

ENVIRONMENTAL PRODUCT DECLARATION

In accordance with ISO 14025:2006 and BS EN15804:2012+A2:2019/AC:2021

Multi-product EPD, based on a representative product

Extruded polystyrene foam boards PNP® XPS for thermal insulation

Programme

The International EPD® System, www.environdec.com

The declaration is registered under the regional programme EPD International
www.environdec.com

Programme operator

EPD International AB

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GENERAL INFORMATION

Programme	Address	Website, e-mail
The International EPD® System	EPD International AB Box 210 60 SE-100 31 Stockholm, Sweden	www.environdec.com info@environdec.com

CEN standard EN 15804 serves as the Core Product Category Rules (PCR)

Product category rules (PCR):	PCR 2019:14 Construction products (EN 15804:A2) (1.3.4) 2024-04-30 C-PCR-005 "Thermal insulation products (EN 16783:2017) Product code according to the main UN product classifier: 369
PCR review was conducted by:	No chair appointed
Independent third-party verification of the declaration and data, according to ISO 14025	☐ EPD process certification ☒ EPD verification
Third party verifier:	Marcel Gomez Ferrer Tel. +34 630 64 35 93 Marcel Gómez Consultoria Ambiental info@marcelgomez.com
Approved by:	The International EPD® System
Procedure for follow-up of data during EPD validity involves third party verifier:	☒ Yes ☐ No
Owner of the declaration:	PNP Orange Kft. Address: 8100 Várpalota, Fehérvári út 28-14., Hungary www.pnpinsulation.com
The life cycle assessment (LCA) was carried out by:	PNP Orange Kft. 8100 Várpalota, Fehérvári út 28-14., Hungary https://www.pnpinsulation.com/
Geographical scope of validity of the declaration:	Europe

The EPD owner has the sole ownership, liability, and responsibility for the EPD.

EPDs within the same product category but from different programs may not be comparable.

EPDs of construction products may not be comparable if they do not comply with BS EN 15804:2012+A2:2019/AC:2021.

EPDs within the same product category but registered in different EPD programmes, or not compliant with EN 15804, may not be comparable. For two EPDs to be comparable, they must be based on the same PCR (including the same version number) or be based on PCR or fully aligned PCR versions; cover products with identical functions, technical performance and usage (e.g. identical declared/functional units); have equivalent system limits and data descriptions; apply data quality requirements, equivalent data collection methods and allocation methods; apply identical cut-off rules and impact assessment methods (including the same version of characterization factors); have equivalent content statements; and be valid at the time of comparison. For more information on comparability, see EN 15804 and ISO 14025.

COMPANY INFORMATION

PNP Orange Kft. is a manufacturer of modern efficient thermal insulation materials made of extruded polystyrene foam under the PNP® trademark.

The company has its own extended network of distributors and at the same time actively supports and serves the professionals on the market working on construction projects.

On a regular basis the company organizes training for distributors and provides the necessary technical support during the design of objects and at the stage of documentation preparation. In addition, the company works on continuously improving the quality and sustainability of its products to meet the needs of the construction industry and current legislation.

PNP® products are manufactured on modern equipment using innovative technologies and are widely used in industrial and civil construction, as well as in the construction of private houses and renovation of residential apartments. PNP® thermal insulation materials help to create a comfortable temperature in the room regardless of the climatic zone: they work effectively both in hot and cold climates.

Customer satisfaction with product quality, service and maintenance is the most important strategic factor of the company's development and is monitored continuously basis in accordance with the internal quality management standards.

REACH information

The production of PNP® boards does not use chemicals restricted by the provisions of the European REACH Regulation (EC) No. 1907/2006 "Registration, assessment, authorization and restriction of the production and use of chemicals":

- Annex XVII - list of substances with restricted access;
- Annex XIV – list of substances for which authorization is required, including HBCD - hexabromocyclododecane is a brominated flame retardant of high ecotoxicity;
- SHVC-list - list of substances of very high concern published by the European Chemical Agency, in concentrations above 0.1% (wt).

Foaming agents that destroy the ozone layer are not used in the production of thermal insulation materials.

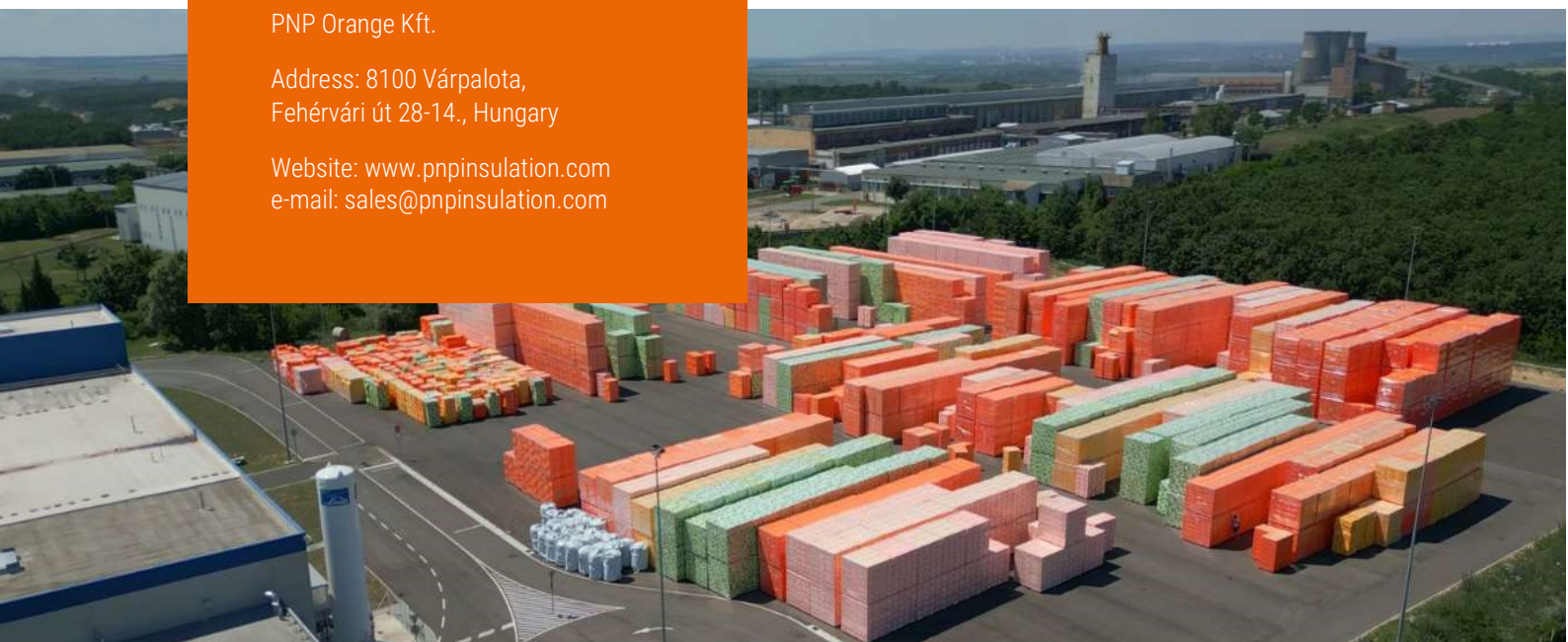
Contacts

Manufacturing enterprises where the declared products are manufactured:

PNP Orange Kft.

Address: 8100 Várpalota,
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Website: www.pnpinsulation.com
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PRODUCT INFORMATION

PNP® XPS board is a high-performance thermal insulation material of the latest generation, manufactured by extrusion from general-purpose polystyrene. Environmental friendliness, moisture resistance, high strength and durability properties, biostability and low thermal conductivity are the main advantages of the PNP® XPS insulation compared to other materials.

Product name and application

PNP® XPS boards with compressive properties ≤ 200 kPa

Thickness: 20, 30, 40, 50, 60, 70, 80, 100, 120, 150 mm
 (TB*): 100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200 and more
 Length: 1,250 m
 Width: 0,600 m

Designed for use in industrial and civil construction, it is a universal material for use in any structures (walls, roofs), where special requirements for structural loads are not imposed.

Typical products:

PNP® XPS 150 / PNP® XPS 150 MG / PNP® XPS 150 W
 PNP® XPS X-Grip
 PNP® XPS 200 / PNP® XPS 200 MG / PNP® XPS 200 W
 BAUFOAM® XPS 150 / BAUFOAM® XPS 150 W
 BAUFOAM® XPS 200 / BAUFOAM® XPS 200 W



PNP® XPS boards with compressive properties 300 kPa

Thickness: 20, 30, 40, 50, 60, 70, 80, 100, 120, 150 mm
 (TB*): 100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200 and more
 Length: 1,250 m
 Width: 0,600 m

Designed for the use in industrial and civil construction, for thermal insulation of loaded structures, such as foundations, floors, stylobates, exploited roofs, as well as in structures with minor fire resistance requirements. Boards of this type are characterized by increased strength and are able to withstand significant loads during the entire service life (more than 50 years).

Typical products:

PNP® XPS 300 / PNP® XPS 300 MG / PNP® XPS 300 W
 BAUFOAM® XPS 300 / BAUFOAM® XPS 300 W



PNP® XPS boards with compressive properties ≥ 500 kPa

Thickness: 40, 50, 60, 70, 80, 100 mm
 (TB*): 100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200 and more
 Length: 1,250 or 2,400 m
 Width: 0,600 m

Designed for use in road, industrial and civil construction, it is a high-strength material for use in any structures where special load requirements are imposed. The PNP® material is used in the foundations of roads, as well as in lightweight embankments.

Typical products:

PNP® XPS 500
 PNP® XPS 700



*for multi-layered products which was produced of same materials by thermobonding technology

Production process

Polystyrene foam boards PNP® XPS are produced by extrusion, which allows to obtain a heat-insulating material with closed cells of 0.1-0.2 mm in size.

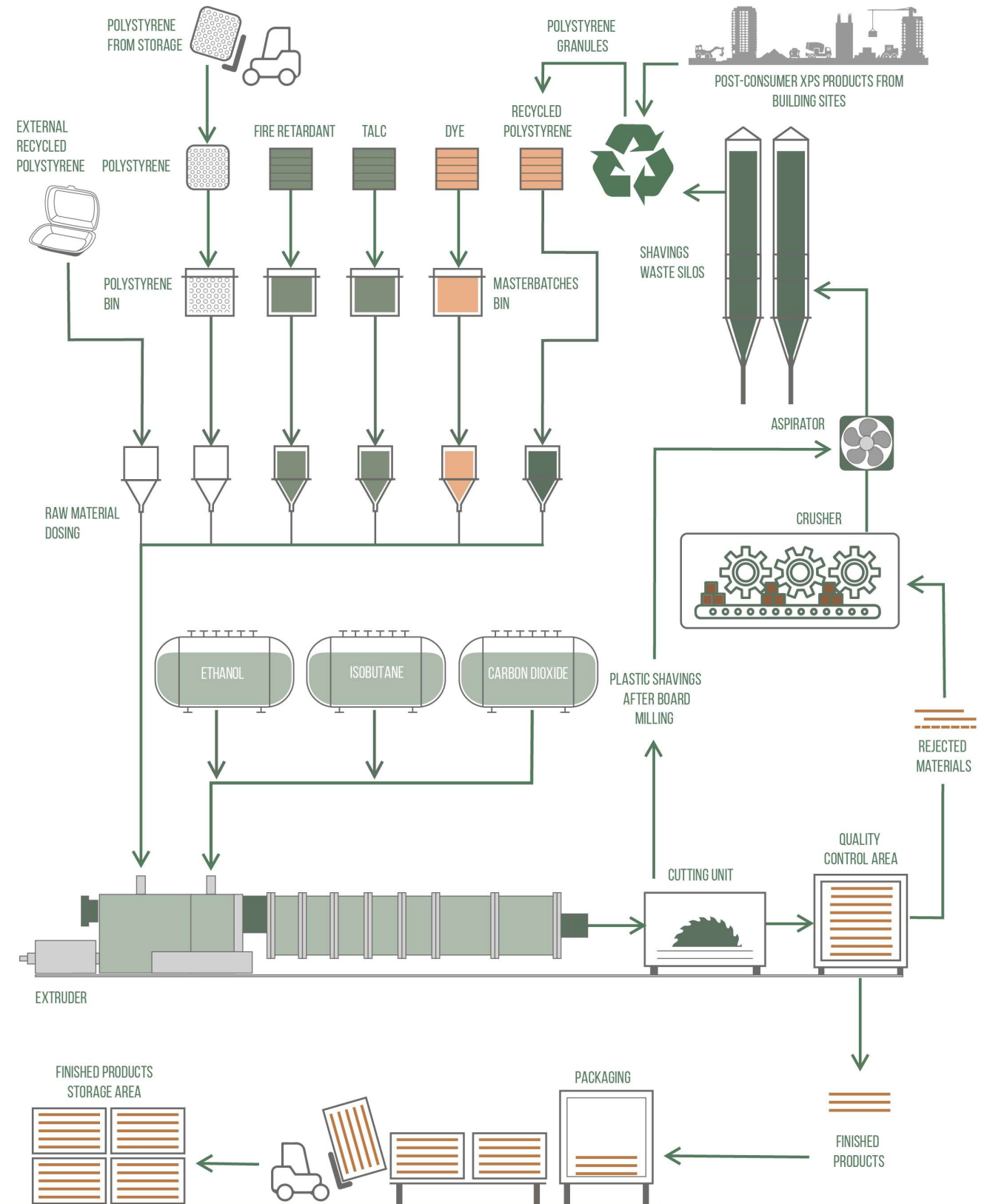
The commercial material is obtained by mixing general-purpose polystyrene granules with various additives in an extruder and then introducing a foaming agent. Under process conditions (pressure up to 270 atm. and temperature up to 230°C), the raw materials are thoroughly mixed, while the porophores (foaming agents) dissolve in the melt. Carbon dioxide is used as the main foaming agent.

Falling from the extruder into the atmosphere, the molten mass is uniformly foamed as a result of the transition of porophores into the gas phase. After cooling and passing through the forming elements, the product mass finally takes the form of a plate.

The technological process of production of extruded polystyrene foam boards PNP® XPS consists of the following stages:

1. Acceptance of incoming raw materials by quantity and quality.
2. Storage of bulk raw materials (polystyrene and functional polystyrene concentrates) and foaming agents.
3. Dosing of bulk raw materials and foaming agents with further mixing, compaction and homogenization in the extruder.
4. Foaming of the reaction mass melt under controlled pressure drop conditions.
5. Obtaining an extruded polystyrene sheet of oval cross-section with further cooling.
6. Cutting from the web of extruded polystyrene foam blanks – boards with raw edges.
7. Processing the edges of oval blanks with a curly milling cutter along the perimeter to obtain commercial polystyrene foam boards of the required geometric dimensions, with a given type of edge processing.
8. Collection of the resulting polystyrene waste, their crushing and granulation.
9. Packing and warehousing of extruded polystyrene foam boards.
10. Factory production control and transfer to the warehouse of commodity extruded polystyrene foam boards.





Technical characteristics

Table 1 shows the main characteristics of the boards made of extruded polystyrene foam boards PNP® XPS

Table 1. Technical characteristics

Characteristics	Test methods	XPS boards with compressive properties		
		≤ 200 kPa	300 kPa	≥ 500 kPa
		PNP® XPS 150, PNP® XPS 150 MG PNP® XPS 150 W, PNP® XPS X-Grip**, PNP® XPS 200, PNP® XPS 200 MG, PNP® XPS 200 W, BAUFOAM® XPS 150 BAUFOAM® XPS 150 W, BAUFOAM® XPS 200 BAUFOAM® XPS 200 W	PNP® XPS 300 PNP® XPS 300 MG PNP® XPS 300 W BAUFOAM® XPS 300 BAUFOAM® XPS 300 W	PNP® XPS 500 PNP® XPS 700
Thickness, mm	EN 823	20 / 30 / 40 / 50 / 60 / 70 / 80 / 100 / 120 / 150 multi-layered product (TB*): 100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200 and more	20/ 30/ 40/ 50/ 60/ 70/ 80/ 100/ 120/ 150 multi-layered product (TB*): 100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200 and more	40/ 50/ 60/ 70/ 80/ 100/ 120/ 150 multi-layered product (TB*): 100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200 and more
Surface		smooth (no index) milled and grooved (MG) waffled (W)	smooth (no index) milled and grooved (MG) waffled (W)	smooth (no index)
Edge		I (square) L (L-shaped)	I (square) L (L-shaped)	I (square) L (L-shaped)
Thickness deviation class	EN 13164	T1	T1	T1
Width, mm	EN 822	600	600	600
Length, mm	EN 822	1250	1250	1250 2400**
Dimensional stability at a certain temperature and humidity (48 h, 70°C, 90%)	EN 1604	DS (70; 90)	DS (70; 90)	DS (70; 90)
Compressive properties	EN 826	CS(10/Y)100 – CS(10/Y)200	CS(10/Y)300	CS(10/Y)500 – CS(10/Y)700
Density, kg/m ³		21.0-27.5	26.5-33.0	35.0-50.0
Thermal conductivity λ ₁₀ , Wt/m·K, not less	EN 12667 EN 12939	0.034–0.035	0.034–0.035	0.034–0.035
Reaction to fire	EN 13501-1	F	E	E
Operating temperature range, °C		-70 ... +75	-70 ... +75	-70 ... +75
		* produced by thermobonding technology ** surface type and reaction to fire class are optional for the product	* produced by thermobonding technology	* produced by thermobonding technology ** on request

CONTENT INFORMATION

Product composition

The approximate composition of the declared products is given in Table 2. During the life cycle of the product any hazardous substance listed in the "Candidate List of Substances of Very High Concern (SVHC) for authorization" has not been used in a percentage higher than 0,1% of the weight of the product.

Package composition

The packaging for protection against damage to finished products during transportation includes LDPE foil. Indicative composition of the product package is represented in Table 2.

Table 2. Approximate composition of extruded polystyrene foam boards PNP® XPS with indicative composition of the package

Product	Weight per 1m ² , kg	Components	Content, % Weight	Post-consumer material, weight - %	Biogenic material, weight-% and kg C/kg
PNP® XPS boards with compressive properties ≤200 kPa	2.4045	Polystyrene	89.10	5	0 resp.0
		Colorant	0.54	0	0 resp.0
		Talc concentrate	0.62	0	0 resp.0
		Ethanol	1.41	0	0 resp.0
		Isobutane	3.33	0	0 resp.0
		Carbon Dioxide	5.00	0	0 resp.0
		Sum	100	4.46	0 resp.0
		Packaging materials	Weight-%(versus the product)	Weight per 1m² of product, kg	Weight biogenic carbon, kg C/kg
		LDPE foil	1.08	0.026	0
		Wooden pallets	0.21	0.005	0.42%
		Sum	1.29	0.031	0
PNP® XPS boards with compressive properties 300 kPa	2.8403	Polystyrene	89.96	5	0 resp.0
		Colorant	0.60	0	0 resp.0
		Talc concentrate	1.33	0	0 resp.0
		Ethanol	0.01	0	0 resp.0
		Isobutane	2.82	0	0 resp.0
		Carbon Dioxide	5.28	0	0 resp.0
		Sum	100	4.50	0 resp.0
		Packaging materials	Weight-% (versus the product)	Weight per 1m² of product, kg	Weight biogenic carbon, kg C/kg
		LDPE foil	0.91	0.026	0
		Wooden pallets	0.17	0.005	0.34%
		Sum	1.09	0.031	0

	Weight per 1m ² , kg	Components	Content, % Weight	Post-consumer material, weight -%	Biogenic material, weight-% and kg C/kg
PNP® XPS boards with compressive properties ≥500 kPa	4.2073	Polystyrene	88.7	5	0 resp.0
		Colorant	0.5	0	0 resp.0
		Talc concentrate	2.0	0	0 resp.0
		Ethanol	0.01	0	0 resp.0
		Isobutane	4.2	0	0 resp.0
		Carbon Dioxide	5.7	0	0 resp.0
		Sum	100	4.44	0 resp.0
		Packaging materials	Weight-(versus the product)	Weight per 1m² of product, kg	Weight biogenic carbon, kg C/kg
		LDPE foil	1.64	0.026	0
		Wooden pallets	0.24	0.005	0.48%
		Sum	1.88	0.031	0

LCA INFORMATION

Life Cycle Assessment information:

Period for data: 2023-2024

The study did not use data older than 10 years.

Declared unit:

1 m² of PNP® XPS with thickness of 100 mm.

The useful life of a properly installed PNP® XPS boards corresponds to the useful life of building and amounts 50 years.

Database(s) and LCA software used:

The LCA was carried out using openLCA 2.2 software and ecoinvent 3.8 databases (Cut-Off System Model).

In the context of this study, the activity data are mainly of "primary type", ie, collected with the support of the Company for the specific production sites.

Description of system boundaries:

The boundaries of the declaration system according to the BS EN 15804:2012+A2:2019/AC:2021 "Cradle to gate" with options: modules C1–C4, module D (A1–A3 + A4–A5 + C + D).

The EPD is valid in Europe.

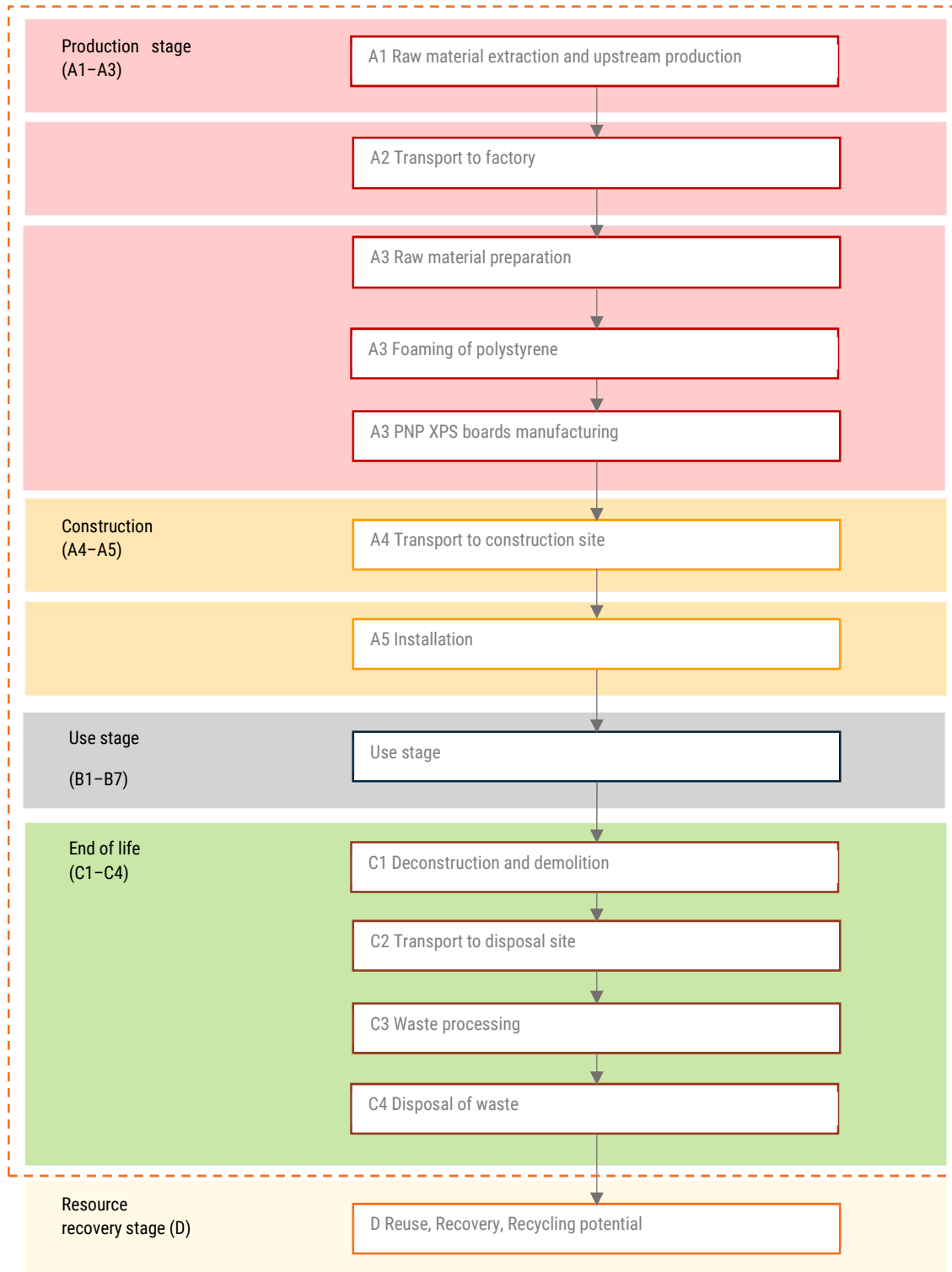
The target audience of the environmental declaration is customers and other parties interested in the results of the environmental impact of the 1 m² PNP® XPS board produced by "PNP Orange Kft."

The EPD with the completed life cycle assessment can be used for B2B communication purposes in the environmental assessment of buildings.

The representative declared product is PNP® XPS boards with compressive properties 300 kPa as a main manufacturing product at the production site (PNP® XPS boards with compressive properties 300 kPa take 92% of the volume of all production of XPS boards).

System diagram

Life cycle information within the System Boundary:



System boundary

This study used the principle that the party responsible for pollution is responsible for paying for the damage caused to the environment, as well as a modular approach to life cycle assessment.

This EPD covers the «cradle to gate» scope with following modules:

- A1 (Raw material supply), A2 (Transport) and A3 (Manufacturing), A4 (Transportation), A5 (Installation of products).
 - C1 (De-construction), C2 (Transport at end-of life), C3 (Waste processing) and C4 (Disposal).
- In addition, module D - benefits and loads beyond the system boundary is included.

Table 3. System boundary

	Product stage			Construction process stage		Use stage							End of life stage				Resource recovery stage
	Raw material supply	Transport	Manufacturing	Transportation	Construction installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction, demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
Module	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Modules declared	X	X	X	X	X	MND	MND	MND	MND	MND	MND	MND	X	X	X	X	X
Location	GLO		HU	GLO	GLO	-	-	-	-	-	-	-	GLO	GLO	GLO	GLO	GLO
Specific data used	>90% GWP-GHG			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation-products	Variation of declared impact products -17% to 46%			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation-sites	0%			-	-	-	-	-	-	-	-	-	-	-	-	-	-

X = declared modules; MND = the module is not declared; GLO = Global; EU = Europe; HU =Hungary.

Cut-off criteria:

The study includes all modules and processes which are stated mandatory in EN 15804:2012+A2:2019/AC:2021 and the applied PCR.

The LCI data shall include, in accordance with EN 15804, a minimum of 95% of the total input flows (mass and energy) per module (eg A1-A3, A4-A5, B1-B5, B6-B7, C1- C4 and module D). In addition, this PCR applies the extended cut-off rule of ISO 21930, which states at least 95% of the environmental impact per module. Plausibility assessments and expert judgment may be used to demonstrate compliance with these criteria.

The study does not exclude any hazardous materials or substances.

It can be assumed that the processes ignored would each have contributed less than 5% to the impact categories under review. Total neglected input flows per module is less than 5% of energy usage and mass.

The production of capital equipment, construction activities, and infrastructure, maintenance and operation of capital equipment, personnel-related activities, energy and water use related to office activities are excluded.

Data sources and data quality:

The quality of data used in this study satisfies the requirements, provided in BS EN15804:2012+A2:2019/AC:2021, ch. 6.3.8.

- Generic data (ecoinvent database v3.8, Cut-Off System Model), used for calculations is no older than 10 years. Producer specific data is no older than 5 years.
- The inventory for this LCA study is based on 2023-2024 production figures for PNP[®] XPS boards manufactured by-" PNP Orange Kft."
- Technological coverage reflects the physical reality for the declared products.

Table 4. Indicators of representativeness of data quality

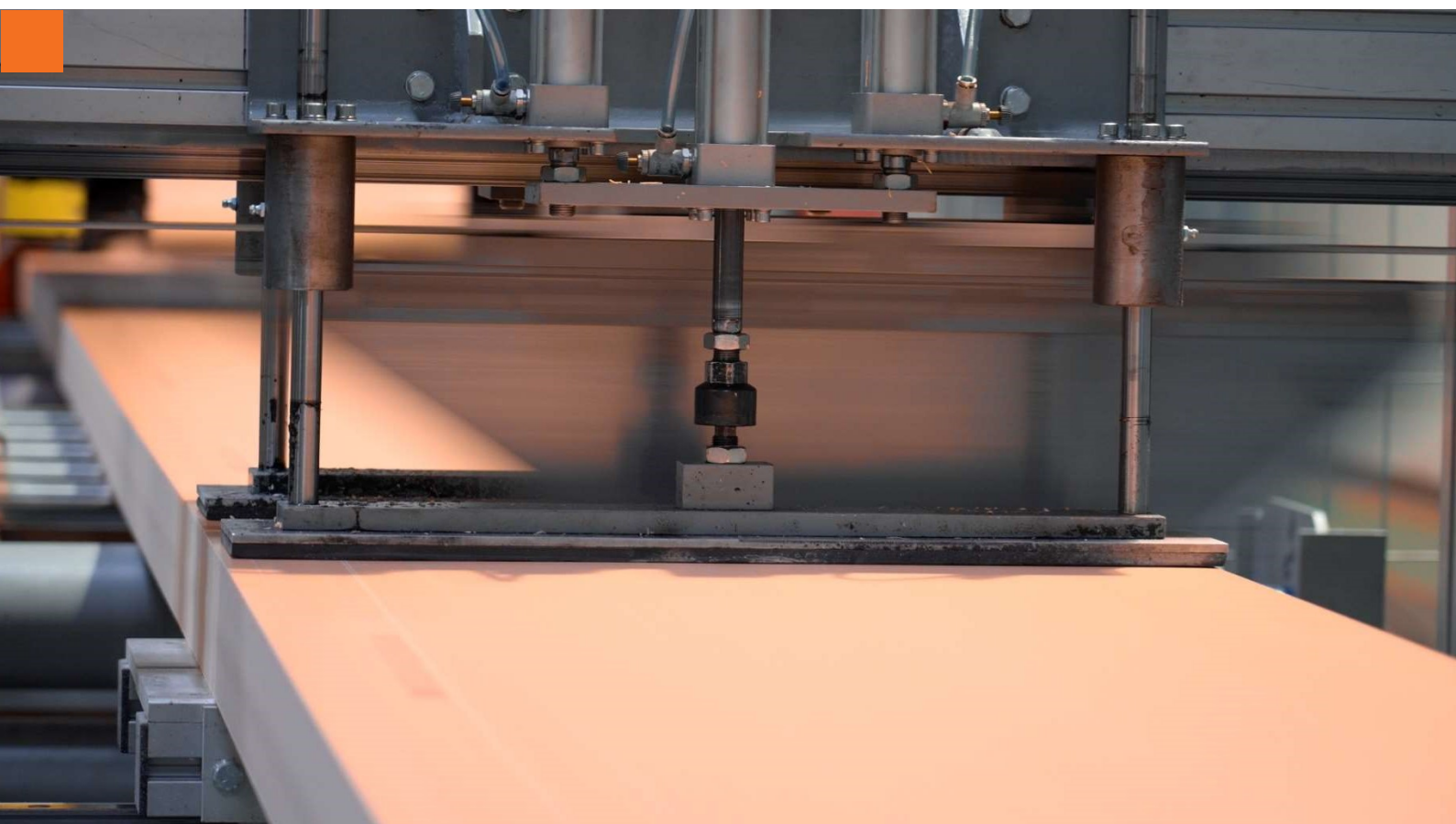
Technological representativeness	Time representativeness	Geographical representativeness	Total rating
4,24	4,16	3.97	4,12

Allocation:

Allocation is required, because some materials, energy, and waste or emissions data cannot be measured separately for the product under study.

Allocation of inputs and outputs of the system is based on a physical property – area.

Allocation used in Ecoinvent 3.8 environmental data sources follows the methodology 'allocation, cut-off by classification'. This methodology is in line with the requirements of the BS EN15804:2012+A2:2019/AC:2021.



LCA SCENARIOS

Modules A1–A3

A1 module includes raw materials production and the consumption of electricity.

Polystyrene foamed extrusion boards consist of such materials as: - general purpose polystyrene, talc concentrate, dye concentrate, flame retardant concentrate, foaming agents (carbon dioxide, isobutane, ethyl alcohol).

The main properties of the components that affect the finished product:

- talc concentrate (improves strength characteristics – compressive properties, density)
- dye concentrate (coloring intensity only)
- foaming agents (carbon dioxide, isobutane, ethyl alcohol (improves strength characteristics – compressive properties, reduces the density of products while maintaining physical and mechanical properties)).

A2 module includes transportation of raw materials from the places of production, as well as transport of packaging materials, to the manufacturing sites.

A3 module includes water consumption, packaging, consumption of auxiliary materials, consumption of diesel, consumption of natural gas, coal, and oxygen, waste generation and waste management processes (landfill and recycling), air emissions, emissions to water, transport of waste to the treatment and final disposal site. Production losses comprise 1%.

Electricity production

Description of the process (as per Ecoinvent v3.8):

The model used data describing high-voltage electricity in Hungary. The table below shows the distribution of electricity sources for Hungary. The shares were calculated based on World Energy Statistics and Balances statistics.

Type of information	Description
Location	Hungary
Geographical representativeness description	Split of energy sources in kWh Coal: 5.0% Oil: 32.2% Nuclear: 16.7% Biofuels and waste: 11.2% Natural gas: 32.0% Hydro: 0.1%
Reference year	2023
Type of data set	Cradle to gate
Source	IEA

Modules A4–A5

A4 module includes transportation from the production gate to the construction site. The product is directly transferred from the truck to the construction site. Mainly trucks of EURO6 class carry out transportation.

Parameter	Value/Description
Fuel type and consumption of vehicle or vehicle type used for transport e.g. long distance truck, boat, etc	a) Truck of 16-32 tn. Fuel consumption: 51L/100 km
Distance* supply of PNP® XPS boards with compressive properties ≤ 200 kPa	Trucks 508.9 km
Distance* supply of PNP® XPS boards with compressive properties 300 kPa	Trucks 578.9 km
Distance* supply of PNP® XPS boards with compressive properties ≥ 500 kPa	Trucks 389.2 km
Capacity utilization (including empty returns)	100%
Bulk density of of PNP® XPS boards with compressive properties ≤200 kPa	2.40 kg/m ²
Bulk density of of PNP® XPS boards with compressive properties 300 kPa	2.84 kg/m ²
Bulk density of of PNP® XPS boards with compressive properties ≥500 kPa	4.19 kg/m ²
Volume capacity utilisation factor	1

*The indicated distances are average values weighted by the amount of cargo transported.

A5 module includes the installation of the material. The impact from the installation of PNP® XPS boards is assumed to be almost negligible. The calculation takes into account 3% loss of material during installation and disposal of packaging.

Parameter	Value/Description
Water usage	Not used
Use of other resources	Not used
Material losses during installation	3% of the product 0.069 kg/m ² LDPE film 0.005 kg/m ² wooden pallets
Waste management	100% of the waste is collected and sent for disposal at a distance of 50 km.

Information about material loss is based on experience.

Modules C1–C4

Description of scenarios and additional technical information for the final stage of the product LCA:

Parameter	Quantity and unit of measurement, description
Module C1. De-construction	
The process of de-construction and demolition	The impact of demolition of PNP® XPS board is considered negligible compared to the impact of demolition of the building as a whole. The impact is therefore considered to be 0.
Module C2. Transport at end-of life	
Transportation to processing plants	It is assumed that 100% of the waste is collected and transported to the processing plants.
Distance to the processing plant	50 km
Type of vehicle	Lorry
Vehicle load capacity	16-32 Metric ton; EURO6, diesel fuel
Module C3. Waste processing	
Waste processing	5-30% (average 15%)
Module C4. Disposal	
Waste disposal	It is considered that 85% of the material waste is sent to landfill.

Module D

Due to the recycling process the product is converted into recycled polystyrene at the end of its service life.

With regard to this module, data on the recycled polystyrene content in the declared products have been considered, which show that, for XPS boards from construction, the net material flow per m² (2.8403 kg/m²) in the following proportion:

Mmr in: $2.8403 \text{ kg} \cdot 30\% = 0.852 \text{ kg}$

Mmr out: $2.8403 \text{ kg} \cdot 85\% = 2.414 \text{ kg}$

Y = 0.852 Displaced material: polystyrene

ENVIRONMENTAL INFORMATION

PNP® XPS boards with compressive properties 300 kPa

The following environmental impact corresponds to the life cycle of **1 m² PNP® XPS boards with a thickness of 100 mm and compressive properties 300 kPa**. For PNP® XPS boards with thickness or strength different from the reference values, the environmental impact can be calculated using the equation (1) in Additional information chapter.

Potential environmental impact – mandatory indicators according to EN 15804:2012+A2:2019/AC:2021.

Results per declared unit												
Product stage		Construction process stage				Use stage		End of life stage				Resource recovery stage
Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
GWP-total	kg CO ₂ eq.	1,01E+01	1,07E+00	2,52E-01	1,14E+01	2,68E-01	3,09E-03	0,00E+00	2,32E-02	1,15E-03	1,22E-02	-4,70E-01
GWP-biogenic	kg CO ₂ eq.	-5,72E-03	9,70E-04	-1,42E-03	-6,17E-03	2,40E-04	1,42E-03	0,00E+00	2,11E-05	4,81E-07	5,72E-03	-2,49E-03
GWP-fossil	kg CO ₂ eq.	1,00E+01	1,07E+00	2,53E-01	1,14E+01	2,68E-01	1,67E-03	0,00E+00	2,31E-02	1,14E-03	6,49E-03	-4,67E-01
GWP-luluc	kg CO ₂ eq.	5,39E-02	4,20E-04	1,60E-04	5,45E-02	1,10E-04	5,40E-07	0,00E+00	9,15E-06	1,19E-07	6,74E-07	-8,20E-04
ODP	kg CFC 11 eq.	4,16E-08	2,47E-07	1,13E-08	3,00E-07	6,21E-08	1,87E-10	0,00E+00	5,36E-09	2,28E-10	1,29E-10	-1,78E-08
AP	mol H ⁺ eq.	3,67E-02	6,84E-03	2,81E-02	7,16E-02	1,89E-03	1,33E-05	0,00E+00	1,60E-04	1,22E-05	6,91E-05	-8,45E-03
EP-freshwater	kg P eq.	1,50E-04	6,99E-05	1,40E-04	3,60E-04	1,75E-05	1,04E-07	0,00E+00	1,52E-06	5,92E-08	3,36E-07	-2,10E-04
EP-marine	kg N eq.	6,03E-03	6,20E-04	2,20E-04	6,87E-03	1,50E-04	2,50E-06	0,00E+00	1,33E-05	4,90E-06	2,78E-05	-4,70E-04
EP-terrestrial	mol N eq.	6,12E-02	6,61E-03	1,70E-03	6,95E-02	1,66E-03	2,72E-05	0,00E+00	1,40E-04	5,37E-05	3,00E-04	-4,17E-03
POCP	kg NMVOC eq.	2,52E-02	2,58E-03	1,01E-01	1,29E-01	6,50E-04	8,48E-06	0,00E+00	5,59E-05	1,50E-05	8,52E-05	-1,24E-03
ADP-minerals&metals*	kg Sb eq.	3,22E-06	3,78E-06	1,06E-06	8,06E-06	9,49E-07	4,66E-09	0,00E+00	8,20E-08	5,86E-10	3,32E-09	-7,01E-07
ADP-fossil*	MJ	2,12E+02	1,62E+01	7,36E+00	2,36E+02	4,06E+00	2,45E-02	0,00E+00	3,51E-01	1,52E-02	8,59E-02	-5,72E+00
WDP*	m ³	5,97E+00	5,80E-02	9,93E-02	6,13E+00	1,39E-02	7,51E-05	0,00E+00	1,20E-03	2,78E-05	1,60E-04	-9,44E-02

* Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.

Acronyms:

GWP-fossil = Global Warming Potential fossil fuels;

GWP-biogenic = Global Warming Potential biogenic;

GWP-luluc = Global Warming Potential land use and land use change;

ODP = Depletion potential of the stratospheric ozone layer;

AP = Acidification potential, Accumulated Exceedance;

EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment;

EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment;

EP-terrestrial = Eutrophication potential, Accumulated Exceedance;

POCP = Formation potential of tropospheric ozone;

ADP-minerals&metals = Abiotic depletion potential for non-fossil resources;

ADP-fossil = Abiotic depletion for fossil resources potential;

WDP = Water (user) deprivation potential, deprivation-weighted water consumption.

Potential environmental impact – additional mandatory and voluntary indicators

Results per declared unit												
Indicator	Unit	A1	A2	A3	A1 - A3	A4	A5	C1	C2	C3	C4	D
GWP-GHG	kg CO ₂ eq.	9,62E+00	1,06E+00	2,47E-01	1,09E+01	2,66E-01	1,65E-03	0,00E+00	2,30E-02	1,12E-03	6,37E-03	-4,59E-01

GWP-GHG: The indicator includes all greenhouse gases included in GWP-total but excludes biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. This indicator is thus equal to the GWP indicator originally defined in EN 15804:2012+A1:2013.

Use of resources

Results per functional or declared unit												
Indicator	Unit	A1	A2	A3	A1 - A3	A4	A5	C1	C2	C3	C4	D
PERE	MJ	3,13E+00	2,31E-01	2,50E-01	3,61E+00	5,80E-02	3,12E-04	0,00E+00	5,01E-03	1,25E-04	7,04E-04	-6,59E-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	0,00E+00	0,00E+00
PERT	MJ	3,13E+00	2,31E-01	2,50E-01	3,61E+00	5,80E-02	3,12E-04	0,00E+00	5,01E-03	1,25E-04	7,04E-04	-6,59E-01
PENRE	MJ	2,29E+02	1,72E+01	7,84E+00	2,54E+02	4,31E+00	2,60E-02	0,00E+00	3,72E-01	1,61E-02	9,12E-02	-6,09E+00
PENRM	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PENRT	MJ	2,29E+02	1,72E+01	7,84E+00	2,54E+02	4,31E+00	2,60E-02	0,00E+00	3,72E-01	1,61E-02	9,12E-02	-6,09E+00
SM	kg	1,42E-01	0,00E+00	0,00E+00	8,52E-01	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	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	0,00E+00	0,00E+00
FW	m ³	1,41E-01	1,83E-03	2,68E-03	1,45E-01	4,60E-04	2,48E-06	0,00E+00	3,97E-05	9,12E-07	5,17E-06	-3,25E-03

Acronyms:

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 non-renewable primary energy resources used as raw materials;
 PENRT = Total use of non-renewable primary energy re-sources;
 SM = Use of secondary material;
 RSF = Use of renewable secondary fuels;
 NRSF = Use of non-renewable secondary fuels;
 FW = Use of net fresh water.

Waste production

Results per functional or declared unit												
Indicator	Unit	A1	A2	A3	A1 - A3	A4	A5	C1	C2	C3	C4	D
Hazardous waste disposed	kg	6,32E-06	4,22E-05	1,74E-06	5,15E-05	1,06E-05	6,42E-08	0.00E+00	9,15E-07	4,01E-08	2,27E-07	2,38E-06
Non-hazardous waste disposed	kg	1,24E-01	8,46E-01	7,25E-02	1,00E+00	2,12E-01	1,55E-01	0.00E+00	1,84E-02	4,26E-01	2,41E+00	-3,35E-02
Radioactive waste disposed	kg	6,86E-06	1,10E-04	1,94E-05	1,37E-04	2,74E-05	1,65E-07	0.00E+00	2,37E-06	1,01E-07	5,73E-07	1,60E-05

Output flows

Results per functional or declared unit												
Indicator	Unit	A1	A2	A3	A1 - A3	A4	A5	C1	C2	C3	C4	D
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	0.00E+00	0.00E+00
Material for recycling	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	4,26E-01	0.00E+00	0.00E+00
Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy, electricity	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy, thermal	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Information on biogenic carbon content

Results per functional or declared unit		
Biogenic carbon content	Unit	Quantity
Biogenic carbon content in product	kg C	0.00E+00
Biogenic carbon content in packaging	kg C	9,17E-03

Note: 1 kg of biogenic carbon is equivalent to 44/12 kg CO₂.

Scatter of impacts on results of PNP[®]XPS boards (per declared unit:1 m²)

The percentage spread of results for modules A1-A3 for each of the products in relation to the average representative product is shown below. Exposure results per 1 m² and 100 mm thickness were calculated for each of the products. Thus, the differences in exposure are due to the different raw material consumption for each product, which ranges from 2.4045 to 4.2073 kg per m² compared to 2.8403 kg/m² for the representative product.

Results per declared unit				
Indicator	Unit	A1-A3 (compressive properties 300 kPa)	A1-A3 (compressive properties ≤200 kPa)	A1-A3 (compressive properties ≥500 kPa)
GWP-total	kg CO ₂ eq.	1,14E+01	-17%	+46%
GWP-fossil	kg CO ₂ eq.	1,14E+01	-16%	+46%
GWP-biogenic	kg CO ₂ eq.	-6,17E-03	-79%	+95%
GWP-luluc	kg CO ₂ eq.	5,45E-02	-43%	+116%
ODP	kg CFC 11 eq.	3,00E-07	-16%	+46%
AP	mol H ⁺ eq.	7,16E-02	-43%	-5%
EP-freshwater	kg P eq.	3,60E-04	-37%	-3%
EP-marine	kg N eq.	6,87E-03	-18%	+50%
EP-terrestrial	mol N eq.	6,95E-02	-15%	+48%
POCP	kg NMVOC eq.	1,29E-01	-76%	-58%
ADP-minerals&metals*	kg Sb eq.	8,06E-06	-15%	+46%
ADP-fossil*	MJ	2,36E+02	-16%	+45%
WDP*	m ³	6,13E+00	-14%	+48%



INTERPRETATION OF RESULTS

The graphs below demonstrate the results for Life Cycle Assessment (LCA) for each type of extruded polystyrene foam. Each column of the chart reflects the impact of the considered environmental indicators in the following order:

- GWP-fossil = Global Warming Potential fossil fuels;
- GWP-biogenic = Global Warming Potential biogenic;
- GWP-luluc = Global Warming Potential land use and land use change;
- GWP-total = Global Warming Potential total;
- ODP = Depletion potential of the stratospheric ozone layer;
- AP = Acidification potential, Accumulated Exceedance;
- EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment;
- EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment;
- EP-terrestrial = Eutrophication potential, Accumulated Exceedance;
- POCP = Formation potential of tropospheric ozone;
- ADP-minerals&metals = Abiotic depletion potential for non-fossil resources;
- ADP-fossil = Abiotic depletion for fossil resources potential;
- WDP = Water (user) deprivation potential, deprivation-weighted water consumption.

The following stages and modules were considered in the analysis:

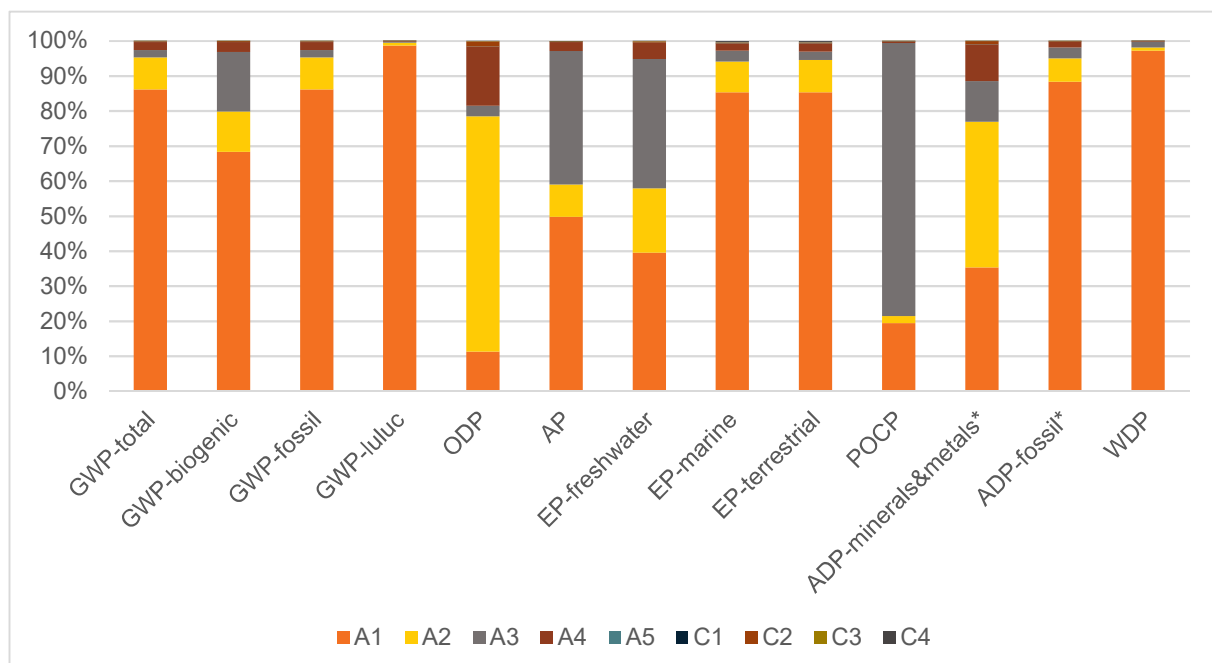
- **Production stage:** A1 (Extraction of raw materials), A2 (Transportation) and A3 (Production)
- **Construction stage:** A4 (Transportation), A5 (Installation of products)
- **Final stage:** C1 (Dismantling), C2 (End-of-life transportation), C3 (Waste recycling) and C4 (Disposal)

A1-A4 are modules of the life cycle with the greatest environmental impact. The A1 module has mostly the greater impact through the modules under study. The represented figures show how impacts are distributed between the modules

A1-A3, A4-A5, C1-C4, D considered in this EPD:

Figure 1. PNP® XPS boards with compressive properties 300 kPa

* The result of the environmental impact indicator should be used with caution since the uncertainty of the results is high and experience with this indicator is limited.



As it can be seen from the graph (Figure 1), the stages A1-A3 are the Life Cycle Stages with the highest impact for all analysed categories. A1 demonstrates the vital influence for majority of ecological indicators, representing up to 98% for Land use and land use change (GWP-luluc). Depletion potential of the stratospheric ozone layer (ODP) has the most impact during A2 stage, accounting for 67%. Eutrophication potential for freshwater (EP-freshwater) has the most significant influence on environment during A1 and A3 modules – 40% and 37% respectively. Almost the same influence has Abiotic depletion potential for non-fossil resources (ADP-minerals&metals) for the modules A1 and A2 of Production stage – around 36% for the first one and 41% for the latter one. Besides, the graph illustrates that the influence of A2 module is vastly superior to A4 module for all analysed categories. Depletion potential of the stratospheric ozone layer (ODP) has the vast effect for both of the stages around 67% for A2 and 17% for A4 stage, and Water deprivation potential (WDP) has the least impact during transportation (both A2 and A4) – less than 1%.

Module A5 also has almost no impact on the environment compared to the production stage A1-A3 (about 0,1%).

End of life stages (C2, C3, C4) have almost negligible influence on the total life cycle results. The influence of Ozon depletion potential for non-fossil resources (ODP) parameter only has a tangible influence, accounting for almost 1,5% on stage C2. All the rest parameters have less than 1% impact for PNP® boards with compressive properties 300 kPa.

Stage D is outside the system in question, so it is not shown on the graph.

Information related to sectoral EPD

*This EPD is not sectoral.

Differences with previous versions

*First version of EPD®.

ADDITIONAL INFORMATION

Electricity modelling

Generation of electricity used in the manufacturing process in module A3 is accounted for in module A3.

The declared energy source behind electricity used in the manufacturing process is descibed in A3 and its climate impact is 0.093 kg CO₂ eq./kWh for manufacturing process.

Results per functional or declared unit		
Indicator	Unit	A1-A3
Climate impact	kg CO ₂ eq./kWh	9.29E-02

Scatter of impacts on results of PNP®XPS boards with compressive properties 300 kPa (per declared unit: 1 m²) for different thicknesses

The percentage spread of results for modules A1-A3 for each of the products in relation to the average representative product is shown below. Exposure results per 1 m² and 100 mm thickness as representative were calculated for each of the thicknesses of the representative product.

Results per declared unit for modules A1-A3																
Indicator	Unit	Thickness														
		100 mm (representative product PNP®XPS 300 kPa)	20 mm	30 mm	40 mm	50 mm	60 mm	70 mm	80 mm	120 mm	150 mm	160 mm	180 mm	200 mm	220 mm	240 mm
GWP-total	kg CO ₂ eq.	1,14E+01	-80%	-61%	-60%	-50%	-40%	-30%	-20%	+20%	+50%	+60%	+80%	+100%	+120%	+140%
GWP-fossil	kg CO ₂ eq.	1,14E+01	-80%	-63%	-60%	-50%	-40%	-30%	-20%	+20%	+50%	+60%	+80%	+100%	+120%	+140%
GWP-biogenic	kg CO ₂ eq.	-6,17E-03	-80%	-63%	-60%	-50%	-40%	-30%	-20%	+20%	+50%	+60%	+80%	+100%	+120%	+140%
GWP-luluc	kg CO ₂ eq.	5,45E-02	-80%	-60%	-60%	-50%	-40%	-30%	-20%	+20%	+50%	+60%	+80%	+100%	+120%	+140%
ODP	kg CFC 11 eq.	3,00E-07	-80%	-68%	-60%	-50%	-40%	-30%	-20%	+20%	+50%	+60%	+80%	+100%	+120%	+140%
AP	mol H ⁺ eq.	7,16E-02	-80%	-65%	-60%	-50%	-40%	-30%	-20%	+20%	+50%	+60%	+80%	+100%	+120%	+140%
EP-freshwater	kg P eq.	3,60E-04	-80%	-66%	-60%	-50%	-40%	-30%	-20%	+20%	+50%	+60%	+80%	+100%	+120%	+140%
EP-marine	kg N eq.	6,87E-03	-80%	-61%	-60%	-50%	-40%	-30%	-20%	+20%	+50%	+60%	+80%	+100%	+120%	+140%
EP-terrestrial	mol N eq.	6,95E-02	-80%	-61%	-60%	-50%	-40%	-30%	-20%	+20%	+50%	+60%	+80%	+100%	+120%	+140%
POCP	kg NMVOC eq.	1,29E-01	-80%	-64%	-60%	-50%	-40%	-30%	-20%	+20%	+50%	+60%	+80%	+100%	+120%	+140%
ADP-minerals&metals*	kg Sb eq.	8,06E-06	-80%	-66%	-60%	-50%	-40%	-30%	-20%	+20%	+50%	+60%	+80%	+100%	+120%	+140%
ADP-fossil*	MJ	2,36E+02	-80%	-61%	-60%	-50%	-40%	-30%	-20%	+20%	+50%	+60%	+80%	+100%	+120%	+140%
WDP*	m3	6,13E+00	-80%	-60%	-60%	-50%	-40%	-30%	-20%	+20%	+50%	+60%	+80%	+100%	+120%	+140%

Scatter of impacts on results of PNP®XPS boards with compressive properties ≤ 200 kPa (per declared unit: 1 m²) for different thicknesses

The percentage spread of results for modules A1-A3 for each of the products in relation to the average representative product is shown below. Exposure results were calculated for each of the thicknesses of the PNP®XPS boards with compressive properties ≤ 200 kPa and compared with the result of representative product.

Results per declared unit for modules A1-A3																	
Indicator	Unit	Thicknesses															
		100 mm (representative product PNP®XPS 300 kPa)	20 mm	30 mm	40 mm	50 mm	60 mm	70 mm	80 mm	100 mm	120 mm	150 mm	160 mm	180 mm	200 mm	220 mm	240 mm
GWP-total	kg CO ₂ eq.	1,14E+01	-83%	-75%	-67%	-58%	-50%	-42%	-33%	-17%	0%	25%	33%	50%	67%	83%	100%
GWP-fossil	kg CO ₂ eq.	1,14E+01	-83%	-75%	-67%	-58%	-50%	-41%	-33%	-16%	0%	25%	34%	50%	67%	84%	101%
GWP-biogenic	kg CO ₂ eq.	-6,17E-03	5%	-30%	-47%	-58%	-65%	-70%	-74%	-79%	-82%	-86%	-87%	-88%	-89%	-90%	-91%
GWP-luluc	kg CO ₂ eq.	5,45E-02	-89%	-83%	-77%	-72%	-66%	-60%	-55%	-43%	-32%	-15%	-9%	2%	14%	25%	36%
ODP	kg CFC 11 eq.	3,00E-07	-83%	-75%	-66%	-58%	-50%	-41%	-33%	-16%	1%	26%	34%	51%	68%	85%	101%
AP	mol H ⁺ eq.	7,16E-02	-89%	-83%	-77%	-71%	-66%	-60%	-54%	-43%	-32%	-14%	-9%	3%	14%	26%	37%
EP-freshwater	kg P eq.	3,60E-04	-87%	-81%	-75%	-69%	-62%	-56%	-50%	-37%	-25%	-6%	0%	13%	25%	38%	50%
EP-marine	kg N eq.	6,87E-03	-84%	-75%	-67%	-59%	-51%	-42%	-34%	-18%	-1%	23%	32%	48%	64%	81%	97%
EP-terrestrial	mol N eq.	6,95E-02	-83%	-75%	-66%	-58%	-49%	-41%	-32%	-15%	2%	27%	36%	53%	70%	87%	104%
POCP	kg NMVOC eq.	1,29E-01	-95%	-93%	-90%	-88%	-85%	-83%	-80%	-76%	-71%	-63%	-61%	-56%	-51%	-46%	-41%
ADP-minerals&metals*	kg Sb eq.	8,06E-06	-83%	-75%	-66%	-58%	-49%	-41%	-32%	-15%	1%	27%	35%	52%	69%	86%	103%
ADP-fossil*	MJ	2,36E+02	-83%	-75%	-67%	-58%	-50%	-41%	-33%	-16%	0%	26%	34%	51%	67%	84%	101%
WDP*	m ³	6,13E+00	-83%	-74%	-66%	-57%	-49%	-40%	-31%	-14%	3%	29%	37%	54%	72%	89%	106%

Scatter of impacts on results of PNP®XPS boards with compressive properties ≥ 500 kPa (per declared unit: 1 m²) for different thicknesses

The percentage spread of results for modules A1-A3 for each of the products in relation to the average representative product is shown below. Exposure results were calculated for each of the thicknesses of the PNP®XPS boards with compressive properties ≥ 500 kPa and compared with the result of representative product.

Results per declared unit for modules A1-A3																	
Indicator	Unit	Thicknesses															
		100 mm (representative product PNP®XPS 300 kPa)	20 mm	30 mm	40 mm	50 mm	60 mm	70 mm	80 mm	100 mm	120 mm	150 mm	160 mm	180 mm	200 mm	220 mm	240 mm
GWP-total	kg CO ₂ eq.	1,14E+01	-71%	-56%	-43%	-27%	-12%	2%	17%	+46%	75%	119%	134%	163%	192%	221%	250%
GWP-fossil	kg CO ₂ eq.	1,14E+01	-71%	-56%	-43%	-27%	-12%	2%	17%	+46%	75%	119%	134%	163%	192%	222%	251%
GWP-biogenic	kg CO ₂ eq.	-6,17E-03	76%	84%	88%	90%	92%	93%	94%	+95%	96%	121%	129%	146%	163%	179%	196%
GWP-luluc	kg CO ₂ eq.	5,45E-02	-57%	-35%	-14%	8%	29%	51%	73%	+116%	159%	224%	245%	288%	331%	375%	418%
ODP	kg CFC 11 eq.	3,00E-07	-71%	-57%	-55%	-28%	-14%	1%	15%	+46%	73%	116%	130%	159%	188%	217%	245%
AP	mol H ⁺ eq.	7,16E-02	-81%	-72%	-64%	-53%	-43%	-34%	-24%	-5%	13%	42%	51%	70%	89%	108%	127%
EP-freshwater	kg P eq.	3,60E-04	-81%	-71%	-64%	-51%	-42%	-32%	-22%	-3%	17%	46%	55%	75%	94%	114%	133%
EP-marine	kg N eq.	6,87E-03	-70%	-55%	-41%	-25%	-10%	5%	20%	+50%	80%	125%	140%	170%	200%	230%	260%
EP-terrestrial	mol N eq.	6,95E-02	-70%	-56%	-42%	-26%	-11%	3%	18%	+48%	77%	122%	136%	166%	196%	225%	255%
POCP	kg NMVOC eq.	1,29E-01	-92%	-87%	-84%	-79%	-75%	-71%	-67%	-58%	-50%	-37%	-33%	-25%	-17%	-8%	0%
ADP-minerals&metals*	kg Sb eq.	8,06E-06	-71%	-56%	-49%	-27%	-13%	2%	17%	+46%	75%	119%	133%	162%	191%	220%	250%
ADP-fossil*	MJ	2,36E+02	-71%	-56%	-43%	-27%	-13%	2%	16%	+45%	75%	118%	133%	162%	191%	220%	249%
WDP*	m ³	6,13E+00	-70%	-56%	-41%	-26%	-11%	3%	18%	+48%	77%	122%	136%	166%	195%	225%	254%

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