Łukasiewicz
Institute of Ceramics
and Building Materials

POLFLAM®
FIRE RESISTANT GLASS

ENVIRONMENTAL PRODUCT DECLARATION

no. 02-11/2024

Fire-resistant glass

POLFLAM Sp. z o.o.

Owner of the EPD:	*POLFLAM Sp. z o.o.*
Programme owner:	*Łukasiewicz Research Network - Institute of Ceramics and Building Materials*
Name of programme:	*Environmental Product Declaration – B2B*
Issued:	***28.11.2024***
Valid until:	***28.11.2029***

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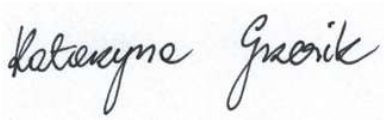
1. GENERAL INFORMATION

Product of declaration:	Fire-resistant glass: • EI, EW, FR 16-20 mm, • EI, EW, FR 21-55 mm, • BR 30-45 mm.
Program owner: Łukasiewicz Research Network– Institute of Ceramics and Building Materials Environmental Engineering Center in Opole. **http://www.icimb.pl/opole/**	**Właściciel deklaracji:** POLFLAM Sp. z o.o. 3 Aleja Krakowska, Jeziorzany 05-555 Tarczyn Telephone: +48 22 726 92 17 Adres: info@polflam.pl **https://www.polflam.pl/**
Declared unit:	1 m^2
Date of issue:	28.11.2024
Declaration valid until:	28.11.2029
Life Cycle Analysis (LCA):	A1-A3, A4, C1-C4 and D according to PN-EN 15804+A2 (Cradle-to-Gate with options)
Product Categorization (PCR) Rules	PN-EN 15804+A2:2020-03 Sustainability of construction works. Environmental Product Declarations. Basic principles of categorization of construction products, ICIMB-PCR A
Representatives:	Polish product, year 2023
Declared durability:	30 years
Reasons for performing LCA:	B2B
Standardy produktu	PN-EN 12543-4
Declarations that are the result of different programs or are not performed in accordance with the standard may not be comparable.	
The Łukasiewicz – Institute of Ceramics and Building Materials Environmental Engineering Center provides access to the Type III environmental declaration for fire-resistant glass to interested parties.	
The declaration owner is responsible for the information and the base evidence. Łukasiewicz Research Network - Institute of Ceramics and Building Materials Center for Environmental Engineering is not responsible for the manufacturer's information and data and evidence regarding the life cycle assessment.	
Authors' team: Katarzyna Kiprian, M.Sc. Ewa Głodek-Bucyk, Ph.D. Patryk Okoń, M.Sc. **Approved:**  Joanna Poluszyńska, PhD Director of the Environmental Engineering Center  Ewa Głodek-Bucyk, Ph.D. Leader of the Process Engineering Research Group	**Review:** CEN standard PN-EN 15804+A2 serves as the main PCR document. Independent verification of declarations and data according to EN ISO 14025:2010 ☐ Internal ☒ External  Katarzyna Grzesik, PhD, DSc

2. MANUFACTURER AND PRODUCT DESCRIPTION

POLFLAM has been in the glass industry since 1992, and has specialized in the production and sale of fire glass since 2005. We have gained a thorough knowledge of both fire glass and the structural systems in which it is used. We have to our credit hundreds of thousands of square meters of glass produced and thousands of realizations in Europe and around the world. Today POLFLAM is a completely independent manufacturer of fire glass: from technology through research - to production.

We offer the product together with a service system:

- laboratory facilities for testing glass and finished constructions,
- consulting and training.

The POLFLAM is a synonym for product quality and reliable and comprehensive service at every stage of the investment.The group of products covered by the declaration are fire-resistant glass:

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

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 fire-resistant glass production begins with the arrival of large-sized 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 waiting for an assembly process.

The assembly process begins with a vertical washing machine where the glass panes undergo a thorough cleaning process. Each plane 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, 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.

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.

The products are produced on the same production line according to the scheme shown below:

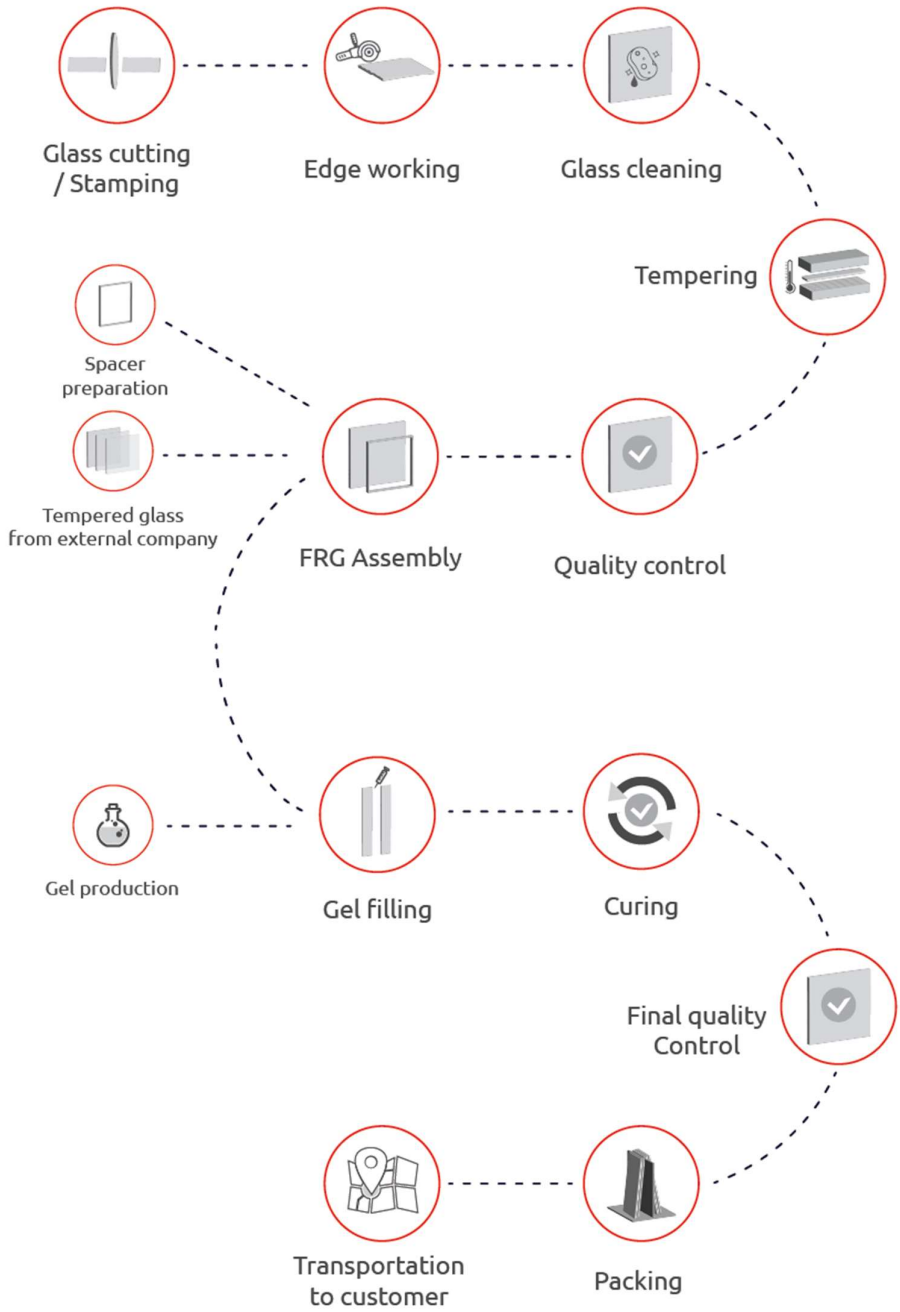


Figure 1: The production diagram of fire-resistant glass by POLFLAM Sp. z o.o.

POLFLAM EI and POLFLAM EW are fully transparent fire-resistant glasses for various applications. POLFLAM EI fire-resistant glass meets integrity with full thermal insulation and POLFLAM EW 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 13501-2. Monolithic POLFLAM EI and POLFLAM EW fire-resistant glass consist of two thermally toughened safety 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 and POLFLAM EW fire-resistant glass are designed for internal applications and as Insulated Glass Units for external building applications.

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

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

Construction of the fire-resistant glass is presented below:

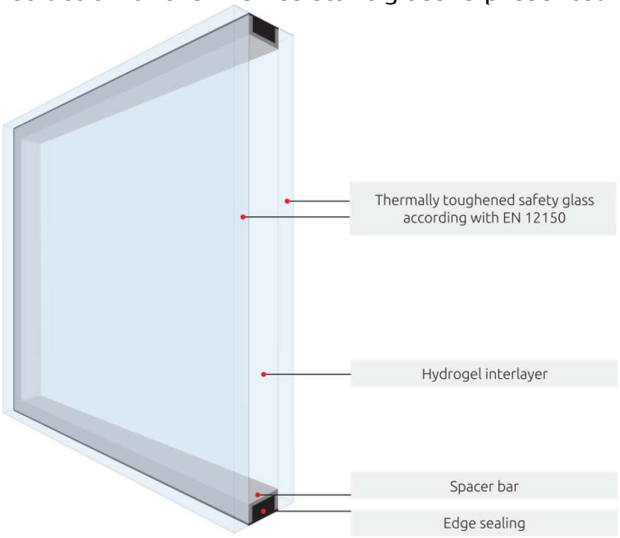


Figure 2: Diagram of the construction of fire-resistant glass produced by POLFLAM Sp. z o.o

DESCRIPTION AND APPLICATION OF PRODUCTS

Monolithic POLFLAM fire-resistant glass EW, EI

Monolithic POLFLAM fire-resistant glass is used in internal partitions, windows, doors and facades.

Table 2 Technical data - monolithic fire-resistant glass POLFLAM EW, EI.

POLFLAM		EW 30	EW 60		EW 90	EW 120	EI 15	EI 30	EI 60		EI 90		EI 120		EI 180
Nominal thickness [mm]		16	16	20	16	16	16	20	25	28	32	35	35	40	55
Thickness tolerance [mm]		± 2	± 2	± 2	± 2	± 2	± 2	± 2	± 2	± 2	± 3	± 3	± 3	± 3	± 3
Weight [kg/m²]		33	33	38	33	33	33	38	45	49	52	57	57	64	83
Fire resistance	EN 13501-2	EW 30	EW 60	EW 60	EW 90	EW 120	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*	88*	87	88*	88*	88*	87	87	87	85	87	87	86	85
Total solar energy transmittance g [%]	EN 410	73*	73*	72	73*	73*	73*	72	70	71	68	70	70	68	66
Thermal properties U_g [W/m²K]	EN 673	4.8*	4.8*	4.4	4.8*	4.8*	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)	41 (-2; -3)	42 (-2; -3)	41 (-2; -3)	41 (-2; -3)	41 (-2; -3)	42 (-2; -3)	44 (-2; -4)	45 (-1; -3)	44 (-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 values

POLFLAM BR fire-resistant glass

POLFLAM BR 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.

Table 3 Technical data - monolithic fire-resistant glass POLFLAM BR.

POLFLAM BR		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/m²]		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/m²K]	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 values

POLFLAM FR fire-resistant glass

POLFLAM FR 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.

Table 4 Technical Data - monolithic fire-resistant glass POLFLAM FR.

POLFLAM FR		**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	± 3
Weight [kg/m²]		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/m²K]	EN 673	4.4	4.0*	3.3	3.4*	NPD
Sound reduction index R_w (C; C_{tr})[dB]	EN 12758	42 (-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				
Max. temperature range		-40 °C / +50 °C				
Curved glass		Yes				

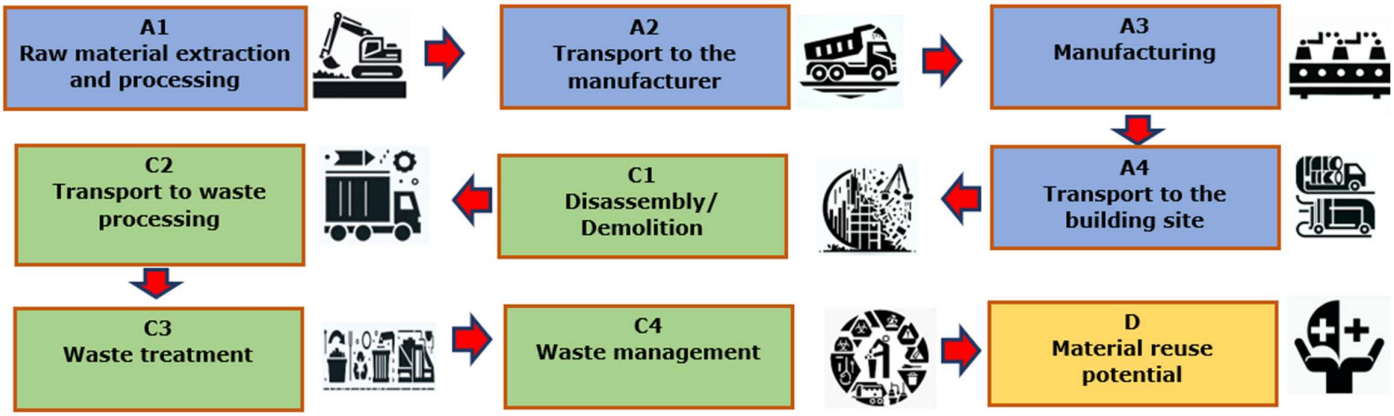
*estimated values

2. LCA: CALCULATION RULES

The environmental declaration is based on average data provided by the owner of the declaration POLFLAM Sp. z o.o. for production plant located in Jeziorzany.

System limitations

The life cycle analysis of the tested products includes modules A1-A3, C1-C4 and D (Cradle to Gate with options) in accordance with EN 15804.



Data collection period

Data on the production process were provided in 2024 for the period 01.01.2023 - 31.12.2023 (12 months) and correspond to the production technology of the time.

Declared unit

1 m²

Assumptions

A1 – extraction and consumption of raw materials refers to specific mass shares in the production process, per unit declared of the product,
A2 – 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 delivery of raw materials,
A3 – CO_2, NO_x, SO_2 and dust emission values from the production process received from the manufacturer,
A4 – refers to the transport of the final product to the construction site is treated as the average weight values of transports to customers,
C1 - describes the handling of fire-resistant glass during disassembly/demolition. Calculations are made on the basis of the developed scenario,
C2 – refers to the transport of construction waste to a recovery or disposal plant. Calculations are made on the basis of the developed scenario,
C3 – takes into account the environmental impact during the processing of demolition waste, containing elements of fire-resistant compound, in a waste recovery plant. Calculations are made on the basis of the developed scenario,
C4 – takes into account the environmental impact of storage and recycling of fire-retardant components. Calculations are made on the basis of the developed scenario,
D – refers to the impact and effects of the use of secondary material. The calculations are performed based on the developed scenario.

Cut-off-criteria	99% of all bulk streams involved in the production process were taken into account. All the energy used in the process was taken into account in the environmental declaration.
General data	The data for the calculations come from Ecoinvent v. 3.9.2 and have been supplemented with KOBiZE *CO_2, SO_2, NO_2, CO and total particulate matter emission indicators for electricity, December 2023.* Emission factors for electricity were determined using the actual KOBiZE data. The Polish electricity emission factor (Ecoinvent supplemented with current national data from KOBiZE) is 0.685 kg CO_2/kWh. A detailed analysis of data quality was part of an external audit.
Allocation	All data on the components manufactured in the plant were provided by the owner of the declaration POLFLAM Sp. z o.o. and were referred to the declared unit of the product – 1 m^2. The allocation rules used in this EPD are based on the general ICIMB-PCR A principles.

3. LCA: SCENARIOS AND ADDITIONAL TECHNICAL INFORMATION

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.

For the life cycle analysis of products covered by the cradle to gate with options environmental declaration, scenarios have been developed for modules A4, C1-C4 and D:

Module A4 – transport to the construction site - Based on the manufacturer's declaration, the following scenario was adopted - Transport is carried out by trucks with a load capacity of 16-32 tons meeting the EURO 6 emission standards, average distance from the plant to the customer 350 km - data from the customer.

Module C1 - Disassembly/demolition – Manual demolition and initial sorting on site have been adopted. The consumption of energy and other raw materials in this module has been omitted due to negligible values The separated fractions from the separation of fire-resistant glass are directed to the waste treatment plant. The modulus is zero.

Module C2 – Transport – Waste is transported to the treatment plant, where, after separating the recyclable fraction and the fraction intended for landfill, the appropriate quantities are directed to further processes.

- 100% of the waste constituting used fire-resistant glass is transported to a recovery plant. It is assumed that 70% of fire-resistant glass is recycled and the remainder is landfilled.
- Transport is carried out by trucks with a load capacity of 7.5-16 tons, meeting the EURO 6 emission standards.
- Transport to the recycling plant and to the landfill takes place at a distance of 100 km from the demolition site.

Module C3 - **Waste treatment** - It is assumed that all waste goes to the waste treatment plant. Electricity consumption per 1 kg of waste is 0.03 kWh/kg, and fuel consumption is 0.315 MJ/kg. The following processes were assumed for the calculations: unloading (loader), crushing (crusher.)

Module C4 – Waste management – It has been assumed that waste that can no longer be used in any other way is sent to the landfill. These are wastes separated in the processing process (module C3).

Module D - **Material reuse potential** - for fire-resistant glass, it is assumed that 70% of the product is recycled.

4. 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 (X –MODULE INCLUDED IN LCA, MND – MODULE NOT DECLARED)																
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**

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-terrestial	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
PM	Potential incidence of disease due to PM emissions
IRP	Potential Human exposure efficiency relative to U235
ETP-fw	Potential comparative Toxic Unit for ecosystems
HTP-c	Potential comparative Toxic Unit for humans (cancerogenic)
HTP-nc	Potential comparative Toxic Unit for humans (non-cancerogenic)
SQP	Potential soil quality index
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

MAIN IMPACT INDICATORS: 1 m² POLFLAM EI, EW, FR 16-20 mm

		Life Cycle Stage								
Indicator	**Unit**	**A1**	**A2**	**A3**	**A4**	**C1**	**C2**	**C3**	**C4**	**D**
GWP-total	kg CO_2 eq.	4,18E+01	1,40E+00	1,78E+01	6,66E-02	0,00E+00	6,14E-01	1,33E+00	3,10E-02	-8,40E-01
GWP-fossil	kg CO_2 eq.	4,16E+01	1,40E+00	2,06E+01	6,65E-02	0,00E+00	6,13E-01	1,31E+00	3,09E-02	-7,53E-01
GWP-biogenic	kg CO_2 eq.	2,33E-01	9,72E-04	-2,78E+00	4,61E-05	0,00E+00	3,59E-04	1,95E-02	7,91E-05	-8,67E-02
GWP-luluc	kg CO_2 eq.	1,78E-02	4,66E-04	3,30E-02	2,21E-05	0,00E+00	1,93E-04	4,72E-04	4,93E-06	-3,32E-04
ODP	kg CFC11 eq.	9,49E-07	2,79E-08	8,29E-08	1,32E-09	0,00E+00	1,23E-08	1,42E-08	1,15E-09	-6,90E-09
AP	mol H+ eq.	3,70E-01	2,92E-03	9,03E-02	1,39E-04	0,00E+00	1,20E-03	1,00E-02	3,72E-04	-2,61E-03
EP-freshwater	kg PO_4 eq.	6,99E-03	9,50E-05	2,42E-02	4,50E-06	0,00E+00	4,02E-05	5,62E-04	1,41E-06	-3,36E-05
EP-marine	kg N eq.	5,89E-02	7,02E-04	1,68E-02	3,33E-05	0,00E+00	2,84E-04	4,09E-03	8,23E-05	-1,61E-03
EP-terrestrial	mol N eq.	7,08E-01	7,57E-03	1,34E-01	3,59E-04	0,00E+00	3,07E-03	4,37E-02	9,00E-04	-1,09E-02
POCP	kg NMVOC eq.	2,07E-01	4,85E-03	4,12E-02	2,30E-04	0,00E+00	2,03E-03	1,30E-02	3,63E-04	-5,56E-03
ADP-minerals & metals	kg Sb eq.	4,45E-04	4,57E-06	2,75E-05	2,16E-07	0,00E+00	1,96E-06	7,19E-07	3,88E-08	-1,04E-06
ADP-fossil	MJ	5,21E+02	1,97E+01	2,31E+02	9,35E-01	0,00E+00	8,56E+00	1,62E+01	7,70E-01	-5,60E+00
WDP	WDP (m^3) world ekw	1,39E+01	8,19E-02	1,03E+00	3,88E-03	0,00E+00	3,26E-02	4,60E-02	2,66E-03	8,55E-01

ADDITIONAL IMPACT INDICATORS: 1 m² POLFLAM EI, EW, FR 16-20 mm

		Life Cycle Stage								
Indicator	**Unit**	**A1**	**A2**	**A3**	**A4**	**C1**	**C2**	**C3**	**C4**	**D**
PM	Disease incidency	3,71E-06	1,03E-07	2,57E-07	4,90E-09	0,00E+00	3,81E-08	2,34E-07	4,87E-09	-4,77E-08
IRP	kBq U235 eq.	1,97E+00	2,56E-02	3,11E-01	1,21E-03	0,00E+00	1,31E-02	8,75E-03	6,58E-04	-6,45E-03
ETP-fw	CTUe	4,35E-03	5,91E-05	1,51E-02	2,80E-06	0,00E+00	2,50E-05	3,50E-04	1,69E-06	-2,17E-05
HTP-c	CTUh	1,40E-07	9,96E-09	4,89E-08	4,72E-10	0,00E+00	3,67E-09	3,88E-09	1,30E-10	-4,00E-09
HTP-nc	CTUh	3,24E-07	1,24E-08	2,49E-07	5,87E-10	0,00E+00	4,96E-09	6,77E-09	1,13E-10	-6,27E-09
SQP	-	1,41E+02	1,19E+01	3,59E+02	5,65E-01	0,00E+00	4,42E+00	1,59E+00	1,56E+00	-1,17E+01

INDICATORS DESCRIBTIONS RESOURCE CONSUMPTION: 1 m² POLFLAM EI, EW, FR 16-20 mm

		Life Cycle Stage								
Indicator	**Unit**	**A1**	**A2**	**A3**	**A4**	**C1**	**C2**	**C3**	**C4**	**D**
PERE	MJ	3,02E+01	3,40E-01	7,86E+01	1,61E-02	0,00E+00	1,66E-01	4,77E-01	3,05E-02	-1,06E-01
PERM	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
PERT	MJ	3,02E+01	3,40E-01	7,86E+01	1,61E-02	0,00E+00	1,66E-01	4,77E-01	3,05E-02	-1,06E-01
PEN-RE	MJ	5,16E+02	1,98E+01	2,92E+02	9,39E-01	0,00E+00	8,53E+00	1,77E+01	1,48E+00	-6,42E+00
RE	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
PENRT	MJ	5,16E+02	1,98E+01	2,92E+02	9,39E-01	0,00E+00	8,53E+00	1,77E+01	1,48E+00	-6,42E+00
SM	kg	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
RSF	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
NRSF	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
FW	m^3	3,94E-01	3,65E-03	4,25E-01	1,73E-04	0,00E+00	2,16E-03	9,13E-03	7,42E-05	-7,99E-04

INDICATORS DESCRIBING OUTPUT STREAMS AND WASTE: 1 m² POLFLAM EI, EW, FR 16-20 mm

	Life Cycle Stage									
Indicator	**Unit (expressed per DU)**	**A1**	**A2**	**A3**	**A4**	**C1**	**C2**	**C3**	**C4**	**D**
Hazardous waste	kg	WN	WN	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	WN	WN	7,87E-06	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Radioactive waste	kg	WN	WN	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	WN	WN	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	WN	WN	1,12E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Materials for energy recovery	kg	WN	WN	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	WN	WN	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00

CARBON ORGANIC

Contents organic carbon in product (kg C_{org})	**0,00E+00**
Contents organic carbon in packaging (kg C_{org})	**5,33E-02**

MAIN IMPACT INDICATORS: 1 m² POLFLAM EI, EW, FR 21-55 mm

	Life Cycle Stage									
Indicator	**Unit**	**A1**	**A2**	**A3**	**A4**	**C1**	**C2**	**C3**	**C4**	**D**
GWP-total	kg CO_2 eq.	5,03E+01	1,73E+00	1,73E+01	6,66E-02	0,00E+00	6,22E-01	1,35E+00	3,08E-02	-1,10E+00
GWP-fossil	kg CO_2 eq.	5,00E+01	1,72E+00	2,09E+01	6,65E-02	0,00E+00	6,22E-01	1,33E+00	3,07E-02	-1,02E+00
GWP-biogenic	kg CO_2 eq.	2,45E-01	1,19E-03	-3,61E+00	4,61E-05	0,00E+00	3,64E-04	1,98E-02	7,87E-05	-8,62E-02
GWP-luluc	kg CO_2 eq.	2,54E-02	5,72E-04	3,65E-02	2,21E-05	0,00E+00	1,96E-04	4,79E-04	4,90E-06	-3,30E-04
ODP	kg CFC11 eq.	1,47E-06	3,43E-08	8,97E-08	1,32E-09	0,00E+00	1,24E-08	1,45E-08	1,15E-09	-6,33E-09
AP	mol H+ eq.	4,23E-01	3,59E-03	9,16E-02	1,39E-04	0,00E+00	1,22E-03	1,01E-02	4,90E-04	-2,78E-03
EP-freshwater	kg PO_4 eq.	9,55E-03	1,17E-04	2,43E-02	4,50E-06	0,00E+00	4,08E-05	5,70E-04	1,40E-06	-3,36E-05
EP-marine	kg N eq.	6,69E-02	8,63E-04	1,72E-02	3,33E-05	0,00E+00	2,88E-04	4,15E-03	8,18E-05	-2,16E-03
EP-terrestrial	mol N eq.	7,99E-01	9,31E-03	1,38E-01	3,59E-04	0,00E+00	3,11E-03	4,44E-02	8,95E-04	-1,11E-02
POCP	kg NMVOC eq.	2,39E-01	5,97E-03	4,28E-02	2,30E-04	0,00E+00	2,06E-03	1,32E-02	3,61E-04	-5,59E-03
ADP-minerals & metals	kg Sb eq.	6,60E-04	5,61E-06	2,96E-05	2,16E-07	0,00E+00	1,98E-06	7,30E-07	3,86E-08	-1,03E-06
ADP-fossil	MJ	6,58E+02	2,43E+01	2,36E+02	9,35E-01	0,00E+00	8,69E+00	1,64E+01	7,65E-01	-5,22E+00
WDP	WDP (m^3) world ekw	1,89E+01	1,01E-01	1,38E+00	3,88E-03	0,00E+00	3,31E-02	4,66E-02	2,65E-03	8,63E-01

ADDITIONAL IMPACT INDICATORS: 1 m² POLFLAM EI, EW, FR 21-55 mm

	Life Cycle Stage									
Indicator	**Unit**	**A1**	**A2**	**A3**	**A4**	**C1**	**C2**	**C3**	**C4**	**D**
PM	Disease incidency	4,18E-06	1,27E-07	2,77E-07	4,90E-09	0,00E+00	3,86E-08	2,37E-07	4,84E-09	-4,58E-08
IRP	kBq U235 eq.	2,58E+00	3,15E-02	3,45E-01	1,21E-03	0,00E+00	1,33E-02	8,88E-03	6,54E-04	-6,18E-03

ETP-fw	CTUe	5,94E-03	7,27E-05	1,51E-02	2,80E-06	0,00E+00	2,54E-05	3,55E-04	2,23E-06	-2,23E-05
HTP-c	CTUh	2,00E-07	1,22E-08	5,59E-08	4,72E-10	0,00E+00	3,73E-09	3,93E-09	1,29E-10	-4,32E-09
HTP-nc	CTUh	4,74E-07	1,52E-08	2,52E-07	5,87E-10	0,00E+00	5,04E-09	6,87E-09	1,13E-10	-8,63E-09
SQP	-	1,74E+02	1,46E+01	4,33E+02	5,65E-01	0,00E+00	4,48E+00	1,61E+00	1,55E+00	-1,09E+01

INDICATORS DESCRIBTIONS RESOURCE CONSUMPTION: 1 m² POLFLAM EI, EW, FR 21-55 mm

		Life Cycle Stage								
Indicator	**Unit**	**A1**	**A2**	**A3**	**A4**	**C1**	**C2**	**C3**	**C4**	**D**
PERE	MJ	3,87E+01	4,18E-01	9,25E+01	1,61E-02	0,00E+00	1,68E-01	4,84E-01	4,01E-02	-1,09E-01
PERM	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
PERT	MJ	3,87E+01	4,18E-01	9,25E+01	1,61E-02	0,00E+00	1,68E-01	4,84E-01	4,01E-02	-1,09E-01
PEN-RE	MJ	6,53E+02	2,43E+01	2,96E+02	9,39E-01	0,00E+00	8,66E+00	1,80E+01	1,95E+00	-6,51E+00
RE	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
PENRT	MJ	6,53E+02	2,43E+01	2,96E+02	9,39E-01	0,00E+00	8,66E+00	1,80E+01	1,95E+00	-6,51E+00
SM	kg	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
RSF	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
NRSF	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
FW	m^3	4,88E-01	4,48E-03	4,34E-01	1,73E-04	0,00E+00	2,19E-03	9,26E-03	9,76E-05	-8,11E-04

INDICATORS DESCRIBING OUTPUT STREAMS AND WASTE: 1 m² POLFLAM EI, EW, FR 21-55 mm

		Life Cycle Stage								
Indicator	**Unit (expressed per DU)**	**A1**	**A2**	**A3**	**A4**	**C1**	**C2**	**C3**	**C4**	**D**
Hazardous waste	kg	WN	WN	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	WN	WN	7,87E-06	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Radioactive waste	kg	WN	WN	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	WN	WN	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	WN	WN	1,38E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Materials for energy recovery	kg	WN	WN	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	WN	WN	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00

CARBON ORGANIC	
Contents organic carbon in product (kg C_{org})	**0,00E+00**
Contents organic carbon in packaging (kg C_{org})	**6,80E-02**

MAIN IMPACT INDICATORS: 1 m² POLFLAM BR 30-45 mm

		Life Cycle Stage								
Indicator	**Unit**	**A1**	**A2**	**A3**	**A4**	**C1**	**C2**	**C3**	**C4**	**D**
GWP-total	kg CO_2 eq.	7,69E+01	2,52E+00	1,61E+01	6,66E-02	0,00E+00	1,22E+00	2,65E+00	1,03E-01	-1,58E+00
GWP-fossil	kg CO_2 eq.	7,65E+01	2,52E+00	2,17E+01	6,65E-02	0,00E+00	1,22E+00	2,61E+00	1,02E-01	-1,41E+00
GWP-biogenic	kg CO_2 eq.	4,36E-01	1,75E-03	-5,67E+00	4,61E-05	0,00E+00	7,12E-04	3,86E-02	2,62E-04	-1,73E-01
GWP-luluc	kg CO_2 eq.	4,05E-02	8,37E-04	4,53E-02	2,21E-05	0,00E+00	3,84E-04	9,36E-04	1,63E-05	-6,69E-04
ODP	kg CFC11 eq.	1,71E-06	5,01E-08	1,07E-07	1,32E-09	0,00E+00	2,43E-08	2,83E-08	3,82E-09	-1,58E-08
AP	mol H+ eq.	6,98E-01	5,25E-03	9,48E-02	1,39E-04	0,00E+00	2,39E-03	1,98E-02	6,38E-04	-5,11E-03
EP-freshwater	kg PO_4 eq.	1,19E-02	1,71E-04	2,46E-02	4,50E-06	0,00E+00	7,98E-05	1,12E-03	4,66E-06	-6,90E-05
EP-marine	kg N eq.	1,12E-01	1,26E-03	1,80E-02	3,33E-05	0,00E+00	5,63E-04	8,12E-03	2,73E-04	-3,04E-03
EP-terrestrial	mol N eq.	1,35E+00	1,36E-02	1,47E-01	3,59E-04	0,00E+00	6,08E-03	8,68E-02	2,98E-03	-2,29E-02
POCP	kg NMVOC eq.	3,88E-01	8,72E-03	4,68E-02	2,30E-04	0,00E+00	4,03E-03	2,58E-02	1,20E-03	-1,16E-02
ADP-minerals & metals	kg Sb eq.	7,45E-04	8,20E-06	3,46E-05	2,16E-07	0,00E+00	3,88E-06	1,43E-06	1,29E-07	-2,13E-06
ADP-fossil	MJ	9,32E+02	3,54E+01	2,47E+02	9,35E-01	0,00E+00	1,70E+01	3,22E+01	2,55E+00	-1,25E+01
WDP	WDP (m^3) world ekw	2,37E+01	1,47E-01	2,24E+00	3,88E-03	0,00E+00	6,47E-02	9,12E-02	8,83E-03	1,70E+00

ADDITIONAL IMPACT INDICATORS: 1 m² POLFLAM BR 30-45 mm

		Life Cycle Stage								
Indicator	**Unit**	**A1**	**A2**	**A3**	**A4**	**C1**	**C2**	**C3**	**C4**	**D**
PM	Disease incidency	7,04E-06	1,86E-07	3,27E-07	4,90E-09	0,00E+00	7,55E-08	4,64E-07	1,61E-08	-1,04E-07
IRP	kBq U235 eq.	3,47E+00	4,60E-02	4,29E-01	1,21E-03	0,00E+00	2,60E-02	1,74E-02	2,18E-03	-1,40E-02
ETP-fw	CTUe	7,42E-03	1,06E-04	1,53E-02	2,80E-06	0,00E+00	4,96E-05	6,94E-04	2,90E-06	-4,29E-05
HTP-c	CTUh	2,28E-07	1,79E-08	7,32E-08	4,72E-10	0,00E+00	7,29E-09	7,69E-09	4,31E-10	-7,99E-09
HTP-nc	CTUh	5,42E-07	2,23E-08	2,60E-07	5,87E-10	0,00E+00	9,85E-09	1,34E-08	3,76E-10	-1,14E-08
SQP	-	2,57E+02	2,14E+01	6,17E+02	5,65E-01	0,00E+00	8,76E+00	3,15E+00	5,17E+00	-2,61E+01

INDICATORS DESCRIBTIONS RESOURCE CONSUMPTION: 1 m² POLFLAM BR 30-45 mm

		Life Cycle Stage a								
Indicator	**Unit**	**A1**	**A2**	**A3**	**A4**	**C1**	**C2**	**C3**	**C4**	**D**
PERE	MJ	5,39E+01	6,10E-01	1,27E+02	1,61E-02	0,00E+00	3,29E-01	9,47E-01	5,22E-02	-2,10E-01
PERM	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
PERT	MJ	5,39E+01	6,10E-01	1,27E+02	1,61E-02	0,00E+00	3,29E-01	9,47E-01	5,22E-02	-2,10E-01
PEN-RE	MJ	9,19E+02	3,56E+01	3,07E+02	9,39E-01	0,00E+00	1,69E+01	3,51E+01	2,54E+00	-1,27E+01
RE	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
PENRT	MJ	9,19E+02	3,56E+01	3,07E+02	9,39E-01	0,00E+00	1,69E+01	3,51E+01	2,54E+00	-1,27E+01
SM	kg	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
RSF	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
NRSF	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
FW	m^3	7,03E-01	6,56E-03	4,58E-01	1,73E-04	0,00E+00	4,28E-03	1,81E-02	1,27E-04	-1,58E-03

INDICATORS DESCRIBING OUTPUT STREAMS AND WASTE: 1 m^2 POLFLAM BR 30-45 mm										
	Life Cycle Stage									
Indicator	**Unit (expressed per DU)**	**A1**	**A2**	**A3**	**A4**	**C1**	**C2**	**C3**	**C4**	**D**
Hazardous waste	kg	WN	WN	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	WN	WN	7,87E-06	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Radioactive waste	kg	WN	WN	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	WN	WN	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	WN	WN	2,01E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Materials for energy recovery	kg	WN	WN	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	WN	WN	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00

CARBON ORGANIC	
Contents organic carbon in product (kg C_{org})	**0,00E+00**
Contents organic carbon in packaging (kg C_{org})	**9,94E-02**

5. INTERPRETATION OF LCA

Figures 3, 4, 5 show contributions of the each life cycle module to the basic impact categories for fire-resistant glass POLFLAM

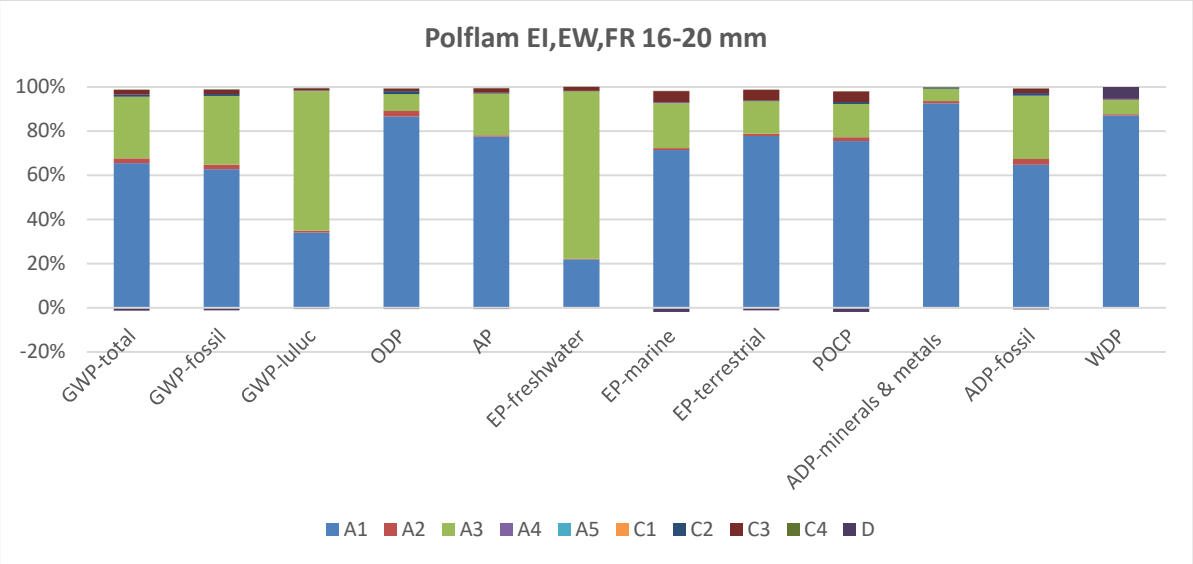


Figure 3 Shares of life cycle modules on the main categories of influence - POLFLAM 16-20 mm EI, EW, FR.

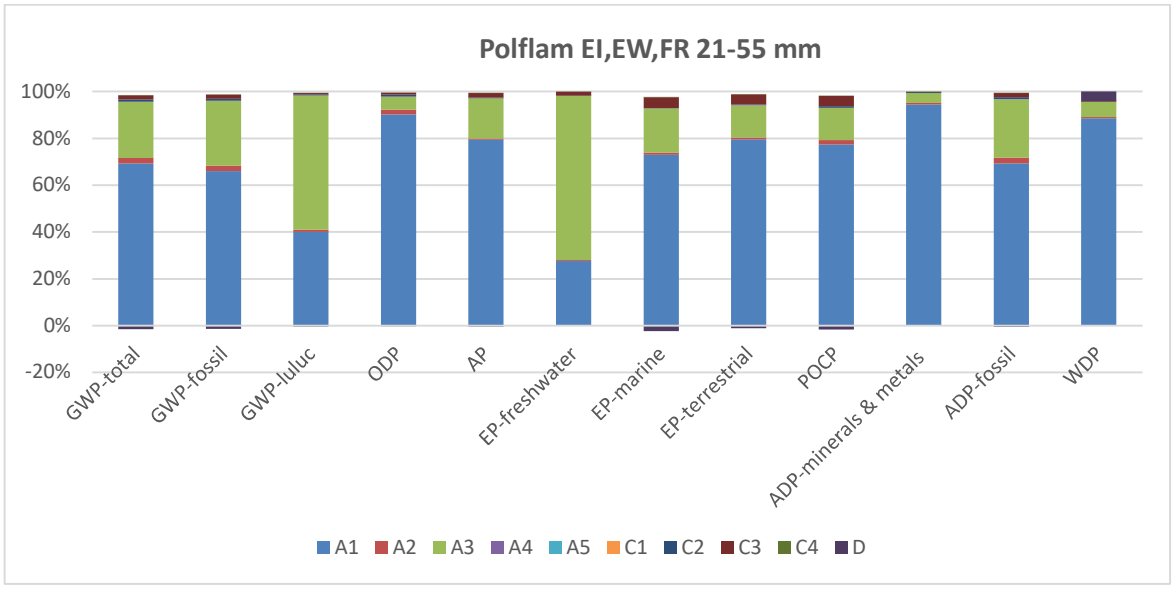


Figure 4 Shares of life cycle modules on the main categories of influence - POLFLAM 21-55 mm EI, EW, FR.

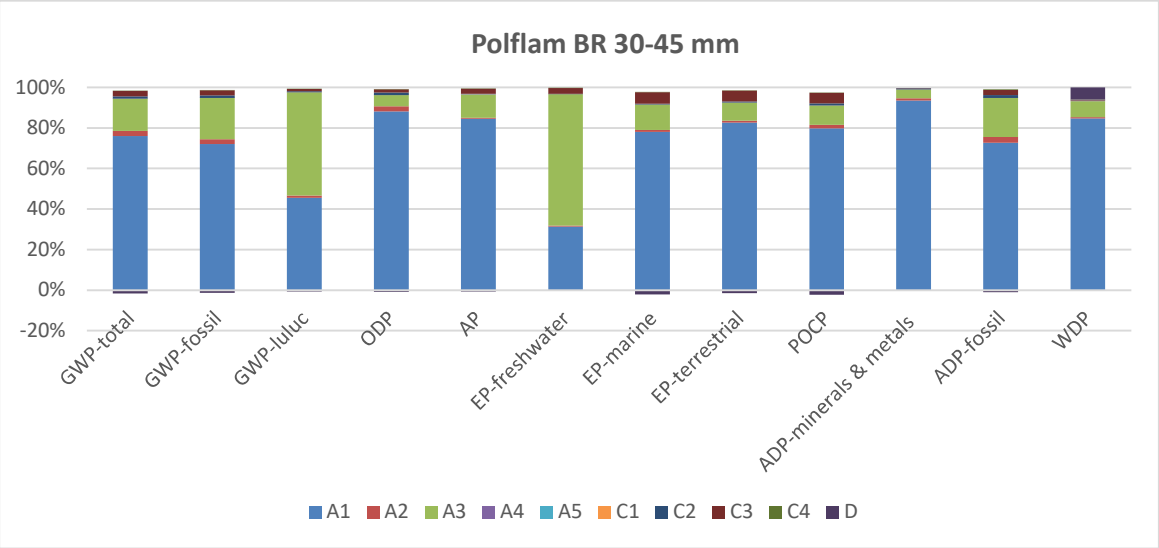


Figure 5 Shares of life cycle modules on the main categories of influence - POLFLAM 30-45 mm BR.

LITERATURE

- ✓ ICIMB-PCR A. General Product Category Rules for Construction Products.
- ✓ PN-EN ISO 14025:2014-04, Environmental labels and declarations -- Type III environmental declarations -- Rules and procedures.
- ✓ PN-EN 15804+A2:2020, Sustainability of building structures -- Environmental product declarations -Basic principles of categorization of 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.
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- ✓ KOBiZE CO2, SO2, NOx, CO and total particulate matter emission factors for electricity, December 2023.
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- ✓ 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 Stichnothe1,2 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 company page of the declaration owner: https://polflam.pl/

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PROCESS ENGINEERING RESEARCH GROUP

TYPE III ENVIRONMENTAL DECLARATION CERTIFICATE

no. 02-11/2024

Products:

FIRE-RESISTANT GLASS

Owner:

POLFLAM Sp. z o.o.

Jeziorzany, 3 Aleja Krakowska
05-555 Tarczyn

The declaration was developed in accordance with the requirements of the standard:

PN-EN 15804+A2: 2020-03

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

The declaration was verified in accordance with the requirements of the standard:

PN-EN ISO 14025:2010

Environmental labels and declarations
Type III environmental declarations. Principles and procedures

The certificate was issued for the first time on **November 28, 2024** and is valid for 5 years or until the said EPD is amended.

Process Engineering Research Group Leader

Ewa Głodek-Bucyk, PhD Eng.

Director of Environmental Engineering Center

Joanna Poluszyńska, PhD

Opole, November 2024