

ENVIRONMENTAL PRODUCT DECLARATION

POLFLAM GAIA LOW-CARBON FIRE-RESISTANT GLASS



Owner of the EPD: POLFLAM Sp. z o.o.

Issued: **03.11.2023**

Valid until: **03.11.2028**

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PROGRAMME INFORMATION

Owner of the EPD:

POLFLAM Sp. z o.o.

Programme owner:

Łukasiewicz Research Network –
Institute of Ceramics and Building
Materials
<http://www.icimb.pl/opole/>

Products covered by the EPD:

Fire-resistant glass

Owner of the EPD:

POLFLAM Sp. z o.o.
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<https://www.polflam.pl/>

Date of issuance:

03.11.2023

Declared product/declared unit:

The declared unit (DU) for the products is 1 m² (square meters) low-carbon fire-resistant glass POLFLAM EW, EI, BR and FR GAIA.

EPD valid until:

03.11.2028

Scope:

The declaration covers the following products: low-carbon fire-resistant glass POLFLAM EW, EI, BR and FR GAIA manufactured in the POLFLAM Sp. z o.o. Jeziorzany, 3 Aleja Krakowska str, 05-555 Tarczyn.

It contains information about the impact of the declared products on the environment.

All data on the production cycle have been collected by POLFLAM Sp. z o.o. from January 1, 2022 to December 31, 2022 (12 months) and corresponded to the production's technology of that time. All data are averaged for total production of fire-resistant glass POLFLAM EW, EI, BR and FR GAIA produced by POLFLAM Sp. z o.o. in Jeziorzany.

The life cycle assessment has been developed in accordance with the requirements of PN-EN ISO 15804+A2:2020, PN-EN ISO 14025 and PN-EN ISO 14040. The rules for product categorization have been adopted in accordance with the PN-EN 15804 standard.

The declaration owner is responsible for the underlying information and evidence. Łukasiewicz Research Network – Institute of Ceramics and Building Materials Environmental Engineering Center in Opole is not responsible for the manufacturer's information and data and evidence regarding the life cycle assessment.

Declarations resulting from different programs or performed not in accordance with the standard may not be compared.

Product Category Rules (PCR)

According to:

PN-EN 15804+A2:2020-03 Sustainability of construction works. Environmental product declarations. Basic principles of categorization of construction products.

Representativeness:

Polish product, year 2022

Reference Service Life (RSL):

30 years

Reasons for performing LCA:

B2B

Life cycle Analysis (LCA):

LCA covers modules A1-A4, C1-C4 and D according to PN-EN 15804+A2 standard (Cradle-to-Gate with options)

Łukasiewicz Research Network – Institute of Ceramics and Building Materials, Environmental Engineering Center provides access to the type III EPD for fire-resistance glass produced by POLFLAM sp. z o.o. to the interested parties.

MANUFACTURER AND PRODUCT DESCRIPTION

POLFLAM® has been in the glass industry since 1992 and has specialized in the production and sale of fire-resistant glass since 2005. In February 2019 the acquisition of POLFLAM by Baltisse was completed.

We are cooperating since many years with system providers of steel, aluminium and timber systems making Polflam fire-resistant glass available in a wide range of systems for every market. Today **POLFLAM®** is a completely independent manufacturer of fire-resistant glass: from technology to research and production.

POLFLAM GAIA is the world's first low-carbon fire-resistant glass. It has been skillfully crafted by combining our hydrogel technology developed by POLFLAM's research lab with the distinctive attributes of low-carbon float glass. Employing environmentally conscious methods, such as the use of alternative fuels, renewable energy, and raw material recycling, this glass ensures a significantly reduced carbon footprint.

We also offer additional product-related services:

- laboratory facilities for testing fire-resistant glass and complete fire-resistant systems
- advisory services and trainings

POLFLAM® is a synonym for product quality, reliable and comprehensive service at every stage of the project. The group of products covered by the declaration are as follows:

- Fire-resistant glass EW GAIA
- Fire-resistant glass EI GAIA
- Fire-resistant glass BR GAIA
- Fire-resistant glass FR GAIA

The indicative composition of products covered by the declaration is presented in the table below. The percentage depends on the type of product.

Table 1 Indicative composition of the products covered by the declaration

Material	Mass fraction [%]
Glass	50-80
Fire protection interlayer (Hydrogel)	20-40
Sealants	2-6
Spacer	2-6

POLFLAM GAIA fire-resistant glass production begins with the arrival of large-sized low-carbon glass panes, which are then transferred to an automated warehouse connected to the horizontal cutting tables. The glass is cut to the required sizes and marked with a product and an unique ID code for traceability purposes and after that loaded onto an initial sorting system which organizes the material flow. Based on customer requirements, the glass then undergoes special edge treatment: seaming, grinding or polishing. The glass sheets are thoroughly cleaned in the washing machine and then transferred to the tempering furnaces. After the tempering process, the glass panes re-enter the downstream sorting system, where they are awaiting for an assembly process.

The assembly process begins with a vertical washing machine where the glass panes undergo a thorough cleaning process. Each pane undergoes careful inspection in a quality control scanner. Meanwhile, our dedicated team produces the necessary spacer bars for the assembly.

Once the quality control check is completed, the spacer bars are installed between the glass panes. Our assembly process involves combining two glass units separated by spacer bar and primary sealant, forming a cavity that is later filled with a hydrogel. The glass edge is precisely sealed with secondary sealant, ensuring maximum tightness of the cavity. After drying of the edge sealant the cavity is being filled with the hydrogel and then it undergoes the curing process, further enhancing the performance of POLFLAM glass.

MANUFACTURER AND PRODUCT DESCRIPTION

Before being packed on stillages, each glass unit with applied product labels undergoes a final quality control in accordance with our stringent internal guidelines. This ensures that every glass unit meets our highest quality standards.

Finally, our finished glass unit is securely packed on either steel or wooden stillages and carefully wrapped with foil.

The safely packed glass units are then loaded onto trucks, ready for delivery to their final destination.

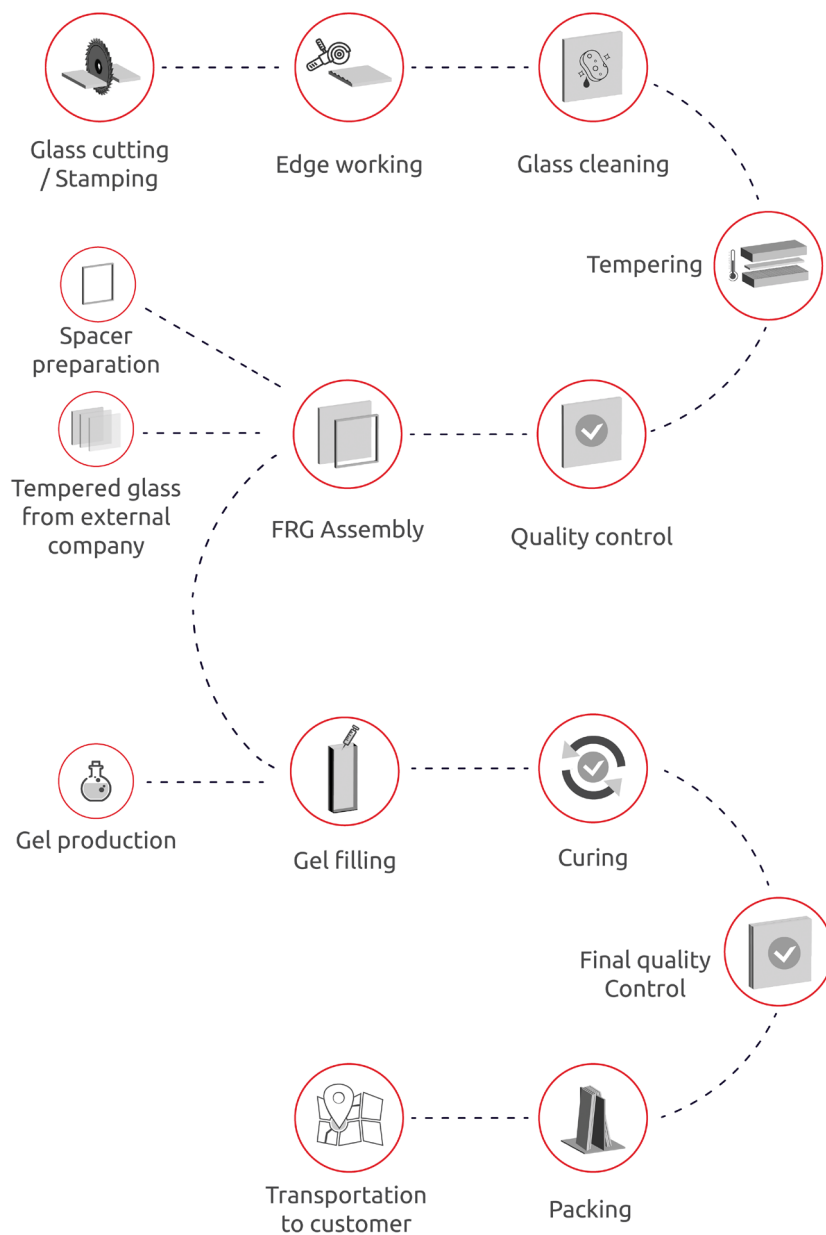


Fig. 1: The production diagram of fire-resistant glass by POLFLAM®

MANUFACTURER AND PRODUCT DESCRIPTION



The production plant of **POLFLAM®**

MANUFACTURER AND PRODUCT DESCRIPTION

POLFLAM EI GAIA and POLFLAM EW GAIA are fully transparent fire-resistant glasses for various applications. POLFLAM EI GAIA fire-resistant glass meets integrity with full thermal insulation and POLFLAM EW GAIA fire-resistant glass meets integrity with reduced heat radiation. The two product families are based on the hydrogel technology developed by **POLFLAM**[®] and meets requirements of EN 14449. Monolithic POLFLAM EI GAIA and POLFLAM EW GAIA fire-resistant glass consist of two thermally toughened safety low-carbon glass panes according to EN 12150 with a minimum thickness of 5 mm, separated by a metal or composite spacer bar around the edges of the glass and a single cavity filled with a hydrogel interlayer with a minimal thickness of 6 mm. The spacer bar with applied Butyl on both sides as primary seal is positioned between the two glass panes and sealed around the perimeter with Polysulphide or Silicone as secondary seal. The hydrogel is produced at **POLFLAM**[®] factory according to the company's own proprietary formula.

Monolithic POLFLAM EI GAIA and POLFLAM EW GAIA fire-resistant glass are designed for internal applications and as Insulated Glass Units for external building applications.

POLFLAM EI GAIA and POLFLAM EW GAIA fire-resistant glass are available in the fire resistance classes according to EN 13501-2:

- EI 15 up to EI 180
- EW 30 up to EW 120

Construction of the fire-resistant glass is presented below:

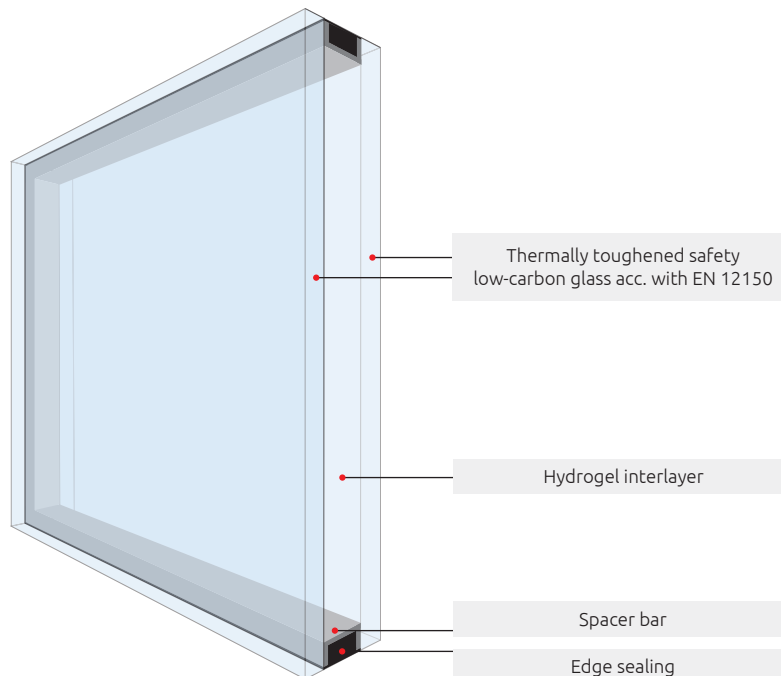


Figure 2: Diagram of the construction of fire-resistant glass produced by **POLFLAM[®]**

POLFLAM EI GAIA AND POLFLAM EW GAIA

Monolithic POLFLAM GAIA fire-resistant glass, made from 5 mm thermally toughened safety low-carbon glass, is used in internal partitions, windows, doors, and facades.

POLFLAM GAIA		EI 15	EI 30	EI 60		EI 90		EI 120		EI 180
Nominal thickness [mm]		16	20	25	28	32	35	35	40	55
Thickness tolerance [mm]		± 2	± 2	± 2	± 2	± 3	± 3	± 3	± 3	± 3
Weight [kg/m ²]		33	38	45	49	52	57	57	64	83
Fire resistance	EN 13501-2	EI 15	EI 30	EI 60	EI 60	EI 90	EI 90	EI 120	EI 120	EI 180
Light transmittance τ_v [%]	EN 410	88*	87	87	87	85	87	87	86	85
Total solar energy transmittance g [%]	EN 410	73*	72	70	71	68	70	70	68	66
Thermal properties U_g [W/m ² K]	EN 673	4.8*	4.4	4.0*	3.7	3.6*	3.3	3.3	3.0	NPD
Sound reduction index R_w (C; C _{tr}) [dB]	EN 12758	41 (-2; -3)	42 (-2; -3)	44 (-2; -4)	45 (-1; -3)	45 (-2; -3)	47 (-1; -4)	47 (-1; -4)	48 (-1; -4)	45 (-1; -4)
Pendulum body impact resistance	EN 12600	1(B)1								
Reaction to fire	EN 13501-1	B-s1, d0								
Max. temperature range		-40 °C / +50 °C								
Curved glass		yes								

* estimated value

POLFLAM GAIA		EW 30		EW 60		EW 90		EW 120	
Nominal thickness [mm]		16	20	16	20	16	20	16	20
Thickness tolerance [mm]		± 2	± 2	± 2	± 2	± 2	± 2	± 2	± 2
Weight [kg/m ²]		33	38	33	38	33	38	33	38
Fire resistance	EN 13501-2	EW 30	EW 30	EW 60	EW 60	EW 90	EW 90	EW 120	EW 120
Light transmittance τ_v [%]	EN 410	88*	87	88*	87	88*	87	88*	87
Total solar energy transmittance g [%]	EN 410	73*	72	73*	72	73*	72	73*	72
Thermal properties U_g [W/m ² K]	EN 673	4.8*	4.4	4.8*	4.4	4.8*	4.4	4.8*	4.4
Sound reduction index R_w (C; C _{tr}) [dB]	EN 12758	41 (-2; -3)	42 (-2; -3)	41 (-2; -3)	42 (-2; -3)	41 (-2; -3)	42 (-2; -3)	41 (-2; -3)	42 (-2; -3)
Pendulum body impact resistance	EN 12600	1(B)1							
Reaction to fire	EN 13501-1	B-s1, d0							
Max. temperature range		-40 °C / +50 °C							
Curved glass		yes							

* estimated value

POLFLAM BR GAIA AND POLFLAM FR GAIA

POLFLAM BR GAIA fire-resistant glass

POLFLAM BR GAIA fire-resistant glass can be installed with the vertical sides of the glasses directly connected (butt-joint) to each other without the use of vertical posts or framing system and is based on a 10 mm thermally toughened safety low-carbon glass.

POLFLAM BR GAIA		EI 30	EI 60		EI 90	EI 120
Nominal thickness [mm]		30	35	38	45	50
Thickness tolerance [mm]		± 2	± 3	± 3	± 3	± 3
Weight [kg/m ²]		65	69	75	82	90
Fire resistance	EN 13501-2	EI 30	EI 60	EI 60	EI 90	EI 120
Light transmittance τ_v [%]	EN 410	84	84	84	84	84
Total solar energy transmittance g [%]	EN 410	68	67	67	64	66
Thermal properties U_g [W/m ² K]	EN 673	4.6*	4.2*	3.6*	3.8*	2.9
Sound reduction index R_w (C; C_{tr}) [dB]	EN 12758	44 (-2; -3)	44 (-2; -3)	44 (-1; -3)	47 (-2; -3)	46 (-1; -3)
Pendulum body impact resistance	EN 12600	1(B)1				
Reaction to fire	EN 13501-1	B-s1, d0				
Max. temperature range		-40 °C / +50 °C				
Curved glass		yes				

* estimated value

POLFLAM FR GAIA fire-resistant glass

POLFLAM FR GAIA fire-resistant glass can be installed in the FR System allowing fire-resistant glass to be installed directly in openings of walls of various materials without the need for a commercial fire-resistant framing system and is based on a 5 mm thermally toughened safety low-carbon glass.

POLFLAM FR GAIA		EI 30	EI 60	EI 90	EI 120	EI 180
Nominal thickness [mm]		20	25	35	35	55
Thickness tolerance [mm]		± 2	± 3	± 3	± 3	± 2
Weight [kg/m ²]		38	45	57	57	83
Fire resistance	EN 13501-2	EI 30	EI 60	EI 90	EI 120	EI 180
Light transmittance τ_v [%]	EN 410	87	87	87	87	85
Total solar energy transmittance g [%]	EN 410	72	70	70	70	66
Thermal properties U_g [W/m ² K]	EN 673	4.4	4.0*	3.3	3.4*	NPD
Sound reduction index R_w (C; C_{tr}) [dB]	EN 12758	44 (-2; -3)	44 (-2; -4)	47 (-1; -4)	45 (-1; -4)	45 (-1; -4)
Pendulum body impact resistance	EN 12600	1(B)1				
Reaction to fire	EN 13501-1	B-s1, d0				
Maximum temperature range		-40 °C / +50 °C				
Curved glass		yes				

* estimated value

LCA: CALCULATION RULES

System boundaries	<p>The life cycle analysis of the tested products includes A1-A3, A4, C1-C4 and D (Cradle to Gate with options) modules in accordance with PN-EN 15804. It includes the following modules:</p> <ul style="list-style-type: none">• A1 – extraction and preparation of raw materials, generation of electricity and Energy carriers for auxiliary processes,• A2 – transport raw materials to the gate of the production plant,• A3 – production, including ancillary processes and emissions,• A4 – transport to the building site,• C1 – deconstruction/demolition,• C2 – transport to the waste processing facility,• C3 – processing of waste material,• C4 – treatment of waste material,• D – re-use potential
Data collection period	<p>Data on the production process was collected in the years 2022 (in the period 01.01.22 to 31.12.22).</p>
Declared unit (DU)	<p>Due to negligible differences between the three groups of products:</p> <ul style="list-style-type: none">• POLFLAM 16-20 mm EI, EW, FR GAIA• POLFLAM 21-55 mm EI, EW, FR GAIA• POLFLAM 30-45 mm BR GAIA <p>the declared unit of 1 m² fire-resistant glass produced by POLFLAM Sp. z o.o. in Jeziorzany.</p>
Assumptions	<p>A1 – EXTRACTION AND CONSUMPTION of raw materials refers to specific mass shares in the production process, per unit of declared product. A2 – TRANSPORT - distances from the place of obtaining raw materials to the production plant individual for each raw material, means of transport differentiated due to the method of raw materials delivery. A3 – PRODUCTION – EMISSION values of CO₂, NO_x, SO₂, dust from the production process obtained by estimation based on fuel consumption. A4 – TRANSPORT of the final product to the construction site is treated as average weight values of transport to customers. C1 – DEMOLITION, including disassembly or demolition of the product from the building, including initial sorting of materials on site - manual disassembly of the product at the end of its useful life is possible. The possible use of power tools for disassembly has a negligible impact on impact category values. Energy consumption in this module is so small that it has been ignored. C2 – TRANSPORT is assumed that 100% of the waste constituting used fire-resistant glass is always transported to a waste recovery or disposal facility. Data is collected based on the developed scenario. C3 – WASTE PROCESSING e.g. collection of waste fractions from demolition and processing of material streams for reuse, recycling and energy recovery. Calculations are made based on the developed scenario. C4 – WASTE MANAGEMENT, takes into account the impact of landfilled waste (cullet). Data is collected based on the developed scenario. D – RECYCLING POTENTIAL, addresses the impact and effects of using secondary material. Calculations are made based on the developed scenario.</p>
Cut-of criteria	<p>99% of all mass flows involved in the production process were taken into account. All the energy used in the process has been taken into account in the EPD.</p>
General data	<p>Data for calculations come from Ecoinvent v. 3.9. and KOBIZE 2022. Emission factors for electricity were determined using actual KOBIZE 2022 data. A detailed analysis of data quality was part of the external audit.</p>
Allocation	<p>All data provided by the manufacturer have been referred to the declared unit (DU) of the product – 1 m² fire-resistance glass produced by POLFLAM Sp. z o.o. in Jeziorzany.</p>

LCA: SCENERIOS AND ADDITIONAL TECHNICAL DATA

For the purpose of analyzing the life cycle of products covered by the environmental declaration in terms of „Cradle to gate with options“, scenarios were developed for modules A4 and C1, C2, C3, C4 and D:

Module A4:

On the basis of the manufacturer's declaration, the following scenario was adopted transport is carried out using trucks with a capacity of 16-32 tons meeting EURO 6 emission standards, average distance from the plant to the customer 350 km – data from the customer.

Module C1:

At the end of its useful life, the product is disassembled manually. The impact of this module can therefore be taken as zero.

Module C2:

Transport to the waste treatment site, the following assumptions were made to calculate the impact of this module:

- 100% of the waste constituting used fire-resistant glass is transported to a recovery facility. It is assumed that 70% of the fire-resistant glass is recycled and the remainder is stored,
- transport is carried out by means of self-unloading vehicles with a capacity of 7.5 - 16 tons, meeting EURO 6 emission standards,
- the material is transported to a waste processing site located within 100 km of the demolition site.

Module C3:

Waste processing, such as the collection of waste fractions from demolition and processing of material streams for reuse, recycling and energy recovery.

Processes assumed: unloading (loader), crushing (crusher).

For calculations assumed:

energy consumption	0,03	kWh/kg
fuel consumption	0,5	MJ/kg

Module C4:

In the developed scenario, it was assumed that 30% of the used fire-resistant glass is subjected to storage.

Module D:

Reuse potential. For fire-resistant glass, it is assumed that 70% of the product is recycled.

LCA: RESULTS

The table below shows the LCA modules included in the calculation of the environmental impact categories for the products covered by the declaration.

SYSTEM BOUNDARIES																	
Products stage			Construction process stage		Use stage							End-of-life stage				Benefits and loads beyond the system boundary	
Raw material supply	Transport	Production	Transport	Construction process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	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	MND	MND	MND	MND	MND	MND	MND	MND	X	X	X	X	X	

X – module included in LCA
MND – module not declared

Products stage

A1 Raw material supply
A2 Transport,
A3 Production

Construction process stage

A4 Transport,
A5 Construction process

End-of-life stage

C1 Deconstruction
C2 Transport
C3 Waste processing
C4 Disposal

Use stage

B1 Use
B2 Maintenance
B3 Repair
B4 Replacement
B5 Refurbishment
B6 Operational energy use
B7 Operational water use



The following tables present the results of the LCA analysis for fire-resistant glass.

Explanations of the abbreviations used to describe the impact categories are given below:

GWP-total	Global warming potential
GWP-fossil	Global warming potential fossil fuel
GWP-biogenic	Global warming potential biogenic
GWP-luluc	Global warming potential land use and land change
ODP	Depletion potential of the stratospheric ozone layer
AP	Acidification potential of land and water
EP-freshwater	Eutrophication potential, fraction of nutrients reaching freshwater end compartment
EP-marine	Eutrophication potential, fraction of nutrients reaching marine end compartment
EP-terrestrial	Eutrophication potential, Accumulated Exceedance
POCP	Formation potential of tropospheric ozone photochemical oxidants
ADP-minerals&metals	Abiotic depletion potential for nonfossil resources
ADP-fossil	Abiotic depletion potential for fossil resources
WDP	Water (user) deprivation potential
PERE	Use of renewable primary energy excluding renewable primary energy resources used as raw materials
PERM	Use of renewable primary energy resources used as raw materials
PERT	Total use of renewable primary energy resources
PEN-RE	Use of non-renewable primary energy resources excluding non-renewable primary energy resources used as raw materials
RE	Use of non-renewable primary energy resources used as raw materials
PENRT	Total use of non-renewable primary energy resources
SM	Use of secondary material
RSF	Use of renewable fuels
NRSF	Use of non-renewable secondary fuels
FW	Use of net fresh water

POLFLAM EI, EW, FR GAIA (16-20 mm)

CORE ENVIRONMENTAL IMPACT INDICATORS: 1 m² POLFLAM EI, EW, FR GAIA (16-20 mm)

Indicator	Unit	Life Cycle Stage						
		A1-A3	A4	C1	C2	C3	C4	D
GWP-total	kg CO ₂ eq.	5,38E+01	5,71E-02	0,00E+00	5,46E-01	1,28E+00	4,34E-02	-1,02E+00
GWP-fossil	kg CO ₂ eq.	5,68E+01	5,70E-02	0,00E+00	5,45E-01	1,26E+00	4,32E-02	-8,91E-01
GWP-biogenic	kg CO ₂ eq.	-3,06E+00	4,92E-05	0,00E+00	4,97E-04	2,02E-02	1,83E-04	-9,73E-02
GWP-luluc	kg CO ₂ eq.	6,00E-02	2,28E-05	0,00E+00	2,58E-04	4,90E-04	9,71E-06	-3,84E-04
ODP	kg CFC11 eq.	5,12E-06	1,32E-08	0,00E+00	1,23E-07	1,82E-07	2,14E-08	-7,81E-08
AP	mol H+ eq.	3,95E-01	1,62E-04	0,00E+00	1,54E-03	1,06E-02	4,23E-04	-2,71E-03
EP-freshwater	kg PO ₄ eq.	3,24E-02	3,74E-06	0,00E+00	4,11E-05	5,69E-04	2,46E-06	-2,97E-05
EP-marine	kg N eq.	8,01E-02	3,29E-05	0,00E+00	3,02E-04	4,18E-03	1,60E-04	-1,95E-03
EP-terrestrial	mol N eq.	8,64E-01	3,59E-04	0,00E+00	3,28E-03	4,47E-02	1,76E-03	-1,16E-02
POCP	kg NMVOC eq.	2,31E-01	1,38E-04	0,00E+00	1,26E-03	1,23E-02	5,02E-04	-5,36E-03
ADP-minerals & metals	kg Sb eq.	4,55E-04	2,02E-07	0,00E+00	2,50E-06	1,15E-06	8,42E-08	-1,02E-06
ADP-fossil	MJ	7,23E+02	8,64E-01	0,00E+00	8,17E+00	1,59E+01	1,40E+00	-5,58E+00
WDP	WDP (m ³) eq.	2,56E+01	2,63E-03	0,00E+00	2,71E-02	3,97E-02	4,42E-03	-6,32E-02

PARAMETERS DESCRIBING RESOURCE: 1 m² POLFLAM EI, EW, FR GAIA (16-20 mm)

Indicator	Unit	Life Cycle Stage						
		A1-A3	A4	C1	C2	C3	C4	D
PERE	MJ	4,92E+02	1,24E-02	0,00E+00	1,38E-01	5,11E-01	2,84E-02	-8,46E-02
PERM	MJ	2,00E+01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PERT	MJ	5,12E+02	1,24E-02	0,00E+00	1,38E-01	5,11E-01	2,84E-02	-8,46E-02
PEN-RE	MJ	8,45E+02	8,99E-01	0,00E+00	8,48E+00	1,80E+01	1,45E+00	-5,87E+00
RE	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PENRT	MJ	8,45E+02	8,99E-01	0,00E+00	8,48E+00	1,80E+01	1,45E+00	-5,87E+00
SM	kg	7,09E-01	0,00E+00	0,00E+00	0,00E+00	6,00E-01	0,00E+00	0,00E+00
RSF	MJ	2,67E+02	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	1,25E+00	1,38E-04	0,00E+00	1,64E-03	1,58E-02	4,85E-05	-5,68E-04

POLFLAM EI, EW, FR GAIA (16-20 mm)

ENVIRONMENTAL INFORMATION DESCRIBING WASTE AND OUTPUT FLOWS: 1 m² POLFLAM EI, EW, FR GAIA (16-20 mm)

Indicator	Unit (expressed per DU)	Life Cycle Stage						
		A1-A3	A4	C1	C2	C3	C4	D
Hazardous waste	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Non-hazardous waste	kg	1,46E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Radioactive waste	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Components for re-use	kg	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	1,18E-01	0,00E+00	0,00E+00	0,00E+00	6,00E-01	0,00E+00	0,00E+00
Materials for energy recovery	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Exported energy	MJ/energy carrier	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00

POLFLAM EI, EW, FR GAIA (21-55 mm)

CORE ENVIRONMENTAL IMPACT INDICATORS: 1 m² POLFLAM EI, EW, FR GAIA (21-55 mm)

Indicator	Unit	Life Cycle Stage						
		A1-A3	A4	C1	C2	C3	C4	D
GWP-total	kg CO ₂ eq.	6,35E+01	5,71E-02	0,00E+00	5,51E-01	1,30E+00	5,69E-02	-1,39E+00
GWP-fossil	kg CO ₂ eq.	6,72E+01	5,70E-02	0,00E+00	5,50E-01	1,28E+00	5,66E-02	-1,33E+00
GWP-biogenic	kg CO ₂ eq.	-3,87E+00	4,92E-05	0,00E+00	5,01E-04	2,05E-02	2,40E-04	-4,72E-02
GWP-luluc	kg CO ₂ eq.	7,22E-02	2,28E-05	0,00E+00	2,60E-04	4,98E-04	1,27E-05	-6,78E-04
ODP	kg CFC11 eq.	6,61E-06	1,32E-08	0,00E+00	1,24E-07	1,85E-07	2,80E-08	-1,03E-07
AP	mol H+ eq.	4,55E-01	1,62E-04	0,00E+00	1,56E-03	1,08E-02	5,55E-04	-3,27E-03
EP-freshwater	kg PO ₄ eq.	3,52E-02	3,74E-06	0,00E+00	4,15E-05	5,78E-04	3,23E-06	-4,47E-05
EP-marine	kg N eq.	8,98E-02	3,29E-05	0,00E+00	3,04E-04	4,25E-03	2,10E-04	-2,85E-03
EP-terrestrial	mol N eq.	9,71E-01	3,59E-04	0,00E+00	3,31E-03	4,54E-02	2,30E-03	-1,33E-02
POCP	kg NMVOC eq.	2,64E-01	1,38E-04	0,00E+00	1,27E-03	1,25E-02	6,59E-04	-4,58E-03
ADP-minerals & metals	kg Sb eq.	6,33E-04	2,02E-07	0,00E+00	2,52E-06	1,17E-06	1,10E-07	-1,41E-06
ADP-fossil	MJ	8,93E+02	8,64E-01	0,00E+00	8,24E+00	1,62E+01	1,83E+00	-7,55E+00
WDP	WDP (m ³) eq.	3,21E+01	2,63E-03	0,00E+00	2,73E-02	4,04E-02	5,79E-03	-4,83E-02

PARAMETERS DESCRIBING RESOURCE: 1 m² POLFLAM EI, EW, FR GAIA (21-55 mm)

Indicator	Unit	Life Cycle Stage						
		A1-A3	A4	C1	C2	C3	C4	D
PERE	MJ	5,03E+02	1,24E-02	0,00E+00	1,40E-01	5,20E-01	3,73E-02	-1,23E-01
PERM	MJ	2,00E+01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PERT	MJ	5,23E+02	1,24E-02	0,00E+00	1,40E-01	5,20E-01	3,73E-02	-1,23E-01
PEN-RE	MJ	9,87E+02	8,99E-01	0,00E+00	8,55E+00	1,63E+01	1,90E+00	-7,96E+00
RE	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PENRT	MJ	9,87E+02	8,99E-01	0,00E+00	8,55E+00	1,63E+01	1,90E+00	-7,96E+00
SM	kg	7,35E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
RSF	MJ	2,67E+02	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	1,20E+00	1,38E-04	0,00E+00	1,65E-03	1,61E-02	6,36E-05	-7,46E-04

POLFLAM EI, EW, FR GAIA (21-55 mm)

ENVIRONMENTAL INFORMATION DESCRIBING WASTE AND OUTPUT FLOWS: 1 m² POLFLAM EI, EW, FR GAIA (21-55 mm)

Indicator	Unit (expressed per DU)	Life Cycle Stage						
		A1-A3	A4	C1	C2	C3	C4	D
Hazardous waste	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Non-hazardous waste	kg	1,46E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Radioactive waste	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Components for re-use	kg	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	1,44E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Materials for energy recovery	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Exported energy	MJ/energy carrier	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00

POLFLAM BR GAIA (30-50 mm)

CORE ENVIRONMENTAL IMPACT INDICATORS: 1 m² POLFLAM BR GAIA (30-50 mm)

Indicator	Unit	Life Cycle Stage						
		A1-A3	A4	C1	C2	C3	C4	D
GWP-total	kg CO ₂ eq.	7,92E+01	5,71E-02	0,00E+00	1,08E+00	2,52E+00	7,47E-02	-1,75E+00
GWP-fossil	kg CO ₂ eq.	8,54E+01	5,70E-02	0,00E+00	1,08E+00	2,48E+00	7,44E-02	-1,63E+00
GWP-biogenic	kg CO ₂ eq.	-6,32E+00	4,92E-05	0,00E+00	9,81E-04	3,97E-02	3,15E-04	-9,47E-02
GWP-luluc	kg CO ₂ eq.	1,16E-01	2,28E-05	0,00E+00	5,09E-04	9,66E-04	1,67E-05	-1,34E-03
ODP	kg CFC11 eq.	8,76E-06	1,32E-08	0,00E+00	2,43E-07	3,58E-07	3,68E-08	-2,01E-07
AP	mol H+ eq.	6,56E-01	1,62E-04	0,00E+00	3,05E-03	2,09E-02	7,30E-04	-5,90E-03
EP-freshwater	kg PO ₄ eq.	3,83E-02	3,74E-06	0,00E+00	8,12E-05	1,12E-03	4,24E-06	-8,60E-05
EP-marine	kg N eq.	1,37E-01	3,29E-05	0,00E+00	5,95E-04	8,23E-03	2,76E-04	-3,55E-03
EP-terrestrial	mol N eq.	1,52E+00	3,59E-04	0,00E+00	6,48E-03	8,80E-02	3,03E-03	-2,35E-02
POCP	kg NMVOC eq.	4,02E-01	1,38E-04	0,00E+00	2,49E-03	2,42E-02	8,66E-04	-8,19E-03
ADP-minerals & metals	kg Sb eq.	7,47E-04	2,02E-07	0,00E+00	4,93E-06	2,27E-06	1,45E-07	-2,72E-06
ADP-fossil	MJ	1,10E+03	8,64E-01	0,00E+00	1,61E+01	3,13E+01	2,41E+00	-1,47E+01
WDP	WDP (m ³) eq.	4,53E+01	2,63E-03	0,00E+00	5,35E-02	7,82E-02	7,61E-03	-5,49E-02

PARAMETERS DESCRIBING RESOURCE: 1 m² POLFLAM BR GAIA (30-50 mm)

Indicator	Unit	Life Cycle Stage						
		A1-A3	A4	C1	C2	C3	C4	D
PERE	MJ	9,24E+02	1,24E-02	0,00E+00	2,73E-01	1,01E+00	4,90E-02	-2,36E-01
PERM	MJ	4,00E+01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PERT	MJ	9,64E+02	1,24E-02	0,00E+00	2,73E-01	1,01E+00	4,90E-02	-2,36E-01
PEN-RE	MJ	9,11E+02	8,48E-01	0,00E+00	1,57E+01	3,37E+01	2,36E+00	-1,43E+01
RE	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PENRT	MJ	9,11E+02	8,48E-01	0,00E+00	1,57E+01	3,37E+01	2,36E+00	-1,43E+01
SM	kg	1,39E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
RSF	MJ	5,34E+02	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	1,44E+00	1,38E-04	0,00E+00	3,23E-03	3,11E-02	8,35E-05	-1,44E-03

POLFLAM BR GAIA (30-50 mm)

ENVIRONMENTAL INFORMATION DESCRIBING WASTE AND OUTPUT FLOWS: 1 m² POLFLAM BR GAIA (30-50 mm)

Indicator	Unit (expressed per DU)	Life Cycle Stage						
		A1-A3	A4	C1	C2	C3	C4	D
Hazardous waste	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Non-hazardous waste	kg	1,46E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Radioactive waste	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Components for re-use	kg	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	2,12E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Materials for energy recovery	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Exported energy	MJ/energy carrier	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00

INTERPRETATION OF LCA

- The LCA analysis proved that the biggest impact on the value of the environmental impact indicators are processes related to the procurement of raw materials and intermediate products (A1). They account for about 80 to nearly 100% of the total value of the impact category. Sub-processes related to the acquisition of raw materials and energy affect the impact categories to varying degrees. The low-carbon glass is manufactured with a significantly reduced carbon footprint compared to traditional glass. Its manufacturing process utilizes renewable energy sources and incorporates recycled materials, further reducing its environmental impact.
- The negative result in the characterization criterion for the climate change – biogenic impact category is mainly due to the fact that racks made of wood are used, which has a negative CO₂ emission rate in its life cycle (not including disposal).
- Transportation to the waste treatment plant (C2) has a very small impact on the overall value of the impact category, amounting to a maximum of about 2% for the main impact categories.
- Waste treatment processes (C3) account for a maximum of up to 6% in the main impact categories. This depends on the amount of material to be processed and the technology at the waste processing plant.
- Given the aforementioned conclusions, the owner of the declaration has a moderate influence on the values of environmental impact indicators, as it depends on external parties. It can only try to change suppliers to those closer to the production site and reduce consumption at the production process level.

LITERATURE

- PN-EN ISO 14025:2014-04, *Environmental labels and declarations – Type III environmental declarations – Rules and procedures.*
- PN-EN 15804+A2:2020, *Sustainability of construction works – Environmental product declarations – Basic rules for categorizing construction products.*
- PN-EN ISO 14040:2009 *Environmental management. Life Cycle Assessment. Principles and structure.*
- PN-EN ISO 14044:2009, *Environmental management. Life Cycle Assessment. Requirements and guidelines*
- EN 15942:2012, *Sustainability of construction works – Environmental product declarations – Communication format business-to-business.*
- PN-EN ISO 12543-4:2022-05, *Glass in construction — Laminated glass and safety laminated glass — Part 4: Durability test methods.*
- PN-EN 572-1:2012, *Glass in building. Basic soda-lime silicate glass products- Definitions and general physical and mechanical properties.*
- M. Asif, A. Davidson, T. Muneer, MImech: *LIFE CYCLE OF WINDOW MATERIALS - A COMPARATIVE ASSESSMENT* FICBSE Millennium Fellow School of Engineering, Napier University, 10 Colinton Road, Edinburgh EH10 5DT, U.K.
- Asif, M., Muneer, T. and Kubie, J., „Sustainability analysis of window frames”, *Building Services Engineering Research and Technology*. 2005, vol. 26, no. 1, pp. 71-87.
- Weir, G. and Muneer, T., „Energy and environmental impact analysis of double-glazed windows”, *Energy Conversion and Management* 1998, vol. 39, no. 3-4, pp. 243-256.
- Heinz Stichnothe^{1,2} and Adisa Azapagic¹ *Life cycle assessment of recycling PVC window frames Resources Conservation and Recycling · February 2013 DOI: 10.1016/j.resconrec.2012.12.005*
- Additional explanatory material can be obtained from the owner of the declaration company website: <http://www.polflam.pl/>



PARTITIONS



WINDOWS
AND DOORS



FACADES
AND ROOFS



FLOORS



SMOKE
BARRIERS



CE marking confirms that a product complies with the relevant harmonised European Norm.

Technical specification of the products are available at www.polflam.com



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