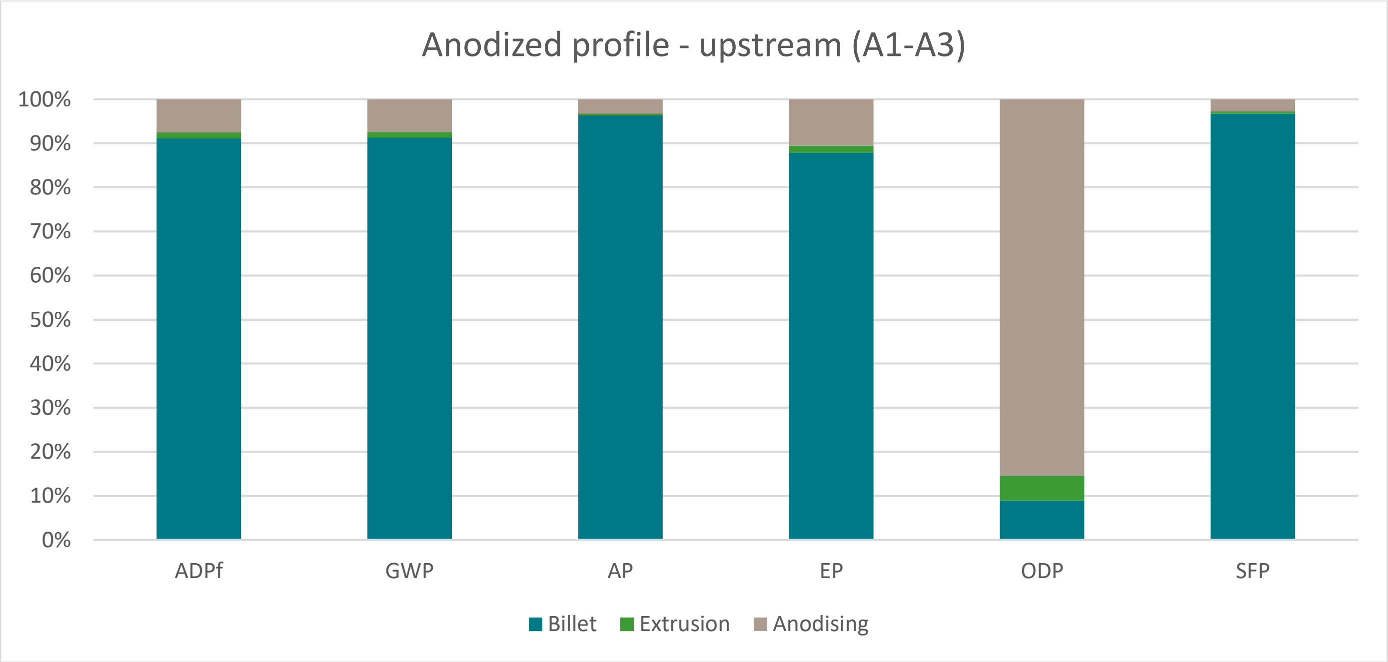


Figure 5. Relative contribution to upstream process of anodized profile

6. Additional Environmental Information

Environment and Health During Manufacturing

The entire manufacturing process is monitored by management systems certified to ISO 9001 and IATF 16949, with regard to quality-related product requirements. All statutory obligations with regard to occupational and workplace safety and the environment have been complied with throughout the entire manufacturing process. This is ensured by management systems certified to ISO 14001 and ISO 45001 which are continuously monitored internally and by external accredited certification bodies.

Environment and Health During Installation

All statutory obligations with regard to occupational and workplace safety and the environment have been complied with throughout the entire manufacturing process. This is ensured by management system certifications to ISO 14001 and ISO 45001 which are continuously monitored internally and by external accredited certification bodies.

Environmental Activities and Certifications

Hydro Extrusion North America maintains corporate certifications to ISO 9001, IATF 16949, ISO 14001, ISO 45001 and the ASI performance standard.

Further Information

See https://www.hydro.com/ for further information.

7. References

AA (2018). International Alloy Designations and Chemical Composition Limits for Wrought Aluminum and Wrought Aluminum Alloys

ISO 14001:2015 - Environmental management systems — Requirements with guidance for use

ISO 14025:2006 - Environmental labels and declarations — Type III environmental declarations — Principles and procedures

ISO 14040:2006/Amd1:2020 - Environmental management – Life cycle assessment – Principles and framework

ISO 14044:2006/Amd1:2017/Amd2:2020 - Environmental management – Life cycle assessment – Requirements and guidelines

ISO 21930:2017 - Sustainability in building construction -- Environmental declaration of building products Part A: Life Cycle Assessment Calculation Rules and Report Requirements

Product Category Rules (PCR) Guidance for Building Related Products and Services Part A: Life Cycle Assessment Calculation Rules and Report Requirements, UL 10010

Product Category Rules (PCR) Guidance for Building Related Products and Services Part B: Aluminum Construction Product EPD Requirements, UL 10010 – 38

UL Environment General Program Instructions March 2022, version 2.7

UNEP (2011). Recycling rates of metals: a status report. Retrieved at https://www.unep.org/resources/report/recycling-rates-metals-status-report (accessed at November 2023)

Ecoinnovazione (2023). Technical report: LCA study of aluminum extrusion profiles produced by Hydro Extrusion North America in Gainesville, Mississauga, Mountain Top, Montreal, North Liberty and Portland.