Type III Environmental Product Declaration No. 554/2023

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PAF 50 SI Facades systems

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Basic information

This declaration is the Type III Environmental Product Declaration (EPD) based on EN 15804+A2 and verified according to ISO 14025 by an external auditor. It contains the information on the impacts of the declared construction materials on the environment and their aspects verified by the independent body according to ISO 14025. Basically, comparison or evaluation of EPD data is possible only if all the compared data were created according to EN 15804+A2.

Life cycle analysis (LCA): A1-A3, B4-B6, C1-C4 and D modules in accordance with EN 15804+A2 (Cradle-to-Gate with options)

The year of preparing the EPD: 2023

Product standard: EN 14351-1+A2

Service Life: 50 years

PCR: ITB-PCR A v. 1.6

Functional unit: 1 m^2

Reasons for performing LCA: B2B

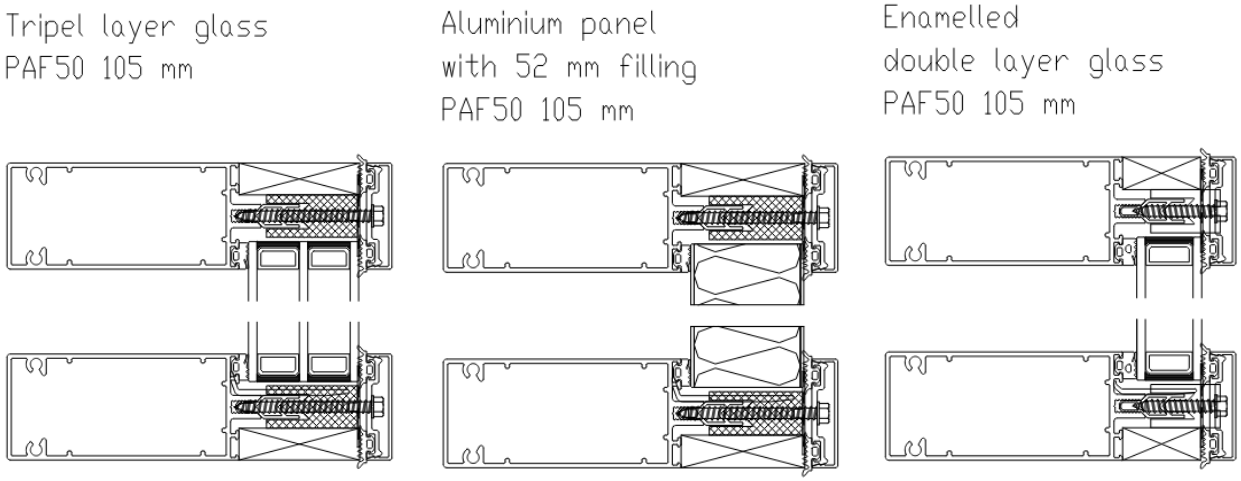
Representativeness: European

MANUFACTURER

FP Alu-glas A/S design, manufacture, and install unitised facades, facadeing, bolted structural glazing, entrances, commercial window, and door systems, and others advanced building products. FP Alu-glas PAF 50 is unitised facade system with design possibilities for quick closure of the building envelope. FP Alu-glas A/S produces windows and doors which can be built together in many different ways for the costumers individual specifications. The facades systems are mainly sold to customers in Denmark, Faroe Island, Iceland and Greenland.
FP Alu-glas is the manufacturing plant within the group. The company is located in Skive. The production facilities including warehouse covers an area of 10.000 m².

PRODUCTS DESCRIPTION AND APPLICATION

FP Alu-glas PAF 50 is a unitized facade system for quick closure of the building envelope. It is possible to design the modules with both transparent and infilled areas. The transparent areas can be both fixed glazing and opening vents or a combination of both. It is possible to create interesting facades by adding extra architecture to the exterior of the facade. This could be aluminium cladding, stone cladding etc.
All aluminium profiles are based on Hydro 4.0 (Reduxa) EPD: NEPD-1840-468-EN.



The technical specifications of PAF 50 facade produced by FP Alu-glas A/S are presented in Tab. 1.

Table 1. The specification of PAF 50 facade systems produced by FP Alu-glas A/S.

Type of material	Percentage in material groups:		
	Triple layer glass	Enamelled double layer glass	Aluminium panel with 52 mm filling
Glass	61.4 - 78.2	61.4 - 78.2	-
Stell element	2.0 - 2.5	2.0 - 2.5	3.4 - 5.3
Aluminium	10.7 – 29.9	10.7 – 30.0	68.0 – 79.8
Rubber	1.9 - 2.4	1.9 - 2.4	3.3 - 5.2
PVC	0.4 - 0.5	0.4 - 0.5	0.7 - 1.1
EPS	0.1 - 0.2	0.1 - 0.2	0.2 - 0.4
Butyl tape	0.4 - 0.5	0.4 - 0.5	0.7 - 1.1
Steel screws	< 1	< 1	< 1

Table 2. Profile variations of PAF 50 facade systems produced by FP Alu-glas A/S.

PAF 50 façade systems	Type of PAF 50 facade systems
15 mm	Triple layer glass Enamelled double layer glass Aluminium panel with 52 mm filling
50 mm	
85 mm	
105 mm	
125 mm	
150 mm	
180 mm	
200 mm	

More information can be found on the FP Alu-glas A/S website:

https://fpgruppen.dk

LIFE CYCLE ASSESSMENT (LCA) – general rules applied

Allocation

The allocation rules used for this EPD are based on EN 15804 + A2 and ITB-PCR A v 1.6. Production of the facade is a line process conducted in the manufacturing plan located in Skive (Denmark). All impacts from raw materials extraction and processing are allocated in A1 module of EPD. Input and output data from the production is inventoried and allocated to the production on the mass basis. Water and energy consumption, associated emissions and generated wastes are allocated to module A3. Energy supply was inventoried for whole production process. Packaging materials were taken into consideration.

System boundary

The life cycle analysis (LCA) of the declared products covers: product stage – modules A1-A3, use stage – modules B4-B6, end of life – modules C1-C4 and benefits and loads beyond the system boundary – module D (cradle-to-gate with options). Energy and water consumption, emissions as well as information on generated wastes were inventoried and were included in the calculations. It can be assumed that the total sum of omitted processes does not exceed 5% of all impact categories. In accordance with EN 15804 + A2, machines and facilities (capital goods) required for the production as well as transportation of employees were not included in LCA.

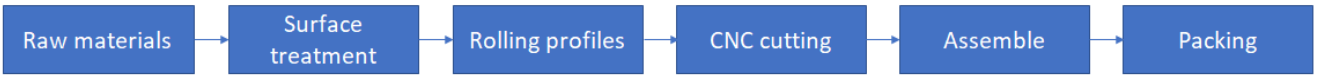


Fig. 1. A scheme of FP Alu-glas PAF 50 facade.

System limits

Minimum 99.0 % input materials and 99.9 % energy consumption (electricity, gas or Diesel) were inventoried in a processing plant and were included in the calculation. In the assessment, all significant parameters from gathered production data are considered, i.e. all material used per formulation, utilized thermal energy, and electric power consumption, direct production waste and available emission measurements. Tires consumption for transport was not considered. Substances with a percentage share of less than 0.1 % of total mass were excluded from the calculations. The packaging products (wooden pallets) are included.

Modules A1 and A2 : *Raw materials supply and transport*

Aluminium profiles are produced on Hydro's factory in Denmark (ca. 230 km). Glass and small accessories are produced in Denmark, Poland or Germany (above 1000 km). Data on transport of the different products to the manufacturing plants is collected and modelled for factory by assessor. Means of transport include lorries (> 16 t). Based on data provided by the manufacturer, all input of transport resources was inventoried. For A2 module (transport) European averages for fuel data are applied.

Module A3 : *Production*

A scheme of FP Alu-glas PAF 50 facade production process is presented in Fig. 1. After anodizing or powder coating aluminium surface treatment which is done by external supplier in Denmark, the profiles are transported (ca. 70 km) to the production facility in Skive. There, these profiles are CNC machined into correct lengths, holes are drilled and the frames are put together and mounted with glass and fittings for facade system.

Module B4-B6 : ***Use stage***

In the use stage all impacts related to the use of the FP Alu-glas PAF 50 facade system over it entire life cycle. This includes provisions for the transport of all materials as well as the energy and water impact associated with use it. If the product contains at least one insulating glass unit, changing it at least once every 30 years shall be included in Module B4. Aluminium panel with 52 mm filling does not contain glass unit, hence the values for the B4 module have zero impacts. There are no consumables, maintenance, repair, replacements or refurbishments related to the use of the PAF 50 facade for the period of the reference service life. PAF 50 facade do not use energy or water during their service life. There are no emissions released from the product during the use. There are no energy use to operate building integrated technical systems like energy use for electrical components e.g. electrical motors. Replacement of the product due to aesthetic reasons (change of interior design) and not related to the loss of performance is not taken into account. Therefore, modules B5-B6 have zero impacts.

Modules C1-C4 and D ***: End-of-life (EoL)***

It is assumed that at the end-of-life, 100 % of FP Alu-glas PAF 50 facade are demounted using electric tools. Materials recovered from dismantled products are recycled, incinerated (module C3) and landfilled (module C4) according to the realistic treatment practice (mass allocation) of industrial waste what is presented in Table 3. 95 % of the resulting aluminium undergo recycling after sorting and cutting while the remaining 5 % is forwarded to landfill as mixed construction and demolition wastes. In turn, 60 % non-glass and non-aluminium components and 30 % glass undergo waste processing while the remaining are forwarded to landfill in the form of mixed construction and demolition wastes. A potential credit resulting from the recycling of aluminium, glass and non-glass and non-aluminium components are presented in module D. Utilization of packaging material which constitute less than 1 % of the total system flows was not taken into consideration.

Table 3. End-of-life scenario for FP Alu-glas PAF 50 facade components.

Material	Waste processing		Landfilling
	Material recovery (reuse, recycling)	Energy recovery (incineration)	
aluminium	95 %	0 %	5 %
glass	30 %	0 %	70 %
non glass and aluminium	30 %	30 %	40 %

Data quality

The data selected for LCA analysis originates from ITB-LCI questionnaires completed by FP Alu-glas A/S using the inventory data, ITB and Ecoinvent database v. 3.9.1. No specific data collected is older than five years and no generic datasets used are older than ten years. The representativeness, completeness, reliability, and consistency are judged as sufficient for calculations. Data for Danish electricity was supported by Ecoinvent database v. 3.9.1. Specific product EPDs were used for hydro aluminium, glass or steel element. Environmental characteristics that were not included in these EPDs were taken from the Ecoinvent database.

Data collection period

The data for manufacture of the declared products refers to period between 01.07.2020 – 30.06.2021 (1 year). The life cycle assessments were prepared for Europe as reference area.

Assumptions and estimates

Impacts were inventoried and calculated for FP Alu-glas PAF 50 facade at the production site located in Skive which are a standard and representative for the FP Alu-glas PAF 50 group system.

Table 4. Conversion factors for the estimation of the environmental impact from specific FP Alu-glas PAF 50 facade. Multiply the LCA-result of each impact category in the environmental impact table with the corresponding factors.

PAF 50 facade systems	Conversion factors for individual thicknesses							
	15 mm	50 mm	85 mm	105 mm	125 mm	150 mm	180 mm	200 mm
Triple layer glass	0.901	0.956	0.986	1.000	1.027	1.088	1.126	1.148
Enamelled double layer glass	0.901	0.956	0.986	1.000	1.027	1.088	1.126	1.148
Aluminium panel with 52 mm filling	0.810	0.916	0.972	1.000	1.049	1.168	1.242	1.284

Additional information

Danish electricity (Ecoinvent v. 3.9.1) emission factors were used. As a general rule, no particular environmental or health protection measures other than those specified by law are necessary.

Calculation rules

LCA was performed using ITB-LCA tool developed in accordance with EN 15804 + A2.

Databases

The data for the processes comes from Ecoinvent v. 3.9.1 and ITB-Database. Specific data quality analysis was a part of external audit.

LIFE CYCLE ASSESSMENT (LCA) – Results

Declared unit

The declaration refers to declared unit (DU) – 1 m^2 of FP Alu-glas PAF 50 facade. The declared unit is calculated based on a 1,48 m x 1,23 m FP Alu-glas PAF 50 facade element, as shown in Fig. 2.

Figure 2: Representative facade element used as reference for the declared unit, dimension 1,48 m x 1,23 m (1,82 m^2).

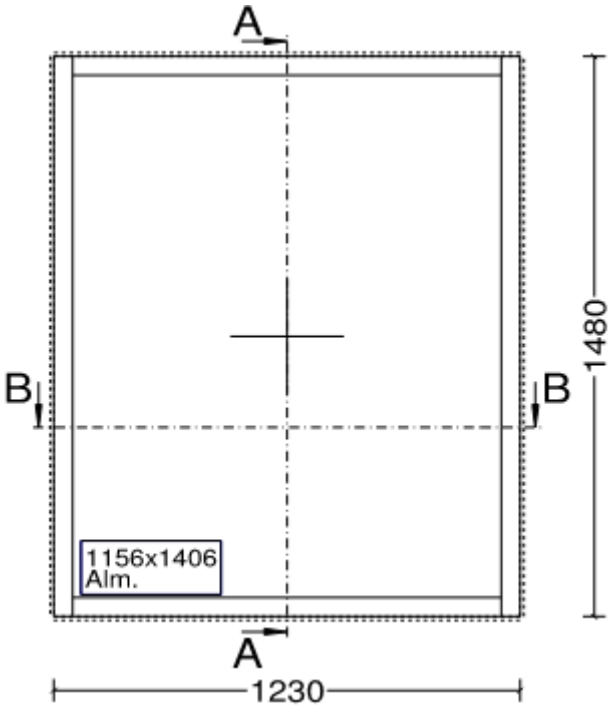


Table 5. System boundaries for the environmental characteristic of FP Alu-glas PAF 50 facade.

Environmental assessment information (MD – Module Declared, MND – Module Not Declared, INA – Indicator Not Assessed)																
Product stage			Construction process		Use stage							End of life				Benefits and loads beyond the system boundary
Raw material supply	Transport	Manufacturing	Transport to construction site	Construction-installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction demolition	Transport	Waste processing	Disposal	Reuse-recovery-recycling potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
MD	MD	MD	MND	MND	MND	MND	MND	MD	MD	MD	MND	MD	MD	MD	MD	MD

Table 6. LCA results of FP Alu-glas PAF 50 glazing facade – environmental impacts

Indicator	Unit	A1	A2	A3	A1-A3	B4	B5	B6	C1	C2	C3	C4	D
Global Warming Potential total	eq. kg CO_2	7.14E+01	5.31E+00	5.82E+00	8.25E+01	3.10E+01	0.00E+00	0.00E+00	5.15E-02	1.77E-01	1.36E+00	2.79E-01	-2.68E+01
Greenhouse gas potential - fossil	eq. kg CO_2	7.35E+01	5.29E+00	5.64E+00	8.45E+01	3.08E+01	0.00E+00	0.00E+00	4.80E-02	1.76E-01	1.16E+00	2.76E-01	-2.68E+01
Greenhouse gas potential - biogenic	eq. kg CO_2	-2.20E+00	1.81E-02	1.70E-01	-2.01E+00	2.46E-01	0.00E+00	0.00E+00	3.31E-03	6.03E-04	2.02E-01	2.17E-03	8.50E-02
Global warming potential - land use and land use change	eq. kg CO_2	7.47E-02	2.08E-03	7.86E-03	8.46E-02	1.18E-02	0.00E+00	0.00E+00	1.52E-04	6.93E-05	3.92E-04	1.77E-04	-3.69E-02
Stratospheric ozone depletion potential	eq. kg CFC 11	7.22E-06	1.23E-06	1.10E-06	9.55E-06	1.06E-06	0.00E+00	0.00E+00	1.04E-09	4.08E-08	9.18E-08	6.38E-08	-2.42E-06
Soil and water acidification potential	eq. mol H^+	8.14E-01	2.15E-02	1.67E-02	8.52E-01	2.98E-01	0.00E+00	0.00E+00	1.88E-04	7.16E-04	3.73E-03	1.70E-03	-1.32E-01
Eutrophication potential - freshwater	eq. kg P	1.89E-02	3.56E-04	1.97E-03	2.12E-02	4.56E-03	0.00E+00	0.00E+00	3.81E-05	1.19E-05	1.09E-04	2.00E-05	-9.77E-03
Eutrophication potential - seawater	eq. kg N	2.53E-01	6.49E-03	3.90E-03	2.63E-01	4.92E-02	0.00E+00	0.00E+00	4.55E-05	2.16E-04	1.44E-03	1.03E-03	-1.62E-01
Eutrophication potential - terrestrial	eq. mol N	2.89E+00	7.08E-02	4.12E-02	3.00E+00	5.90E-01	0.00E+00	0.00E+00	5.18E-04	2.36E-03	1.44E-02	6.54E-03	-1.69E+00
Potential for photochemical ozone synthesis	eq. kg NMVOC	8.20E-01	2.17E-02	1.23E-02	8.54E-01	1.63E-01	0.00E+00	0.00E+00	1.22E-04	7.22E-04	4.00E-03	1.90E-03	-5.11E-01
Potential for depletion of abiotic resources - non-fossil resources	eq. kg Sb	7.89E-03	1.88E-05	1.70E-05	7.93E-03	3.33E-04	0.00E+00	0.00E+00	3.17E-07	6.25E-07	8.27E-06	6.31E-07	-1.75E-05
Abiotic depletion potential - fossil fuels	MJ	8.17E+02	7.86E+01	1.37E+02	1.03E+03	3.53E+02	0.00E+00	0.00E+00	8.10E-01	2.62E+00	7.24E+00	4.61E+00	-2.15E+02
Water deprivation potential	eq. m^3	4.50E+01	3.63E-01	2.08E+00	4.74E+01	7.61E+00	0.00E+00	0.00E+00	3.46E-02	1.21E-02	1.55E-01	2.14E-02	-2.18E+01

Table 7. LCA results of FP Alu-glas PAF 50 glazing facade – additional impacts indicators

Indicator	Unit	A1	A2	A3	A1-A3	B4	B5	B6	C1	C2	C3	C4	D
Particulate matter	disease incidence	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA
Potential human exposure efficiency relative to U235	eg. kBq U235	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA
Potential comparative toxic unit for ecosystems	CTUe	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA
Potential comparative toxic unit for humans (cancer effects)	CTUh	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA
Potential comparative toxic unit for humans (non-cancer effects)	CTUh	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA
Potential soil quality index	dimensionless	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA

Table 8. LCA results of FP Alu-glas PAF 50 glazing facade - the resource use

Indicator	Unit	A1	A2	A3	A1-A3	B4	B5	B6	C1	C2	C3	C4	D
Consumption of renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	4.81E+02	1.13E+00	3.97E+01	5.22E+02	2.32E+01	0.00E+00	0.00E+00	7.91E-01	3.76E-02	4.48E-01	0.00E+00	-3.81E+02
Consumption of renewable primary energy resources used as raw materials	MJ	1.88E+01	0.00E+00	0.00E+00	1.88E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total consumption of renewable primary energy resources	MJ	5.00E+02	1.13E+00	3.97E+01	5.41E+02	2.32E+01	0.00E+00	0.00E+00	7.91E-01	3.76E-02	6.48E-01	5.58E-02	-3.81E+02
Consumption of non-renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	7.74E+02	7.86E+01	1.41E+02	9.94E+02	3.53E+02	0.00E+00	0.00E+00	8.10E-01	2.62E+00	-1.12E+02	0.00E+00	-2.25E+02
Consumption of non-renewable primary energy resources used as raw materials	MJ	5.40E+01	0.00E+00	0.00E+00	5.40E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.13E+02	0.00E+00	0.00E+00
Total consumption of non-renewable primary energy resources	MJ	8.28E+02	7.86E+01	1.41E+02	1.05E+03	3.53E+02	0.00E+00	0.00E+00	8.10E-01	2.62E+00	7.24E+00	4.55E+00	-2.25E+02
Consumption of secondary materials	kg	5.72E-01	2.63E-02	1.84E-02	6.17E-01	8.89E-02	0.00E+00	0.00E+00	2.51E-04	8.78E-04	1.08E-02	1.59E-03	0.00E+00
Consumption of renewable secondary fuels	MJ	3.36E-01	2.90E-04	7.61E-05	3.36E-01	1.68E-02	0.00E+00	0.00E+00	1.15E-06	9.68E-06	2.82E-04	3.10E-05	0.00E+00
Consumption of non-renewable secondary fuels	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net consumption of freshwater resources	m^3	1.94E+00	9.89E-03	8.09E-02	2.03E+00	1.97E-01	0.00E+00	0.00E+00	1.50E-03	3.30E-04	3.28E-03	5.11E-03	-1.50E+00

Table 9. LCA results of FP Alu-glas PAF 50 glazing facade – waste categories

Indicator	Unit	A1	A2	A3	A1-A3	B4	B5	B6	C1	C2	C3	C4	D
Hazardous waste neutralized	kg	8.30E-01	8.82E-02	1.72E-01	1.09E+00	3.93E-01	0.00E+00	0.00E+00	3.28E-03	2.94E-03	4.43E-02	7.56E-03	-2.02E-01
Non-hazardous waste neutralised	kg	4.22E+01	1.57E+00	9.17E+00	5.29E+01	1.98E+01	0.00E+00	0.00E+00	1.82E-01	5.22E-02	6.55E-01	1.27E+00	-9.57E+00
Radioactive waste	kg	2.45E-03	5.41E-04	5.57E-04	3.55E-03	5.79E-04	0.00E+00	0.00E+00	4.23E-06	1.80E-05	4.57E-05	2.90E-05	-1.10E-03
Components for re-use	kg	0.00E+00	0.00E+00	1.92E-04	1.92E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling	kg	1.21E-01	2.43E-04	5.22E-03	1.26E-01	5.03E-03	0.00E+00	0.00E+00	1.03E-04	8.11E-06	1.01E+01	1.08E-05	-3.68E-02
Materials for energy recovery	kg	2.18E-04	1.97E-06	1.97E-06	2.21E-04	1.15E-04	0.00E+00	0.00E+00	1.56E-08	6.56E-08	9.84E-07	3.09E-07	-4.32E-05
Energy exported	MJ	3.33E+00	8.72E-02	4.20E-01	3.83E+00	3.10E+00	0.00E+00	0.00E+00	8.09E-03	2.91E-03	3.01E+00	1.08E-02	-1.29E-01

Table 10. LCA results of FP Alu-glas PAF 50 aluminium panel facade – environmental impacts

Indicator	Unit	A1	A2	A3	A1-A3	B4	B5	B6	C1	C2	C3	C4	D
Global Warming Potential total	eq. kg CO_2	1.08E+02	8.91E+00	9.76E+00	1.27E+02	0.00E+00	0.00E+00	0.00E+00	5.15E-02	1.79E-01	2.10E+00	1.48E-01	-8.19E+01
Greenhouse gas potential - fossil	eq. kg CO_2	1.11E+02	8.87E+00	9.46E+00	1.29E+02	0.00E+00	0.00E+00	0.00E+00	4.80E-02	1.78E-01	1.73E+00	1.48E-01	-8.21E+01
Greenhouse gas potential - biogenic	eq. kg CO_2	-1.23E+00	3.03E-02	2.85E-01	-9.17E-01	0.00E+00	0.00E+00	0.00E+00	3.31E-03	6.09E-04	3.75E-01	2.49E-04	2.60E-01
Global warming potential - land use and land use change	eq. kg CO_2	1.49E-01	3.48E-03	1.32E-02	1.65E-01	0.00E+00	0.00E+00	0.00E+00	1.52E-04	7.00E-05	6.41E-04	2.27E-05	-1.13E-01
Stratospheric ozone depletion potential	eq. kg CFC 11	6.58E-06	2.05E-06	1.85E-06	1.05E-05	0.00E+00	0.00E+00	0.00E+00	1.04E-09	4.12E-08	1.35E-07	7.14E-09	-2.42E-06
Soil and water acidification potential	eq. mol H^+	8.12E-01	3.60E-02	2.81E-02	8.76E-01	0.00E+00	0.00E+00	0.00E+00	1.88E-04	7.23E-04	5.79E-03	1.96E-04	-3.85E-01
Eutrophication potential - freshwater	eq. kg P	3.39E-02	5.96E-04	3.30E-03	3.77E-02	0.00E+00	0.00E+00	0.00E+00	3.81E-05	1.20E-05	1.85E-04	3.07E-06	-2.72E-02
Eutrophication potential - seawater	eq. kg N	3.83E-01	1.09E-02	6.54E-03	4.01E-01	0.00E+00	0.00E+00	0.00E+00	4.55E-05	2.18E-04	2.21E-03	6.90E-04	-3.20E-01
Eutrophication potential - terrestrial	eq. mol N	4.17E+00	1.19E-01	6.90E-02	4.36E+00	0.00E+00	0.00E+00	0.00E+00	5.18E-04	2.38E-03	2.18E-02	7.22E-04	-3.33E+00
Potential for photochemical ozone synthesis	eq. kg NMVOC	1.28E+00	3.63E-02	2.05E-02	1.33E+00	0.00E+00	0.00E+00	0.00E+00	1.22E-04	7.29E-04	6.08E-03	2.38E-04	-1.01E+00
Potential for depletion of abiotic resources - non-fossil resources	eq. kg Sb	7.65E-03	3.15E-05	2.85E-05	7.71E-03	0.00E+00	0.00E+00	0.00E+00	3.17E-07	6.32E-07	1.43E-05	7.11E-08	-9.76E-05
Abiotic depletion potential - fossil fuels	MJ	1.28E+03	1.32E+02	2.30E+02	1.65E+03	0.00E+00	0.00E+00	0.00E+00	8.10E-01	2.65E+00	1.10E+01	5.32E-01	-8.20E+02
Water deprivation potential	eq. m^3	6.15E+01	6.09E-01	3.48E+00	6.56E+01	0.00E+00	0.00E+00	0.00E+00	3.46E-02	1.22E-02	2.37E-01	2.85E-03	-4.30E+01

Table 11. LCA results of FP Alu-glas PAF 50 aluminium panel facade – additional impacts indicators

Indicator	Unit	A1	A2	A3	A1-A3	B4	B5	B6	C1	C2	C3	C4	D
Particulate matter	disease incidence	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA
Potential human exposure efficiency relative to U235	eg. kBq U235	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA
Potential comparative toxic unit for ecosystems	CTUe	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA
Potential comparative toxic unit for humans (cancer effects)	CTUh	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA
Potential comparative toxic unit for humans (non-cancer effects)	CTUh	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA
Potential soil quality index	dimensionless	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA

Table 12. LCA results of FP Alu-glas PAF 50 aluminium panel facade - the resource use

Indicator	Unit	A1	A2	A3	A1-A3	B4	B5	B6	C1	C2	C3	C4	D
Consumption of renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	7.63E+02	1.89E+00	6.65E+01	8.32E+02	0.00E+00	0.00E+00	0.00E+00	7.91E-01	3.79E-02	6.47E-01	0.00E+00	-6.60E+02
Consumption of renewable primary energy resources used as raw materials	MJ	8.87E+00	0.00E+00	0.00E+00	8.87E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-1.92E+00
Total consumption of renewable primary energy resources	MJ	7.72E+02	1.89E+00	6.65E+01	8.40E+02	0.00E+00	0.00E+00	0.00E+00	7.91E-01	3.79E-02	1.01E+00	8.60E-03	-6.62E+02
Consumption of non-renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	1.30E+03	1.32E+02	2.37E+02	1.67E+03	0.00E+00	0.00E+00	0.00E+00	8.10E-01	2.65E+00	-1.62E+02	0.00E+00	-9.28E+02
Consumption of non-renewable primary energy resources used as raw materials	MJ	1.04E+02	0.00E+00	0.00E+00	1.04E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.63E+02	0.00E+00	-3.03E-01
Total consumption of non-renewable primary energy resources	MJ	1.40E+03	1.32E+02	2.37E+02	1.77E+03	0.00E+00	0.00E+00	0.00E+00	8.10E-01	2.65E+00	1.10E+01	4.20E-01	-9.28E+02
Consumption of secondary materials	kg	2.24E+00	4.41E-02	3.09E-02	2.31E+00	0.00E+00	0.00E+00	0.00E+00	2.51E-04	8.87E-04	1.65E-02	1.74E-04	-1.56E+00
Consumption of renewable secondary fuels	MJ	4.29E-04	4.87E-04	1.28E-04	1.04E-03	0.00E+00	0.00E+00	0.00E+00	1.15E-06	9.77E-06	4.88E-04	6.39E-06	0.00E+00
Consumption of non-renewable secondary fuels	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net consumption of freshwater resources	m^3	2.52E+00	1.66E-02	1.36E-01	2.67E+00	0.00E+00	0.00E+00	0.00E+00	1.50E-03	3.33E-04	5.05E-03	5.72E-04	-2.18E+00

Table 13. LCA results of FP Alu-glas PAF 50 aluminium panel facade – waste categories

Indicator	Unit	A1	A2	A3	A1-A3	B4	B5	B6	C1	C2	C3	C4	D
Hazardous waste neutralized	kg	4.66E-01	1.48E-01	2.88E-01	9.02E-01	0.00E+00	0.00E+00	0.00E+00	3.28E-03	2.97E-03	6.93E-02	9.66E-04	-2.02E-01
Non-hazardous waste neutralised	kg	3.99E+01	2.62E+00	1.54E+01	5.79E+01	0.00E+00	0.00E+00	0.00E+00	1.82E-01	5.27E-02	1.05E+00	1.72E+00	-2.45E+01
Radioactive waste	kg	4.53E-02	9.07E-04	9.33E-04	4.72E-02	0.00E+00	0.00E+00	0.00E+00	4.23E-06	1.82E-05	6.76E-05	3.28E-06	-3.93E-02
Components for re-use	kg	0.00E+00	0.00E+00	1.92E-04	1.92E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling	kg	1.16E-01	4.08E-04	8.75E-03	1.25E-01	0.00E+00	0.00E+00	0.00E+00	1.03E-04	8.19E-06	1.79E+01	1.28E-06	-3.68E-02
Materials for energy recovery	kg	5.38E-05	3.30E-06	3.29E-06	6.04E-05	0.00E+00	0.00E+00	0.00E+00	1.56E-08	6.62E-08	1.51E-06	1.63E-08	-4.32E-05
Energy exported	MJ	2.79E-01	1.46E-01	7.04E-01	1.13E+00	0.00E+00	0.00E+00	0.00E+00	8.09E-03	2.94E-03	4.36E+00	1.21E-03	-1.29E-01

ANNEX for EN 15804:2013+A1

Characterization factors for EN 15804: 2013 + A1 comes from Ecoinvent CML v. 4.8 and ITB-Database.

Table 14. LCA results of FP Alu-glas PAF 50 glazing facade – environmental impacts

Indicator	Unit	A1	A2	A3	A1-A3	B4	B5	B6	C1	C2	C3	C4	D
Global Warming Potential	eq. kg CO_2	7.55E+01	5.96E+00	5.99E+00	8.74E+01	3.11E+01	0.00E+00	0.00E+00	4.84E-02	1.99E-01	2.08E+00	2.80E-01	-2.68E+01
Depletion potential of the stratospheric ozone layer	eq. kg CFC 11	7.77E-06	1.07E-07	3.11E-07	8.19E-06	5.67E-07	0.00E+00	0.00E+00	9.27E-10	3.57E-09	1.52E-08	4.46E-09	-2.42E-06
Acidification potential of soil and water	eq. kg SO_2	4.72E-01	1.49E-02	1.14E-02	4.98E-01	2.45E-01	0.00E+00	0.00E+00	1.45E-04	4.96E-04	5.15E-03	1.16E-03	-1.32E-01
Eutrophication potential	eq. kg $(PO_4)^{-3}$	7.34E-02	3.84E-03	7.93E-03	8.52E-02	3.44E-02	0.00E+00	0.00E+00	1.40E-04	1.28E-04	2.63E-03	3.99E-03	-9.77E-03
Formation potential of tropospheric ozone	eq. kg Ethene	3.00E-02	1.40E-03	1.09E-03	3.25E-02	1.24E-02	0.00E+00	0.00E+00	1.07E-05	4.65E-05	5.31E-04	1.07E-04	-7.09E-03
Abiotic depletion potential (ADP-elements) for non-fossil resources	eq. kg Sb	4.05E-03	1.93E-05	1.68E-05	4.08E-03	2.77E-04	0.00E+00	0.00E+00	3.16E-07	6.42E-07	7.29E-06	4.19E-07	-1.75E-05
Abiotic depletion potential (ADP-fossil fuels) for fossil resources	MJ	8.14E+02	8.38E+01	1.27E+02	1.02E+03	3.28E+02	0.00E+00	0.00E+00	5.42E-01	2.79E+00	1.66E+01	4.76E+00	-2.15E+02

Table 15. LCA results of FP Alu-glas PAF 50 glazing facade - the resource use

Indicator	Unit	A1	A2	A3	A1-A3	B4	B5	B6	C1	C2	C3	C4	D
Consumption of renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	4.76E+02	1.32E+00	3.97E+01	5.17E+02	2.33E+01	0.00E+00	0.00E+00	7.91E-01	4.39E-02	6.49E-01	6.38E-02	-3.81E+02
Consumption of renewable primary energy resources used as raw materials	MJ	1.40E+01	0.00E+00	0.00E+00	1.40E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total consumption of renewable primary energy resources	MJ	4.90E+02	1.32E+00	3.97E+01	5.31E+02	2.33E+01	0.00E+00	0.00E+00	7.91E-01	4.39E-02	6.49E-01	6.38E-02	-3.81E+02
Consumption of non-renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	8.32E+02	8.57E+01	9.88E+01	1.02E+03	3.55E+02	0.00E+00	0.00E+00	8.10E-01	2.85E+00	-1.12E+02	-2.06E+01	-2.25E+02
Consumption of non-renewable primary energy resources used as raw materials	MJ	5.42E+01	0.00E+00	4.15E+01	9.58E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.13E+02	2.55E+01	0.00E+00
Total consumption of non-renewable primary energy resources	MJ	8.86E+02	8.57E+01	1.40E+02	1.11E+03	3.55E+02	0.00E+00	0.00E+00	8.10E-01	2.85E+00	7.24E+00	4.83E+00	-2.25E+02
Consumption of secondary materials	kg	6.03E-01	3.86E-02	2.04E-02	6.62E-01	9.31E-02	0.00E+00	0.00E+00	2.51E-04	1.28E-03	1.10E-02	1.78E-03	0.00E+00
Consumption of renewable secondary fuels	MJ	4.25E-01	4.90E-04	6.85E-05	4.25E-01	1.69E-02	0.00E+00	0.00E+00	1.15E-06	1.63E-05	2.81E-04	3.14E-05	0.00E+00
Consumption of non-renewable secondary fuels	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net consumption of freshwater resources	m^3	2.02E+00	1.02E-02	7.88E-02	2.10E+00	1.97E-01	0.00E+00	0.00E+00	1.50E-03	3.40E-04	3.26E-03	5.06E-03	-1.50E+00

Table 16. LCA results of FP Alu-glas PAF 50 glazing facade – waste categories

Indicator	Unit	A1	A2	A3	A1-A3	B4	B5	B6	C1	C2	C3	C4	D
Hazardous waste neutralized	kg	2.39E+00	5.74E-02	1.77E-01	2.63E+00	3.82E-01	0.00E+00	0.00E+00	3.28E-03	1.91E-03	4.02E-02	3.20E-03	-2,02E-01
Non-hazardous waste neutralised	kg	4.87E+01	1.75E+00	9.36E+00	5.98E+01	1.99E+01	0.00E+00	0.00E+00	1.82E-01	5.82E-02	6.56E-01	1.27E+00	-9,57E+00
Radioactive waste	kg	2.28E-03	2.76E-05	2.16E-04	2.52E-03	4.02E-04	0.00E+00	0.00E+00	4.23E-06	9.21E-07	1.29E-05	9.66E-07	1,10E-03
Components for re-use	kg	0.00E+00	0.00E+00	1.92E-04	1.92E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0,00E+00
Materials for recycling	kg	1.72E-01	6.27E-04	5.27E-03	1.78E-01	5.16E-03	0.00E+00	0.00E+00	1.03E-04	2.09E-05	1.01E+01	2.69E-05	0,00E+00
Materials for energy recovery	kg	1.20E-04	5.26E-06	1.51E-06	1.27E-04	1.16E-04	0.00E+00	0.00E+00	1.56E-08	1.75E-07	9.45E-07	3.17E-07	0,00E+00
Energy exported	MJ	1.12E+00	3.19E-02	4.08E-01	1.56E+00	1.01E+00	0.00E+00	0.00E+00	8.09E-03	1.06E-03	2.99E+00	1.03E-03	0,00E+00

Table 17. LCA results of FP Alu-glas PAF 50 aluminium panel facade – environmental impacts

Indicator	Unit	A1	A2	A3	A1-A3	B4	B5	B6	C1	C2	C3	C4	D
Global Warming Potential	eq. kg CO_2	1.11E+02	1.00E+01	1.00E+01	1.31E+02	0.00E+00	0.00E+00	0.00E+00	4.84E-02	1.79E-01	3.24E+00	1.22E-01	-8.19E+01
Depletion potential of the stratospheric ozone layer	eq. kg CFC 11	7.12E-06	1.79E-07	5.21E-07	7.82E-06	0.00E+00	0.00E+00	0.00E+00	9.27E-10	1.78E-01	2.41E-08	5.32E-10	-2.42E-06
Acidification potential of soil and water	eq. kg SO_2	6.05E-01	2.50E-02	1.91E-02	6.49E-01	0.00E+00	0.00E+00	0.00E+00	1.45E-04	6.09E-04	8.44E-03	1.04E-04	-3.85E-01
Eutrophication potential	eq. kg $(PO_4)^{-3}$	8.14E-02	6.43E-03	1.33E-02	1.01E-01	0.00E+00	0.00E+00	0.00E+00	1.40E-04	7.00E-05	4.52E-03	5.38E-03	-2.72E-02
Formation potential of tropospheric ozone	eq. kg Ethene	9.74E-02	2.34E-03	1.83E-03	1.02E-01	0.00E+00	0.00E+00	0.00E+00	1.07E-05	4.12E-08	8.70E-04	2.70E-05	-2.10E-02
Abiotic depletion potential (ADP-elements) for non-fossil resources	eq. kg Sb	3.65E-03	3.23E-05	2.82E-05	3.71E-03	0.00E+00	0.00E+00	0.00E+00	3.16E-07	7.23E-04	1.22E-05	3.85E-08	-9.76E-05
Abiotic depletion potential (ADP-fossil fuels) for fossil resources	MJ	1.29E+03	1.40E+02	2.12E+02	1.64E+03	0.00E+00	0.00E+00	0.00E+00	5.42E-01	1.20E-05	2.62E+01	4.96E-01	-8.20E+02

Table 18. LCA results of FP Alu-glas PAF 50 aluminium panel facade - the resource use

Indicator	Unit	A1	A2	A3	A1-A3	B4	B5	B6	C1	C2	C3	C4	D
Consumption of renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	7.65E+02	2.21E+00	6.66E+01	8.34E+02	0.00E+00	0.00E+00	0.00E+00	7.91E-01	2.38E-03	6.47E-01	1.91E-02	-6.60E+02
Consumption of renewable primary energy resources used as raw materials	MJ	2.04E+01	0.00E+00	0.00E+00	2.04E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.29E-04	0.00E+00	0.00E+00	-1.92E+00
Total consumption of renewable primary energy resources	MJ	7.86E+02	2.21E+00	6.66E+01	8.54E+02	0.00E+00	0.00E+00	0.00E+00	7.91E-01	6.32E-07	1.01E+00	1.91E-02	-6.62E+02
Consumption of non-renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	1.33E+03	1.44E+02	1.66E+02	1.64E+03	0.00E+00	0.00E+00	0.00E+00	8.10E-01	2.65E+00	-1.62E+02	-3.63E+01	-9.28E+02
Consumption of non-renewable primary energy resources used as raw materials	MJ	1.05E+02	0.00E+00	6.96E+01	1.74E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.22E-02	1.63E+02	3.68E+01	-3.03E-01
Total consumption of non-renewable primary energy resources	MJ	1.44E+03	1.44E+02	2.35E+02	1.82E+03	0.00E+00	0.00E+00	0.00E+00	8.10E-01	0.00E+00	1.10E+01	5.13E-01	-9.28E+02
Consumption of secondary materials	kg	2.32E+00	6.46E-02	3.42E-02	2.42E+00	0.00E+00	0.00E+00	0.00E+00	2.51E-04	3.79E-02	1.65E-02	1.83E-04	-1.56E+00
Consumption of renewable secondary fuels	MJ	4.08E-01	8.21E-04	1.15E-04	4.09E-01	0.00E+00	0.00E+00	0.00E+00	1.15E-06	0.00E+00	4.88E-04	7.20E-06	0.00E+00
Consumption of non-renewable secondary fuels	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.79E-02	0.00E+00	0.00E+00	0.00E+00
Net consumption of freshwater resources	m^3	2.61E+00	1.71E-02	1.32E-01	2.76E+00	0.00E+00	0.00E+00	0.00E+00	1.50E-03	2.65E+00	5.05E-03	6.04E-04	-2.18E+00

Table 19. LCA results of FP Alu-glas PAF 50 aluminium panel facade – waste categories

Indicator	Unit	A1	A2	A3	A1-A3	B4	B5	B6	C1	C2	C3	C4	D
Hazardous waste neutralized	kg	1.71E+00	9.62E-02	2.97E-01	2.11E+00	0.00E+00	0.00E+00	0.00E+00	3.28E-03	2.65E+00	6.93E-02	2.60E-04	-2.02E-01
Non-hazardous waste neutralised	kg	5.16E+01	2.93E+00	1.57E+01	7.02E+01	0.00E+00	0.00E+00	0.00E+00	1.82E-01	8.87E-04	1.05E+00	1.72E+00	-2.45E+01
Radioactive waste	kg	4.50E-02	4.63E-05	3.62E-04	4.54E-02	0.00E+00	0.00E+00	0.00E+00	4.23E-06	9.77E-06	6.76E-05	2.46E-07	-3.93E-02
Components for re-use	kg	0.00E+00	0.00E+00	1.92E-04	1.92E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling	kg	1.21E-01	1.05E-03	8.83E-03	1.31E-01	0.00E+00	0.00E+00	0.00E+00	1.03E-04	3.33E-04	1.79E+01	4.43E-06	0.00E+00
Materials for energy recovery	kg	6.08E-06	8.81E-06	2.53E-06	1.74E-05	0.00E+00	0.00E+00	0.00E+00	1.56E-08	0.00E+00	1.51E-06	9.24E-09	0.00E+00
Energy exported	MJ	1.43E-01	5.35E-02	6.83E-01	8.80E-01	0.00E+00	0.00E+00	0.00E+00	8.09E-03	2.97E-03	4.36E+00	3.70E-04	0.00E+00

Verification

The process of verification of this EPD is in accordance with ISO 14025 and ISO 21930. After verification. this EPD is valid for a 5-year-period. EPD does not have to be recalculated after 5 years, if the underlying data have not changed significantly.

The basis for LCA analysis was EN 15804 + A2 and ITB PCR A
Independent verification corresponding to ISO 14025 (subclause 8.1.3) [x] external [ ] internal
External verification of EPD: Halina Prejzner, PhD Eng. LCA, LCI audit and input data verification: Mateusz Kozicki, PhD Verification of LCA: Michał Piasecki, PhD, D.Sc. Eng. Signature Not Verified Dokument podpisany przez Mateusz Kozicki; ITB Data: 2023.12.15 14:10:37 CET Signature Not Verified Dokument podpisany przez Michal Piasecki; ITB Data: 2023.12.15 14:53:38 CET

Note 1: The declaration owner has the sole ownership, liability and responsibility for the information provided and contained in EPD. Declarations within the same product category but from different programs may not be comparable. Declarations of construction products may not be comparable if they do not comply with EN 15804 + A2. For further information about comparability, see EN 15804 + A2 and ISO 14025. Depending on the application, a corresponding conversion factor such as the specific weight per surface area must be taken into consideration.

Note 2: ITB is a public Research Organization and Notified Body (EC Reg. no 1488) to the European Commission and to other Member States of the European Union designated for the tasks concerning the assessment of building products' performance. ITB acts as the independent, third-party verification organization (17065/17025 certified). ITB-EPD program is recognized and registered member of The European Platform – Association of EPD program operators and ITB-EPD declarations are registered and stored in the international ECO-PORTAL.

Normative references

- ITB-PCR A General Product Category Rules for Construction Products
- ISO 14025:2006. Environmental labels and declarations – Type III environmental declarations – Principles and procedures
- ISO 21930:2017 Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services
- ISO 14044:2006 Environmental management – Life cycle assessment – Requirements and guidelines
- ISO 15686-1:2011 Buildings and constructed assets – Service life planning – Part 1: General principles and framework
- ISO 15686-8:2008 Buildings and constructed assets – Service life planning – Part 8: Reference service life and service-life estimation
- EN 15804:2012+A2:2019 Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products
- ISO 14067:2018 Greenhouse gases - Carbon footprint of products - Requirements and guidelines for quantification
- EN 15942:2012 Sustainability of construction works – Environmental product declarations – Communication format business-to-business
- EN 13830: 2003 Curtain Walling – Product standard
- EN 14351-1+A2 Windows and doors - Product standard, performance characteristics - Part 1: Windows and external pedestrian doorsets

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CERTIFICATE № 554/2023
of TYPE III ENVIRONMENTAL DECLARATION

Products:

PAF 50 SI Facades systems

Manufacturer:

FP Alu-glas A/S

Hjortevej 4 , DK-7800 Skieve, Denmark

confirms the correctness of the data included in the development of
Type III Environmental Declaration and accordance with the requirements of the standard

EN 15804+A2

Sustainability of construction works.
Environmental product declarations.
Core rules for the product category of construction products.

This certificate, issued on 15th December 2023 is valid for 5 years
or until amendment of mentioned Environmental Declaration

Head of the Thermal Physic, Acoustics and Environment Department
Agnieszka Winkler-Skalna, PhD

INSTYTUT TECHNIKI BUDOWLANEJ

Deputy Director for Research and Innovation
Krzysztof Kuczyński, PhD

Warsaw, December 2023