ENVIRONMENTAL PRODUCT DECLARATION

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

Anodised sheet for architectural cladding

Owner of the declaration:

Publisher and Programme holder:	EUROPEAN ALUMINIUM
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GENERAL INFORMATION

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Publisher and Programme holder EUROPEAN ALUMINIUM Avenue des Nerviens 85 1040 Etterbeek – Belgium VAT : BE 0480.720.716 info@european-aluminium.eu www.european-aluminium.eu	EUROPEAN ALUMINIUM AISBL Avenue des Nerviens 85 1040 Brussels, Belgium Paul Voss, Director General
The declaration is based on the Product Category Rules	European Aluminium General Programme Instructions version 3, 23rd of September 2020
Declared Unit	1 m^2 of Anodised sheet for architectural cladding
Scope of the Environmental Product Declaration	This EPD covers 1 m^2 of Anodised sheet for architectural cladding type TECTURA ALFHA1 PRE. These EPD results have been calculated from an LCA tool for EPD, based on the LCA for expert database, initially realised by Thinkstep in 2013 and updated by Ecoinnovazione in 2019. Among the product family, one representative product has been selected and corresponding EPD results have been calculated based on specific bill of materials. The results generated by the collective tool can be considered as a good proxy to model Anodised sheet for architectural cladding produced by Speira. The EPD may be used in a B2B context within the European Market.
Liability	The owner of the declaration is liable for the underlying manufacturing information and European Aluminium is not liable in this respect.
Disclaimers	This EPD cannot be used as a guarantee of the recycled content of the actual product sold on the market. A specific declaration may be asked from the supplier. The use of this EPD within BIM tools is in principle limited to the products explicitly included in the EPD. The scaling of results to model similar products can only be done if justified and transparently reported in the project report. Any responsibility regarding the misuse of this EPD by third parties is not accepted by the Programme Operator.

Verification	Verifier
EN15804:2012 +A2:2019 serves as core PCR completed by European Aluminium PCR 03/2020	
Verification of the EPD by an independent third party in accordance with ISO 14025	
☐ Internally	☒ Externally

1 PRODUCT

1.1 Product description and applications

This Environmental Product Declaration (EPD) is for business-to-business communication. The product object of the EPD is TECTURA ALFHA1 PRE. ALFHA1 is a unique 5005 quality especially developed for façade cladding. It achieves excellent results in a wide variety of anodization processes, combining a perfect, uniform, silver-shiny surface with superior flatness and bendability – just the right solution for high demanding applications. ALFHA1 is manufactured with specialized and extremely narrow process parameters, making it extremely reproducible even across different batches.

The representative products are anodised sheets for industrial cladding of 1, 2 and 3 mm of Aluminium sheet thickness and 10, 15 and 20 µm of anodic layer thickness. EPD results have been calculated for 9 representative products, which are detailed in Table 1

Table 1 Details representative products

ID	Name	Model	Aluminum sheet thickness (mm)	Anodic layer thickness (µm)
1	TECTURA ALFHA1 PRE10	Anodised sheet for architectural cladding	1	10
2	TECTURA ALFHA1 PRE15	Anodised sheet for architectural cladding	1	15
3	TECTURA ALFHA1 PRE20	Anodised sheet for architectural cladding	1	20
4	TECTURA ALFHA1 PRE10	Anodised sheet for architectural cladding	2	10
5	TECTURA ALFHA1 PRE15	Anodised sheet for architectural cladding	2	15
6	TECTURA ALFHA1 PRE20	Anodised sheet for architectural cladding	2	20
7	TECTURA ALFHA1 PRE10	Anodised sheet for architectural cladding	3	10
8	TECTURA ALFHA1 PRE15	Anodised sheet for architectural cladding	3	15
9	TECTURA ALFHA1 PRE20	Anodised sheet for architectural cladding	3	20

1.2 Technical Data

TECTURA ALFHA1 PRE® anodised solid aluminium further combines excellent flatness with good deformation properties; is corrosion- UV- and scratch resistant; non-combustible and 100% recyclable.

According to the client requirements, anodised coils and sheets are produced from other anodising qualities made of alloy series EN-AW 1xxx (e.g. 1050A), 3xxx, 5xxx (e.g. 5005, 5754) or 6xxx (e.g. 6061) for which the precise composition and microstructure are optimized to satisfy the anodising

requirements. On average, these anodised coils and sheets contain at least 95%w of aluminium. The technical data related to these anodised aluminium coils and sheets are publicly available or can be provided by Speira GmbH.

For the most up-to-date values of the technical data, please refer to the product specifications available on the Speira website (www.speira.com).

Most relevant standards for applications of aluminium sheet products in buildings are EN 485-2, EN 507, EN 508-2, EN 573-3, EN 1396, EN 13501-1, EN 14782, EN 14783, EN 13964/+A1. Please refer to the latest version of those standards.

1.3 Process description

The anodised sheet is produced using an aluminium sheet that undergoes a further anodization process which increases the resistance to atmospheric corrosion. Other auxiliary materials are used, as for example some acids (sulphuric acid) or alkalis (sodium hydroxide). The aluminium production and the rolling are described in European Aluminium's environmental profile report.

The production phase includes mainly the following steps:

1. Aluminium production and rolling
2. Continuous coil anodising

The main background production processes are reported in Figure 1.

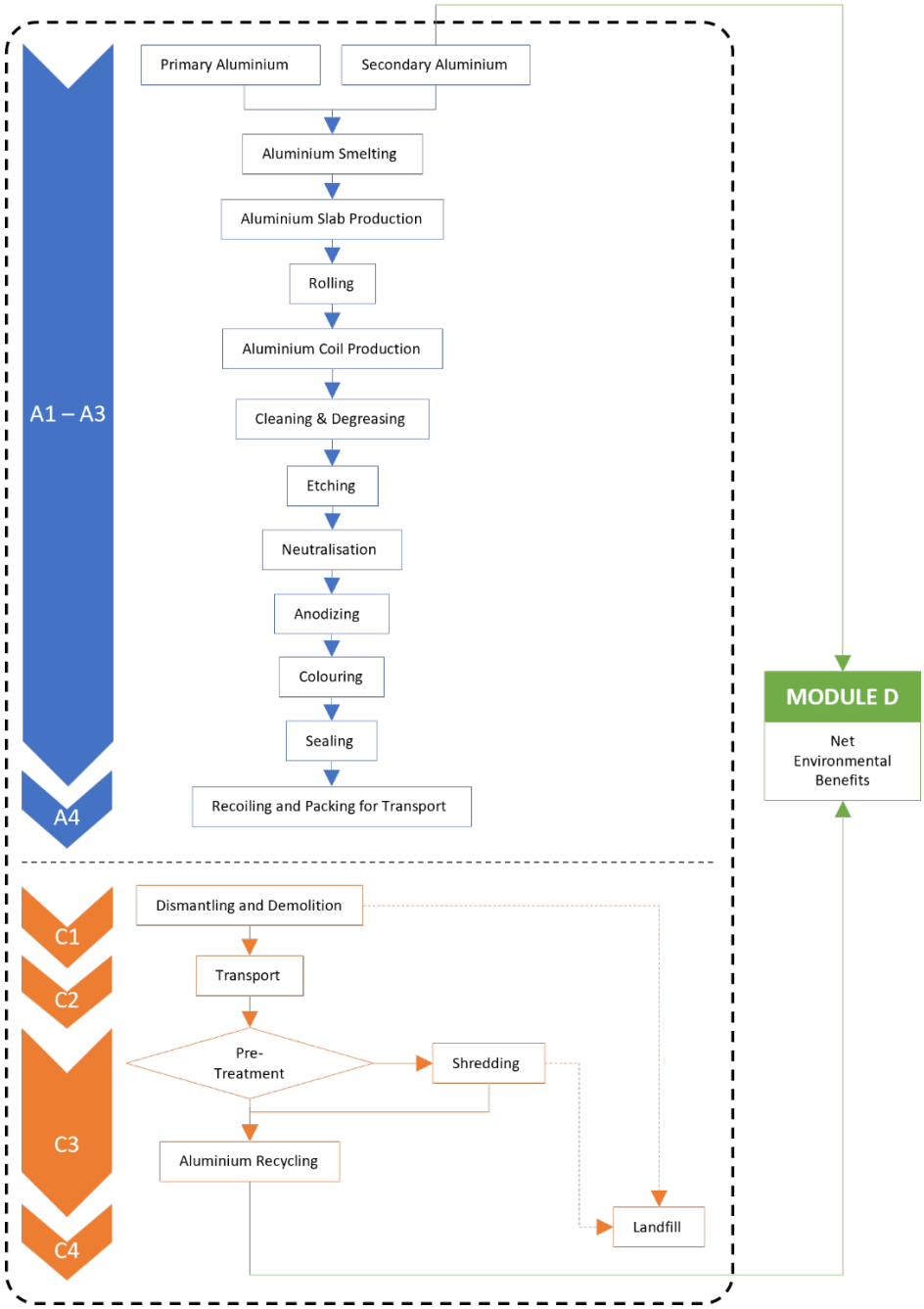

Figure 1 Main production processes and components of the anodised sheet

The upstream aluminium processes have been modelled using European Aluminium LCI datasets for the primary aluminium production, recycling and remelting as described in the European Aluminium Environmental profile report 2018.

At the end-of-life stage, the coil coated aluminium sheets should be specifically dismantled and collected in order to be treated since the aluminium can be efficiently recycled. After having been collected, the coil coated aluminium sheets are treated through shredding and sorting.

1.4 Health and safety aspects during production and installation

Continuous anodising requires the use of acid and alkaline solutions as well as some organometallic salt for colouring purposes. All those processes are very well controlled and workers are not in direct contacts with those solutions or related emissions. Waste solutions are systematically collected and treated. There are no relevant aspects of occupational health and safety during the further processing and installation of the aluminium coil and sheet. Under normal installation, no measurable environmental impacts can be associated to use of anodised aluminium coil. There is no release of any substance from the REACH SVHC list during further processing or during the use phase.

1.5 Reference service life

Since the use phase is not modelled, no specific information can be given about the Reference Service Life. In normal use, aluminium building products are not altered or corroded over time. A regular cleaning (e.g. once a year) of the product suffices to secure a long service life. However, the use of highly alkaline (pH >10) or highly acidic (pH < 4) cleaning solutions should be avoided. In practice, a service life of 50 years can be assumed in normal use for such application.

2 LCA – CALCULATION RULES

2.1 Declared unit & bill of materials

The Bill of Materials of the analysed product is reported in Table 2. The declared unit corresponds to 1 m2 of coil anodised aluminium sheet.

Table 2 Bill of materials (kg) of the declared unit for the product

Sheet thickness (mm)	Aluminium mass (kg)
1	2.70
2	5.40
3	8.10

2.2 System boundary

This EPD is from cradle to gate with modules C1-C4 and module D, as reported in Table 3.

The production stage (modules A1-A3) includes processes that provide materials and energy input for the system, manufacturing, and transport processes up to the factory gate, as well as waste processing. For the end-of-life, the default scenario defined in the General Product Instructions and detailed in 3.2 is applied.

Table 3 Modules declared

Production			Installation		Use stage							End-of-Life				Next product system
Raw material	Transport	Manufacturing	Transport to	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy	Operational water	Deconstruction	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	ND	ND	ND	ND	ND	ND	ND	ND	X	X	X	X	X

Note: ND: Not Declared; X: Module included in the LCA.

Module A4 is declared for a distance of 1 km to give the possibility to adjust the resulting Environmental impacts depending on the specific distance at hand.

2.3 Energy mix

In the model developed the background electricity mix used is the European electricity mix (EU-28 Electricity grid mix (2019)). For details about the electricity modelling in the datasets: production of primary aluminium, extrusion, rolling and recycling please refer to the Environmental Profile Report 2018.

2.4 Allocation

The scrap which are produced along the production chain are recycled into the same production chain and are modelled as “closed-loop” within Module A. This recycling loop has been modelled in the LCA for expert model so that the Anodised sheet for architectural cladding is the only product exiting the gate. Hence, the production process does not deliver any co-products.

At the end-of-life stage, the Anodised sheet for architectural cladding is sent to an end-of-life treatment which is modelled according to the scenario reported in 3.2. The environmental burdens and benefits of recycling and energy recovery are calculated in module D accordingly.

2.5 Assumptions and Cut-off criteria

The aluminium sheets are composed of a mix of 60% primary aluminium and 40% recycled aluminium. Such mix represents the typical sourcing of aluminium in Europe, all markets included. For the primary aluminium, a primary aluminium ingot consumption mix was considered (European production + net fraction of imports into Europe). Alloying elements were not considered, and a pure aluminium sheet has been assumed as a proxy.

2.6 Data quality

Representativeness

Technological: All primary and secondary data were modelled to be specific to the technologies or technology mixes under study. Where technology-specific data were unavailable, proxy data were used. For the aluminium production, extrusion profiles and recycling, the datasets described in the Environmental Profile Report 2018 of European Aluminium have been used and integrated with the EPD profile of the low carbon primary aluminium. The modelling reflects the specific BoM of the analysed products. Technological representativeness is considered as being very good.

Geographical: All primary data were collected specifically to the countries under study. Regarding secondary data, where EU region-specific data were unavailable, DE datasets were used. For the aluminium production, extrusion profiles and recycling, the datasets described in the Environmental Profile Report 2018 of European Aluminium have been used. Geographical representativeness is considered as being good.

Temporal: Primary data refer to the year 2021, and all secondary data come from the LCA for expert version 2021.2, including those on aluminium production, which are the most recent ones as described in the Environmental Profile Report 2018 of European Aluminium.

Completeness

All known operating data was taken into consideration in the analysis. Based on earlier studies conducted by European Aluminium, it can be assumed that the ignored processes or flows contribute to much less than 5% of the impact categories under review.

The process chain is considered sufficiently complete regarding the goal and scope of this study.

Overall, the data quality can be described as good.

2.7 Software and databases

These EPD results have been calculated from an LCA tool for EPD, based on the LCA for expert database. Currently, the EPD software is using the software LCA for expert version 2021.2.

2.8 Comparability

As a general rule, a comparison or evaluation of EPD data may be possible when all of the data to be compared has been drawn up in accordance with EN 15804 and the building context or product-specific characteristics are taken into consideration.

3 LCA – SCENARIOS AND ADDITIONAL INFORMATION

3.1 Scenario for additional modules

Module A4 is taken into consideration in this Declaration, and it has been modelled according to the information reported in Table 4.

Table 4 Module A4 – Transport to the building site

Scenario information	Unit (expressed per DU)
Fuel type and consumption of vehicle or vehicle type used for transport e.g. long-distance truck, boat, etc.	Truck-trailer, Euro 4, 34 - 40t gross weight / 27t payload capacity, diesel driven
Distance	1 km
Capacity utilisation (including empty returns)	61 %
Bulk density of transported products	-
Volume capacity utilisation factor (factor = 1 or <1 or ≥1 for compressed or nested packaged products)	Not applicable

3.2 Scenario for Mod. C1-C4

The default scenario for the end-of-life of the Anodised sheet for architectural cladding, as reported in the General Programme Instructions, is the following:

- collection rate: 99%;
- shredding efficiency: 99%;
- scrap recycled through refining process: 96,5%
- overall aluminium recycling rate: 95%

Table 5 reports the main parameters of the end-of-life scenarios for the main materials and components.

Table 5 Parameters of the end-of-life scenarios for the main materials and components, related to the DU

Processes	Unit (expressed per FU or DU of components, products, or materials and by type of material)	TECTURA ALFHA1 PRE – 1 mm of aluminium sheets thickness and 10, 15, 20 µm of anodic layer thickness
Collection process	Kg collected separately	Aluminium sheet: 2.67 kg
Recovery system	Kg for recycling	Aluminium sheet: 2.65 kg
Disposal	Kg to landfill	Aluminium sheet: 0.03 kg

Table 6 Parameters of the end-of-life scenarios for the main materials and components, related to the DU

Processes	Unit (expressed per FU or DU of components, products, or materials and by type of material)	TECTURA ALFHA1 PRE – 2 mm of aluminium sheets thickness and 10, 15, 20 µm of anodic layer thickness
Collection process	Kg collected separately	Aluminium sheet: 5.35 kg
Recovery system	Kg for recycling	Aluminium sheet: 5.29 kg
Disposal	Kg to landfill	Aluminium sheet: 0.05 kg

Table 7 Parameters of the end-of-life scenarios for the main materials and components, related to the DU

Processes	Unit (expressed per FU or DU of components, products, or materials and by type of material)	TECTURA ALFHA1 PRE – 3 mm of aluminium sheets thickness and 10, 15, 20 µm of anodic layer thickness
Collection process	Kg collected separately	Aluminium sheet: 8.02 kg
Recovery system	Kg for recycling	Aluminium sheet: 7.94 kg
Disposal	Kg to landfill	Aluminium sheet: 0.08 kg

Note to Tables 5, 6 e 7:

Material collected separately: This amount refers to the waste stream collected separately per material before being subjected to shredding

Material for recycling: This amount refers to the waste stream sent to recycling per material after the shredding and/or sorting process.

Material for final deposition – aluminium: this amount includes the aluminium not collected separately and the shredding losses.

3.3 Scenario Mod. D

Module D includes:

- a transport from the scrap dealers to the recycling plants, considering an average distance of 200 km;
- recycling of Aluminium through refining;
- a net credit for the avoided production of primary aluminium;

The calculation of module D has been implemented in line with the General Programme Instructions of European Aluminium, thus based on the difference between the scrap used at the input and output side. In some cases, this may result in environmental burdens instead of environmental benefits if the product system is a net consumer of valuable secondary material.

3.4 Additional environmental information

In case of fire, aluminium is a non-combustible construction material (European Fire Class A1) in accordance with Commission Decision 96/603/EC (later amended by European Commission Decision 2000/605/EC to follow the new classification system defined in Commission Decision 2000/147/EC, where Class A1 substituted the former Class A), and does therefore not make any contribution to fire.

4 LCA RESULTS – ANODISED SHEET FOR ARCHITECTURAL CLADDING – 1 mm sheet thickness; 10, 15, 20 µm anodic layer

4.1 Core Environmental impacts indicators

Table 8 Core Environmental impacts indicators for 1 m² Anodised sheet for architectural cladding – 1 mm of aluminium sheet thickness and 10 µm of anodic layer thickness

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
GWP - total	kg CO_2 eq.	1.95E+01	1.67E-04	3.61E-01	3.32E-02	8.58E-02	7.91E-04	-1.28E+01
GWP – fossil	kg CO_2 eq.	1.94E+01	1.66E-04	3.57E-01	3.31E-02	8.50E-02	8.12E-04	-1.28E+01
GWP – biogenic	kg CO_2 eq.	5.21E-02	-6.16E-07	3.81E-03	-1.23E-04	5.28E-04	-2.36E-05	-2.67E-02
GWP - luluc	kg CO_2 eq.	4.89E-03	1.00E-06	6.40E-05	1.99E-04	2.07E-04	2.39E-06	-2.17E-03
ODP	kg CFC 11 eq.	1.52E-10	2.93E-17	6.43E-12	5.82E-15	2.67E-15	3.16E-18	-9.60E-11
AP	mol H^+ eq.	9.22E-02	1.15E-06	7.66E-04	2.29E-04	1.46E-04	5.79E-06	-7.43E-02
EP - freshwater	kg PO_4^{3-} eq.	3.76E-05	3.90E-10	1.31E-06	7.75E-08	3.60E-07	1.36E-09	-5.67E-06
EP - marine	kg N eq.	1.53E-02	5.76E-07	1.88E-04	1.15E-04	4.09E-05	1.50E-06	-1.07E-02
EP - terrestrial	mol N eq.	1.65E-01	6.36E-06	1.97E-03	1.27E-03	4.27E-04	1.65E-05	-1.16E-01
POCP	kg NMVOC eq.	4.52E-02	1.09E-06	5.04E-04	2.17E-04	1.03E-04	4.55E-06	-3.22E-02
ADP-MM (**)	kg Sb eq.	1.19E-05	1.18E-11	5.43E-08	2.36E-09	3.23E-08	7.67E-11	-2.87E-06
ADPF (**)	MJ	2.68E+02	2.27E-03	7.39E+00	4.51E-01	1.08E+00	1.08E-02	-1.57E+02
WDP (**)	m^3	4.28E+00	8.70E-07	7.77E-02	1.73E-04	1.91E-03	8.72E-05	-1.90E+00

Note: GWP – Global Warming Potential; ODP – Ozone Depletion; AP – acidification potential for soil and water; EP – Eutrophication potential; POCP – formation potential of tropospheric ozone; ADP - MM – abiotic depletion potential for non fossil resources; ADPF – Abiotic depletion potential for fossil resources; WDP – Water deprivation potential.

(**) **Disclaimer**: the results of this Environmental impacts indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

Table 9 Core Environmental impacts indicators for 1 m^2 Anodised sheet for architectural cladding - 1 mm of aluminium sheet thickness and 15 µm of anodic layer thickness

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
GWP - total	kg CO_2 eq.	1.96E+01	1.67E-04	3.61E-01	3.32E-02	8.58E-02	7.91E-04	-1.28E+01
GWP – fossil	kg CO_2 eq.	1.96E+01	1.66E-04	3.57E-01	3.31E-02	8.50E-02	8.12E-04	-1.28E+01
GWP – biogenic	kg CO_2 eq.	5.27E-02	-6.16E-07	3.81E-03	-1.23E-04	5.28E-04	-2.36E-05	-2.67E-02
GWP - luluc	kg CO_2 eq.	4.90E-03	1.00E-06	6.40E-05	1.99E-04	2.07E-04	2.39E-06	-2.17E-03
ODP	kg CFC 11 eq.	1.53E-10	2.93E-17	6.43E-12	5.82E-15	2.67E-15	3.16E-18	-9.60E-11
AP	mol H^+ eq.	9.23E-02	1.15E-06	7.66E-04	2.29E-04	1.46E-04	5.79E-06	-7.43E-02
EP - freshwater	kg PO_4^{3-} eq.	3.78E-05	3.90E-10	1.31E-06	7.75E-08	3.60E-07	1.36E-09	-5.67E-06
EP - marine	kg N eq.	1.53E-02	5.76E-07	1.88E-04	1.15E-04	4.09E-05	1.50E-06	-1.07E-02
EP - terrestrial	mol N eq.	1.66E-01	6.36E-06	1.97E-03	1.27E-03	4.27E-04	1.65E-05	-1.16E-01
POCP	kg NMVOC eq.	4.54E-02	1.09E-06	5.04E-04	2.17E-04	1.03E-04	4.55E-06	-3.22E-02
ADP-MM (**)	kg Sb eq.	1.19E-05	1.18E-11	5.43E-08	2.36E-09	3.23E-08	7.67E-11	-2.87E-06
ADPF (**)	MJ	2.70E+02	2.27E-03	7.39E+00	4.51E-01	1.08E+00	1.08E-02	-1.57E+02
WDP (**)	m^3	4.29E+00	8.70E-07	7.77E-02	1.73E-04	1.91E-03	8.72E-05	-1.90E+00

Note: GWP – Global Warming Potential; ODP – Ozone Depletion; AP – acidification potential for soil and water; EP – Eutrophication potential; POCP – formation potential of tropospheric ozone; ADP - MM – abiotic depletion potential for non fossil resources; ADPF – Abiotic depletion potential for fossil resources; WDP – Water deprivation potential.

(**) **Disclaimer**: the results of this Environmental impacts indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

Table 10 Core Environmental impacts indicators for 1 m² Anodised sheet for architectural cladding – 1 mm of aluminium sheet thickness and 20 µm of anodic layer thickness

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
GWP - total	kg CO_2 eq.	1.99E+01	1.67E-04	3.61E-01	3.32E-02	8.58E-02	7.91E-04	-1.28E+01
GWP – fossil	kg CO_2 eq.	1.99E+01	1.66E-04	3.57E-01	3.31E-02	8.50E-02	8.12E-04	-1.28E+01
GWP – biogenic	kg CO_2 eq.	5.50E-02	-6.16E-07	3.81E-03	-1.23E-04	5.28E-04	-2.36E-05	-2.67E-02
GWP - luluc	kg CO_2 eq.	4.92E-03	1.00E-06	6.40E-05	1.99E-04	2.07E-04	2.39E-06	-2.17E-03
ODP	kg CFC 11 eq.	1.57E-10	2.93E-17	6.43E-12	5.82E-15	2.67E-15	3.16E-18	-9.60E-11
AP	mol H^+ eq.	9.28E-02	1.15E-06	7.66E-04	2.29E-04	1.46E-04	5.79E-06	-7.43E-02
EP - freshwater	kg PO_4^{3-} eq.	3.85E-05	3.90E-10	1.31E-06	7.75E-08	3.60E-07	1.36E-09	-5.67E-06
EP - marine	kg N eq.	1.54E-02	5.76E-07	1.88E-04	1.15E-04	4.09E-05	1.50E-06	-1.07E-02
EP - terrestrial	mol N eq.	1.67E-01	6.36E-06	1.97E-03	1.27E-03	4.27E-04	1.65E-05	-1.16E-01
POCP	kg NMVOC eq.	4.57E-02	1.09E-06	5.04E-04	2.17E-04	1.03E-04	4.55E-06	-3.22E-02
ADP-MM (**)	kg Sb eq.	1.19E-05	1.18E-11	5.43E-08	2.36E-09	3.23E-08	7.67E-11	-2.87E-06
ADPF (**)	MJ	2.76E+02	2.27E-03	7.39E+00	4.51E-01	1.08E+00	1.08E-02	-1.57E+02
WDP (**)	m^3	4.33E+00	8.70E-07	7.77E-02	1.73E-04	1.91E-03	8.72E-05	-1.90E+00

Note: GWP – Global Warming Potential; ODP – Ozone Depletion; AP – acidification potential for soil and water; EP – Eutrophication potential; POCP – formation potential of tropospheric ozone; ADP - MM – abiotic depletion potential for non fossil resources; ADPF – Abiotic depletion potential for fossil resources; WDP – Water deprivation potential.

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4.1.1 Additional Environmental impacts indicators

Table 11 Additional Environmental impacts indicators for 1 m² Anodised sheet for architectural cladding – 1 mm of aluminium sheet thickness and 10 µm of anodic layer thickness

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
Particular Matter emissions	Disease incidence	1.21E-06	3.82E-12	6.51E-09	7.61E-10	1.08E-09	7.19E-11	-1.04E-06
Ionising radiation - human health (*)	[kBq U235 eq.]	3.18E+00	2.44E-07	1.94E-01	4.87E-05	9.98E-03	1.19E-05	-1.79E+00
Eco-toxicity (freshwater) (**)	[CTUe]	8.54E+01	1.69E-03	3.28E+00	3.36E-01	4.29E-01	6.14E-03	-5.17E+01
Human toxicity - cancer effects (**)	[CTUh]	4.46E-09	3.37E-14	1.09E-10	6.70E-12	5.93E-11	9.06E-13	-3.22E-09
Human toxicity - non-cancer effects (**)	[CTUh]	1.34E-07	1.81E-12	2.70E-09	3.61E-10	4.89E-10	1.00E-10	-9.28E-08
Land Use related impacts/ Soil quality (**)	dimensionless	2.98E+01	8.05E-04	2.90E+00	1.60E-01	5.32E-01	2.18E-03	-4.54E+00

(*) **Disclaimer**: This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

(**) **Disclaimer**: the results of this Environmental impacts indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

Table 12 Additional Environmental impacts indicators for 1 m² Anodised sheet for architectural cladding - 1 mm of aluminium sheet thickness and 15 µm of anodic layer thickness

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
Particular Matter emissions	Disease incidence	1.21E-06	3.82E-12	6.51E-09	7.61E-10	1.08E-09	7.19E-11	-1.04E-06
Ionising radiation - human health (*)	[kBq U235 eq.]	3.20E+00	2.44E-07	1.94E-01	4.87E-05	9.98E-03	1.19E-05	-1.79E+00
Eco-toxicity (freshwater) (**)	[CTUe]	8.58E+01	1.69E-03	3.28E+00	3.36E-01	4.29E-01	6.14E-03	-5.17E+01
Human toxicity - cancer effects (**)	[CTUh]	4.49E-09	3.37E-14	1.09E-10	6.70E-12	5.93E-11	9.06E-13	-3.22E-09
Human toxicity - non-cancer effects (**)	[CTUh]	1.35E-07	1.81E-12	2.70E-09	3.61E-10	4.89E-10	1.00E-10	-9.28E-08
Land Use related impacts/ Soil quality (**)	dimensionless	3.02E+01	8.05E-04	2.90E+00	1.60E-01	5.32E-01	2.18E-03	-4.54E+00

(*) **Disclaimer**: This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

(**) **Disclaimer**: the results of this Environmental impacts indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

Table 13 Additional Environmental impacts indicators for 1 m² Anodised sheet for architectural cladding – 1 mm of aluminium sheet thickness and 20 µm of anodic layer thickness

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
Particular Matter emissions	Disease incidence	1.21E-06	3.82E-12	6.51E-09	7.61E-10	1.08E-09	7.19E-11	-1.04E-06
Ionising radiation - human health (*)	[kBq U235 eq.]	3.31E+00	2.44E-07	1.94E-01	4.87E-05	9.98E-03	1.19E-05	-1.79E+00
Eco-toxicity (freshwater) (**)	[CTUe]	8.77E+01	1.69E-03	3.28E+00	3.36E-01	4.29E-01	6.14E-03	-5.17E+01
Human toxicity - cancer effects (**)	[CTUh]	4.56E-09	3.37E-14	1.09E-10	6.70E-12	5.93E-11	9.06E-13	-3.22E-09
Human toxicity - non-cancer effects (**)	[CTUh]	1.37E-07	1.81E-12	2.70E-09	3.61E-10	4.89E-10	1.00E-10	-9.28E-08
Land Use related impacts/ Soil quality (**)	dimensionless	3.18E+01	8.05E-04	2.90E+00	1.60E-01	5.32E-01	2.18E-03	-4.54E+00

(*) **Disclaimer**: This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.
(**) **Disclaimer**: the results of this Environmental impacts indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

4.2 Resource use

Table 14 Resource use for 1 m² Anodised sheet for architectural cladding - 1 mm of aluminium sheet thickness and 10 µm of anodic layer thickness

Parameter	Unit	A1-A3	A4	C1	C2	C3	C4	D
PERE	MJ	1.05E+02	1.47E-04	4.39E+00	2.92E-02	5.81E-01	1.45E-03	-7.12E+01
PERM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	1.05E+02	1.47E-04	4.39E+00	2.92E-02	5.81E-01	1.45E-03	-7.12E+01
PENRE	MJ	2.68E+02	2.27E-03	7.39E+00	4.52E-01	1.08E+00	1.08E-02	-1.57E+02
PENRM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	2.68E+02	2.27E-03	7.39E+00	4.52E-01	1.08E+00	1.08E-02	-1.57E+02
SM	kg	1.17E+00	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	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	2.57E-01	1.34E-07	3.54E-03	2.66E-05	3.13E-04	2.66E-06	-1.80E-01

Note: PERE – use of renewable primary energy resources used as raw materials; PERT – Total use of renewable primary energy resources; PENRE – use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM – use of non-renewable primary energy resources used as raw materials; PENRT – Total use of non-renewable primary energy resources; SM – Use of secondary materials; RSF – Use of renewable secondary fuels; NRSF – use of non-renewable secondary fuels; FW – use of net fresh water.

Table 15 Resource use for 1 m² Anodised sheet for architectural cladding - 1 mm of aluminium sheet thickness and 15 µm of anodic layer thickness

Parameter	Unit	A1-A3	A4	C1	C2	C3	C4	D
PERE	MJ	1.05E+02	1.47E-04	4.39E+00	2.92E-02	5.81E-01	1.45E-03	-7.12E+01
PERM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	1.05E+02	1.47E-04	4.39E+00	2.92E-02	5.81E-01	1.45E-03	-7.12E+01
PENRE	MJ	2.70E+02	2.27E-03	7.39E+00	4.52E-01	1.08E+00	1.08E-02	-1.57E+02
PENRM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	2.70E+02	2.27E-03	7.39E+00	4.52E-01	1.08E+00	1.08E-02	-1.57E+02
SM	kg	1.17E+00	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	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	2.58E-01	1.34E-07	3.54E-03	2.66E-05	3.13E-04	2.66E-06	-1.80E-01

Note: PERE – use of renewable primary energy resources used as raw materials; PERT – Total use of renewable primary energy resources; PENRE – use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM – use of non-renewable primary energy resources used as raw materials; PENRT – Total use of non-renewable primary energy resources; SM – Use of secondary materials; RSF – Use of renewable secondary fuels; NRSF – use of non-renewable secondary fuels; FW – use of net fresh water.

Table 16 Resource use for 1 m² Anodised sheet for architectural cladding - 1 mm of aluminium sheet thickness and 20 µm of anodic layer thickness

Parameter	Unit	A1-A3	A4	C1	C2	C3	C4	D
PERE	MJ	1.08E+02	1.47E-04	4.39E+00	2.92E-02	5.81E-01	1.45E-03	-7.12E+01
PERM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	1.08E+02	1.47E-04	4.39E+00	2.92E-02	5.81E-01	1.45E-03	-7.12E+01
PENRE	MJ	2.76E+02	2.27E-03	7.39E+00	4.52E-01	1.08E+00	1.08E-02	-1.57E+02
PENRM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	2.76E+02	2.27E-03	7.39E+00	4.52E-01	1.08E+00	1.08E-02	-1.57E+02
SM	kg	1.17E+00	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	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	2.60E-01	1.34E-07	3.54E-03	2.66E-05	3.13E-04	2.66E-06	-1.80E-01

Note: PERE – use of renewable primary energy resources used as raw materials; PERT – Total use of renewable primary energy resources; PENRE – use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM – use of non-renewable primary energy resources used as raw materials; PENRT – Total use of non-renewable primary energy resources; SM – Use of secondary materials; RSF – Use of renewable secondary fuels; NRSF – use of non-renewable secondary fuels; FW – use of net fresh water.

4.3 Output flows, waste categories

Table 17 Output flows, waste categories for 1 m² Anodised sheet for architectural cladding - 1 mm of aluminium sheet thickness and 10 µm of anodic layer thickness

Parameter	Unit	A1-A3	A4	C1	C2	C3	C4	D
HWD	kg	1.53E-07	6.08E-15	-5.74E-10	1.21E-12	8.36E-10	1.14E-12	-1.11E-07
NHWD	kg	4.48E+00	3.31E-07	5.38E-03	6.58E-05	1.11E-03	5.38E-02	-3.83E+00
RWD	kg	1.78E-02	2.37E-09	1.17E-03	4.72E-07	1.01E-04	1.13E-07	-9.36E-03
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.65E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EET	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Note: HWD – hazardous waste disposed; NHWD – Non-hazardous waste disposed; RWD – Radioactive waste disposed; CRU – Components for re-use; MFR – Materials for recycling; MER – Materials for energy recovery; EEE – Exported electrical energy; EET – Exported thermal energy

Table 18 Output flows, waste categories for 1 m² Anodised sheet for architectural cladding - 1 mm of aluminium sheet thickness and 15 µm of anodic layer thickness

Parameter	Unit	A1-A3	A4	C1	C2	C3	C4	D
HWD	kg	1.53E-07	6.08E-15	-5.74E-10	1.21E-12	8.36E-10	1.14E-12	-1.11E-07
NHWD	kg	4.48E+00	3.31E-07	5.38E-03	6.58E-05	1.11E-03	5.38E-02	-3.83E+00
RWD	kg	1.80E-02	2.37E-09	1.17E-03	4.72E-07	1.01E-04	1.13E-07	-9.36E-03
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.65E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EET	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Note: HWD – hazardous waste disposed; NHWD – Non-hazardous waste disposed; RWD – Radioactive waste disposed; CRU – Components for re-use; MFR – Materials for recycling; MER – Materials for energy recovery; EEE – Exported electrical energy; EET – Exported thermal energy

Table 19 Output flows, waste categories for 1 m² Anodised sheet for architectural cladding - 1 mm of aluminium sheet thickness and 20 µm of anodic layer thickness

Parameter	Unit	A1-A3	A4	C1	C2	C3	C4	D
HWD	kg	1.53E-07	6.08E-15	-5.74E-10	1.21E-12	8.36E-10	1.14E-12	-1.11E-07
NHWD	kg	4.49E+00	3.31E-07	5.38E-03	6.58E-05	1.11E-03	5.38E-02	-3.83E+00
RWD	kg	1.86E-02	2.37E-09	1.17E-03	4.72E-07	1.01E-04	1.13E-07	-9.36E-03
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.65E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EET	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Note: HWD – hazardous waste disposed; NHWD – Non-hazardous waste disposed; RWD – Radioactive waste disposed; CRU – Components for re-use; MFR – Materials for recycling; MER – Materials for energy recovery; EEE – Exported electrical energy; EET – Exported thermal energy

5 LCA RESULTS – ANODISED SHEET FOR ARCHITECTURAL CLADDING – 2 mm sheet thickness; 10, 15, 20 µm anodic layer

5.1 Core Environmental impacts indicators

Table 20 Core Environmental impacts indicators for 1 m^2 Anodised sheet for architectural cladding – 2 mm of aluminium sheet thickness and 10 µm of anodic layer thickness

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
GWP - total	kg CO_2 eq.	3.55E+01	3.33E-04	7.31E-01	6.63E-02	1.72E-01	1.58E-03	-2.56E+01
GWP – fossil	kg CO_2 eq.	3.54E+01	3.32E-04	7.23E-01	6.62E-02	1.70E-01	1.62E-03	-2.56E+01
GWP – biogenic	kg CO_2 eq.	5.79E-02	-1.23E-06	7.59E-03	-2.45E-04	1.06E-03	-4.72E-05	-5.34E-02
GWP - luluc	kg CO_2 eq.	9.44E-03	2.00E-06	1.80E-04	3.98E-04	4.14E-04	4.77E-06	-4.34E-03
ODP	kg CFC 11 eq.	2.72E-10	5.85E-17	1.29E-11	1.16E-14	5.34E-15	6.31E-18	-1.92E-10
AP	mol H^+ eq.	1.78E-01	2.31E-06	1.58E-03	4.59E-04	2.92E-04	1.16E-05	-1.49E-01
EP - freshwater	kg PO_4^{3-} eq.	4.78E-05	7.79E-10	2.64E-06	1.55E-07	7.19E-07	2.73E-09	-1.13E-05
EP - marine	kg N eq.	2.91E-02	1.15E-06	3.97E-04	2.29E-04	8.17E-05	3.00E-06	-2.13E-02
EP - terrestrial	mol N eq.	3.16E-01	1.27E-05	4.18E-03	2.53E-03	8.54E-04	3.30E-05	-2.33E-01
POCP	kg NMVOC eq.	8.67E-02	2.18E-06	1.07E-03	4.35E-04	2.06E-04	9.10E-06	-6.45E-02
ADP-MM (**)	kg Sb eq.	1.54E-05	2.37E-11	1.09E-07	4.71E-09	6.46E-08	1.53E-10	-5.75E-06
ADPF (**)	MJ	4.73E+02	4.54E-03	1.49E+01	9.03E-01	2.15E+00	2.16E-02	-3.13E+02
WDP (**)	m^3	6.53E+00	1.74E-06	1.55E-01	3.46E-04	3.82E-03	1.74E-04	-3.80E+00

Note: GWP – Global Warming Potential; ODP – Ozone Depletion; AP – acidification potential for soil and water; EP – Eutrophication potential; POCP – formation potential of tropospheric ozone; ADP - MM – abiotic depletion potential for non fossil resources; ADPF – Abiotic depletion potential for fossil resources; WDP – Water deprivation potential.

(**) **Disclaimer**: the results of this Environmental impacts indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

Table 21 Core Environmental impacts indicators for 1 m² Anodised sheet for architectural cladding - 2 mm of aluminium sheet thickness and 15 µm of anodic layer thickness

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
GWP - total	kg CO_2 eq.	3.56E+01	3.33E-04	7.31E-01	6.63E-02	1.72E-01	1.58E-03	-2.56E+01
GWP – fossil	kg CO_2 eq.	3.56E+01	3.32E-04	7.23E-01	6.62E-02	1.70E-01	1.62E-03	-2.56E+01
GWP – biogenic	kg CO_2 eq.	5.86E-02	-1.23E-06	7.59E-03	-2.45E-04	1.06E-03	-4.72E-05	-5.34E-02
GWP - luluc	kg CO_2 eq.	9.44E-03	2.00E-06	1.80E-04	3.98E-04	4.14E-04	4.77E-06	-4.34E-03
ODP	kg CFC 11 eq.	2.73E-10	5.85E-17	1.29E-11	1.16E-14	5.34E-15	6.31E-18	-1.92E-10
AP	mol H^+ eq.	1.78E-01	2.31E-06	1.58E-03	4.59E-04	2.92E-04	1.16E-05	-1.49E-01
EP - freshwater	kg PO_4^{3-} eq.	4.79E-05	7.79E-10	2.64E-06	1.55E-07	7.19E-07	2.73E-09	-1.13E-05
EP - marine	kg N eq.	2.91E-02	1.15E-06	3.97E-04	2.29E-04	8.17E-05	3.00E-06	-2.13E-02
EP - terrestrial	mol N eq.	3.17E-01	1.27E-05	4.18E-03	2.53E-03	8.54E-04	3.30E-05	-2.33E-01
POCP	kg NMVOC eq.	8.68E-02	2.18E-06	1.07E-03	4.35E-04	2.06E-04	9.10E-06	-6.45E-02
ADP-MM (**)	kg Sb eq.	1.55E-05	2.37E-11	1.09E-07	4.71E-09	6.46E-08	1.53E-10	-5.75E-06
ADPF (**)	MJ	4.75E+02	4.54E-03	1.49E+01	9.03E-01	2.15E+00	2.16E-02	-3.13E+02
WDP (**)	m^3	6.54E+00	1.74E-06	1.55E-01	3.46E-04	3.82E-03	1.74E-04	-3.80E+00

Note: GWP – Global Warming Potential; ODP – Ozone Depletion; AP – acidification potential for soil and water; EP – Eutrophication potential; POCP – formation potential of tropospheric ozone; ADP - MM – abiotic depletion potential for non fossil resources; ADPF – Abiotic depletion potential for fossil resources; WDP – Water deprivation potential.

(**) **Disclaimer**: the results of this Environmental impacts indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

Table 22 Core Environmental impacts indicators for 1 m² Anodised sheet for architectural cladding – 2 mm of aluminium sheet thickness and 20 µm of anodic layer thickness

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
GWP - total	kg CO_2 eq.	3.59E+01	3.33E-04	7.31E-01	6.63E-02	1.72E-01	1.58E-03	-2.56E+01
GWP – fossil	kg CO_2 eq.	3.59E+01	3.32E-04	7.23E-01	6.62E-02	1.70E-01	1.62E-03	-2.56E+01
GWP – biogenic	kg CO_2 eq.	6.09E-02	-1.23E-06	7.59E-03	-2.45E-04	1.06E-03	-4.72E-05	-5.34E-02
GWP - luluc	kg CO_2 eq.	9.47E-03	2.00E-06	1.80E-04	3.98E-04	4.14E-04	4.77E-06	-4.34E-03
ODP	kg CFC 11 eq.	2.77E-10	5.85E-17	1.29E-11	1.16E-14	5.34E-15	6.31E-18	-1.92E-10
AP	mol H^+ eq.	1.79E-01	2.31E-06	1.58E-03	4.59E-04	2.92E-04	1.16E-05	-1.49E-01
EP - freshwater	kg PO_4^{3-} eq.	4.87E-05	7.79E-10	2.64E-06	1.55E-07	7.19E-07	2.73E-09	-1.13E-05
EP - marine	kg N eq.	2.92E-02	1.15E-06	3.97E-04	2.29E-04	8.17E-05	3.00E-06	-2.13E-02
EP - terrestrial	mol N eq.	3.18E-01	1.27E-05	4.18E-03	2.53E-03	8.54E-04	3.30E-05	-2.33E-01
POCP	kg NMVOC eq.	8.71E-02	2.18E-06	1.07E-03	4.35E-04	2.06E-04	9.10E-06	-6.45E-02
ADP-MM (**)	kg Sb eq.	1.55E-05	2.37E-11	1.09E-07	4.71E-09	6.46E-08	1.53E-10	-5.75E-06
ADPF (**)	MJ	4.81E+02	4.54E-03	1.49E+01	9.03E-01	2.15E+00	2.16E-02	-3.13E+02
WDP (**)	m^3	6.58E+00	1.74E-06	1.55E-01	3.46E-04	3.82E-03	1.74E-04	-3.80E+00

Note: GWP – Global Warming Potential; ODP – Ozone Depletion; AP – acidification potential for soil and water; EP – Eutrophication potential; POCP – formation potential of tropospheric ozone; ADP - MM – abiotic depletion potential for non fossil resources; ADPF – Abiotic depletion potential for fossil resources; WDP – Water deprivation potential.

(**) **Disclaimer**: the results of this Environmental impacts indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

5.1.1 Additional Environmental impacts indicators

Table 23 Additional Environmental impacts indicators for 1 m² Anodised sheet for architectural cladding – 2 mm of aluminium sheet thickness and 10 µm of anodic layer thickness

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
Particular Matter emissions	Disease incidence	2.37E-06	7.65E-12	1.35E-08	1.52E-09	2.15E-09	1.44E-10	-2.08E-06
Ionising radiation - human health (*)	[kBq U235 eq.]	5.39E+00	4.89E-07	3.88E-01	9.73E-05	2.00E-02	2.37E-05	-3.58E+00
Eco-toxicity (freshwater) (**)	[CTUe]	1.52E+02	3.37E-03	6.64E+00	6.71E-01	8.58E-01	1.23E-02	-1.03E+02
Human toxicity - cancer effects (**)	[CTUh]	8.14E-09	6.74E-14	2.19E-10	1.34E-11	1.19E-10	1.81E-12	-6.44E-09
Human toxicity - non-cancer effects (**)	[CTUh]	2.43E-07	3.63E-12	5.51E-09	7.22E-10	9.78E-10	2.00E-10	-1.86E-07
Land Use related impacts/ Soil quality (**)	dimensionless	4.51E+01	1.61E-03	5.84E+00	3.21E-01	1.06E+00	4.35E-03	-9.09E+00

(*) **Disclaimer**: This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

(**) **Disclaimer**: the results of this Environmental impacts indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

Table 24 Additional Environmental impacts indicators for 1 m² Anodised sheet for architectural cladding - 2 mm of aluminium sheet thickness and 15 µm of anodic layer thickness

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
Particular Matter emissions	Disease incidence	2.37E-06	7.65E-12	1.35E-08	1.52E-09	2.15E-09	1.44E-10	-2.08E-06
Ionising radiation - human health (*)	[kBq U235 eq.]	5.41E+00	4.89E-07	3.88E-01	9.73E-05	2.00E-02	2.37E-05	-3.58E+00
Eco-toxicity (freshwater) (**)	[CTUe]	1.53E+02	3.37E-03	6.64E+00	6.71E-01	8.58E-01	1.23E-02	-1.03E+02
Human toxicity - cancer effects (**)	[CTUh]	8.16E-09	6.74E-14	2.19E-10	1.34E-11	1.19E-10	1.81E-12	-6.44E-09
Human toxicity - non-cancer effects (**)	[CTUh]	2.44E-07	3.63E-12	5.51E-09	7.22E-10	9.78E-10	2.00E-10	-1.86E-07
Land Use related impacts/ Soil quality (**)	dimensionless	4.55E+01	1.61E-03	5.84E+00	3.21E-01	1.06E+00	4.35E-03	-9.09E+00

(*) **Disclaimer**: This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.
(**) **Disclaimer**: the results of this Environmental impacts indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

Table 25 Additional Environmental impacts indicators for 1 m² Anodised sheet for architectural cladding – 2 mm of aluminium sheet thickness and 20 µm of anodic layer thickness

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
Particular Matter emissions	Disease incidence	2.37E-06	7.65E-12	1.35E-08	1.52E-09	2.15E-09	1.44E-10	-2.08E-06
Ionising radiation - human health (*)	[kBq U235 eq.]	5.52E+00	4.89E-07	3.88E-01	9.73E-05	2.00E-02	2.37E-05	-3.58E+00
Eco-toxicity (freshwater) (**)	[CTUe]	1.55E+02	3.37E-03	6.64E+00	6.71E-01	8.58E-01	1.23E-02	-1.03E+02
Human toxicity - cancer effects (**)	[CTUh]	8.24E-09	6.74E-14	2.19E-10	1.34E-11	1.19E-10	1.81E-12	-6.44E-09
Human toxicity - non-cancer effects (**)	[CTUh]	2.46E-07	3.63E-12	5.51E-09	7.22E-10	9.78E-10	2.00E-10	-1.86E-07
Land Use related impacts/ Soil quality (**)	dimensionless	4.71E+01	1.61E-03	5.84E+00	3.21E-01	1.06E+00	4.35E-03	-9.09E+00

(*) **Disclaimer**: This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.
(**) **Disclaimer**: the results of this Environmental impacts indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

5.2 Resource use

Table 26 Resource use for 1 m² Anodised sheet for architectural cladding - 2 mm of aluminium sheet thickness and 10 µm of anodic layer thickness

Parameter	Unit	A1-A3	A4	C1	C2	C3	C4	D
PERE	MJ	1.87E+02	2.93E-04	8.78E+00	5.84E-02	1.16E+00	2.90E-03	-1.42E+02
PERM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	1.87E+02	2.93E-04	8.78E+00	5.84E-02	1.16E+00	2.90E-03	-1.42E+02
PENRE	MJ	4.73E+02	4.54E-03	1.49E+01	9.03E-01	2.15E+00	2.16E-02	-3.14E+02
PENRM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	4.73E+02	4.54E-03	1.49E+01	9.03E-01	2.15E+00	2.16E-02	-3.14E+02
SM	kg	2.34E+00	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	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	4.59E-01	2.67E-07	7.09E-03	5.32E-05	6.26E-04	5.32E-06	-3.61E-01

Note: PERE – use of renewable primary energy resources used as raw materials; PERT – Total use of renewable primary energy resources; PENRE – use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM – use of non-renewable primary energy resources used as raw materials; PENRT – Total use of non-renewable primary energy resources; SM – Use of secondary materials; RSF – Use of renewable secondary fuels; NRSF – use of non-renewable secondary fuels; FW – use of net fresh water.

Table 27 Resource use for 1 m² Anodised sheet for architectural cladding - 2 mm of aluminium sheet thickness and 15 µm of anodic layer thickness

Parameter	Unit	A1-A3	A4	C1	C2	C3	C4	D
PERE	MJ	1.88E+02	2.93E-04	8.78E+00	5.84E-02	1.16E+00	2.90E-03	-1.42E+02
PERM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	1.88E+02	2.93E-04	8.78E+00	5.84E-02	1.16E+00	2.90E-03	-1.42E+02
PENRE	MJ	4.75E+02	4.54E-03	1.49E+01	9.03E-01	2.15E+00	2.16E-02	-3.14E+02
PENRM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	4.75E+02	4.54E-03	1.49E+01	9.03E-01	2.15E+00	2.16E-02	-3.14E+02
SM	kg	2.34E+00	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	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	4.59E-01	2.67E-07	7.09E-03	5.32E-05	6.26E-04	5.32E-06	-3.61E-01

Note: PERE – use of renewable primary energy resources used as raw materials; PERT – Total use of renewable primary energy resources; PENRE – use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM – use of non-renewable primary energy resources used as raw materials; PENRT – Total use of non-renewable primary energy resources; SM – Use of secondary materials; RSF – Use of renewable secondary fuels; NRSF – use of non-renewable secondary fuels; FW – use of net fresh water.

Table 28 Resource use for 1 m² Anodised sheet for architectural cladding - 2 mm of aluminium sheet thickness and 20 µm of anodic layer thickness

Parameter	Unit	A1-A3	A4	C1	C2	C3	C4	D
PERE	MJ	1.90E+02	2.93E-04	8.78E+00	5.84E-02	1.16E+00	2.90E-03	-1.42E+02
PERM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	1.90E+02	2.93E-04	8.78E+00	5.84E-02	1.16E+00	2.90E-03	-1.42E+02
PENRE	MJ	4.81E+02	4.54E-03	1.49E+01	9.03E-01	2.15E+00	2.16E-02	-3.14E+02
PENRM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	4.81E+02	4.54E-03	1.49E+01	9.03E-01	2.15E+00	2.16E-02	-3.14E+02
SM	kg	2.34E+00	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	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	4.61E-01	2.67E-07	7.09E-03	5.32E-05	6.26E-04	5.32E-06	-3.61E-01

Note: PERE – use of renewable primary energy resources used as raw materials; PERT – Total use of renewable primary energy resources; PENRE – use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM – use of non-renewable primary energy resources used as raw materials; PENRT – Total use of non-renewable primary energy resources; SM – Use of secondary materials; RSF – Use of renewable secondary fuels; NRSF – use of non-renewable secondary fuels; FW – use of net fresh water.

5.3 Output flows, waste categories

Table 29 Output flows, waste categories for 1 m² Anodised sheet for architectural cladding - 2 mm of aluminium sheet thickness and 10 µm of anodic layer thickness

Parameter	Unit	A1-A3	A4	C1	C2	C3	C4	D
HWD	kg	3.05E-07	1.22E-14	-1.15E-09	2.42E-12	1.67E-09	2.29E-12	-2.21E-07
NHWD	kg	8.90E+00	6.62E-07	1.08E-02	1.32E-04	2.23E-03	1.08E-01	-7.67E+00
RWD	kg	2.98E-02	4.75E-09	2.33E-03	9.44E-07	2.03E-04	2.26E-07	-1.87E-02
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.29E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EET	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Note: HWD – hazardous waste disposed; NHWD – Non-hazardous waste disposed; RWD – Radioactive waste disposed; CRU – Components for re-use; MFR – Materials for recycling; MER – Materials for energy recovery; EEE – Exported electrical energy; EET – Exported thermal energy

Table 30 Output flows, waste categories for 1 m² Anodised sheet for architectural cladding - 2 mm of aluminium sheet thickness and 15 µm of anodic layer thickness

Parameter	Unit	A1-A3	A4	C1	C2	C3	C4	D
HWD	kg	3.05E-07	1.22E-14	-1.15E-09	2.42E-12	1.67E-09	2.29E-12	-2.21E-07
NHWD	kg	8.90E+00	6.62E-07	1.08E-02	1.32E-04	2.23E-03	1.08E-01	-7.67E+00
RWD	kg	3.00E-02	4.75E-09	2.33E-03	9.44E-07	2.03E-04	2.26E-07	-1.87E-02
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.29E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EET	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Note: HWD – hazardous waste disposed; NHWD – Non-hazardous waste disposed; RWD – Radioactive waste disposed; CRU – Components for re-use; MFR – Materials for recycling; MER – Materials for energy recovery; EEE – Exported electrical energy; EET – Exported thermal energy

Table 31 Output flows, waste categories for 1 m² Anodised sheet for architectural cladding - 2 mm of aluminium sheet thickness and 20 µm of anodic layer thickness

Parameter	Unit	A1-A3	A4	C1	C2	C3	C4	D
HWD	kg	3.05E-07	1.22E-14	-1.15E-09	2.42E-12	1.67E-09	2.29E-12	-2.21E-07
NHWD	kg	8.91E+00	6.62E-07	1.08E-02	1.32E-04	2.23E-03	1.08E-01	-7.67E+00
RWD	kg	3.06E-02	4.75E-09	2.33E-03	9.44E-07	2.03E-04	2.26E-07	-1.87E-02
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.29E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EET	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Note: HWD – hazardous waste disposed; NHWD – Non-hazardous waste disposed; RWD – Radioactive waste disposed; CRU – Components for re-use; MFR – Materials for recycling; MER – Materials for energy recovery; EEE – Exported electrical energy; EET – Exported thermal energy

6 LCA RESULTS – ANODISED SHEET FOR ARCHITECTURAL CLADDING – 3 mm sheet thickness; 10, 15, 20 µm anodic layer

6.1 Core Environmental impacts indicators

Table 32 Core Environmental impacts indicators for 1 m^2 Anodised sheet for architectural cladding – 3 mm of aluminium sheet thickness and 10 µm of anodic layer thickness

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
GWP - total	kg CO_2 eq.	5.15E+01	5.00E-04	1.11E+00	9.95E-02	2.57E-01	2.37E-03	-3.84E+01
GWP – fossil	kg CO_2 eq.	5.15E+01	4.99E-04	1.10E+00	9.92E-02	2.55E-01	2.44E-03	-3.83E+01
GWP – biogenic	kg CO_2 eq.	6.38E-02	-1.85E-06	1.14E-02	-3.68E-04	1.58E-03	-7.08E-05	-8.02E-02
GWP - luluc	kg CO_2 eq.	1.40E-02	3.00E-06	3.48E-04	5.97E-04	6.21E-04	7.16E-06	-6.51E-03
ODP	kg CFC 11 eq.	3.93E-10	8.78E-17	1.93E-11	1.75E-14	8.02E-15	9.47E-18	-2.88E-10
AP	mol H^+ eq.	2.65E-01	3.46E-06	2.43E-03	6.88E-04	4.37E-04	1.74E-05	-2.23E-01
EP - freshwater	kg PO_4^{3-} eq.	5.79E-05	1.17E-09	3.99E-06	2.33E-07	1.08E-06	4.09E-09	-1.70E-05
EP - marine	kg N eq.	4.29E-02	1.73E-06	6.27E-04	3.44E-04	1.23E-04	4.51E-06	-3.20E-02
EP - terrestrial	mol N eq.	4.67E-01	1.91E-05	6.61E-03	3.80E-03	1.28E-03	4.95E-05	-3.49E-01
POCP	kg NMVOC eq.	1.28E-01	3.28E-06	1.69E-03	6.52E-04	3.09E-04	1.37E-05	-9.67E-02
ADP-MM (**)	kg Sb eq.	1.90E-05	3.55E-11	1.65E-07	7.07E-09	9.68E-08	2.30E-10	-8.62E-06
ADPF (**)	MJ	6.78E+02	6.80E-03	2.25E+01	1.35E+00	3.23E+00	3.23E-02	-4.70E+02
WDP (**)	m^3	8.78E+00	2.61E-06	2.33E-01	5.19E-04	5.73E-03	2.62E-04	-5.69E+00

Note: GWP – Global Warming Potential; ODP – Ozone Depletion; AP – acidification potential for soil and water; EP – Eutrophication potential; POCP – formation potential of tropospheric ozone; ADP - MM – abiotic depletion potential for non fossil resources; ADPF – Abiotic depletion potential for fossil resources; WDP – Water deprivation potential.

(**) **Disclaimer**: the results of this Environmental impacts indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

Table 33 Core Environmental impacts indicators for 1 m² Anodised sheet for architectural cladding - 3 mm of aluminium sheet thickness and 15 µm of anodic layer thickness

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
GWP - total	kg CO_2 eq.	5.17E+01	5.00E-04	1.11E+00	9.95E-02	2.57E-01	2.37E-03	-3.84E+01
GWP – fossil	kg CO_2 eq.	5.16E+01	4.99E-04	1.10E+00	9.92E-02	2.55E-01	2.44E-03	-3.83E+01
GWP – biogenic	kg CO_2 eq.	6.44E-02	-1.85E-06	1.14E-02	-3.68E-04	1.58E-03	-7.08E-05	-8.02E-02
GWP - luluc	kg CO_2 eq.	1.40E-02	3.00E-06	3.48E-04	5.97E-04	6.21E-04	7.16E-06	-6.51E-03
ODP	kg CFC 11 eq.	3.93E-10	8.78E-17	1.93E-11	1.75E-14	8.02E-15	9.47E-18	-2.88E-10
AP	mol H^+ eq.	2.65E-01	3.46E-06	2.43E-03	6.88E-04	4.37E-04	1.74E-05	-2.23E-01
EP - freshwater	kg PO_4^{3-} eq.	5.81E-05	1.17E-09	3.99E-06	2.33E-07	1.08E-06	4.09E-09	-1.70E-05
EP - marine	kg N eq.	4.29E-02	1.73E-06	6.27E-04	3.44E-04	1.23E-04	4.51E-06	-3.20E-02
EP - terrestrial	mol N eq.	4.68E-01	1.91E-05	6.61E-03	3.80E-03	1.28E-03	4.95E-05	-3.49E-01
POCP	kg NMVOC eq.	1.28E-01	3.28E-06	1.69E-03	6.52E-04	3.09E-04	1.37E-05	-9.67E-02
ADP-MM (**)	kg Sb eq.	1.90E-05	3.55E-11	1.65E-07	7.07E-09	9.68E-08	2.30E-10	-8.62E-06
ADPF (**)	MJ	6.80E+02	6.80E-03	2.25E+01	1.35E+00	3.23E+00	3.23E-02	-4.70E+02
WDP (**)	m^3	8.79E+00	2.61E-06	2.33E-01	5.19E-04	5.73E-03	2.62E-04	-5.69E+00

Note: GWP – Global Warming Potential; ODP – Ozone Depletion; AP – acidification potential for soil and water; EP – Eutrophication potential; POCP – formation potential of tropospheric ozone; ADP - MM – abiotic depletion potential for non fossil resources; ADPF – Abiotic depletion potential for fossil resources; WDP – Water deprivation potential.

(**) **Disclaimer**: the results of this Environmental impacts indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

Table 34 Core Environmental impacts indicators for 1 m² Anodised sheet for architectural cladding – 3 mm of aluminium sheet thickness and 20 µm of anodic layer thickness

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
GWP - total	kg CO_2 eq.	5.20E+01	5.00E-04	1.11E+00	9.95E-02	2.57E-01	2.37E-03	-3.84E+01
GWP – fossil	kg CO_2 eq.	5.19E+01	4.99E-04	1.10E+00	9.92E-02	2.55E-01	2.44E-03	-3.83E+01
GWP – biogenic	kg CO_2 eq.	6.67E-02	-1.85E-06	1.14E-02	-3.68E-04	1.58E-03	-7.08E-05	-8.02E-02
GWP - luluc	kg CO_2 eq.	1.40E-02	3.00E-06	3.48E-04	5.97E-04	6.21E-04	7.16E-06	-6.51E-03
ODP	kg CFC 11 eq.	3.97E-10	8.78E-17	1.93E-11	1.75E-14	8.02E-15	9.47E-18	-2.88E-10
AP	mol H^+ eq.	2.65E-01	3.46E-06	2.43E-03	6.88E-04	4.37E-04	1.74E-05	-2.23E-01
EP - freshwater	kg PO_4^{3-} eq.	5.88E-05	1.17E-09	3.99E-06	2.33E-07	1.08E-06	4.09E-09	-1.70E-05
EP - marine	kg N eq.	4.31E-02	1.73E-06	6.27E-04	3.44E-04	1.23E-04	4.51E-06	-3.20E-02
EP - terrestrial	mol N eq.	4.69E-01	1.91E-05	6.61E-03	3.80E-03	1.28E-03	4.95E-05	-3.49E-01
POCP	kg NMVOC eq.	1.29E-01	3.28E-06	1.69E-03	6.52E-04	3.09E-04	1.37E-05	-9.67E-02
ADP-MM (**)	kg Sb eq.	1.90E-05	3.55E-11	1.65E-07	7.07E-09	9.68E-08	2.30E-10	-8.62E-06
ADPF (**)	MJ	6.86E+02	6.80E-03	2.25E+01	1.35E+00	3.23E+00	3.23E-02	-4.70E+02
WDP (**)	m^3	8.84E+00	2.61E-06	2.33E-01	5.19E-04	5.73E-03	2.62E-04	-5.69E+00

Note: GWP – Global Warming Potential; ODP – Ozone Depletion; AP – acidification potential for soil and water; EP – Eutrophication potential; POCP – formation potential of tropospheric ozone; ADP - MM – abiotic depletion potential for non fossil resources; ADPF – Abiotic depletion potential for fossil resources; WDP – Water deprivation potential.

(**) **Disclaimer**: the results of this Environmental impacts indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

6.1.1 Additional Environmental impacts indicators

Table 35 Additional Environmental impacts indicators for 1 m² Anodised sheet for architectural cladding – 3 mm of aluminium sheet thickness and 10 µm of anodic layer thickness

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
Particular Matter emissions	Disease incidence	3.53E-06	1.15E-11	2.10E-08	2.28E-09	3.23E-09	2.16E-10	-3.12E-06
Ionising radiation - human health (*)	[kBq U235 eq.]	7.59E+00	7.33E-07	5.82E-01	1.46E-04	2.99E-02	3.56E-05	-5.37E+00
Eco-toxicity (freshwater) (**)	[CTUe]	2.19E+02	5.06E-03	1.01E+01	1.01E+00	1.29E+00	1.84E-02	-1.55E+02
Human toxicity - cancer effects (**)	[CTUh]	1.18E-08	1.01E-13	3.32E-10	2.01E-11	1.78E-10	2.72E-12	-9.67E-09
Human toxicity - non-cancer effects (**)	[CTUh]	3.52E-07	5.44E-12	8.42E-09	1.08E-09	1.47E-09	3.00E-10	-2.78E-07
Land Use related impacts/ Soil quality (**)	dimensionless	6.04E+01	2.42E-03	8.82E+00	4.81E-01	1.60E+00	6.53E-03	-1.36E+01

(*) **Disclaimer**: This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

(**) **Disclaimer**: the results of this Environmental impacts indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

Table 36 Additional Environmental impacts indicators for 1 m² Anodised sheet for architectural cladding - 3 mm of aluminium sheet thickness and 15 µm of anodic layer thickness

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
Particular Matter emissions	Disease incidence	3.53E-06	1.15E-11	2.10E-08	2.28E-09	3.23E-09	2.16E-10	-3.12E-06
Ionising radiation - human health (*)	[kBq U235 eq.]	7.62E+00	7.33E-07	5.82E-01	1.46E-04	2.99E-02	3.56E-05	-5.37E+00
Eco-toxicity (freshwater) (**)	[CTUe]	2.20E+02	5.06E-03	1.01E+01	1.01E+00	1.29E+00	1.84E-02	-1.55E+02
Human toxicity - cancer effects (**)	[CTUh]	1.18E-08	1.01E-13	3.32E-10	2.01E-11	1.78E-10	2.72E-12	-9.67E-09
Human toxicity - non-cancer effects (**)	[CTUh]	3.53E-07	5.44E-12	8.42E-09	1.08E-09	1.47E-09	3.00E-10	-2.78E-07
Land Use related impacts/ Soil quality (**)	dimensionless	6.07E+01	2.42E-03	8.82E+00	4.81E-01	1.60E+00	6.53E-03	-1.36E+01

(*) **Disclaimer**: This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.
(**) **Disclaimer**: the results of this Environmental impacts indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

Table 37 Additional Environmental impacts indicators for 1 m² Anodised sheet for architectural cladding – 3 mm of aluminium sheet thickness and 20 µm of anodic layer thickness

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
Particular Matter emissions	Disease incidence	3.53E-06	1.15E-11	2.10E-08	2.28E-09	3.23E-09	2.16E-10	-3.12E-06
Ionising radiation - human health (*)	[kBq U235 eq.]	7.73E+00	7.33E-07	5.82E-01	1.46E-04	2.99E-02	3.56E-05	-5.37E+00
Eco-toxicity (freshwater) (**)	[CTUe]	2.22E+02	5.06E-03	1.01E+01	1.01E+00	1.29E+00	1.84E-02	-1.55E+02
Human toxicity - cancer effects (**)	[CTUh]	1.19E-08	1.01E-13	3.32E-10	2.01E-11	1.78E-10	2.72E-12	-9.67E-09
Human toxicity - non-cancer effects (**)	[CTUh]	3.55E-07	5.44E-12	8.42E-09	1.08E-09	1.47E-09	3.00E-10	-2.78E-07
Land Use related impacts/ Soil quality (**)	dimensionless	6.24E+01	2.42E-03	8.82E+00	4.81E-01	1.60E+00	6.53E-03	-1.36E+01

(*) **Disclaimer**: This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.
(**) **Disclaimer**: the results of this Environmental impacts indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

6.2 Resource use

Table 38 Resource use for 1 m² Anodised sheet for architectural cladding - 3 mm of aluminium sheet thickness and 10 µm of anodic layer thickness

Parameter	Unit	A1-A3	A4	C1	C2	C3	C4	D
PERE	MJ	2.70E+02	4.40E-04	1.32E+01	8.76E-02	1.74E+00	4.35E-03	-2.14E+02
PERM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	2.70E+02	4.40E-04	1.32E+01	8.76E-02	1.74E+00	4.35E-03	-2.14E+02
PENRE	MJ	6.78E+02	6.81E-03	2.25E+01	1.35E+00	3.23E+00	3.24E-02	-4.70E+02
PENRM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	6.78E+02	6.81E-03	2.25E+01	1.35E+00	3.23E+00	3.24E-02	-4.70E+02
SM	kg	3.51E+00	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	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	6.61E-01	4.01E-07	1.06E-02	7.97E-05	9.39E-04	7.98E-06	-5.41E-01

Note: PERE – use of renewable primary energy resources used as raw materials; PERT – Total use of renewable primary energy resources; PENRE – use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM – use of non-renewable primary energy resources used as raw materials; PENRT – Total use of non-renewable primary energy resources; SM – Use of secondary materials; RSF – Use of renewable secondary fuels; NRSF – use of non-renewable secondary fuels; FW – use of net fresh water.

Table 39 Resource use for 1 m² Anodised sheet for architectural cladding - 3 mm of aluminium sheet thickness and 15 µm of anodic layer thickness

Parameter	Unit	A1-A3	A4	C1	C2	C3	C4	D
PERE	MJ	2.70E+02	4.40E-04	1.32E+01	8.76E-02	1.74E+00	4.35E-03	-2.14E+02
PERM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	2.70E+02	4.40E-04	1.32E+01	8.76E-02	1.74E+00	4.35E-03	-2.14E+02
PENRE	MJ	6.81E+02	6.81E-03	2.25E+01	1.35E+00	3.23E+00	3.24E-02	-4.70E+02
PENRM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	6.81E+02	6.81E-03	2.25E+01	1.35E+00	3.23E+00	3.24E-02	-4.70E+02
SM	kg	3.51E+00	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	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	6.61E-01	4.01E-07	1.06E-02	7.97E-05	9.39E-04	7.98E-06	-5.41E-01

Note: PERE – use of renewable primary energy resources used as raw materials; PERT – Total use of renewable primary energy resources; PENRE – use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM – use of non-renewable primary energy resources used as raw materials; PENRT – Total use of non-renewable primary energy resources; SM – Use of secondary materials; RSF – Use of renewable secondary fuels; NRSF – use of non-renewable secondary fuels; FW – use of net fresh water.

Table 40 Resource use for 1 m² Anodised sheet for architectural cladding - 3 mm of aluminium sheet thickness and 20 µm of anodic layer thickness

Parameter	Unit	A1-A3	A4	C1	C2	C3	C4	D
PERE	MJ	2.73E+02	4.40E-04	1.32E+01	8.76E-02	1.74E+00	4.35E-03	-2.14E+02
PERM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	2.73E+02	4.40E-04	1.32E+01	8.76E-02	1.74E+00	4.35E-03	-2.14E+02
PENRE	MJ	6.86E+02	6.81E-03	2.25E+01	1.35E+00	3.23E+00	3.24E-02	-4.70E+02
PENRM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	6.86E+02	6.81E-03	2.25E+01	1.35E+00	3.23E+00	3.24E-02	-4.70E+02
SM	kg	3.51E+00	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	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	6.63E-01	4.01E-07	1.06E-02	7.97E-05	9.39E-04	7.98E-06	-5.41E-01

Note: PERE – use of renewable primary energy resources used as raw materials; PERT – Total use of renewable primary energy resources; PENRE – use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM – use of non-renewable primary energy resources used as raw materials; PENRT – Total use of non-renewable primary energy resources; SM – Use of secondary materials; RSF – Use of renewable secondary fuels; NRSF – use of non-renewable secondary fuels; FW – use of net fresh water.

6.3 Output flows, waste categories

Table 41 Output flows, waste categories for 1 m² Anodised sheet for architectural cladding - 3 mm of aluminium sheet thickness and 10 µm of anodic layer thickness

Parameter	Unit	A1-A3	A4	C1	C2	C3	C4	D
HWD	kg	4.56E-07	1.82E-14	-1.72E-09	3.63E-12	2.51E-09	3.43E-12	-3.32E-07
NHWD	kg	1.33E+01	9.93E-07	1.62E-02	1.98E-04	3.34E-03	1.61E-01	-1.15E+01
RWD	kg	4.18E-02	7.12E-09	3.50E-03	1.42E-06	3.04E-04	3.39E-07	-2.81E-02
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.94E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EET	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Note: HWD – hazardous waste disposed; NHWD – Non-hazardous waste disposed; RWD – Radioactive waste disposed; CRU – Components for re-use; MFR – Materials for recycling; MER – Materials for energy recovery; EEE – Exported electrical energy; EET – Exported thermal energy

Table 42 Output flows, waste categories for 1 m² Anodised sheet for architectural cladding - 3 mm of aluminium sheet thickness and 15 µm of anodic layer thickness

Parameter	Unit	A1-A3	A4	C1	C2	C3	C4	D
HWD	kg	4.56E-07	1.82E-14	-1.72E-09	3.63E-12	2.51E-09	3.43E-12	-3.32E-07
NHWD	kg	1.33E+01	9.93E-07	1.62E-02	1.98E-04	3.34E-03	1.61E-01	-1.15E+01
RWD	kg	4.20E-02	7.12E-09	3.50E-03	1.42E-06	3.04E-04	3.39E-07	-2.81E-02
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.94E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EET	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Note: HWD – hazardous waste disposed; NHWD – Non-hazardous waste disposed; RWD – Radioactive waste disposed; CRU – Components for re-use; MFR – Materials for recycling; MER – Materials for energy recovery; EEE – Exported electrical energy; EET – Exported thermal energy

Table 43 Output flows, waste categories for 1 m² Anodised sheet for architectural cladding - 3 mm of aluminium sheet thickness and 20 µm of anodic layer thickness

Parameter	Unit	A1-A3	A4	C1	C2	C3	C4	D
HWD	kg	4.56E-07	1.82E-14	-1.72E-09	3.63E-12	2.51E-09	3.43E-12	-3.32E-07
NHWD	kg	1.33E+01	9.93E-07	1.62E-02	1.98E-04	3.34E-03	1.61E-01	-1.15E+01
RWD	kg	4.26E-02	7.12E-09	3.50E-03	1.42E-06	3.04E-04	3.39E-07	-2.81E-02
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.94E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EET	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Note: HWD – hazardous waste disposed; NHWD – Non-hazardous waste disposed; RWD – Radioactive waste disposed; CRU – Components for re-use; MFR – Materials for recycling; MER – Materials for energy recovery; EEE – Exported electrical energy; EET – Exported thermal energy

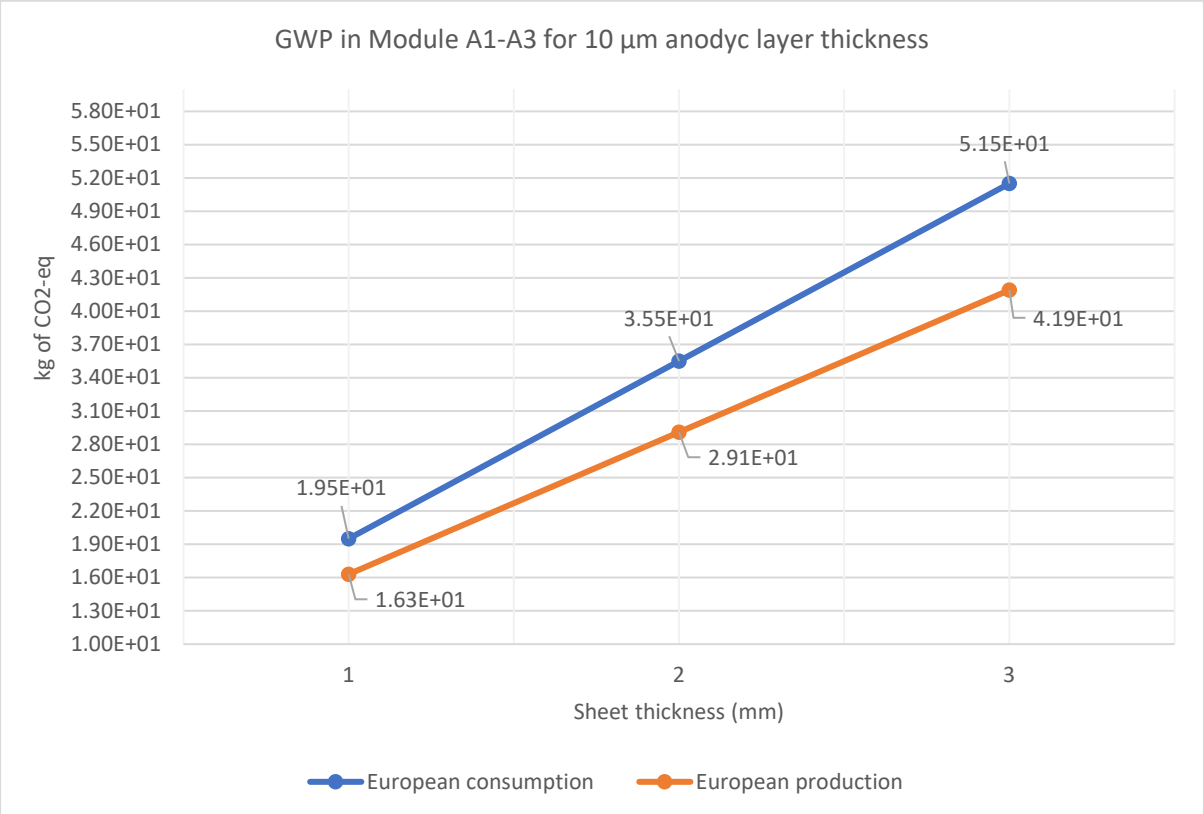
7 LCA – INTERPRETATION

The analysis of the LCIA results for all the products declared shows that most of the environmental impacts come from the aluminium coil and sheet manufacturing. Within the manufacturing processes, the primary aluminium production is dominant, especially the alumina production and the electrolysis. The rolling process, which converts ingot into coil, and the subsequent foreground anodising process contribute much less to the LCA results. The LCA modelling and the impact of the primary aluminium production are detailed in European Aluminium's environmental profile report.

The evolution of GWP of Module A1-A3 for the 3 sheet thicknesses is shown in the following diagram. Keeping the anodic layer thickness constant (we took 10 µm as an example) and increasing the aluminium sheet thickness (doubling or tripling), the GWP increases by 45% and 62% respectively. The GWP values change from 1.95E+01 kg for the 1 mm-thick sheet to 3.55E+01 kg for the 2 mm-thick sheet to 5.15E+01 kg of CO2-equiv for the 3 mm-thick sheet. The other indicators follow the same trends, e.g. ODP increases from 1.52E-10 to 2.72E-10 to 3.93E-10 [kg CFC11-eq.] and acidification potential from 9.22E-02 to 1.78E-01 to 2.65E-01 [kg SO2-eq.].

Comparing the GWP value of European primary aluminium consumption (i.e. European production + net fraction of imports into Europe, as used in the present EPD) with that of European primary aluminium production scenario (i.e. using 100% of primary aluminium produced in Europe), the kg of CO2-eq. decreases by 16%, 18% and 19% for an Aluminium sheet thickness of 1mm ,2mm and 3m respectively.

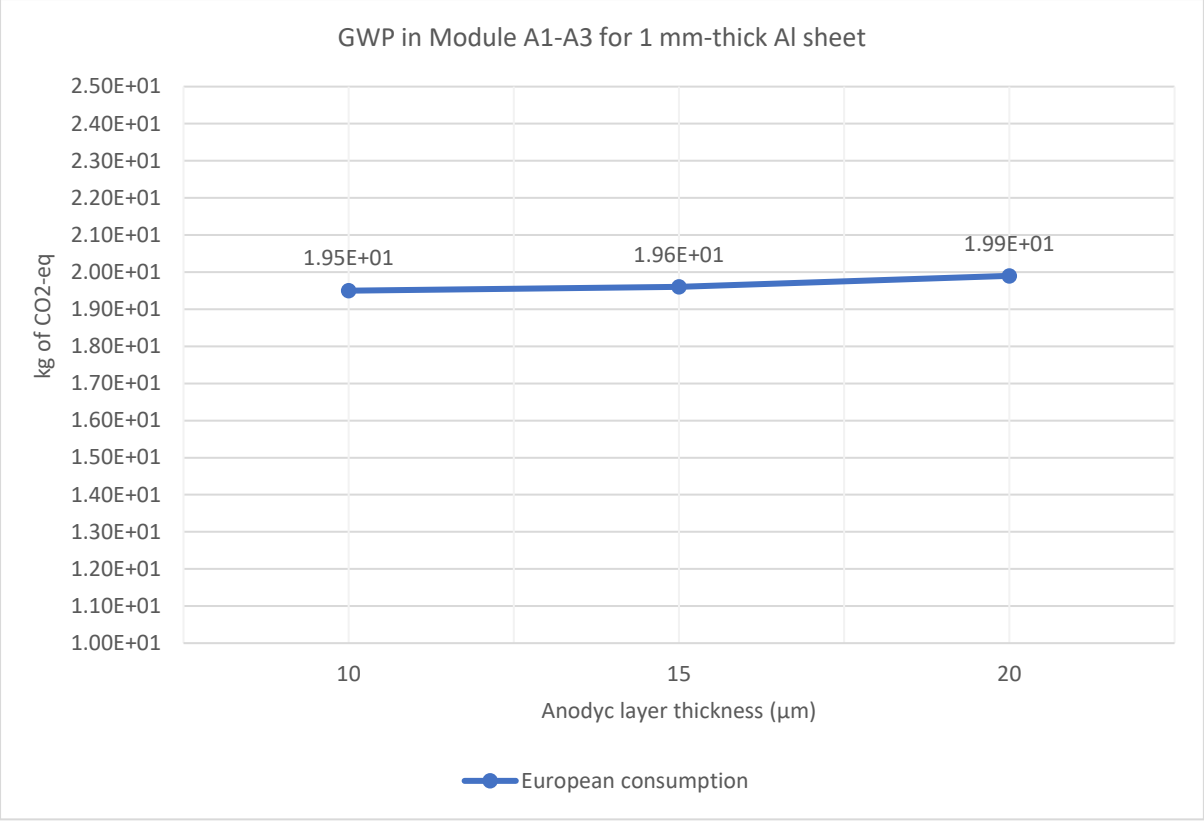
Figure 2 Sensitivity analysis: EU consumption GWP against EU production GWP



Anodising process (module A1-A3)

The anodising process only slightly influences the EPD results of anodised sheets, e.g. an increase of the anodic layer from 10 to 20 µm generates an increase of the various indicators between 0 and 5% as illustrated in the next diagram for A1-A3 module considering 1 mm aluminium sheet thickness.

Figure 3 Comparison of GWP value between different anodic layers for the same thickness of aluminium sheet



8 OTHER INFORMATION

Speira is a leading European aluminium rolling and recycling company, comprising a total of eleven recycling and production sites in Germany and Norway plus own research and development. Speira recycles up to 650,000 tons of aluminium per year and produces around one million tons of advanced rolled products. The plants include the Alunorf joint venture, the world's largest aluminium rolling mill, and Grevenbroich, the world's largest refining plant in the world. With approximately 5,500 employees, Speira is proud to supply some of the best-known industrial companies in the global sectors automotive, packaging, printing, engineering, building and construction.

Additional information about corporate responsibility, sustainability policy, management systems and available products can be found on the website www.speira.com.

These EPD results have been calculated from an LCA tool for EPD, based on the LCA for expert database, initially realised by thinkstep GmbH in 2013 and updated by Ecoinnovazione in 2019 and 2022 (Ecoinnovazione S.r.l. – spin-off ENEA Via della Liberazione, 6/c, 40128 Bologna BO www.ecoinnovazione.it)

9 REFERENCES

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EN 14782:2006, Self-supporting metal sheet for roofing, external cladding and internal lining - Product specification and requirements.

EN 14783:2013, Fully supported metal sheet and strip for roofing, external cladding and internal lining - Product specification and requirements.

EN 13964:2004/+A1:2006, Suspended ceilings - Requirements and test methods.

Please refer to the latest version of those standards.