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The Norwegian EPD Foundation

ENVIRONMENTAL PRODUCT DECLARATION

in accordance with ISO 14025, ISO 21930 and EN 15804

Owner of the declaration:	Hydro Aluminium AS
Program operator:	The Norwegian EPD Foundation
Publisher:	The Norwegian EPD Foundation
Declaration number:	NEPD-1839-768-EN
Registration number:	NEPD-1839-768-EN
ECO Platform reference number:	-
Issue date:	05.08.2019
Valid to:	05.08.2024

Hydro Aluminium Extrusion Ingot Europe

Hydro Aluminium AS

www.epd-norge.no

General information

Product:
Hydro Aluminium Extrusion Ingot Europe

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Declaration number:
NEPD-1839-768-EN

Place of production:
Primary: Husnes, Karmøy, Sunndal, Slovalco
Remelters: Azuqueca, Clervaux, Deeside, Luce, Rackwitz

ECO Platform reference number:

Management system:
ISO 14001, ISO 50001

This declaration is based on Product Category Rules:
CEN Standard EN 15804 serves as core PCR
NPCR 013, "Version 3.0 Part B for steel and aluminium construction products"

Organisation no:
917,537,534

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

Issue date:
05.08.2019

Valid to:
05.08.2024

Declared unit:
1kg Aluminium extrusion ingot, average of Hydro's European extrusion ingot production

Year of study:
2019

Declared unit with option:
1 kg of aluminium extrusion ingot, including waste handling and possible environmental benefits after end of life.

Comparability:
EPD of construction products may not be comparable if they not comply with EN 15804 and seen in a building context.

Functional unit:
The product is an input to several different building products and no use scenarios are defined, hence no functional unit

The EPD has been worked out by:
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Irmeline de Sadeleer Østfoldforskning

Verification:
The CEN Norm EN 15804 serves as the core PCR. Independent verification of the declaration and data, according to ISO14025:2010

☐ internal ☑ external

Third party verifier:

Jane Anderson

Jane Anderson, ConstructionLCA Limited
(Independent verifier approved by EPD Norway)

Approved

Håkon Hauan
Managing Director of EPD-Norway

Product

Product description:
This EPD covers the Aluminium alloys for Hydro Aluminium's extrusion ingot products in Europe. The EPD results represent an average of all products produced in Hydro Aluminium Primary Metal casthouses in Europe, covering the integrated process route of Aluminum production. The calculation includes "Cradle to gate with options" apporach covering the full value chain both for primary and remelt production.

Product specification:
Extrusion ingots of aluminium alloys is produced by vertical continuous casting, from primary or recycled metal. The metal is heat treathed and sawed to lenghts in the respective casthouse before shipping to the extrusion plant.
Aluminum extrusion ingots are used as input material in the extrusion process to produce aluminium profiles for further manufacturing of products for various applications.

Materials	kg	%
Potline	0.4 - 0.6	40 - 60
External cold metal	0.1 - 0.2	10 - 20
3:1 scrap	0.1 - 0.2	10 - 20
Post consumer scrap	0.05 - 0.1	5 - 10
Process scrap	0.1 - 0.2	10 - 20
Alloys	0.01 - 0.02	1 - 2

Market:
Examples of industries we serve in Europe: Building and Construction, Automotive and Transport, Electronics, HVAC&R, General Engineering and Solar.

Technical data:
All products are produced according to European standard EN 486. The products have a chemical composition within the alloy groups: 1000, 3000, 5000 and 6000.

For more detailed information about chemical composition, diameters, lengths and tolerances:
www.hydro.com/en/products/casthouse-products/

Name	Typcial Values 6xxx alloys	Unit
Density	2.66-2.71	(kg/m3) x 103
Melting point (Typical)	575-655	°C
Electrical conductivity (Typical) at 20°C/at 68°F	Equal Volume: 22-36	MS/m (0.58*%IACS)
Thermal conductivity (Typical) at 25°c/at 77°F	130-220	W/(m.K)
Average Coefficient of thermal expansion (Typical) 20° to 100°c /68° to 212°F	19.4-24.1	per °C
Modulus of elasticity (Typical)	69-72	MPa * 103
Chemical composition	Varying alloy by alloy, most case Al > 98	% by mass

Reference service life, product:
Dependent on product application, but the material itself has an infinite life time.

Reference service life, building:
Dependent on product application, but the material itself has an infinite life time.

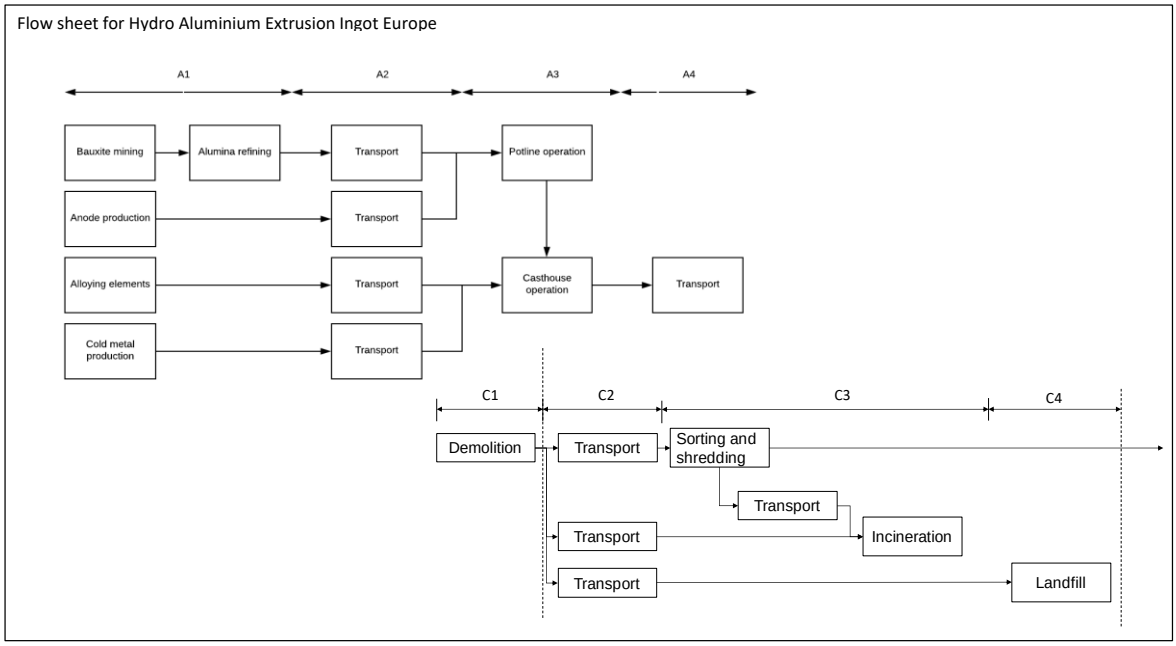
LCA: Calculation rules

Declared unit with option:
1 kg of aluminium extrusion ingot. The EPD also covers modules C2-C4 and D.

The extrusion ingot is produced in three Norwegian smelters: Husnes, Karmøy and Sunndalsøra, and in five European remelters: Azuqueca, Clervaux, Deeside, Luce, and Rackwitz. The results presented here is a weighted average of production volumes in 2017.

System boundary:
Cradle to gate with options. The following stages have been declared: A1-A4, C2-C4, and D. Further specified in flow sheet below.

Module D covers the potential benefits from recycling of Hydro Aluminium Extrusion Ingot Europe after end of useful life. Module D covers all necessary stages from C3 until the aluminium is back on the market and compares to the environmental performance of an average market aluminium extrusion ingot. The module is further specified under scenarios.



Data quality:
Specific data are used for all of Hydro's processes, based on the production year 2017, and are collected the first months of 2019. As Hydro have ownership in a total value chain from mining of bauxite to production of aluminium extrusion ingots, all stages from A1 to A4 are covered by specific data. Background data on for instance transport and electricity production are from ecoinvent 3.4 (April 2018). Results for extrusion ingot 4.0 is calculated for each of the production sites and a weighted average is made based on the production volumes in each site.

Allocation:
The allocation is made in accordance with the provisions of EN 15804. Incoming energy and water and waste production in-house is allocated equally among all products through mass allocation. For almost all processes, detailed data are provided for each process step, and the main allocation is between aluminium hydroxide and aluminium oxide in the production of alumina. Effects of primary production of recycled materials are allocated to the main product in which the material was used. The recycling process and transportation of the material is allocated to this analysis.

Cut-off criteria:
All major raw materials and all the essential energy is included. The production process for raw materials and energy flows that are included with very small amounts (<1%) are not included. This cut-off rule does not apply for hazardous materials and substances, and mostly apply for alloying elements that are added in less than per thousandth.

LCA: Scenarios and additional technical information

The following information describe the scenarios in the different modules of the EPD.

The transport from production sites to market is assumed to be the weighted distance from the three smelters in Norway, the one in Slovakia, and the remelters on the European continent to a location in central Europe. The average distance by truck is assumed to be 400 km.

Transport from production place to user (A4)

Type	Capacity utilisation (incl. return) %	Type of vehicle	Distance km	Fuel/Energy consumption
Truck	50	Lorry, >32 metric tons, Euro V	400	2.46E-02 l/tkm
Boat	80	Cargo ship, 5000 tons	1320	1.22E-02 l/tkm

Most of the aluminium used for construction purposes is collected (approximately 96%) and recycled (approximately 97% of the collected aluminium), giving a total of 93% recycled. The aluminium is transported to a material processing site where different materials, including metals are shredded and sorted.

End of Life (C2, C3, C4)

	Unit	Value
Hazardous waste disposed	kg	-
Collected as mixed construction waste	kg	0.96
Reuse	kg	-
Recycling	kg	0.933
Energy recovery	kg	0.027*
To landfill	kg	0.04**

* 27 grams of the original 1 kilogram of aluminium is going to incineration. No loads or benefits are attributed to this flow.

** There will be a small portion of extruded aluminium ending as aggregate at the construction site. This is included under "To landfill" where no loads or benefits are included

Transport to waste processing (C2)

Type	Capacity utilisation (incl. return) %	Type of vehicle	Distance km	Fuel/Energy consumption
Truck	40	Lorry, 16-32 metric tons, Euro IV	50	4.80E-02 l/tkm

Aluminium from construction site to waste handling site is assumed to be transported in an older medium-sized lorry with smaller capacity utilization than in the production system

Benefits and loads beyond the system boundaries (D)

	Unit	Value
Aluminium extrusion ingot to material recycling	g	861

Aluminium collected and recycled is assumed to replace an average extrusion ingot in Europe consisting of 40% recycled and 60% primary aluminium. This is a conservative approach. The original ingot contained 10.9% recycled aluminium, and this is subtracted before the calculation to avoid double counting of benefits.

LCA: Results

All results are calculated with the use of SimaPro v.9 (2019) and impact methods according to ISO 15804. Results are based on a weighted average between three production sites. Variations in results for the individual sites are between 24% (GWP) as the smallest and 72% (EP) as the largest.

System boundaries (X=included, MND= module not declared, MNR=module not relevant)

Product stage			Assemby stage		Use stage							End of life stage				Beyond the system boundaries
Raw materials	Transport	Manufacturing	Transport	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
x	x	x	x	MND	MND	MND	MND	MND	MND	MND	MND	MND	x	x	x	x

Environmental impact

Parameter	Unit	A1-A3	A4	C2	C3	C4	D
GWP	kg CO_2-eqv	5.71E+00	7.52E-02	7.85E-03	2.50E-01	0.00E+00	-4.53E+00
ODP	kg CFC11-eqv	4.75E-07	1.76E-08	1.46E-09	9.72E-09	0.00E+00	-2.78E-07
POCP	kg C_2H_4-eqv	2.38E-03	1.76E-05	1.30E-06	3.07E-05	0.00E+00	-2.44E-03
AP	kg SO_2-eqv	3.64E-02	3.94E-04	3.08E-05	7.04E-04	0.00E+00	-2.89E-02
EP	kg PO_4^{3-}-eqv	2.78E-03	6.82E-05	5.52E-06	1.61E-04	0.00E+00	-1.51E-03
ADPM	kg Sb-eqv	1.22E-05	2.00E-07	2.37E-08	1.66E-06	0.00E+00	-1.13E-05
ADPE	MJ	5.07E+01	1.43E+00	1.20E-01	1.34E+00	0.00E+00	-4.34E+01

GWP Global warming potential; ODP Depletion potential of the stratospheric ozone layer; POCP Formation potential of tropospheric photochemical oxidants; AP Acidification potential of land and water; EP Eutrophication potential; ADPM Abiotic depletion potential for non fossil resources; ADPE Abiotic depletion potential for fossil resources

Resource use

Parameter	Unit	A1-A3	A4	C2	C3	C4	D
RPEE	MJ	4.68E+01	1.28E-02	1.20E-03	1.73E-01	0.00E+00	-2.14E+01
RPEM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TPE	MJ	4.68E+01	1.28E-02	1.20E-03	1.73E-01	0.00E+00	-2.14E+01
NRPE	MJ	6.55E+01	1.45E+00	1.22E-01	1.54E+00	0.00E+00	-5.33E+01
NRPM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TRPE	MJ	6.55E+01	1.45E+00	1.22E-01	1.54E+00	0.00E+00	-5.33E+01
SM	kg	7.19E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
W	m^3	1.36E-01	0.00E+00	4.55E-05	1.49E-03	0.00E+00	-4.06E-02

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

End of life - Waste

Parameter	Unit	A1-A3	A4	C2	C3	C4	D
HW	kg	1.30E+00	7.81E-07	7.68E-08	6.17E-03	0.00E+00	4.58E-03
NHW	kg	2.84E+00	5.44E-02	6.42E-03	1.17E+00	4.00E-02	-2.32E+00
RW	kg	3.45E-04	9.92E-06	8.19E-07	4.85E-06	0.00E+00	-2.11E-04

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

End of life - Output flow

Parameter	Unit	A1-A3	A4	C2	C3	C4	D
CR	kg	-	-	-	-	-	-
MR	kg	-	-	9.60E-01	9.33E-01	-	9.33E-01
MER	kg	-	-	-	2.70E-02	-	-
EEE	MJ	-	-	-	-	-	-
ETE	MJ	-	-	-	-	-	-

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

Reading example: 9,0 E-03 = $9,0*10^{-3}$ = 0,009

Additional Norwegian requirements

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

National production mix from import, low voltage (production of transmission lines, in addition to direct emissions and losses in grid) of applied electricity for the manufacturing prosess (A3). Here the value for the production in Norway is shown which contributes to the largest volume of the average.

Data source	Amount	Unit
ecoinvent v3.4 (April 2018)	4	g CO_2-eqv/kWh

Dangerous substances

- ☒ The product contains no substances given by the REACH Candidate list or the Norwegian priority list
- ☐ The product contains substances given by the REACH Candidate list or the Norwegian priority list that are less than 0,1 % by weight.
- ☐ The product contain dangerous substances, more then 0,1% by weight, given by the REACH Candidate List or the Norwegian Priority list, see table.
- ☐ The product contains no substances given by the REACH Candidate list or the Norwegian priority list. The product is classified as hazardous waste (Avfallsforskiften, Annex III), see table.

Name	CAS no.	Amount

Indoor environment
Not relevant

Carbon footprint
Carbon footprint has not been worked out for the product.

Bibliography

ISO 14025:2010	*Environmental labels and declarations - Type III environmental declarations - Principles and procedures*
ISO 14044:2006	*Environmental management - Life cycle assessment - Requirements and guidelines*
EN 15804:2012+A1:2013	*Sustainability of construction works - Environmental product declaration - Core rules for the product category of construction products*
ISO 21930:2007	*Sustainability in building construction - Environmental declaration of building products*
NPCR 013	*NPCR 013 version 3.0 Part B for steel and aluminium construction products.*
Sadeleer, I., Brekke, A. and Lyng, Kari-Anne (2019)	*Background report for the Environmental Product Declarations for: Hydro Extrusion Ingot 4.0, Hydro Extrusion Ingot Europe and Hydro Extrusion Ingot 75R.*

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