GREENVIEW

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Wooden roof windows

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Basic information

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

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

The year of preparing the EPD: 2023

Product standard: EN 14351-1+A2

Service Life: 30 years

PCR: ITB-PCR A

Functional unit: 1 m^2 wooden roof window

Reasons for performing LCA: B2B

Representativeness: Poland, European

MANUFACTURER

FAKRO is a private company established in Poland in 1991. The company is manufacturer of wooden and aluminium-clad plastic windows of different designs and opening methods, flat roof windows, flashings, automatic control, access roof lights, light tunnels, smoke ventilation, loft ladders - accessories for roof windows: Venetian blinds, pleated blinds, internal and external roller shutters, external awning blinds, installation accessories and roofing membranes and underlays. The company employs over 3 000 employees. The company has 11 manufacturing companies and 17 distribution companies all over the world. FAKRO has an extended distribution network in over 60 countries where there is a demand for roof windows.

Fig. 1. FAKRO PP Sp. z o.o. manufacturing plant located in Nowy Sącz, Poland.

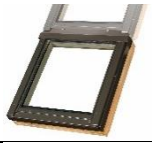
PRODUCTS DESCRIPTION AND APPLICATION

FAKRO roof windows are designed to be built into the roofs of single-family houses with habitable attics and other administrative and service buildings intended for permanent residence of people such as offices, hotels and schools. These windows can be used in any climate zone. They illuminate the interior, allow ventilation of the attic and provide a view to the outside.

Roof windows are made of pine wood, glued in layers and impregnated. In the standard version, windows are painted with clear varnish (e.g. FT**P**), but there is an option to use white varnish (e.g. FT**U**, FT**W**). They are installed in roofs with pitches from 15° to 90° together with flashings. Windows are manufactured using the thermoPro technology featuring energy-efficiency, durability, tightness and facilitated installation process. Windows are characterised by increased burglary resistance as they come with the topSafe system. They can be equipped with an automatic air inlet which provides the optimum amount of fresh air. Windows in the opening version are operated by means of the handle with a two-step micro-opening placed in the bottom section of the sash. They are covered from the outside with aluminium sheet profiles, protected by a polyester coating on both sides.

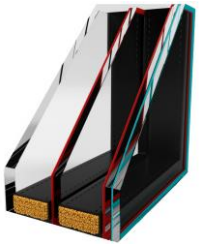
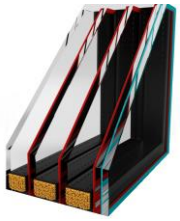
Wooden roof windows include a number of product options included in Table 1:

Table 1: Windows types.

WINDOW TYPE		DESCRIPTION
Pivot window: FT_/FT_-X, FT_-V, FTT, TT_- X, FT_-V Z-wave/Wifi/Solar		The hinge situated in the middle of the window enables the sash to be rotated through 180° and left open. The window can be opened manually and automatically in the Z-Wave/ Wifi/ Solar version.
Top hung and pivot window: FP_,FP-_V,FP_ MAX/ FP_-X MAX, FE_, FPT MAX		The window can be opened via top hung or pivot function. The top hung method makes it possible to leave the sash in any range up to 45°, while the pivot option makes it possible to rotate the sash through 180°.
Window with raised axis of rotation: FY_, FY_-X, FY_-V		The pivot window with axis of rotation situated above its centre. The sash can be rotated through 160°.
Duet proSky window: FDY, FDY-X, FDY-V		Double-sash window. The upper sash is opened like a pivot window with its axis of rotation situated above the centre of the window. The bottom sash is non-opening.
Non-opening window designed for vertical combinations: FX_		Non-opening window installed exclusively beneath a standard roof window, e.g. FT, FP. Designed for vertical combinations.
Smoke ventilation window: FS_		The window is a part of gravitational smoke ventilation system and is used for extraction of smoke and heat emitted in a building during a fire.
Side hung escape window: FW_		The window is side-hung and therefore side-opening. Opening side can be changed before installation.
Balcony window: FG_/FG_-X, FG_-V		The window whose sashes when opened create a balcony. The upper top hung sash opens upwards, while the lower sash can be tilted forwards, allowing easy access to the balcony recess.
Non-opening window: FN_		Non-opening roof window.
Skylight: FX, FV, FV_		Roof window (Skylight) is available in opening and non-opening versions. Opening window feature manual option (opened via a crank), electric (Z-Wave system) and solar (equipped with a photovoltaic panel).
L-shaped combination window: BD_, BV_, BX_, BL_, BR_		Designed for installation in a vertical wall within the loft space to extend the standard roof window into the wall, e.g. FT, FP.

Windows are equipped with double, triple and quadruple glazed units, while their different configurations can be found in Table 2.

Table 2: Sample glazing units.

STRUCTURE	SAMPLE NAME	CROSS-SECTION
DOUBLE-GLAZED UNITS		
4-16-4	U2, U3, U3G, Z6, G3, G32	
4–17–4	U30	
4–14-33.1	L2, L3, G2	
4-14-33.2	G31	
4–15– 33.2	P2, P20, O5	
6–12–33.2	R1, G61	
4–15– 33.4	P4	
TRIPLE-GLAZED UNITS		
4-12-4-12-4	U4	
4-12-4-10-33.2	L4	
4-10-4-10-4	U5	
4-16-4-16-4	U50, U41	
4-10-4-8-33.2	P5, R5	
4-15-4-15-33.2	P50	
8-16-4-18-33.2	R3	
8-14-4-12-33.2	R50	
6-18-4-18-33.2	U6	
QUADRUPLE-GLAZED UNITS		
4-12-4-12-4-12-4	U8	
4-10-4-12-4-12-33.2	U8 VSG	

The FTP-V pivot window with the U30 glazing unit (double-glazed), the FTP-V window with the P50 glazing unit (triple-glazed) and the FTT U8 window (quadruple-glazed) sized 78 x 118 cm were adopted as representative windows.

Table 3. Composition and percentage of input materials of glazed window with dimensions of 78 x 118 cm and packaging materials produced by FAKRO PP Sp. z o.o.

MATERIAL	FTP-V double-glazed U30	FTP-V triple-glazed P50	FTT quadruple-glazed U8
GLASS	40%	52%	51%
WOOD	40%	32%	30%
METAL	11%	9%	12%
OTHER	9%	7%	7%

MATERIAL	PERCENTAGE
CARDBOARD	99%
PAPER	1%

MATERIAL	PERCENTAGE
CARDBOARD	94%
FOIL	5%
PAPER	1%

Detailed parameters of windows are specified in their Declarations of Performance, which can be downloaded from the company's website. These values may vary in individual windows depending on the model and type of glazing unit.

More information can be found on FAKRO PP Sp. z o.o. website: *www.fakro.pl*

LIFE CYCLE ASSESSMENT (LCA) – general rules applied

Allocation

The allocation rules used for this EPD are based on general ITB PCR A v. 1 .6. Production of wooden roof windows is a line process conducted in the manufacturing plan located in Nowy Sącz (Poland). All impacts from raw materials extraction and processing are allocated in A1 module of EPD. Impacts from the FAKRO production were inventoried on the annual production volume expressed in kg. Water and energy consumption, associated emissions and generated wastes are allocated to module A3. Energy supply was inventoried for whole production process. Packaging materials were taken into consideration.

System limits

The life cycle analysis (LCA) of the declared products covers: product stage – modules A1-A3, end of life – modules C1-C4 and benefits and loads beyond the system boundary – module D (cradle-to-gate with options) in accordance with EN 15804 + A2 and ITB PCR A v. 1.6. Energy and water consumption, emissions as well as information on generated wastes were inventoried and were included in the calculations. It can be assumed that the total sum of omitted processes does not exceed 5% of all impact categories. In accordance with EN 15804 + A2, machines and facilities (capital goods) required for the production as well as transportation of employees were not included in LCA.

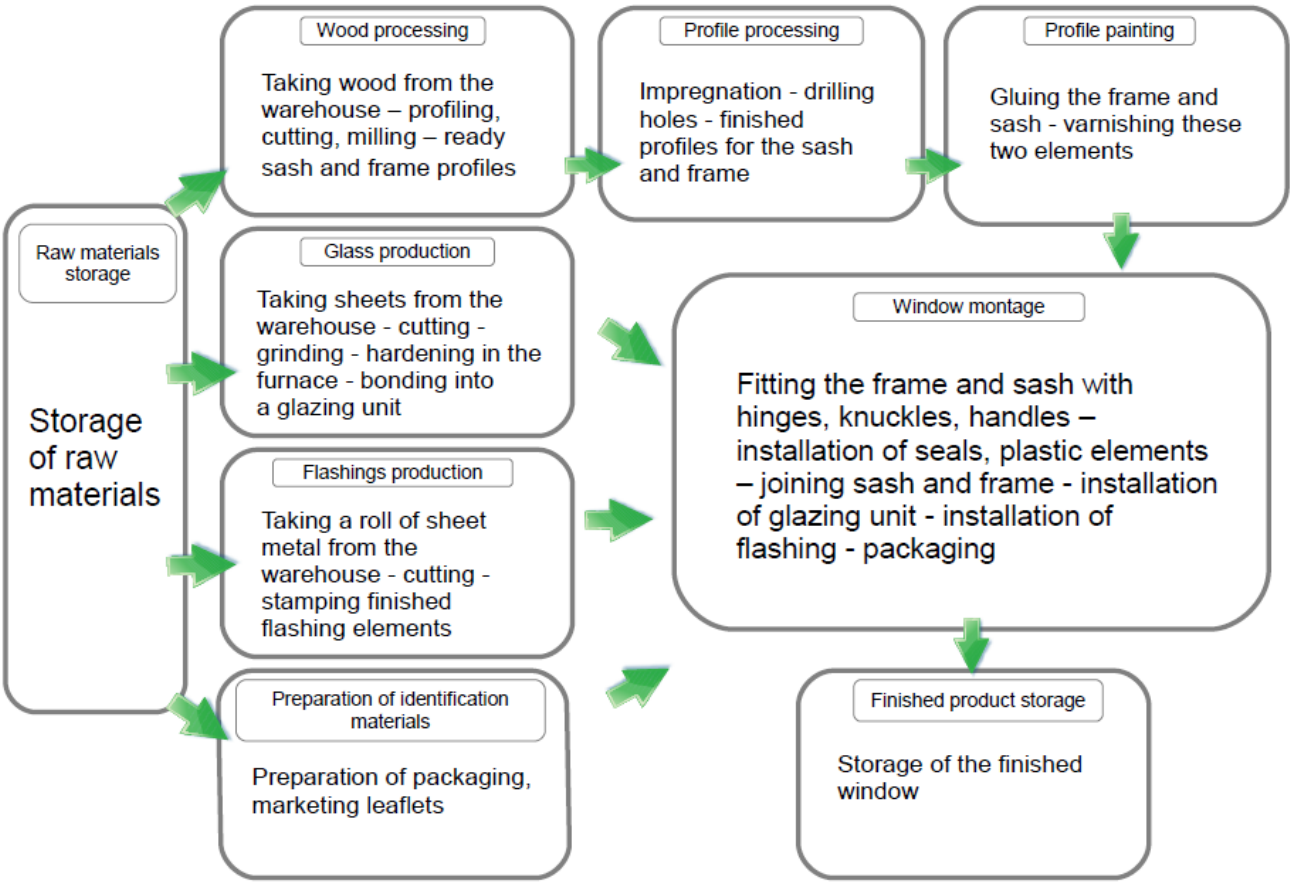


Fig. 2. A scheme of wooden roof windows production by FAKRO PP Sp. z o. o.

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

Raw materials such as pinewood, aluminium, steel, glass or PVC are produced in Poland and others European plants of leading chemical manufacturers whereas other ancillary items come mainly from local suppliers. Data on transport of the different products to the manufacturing plants is collected and modelled for factory by assessor. Means of transport include small truck (< 10 t e.g. couriers), average (10 – 16 t) and big (>16 t) trucks are applied. Based on data provided by the manufacturer, all input of transport resources was inventoried in details.

Module A3: *Production*

A scheme of wooden roof windows production process is presented in Fig. 2.

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

It is assumed that at the end-of-life, 100% of wooden roof windows are demounted using electric tools (module C1) and it is transported to waste processing plant distant by 60 km, on 16-32 t lorry (Euro 5) (module C2). Materials recovered from dismantled products are recycled, incinerated (module C3) and landfilled (module C4) according to the realistic treatment practice (mass allocation) of industrial waste what is presented in Table 4. 95 % of the resulting aluminium undergo recycling

after sorting and cutting while the remaining 5 % is forwarded to landfill as mixed construction and demolition wastes. In turn, 50 % of wood is incinerated while the 50 % remaining waste materials are forwarded to landfill in the form of mixed construction and demolition wastes. In the case of glass, 30% is waste processed, while 70% goes to landfill. A potential credit resulting from the recycling of wood, aluminium and glass are presented in module D. Utilization of packaging material was not taken into consideration.

Table 4. End-of-life scenario for wooden roof windows manufactured by FAKRO PP Sp. z o. o.

Material	Waste processing	Landfilling
wood	50 %	50 %
aluminium	95 %	5 %
glass	30 %	70 %

Data quality

The data selected for LCA analysis originates from ITB-LCI questionnaires completed by FAKRO PP Sp. z o. o. using the inventory data, ITB and Ecoinvent database v. 3.9.1 and KOBiZE. KOBiZE data is supplemented with Ecoinvent v. 3.9.1 data on the national electricity mix impact where no specific indicator data is provided. No specific data collected is older than five years and no generic datasets used are older than ten years. The representativeness, completeness, reliability, and consistency are judged as good.

Data collection period

The data for manufacture of the declared products refers to period between 01.01.2022 – 01.01.2023 (1 year). The life cycle assessments were prepared for Poland and Europe as reference area.

Assumptions and estimates

Impacts were inventoried and calculated for double, triple and quadruple glazed windows with dimensions of 78 x 118 cm which are a standard and representative for the wooden roof windows group system.

Calculation rules

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

Databases

The data for the processes comes from Ecoinvent v. 3.9.1 and ITB-Database. Specific data quality analysis was a part of external audit. Specific data quality analysis was a part of external audit. Polish electricity mix used (production) is 0.761 kg CO_2/kWh (KOBiZE 2022).

LIFE CYCLE ASSESSMENT (LCA) – Results

Declared unit

The declaration refers to declared unit (DU) – 1 m^2 wooden roof window with dimensions of 78 x 118 cm, manufactured by FAKRO PP Sp. z o. o.

Table 5. System boundaries for the environmental characteristic of wooden roof windows with dimensions of 78 x 118 cm.

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

Table 6. LCA results of wooden roof windows with dimensions of 78 x 118 cm and double glazing – environmental impacts (DU: 1 m^2)

Indicator	Unit	A1	A2	A3	A1-A3	C1	C2	C3	C4	D
Global Warming Potential	eq. kg CO_2	5.83E+01	8.34E-01	2.93E+00	6.20E+01	8.75E-02	3.69E-01	1.10E+01	8.78E-01	-1.93E+01
Greenhouse gas potential - fossil	eq. kg CO_2	9.48E+01	8.31E-01	9.07E+00	1.05E+02	8.59E-02	3.68E-01	2.03E-01	1.88E-01	-2.41E+01
Greenhouse gas potential - biogenic	eq. kg CO_2	-3.87E+01	2.55E-03	-6.15E+00	-4.48E+01	1.55E-03	1.26E-03	1.08E+01	6.90E-01	4.92E+00
Global warming potential - land use and land use change	eq. kg CO_2	2.15E+00	3.46E-04	2.68E-03	2.15E+00	2.02E-05	1.44E-04	1.44E-04	1.57E-04	-6.71E-02
Stratospheric ozone depletion potential	eq. kg CFC 11	2.48E-06	1.69E-07	1.67E-07	2.81E-06	1.51E-09	8.51E-08	9.56E-09	3.50E-08	-2.25E-06
Soil and water acidification potential	eq. mol H+	1.12E+00	3.16E-03	8.72E-02	1.21E+00	8.35E-04	1.49E-03	1.80E-03	1.50E-03	-1.50E+00
Eutrophication potential - freshwater	eq. kg P	2.62E-02	5.76E-05	1.48E-02	4.10E-02	1.43E-04	2.47E-05	9.08E-05	2.73E-05	-2.59E-03
Eutrophication potential - seawater	eq. kg N	1.37E-01	9.37E-04	1.29E-02	1.50E-01	1.19E-04	4.51E-04	8.41E-04	3.07E-03	-7.96E-02
Eutrophication potential - terrestrial	eq. mol N	1.67E+00	1.02E-02	1.08E-01	1.78E+00	1.02E-03	4.92E-03	7.76E-03	5.85E-03	-1.60E+00
Potential for photochemical ozone synthesis	eq. kg NMVOC	4.41E-01	3.30E-03	5.80E-02	5.02E-01	2.86E-04	1.51E-03	2.04E-03	1.97E-03	-2.76E-01
Potential for depletion of abiotic resources - non-fossil resources	eq. kg Sb	1.18E-02	3.03E-06	1.40E-05	1.18E-02	1.14E-07	1.30E-06	3.06E-06	5.11E-07	-3.40E-02
Abiotic depletion potential - fossil fuels	MJ	1.10E+03	1.23E+01	1.40E+02	1.25E+03	1.29E+00	5.46E+00	2.02E+00	4.27E+00	-3.44E+02
Water deprivation potential	eq. m^3	3.27E+01	5.82E-02	2.82E+00	3.56E+01	2.61E-02	2.52E-02	5.08E-01	2.16E-02	-2.39E+01

Table 7. LCA results of wooden roof windows with dimensions of 78 x 118 cm and double glazing – additional impacts indicators (DU: 1 m^2)

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

Table 8. LCA results of wooden roof windows with dimensions of 78 x 118 cm and double glazing - the resource use (DU: 1 m^2)

Indicator	Unit	A1	A2	A3	A1-A3	C1	C2	C3	C4	D
Consumption of renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	2.77E+02	1.86E-01	-6.13E+00	2.71E+02	9.33E-02	7.83E-02	-1.02E+02	-1.02E+02	-7.01E+01
Consumption of renewable primary energy resources used as raw materials	MJ	3.06E+02	0.00E+00	2.78E+01	3.34E+02	0.00E+00	0.00E+00	1.02E+02	1.02E+02	-3.07E+01
Total consumption of renewable primary energy resources	MJ	5.88E+02	1.86E-01	2.17E+01	6.10E+02	9.33E-02	7.83E-02	1.41E-01	6.43E-02	-9.61E+01
Consumption of non-renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	1.03E+03	1.23E+01	1.43E+02	1.18E+03	1.36E+00	5.46E+00	9.71E-01	1.89E+00	-3.81E+02
Consumption of non-renewable primary energy resources used as raw materials	MJ	7.39E+01	0.00E+00	2.96E+00	7.68E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-1.25E+00
Total consumption of non-renewable primary energy resources	MJ	1.10E+03	1.23E+01	1.47E+02	1.26E+03	1.36E+00	5.46E+00	2.02E+00	4.24E+00	-3.47E+02
Consumption of secondary materials	kg	1.08E+00	4.41E-03	1.25E-02	1.10E+00	1.04E-04	1.83E-03	3.63E-03	1.54E-03	-3.91E+00
Consumption of renewable secondary fuels	MJ	1.98E+00	4.84E-05	1.09E-04	1.98E+00	5.68E-07	2.02E-05	1.03E-04	3.95E-05	1.86E-03
Consumption of non-renewable secondary fuels	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net consumption of freshwater resources	m^3	5.59E-01	1.56E-03	3.22E-02	5.92E-01	4.18E-04	6.87E-04	-9.47E-04	4.53E-03	7.62E-02

Table 9. LCA results of wooden roof windows with dimensions of 78 x 118 cm and double glazing – waste categories (DU: 1 m^2)

Indicator	Unit	A1	A2	A3	A1-A3	C1	C2	C3	C4	D
Hazardous waste neutralized	kg	5.12E+00	1.31E-02	9.92E-03	5.14E+00	2.66E-07	6.13E-03	2.05E-02	5.53E-03	1.15E+00
Non-hazardous waste neutralised	kg	1.05E+02	2.54E-01	1.15E+00	1.07E+02	7.60E-03	1.09E-01	9.98E-01	9.55E-02	-5.64E+00
Radioactive waste	kg	1.83E-03	7.43E-05	1.33E-04	2.04E-03	1.11E-06	3.76E-05	5.08E-06	1.56E-05	-2.94E-03
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	0.00E+00	0.00E+00
Materials for recycling	kg	1.41E-01	4.69E-05	2.60E-03	1.44E-01	7.81E-06	1.69E-05	3.85E+00	2.01E-05	-3.32E-01
Materials for energy recovery	kg	3.14E-04	3.05E-07	4.76E-04	7.91E-04	1.09E-08	1.37E-07	2.57E-07	2.29E-07	2.13E-05
Energy exported	MJ	2.84E+00	1.48E-02	3.91E-01	3.24E+00	3.73E-03	6.06E-03	2.78E-02	5.86E-03	9.61E-02

Table 10. LCA results of wooden roof windows with dimensions of 78 x 118 cm and triple glazing – environmental impacts (DU: 1 m^2)

Indicator	Unit	A1	A2	A3	A1-A3	C1	C2	C3	C4	D
Global Warming Potential	eq. kg CO_2	6.87E+01	8.34E-01	2.93E+00	7.24E+01	8.75E-02	4.65E-01	1.10E+01	9.42E-01	-1.81E+01
Greenhouse gas potential - fossil	eq. kg CO_2	1.05E+02	8.31E-01	9.07E+00	1.15E+02	8.59E-02	4.64E-01	2.17E-01	2.50E-01	-2.30E+01
Greenhouse gas potential - biogenic	eq. kg CO_2	-3.86E+01	2.55E-03	-6.15E+00	-4.48E+01	1.55E-03	1.58E-03	1.08E+01	6.91E-01	4.94E+00
Global warming potential - land use and land use change	eq. kg CO_2	2.15E+00	3.46E-04	2.68E-03	2.16E+00	2.02E-05	1.82E-04	1.62E-04	2.15E-04	-6.66E-02
Stratospheric ozone depletion potential	eq. kg CFC 11	2.70E-06	1.69E-07	1.67E-07	3.04E-06	1.51E-09	1.07E-07	1.23E-08	5.62E-08	-2.18E-06
Soil and water acidification potential	eq. mol H+	1.23E+00	3.16E-03	8.72E-02	1.32E+00	8.35E-04	1.88E-03	1.89E-03	2.06E-03	-1.49E+00
Eutrophication potential - freshwater	eq. kg P	2.77E-02	5.76E-05	1.48E-02	4.26E-02	1.43E-04	3.12E-05	9.75E-05	3.37E-05	-2.19E-03
Eutrophication potential - seawater	eq. kg N	1.53E-01	9.37E-04	1.29E-02	1.67E-01	1.19E-04	5.68E-04	8.71E-04	3.27E-03	-7.84E-02
Eutrophication potential - terrestrial	eq. mol N	1.87E+00	1.02E-02	1.08E-01	1.99E+00	1.02E-03	6.20E-03	8.09E-03	8.02E-03	-1.57E+00
Potential for photochemical ozone synthesis	eq. kg NMVOC	4.97E-01	3.30E-03	5.80E-02	5.58E-01	2.86E-04	1.90E-03	2.13E-03	2.60E-03	-2.73E-01
Potential for depletion of abiotic resources - non-fossil resources	eq. kg Sb	1.19E-02	3.03E-06	1.40E-05	1.19E-02	1.14E-07	1.64E-06	3.13E-06	7.20E-07	-3.40E-02
Abiotic depletion potential - fossil fuels	MJ	1.22E+03	1.23E+01	1.40E+02	1.37E+03	1.29E+00	6.88E+00	2.30E+00	5.79E+00	-3.34E+02
Water deprivation potential	eq. m^3	3.54E+01	5.82E-02	2.82E+00	3.82E+01	2.61E-02	3.18E-02	5.11E-01	2.86E-02	-2.24E+01

Table 11. LCA results of wooden roof windows with dimensions of 78 x 118 cm and triple glazing – additional impacts indicators (DU: 1 m^2)

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

Table 12. LCA results of wooden roof windows with dimensions of 78 x 118 cm and triple glazing - the resource use (DU: 1 m^2)

Indicator	Unit	A1	A2	A3	A1-A3	C1	C2	C3	C4	D
Consumption of renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	2.85E+02	1.86E-01	-6.13E+00	2.79E+02	9.33E-02	9.87E-02	-1.02E+02	-1.02E+02	-6.99E+01
Consumption of renewable primary energy resources used as raw materials	MJ	3.06E+02	0.00E+00	2.78E+01	3.34E+02	0.00E+00	0.00E+00	1.02E+02	1.02E+02	-3.07E+01
Total consumption of renewable primary energy resources	MJ	5.96E+02	1.86E-01	2.17E+01	6.17E+02	9.33E-02	9.87E-02	1.63E-01	8.22E-02	-9.43E+01
Consumption of non-renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	1.14E+03	1.23E+01	1.43E+02	1.30E+03	1.36E+00	6.88E+00	9.71E-01	1.89E+00	-3.78E+02
Consumption of non-renewable primary energy resources used as raw materials	MJ	7.39E+01	0.00E+00	2.96E+00	7.68E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-1.25E+00
Total consumption of non-renewable primary energy resources	MJ	1.21E+03	1.23E+01	1.47E+02	1.37E+03	1.36E+00	6.88E+00	2.30E+00	5.77E+00	-3.37E+02
Consumption of secondary materials	kg	1.11E+00	4.41E-03	1.25E-02	1.13E+00	1.04E-04	2.31E-03	3.72E-03	2.07E-03	-3.91E+00
Consumption of renewable secondary fuels	MJ	1.98E+00	4.84E-05	1.09E-04	1.98E+00	5.68E-07	2.54E-05	1.05E-04	4.91E-05	2.88E-03
Consumption of non-renewable secondary fuels	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net consumption of freshwater resources	m^3	6.26E-01	1.56E-03	3.22E-02	6.60E-01	4.18E-04	8.66E-04	-7.28E-04	6.22E-03	1.18E-01

Table 13. LCA results of wooden roof windows with dimensions of 78 x 118 cm and triple glazing – waste categories (DU: 1 m^2)

Indicator	Unit	A1	A2	A3	A1-A3	C1	C2	C3	C4	D
Hazardous waste neutralized	kg	5.24E+00	1.31E-02	9.92E-03	5.27E+00	2.66E-07	7.72E-03	2.12E-02	8.00E-03	1.23E+00
Non-hazardous waste neutralised	kg	1.12E+02	2.54E-01	1.15E+00	1.14E+02	7.60E-03	1.37E-01	1.53E+00	1.24E-01	-3.31E+00
Radioactive waste	kg	1.97E-03	7.43E-05	1.33E-04	2.18E-03	1.11E-06	4.74E-05	6.90E-06	2.52E-05	-2.90E-03
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	0.00E+00	0.00E+00
Materials for recycling	kg	1.43E-01	4.69E-05	2.60E-03	1.45E-01	7.81E-06	2.13E-05	3.85E+00	2.36E-05	-3.32E-01
Materials for energy recovery	kg	3.55E-04	3.05E-07	4.76E-04	8.32E-04	1.09E-08	1.72E-07	2.63E-07	3.36E-07	2.32E-05
Energy exported	MJ	3.93E+00	1.48E-02	3.91E-01	4.33E+00	3.73E-03	7.64E-03	2.91E-02	9.43E-03	1.46E-01

Table 14. LCA results of wooden roof windows with dimensions of 78 x 118 cm and quadruple glazing – environmental impacts (DU: 1 m^2)

Indicator	Unit	A1	A2	A3	A1-A3	C1	C2	C3	C4	D
Global Warming Potential	eq. kg CO_2	1.09E+02	8.34E-01	2.93E+00	1.13E+02	8.75E-02	5.82E-01	1.34E+01	1.14E+00	-3.19E+01
Greenhouse gas potential - fossil	eq. kg CO_2	1.56E+02	8.31E-01	9.07E+00	1.66E+02	8.59E-02	5.80E-01	2.92E-01	3.04E-01	-4.00E+01
Greenhouse gas potential - biogenic	eq. kg CO_2	-4.89E+01	2.55E-03	-6.15E+00	-5.51E+01	1.55E-03	1.98E-03	1.31E+01	8.38E-01	8.16E+00
Global warming potential - land use and land use change	eq. kg CO_2	2.08E+00	3.46E-04	2.68E-03	2.08E+00	2.02E-05	2.27E-04	2.35E-04	2.62E-04	-1.11E-01
Stratospheric ozone depletion potential	eq. kg CFC 11	3.84E-06	1.69E-07	1.67E-07	4.18E-06	1.51E-09	1.34E-07	1.64E-08	6.84E-08	-3.71E-06
Soil and water acidification potential	eq. mol H+	2.19E+00	3.16E-03	8.72E-02	2.28E+00	8.35E-04	2.35E-03	2.50E-03	2.50E-03	-2.49E+00
Eutrophication potential - freshwater	eq. kg P	4.17E-02	5.76E-05	1.48E-02	5.65E-02	1.43E-04	3.90E-05	1.32E-04	4.09E-05	-5.02E-03
Eutrophication potential - seawater	eq. kg N	2.35E-01	9.37E-04	1.29E-02	2.49E-01	1.19E-04	7.10E-04	1.13E-03	3.97E-03	-1.32E-01
Eutrophication potential - terrestrial	eq. mol N	3.07E+00	1.02E-02	1.08E-01	3.19E+00	1.02E-03	7.74E-03	1.03E-02	9.75E-03	-2.64E+00
Potential for photochemical ozone synthesis	eq. kg NMVOC	7.72E-01	3.30E-03	5.80E-02	8.33E-01	2.86E-04	2.37E-03	2.74E-03	3.16E-03	-4.58E-01
Potential for depletion of abiotic resources - non-fossil resources	eq. kg Sb	2.67E-02	3.03E-06	1.40E-05	2.67E-02	1.14E-07	2.05E-06	5.01E-06	8.75E-07	-5.64E-02
Abiotic depletion potential - fossil fuels	MJ	1.76E+03	1.23E+01	1.40E+02	1.91E+03	1.29E+00	8.60E+00	3.07E+00	7.04E+00	-5.74E+02
Water deprivation potential	eq. m^3	5.67E+01	5.82E-02	2.82E+00	5.95E+01	2.61E-02	3.98E-02	6.26E-01	3.47E-02	-3.90E+01

Table 15. LCA results of wooden roof windows with dimensions of 78 x 118 cm and quadruple glazing – additional impacts indicators (DU: 1 m^2)

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

Table 16. LCA results of wooden roof windows with dimensions of 78 x 118 cm and quadruple glazing - the resource use (DU: 1 m^2)

Indicator	Unit	A1	A2	A3	A1-A3	C1	C2	C3	C4	D
Consumption of renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	3.83E+02	1.86E-01	-6.13E+00	3.77E+02	9.33E-02	1.23E-01	-1.24E+02	-1.24E+02	-1.17E+02
Consumption of renewable primary energy resources used as raw materials	MJ	3.85E+02	0.00E+00	2.78E+01	4.13E+02	0.00E+00	0.00E+00	1.24E+02	1.24E+02	-5.09E+0
Total consumption of renewable primary energy resources	MJ	7.73E+02	1.86E-01	2.17E+01	7.95E+02	9.33E-02	1.23E-01	2.36E-01	9.99E-02	-1.59E+02
Consumption of non-renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	1.68E+03	1.23E+01	1.43E+02	1.83E+03	1.36E+00	8.60E+00	1.18E+00	2.29E+00	-6.39E+02
Consumption of non-renewable primary energy resources used as raw materials	MJ	8.75E+01	0.00E+00	2.96E+00	9.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-2.07E+0
Total consumption of non-renewable primary energy resources	MJ	1.76E+03	1.23E+01	1.47E+02	1.92E+03	1.36E+00	8.60E+00	3.07E+00	7.00E+00	-5.79E+0
Consumption of secondary materials	kg	2.15E+00	4.41E-03	1.25E-02	2.17E+00	1.04E-04	2.88E-03	5.02E-03	2.51E-03	-6.49E+0
Consumption of renewable secondary fuels	MJ	2.58E+00	4.84E-05	1.09E-04	2.58E+00	5.68E-07	3.18E-05	1.69E-04	5.97E-05	3.63E-03
Consumption of non-renewable secondary fuels	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net consumption of freshwater resources	m^3	8.55E-01	1.56E-03	3.22E-02	8.89E-01	4.18E-04	1.08E-03	-7.22E-04	7.57E-03	1.46E-01

Table 17. LCA results of wooden roof windows with dimensions of 78 x 118 cm and quadruple glazing – waste categories (DU: 1 m^2)

Indicator	Unit	A1	A2	A3	A1-A3	C1	C2	C3	C4	D
Hazardous waste neutralized	kg	7.90E+00	1.31E-02	9.92E-03	2.31E-02	2.66E-07	9.65E-03	2.85E-02	9.73E-03	1.94E+00
Non-hazardous waste neutralised	kg	1.69E+02	2.54E-01	1.15E+00	1.71E+02	7.60E-03	1.71E-01	1.90E+00	1.51E-01	-8.17E+00
Radioactive waste	kg	3.51E-03	7.43E-05	1.33E-04	3.72E-03	1.11E-06	5.92E-05	9.26E-06	3.07E-05	-4.87E-03
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	0.00E+00	0.00E+00
Materials for recycling	kg	2.94E-01	4.69E-05	2.60E-03	2.97E-01	7.81E-06	2.66E-05	6.38E+00	2.87E-05	-5.51E-01
Materials for energy recovery	kg	4.74E-04	3.05E-07	4.76E-04	9.51E-04	1.09E-08	2.15E-07	3.65E-07	4.08E-07	3.62E-05
Energy exported	MJ	5.61E+00	1.48E-02	3.91E-01	6.02E+00	3.73E-03	9.54E-03	4.66E-02	1.15E-02	1.62E-01

Verification

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

The basis for LCA analysis was EN 15804 + A2 and ITB PCR A
Independent verification corresponding to ISO 14025 (subclause 8.1.3) ☒ external ☐ internal
External verification of EPD: Halina Prejzner, PhD Eng LCA, LCI audit and input data verification: Mateusz Kozicki, PhD Verification of LCA: Michał Piasecki, PhD. DSc. Eng Signature Not Verified Dokument podpisany przez Mateusz Kozicki, ITB Data: 2023.12.29 09:49:45 CET

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Normative references

- ITB PCR A v. 1.6 General Product Category Rules for Construction Products
- ISO 14025:2006. Environmental labels and declarations – Type III environmental declarations – Principles and procedures
- ISO 21930:2017 Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services
- ISO 14044:2006 Environmental management – Life cycle assessment – Requirements and guidelines
- ISO 15686-1:2011 Buildings and constructed assets – Service life planning – Part 1: General principles and framework
- ISO 15686-8:2008 Buildings and constructed assets – Service life planning – Part 8: Reference service life and service-life estimation
- EN 15804:2012+A2:2019 Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products
- ISO 14067:2018 Greenhouse gases - Carbon footprint of products - Requirements and guidelines for quantification
- EN 15942:2012 Sustainability of construction works – Environmental product declarations – Communication format business-to-business
- EN 14351-1+A2 Windows and doors - Product standard, performance characteristics - Part 1: Windows and external pedestrian doorsets

Elektronicznie podpisany przez Agnieszka Winkler-Skalna; ITB
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CERTIFICATE № 578/2023
of TYPE III ENVIRONMENTAL DECLARATION

Products:

Wooden roof windows

Manufacturer:

FAKRO PP Sp. z o.o.
ul. Węgierska 144a, Nowy Sącz, Poland

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

EN 15804+A2

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

This certificate, issued on 29th December 2023 is valid for 5 years
or until amendment of mentioned Environmental Declaration

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

INSTYTUT TECHNIKI BUDOWLANEJ

Deputy Director for Research and Innovation
Krzysztof Kuczyński, PhD

Warsaw, December 2023