Łukasiewicz
Instytut Ceramiki
i Materiałów Budowlanych

FAKRO

ENVIRONMENTAL PRODUCT DECLARATION

No. 01-11/2022

ALUMINUM CLAD-PVC ROOF WINDOWS

WITH SINGLE AND DOUBLE GLAZING UNITS

FAKRO PP Sp. z o.o

Owner of the EPD:	*FAKRO PP Sp. z o.o.*
Programme owner:	*Łukasiewicz Research Network – Institute of Ceramics and Building Materials* *Environmental Engineering Center*
Name of programme:	*Deklaracje Środowiskowe Produktów – B2B*
Issued:	***21/11/2022***
Valid until:	***21/11/2027***

1. GENERAL INFORMATION

Owner of the EPD: FAKRO PP Sp. z o.o.	**Products covered by the EPD:** Aluminum clad-PVC roof windows with single-chamber and double-chamber glazing units
Programme owner: Łukasiewicz Research Network - Institute for Ceramics And Building Materials Environmental Engineering Center **http://www.icimb.pl/opole/**	**Owner of the EPD:** FAKRO PP sp. z o.o. 144a Węgierska Str. 33-300 Nowy Sącz Telephone: +48 18 444-0-444 Fax: +48 18 444-0-333 E-mail: fakro@fakro.pl **https://www.fakro.com/**
Date of issuance: 21/11/2022	**Declared product/declared unit:** The declared unit (DU) for the products covered by the EPD is 1 m^2 (1 square meter) roof window with single-chamber and double-chamber glazing units.
EPD valid until: 21/11/2027	**Scope:** EPD covers a product group (roof windows): **PTP, PTP-V, PNP, PNP-V, PPP, PPP-V, PPP MAX, PPP-V MAX, PWP with single-chamber glazing units** and **PTP, PTP-V, PNP, PNP-V, PPP, PPP-V, PPP MAX, PPP-V MAX, PWP with double-chamber glazing units** manufactured at FAKRO PP Sp. z.o.o. plant in Nowy Sącz, 144a Węgierska Str. It contains information on the environmental impact of declared products All data on the production cycle was collected by FAKRO PP Sp. z.o.o from 01/06/2021 do 01.06.2022 (12 months) and corresponds to the production technology of the time. These are average data, determined separately for both product groups on the basis of the share of products covered by the declaration in the total production in the plant. The life cycle assessment was developed in accordance with the requirements of PN-EN ISO 15804 + A2: 2020, PN-EN ISO 14025 and PN-EN ISO 14040. The product categorization rules were adopted in accordance with PN-EN 15804. The owner of the declaration is responsible for the information and underlying evidence. The

	Łukasiewicz Research Network - Institute of Ceramics and Building Materials, Environmental Engineering Center is not responsible for the manufacturer's information, data and evidence regarding the life cycle assessment. Declarations resulting from different programs or not performed according to the standards may not be comparable.
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 2021/2022
Reference Service Life (RSL):	25 years
Reasons for performing LCA:	B2B
Life Cycle Analysis (LCA):	LCA covers modules A1-A3, 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 aluminum clad-PVC roof windows made by FAKRO PP Sp. z.o.o to the interested parties.

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Verification:

CEN PN-EN 15804+A2 standard serves as main PCR.
Independent EPD and data verification according to PN-EN ISO 14025:2010 standard.

☐ internal ☒ external

Katarzyna Grzesik, PhD Eng.

2. MANFACTURER AND PRODUCT DESCRIPTION

The FAKRO Group is an international company operating in the construction industry since 1991. The FAKRO Group, which employs over 4,000 people, consists of 11 production companies and 17 distribution companies. FAKRO's offer includes mainly:

- Wooden and aluminium-PVC roof windows of various designs and opening methods. In addition to roof windows, the product offer includes windows for flat roofs,
- Flanges, electric control units, loft ladders, hatches, tubular skylights, smoke vents,
- Accessories for roof windows: blinds, curtains, internal and external blinds, external awnings, mounting accessories, foils and membranes.

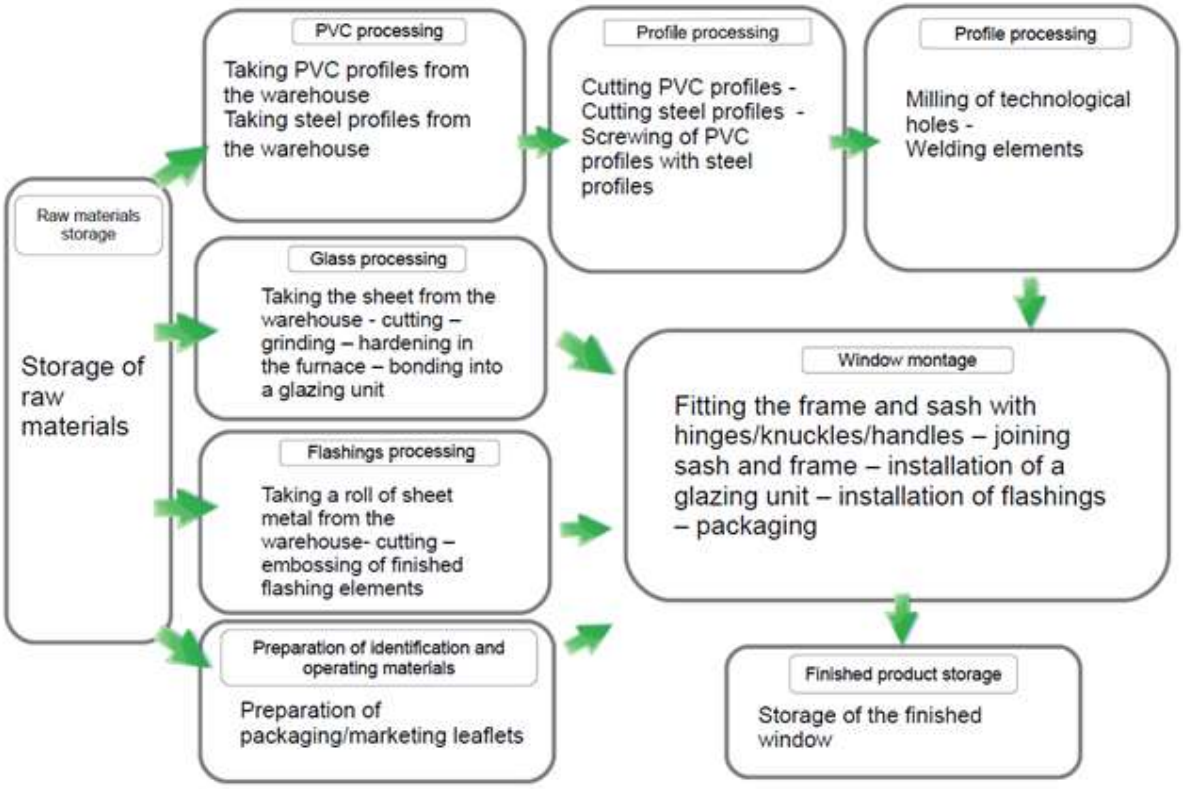
The company's headquarters is in Nowy Sącz, where FAKRO has over 230,000 m^2 of production, warehouse and office space at its disposal. The environmental impact of purchased products is of increasing importance for both consumers and producers. Therefore, the production process at FAKRO is subject to numerous assessments, which has been confirmed by numerous certificates awarded to FAKRO. Aluminum-plastic windows have CEKAL, IGCC / IGMA and ift Rosenheim certificates for the glazing used in these windows.

The materials from which aluminium-clad PVC roof windows are made are:

- PVC profiles - main material,
- Glass - single and double glazing units,
- Steel - elements of the window frame,
- Aluminum – cladding,
- Zamak - window fittings,
- Plastics (ABS, PA6, PE, POM, TPE) - additional window elements,
- EPS - insulation material used in window frames,
- Silicone – sealings of glazing units

The materials are taken from the warehouse and sent to the appropriate departments, where the window components are processed. Glazing units, flashings and PVC profiles are treated separately. Then the components go to the final assembly line, where they are joined together according to the model specification. Then they are packed and sent to the finished product warehouse.

The production scheme is shown in the figure below.



Aluminum-clad PVC roof windows are windows mounted in the roof slope, enabling very good lighting of the interior, ventilation of the room and contact with the external environment.

These windows are made of multi-chamber PVC-U profiles (polyvinyl chloride), which are reinforced inside with galvanized steel cores, which prevents their deformation. The windows are available in the following colors:

- White (RAL 9010),
- Golden Oak veneer (GO),
- Pine veneer (PI),
- Anthracite veneer (AC).

As standard, these windows are equipped with the topSafe system ensuring increased resistance to burglary, a sash guidance system, a quadruple sealing system and a locking bolt allowing the sash to be locked in a rotated position. The windows can be equipped with the V35 air inlet (eg **PTP-V**), which ensures smooth regulation of the air inflow to the rooms. The handle located in the lower part of the sash (with the exception of the plastic access hatch window, where the handle is located in the middle of the sash), enables easy operation and two-stage micro-opening. The windows are covered from the outside with sheet metal profiles made of aluminum, protected on both sides with a polyester coating.

Aluminum clad-PVC roof windows include a number of varieties:

- **PTP** and **PTP-V** are pivot windows. The hinge placed in the middle of the window allows the sash to be rotated 180 ° and left in the open position. The V-variant is equipped with an air inlet.
- **PPP** and **PPP-V** are windows with a tilt-and-turn structure. The tilt function allows you to leave the sash in any position in the range from 0 ° to 35 °, while the swivel function allows you to rotate the sash by 180 °. The opening method can be changed using the preSelect switch located on the side of the frame, accessible after opening the window. The V-variant is equipped with an air inlet.
- **PPP MAX** and **PPP-V MAX** are new generation tilt and turn windows. The tilt function in this model allows you to leave the sash in any position in the range from 0 ° to 45 ° (almost 30% more than in the previous version). The opening method can be changed using the preSelect switch located on the side of the frame, accessible after opening the window. The V-variant is equipped with an air inlet.
- **PNP** and **PNP-V** are fixed, non-opening roof windows. The V-variant is equipped with an air inlet.
- **PWP** is a hatch window with a flap construction, side opening to an angle of 90 ° (can be installed with the side opening to the right or left).

The windows are equipped with single-chamber and double-chamber glazing units, and their various configurations are included in the EPD.

Single-chamber units may have the following structure:

- 4-16-4 (incl. U2, U3, U3A),
- 4-14-33.1 (incl. L2, L3, G2),
- 4-15-33.2 (incl. P2),
- 6-12-33.2 (incl. R1, G61)

Double-chamber units may have the following structure:

- 4-12-4-12-4 (incl. U4),
- 4-10-4-10-4 (incl. U5),
- 4-12-4-10-33.2 (incl. L4),
- 4-10-4-8-33.2 (incl. P5, R5).

Among the available glazing units there are thermal insulation, anti-burglary and acoustic units as well as packages with a safe laminated glass. These units are filled with a noble gas: argon or krypton, and the glass panes are usually separated from each other by a warm TGI distance frame or, less frequently, a steel frame.

The performance of the windows is specified in the declarations of performance, which can be downloaded from the company's website. These values may vary from window to window depending on the model and type of glazing unit.

The windows included in this declaration are available with single-chamber as well as double-chamber glazing units. The specifications are given in the table below.

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No. 01-11/2022

FAKRO®

Performance of aluminium clad-PVC roof windows produced by FAKRO PP Sp. z o.o.

Product name	Glazing unit	Construction of the glazing unit	Wind load resistance	Reaction to fire	Resistance to external fire	Watertightness	Impact resistance	Acoustic properties [dB]	Thermal conductivity [W/m²K]	Air permeability
PNP-V PTP-V PPP-V PPP V MAX	U3	4H-16-4	C4 Class	B-s2, d0	BROOF (t1)	E900 Class	Class 3 – 450 mm	32 (-1;-4)	1,3	Class 3
	U4	4H-12-4-12-4						33 (-2;-5)	1,1	
	U5	4H-10-4H-10-4H						34 (-2;-6)	1,0	
	P2	4H-15-33.2						33 (-1;-4)	1,3	
	P5	4H-10-4H-8-33.2						36 (1; 3)	1,0	
PNP PTP ppp PPP MAX	U3	4H-16-4	C4 Class	B-s2, d0	BROOF (t1)	E900 Class	Class 3 – 450 mm	34 (-2;-5)	1,3	Class 3
	U4	4H-12-4-12-4						33 (-2;-5)	1,1	
	U5	4H-10-4H-10-4H						34 (-2;-5)	1,0	
	P2	4H-15-33.2						36 (-1;-4)	1,3	
	P5	4H-10-4H-8-33.2						38 (-1;-4)	1,0	
PWP	U3	4H-16-4	C4 Class	n.a.	n.a.	E900 Class	Class 5 – 950 mm	34 (-2;-5)	1,4	Class 3
	U5	4H-10-4H-10-4H						34 (-1;-4)	1,2	
	P2	4H-15-33.2						37 (-2;-5)	1,4	
	P5	4H-10-4H-8-33.2						37 (-1;-4)	1,2	

3. LCA: CALCULATION RULES

System boundaries

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

- A1 - extraction and preparation of raw materials, generation of electricity and energy carriers for auxiliary processes,
- A2 - transport of raw materials to the gate of the production plant,
- A3 - production, including ancillary processes and emissions.
- 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

Data on the production process was collected in the years 2021-2022, in the period from 01/06/21 to 01/06/22.

Declared unit (DU)

Due to neglegible differences between the two groups of products, the declared unit of 1 m^2 of aluminum-plastic roof windows with single-chamber and double-chamber glazing units produced by FAKRO PP Sp. z o.o. in Nowy Sącz.

Assumptions

A1 - extraction and consumption of raw materials refers to specific mass shares in the production process per declared unit 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 raw materials delivery,

A3 - values of CO2, NOx, SO2, dust and other emissions from the production process obtained as a result of measurements carried out at the plant, other estimated on the basis of fuel consumption.

C1 – module C1 describes the disassembly of the roof window at the end of its service life. Data is collected on the basis of a developed scenario. Impact category values for this module are negligible and have been assumed to be zero.

C2 – module C2 refers to the transport of used roof windows to a waste recovery or disposal facility. Data is collected on the basis of a developed scenario. The transport of used windows is sent to a waste treatment plant.

C3 – Module C3 takes into account the environmental impact of processing roof window waste at a waste treatment plant. Data is collected on the basis of a developed scenario. Module C3 takes into account the impact of energy consumption on the environment.

C4 – module C4 describes the process of utilization/storage of waste resulting from the processing of used roof windows. The benefits of reusing glass and metal scrap are covered in module D. The environmental impact of incineration of plastic waste is covered in module C4. The associated energy benefits are included in Module D.

D – Module D describes the benefits of reusing waste from roof window processing in Module C3. Recycling of glass and metal as well as energy (heat) generated as a result of incineration of plastic waste in the thermal waste disposal plant were taken into account. The energy benefit from incineration was interpreted as energy exported in module D.

Cut-off criteria	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.
Generic data	The main source of general and auxiliary data is the EcoInvent 3.8 database and manufacturer's reports.
Allocation	The products covered by the environmental declaration are manufactured at the plant in Nowy Sącz. All data provided by the manufacturer were related to the declared unit (DU) of the product – **1 m²** (1 square meter) of aluminum clad-PVC roof windows with single-chamber and double-chamber glazing units manucatured by FAKRO PP Sp. z.o.o. in Nowy Sącz.

4. LCA: SCENARIOS AND ADDITIONAL TECHNICAL DATA

For the life cycle analysis of the products covered by the "Cradle to gate with options" environmental declaration, scenarios were developed for modules C1-C4 and D:

C1 - It is assumed that manual removal of the window is possible, and the possible use of power tools has a minimal impact on the values of the impact category and is negligible.

C2 – The transport of used windows is directed to a waste treatment plant.

The following assumptions were made:

- 100% of the weight of used windows is sent to a waste processing plant,
- Transport is carried out using self-dumping trucks with a capacity of 7.5 - 16 tons, meeting EURO 5 emission standards
- The material is transported to a waste treatment site 100 km from the demolition site.

C3 - The scenario envisages the process of processing used windows by manually separating window elements from each other and mechanical processing (grinding) of some fractions resulting from separation. Insulating glass units, plastic elements, steel frames, aluminum elements and fittings made of zamak are separated first. Glass and plastics are mechanically shredded, while steel scrap is not subjected to additional processing and is sent for recycling. The same applies

to waste glass - it is assumed that the glass breaker is recycled as packaging glass. The benefits of using these secondary materials are included in module D. Plastic waste is used for energy (in waste incineration plants). It is determined that the energy consumption per kilogram of window waste is approx. 0.03 kWh/kg of electricity and approx. 0.5 MJ/kg of thermal energy from fuel combustion.

C4 - It is assumed that the efficiency of secondary use of glass breaker is 30%, scrap (aluminum, steel, zamak) - 90%, while 100% of plastic waste is disposed of in a waste incineration plant. The rest of the waste is deposited in a landfill.

D – Recycling of glass and metal, as well as energy (heat) resulting from the incineration of plastic waste in a waste incineration plant are taken into account. The amount of energy was determined on the basis of the amount of processed material, the calorific value and the efficiency of the heat recovery process, which was assumed at the level of 30%.

5. 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, INA – INDICATOR NOT ASSESSED)																
Product stage			**Construction process stage**		**Use stage**							**End-of-life stage**				**Benefits and loads beyond the system boundary**
Raw material supply	Transport	Production	Transport to the construction site	Construction proces	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**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**X**	**X**	**X**	**X**	**X**

The following tables present the results of the LCA analysis for roof windows with single and double glazing. Explanations of the abbreviations used to describe the impact categories are given below:

GWP	Global warming potential
ODP	Depletion potential of the stratospheric ozone layer
AP	Acidification potential of land and water
EP	Eutrophication potential
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
PENRE	Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials
PENRM	Use of nonrenewable 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 secondary fuels
NRSF	Use of non-renewable secondary fuels
FW	Use of net fresh water

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ENVIRONMENTAL PRODUCT DECLARATION
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ROOF WINDOWS WITH SINGLE-CHAMBER GLAZING UNITS

CORE ENVIRONMENTAL IMPACT INDICATORS: 1 m² of aluminum clad-PVC roof windows with single-chamber glazing units manucatured in FAKRO PP Sp. z o.o.

	Life Cycle Stage								
Indicator	**Unit**	**A1**	**A2**	**A3**	**C1**	**C2**	**C3**	**C4**	**D**
GWP-total	kg CO_2 eq.	9,92E+01	2,50E+00	9,10E+00	0,00E+00	7,91E-01	2,71E+00	2,99E+01	-1,97E+01
GWP-fossil	kg CO_2 eq.	1,06E+02	2,50E+00	9,08E+00	0,00E+00	7,90E-01	2,71E+00	2,98E+01	-1,90E+01
GWP-biogenic	kg CO_2 eq.	-6,77E+00	7,64E-04	4,66E-03	0,00E+00	4,00E-04	5,00E-03	6,45E-02	-7,18E-01
GWP-luluc	kg CO_2 eq.	1,60E-01	9,94E-04	1,65E-03	0,00E+00	3,86E-04	4,22E-04	4,14E-03	-1,80E-02
ODP	kg CFC11 eq.	1,94E-05	5,53E-07	1,15E-07	0,00E+00	1,68E-07	3,58E-07	9,41E-07	-1,31E-06
AP	mol H+ eq.	6,57E-01	8,86E-03	2,79E-02	0,00E+00	3,21E-03	2,47E-02	2,22E-02	-1,09E-01
EP-freshwater	kg PO_4 eq.	4,70E-03	3,71E-05	1,25E-04	0,00E+00	7,49E-06	1,53E-04	1,02E-04	-8,50E-04
EP-marine	kg N eq.	1,14E-01	1,99E-03	4,95E-03	0,00E+00	9,01E-04	8,25E-03	5,42E-03	-2,12E-02
EP-terrestrial	mol N eq.	1,23E+00	2,23E-02	4,94E-02	0,00E+00	9,97E-03	9,09E-02	5,91E-02	-2,25E-01
POCP	kg NMVOC eq.	3,77E-01	7,94E-03	2,45E-02	0,00E+00	3,04E-03	2,50E-02	1,64E-02	-8,61E-02
ADP-minerals & metals	kg Sb eq.	1,47E-03	1,49E-05	2,21E-06	0,00E+00	3,49E-06	4,33E-06	3,20E-05	-6,20E-04
ADP-fossil	MJ	1,50E+03	3,74E+01	2,04E+01	0,00E+00	1,14E+01	3,41E+01	4,62E+01	-2,22E+02
WDP	m^3 world eq. deprived	4,08E+01	2,30E-01	1,23E-01	0,00E+00	4,33E-02	1,85E-01	4,34E+01	-6,95E+00

ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS: 1 m² of aluminum clad-PVC roof windows with single-chamber glazing units manucatured in FAKRO PP Sp. z o.o.

	Life Cycle Stage								
Indicator	**Unit**	**A1**	**A2**	**A3**	**C1**	**C2**	**C3**	**C4**	**D**
PM	Disease incidency	6,99E-06	2,14E-07	2,85E-07	5,83E-08	4,61E-07	1,67E-07	-1,71E-06	5,83E-08
IRP	kBq U235 eq.	2,73E+00	1,62E-01	1,51E-02	4,63E-02	1,07E-01	1,84E-01	-6,61E-01	4,63E-02
ETP-fw	CTUe	2,57E+03	2,74E+01	1,42E+02	1,05E+01	2,79E+01	1,66E+03	-6,75E+02	1,05E+01
HTP-c	CTUh	2,23E-06	3,43E-08	1,62E-07	9,67E-09	2,69E-08	4,65E-07	-6,49E-07	9,67E-09
HTP-nc	CTUh	2,01E-07	1,57E-09	2,01E-08	3,44E-10	8,99E-10	6,04E-09	-1,18E-07	3,44E-10
SQP	-	8,96E+02	2,37E+01	1,17E+02	6,68E+00	5,10E+00	2,62E+01	-9,55E+01	6,68E+00

PARAMETERS DESCRIBING RESOURCE USE: 1 m² of aluminum clad-PVC roof windows with single-chamber glazing units manucatured in FAKRO PP Sp. z o.o.

	Life Cycle Stage								
Indicator	**Unit**	**A1**	**A2**	**A3**	**C1**	**C2**	**C3**	**C4**	**D**
PERE	MJ	INA	INA	4,78E-01	0,00E+00	0,00E+00	5,67E-01	0,00E+00	0,00E+00
PERM	MJ	INA	INA	6,51E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PERT	MJ	INA	INA	6,98E+00	0,00E+00	0,00E+00	5,67E-01	0,00E+00	0,00E+00
PEN-RE	MJ	1,53E+03	3,90E+01	2,93E+01	0,00E+00	2,33E+01	9,18E+00	0,00E+00	-5,31E+02
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

PENRT	MJ	1,53E+03	3,90E+01	2,93E+01	0,00E+00	3,32E-01	5,07E-02	0,00E+00	-5,31E+02
SM	kg	0,00E+00	0,00E+00	5,42E-01	0,00E+00	0,00E+00	3,50E+01	2,53E+01	0,00E+00
RSF	MJ	INA	INA	4,10E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
NRSF	MJ	INA	INA	0,00E+00	0,00E+00	0,00E+00	0,00E+00.	4,95E+02	0,00E+00
FW	m^3	4,00E+02	2,56E+00	1,21E+00	INA	INA	INA	INA	INA

ENVIRONMENTAL INFORMATION DESCRIBING WASTE AND OUTPUT FLOWS: 1 m^2 of aluminum clad-PVC roof windows with single-chamber glazing units manucatured in FAKRO PP Sp. z o.o.

	Life Cycle Stage								
Indicator	**Unit (expressed per DU)**	**A1**	**A2**	**A3**	**C1**	**C2**	**C3**	**C4**	**D**
Hazardous waste	kg	INA	INA	0,00E+00	0,00E+00	INA	INA	INA	INA
Non-hazardous waste	kg	INA	INA	6,60E-03	0,00E+00	INA	9,71E+00	INA	INA
Radioactive waste	kg	INA	INA	0,00E+00	0,00E+00	INA	INA	INA	INA
Components for re-use	kg	INA	INA	0,00E+00	0,00E+00	INA	INA	0,00E+00	INA
Materials for recycling	kg	INA	INA	6,60E-03	0,00E+00	0,00E+00	1,11E+01	0,00E+00	INA
Materials for energy recovery	kg	INA	INA	0,00E+00	0,00E+00	0,00E+00	1,42E+01	0,00E+00	INA
Exported energy	MJ/energy carrier	INA	INA	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,49E+02

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ENVIRONMENTAL PRODUCT DECLARATION
No. 01-11/2022

FAKRO®

ROOF WINDOWS WITH DOUBLE-CHAMBER GLAZING UNITS

CORE ENVIRONMENTAL IMPACT INDICATORS: 1 m² of aluminum clad-PVC roof windows with double-chamber glazing units manucatured in FAKRO PP Sp. z o.o.

	Life Cycle Stage								
Indicator	**Unit**	**A1**	**A2**	**A3**	**C1**	**C2**	**C3**	**C4**	**D**
GWP-total	kg CO_2 eq.	1,11E+02	1,96E+00	9,10E+00	0,00E+00	9,67E-01	3,32E+00	3,19E+01	-2,17E+01
GWP-fossil	kg CO_2 eq.	1,18E+02	1,96E+00	9,08E+00	0,00E+00	9,66E-01	3,31E+00	3,18E+01	-2,10E+01
GWP-biogenic	kg CO_2 eq.	-6,75E+00	4,13E-04	4,66E-03	0,00E+00	4,89E-04	6,12E-03	6,89E-02	-6,75E-01
GWP-luluc	kg CO_2 eq.	1,73E-01	7,62E-04	1,65E-03	0,00E+00	4,72E-04	5,16E-04	4,42E-03	-1,98E-02
ODP	kg CFC11 eq.	2,09E-05	4,33E-07	1,15E-07	0,00E+00	2,05E-07	4,38E-07	1,00E-06	-1,58E-06
AP	mol H+ eq.	7,56E-01	6,75E-03	2,79E-02	0,00E+00	3,93E-03	3,02E-02	2,37E-02	-1,28E-01
EP-freshwater	kg PO_4 eq.	5,05E-03	2,94E-05	1,25E-04	0,00E+00	9,16E-06	1,87E-04	1,09E-04	-8,89E-04
EP-marine	kg N eq.	1,30E-01	1,47E-03	4,95E-03	0,00E+00	1,10E-03	1,01E-02	5,79E-03	-2,39E-02
EP-terrestrial	mol N eq.	1,42E+00	1,66E-02	4,94E-02	0,00E+00	1,22E-02	1,11E-01	6,30E-02	-2,57E-01
POCP	kg NMVOC eq.	4,26E-01	5,95E-03	2,45E-02	0,00E+00	3,72E-03	3,06E-02	1,75E-02	-9,45E-02
ADP-minerals & metals	kg Sb eq.	1,56E-03	1,09E-05	2,21E-06	0,00E+00	4,27E-06	5,29E-06	3,42E-05	-6,35E-04
ADP-fossil	MJ	1,66E+03	2,93E+01	2,04E+01	0,00E+00	1,40E+01	4,17E+01	4,93E+01	-2,51E+02
WDP	m^3 world eq. deprived	4,42E+01	1,82E-01	1,26E-01	0,00E+00	5,30E-02	2,27E-01	4,63E+01	-7,33E+00

ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS: 1 m² of aluminum clad-PVC roof windows with double-chamber glazing units manucatured in FAKRO PP Sp. z o.o.

	Life Cycle Stage								
Indicator	**Unit**	**A1**	**A2**	**A3**	**C1**	**C2**	**C3**	**C4**	**D**
PM	Disease incidency	8,04E-06	1,64E-07	2,85E-07	7,13E-08	5,63E-07	1,78E-07	-1,96E-06	7,13E-08
IRP	kBq U235 eq.	3,26E+00	1,26E-01	1,51E-02	5,67E-02	1,31E-01	1,96E-01	-7,70E-01	5,67E-02
ETP-fw	CTUe	2,84E+03	2,11E+01	1,42E+02	1,29E+01	3,41E+01	1,78E+03	-7,08E+02	1,29E+01
HTP-c	CTUh	2,36E-06	2,63E-08	1,62E-07	1,18E-08	3,29E-08	4,96E-07	-6,78E-07	1,18E-08
HTP-nc	CTUh	2,07E-07	1,14E-09	2,01E-08	4,20E-10	1,10E-09	6,44E-09	-1,19E-07	4,20E-10
SQP	-	9,37E+02	1,87E+01	1,17E+02	8,17E+00	6,24E+00	2,79E+01	-1,16E+02	8,17E+00

PARAMETERS DESCRIBING RESOURCE USE: 1 m² of aluminum clad-PVC roof windows with double-chamber glazing units manucatured in FAKRO PP Sp. z o.o.

	Life Cycle Stage								
Indicator	**Unit**	**A1**	**A2**	**A3**	**C1**	**C2**	**C3**	**C4**	**D**
PERE	MJ	INA	INA	4,78E-01	0,00E+00	0,00E+00	6,93E-01	0,00E+00	0,00E+00
PERM	MJ	INA	INA	6,51E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PERT	MJ	INA	INA	6,98E+00	0,00E+00	0,00E+00	5,67E-01	0,00E+00	0,00E+00
PEN-RE	MJ	1,79E+03	3,06E+01	2,75E+01	0,00E+00	2,85E+01	1,12E+01	0,00E+00	-5,79E+02
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

PENRT	MJ	1,53E+03	3,90E+01	2,93E+01	0,00E+00	3,32E-01	5,07E-02	0,00E+00	-5,79E+02
SM	kg	0,00E+00	0,00E+00	5,42E-01	0,00E+00	0,00E+00	4,28E+01	2,85E+01	0,00E+00
RSF	MJ	INA	INA	4,10E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
NRSF	MJ	INA	INA	0,00E+00	0,00E+00	0,00E+00	0,00E+00.	5,29E+02	0,00E+00
FW	m^3	4,28E+02	1,96E+00	1,17E+00	INA	INA	INA	INA	INA

ENVIRONMENTAL INFORMATION DESCRIBING WASTE AND OUTPUT FLOWS: 1 m^2 of aluminum clad-PVC roof windows with double-chamber glazing units manucatured in FAKRO PP Sp. z o.o..

	Life Cycle Stage								
Indicator	**Unit (expressed per DU)**	**A1**	**A2**	**A3**	**C1**	**C2**	**C3**	**C4**	**D**
Hazardous waste	kg	INA	INA	0,00E+00	0,00E+00	INA	INA	INA	INA
Non-hazardous waste	kg	INA	INA	6,60E-03	0,00E+00	INA	1,43E+01	INA	INA
Radioactive waste	kg	INA	INA	0,00E+00	0,00E+00	INA	INA	INA	INA
Components for re-use	kg	INA	INA	0,00E+00	0,00E+00	INA	INA	0,00E+00	INA
Materials for recycling	kg	INA	INA	6,60E-03	0,00E+00	0,00E+00	1,34E+01	0,00E+00	INA
Materials for energy recovery	kg	INA	INA	0,00E+00	0,00E+00	0,00E+00	1,51E+01	0,00E+00	INA
Exported energy	MJ/energy carrier	INA	INA	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,59E+02

6. INTERPRETATION OF LCA

As a result of the LCA analysis carried out in accordance with the requirements and assumptions regarding the system boundaries and cut-off criteria for a group of products (aluminum-plastic windows) manufactured by FAKRO PP SP. z o.o. the following conclusions were made:

- The LCA analysis proved that the processes related to the acquisition of raw materials and components (A1) have the greatest impact on the value of the environmental impact indicators. They constitute up to approximately 80% to nearly 100% of the total value of the impact category. Different processes influence different categories of influence to a different degree. The processes related to the production of PVC profiles, glass and aluminum and steel elements have the largest share in the main impact categories.

- High values of the impact categories for these processes result from the fact that the materials produced as a result of these processes have the largest mass share per declared unit. In addition, these are energy-intensive processes, requiring the supply of large amounts of heat and electricity (mainly from non-renewable sources) and the acquisition of non-renewable resources.
- The impact of transport to site (A2) on the impact categories is up to 5% of the total impact in the main categories. This is due to the fact that raw materials are delivered to the production site from Europe, distances do not exceed 350 km (except for the supply of polyethylene and some basic materials, such as some aluminum and steel elements).
- Due to the nature of the production process, which mainly consists of material processing and assembly of ready-made elements, the values of the main impact categories in the A3 module are up to 10% in the analyzed product groups. Taking into account the above mentioned conclusions, the owner of the declaration has a moderate influence on the values of the environmental impact indicators, as it depends on external entities. It can only try to change suppliers closer to the production plant and reduce consumption at the production process level.

- Transport to the waste treatment plant (C2) has a very small impact on the overall value of the impact category compared to the other modules.

- Processes related to waste treatment (C3) account for up to 7% in the main impact categories. It depends on the amount of material to be processed and the technology in the waste treatment plant.

- The impacts related to waste disposal/landfill (C4) are significant. This is due to the way of handling plastic waste resulting from the processing of roof windows. Incineration of plastics releases significant amounts of substances into the environment that have a negative impact on its quality and impact category values.

- An analysis of the potential for reuse of the material (D) showed that the reuse of waste from roof windows can reduce the negative impact on environmental indicators by up to 25% and reduce the GWP indicator by approx. 15%. The included thermal energy obtained as a result of thermal processing of plastic waste allows to some extent compensate for the negative impact of the process itself on the environment.

- The above conclusions show that reasonable waste management allows for a significant reduction of the product's environmental impact in the end-of-life phase.

7. 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.
- ✓ Data from the company website: www.fakro.pl

Explanatory materials can be found on the manufacturers website: **www.fakro.com**