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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-1840-468-EN
Registration number:	NEPD-1840-768-EN
ECO Platform reference number:	-
Issue date:	05.08.2019
Valid to:	05.08.2024

Hydro 4.0 Aluminium Extrusion Ingot

Hydro Aluminium AS

Hydro

www.epd-norge.no

General information

Product:
Hydro 4.0 Aluminium

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Declaration number:
NEPD-1840-768-EN

Place of production:
Sunndalsøra, Husnes and Karmøy

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:
1 kg of aluminium extrusion ingot produced according to the certified 4.0 route

Year of study:
2019

Declared unit with option:
1 kg of aluminium extrusion ingot produced according to the certified 4.0 route, including waste handling and possible environmental loads and 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:
Andreas Brekke, Irmeline de Sadeleer, and Kari-Anne Lyng

PhD, Andreas Brekke 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, ConstructionLCA Limited
(Independent verifier approved by EPD Norway)

Approved

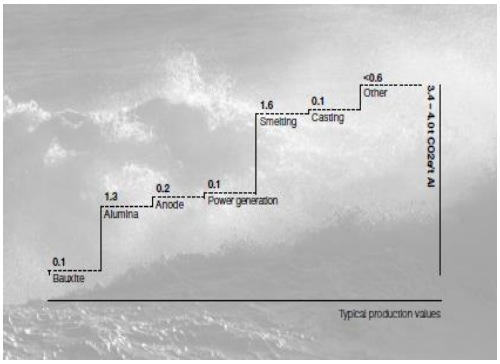
Håkon Hauan
Managing Director of EPD-Norway

Product

Product description:

This EPD covers the Aluminum under the brand Hydro 4,0. The primary Aluminum used in the products is produced based on renewable power production in Norway, ensuring maximum Carbon footprint of 4,0 tons CO_2-eq/ton Aluminium. The carbon footprint of the Aluminum is calculated on individual batches, and the methodology complies with ISO 14064-1. The calculation covers the integrated process route of Aluminum production covering Bauxite Mining, Alumina Refining, Anode production, Smelting, Power Generation and Casting.The calculation covers the integrated process route of Aluminum production covering Bauxite Mining, Alumina Refining, Anode production, Smelting, Power Generation and Casting. Other contributions: Includes: Transport of raw material, Aluminum from alloying elements, cold metal and external scrap. The calculation of the carbon footprint does not include infrastructure and a few process inputs, which explains the discrepancy between the results reported in this EPD and Hydro's reported carbon footprint. The infrastructure accounts for 0.15 tons CO_2-eq/ton Aluminium.

Product specification:



Materials	kg	%
Potlinemetal	0.9	90
Internal scrap	0.08	8
External cold metal (Russian)	0.01	1
Alloying elements	0.01	1

Examples of industries we serve: Building and Constructions, Automotive and Transport, Packaging, Electronics, HVAC&R, Consumer Goods, General Engineering and Solar.
All products are produced at Hydro's Norwegian Casthouses in Husnes, Karmøy and Sunndal in shape of Extrusion Ingots.

All products are produced according to European standards specific for each casthouse products. The products are variants within the 1000-, 3000-, 5000-and 6000-alloy groups.

For more detailed information about shapes, dimensions and tolerances: www.hydro.com/en/products/casthouse-products/

Technical data:

All products are produced according to European standards specific for each casthouse products. The products are variants within the 1000-, 3000-, 5000-, 6000- and 8000 alloy groups.
For more detailed information about shapes, dimensions and tolerances:
www.hydro.com/en/products/casthouse-products/

Market:

Europe

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

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

LCA: Calculation rules

Declared unit with option:

1 kg of aluminium extrusion ingot produced according to Hydro's certified 4.0 route. The EPD also covers modules C2-C4 and D

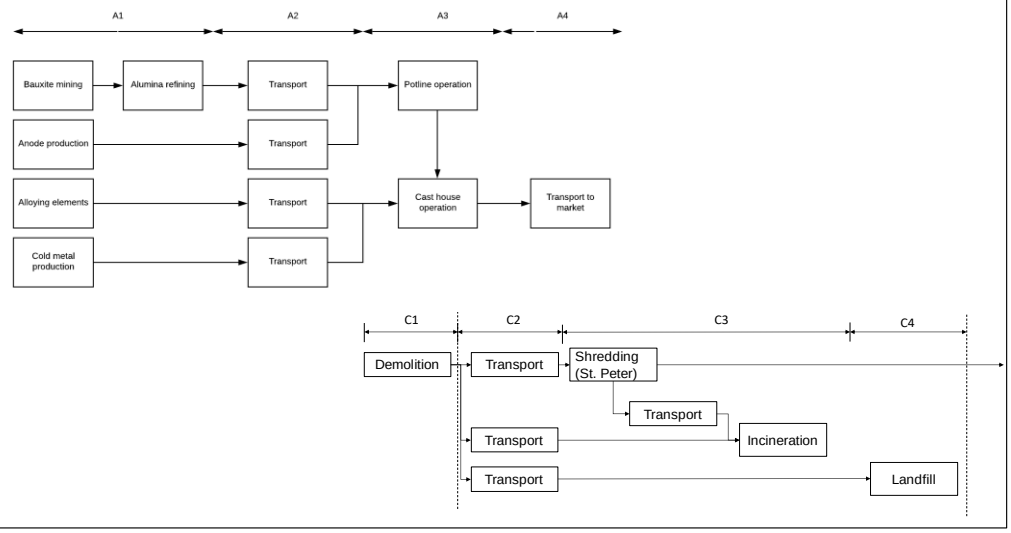
The extrusion ingot is produced in three Norwegian smelters: Husnes, Karmøy and Sunndalsøra. The results presented here is a weighted average of production volumes in 2017

System boundary:

Cradle to gate with options. The following stages have been declared: A1-A4, C2-C4, and D. Further specified in the flow sheet on the next page

Module D covers the potential benefits from recycling of Hydro Aluminium Extrusion Ingot 4.0 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.

Flow sheet for Hydro 4.0 Aluminium Extrusion Ingot



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.

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.

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.

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 to a location in central Europe. 400 km from port to market is chosen as a realistic distance.

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 (apporximately 96%) and recycled (approximately 93% of the collected aluminium). The aluminium is transported to a material processing plant where different materials, including metals

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**

* 70 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 "energy recovery" 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	933

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. If the original ingot contained any recycled aluminium, this would have been 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 0% (ADPM) as the smallest and 7% (RPEE) 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	MNR	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	4.00E+00	5.53E-02	7.88E-03	2.51E-01	0.00E+00	-4.91E+00
ODP	kg CFC11-eqv	3.61E-07	1.81E-08	1.46E-09	9.72E-09	0.00E+00	-3.01E-07
POCP	kg C_2H_4-eqv	1.06E-03	1.98E-05	1.30E-06	3.07E-05	0.00E+00	-2.64E-03
AP	kg SO_2-eqv	1.98E-02	4.93E-04	3.08E-05	7.04E-04	0.00E+00	-3.13E-02
EP	kg PO_4^{3-}-eqv	1.46E-03	5.28E-05	5.52E-06	1.61E-04	0.00E+00	-1.63E-03
ADPM	kg Sb-eqv	2.62E-06	7.22E-08	2.37E-08	1.66E-06	0.00E+00	-1.23E-05
ADPE	MJ	3.22E+01	1.45E+00	1.20E-01	1.34E+00	0.00E+00	-4.71E+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	5.70E+01	1.07E-02	1.20E-03	1.73E-01	0.00E+00	-2.32E+01
RPEM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TPE	MJ	5.70E+01	1.07E-02	1.20E-03	1.73E-01	0.00E+00	-2.32E+01
NRPE	MJ	3.36E+01	1.46E+00	1.22E-01	1.54E+00	0.00E+00	-5.78E+01
NRPM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TRPE	MJ	3.36E+01	1.46E+00	1.22E-01	1.54E+00	0.00E+00	-5.78E+01
SM	kg	0.00E+00	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	2.24E-01	2.18E-04	2.28E-05	7.44E-04	0.00E+00	-4.40E-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	3.02E-02	6.25E-07	7.68E-08	6.17E-03	0.00E+00	4.96E-03
NHW	kg	1.43E+00	5.43E-02	6.42E-03	1.17E+00	4.00E-02	-2.51E+00
RW	kg	1.64E-04	1.02E-05	8.19E-07	4.85E-06	0.00E+00	-2.29E-04

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

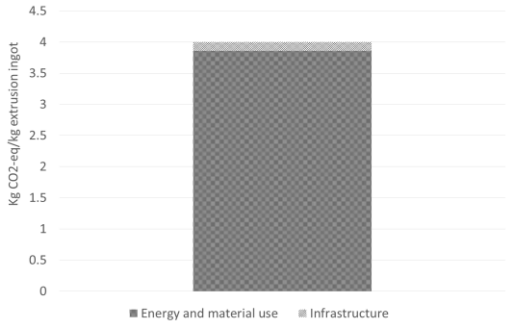
End of life - Output flow

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

The contribution of infrastructure to the results for GWP:



Additional Norwegian requirements

Greenhouse gas emission from the use of electricity in the manufacturing phase
Hydro aluminium's manufacturing plants in Norway are situated close to hydro power stations and their numbers on power consumption is based on high voltage electricity directly delivered to the plant.

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.

Indoor environment
Not relevant

Carbon footprint
The product is marketed with a carbon footprint calculated with a methodology deviating from ISO 15804, and no carbon footprint has been produced with EPD methodology

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*
LCI/LCA Report	*Background report for Hydro Extrusion Ingot 4.0. Report no: OR ??.19*
NPCR 013	*NPCR 013 Version 3.0 Part B for steel and aluminium construction products*

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