ENVIRONMENTAL PRODUCT DECLARATION

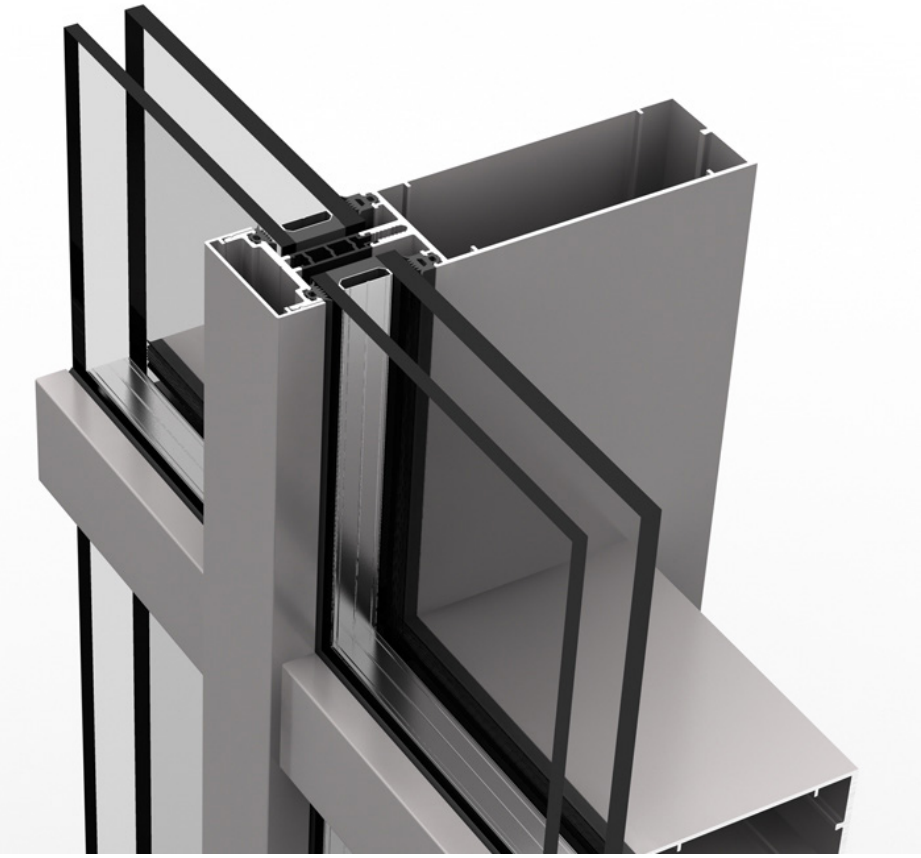
THE INTERNATIONAL EPD® SYSTEM

ECO PLATFORM EPD VERIFIED

STRUGAL

In accordance with ISO 14025 and EN 15804-2012+A2:2019 for

CURTAIN WALLS: STRUGAL S52CR, STRUGAL S52CRi, STRUGAL S52NT and STRUGAL S52SGi



EPD Program	The International EPD® System. www.environdec.com
Programme operator	EPD International AB
CPC Code	CPC 2.0 41532 Aluminium bars, rods and profiles, of aluminium
Based on	PCR 2019:14 Construction Products v1.0
Declaration number	S-P-05213
Publication date	2022-01-10
Valid until	2027-01-10
Market coverage	Worldwide
Representativeness	Spain

(*) An EPD should provide current information and may be updated if conditions change. The stated validity is therefore subject to the continued registration and publication at www.environdec.com

STRUGAL

At STRUGAL, we have been providing innovative solutions for building and industry for over 40 years. With a marked commitment to our customers and our environment, we are a clear reference in aluminium carpentry systems and façades for architects and developers, always seeking the satisfaction of our customers and the well-being of the end user.

We are constantly innovating, both in technological investment, in manufacturing processes and in the design of new products, trying to be at the forefront of the sector, improving every day.

With 6 production plants, its own technological center and international presence, STRUGAL is a company with headquarters at Alcalá de Guadaíra, Sevilla. We have more than 300,000 m2 of facilities, 1,500 employees in our production plants, 18 distribution centres and offices. We offer solutions for architecture and industry.

We offer a wide variety of products for the building industry, such as aluminium profiles, aluminium finished windows, PVC finished windows, aluminium doors, solar protection systems and light fronts.

Our systems meet the highest expectations in terms of quality and design, and STRUGAL provides a comprehensive service to the manufacturer-installer. From the profile, an infinite number of finishes and a wide range of accessories, to the corresponding tests, complying at all times with the regulations in force.

PRODUCT

Product description

This EPD shows different curtain wall systems assembled from anodized/coated extruded aluminum profiles manufactured by STRUGAL. The declared products are specific to the different series designed by the company.

Curtain walls are used as external cladding on buildings. Products do not constitute a structural element of the building.

Composition

The curtain walls consist of mullions and transoms made from coated/anodized aluminium profiles. Insulating glass units (IGU) are placed between the aluminium profiles.

To ensure the air and water tightness of the wall, EPDM seals and other plastic materials are used. Other auxiliary components made of various materials such as aluminium, steel, zamak and plastics are also used.

The results of this EPD are representative for the following curtain walls systems: STRUGAL S52CR, STRUGAL S52CRi, STRUGAL S52NT and STRUGAL S52SGi.

The technical data of the declared products as well as their composition are shown in the following tables. None of the declared curtain wall systems contain substances included in the list of Substances of Very High Concern with a concentration of more than 0.1% by weight.

Packaging

The curtain walls are supplied on request with dimensions appropriate for each project in which they are implemented. Aluminium profiles and UVA are supplied separately. The aluminium profiles are supplied directly from the factory or from distribution centres under STRUGAL's control. The profiles are delivered on wooden pallets protected by cardboard corners and plastic film. These packaging elements have been included in the study. On the other hand, the packaging of insulating glass units (IGUs) has not been taken into account.

	STRUGAL S52CR	STRUGAL S52CRi	STRUGAL S52NT	STRUGAL S52SGi
Frame thickness (mm)	52	52	52	52
IGU	66.1/12Arg/44.1 BE	66.1/20Arg/44.1 BE	66.1/12Arg/44.1 BE	66.1/20Arg/44.1 BE
Thermal insulation (W/m^2K)	1,1	1,1	1,1	1,1
Air tightness UNE-EN 12207	AE (750 Pa)	AE (750 Pa)	AE (750 Pa)	AE (750 Pa)
Water tightness UNE-EN 12208	RE1350	RE1500	RE1350	RE1500
Wind load resistance UNE -EN 12210	Suitable, Design load ±2000Pa, Safety ±3000 Pa	Suitable, Design load ±2000Pa, Safety ±3000 Pa	Suitable, Design load ±2000Pa, Safety ±3000 Pa	Suitable, Design load ±2000Pa, Safety ±3000 Pa

Reference service life and use phase

As the use phase is not included in the analysis, the reference service life is not specified. In normal use, aluminium building products do not suffer significant alteration over time. In practice, a lifetime of 50 years can be assumed under normal conditions of use for this type of application with the exception of IGU which normally needs to be replaced after 30 years.

Recycling and disposal

Aluminium products are highly recyclable. During aluminium profile production, all post-industrial scrap (extrusion drop-offs from cutting, unfit material and discards, etc.) is fed back into the billet production process. Proceed in the same way with the aluminum cutouts generated during the assembly of the curtain wall.

When an aluminium building product reaches the end of its life, it is systematically and selectively collected and sent to recycling facilities for secondary billet production. A collection rate for aluminium products next to 95% is well documented in construction sector. Finally, recycling rate depends on smelting yield that includes metal losses during scrap preparation and melting.

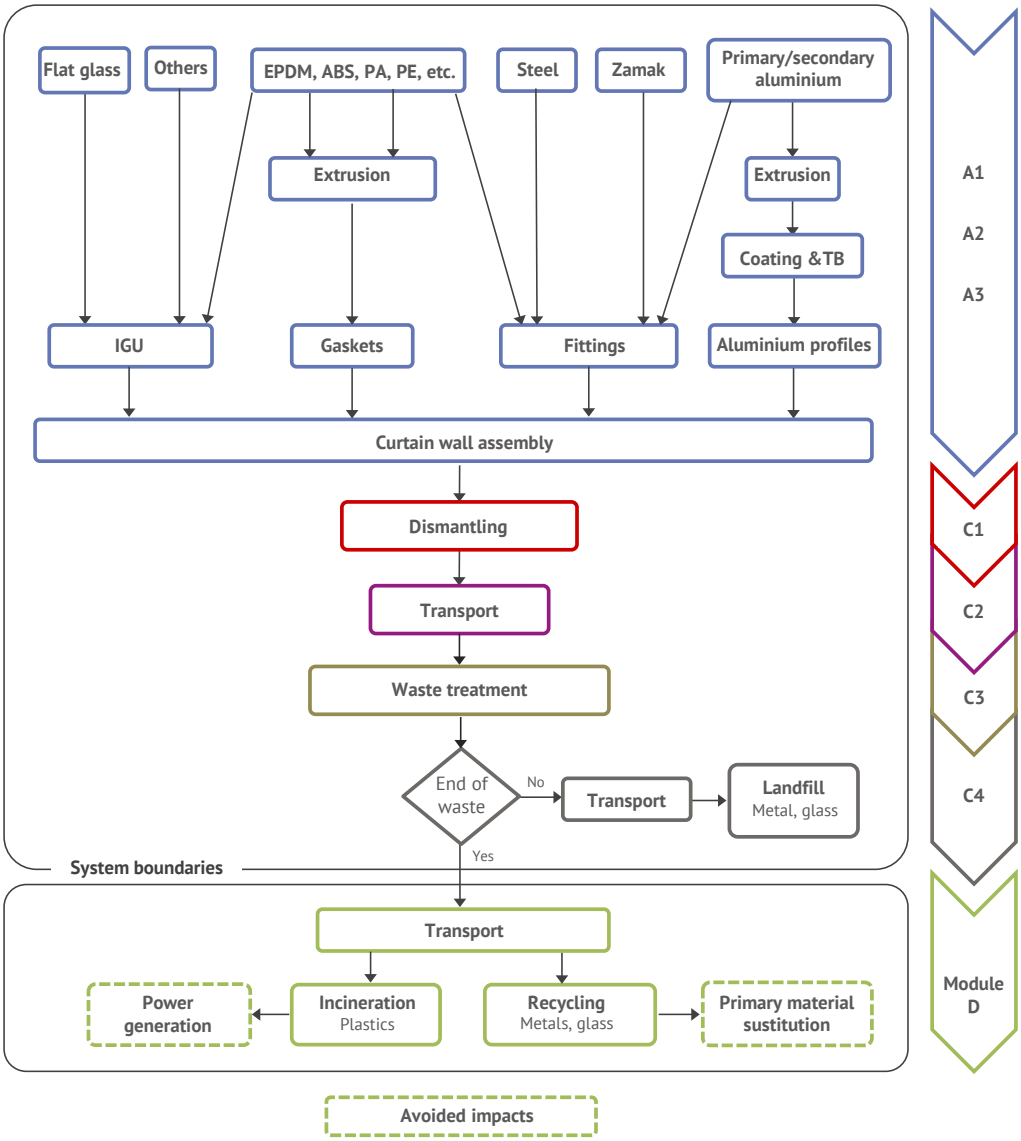
	STRUGAL S52CR	STRUGAL S52CRi	STRUGAL S52NT	STRUGAL S52SGi
Aluminium profile	**366.9 kg**	**298.2 kg**	**397.1 kg**	**328.4 kg**
Aluminium	356.3	290.6	386.3	320.6
Coating powder	10.53	7.60	10.80	7.87
IGU	**4707 kg**	**4733 kg**	**4707 kg**	**4733 kg**
Flat glass	2752	2752	2752	2752
Flat glass (low-e)	1835	1835	1835	1835
PVB	76.02	76.02	76.02	76.02
Zeolite	19.55	32.59	19.55	32.59
Polysulfide	11.51	19.18	11.51	19.18
Aluminium	10.00	14.00	10.00	14.00
Argon	1.79	2.99	1.79	2.99
PB	0.87	0.87	0.87	0.87
Gasket and fittings	**118.9 kg**	**84.1 kg**	**96.0 kg**	**86.9 kg**
PVC	45.44	13.40	19.72	13.51
EPDM	41.06	36.33	46.39	41.66
Aluminium	22.62	25.67	22.62	25.67
Stainless steel	5.21	3.71	5.21	3.71
Zamak	4.20	4.20	1.56	1.56
steel	0.39	0.39	0.39	0.39
TPE	0	0	0.11	0.11
PE	0	0.42	0	0.26
Secondary material	**240.5 kg**	**196.1 kg**	**260.7 kg**	**216.3 kg**
Renewable material	-	-	-	-
Packaging	**14.8 kg**	**12.1 kg**	**16.1 kg**	**13.3 kg**
Cardboard	2.30	1.88	2.50	2.07
Plastic film	4.49	3.66	4.87	4.04
Polyethylene foam	1.20	0.98	1.30	1.08
Plastic strap	0.07	0.05	0.07	0.06
Wood	6.67	5.44	7.24	6.00
Paper	0.09	0.08	0.10	0.08
Biogenic carbon	3.94	3.21	4.27	3.54

Hence, aluminium supply at the beginning of the product system has a content of recycled material from post-industrial and post-consumer scrap with the consequent reduction of environmental burdens. In module D are reported only the net benefits of recycling, i.e. the burder savings at the end of life minus the benefits already considered in the module A1 due to secondary aluminium content. In this EPD, the scrap not collected at the end of life (5%) is sent to landfill.

For the rest of the components of the windows, i.e. IGU, fittings and gaskets, EoL scenarios have been setup according to default values specified in EN 1721 for doors and windows as it is understood that these elements share the same fate.

System boundaries

The scope of the study is set to be "Cradle-to-gate with options". Processes included in the assessment are presented on the diagram below.



LCA INFORMATION

Declared unit

The declared unit is 1 m^2 of curtain wall with the technical characteristics shown on page 2 and a reference life of 50 years.

The indicators stated in this EPD have been calculated on the basis of a façade size of 15.0 m x 6.4 m. To obtain the environmental impacts and other parameters referring to 1 m^2 of product, these indicators were divided by the area of the façade (96.0 m^2). As a conservative estimate, 100% of the edge profiles of this representative product have been considered. In practice, the edge profiles are shared with other curtain wall of other facades of the building.

Goal and scope

This EPD evaluates the environmental impacts and parameters of 1 m^2 of curtain wall from cradle to gate with options (end of life and recycling). Hence, this is a cradle to gate EPD with C1-C2-C3-C4-D modules.

This EPD is the basis for B2B communication for customers and relevant stakeholders within the building sector.

System boundaries

This EPD provides information on the production stage of the aluminium profiles (raw material supply, transport to plants and manufacturing), IGU, gaskets and auxiliary components, and their end-of-life. Recycling potential of aluminium and others materials with burdens saving due to use in a second product systems is also reported. The information is presented in a modular way separated in the following stages.

A1-3 - Cradle to gate

The aggregation of the modules A1, A2 and A3 is allowed by EN 15804. This rule is applied in this EPD and denoted by A1-3. This module represents the manufacture and packaging of aluminium profiles (including extraction and processing of raw materials and the transport to production sites), the production of the rest of the elements of curtain walls (IGU, gaskets and auxiliary components).

C1 - De-construction

No information was found in the life cycle databases consulted for the dismantling operations of curtain walls, nor was there a bibliography regarding the inputs or residues generated during these operations.Then there is no

Stage	Production			Construction		Use							End-of-life				Resource recovery
Module	Raw materials supply	Transport	Manufacturing	Transport	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction	Transport	Waste processing	Disposal	Reuse, recovery or recycling potentials
	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Declared module	X	X	X	ND	ND	ND	ND	ND	ND	ND	ND	ND	X	X	X	X	X
Geography	EU	EU	ES	-	-	-	-	-	-	-	-	-	ES	ES	ES	ES	EU
Specific data	97%			-	-	-	-	-	-	-	-	-	-	-	-	-	-

ND - Not declared

contribution on impact categories of this module.

C2 - Transport to waste processing

A distance of 200 km has been assumed for the transport to scrap dealers. Transport is calculated on the basis of a scenario with the parameters described in the attached table.

C3 - Waste processing for reuse, recovery and/or recycling

In the databases consulted, no information was found on the treatment of waste generated in the dismantling of curtain walls as a whole, although the treatment operations in a CDW plant for curtain wall glass were included.

C4 - Final disposal

End of life scenarios, routes for final disposal, recovery rates and efficiencies in recycling for all components are modelled based on default figures provided by EN 17213 for doors and windows (see attached table).

D - Allocation by reuse, recovery or recycling

For aluminium profiles, module D report the environmental burden of recycled scrap generated at the end of life minus that used at the production stage. Scrap inputs to the production stage are subtracted from scrap to be recycled at end of life in order to obtain the net scrap output from the product system. This remaining net scrap is then sent to recycling. Loads and benefits are assessed at the point of functional equivalence, i.e. where the substitution of primary aluminium takes place.

Parameters, C2 module	
Transport by road (1)	Lorry, 17.3 t max payload
Diesel consumption (l/km)	0.221
Distance (km)	200
Volume capacity utilization	100%
Mass capacity utilisation	67%

(1) Technology mix, Euro 0, 1, 2, 3, 4

Parameters, C3 module	
Energy carrier	Electricity, low voltage {ES}
Consumption (kWh) (1)	1.27

(1) For declared unit

Parameters, C4 and D modules	
Recovery rate for metals (recycling)	95%
Recovery rate for glass (recycling)	30%
Recovery rate for plastics (energy valorization)	95%
Metals and plastics to landfill	5%
Glass to landfill	70%
Efficiency for materials recycling	90%
Efficiency for energy valorization	60%

This criteria is also applied in the case of other metals and glass that are sent to recycling.

For clarity in the results tables, only modules with a non-zero contribution to the impact categories and parameters stated in this EPD are shown.

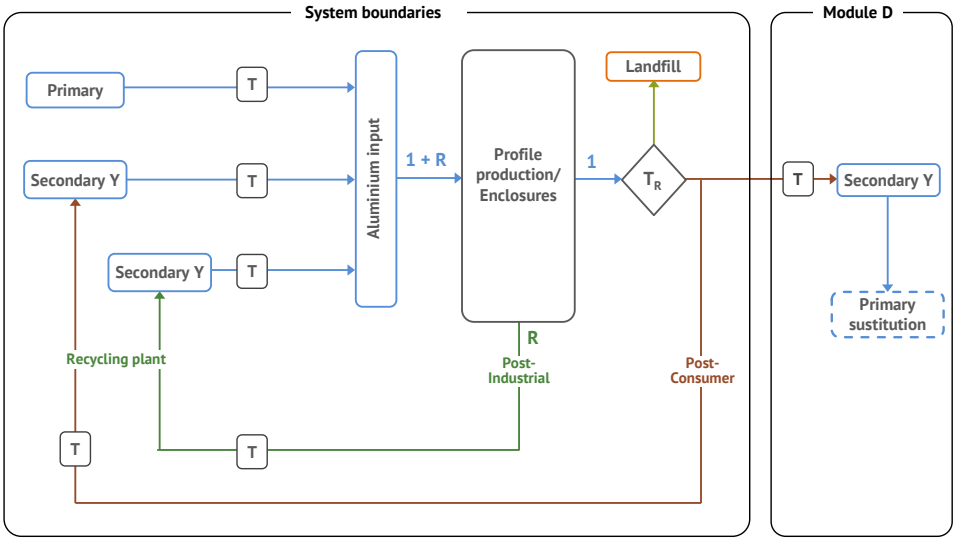
Time representativeness

All primary information used for the development of this EPD is based on production data for aluminium profiles manufactured in 2018, 2019 and 2020 by STRUGAL at its facilities. Data for IGU, gaskets and auxiliary components are based on information updated to 2020.

Database(s) and LCA software used

For all processes included in the LCA study, the Ecoinvent 3.6 database has been used.

The LCA study was carried out using a model based on excel templates. For the life cycle impact assessment (LCIA) of the above mentioned processes, the characterisation factors of the EC-JRC EF 2.0 method available at http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml.



R – Process losses T_R – Recovery Rate Y – Smelting yield T - Transport

Data Quality

All the activity data pertaining to the core processes were collected through surveys and meetings held with the technical staff of STRUGAL. Data were collected on production, consumption of raw materials and energy and the generation of waste, effluents and emissions. These inventories represent the average production of the aluminium profiles manufactured by STRUGAL and the curtain wall systems analysed. For those processes that are not under the control of the organisation, first-hand data from the aluminium sector were used to achieve the required accuracy, consistency and representativeness.

Specific regional databases have been used to include electricity, natural gas or diesel consumption in the life cycle inventory. For transport, raw material production or end-of-life processes, databases were chosen according to their technological and geographical representativeness of the actual process. Technological and geographical representativeness is ensured for all concerns included in the LCA, including those of greatest relevance to the final result. For example, for climate change, the technological representativeness of the processes that contribute 92% of the total value has been qualified as very good or good according to Annex E of the UNE EN 15804 standard. The environmental databases used are less than 3 years old.

Estimates and Assumptions

During the preparation of the inventories, it was possible to distinguish the energy consumption assigned to the main stages of production of aluminium profiles: extrusion, coating and anodising. The electricity consumed in the incorporation of the TBB, in packaging, as well as in other common plant services, has been assigned to the total number of tonnes extruded. This assumption does not entail a significant loss of precision, as its impact on the final result has been found to be very low.

The surface treatments chosen to complete the coating and anodising processes are the most complete and those that require the use of the greatest amount of chemical products per square metre of surface treated, thus meeting a conservative criterion.

Information has been collected from STRUGAL's aluminium billet suppliers. In all cases, the geographical area of the manufacturer and the recycling content of all of them was taken into account. This recycling content amounts to 67%, which reduces the environmental impact of the incoming aluminium. This value also allows the balance of aluminium leaving the limits of the system to calculate the avoided impacts of module D.

All the aluminium scrap produced during the manufacturing of profiles (post-industrial scrap) is sent for recycling. Although this recycling process is in most cases carried out at a different location from where the scrap is generated, it has been modelled in all cases as an effective closed cycle as there is no loss of inherent properties of the aluminium during the process. In addition, the scrap is used in the production of the same products that generate it. Due to this circumstance, no load allocation has been carried out and it has been considered that the aluminium profiles are the only product generated in module A1-3, with no other co-product. In this way, all post-industrial aluminium scrap is free of charge when it enters the system again. In any case, it does include the transport to recycling of the scrap generated by STRUGAL.

The materials and weight of the fittings and seals were obtained from the breakdown of the STRUGAL curtain walls systems. Not only the materials they are made of but also the manufacturing process such as extrusion or injection moulding in the case of plastic components or forging or machining in the case of metal components have been taken into account. In the case of UVA, the weight of some components such as glass, aluminium, zeolite, argon and sealants have been modelled from geometric calculations based on specifications together with density values obtained from material databases. Environmental aspects such as water and electricity consumed, or glass offcuts generated during the manufacturing of IGU, have been obtained from the ecoinvent database.

In order to obtain the net aluminium output of the system at the end of the useful life of profiles, the scrap input at the production stage is subtracted from the scrap sent for recycling at the end of its useful life. In Module D, the environmental burdens and benefits of recycling the net scrap leaving the system are allocated. These environmental aspects have been assessed up to the point of functional equivalence (the point at which the replacement of primary aluminium takes place), i.e. the production of secondary aluminium billet. In this recycling process, the performance of the melting furnaces for each of the scrap fractions (anodised, coated) has been taken into account.

RESULTS

STRUGAL S52CR

			COATED					ANODIZED				
			A1-3	C2	C3	C4	D	A1-3	C2	C3	C4	D
BASIC ENVIRONMENTAL IMPACTS	CC-2013	kg CO_2 eq	85.0	1.87	7.08E-02	0.619	-14.9	85.9	1.87	7.08E-02	0.618	-14.8
	CC-total	kg CO_2 eq	86.5	1.89	7.22E-02	0.631	-15.3	87.5	1.89	7.22E-02	0.630	-15.2
	CC-fossil	kg CO_2 eq	85.9	1.89	7.15E-02	0.630	-15.0	86.8	1.89	7.15E-02	0.629	-14.8
	CC-biogenic	kg CO_2 eq	0.392	1.02E-03	2.17E-04	5.78E-04	-0.145	0.480	1.02E-03	2.17E-04	5.78E-04	-0.144
	CC-luluc	kg CO_2 eq	0.201	6.74E-04	5.28E-04	2.24E-04	-0.190	0.211	6.72E-04	5.28E-04	2.24E-04	-0.187
	OD	kg CFC-11 eq	5.90E-04	4.30E-07	8.89E-09	1.70E-07	-2.65E-06	1.10E-05	4.30E-07	8.89E-09	1.70E-07	-2.64E-06
	A	mol H^+ eq	0.744	5.44E-03	6.54E-04	3.32E-03	-0.203	0.746	5.43E-03	6.54E-04	3.32E-03	-0.203
	EAF	kg P eq	2.94E-03	1.51E-05	2.94E-06	6.08E-06	-7.09E-04	2.46E-03	1.51E-05	2.94E-06	6.08E-06	-7.03E-04
	EAM	kg N eq	0.113	1.08E-03	1.27E-04	1.02E-03	-2.96E-02	0.114	1.07E-03	1.27E-04	1.02E-03	-2.95E-02
	ET	mol N eq	1.35	1.20E-02	1.42E-03	1.12E-02	-0.355	1.36	1.20E-02	1.42E-03	1.12E-02	-0.354
	POF	kg NMVOC eq	0.358	4.61E-03	3.89E-04	3.43E-03	-0.093	0.359	4.60E-03	3.89E-04	3.43E-03	-0.093
	AD-non fossil	kg Sb eq	6.52E-03	5.22E-05	5.26E-07	1.31E-05	-3.26E-03	5.94E-03	5.21E-05	5.26E-07	1.31E-05	-3.26E-03
	AD-fossil	MJ	1080	28.6	1.54	11.54	-331	1103	28.6	1.54	11.54	-329
	WU	m^3 eq	21.0	8.10E-02	4.11E-02	0.244	-5.84	21.5	8.08E-02	4.11E-02	0.244	-5.84
ADDITIONAL ENVIRONMENTAL IMPACTS	PM	Disease incidence	5.87E-04	1.20E-07	4.36E-09	6.32E-08	-1.74E-06	7.47E-06	1.20E-07	4.36E-09	6.32E-08	-1.73E-06
	IR	kBq U235 eq	3.73	0.125	1.54E-02	4.88E-02	-2.13	4.10	0.125	1.54E-02	4.88E-02	-2.11
	EF	CTUe	2352	23.0	1.28	9.12	-389	2689	23.0	1.28	9.10	-389
	HT-c	CTUh	5.79E-04	6.42E-10	4.42E-11	2.57E-10	-2.23E-08	7.41E-08	6.41E-10	4.42E-11	2.57E-10	-2.19E-08
	HT-nc	CTUh	5.82E-04	2.43E-08	1.07E-09	8.18E-09	-3.38E-07	1.04E-05	2.42E-08	1.07E-09	8.18E-09	-3.33E-07
	LU	Dimensionless	398	20.0	1.04	15.2	-78.8	404	20.0	1.04	15.2	-78.7

ENVIRONMENTAL IMPACTS. CC-2013: Climatic Change according to EN 15804:2012+A1:2013; **CC-total**: Climatic Change - total; **CC-fossil:** Climatic Change - fossil; **CC-biogenic**: Climate change - biogenic; **CC-luluc**: Climate change - land use and land use change; **OD**: Ozone depletion; **A**: Acidification ; **EAF**: Eutrophication aquatic freshwater; **EAM**: Eutrophication aquatic marine; **ET**: Eutrophication terrestrial; **POF**: Photochemical ozone formation; **AD- non fossil**: Abiotic resource depletion - minerals and metals (1); **AD-fossil**: Abiotic resource depletion - fossils (1); **WU**: Water use (1); **PM**: Particulate matter emissions (1); **IR**: Ionising radiation (2); **EF**: Ecotoxicity - freshwater (1); **HT-c**: Human toxicity, cancer effects (1); **HT-nc**: Human toxicity, non-cancer effects (1); **LU**: Land use (1).

(1) The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.

(2) 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.

STRUGAL S52CR

			COATED					ANODIZED				
			A1-3	C2	C3	C4	D	A1-3	C2	C3	C4	D
RESOURCE USE	PERE	MJ	114	4.10E-01	0.36	1.42E-01	-68.5	118	4.09E-01	0.36	1.42E-01	-67.7
	PERM	MJ	0	0	0	0	0	0	0	0	0	0
	PERT	MJ	114	4.10E-01	0.36	1.42E-01	-68.5	118	4.09E-01	0.36	1.42E-01	-67.7
	PENRE	MJ	1158	30.4	1.59	12.3	-352	1182	30.3	1.59	12.3	-350
	PENRM	MJ	0	0	0	0	0	0	0	0	0	0
	PENRT	MJ	1158	30.4	1.59	12.3	-352	1182	30.3	1.59	12.3	-350
	SM	kg	3.10	0	0	0	0	3.10	0	0	0	0
	RSF	MJ	0	0	0	0	0	0	0	0	0	0
	NRSF	MJ	0	0	0	0	0	0	0	0	0	0
	FW	m^3 eq	404	1.63	1.11	0.62	-181	412	1.63	1.11	0.62	-179
WASTE	HWD	kg	3.13E-02	0	0	0	7.71E-03	3.06E-02	0	0	0	7.53E-03
	NHWD	kg	16.3	1.39	0	34.1	-3.03	16.3	1.39	0	34.1	-2.99
	RWD	kg	2.96E-02	0	0	0	-1.89E-03	2.92E-02	0	0	0	-1.87E-03
OUTPUT FLOWS	CRU	kg	0	0	0	0	0	0	0	0	0	0
	MFR	kg	4.37	0	18.3	0	0	4.37	0	18.2	0	0
	MER	kg	0	0	1.61	0	0	0	0	1.61	0	0
	EE-e	MJ	0	0	48.4	0	0	0	0	48.4	0	0
	EE-t	MJ	0	0	0	0	0	0	0	0	0	0

RESOURCE USE. PERE: Renewable primary energy as energy carrier; **PERM**: Renewable primary energy resource as material utilization; **PERT**: Total use of renewable primary energy resources; **PENRE**: Non-renewable primary energy as energy carrier; **PENRM**: Non-renewable primary energy as material utilization; **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.

WASTE CATEGORIES. HWD: Hazardous waste disposed; **NHWD**: Non-hazardous waste disposed; **RWD**: Radioactive waste disposed.

OUTPUT FLOWS. CRU: Components for re-use; **MFR**: Materials for recycling; **MER**: Materials for energy recovery; **EE-e**: Exported energy (electricity); **EE-t**: Exported energy (thermal)

STRUGAL S52CRI

			COATED					ANODIZED				
			A1-3	C2	C3	C4	D	A1-3	C2	C3	C4	D
BASIC ENVIRONMENTAL IMPACTS	CC-2013	kg CO_2 eq	82.5	1.83	7.08E-02	0.606	-13.5	83.3	1.82	7.08E-02	0.605	-13.4
	CC-total	kg CO_2 eq	83.9	1.84	7.22E-02	0.617	-13.9	84.8	1.84	7.22E-02	0.616	-13.8
	CC-fossil	kg CO_2 eq	83.4	1.84	7.15E-02	0.616	-13.6	84.2	1.84	7.15E-02	0.615	-13.5
	CC-biogenic	kg CO_2 eq	0.372	9.91E-04	2.17E-04	5.77E-04	-0.138	0.445	9.90E-04	2.17E-04	5.76E-04	-0.138
	CC-luluc	kg CO_2 eq	0.177	6.56E-04	5.28E-04	2.20E-04	-0.164	0.186	6.55E-04	5.28E-04	2.20E-04	-0.162
	OD	kg CFC-11 eq	4.29E-04	4.19E-07	8.89E-09	1.68E-07	-2.47E-06	1.05E-05	4.19E-07	8.89E-09	1.68E-07	-2.45E-06
	A	mol H^+ eq	0.727	5.29E-03	6.54E-04	3.30E-03	-0.191	0.730	5.29E-03	6.54E-04	3.30E-03	-0.191
	EAF	kg P eq	2.66E-03	1.47E-05	2.94E-06	5.99E-06	-6.34E-04	2.32E-03	1.47E-05	2.94E-06	5.99E-06	-6.30E-04
	EAM	kg N eq	0.111	1.05E-03	1.27E-04	1.02E-03	-2.80E-02	0.112	1.05E-03	1.27E-04	1.02E-03	-2.79E-02
	ET	mol N eq	1.33	1.17E-02	1.42E-03	1.12E-02	-0.337	1.34	1.17E-02	1.42E-03	1.12E-02	-0.336
	POF	kg NMVOC eq	0.350	4.49E-03	3.89E-04	3.41E-03	-0.088	0.351	4.48E-03	3.89E-04	3.41E-03	-0.087
	AD-non fossil	kg Sb eq	6.27E-03	5.09E-05	5.26E-07	1.28E-05	-3.26E-03	5.85E-03	5.08E-05	5.26E-07	1.28E-05	-3.26E-03
	AD-fossil	MJ	1031	27.9	1.54	11.39	-299	1052	27.8	1.54	11.38	-297
	WU	m^3 eq	20.1	7.89E-02	4.11E-02	0.244	-5.19	20.6	7.88E-02	4.11E-02	0.244	-5.19
ADDITIONAL ENVIRONMENTAL IMPACTS	PM	Disease incidence	4.26E-04	1.17E-07	4.36E-09	6.26E-08	-1.69E-06	7.34E-06	1.17E-07	4.36E-09	6.26E-08	-1.68E-06
	IR	kBq U235 eq	3.48	0.122	1.54E-02	4.81E-02	-1.81	3.79	0.122	1.54E-02	4.81E-02	-1.80
	EF	CTUe	2460	22.4	1.28	8.91	-370	2738	22.4	1.28	8.90	-369
	HT-c	CTUh	4.19E-04	6.25E-10	4.42E-11	2.51E-10	-1.99E-08	6.88E-08	6.24E-10	4.42E-11	2.51E-10	-1.96E-08
	HT-nc	CTUh	4.21E-04	2.36E-08	1.07E-09	8.03E-09	-3.05E-07	8.59E-06	2.36E-08	1.07E-09	8.03E-09	-3.02E-07
	LU	Dimensionless	388	19.5	1.04	15.2	-74.4	394	19.5	1.04	15.2	-74.4

ENVIRONMENTAL IMPACTS. CC-2013: Climatic Change according to EN 15804:2012+A1:2013; **CC-total**: Climatic Change - total; **CC-fossil:** Climatic Change - fossil; **CC-biogenic**: Climate change - biogenic; **CC-luluc**: Climate change - land use and land use change; **OD**: Ozone depletion; **A**: Acidification ; **EAF**: Eutrophication aquatic freshwater; **EAM**: Eutrophication aquatic marine; **ET**: Eutrophication terrestrial; **POF**: Photochemical ozone formation; **AD- non fossil**: Abiotic resource depletion - minerals and metals (1); **AD-fossil**: Abiotic resource depletion - fossils (1); **WU**: Water use (1); **PM**: Particulate matter emissions (1); **IR**: Ionising radiation (2); **EF**: Ecotoxicity - freshwater (1); **HT-c**: Human toxicity, cancer effects (1); **HT-nc**: Human toxicity, non-cancer effects (1); **LU**: Land use (1).

(1) The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.

(2) 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.

STRUGAL S52CRI

			COATED					ANODIZED				
			A1-3	C2	C3	C4	D	A1-3	C2	C3	C4	D
RESOURCE USE	PERE	MJ	102	3.99E-01	0.36	1.39E-01	-58.9	106	3.98E-01	0.36	1.39E-01	-58.3
	PERM	MJ	0	0	0	0	0	0	0	0	0	0
	PERT	MJ	102	4.00E-01	0.36	1.40E-01	-58.9	106	3.99E-01	0.36	1.39E-01	-58.3
	PENRE	MJ	1106	29.6	1.59	12.1	-318	1128	29.5	1.59	12.1	-316
	PENRM	MJ	0	0	0	0	0	0	0	0	0	0
	PENRT	MJ	1106	29.6	1.59	12.1	-318	1128	29.5	1.59	12.1	-316
	SM	kg	2.53	0	0	0	0	2.53	0	0	0	0
	RSF	MJ	0	0	0	0	0	0	0	0	0	0
	NRSF	MJ	0	0	0	0	0	0	0	0	0	0
	FW	m^3 eq	362	1.59	1.11	0.60	-153	370	1.59	1.11	0.60	-152
WASTE	HWD	kg	2.61E-02	0	0	0	6.77E-03	2.55E-02	0	0	0	6.64E-03
	NHWD	kg	15.6	1.36	0	34.2	-2.74	15.5	1.35	0	34.2	-2.71
	RWD	kg	2.47E-02	0	0	0	-1.65E-03	2.44E-02	0	0	0	-1.64E-03
OUTPUT FLOWS	CRU	kg	0	0	0	0	0	0	0	0	0	0
	MFR	kg	4.19	0	17.6	0	0	4.19	0	17.5	0	0
	MER	kg	0	0	1.25	0	0	0	0	1.25	0	0
	EE-e	MJ	0	0	37.6	0	0	0	0	37.6	0	0
	EE-t	MJ	0	0	0	0	0	0	0	0	0	0

RESOURCE USE. PERE: Renewable primary energy as energy carrier; **PERM**: Renewable primary energy resource as material utilization; **PERT**: Total use of renewable primary energy resources; **PENRE**: Non-renewable primary energy as energy carrier; **PENRM**: Non-renewable primary energy as material utilization; **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.

WASTE CATEGORIES. HWD: Hazardous waste disposed; **NHWD**: Non-hazardous waste disposed; **RWD**: Radioactive waste disposed.

OUTPUT FLOWS. CRU: Components for re-use; **MFR**: Materials for recycling; **MER**: Materials for energy recovery; **EE-e**: Exported energy (electricity); **EE-t**: Exported energy (thermal)

STRUGAL S52NT

			COATED					ANODIZED				
			A1-3	C2	C3	C4	D	A1-3	C2	C3	C4	D
BASIC ENVIRONMENTAL IMPACTS	CC-2013	kg CO_2 eq	86.1	1.89	7.08E-02	0.612	-14.8	87.1	1.89	7.08E-02	0.611	-14.6
	CC-total	kg CO_2 eq	87.6	1.91	7.22E-02	0.623	-15.2	88.7	1.91	7.22E-02	0.622	-15.0
	CC-fossil	kg CO_2 eq	87.0	1.91	7.15E-02	0.622	-14.8	88.0	1.90	7.15E-02	0.621	-14.7
	CC-biogenic	kg CO_2 eq	0.390	1.03E-03	2.17E-04	5.71E-04	-0.142	0.485	1.02E-03	2.17E-04	5.71E-04	-0.141
	CC-luluc	kg CO_2 eq	0.215	6.79E-04	5.28E-04	2.22E-04	-0.194	0.226	6.78E-04	5.28E-04	2.22E-04	-0.191
	OD	kg CFC-11 eq	6.14E-04	4.34E-07	8.89E-09	1.69E-07	-2.64E-06	1.09E-05	4.33E-07	8.89E-09	1.68E-07	-2.62E-06
	A	mol H^+ eq	0.753	5.48E-03	6.54E-04	3.31E-03	-0.200	0.756	5.47E-03	6.54E-04	3.31E-03	-0.199
	EAF	kg P eq	3.01E-03	1.52E-05	2.94E-06	6.02E-06	-6.94E-04	2.52E-03	1.52E-05	2.94E-06	6.02E-06	-6.88E-04
	EAM	kg N eq	0.114	1.08E-03	1.27E-04	1.02E-03	-2.90E-02	0.115	1.08E-03	1.27E-04	1.02E-03	-2.89E-02
	ET	mol N eq	1.36	1.21E-02	1.42E-03	1.12E-02	-0.348	1.37	1.21E-02	1.42E-03	1.12E-02	-0.347
	POF	kg NMVOC eq	0.362	4.65E-03	3.89E-04	3.42E-03	-0.092	0.363	4.64E-03	3.89E-04	3.42E-03	-0.091
	AD-non fossil	kg Sb eq	4.48E-03	5.27E-05	5.26E-07	1.29E-05	-1.43E-03	3.88E-03	5.26E-05	5.26E-07	1.29E-05	-1.43E-03
	AD-fossil	MJ	1091	28.8	1.54	11.44	-323	1117	28.8	1.54	11.44	-321
	WU	m^3 eq	20.8	8.16E-02	4.11E-02	0.244	-5.40	21.4	8.15E-02	4.11E-02	0.244	-5.40
ADDITIONAL ENVIRONMENTAL IMPACTS	PM	Disease incidence	6.11E-04	1.21E-07	4.36E-09	6.28E-08	-1.76E-06	7.57E-06	1.21E-07	4.36E-09	6.28E-08	-1.75E-06
	IR	kBq U235 eq	3.84	0.126	1.54E-02	4.83E-02	-2.02	4.24	0.126	1.54E-02	4.83E-02	-2.01
	EF	CTUe	2379	23.2	1.28	9.00	-367	2744	23.2	1.28	8.98	-366
	HT-c	CTUh	6.04E-04	6.47E-10	4.42E-11	2.55E-10	-2.30E-08	7.72E-08	6.46E-10	4.42E-11	2.55E-10	-2.25E-08
	HT-nc	CTUh	6.06E-04	2.45E-08	1.07E-09	8.09E-09	-3.32E-07	1.11E-05	2.44E-08	1.07E-09	8.09E-09	-3.28E-07
	LU	Dimensionless	402	20.2	1.04	15.2	-76.2	409	20.1	1.04	15.2	-76.1

ENVIRONMENTAL IMPACTS. CC-2013: Climatic Change according to EN 15804:2012+A1:2013; **CC-total**: Climatic Change - total; **CC-fossil:** Climatic Change - fossil; **CC-biogenic**: Climate change - biogenic; **CC-luluc**: Climate change - land use and land use change; **OD**: Ozone depletion; **A**: Acidification ; **EAF**: Eutrophication aquatic freshwater; **EAM**: Eutrophication aquatic marine; **ET**: Eutrophication terrestrial; **POF**: Photochemical ozone formation; **AD- non fossil**: Abiotic resource depletion - minerals and metals (1); **AD-fossil**: Abiotic resource depletion - fossils (1); **WU**: Water use (1); **PM**: Particulate matter emissions (1); **IR**: Ionising radiation (2); **EF**: Ecotoxicity - freshwater (1); **HT-c**: Human toxicity, cancer effects (1); **HT-nc**: Human toxicity, non-cancer effects (1); **LU**: Land use (1).

(1) The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.

(2) 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.

STRUGAL S52NT

			COATED					ANODIZED				
			A1-3	C2	C3	C4	D	A1-3	C2	C3	C4	D
RESOURCE USE	PERE	MJ	120	4.13E-01	0.36	1.40E-01	-67.8	124	4.12E-01	0.36	1.40E-01	-67.0
	PERM	MJ	0	0	0	0	0	0	0	0	0	0
	PERT	MJ	120	4.14E-01	0.36	1.41E-01	-67.8	124	4.13E-01	0.36	1.41E-01	-67.0
	PENRE	MJ	1169	30.6	1.59	12.1	-344	1196	30.6	1.59	12.1	-342
	PENRM	MJ	0	0	0	0	0	0	0	0	0	0
	PENRT	MJ	1169	30.6	1.59	12.1	-344	1196	30.6	1.59	12.1	-342
	SM	kg	3.41	0	0	0	0	3.41	0	0	0	0
	RSF	MJ	0	0	0	0	0	0	0	0	0	0
	NRSF	MJ	0	0	0	0	0	0	0	0	0	0
	FW	m^3 eq	427	1.64	1.11	0.61	-176	437	1.64	1.11	0.61	-174
WASTE	HWD	kg	3.39E-02	0	0	0	8.47E-03	3.32E-02	0	0	0	8.28E-03
	NHWD	kg	16.8	1.40	0	34.0	-3.09	16.7	1.40	0	34.0	-3.05
	RWD	kg	3.22E-02	0	0	0	-1.82E-03	3.18E-02	0	0	0	-1.81E-03
OUTPUT FLOWS	CRU	kg	0	0	0	0	0	0	0	0	0	0
	MFR	kg	4.54	0	18.6	0	0	4.54	0	18.5	0	0
	MER	kg	0	0	1.41	0	0	0	0	1.41	0	0
	EE-e	MJ	0	0	42.4	0	0	0	0	42.4	0	0
	EE-t	MJ	0	0	0	0	0	0	0	0	0	0

RESOURCE USE. PERE: Renewable primary energy as energy carrier; **PERM**: Renewable primary energy resource as material utilization; **PERT**: Total use of renewable primary energy resources; **PENRE**: Non-renewable primary energy as energy carrier; **PENRM**: Non-renewable primary energy as material utilization; **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.

WASTE CATEGORIES. HWD: Hazardous waste disposed; **NHWD**: Non-hazardous waste disposed; **RWD**: Radioactive waste disposed.

OUTPUT FLOWS. CRU: Components for re-use; **MFR**: Materials for recycling; **MER**: Materials for energy recovery; **EE-e**: Exported energy (electricity); **EE-t**: Exported energy (thermal)

STRUGAL S52SGI

			COATED					ANODIZED				
			A1-3	C2	C3	C4	D	A1-3	C2	C3	C4	D
BASIC ENVIRONMENTAL IMPACTS	CC-2013	kg CO_2 eq	84.0	1.85	7.08E-02	0.608	-13.9	84.9	1.84	7.08E-02	0.608	-13.8
	CC-total	kg CO_2 eq	85.4	1.87	7.22E-02	0.619	-14.3	86.4	1.86	7.22E-02	0.619	-14.2
	CC-fossil	kg CO_2 eq	84.9	1.86	7.15E-02	0.618	-14.0	85.8	1.86	7.15E-02	0.618	-13.9
	CC-biogenic	kg CO_2 eq	0.368	1.00E-03	2.17E-04	5.76E-04	-0.138	0.447	1.00E-03	2.17E-04	5.75E-04	-0.137
	CC-luluc	kg CO_2 eq	0.189	6.64E-04	5.28E-04	2.21E-04	-0.175	0.198	6.63E-04	5.28E-04	2.21E-04	-0.172
	OD	kg CFC-11 eq	4.42E-04	4.24E-07	8.89E-09	1.68E-07	-2.52E-06	1.07E-05	4.23E-07	8.89E-09	1.68E-07	-2.51E-06
	A	mol H^+ eq	0.737	5.36E-03	6.54E-04	3.30E-03	-0.194	0.741	5.35E-03	6.54E-04	3.30E-03	-0.193
	EAF	kg P eq	2.73E-03	1.49E-05	2.94E-06	6.01E-06	-6.50E-04	2.39E-03	1.49E-05	2.94E-06	6.01E-06	-6.45E-04
	EAM	kg N eq	0.112	1.06E-03	1.27E-04	1.02E-03	-2.82E-02	0.113	1.06E-03	1.27E-04	1.02E-03	-2.81E-02
	ET	mol N eq	1.34	1.19E-02	1.42E-03	1.12E-02	-0.339	1.35	1.18E-02	1.42E-03	1.12E-02	-0.339
	POF	kg NMVOC eq	0.355	4.54E-03	3.89E-04	3.42E-03	-0.089	0.356	4.54E-03	3.89E-04	3.41E-03	-0.089
	AD-non fossil	kg Sb eq	4.23E-03	5.15E-05	5.26E-07	1.28E-05	-1.43E-03	3.80E-03	5.14E-05	5.26E-07	1.28E-05	-1.43E-03
	AD-fossil	MJ	1053	28.2	1.54	11.42	-307	1076	28.2	1.54	11.42	-305
	WU	m^3 eq	20.4	7.98E-02	4.11E-02	0.244	-5.21	21.0	7.97E-02	4.11E-02	0.244	-5.21
ADDITIONAL ENVIRONMENTAL IMPACTS	PM	Disease incidence	4.39E-04	1.18E-07	4.36E-09	6.27E-08	-1.71E-06	7.45E-06	1.18E-07	4.36E-09	6.27E-08	-1.70E-06
	IR	kBq U235 eq	3.59	0.123	1.54E-02	4.82E-02	-1.88	3.92	0.123	1.54E-02	4.82E-02	-1.87
	EF	CTUe	2490	22.7	1.28	8.95	-358	2789	22.7	1.28	8.93	-358
	HT-c	CTUh	4.32E-04	6.32E-10	4.42E-11	2.52E-10	-2.07E-08	7.16E-08	6.31E-10	4.42E-11	2.52E-10	-2.04E-08
	HT-nc	CTUh	4.34E-04	2.39E-08	1.07E-09	8.06E-09	-3.07E-07	9.11E-06	2.39E-08	1.07E-09	8.06E-09	-3.04E-07
	LU	Dimensionless	393	19.7	1.04	15.2	-74.6	399	19.7	1.04	15.2	-74.6

ENVIRONMENTAL IMPACTS. CC-2013: Climatic Change according to EN 15804:2012+A1:2013; **CC-total**: Climatic Change - total; **CC-fossil:** Climatic Change - fossil; **CC-biogenic**: Climate change - biogenic; **CC-luluc**: Climate change - land use and land use change; **OD**: Ozone depletion; **A**: Acidification ; **EAF**: Eutrophication aquatic freshwater; **EAM**: Eutrophication aquatic marine; **ET**: Eutrophication terrestrial; **POF**: Photochemical ozone formation; **AD- non fossil**: Abiotic resource depletion - minerals and metals (1); **AD-fossil**: Abiotic resource depletion - fossils (1); **WU**: Water use (1); **PM**: Particulate matter emissions (1); **IR**: Ionising radiation (2); **EF**: Ecotoxicity - freshwater (1); **HT-c**: Human toxicity, cancer effects (1); **HT-nc**: Human toxicity, non-cancer effects (1); **LU**: Land use (1).

(1) The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.

(2) 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.

STRUGAL S52SGI

			COATED					ANODIZED				
			A1-3	C2	C3	C4	D	A1-3	C2	C3	C4	D
RESOURCE USE	PERE	MJ	108	4.04E-01	0.36	1.40E-01	-62.0	111	4.03E-01	0.36	1.40E-01	-61.3
	PERM	MJ	0	0	0	0	0	0	0	0	0	0
	PERT	MJ	108	4.04E-01	0.36	1.40E-01	-62.0	111	4.04E-01	0.36	1.40E-01	-61.3
	PENRE	MJ	1129	29.9	1.59	12.1	-326	1153	29.9	1.59	12.1	-324
	PENRM	MJ	0	0	0	0	0	0	0	0	0	0
	PENRT	MJ	1129	29.9	1.59	12.1	-326	1153	29.9	1.59	12.1	-324
	SM	kg	2.78	0	0	0	0	2.78	0	0	0	0
	RSF	MJ	0	0	0	0	0	0	0	0	0	0
	NRSF	MJ	0	0	0	0	0	0	0	0	0	0
	FW	m^3 eq	383	1.61	1.11	0.61	-161	391	1.60	1.11	0.61	-159
WASTE	HWD	kg	2.81E-02	0	0	0	7.53E-03	2.76E-02	0	0	0	7.39E-03
	NHWD	kg	16.0	1.37	0	34.2	-2.85	16.0	1.37	0	34.2	-2.82
	RWD	kg	2.68E-02	0	0	0	-1.70E-03	2.65E-02	0	0	0	-1.69E-03
OUTPUT FLOWS	CRU	kg	0	0	0	0	0	0	0	0	0	0
	MFR	kg	4.26	0	17.9	0	0	4.25	0	17.8	0	0
	MER	kg	0	0	1.30	0	0	0	0	1.30	0	0
	EE-e	MJ	0	0	39.2	0	0	0	0	39.2	0	0
	EE-t	MJ	0	0	0	0	0	0	0	0	0	0

RESOURCE USE. PERE: Renewable primary energy as energy carrier; **PERM**: Renewable primary energy resource as material utilization; **PERT**: Total use of renewable primary energy resources; **PENRE**: Non-renewable primary energy as energy carrier; **PENRM**: Non-renewable primary energy as material utilization; **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.

WASTE CATEGORIES. HWD: Hazardous waste disposed; **NHWD**: Non-hazardous waste disposed; **RWD**: Radioactive waste disposed.

OUTPUT FLOWS. CRU: Components for re-use; **MFR**: Materials for recycling; **MER**: Materials for energy recovery; **EE-e**: Exported energy (electricity); **EE-t**: Exported energy (thermal)

VERIFICATION

This EPD is in accordance with ISO 14025 and with the requirements set by the basic product category rules for construction products 15804:2012+A2:2019 and by the general rules of The International EPD® System programme. For EoL scenarios, the specifications of the EN 17213 standard for environmental product declarations for windows and doors have also been met. The results shown in this EPD are based on the LCA report for STRUGAL products EPD dated 5 November 2021 according to ISO 14044.

This EPD does not contain comparative claims and its results are not comparable with other EPDs where these do not comply with the requirements set out in EN 15804. On the other hand, EPD with the same product category, but from different programmes, may not be comparable. This EPD is representative of the products covered.

The holder of this Declaration is responsible for its contents and for keeping the supporting documentation on which the statements and data contained therein are based for the period of validity of this Declaration.

EPD Programme	The International EPD® System EPD International AB Box 210 60 SE-100 31 Stockholm Sweden www.environdec.com info@environdec.com
EPD registration number	S-P-05213
EPD owner	STRUGAL
Declared unit	1 m^2 of curtain wall
System boundaries	Cradle to gate with options
Published	2022 - 01 - 10
Valid until	2027 - 01 - 10
Reference year for data	2018-2019-2020
Geographical scope	Wordwide
Product group classification	CPC 2.0 41532 Aluminium bars, rods and profiles, of aluminium
Product Category Rules	PCR 2019:14 Construction Products v1.0. PCR moderator: Martin Erlandsson, IVL Swedish Environmental Research Institute, martin.erlandsson@ivl.se
PCR review was conducted by	Technical Committee of The International EPD® System
Independent verification of the declaration and data, according to ISO 14025:2006	☒ External ☐ Internal ☐ EPD®
Third-party verifier	Lorena Pereda Centro Tecnológico de Miranda de Ebro www. ctme.es
EPD prepared by	IDNÓVAM Innovación y desarrollo para el ambiente info@idnovam.com

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