PENOPLEX®
effective thermal insulation

EPD®

ECO PLATFORM EPD VERIFIED

ENVIRONMENTAL PRODUCT DECLARATION

In accordance with
ISO 14025:2006 and BS EN 15804:2012+A2:2019

EXTRUDED POLYSTYRENE FOAM BOARDS PENOPLEX® FOR THERMAL INSULATION

EN 13164:2012+A1:2015

LLC "PENOPLEX SPb"
Address: Saperny lane, 1, letter "A", Saint-Petersburg, Russia, 191014

Programme
The International EPD® System,
www.environdec.com

The declaration is registered under the regional programme EPD Russia,
www.epdrussia.org

Programme operator
EPD International AB

EPD registration number
S-P-07715

Publication date
2023-05-16

Valid until
2028-05-15

CONTENT

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) (1.11) 2021-02-05 C-PCR-005 "Thermal insulation products (EN 16783:2017) Product code according to the main UN product classifier: 369
PCR review was conducted by:	Claudia A. Peña info@environdec.com
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:	LLC "PENOPLEX SPb" Saperny lane, 1, letter "A", Saint-Petersburg, Russia, 191014 www.penoplex.com
The life cycle assessment (LCA) was carried out with the participation of:	EcoStandard Group Perevedenovsky Lane, 13/16, Moscow, Russia, 105082 www.ecostandardgroup.ru
LCA Expert:	Elizaveta Andreeva andreeva.e@ecostandard.ru
Geographical scope of validity of the declaration:	in all countries

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.

COMPANY INFORMATION

LLC "PENOPLEX SPb" is one of the largest manufacturers of building materials in Europe. To date, the company has 13 factories.

For more than 20 years, the company has been producing high-quality construction and decorative finishing materials. The company's portfolio contains materials that can fully provide technical solutions for various structures of buildings and structures. Throughout its history, the company has received more than 10 patents for inventions in the construction field and modernization of the production process. Today the company employs more than 1500 people who contribute to the development of the company daily.

The company is a developer of more than 5 State and interstate standards for the application, design and use of extruded polystyrene foam boards PENOPLEX®.

The company is a responsible manufacturer that annually undergoes audits according to the ISO 9001 quality management system.

The structure of LLC "PENOPLEX SPb" includes companies that are engaged in the production and sale of products in the following areas:

PENOPLEX® – thermal insulation materials,
STYROVIT® – general purpose polystyrene,
PLINTEX® – decorative and finishing materials made of polystyrene,
PLASTFOIL® – waterproofing materials.

REACH INFORMATION

The production of PENOPLEX® XPS 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

Head organization

LLC "PENOPLEX SPb"
Saperny lane, 1, letter "A", Saint-Petersburg, Russia, 191014

Website: www.penoplex.com
e-mail: export@penoplex.com

Manufacturing enterprises where the declared products are manufactured

- KIRISHI
  187110, Russia, Leningrad region, Entuziastov Highway, Kirishi 36
- NOVOSIBIRSK
  630126, Russia, Novosibirsk region, Novosibirsk, Vybornaya street, house 201
- KHABAROVSK
  680052, Russia, Khabarovsk Krai, Khabarovsk, Gagarin str. 22, letter V.
- TAGANROG
  347927, Russia, Rostov region, Taganrog, Polyakovskoe highway, 45
- PERM
  614065, Russia, Perm Krai, Perm, Promyshlennaya street, house 133
- ZAVOLZHYE
  606520, Russia, Nizhny Novgorod region, Zavolzhye, Privokzalnaya str., 4
- NOVOMOSKOVSK
  301651, Russia, Tula region, Novomoskovsk, Svobody str., 2
- CHEREMHOVO
  Russia, Irkutsk region, Cheremkhovo, Vostochny proezd str., 6
- CHEKHOV
  LLC "Chekhov thermal insulation"
  142324, Russia, Moscow region, Chekhov, Kryukovo village, territory of the Chekhov PCT, building 5

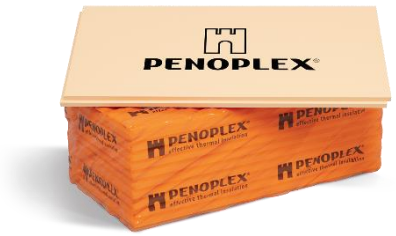
PRODUCT INFORMATION

PENOPLEX® board is a high-performance thermal insulation material of the latest generation, manufactured by extrusion from general-purpose polystyrene. Zero water absorption, high strength, environmental friendliness and low thermal conductivity are the main advantages of the PENOPLEX® insulation compared to other materials.

PRODUCT NAME AND APPLICATION

PENOPLEX® boards with compressive strength ≤ 200 kPa

Thickness: 20 / 30 / 40 / 50 / 60 / 70 / 80 / 100 / 120 / 150 mm
22.5 / 52 / 54 / 100 mm
Length: 1,185 / 3,020 m
Width: 0,585 /0,600 /0,604 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:
PENOPLEX OSNOVA® (PENOPLEX KOMFORT®, PENOPLEX® BASE, PENOPLEX® BASE 200, PENOPLEX® KOMFORT Euro, PENOPLEX® GENERAL 150)
PENOPLEX® FASAD (PENOPLEX STENA®, PENOPLEX® WALL 150, PENOPLEX® FACADE 150, PENOPLEX® FASSADE Euro)
PENOPLEX® SENDVICH, PENOPLEX® SENDVICH F (F/K)

PENOPLEX® boards with compressive strength 200 - 500 kPa

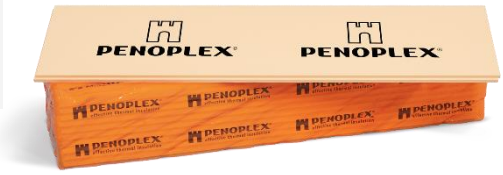
Thickness: 20/ 30/ 40/ 50/ 60/ 70/ 80/ 100/ 120/ 150 mm
Length: 1,185 / 2,400 m
Width: 0,585 /0,600 m

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:
PENOPLEX FUNDAMENT® (PENOPLEX® FOUNDATION 300, PENOPLEX® FUNDAMENT Euro)
PENOPLEX® GEO C
PENOPLEX® KROVLYA
PENOPLEX® TRAK 250
PENOPLEX® TRAK 400
PENOPLEX® EKSTRIM
PENOPLEX® SKATNAYA KROVLYA
PENOPLEX® STRONG (PENOPLEX® STRONG 300, PENOPLEX® GEO)
PENOPLEX® 45 C

PENOPLEX® boards with compressive strength ≥ 500 kPa

Thickness: 40/ 50/ 60/ 70/ 80/ 100 mm
Length: 1,185 / 2,400 m
Width: 0,585 /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 PENOPLEX® material is used in the foundations of roads, as well as in lightweight embankments.

Typical products:
PENOPLEX® TRAK 700
PENOPLEX® EXTRA (PENOPLEX® EXTRA 500, PENOPLEX® 45)
PENOPLEX® 75

PRODUCTION PROCESS

Polystyrene foam boards PENOPLEX® 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 PENOPLEX® 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.

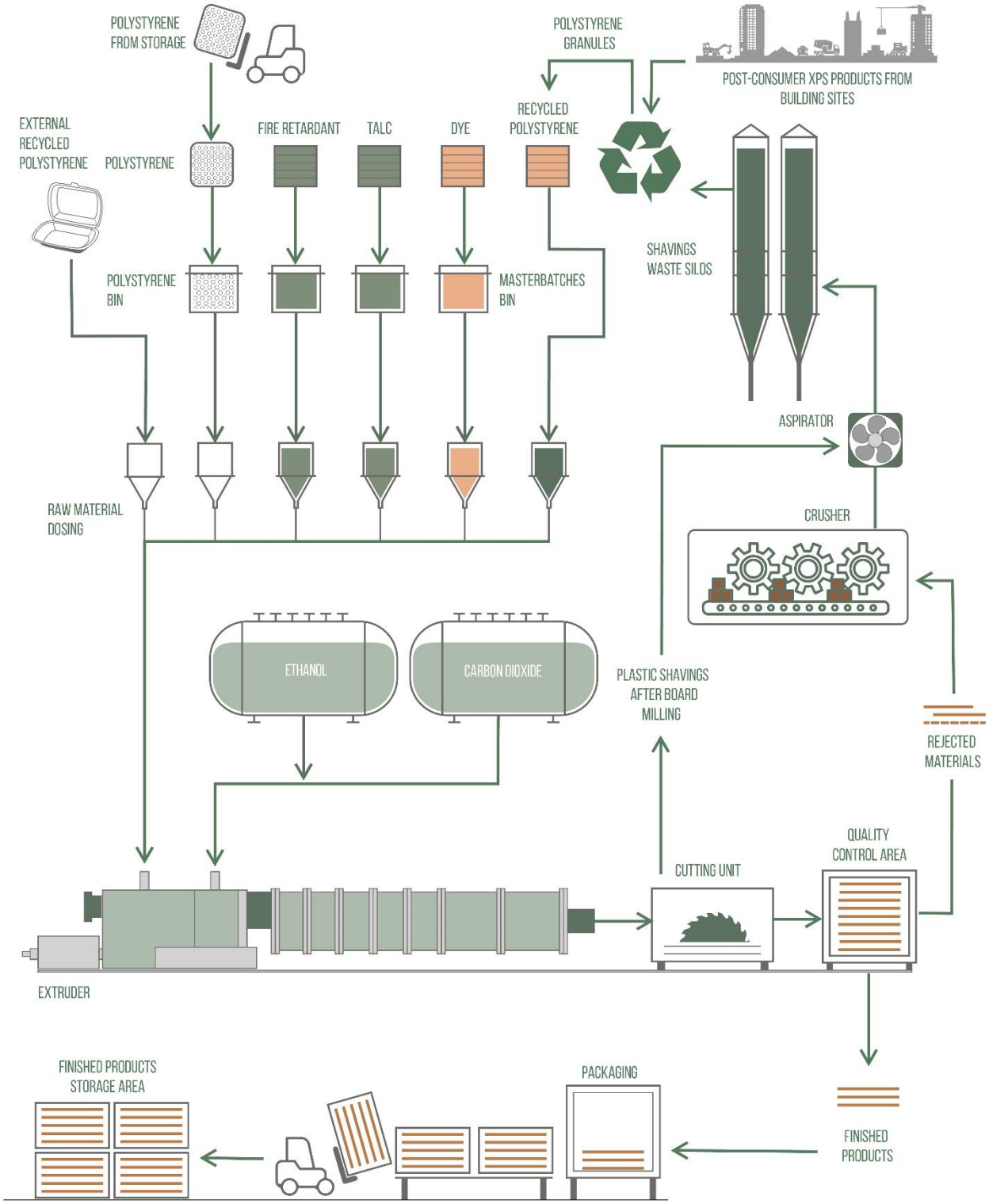
6. Cutting from the web of extruded polystyrene foam blanks – boards with raw edges.

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 extrusion polystyrene foam boards.

10. Acceptance tests, certification and transfer to the warehouse of commodity extruded polystyrene foam boards.


POLYSTYRENE FROM STORAGE
POLYSTYRENE GRANULES
POST-CONSUMER XPS PRODUCTS FROM BUILDING SITES
EXTERNAL RECYCLED POLYSTYRENE
POLYSTYRENE
FIRE RETARDANT
TALC
DYE
RECYCLED POLYSTYRENE
SHAVINGS WASTE SILOS
POLYSTYRENE BIN
MASTERBATCHES BIN
ASPIRATOR
RAW MATERIAL DOSING
CRUSHER
ETHANOL
CARBON DIOXIDE
PLASTIC SHAVINGS AFTER BOARD MILLING
REJECTED MATERIALS
QUALITY CONTROL AREA
CUTTING UNIT
EXTRUDER
FINISHED PRODUCTS STORAGE AREA
PACKAGING
FINISHED PRODUCTS

TECHNICAL CHARACTERISTICS

Table 1 shows the main characteristics of the boards made of extruded polystyrene foam boards PENOPLEX®.

TABLE 1. TECHNICAL CHARACTERISTICS

Characteristics	Test methods	XPS boards PENOPLEX® with compressive strength		
		≤ 200 kPa	200 - 500 kPa	≥ 500 kPa
Thickness, mm	EN 823	20 / 30 / 40 / 50 / 60 / 70 / 80 / 100 / 120 / 150 22.5 / 52 / 54/ 100*	20/ 30/ 40/ 50/ 60/ 70/ 80/ 100/ 120/ 150 40/ 50/ 60/ 80/ 100* 40/ 50/ 60/ 70/ 80/ 100/ 120/ 150 **	40/ 50/ 60/ 70/ 80/ 100/ 120/ 150 40/ 50/ 60/ 70/ 80/ 100*
Thickness deviation class	EN 13164	T1	T1	T1
Width, mm	EN 822	585 600 / 604*	585 600*	585 600*
Lenght, mm	EN 822	1185 3020*	1185 2400*	1185 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)
Color	Manufacturer's Technical Specification (MTC)	Orange (white, blue or grey)*	Orange (white, blue or grey)	Orange (white, blue or grey)
Compressive strength at 10% linear deformation, MPa, not less	EN 826	Range: 0.13 – 0.20 Medium: 0.17	Range: 0.20 – 0.40 Medium: 0.30	Range: 0.50 – 0.70 Medium: 0.58
Compressive strength class	EN 13164	CS(10/Y)100 – CS(10/Y)200	CS(10/Y)200 – CS(10/Y)400	CS(10/Y)500 – CS(10/Y)700
Density, kg/m^3	GOST 17177	19.0 – 35.0	24.0-40.0	35.0-53.0
Thermal conductivity λ_{10}, Wt/m*K, not less	EN 12667 EN 12939	0.034	0.034	0.034
Water absorption, % to volume, not less	EN 12087, MTC	0.4 – 0.5	0.4-0.5	0.2-0.5
Flammability group	GOST 30244	G4	G4 / G3 ***	G4 / G3**
Reaction to fire	EN 13501-1	F	F-E	E
Operating temperature range, C°	MTC	-70 … +75	-70 … +75	-70 … +75
		* - PENOPLEX® SENDVICH, PENOPLEX® SENDVICH F (F/K)	* - PENOPLEX® 45 C ** - PENOPLEX® EKSTRIM *** - PENOPLEX® TRAK 250, PENOPLEX® TRAK 400, PENOPLEX® KROVLYA	* - PENOPLEX® 45, PENOPLEX® 75 ** - PENOPLEX® TRAK 700

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.

TABLE 2. APPROXIMATE COMPOSITION OF EXTRUDED POLYSTYRENE FOAM BOARDS PENOPLEX®

Product	Weight per 1m² of product with 50 mm thickness, kg	Components	Content, % weight	Post-consumer material, weight - %	Renewable material, weight-%
XPS boards PENOPLEX® with compressive strength ≤ 200 kPa	1.0563	Polystyrene	78.0-96.5	5	0
		Dye	0.3-0.6	0	0
		Talc concentrate	0.3-1.0	0	0
		Ethanol	0.0-2.0	0	0
		Carbon Dioxide	3.5-5.5	0	0
XPS boards PENOPLEX® with compressive strength 200 – 500 kPa	1.4870	Polystyrene	67.0-96.0	5	0
		Dye	0.3-0.6	0	0
		Talc concentrate	0.6-1.5	0	0
		Ethanol	0.0-1.7	0	0
		Carbon Dioxide	3.5-5.5	0	0
		Flame retardant	0.0-4.0	0	0
XPS boards PENOPLEX® with compressive strength ≥ 500 kPa	1.8943	Polystyrene	61.5-96.0	5	0
		Dye	0.3-0.6	0	0
		Talc concentrate	1.0-2.5	0	0
		Carbon Dioxide	3.5-5.5	0	0

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 3.

TABLE 3. INDICATIVE COMPOSITION OF THE PACKAGE OF XPS BOARDS PENOPLEX®

Product	Weight per 1m² of product with 50 mm thickness, kg	Packaging materials	Weight-%(versus the product)
XPS boards PENOPLEX® with compressive strength ≤ 200 kPa	0.026	LDPE foil	2.46%
	0.005	Wooden pallets	0.47%
XPS boards PENOPLEX® with compressive strength 200 – 500 kPa	0.026	LDPE foil	1.75%
	0.005	Wooden pallets	0.34%
XPS boards PENOPLEX® with compressive strength ≥ 500 kPa	0.027	LDPE foil	1.41%
	0.005	Wooden pallets	0.26%

LCA INFORMATION

Life Cycle Assessment information:

Period for data: 2021

The study did not use data older than 10 years.

Declared unit:

1 m^2 of XPS with thickness of 50 mm.

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

Database(s) and LCA software used:

The LCA was carried out using openLCA 1.11.0 software and ecoinvent 3.8 databases (Cut-Off System Model).

Description of system boundaries:

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

The EPD is valid in all countries.

The target audience of the environmental declaration is customers and other parties interested in the results of the environmental impact of the 1 m^2 XPS board PENOPLEX® produced by LLC "PENOPLEX SPb".

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

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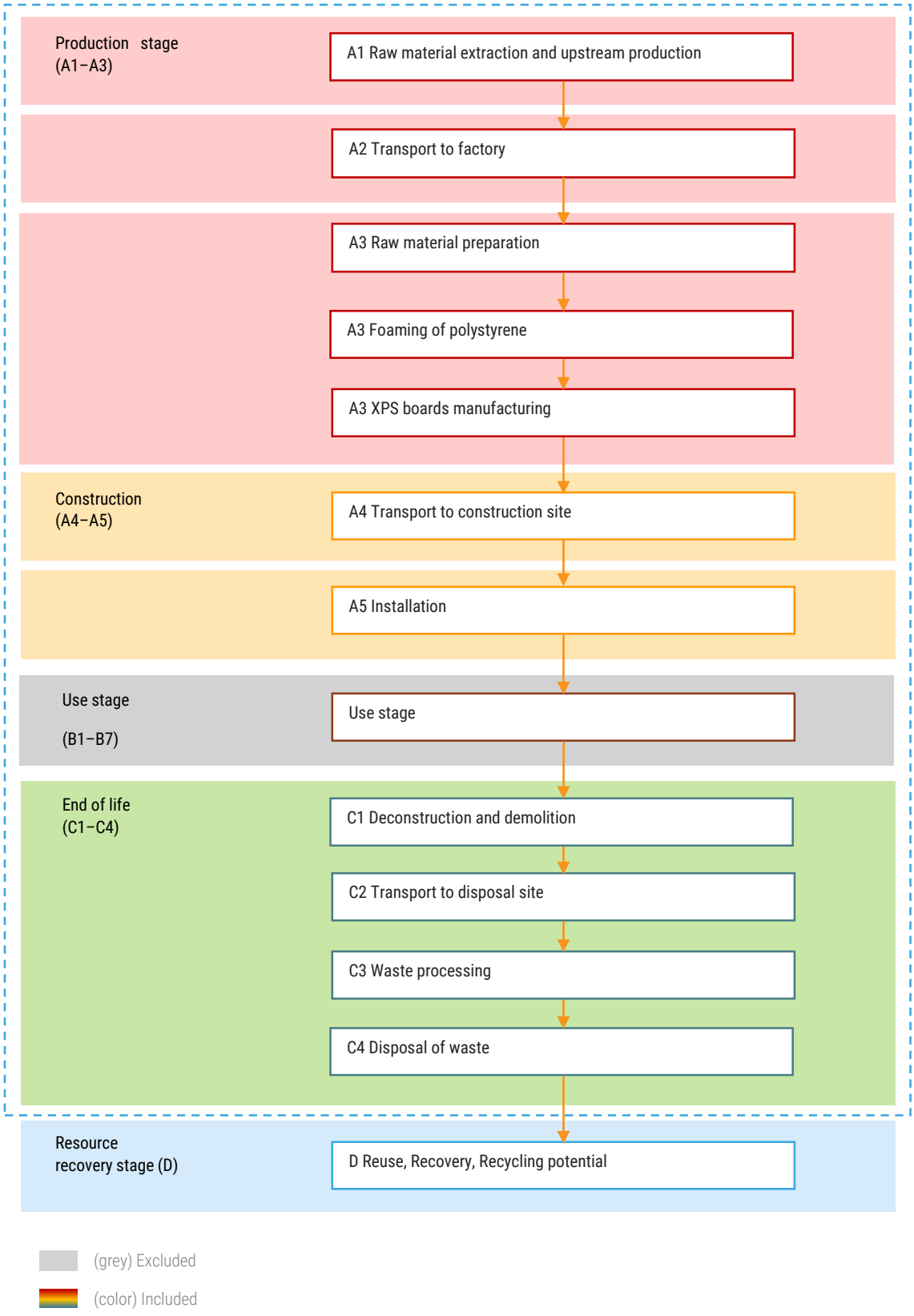
SYSTEM DIAGRAM:

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	Transport	Construction installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction, 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		RU	GLO	GLO	-	-	-	-	-	-	-	GLO	GLO	GLO	GLO	GLO
Specific data used	>90% GWP-GHG			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Varieties of products	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Varieties of sites	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-

X = declared modules; MND = the module is not declared; GLO = Global, RU = Russia

Cut-off criteria:

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

The study does not exclude any hazardous materials or substances.

It can be assumed that the processes ignored would each have contributed less than 1% 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 EN 15804:2012+A2:2019, 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 2021 production figures for XPS boards PENOPLEX® manufactured by LLC "PENOPLEX SPb".
- Technological coverage reflects the physical reality for the declared products.

TABLE 5. INDICATORS OF REPRESENTATIVENESS OF DATA QUALITY

Technological representativeness	Time representativeness	Geographical representativeness	Total rating
3.85	3.98	4.04	3.96

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 EN 15804:2012+A2:2019.

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, ethyl alcohol).

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

- talc concentrate (improves strength characteristics-compression at 10% deformation, bending, density)

- dye concentrate (coloring intensity only)

- flame retardant concentrate (reduces the flammability of polystyrene foam boards)

- foaming agents (carbon dioxide, ethyl alcohol (improves strength characteristics-compression at 10% deformation, 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 2%.

Electricity production

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

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

Type of information	Description
Location	Russian Federation
Geographical representativeness description	Split of energy sources in kWh Hydro: 19.39% Nuclear: 19.63% Hard coal and lignite: 15.27% Natural gas: 45.52% Other: 0.19%
Reference year	2020
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 EURO5 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 b) Freight train

Distance* supply of XPS boards PENOPLEX® with compressive strength ≤ 200 kPa	Trucks 502.5 km Freight trains: 4.6 km
Distance* supply of XPS boards PENOPLEX® with compressive strength 200-500 kPa	Trucks 635.8 km Freight trains: 164.3 km
Distance* supply of XPS boards PENOPLEX® with compressive strength ≥ 500 kPa	Trucks 653.2 km Freight trains: 441.8 km
Capacity utilization (including empty returns)	100%
Bulk density of of XPS boards PENOPLEX® with compressive strength ≤200 kPa	1.0563 kg/m^2
Bulk density of of XPS boards PENOPLEX® with compressive strength 200-500 kPa	1.4870 kg/m^2
Bulk density of of XPS boards PENOPLEX® with compressive strength ≥500 kPa	1.8943 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 PENOPLEX® 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 0.026 kg/m^2 LDPE film
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 XPS board PENOPLEX® 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; EURO5, 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.

Extruded polystyrene foam boards PENOPLEX® is 100% recyclable.

ENVIRONMENTAL INFORMATION

XPS BOARDS PENOPLEX® WITH COMPRESSIVE STRENGTH ≤ 200 KPA

The following environmental impact corresponds to the life cycle of 1 m^2 XPS boards PENOPLEX® with a thickness of 50 mm and a compressive strength ≤200 kPa. For PENOPLEX® 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

Results per declared unit											
Product stage		Construction process stage			Use stage		End of life stage				Resource recovery stage
Indicator	Unit	A1	A2	A3	A4	A5	C1	C2	C3	C4	D
GWP-total	kg CO_2 eq.	3,70E+00	3,84E-01	1,21E+00	8,86E-02	9,80E-04	0.00E+00	8,72E-03	8.81E-02	2.41E-03	-1,04E+00
GWP-fossil	kg CO_2 eq.	3,70E+00	3,83E-01	1,21E+00	8,84E-02	9,80E-04	0.00E+00	8,70E-03	8.83E-02	2.41E-03	-1,04E+00
GWP-biogenic	kg CO_2 eq.	-1,26E-02	3,50E-04	2,50E-04	8,00E-05	7,69E-07	0.00E+00	7,90E-06	-2.10E-04	1.01E-06	-5,52E-03
GWP-luluc	kg CO_2 eq.	1,65E-02	1,50E-04	3,00E-03	3,47E-05	3,13E-07	0.00E+00	3,41E-06	2.02E-05	2.51E-06	-1,83E-03
ODP	kg CFC 11 eq.	9,10E-09	8,94E-08	8,89E-08	2,04E-08	2,20E-10	0.00E+00	2,03E-09	4.80E-09	4.80E-10	-3.94E-08
AP	mol H^+ eq.	1,45E-02	3,54E-03	1,77E-03	7,25E-04	8,64E-06	0.00E+00	8,00E-05	4.90E-04	2.57E-05	-5.00E-03
EP-freshwater	kg P eq.	5,50E-05	2,49E-05	5,60E-04	5,73E-06	6,03E-08	0.00E+00	5,65E-07	3.11E-05	1.25E-07	-4.65E-04
EP-marine	kg N eq.	2,34E-03	6,70E-04	9,70E-04	1,10E-04	1,94E-06	0.00E+00	1,52E-05	9.66E-05	1.03E-05	-1.05E-03
EP-terrestrial	mol N eq.	2,44E-02	7,27E-03	3,17E-03	1,18E-03	2,11E-05	0.00E+00	1,65E-04	1.01E-03	1.10E-04	-9.76E-03
POCP	kg NMVOC eq.	1,01E-02	2,09E-03	1,19E-02	3,65E-04	6,19E-06	0.00E+00	4,73E-05	2.80E-04	3.17E-05	-2.76E-03
ADP-minerals&metals*	kg Sb eq.	7,89E-07	1,34E-06	1,19E-06	3,08E-07	2,71E-09	0.00E+00	3,05E-08	4.38E-07	1.24E-09	-1.56E-06
ADP-fossil*	MJ	7,86E+01	5,84E+00	2,00E+01	1,34E+00	1,44E-02	0.00E+00	1,33E-01	9.32E-01	3.20E-02	-1.27E+01
WDP*	m^3	2,28E+00	1,96E-02	2,72E-01	4,53E-03	4,36E-05	0.00E+00	4,45E-04	1.40E-02	5.86E-05	-2.72E-01

* 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	A4	A5	C1	C2	C3	C4	D
GWP-GHG	kg CO2 eq.	3,55E+00	3,80E-01	1,19E+00	8,77E-02	9,70E-04	0.00E+00	8,64E-03	8.75E-02	2.37E-03	-1,02E+00

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	A4	A5	C1	C2	C3	C4	D
PERE	MJ	1,49E+00	8,23E-02	1,17E+00	1,92E-02	1,83E-04	0.00E+00	1,87E-03	3.99E-02	2.61E-04	-1,46E+00
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
PERT	MJ	1,49E+00	8,23E-02	1,17E+00	1,92E-02	1,83E-04	0.00E+00	1,87E-03	3.99E-02	2.61E-04	-1,46E+00
PENRE	MJ	8,46E+01	6,20E+00	2,15E+01	1,42E+00	1,53E-02	0.00E+00	1,41E-01	9.56E-01	3.39E-02	-1,35E+01
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
PENRT	MJ	8,46E+01	6,20E+00	2,15E+01	1,42E+00	1,53E-02	0.00E+00	1,41E-01	9.56E-01	3.39E-02	-1,35E+01
SM	kg	1.06E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	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
FW	m^3	5,35E-02	6,50E-04	1,79E-02	1,50E-04	1,44E-06	0.00E+00	1,48E-05	2.80E-04	1.92E-06	-7,22E-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 and output flows

Waste production

Results per functional or declared unit											
Indicator	Unit	A1	A2	A3	A4	A5	C1	C2	C3	C4	D
Hazardous waste disposed	kg	1,36E-06	1,53E-05	2,02E-05	3,49E-07	3,77E-08	0.00E+00	6,93E-07	3.04E-06	8.45E-08	-5,28E-06
Non-hazardous waste disposed	kg	4,67E-02	3,00E-01	9,14E-01	6,86E-02	8,99E-02	0.00E+00	1,37E-02	9.89E-03	8.97E-01	-7,42E-02
Radioactive waste disposed	kg	2,34E-06	3,95E-05	6,75E-05	9,06E-06	9,71E-08	0.00E+00	1,79E-06	2.40E-06	2.13E-07	-3,54E-05

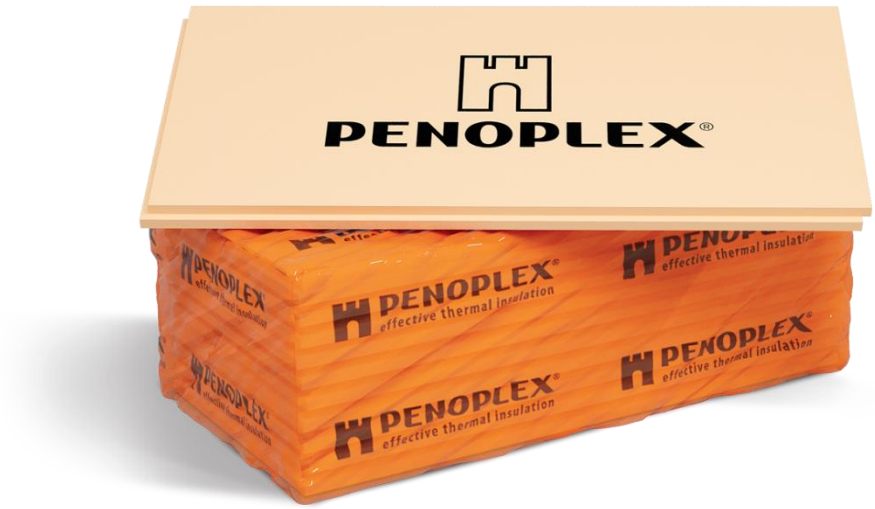
Output flows

Results per functional or declared unit											
Indicator	Unit	A1	A2	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
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	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
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
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

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 CO_2.



XPS BOARDS PENOPLEX® WITH COMPRESSIVE STRENGTH 200-500 KPA

The environmental impact indicated below corresponds to the life cycle of 1m^2 XPS boards PENOPLEX® of 50 mm thickness and a compressive strength of 200-500 kPa. For XPS boards PENOPLEX® with thicknesses other than the reference values, the environmental impact can be calculated using equation (1) in Additional information chapter.

Potential environmental impact – mandatory indicators according to EN 15804:2012+A2:2019

Results per functional or declared unit											
Product stage		Construction process stage			Use stage		End of life stage				Resource recovery stage
Indicator	Unit	A1	A2	A3	A4	A5	C1	C2	C3	C4	D
GWP-total	kg CO_2 eq.	5,54E+00	4,79E-01	2,96E-01	1,69E-01	1,27E-03	0.00E+00	1,23E-02	1.24E-01	3.40E-03	-1,04E+00
GWP-fossil	kg CO_2 eq.	5,52E+00	4,78E-01	2,95E-01	1,69E-01	1,27E-03	0.00E+00	1,23E-02	1.24E-01	3.40E-03	-1,04E+00
GWP-biogenic	kg CO_2 eq.	-1,79E-02	4,35E-04	2,10E-04	2,30E-04	9,91E-07	0.00E+00	1,11E-05	-2.90E-04	1.43E-06	-5,52E-03
GWP-luluc	kg CO_2 eq.	3,30E-02	1,85E-04	6,50E-04	8,00E-05	4,04E-07	0.00E+00	4,80E-06	2.84E-05	3.53E-07	-1,83E-03
ODP	kg CFC 11 eq.	5,19E-08	1,12E-07	1,87E-08	3,78E-08	2,83E-10	0.00E+00	2,86E-09	6.76E-09	6.76E-10	-3,94E-08
AP	mol H^+ eq.	3,74E-02	4,42E-03	7,10E-04	1,44E-03	1,11E-05	0.00E+00	1,15E-04	6.90E-04	3.62E-05	-5,00E-03
EP-freshwater	kg P eq.	4,63E-03	3.11E-05	1,20E-04	1,24E-05	7,77E-08	0.00E+00	7,96E-07	4.38E-05	1.76E-07	-4,65E-04
EP-marine	kg N eq.	5,51E-03	8,35E-04	2,50E-04	2,20E-04	2,50E-06	0.00E+00	2,14E-05	1.40E-04	1.46E-05	-1,05E-03
EP-terrestrial	mol N eq.	6,49E-02	9,08E-03	9,90E-04	2,29E-03	2,72E-05	0.00E+00	2,30E-04	1.42E-03	1.60E-04	-9,76E-03
POCP	kg NMVOC eq.	2,02E-02	2,61E-03	3,08E-03	7,25E-04	7,98E-06	0.00E+00	6,50E-05	3.90E-04	4.46E-05	-2,76E-03
ADP-minerals&metals*	kg Sb eq.	5,03E-02	1,68E-06	5,25E-07	6,01E-07	3,49E-09	0.00E+00	4,30E-08	6.16E-07	1.74E-09	-1,56E-06
ADP-fossil*	MJ	1,14E+02	7,29E+00	5,63E+00	2,63E+00	1,86E-02	0.00E+00	1,87E-01	1.31E+00	4.50E-02	-1,27E+01
WDP*	m^3	3,41E+00	2,45E-02	7,82E-02	1,04E-02	5,62E-05	0.00E+00	6,30E-04	1.97E-02	8.25E-05	-2,72E-01

* 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 functional or declared unit											
Indicator	Unit	A1	A2	A3	A4	A5	C1	C2	C3	C4	D
GWP-GHG	kg CO_2 eq.	5,33E+00	4,75E-01	2,89E-01	1,67E-01	1,25E-03	0.00E+00	1,22E-02	1.23E-01	3.34E-03	1,02E+00

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	A4	A5	C1	C2	C3	C4	D
PERE	MJ	3,01E+00	1,03E-01	2,64E-01	1,90E-01	2,37E-04	0.00E+00	2,64E-03	5.71E-02	3.74E-04	-1,46E+00
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
PERT	MJ	3,01E+00	1,03E-01	2,64E-01	1,90E-01	2,37E-04	0.00E+00	2,64E-03	5.71E-02	3.74E-04	-1,46E+00
PENRE	MJ	1,22E+02	7,74E+00	6,06E+00	2,78E+00	1,97E-02	0.00E+00	1,98E-01	1.35E+00	4.78E-02	-1,35E+01
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
PENRT	MJ	1,22E+02	7,74E+00	6,06E+00	2,78E+00	1,97E-02	0.00E+00	1,98E-01	1.35E+00	4.78E-02	-1,35E+01
SM	kg	1,49E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	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
FW	m^3	8,13E-02	8,15E-04	4,19E-03	3,40E-04	1,86E-06	0.00E+00	2,08E-05	4.00E-04	2.71E-06	-7,20E-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 and output flows

Waste production

Results per functional or declared unit											
Indicator	Unit	A1	A2	A3	A4	A5	C1	C2	C3	C4	D
Hazardous waste disposed	kg	1,12E-05	1,90E-05	4,30E-06	6,53E-06	4,86E-08	0.00E+00	4,88E-07	4.28E-06	1.19E-07	-5,28E-06
Non-hazardous waste disposed	kg	2,48E-01	3,75E-01	1,20E-02	1,24E-01	1,16E-01	0.00E+00	9,61E-03	1.39E-02	1.26E+00	-7,42E-02
Radioactive waste disposed	kg	3,03E-05	4,93E-05	1,42E-05	1,80E-05	1,25E-07	0.00E+00	1,26E-06	3.38E-06	3.00E-07	-3,54E-05

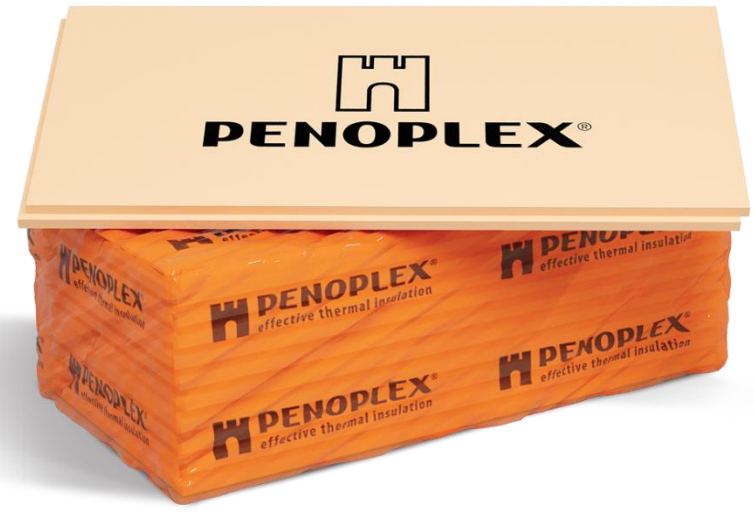
Output flows

Results per functional or declared unit											
Indicator	Unit	A1	A2	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
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	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
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
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

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 CO_2.



XPS BOARDS PENOPLEX® WITH COMPRESSIVE STRENGTH ≥ 500 KPA

The environmental impact indicated below corresponds to the life cycle of 1m^2 XPS boards PENOPLEX® of 50 mm thickness and a compressive strength of ≥ 500 kPa. For XPS boards PENOPLEX® with thicknesses other than the reference values, the environmental impact can be calculated using equation (1) in Additional information chapter.

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

Results per functional or declared unit											
Product stage		Construction process stage			Use stage		End of life stage				Resource recovery stage
Indicator	Unit	A1	A2	A3	A4	A5	C1	C2	C3	C4	D
GWP-total	kg CO_2 eq.	6,81E+00	6,03E-01	1,50E-01	2,46E-01	1,55E-03	0.00E+00	1,56E-02	1.58E-01	4.33E-03	-1,69E+00
GWP-fossil	kg CO_2 eq.	6,78E+00	6,02E-01	1,50E-01	2,46E-01	1,54E-03	0.00E+00	1,56E-02	1.58E-01	4.33E-03	-1,68E+00
GWP-biogenic	kg CO_2 eq.	-2,90E-02	5,45E-04	2,10E-04	4,85E-04	1,21E-06	0.00E+00	1,42E-05	-3.80E-04	1.82E-06	-8,97E-03
GWP-luluc	kg CO_2 eq.	5,91E-02	2,35E-04	2,60E-04	1,50E-04	4,92E-07	0.00E+00	6,11E-06	3.62E-05	4.49E-07	-2,97E-03
ODP	kg CFC 11 eq.	4,33E-08	1,41E-07	7,84E-09	5,26E-08	3,45E-10	0.00E+00	3,64E-09	8.61E-09	8.61E-10	-6,40E-08
AP	mol H^+ eq.	2,76E-02	5,56E-03	5,80E-04	2,20E-03	1,36E-05	0.00E+00	1,45E-04	8.80E-04	4.61E-05	-3,04E-02
EP-freshwater	kg P eq.	1,15E-04	3,91E-05	5,28E-05	2,12E-05	9,47E-08	0.00E+00	1,01E-06	5.58E-05	2.24E-07	-7,55E-04
EP-marine	kg N eq.	4,80E-03	1,05E-03	1,20E-04	3,45E-04	3,04E-06	0.00E+00	2,72E-05	1.70E-04	1.85E-05	-1,70E-03
EP-terrestrial	mol N eq.	4,77E-02	1,14E-02	6,90E-04	3,43E-03	3,32E-05	0.00E+00	2,95E-04	1.81E-03	2.00E-04	-1,50E-02
POCP	kg NMVOC eq.	1,93E-02	3,28E-03	9,80E-04	1,12E-03	9,73E-06	0.00E+00	8,50E-05	4.90E-04	5.68E-05	-4,48E-03
ADP-minerals&metals*	kg Sb eq.	2,32E-06	2,11E-06	4,40E-07	9,01E-07	4,25E-09	0.00E+00	5,47E-08	7.85E-07	2.22E-09	-2,53E-06
ADP-fossil*	MJ	1,43E+02	9,18E+00	3,34E+00	3,97E+00	2,26E-02	0.00E+00	2,29E-01	1.67E+00	5.73E-02	-2,06E+01
WDP*	m^3	4,03E+00	3,09E-02	4,79E-02	1,87E-02	6,85E-05	0.00E+00	8,00E-04	2.51E-02	1.10E-04	-3,40E-01

* 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 functional or declared unit											
Indicator	Unit	A1	A2	A3	A4	A5	C1	C2	C3	C4	D
GWP-GHG	kg CO_2 eq.	6,56E+00	5,98E-01	1,47E-01	2,44E-01	1,53E-03	0.00E+00	1,55E-02	1.57E-01	4.25E-03	-1,65E+00

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	A4	A5	C1	C2	C3	C4	D
PERE	MJ	3,04E+00	1,29E-01	1,15E-01	1,14E-01	2,90E-04	0.00E+00	3,36E-03	7.27E-02	4.76E-04	2,37E+00
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
PERT	MJ	3,04E+00	1,29E-01	1,15E-01	1,14E-01	2,90E-04	0.00E+00	3,36E-03	7.27E-02	4.76E-04	2,37E+00
PENRE	MJ	1,54E+02	9,75E+00	3,59E+00	4,20E+00	2,40E-02	0.00E+00	2,53E-01	1.76E+00	6.08E-02	2,20E+01
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
PENRT	MJ	1,54E+02	9,75E+00	3,59E+00	4,20E+00	2,40E-02	0.00E+00	2,53E-01	1.76E+00	6.08E-02	2,20E+01
SM	kg	9,47E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	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
FW	m^3	9,56E-02	1,03E-03	1,96E-03	6,10E-04	2,27E-06	0.00E+00	2,65E-05	5.10E-04	3.45E-06	1,17E-02

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 and output flows

Waste production

Results per functional or declared unit											
Indicator	Unit	A1	A2	A3	A4	A5	C1	C2	C3	C4	D
Hazardous waste disposed	kg	7,89E-06	2,40E-05	1,79E-06	9,23E-06	5,93E-08	0.00E+00	6,21E-07	5.45E-06	1.51E-07	-8,58E-06
Non-hazardous waste disposed	kg	1,92E-01	4,73E-01	7,44E-03	1,67E-01	1,41E-01	0.00E+00	1,22E-02	1.77E-02	1.61E+00	-1,21E-01
Radioactive waste disposed	kg	1,70E-05	6,00E-05	5,83E-06	2,78E-05	1,53E-07	0.00E+00	1,61E-06	4.30E-06	3.82E-07	-6,00E-05

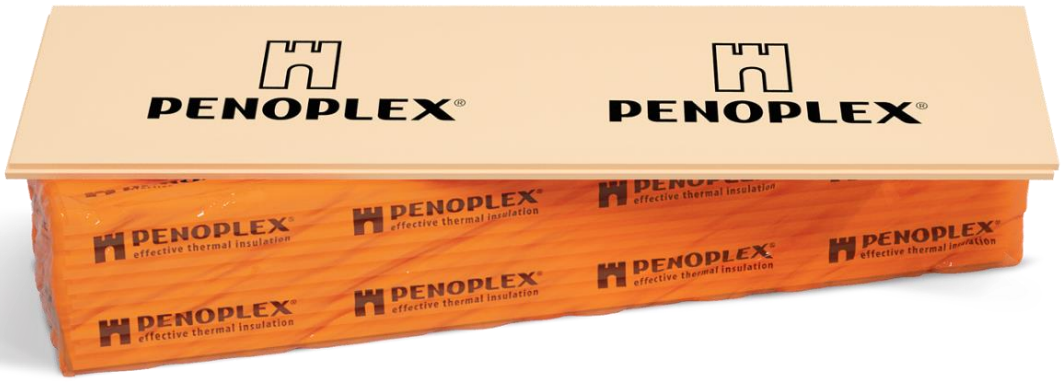
Output flows

Results per functional or declared unit											
Indicator	Unit	A1	A2	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
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	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
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
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

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 CO_2.



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)

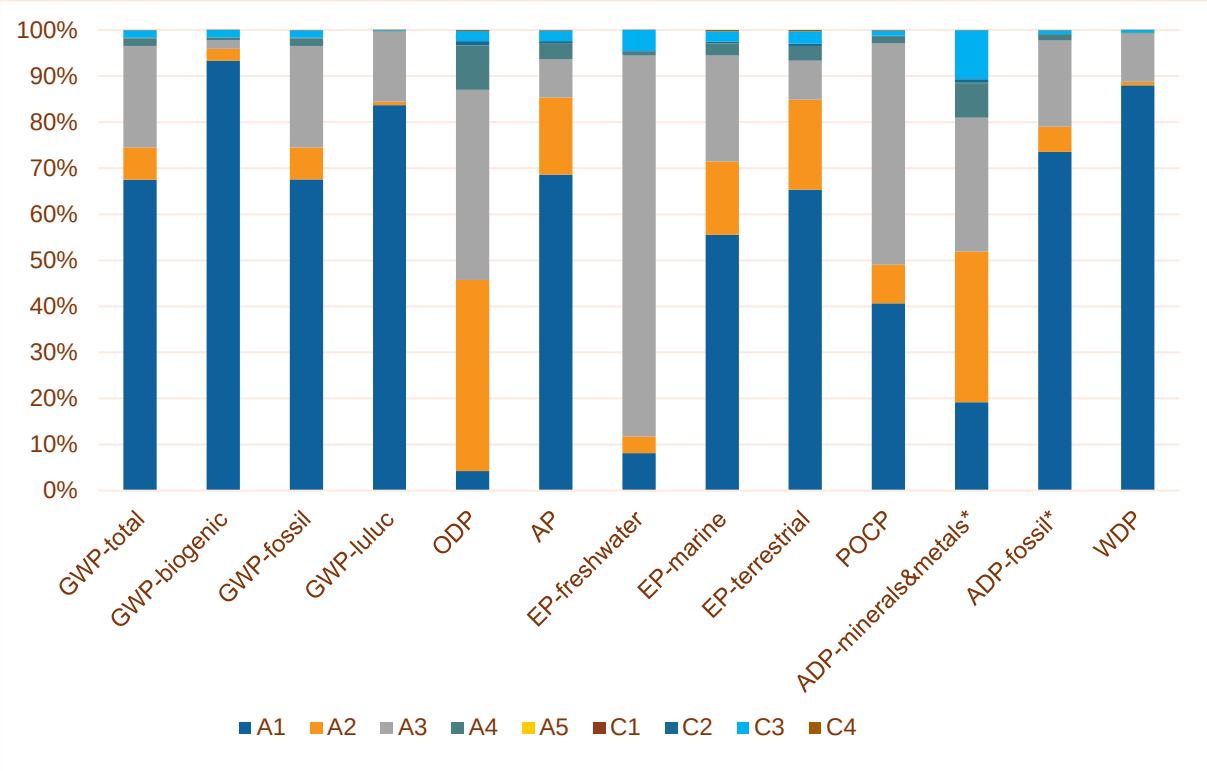
- **Construction stage:** A4 (Transportation), A5 (Installation of products)

- **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. XPS boards PENOPLEX® with compressive strength ≤ 200 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.

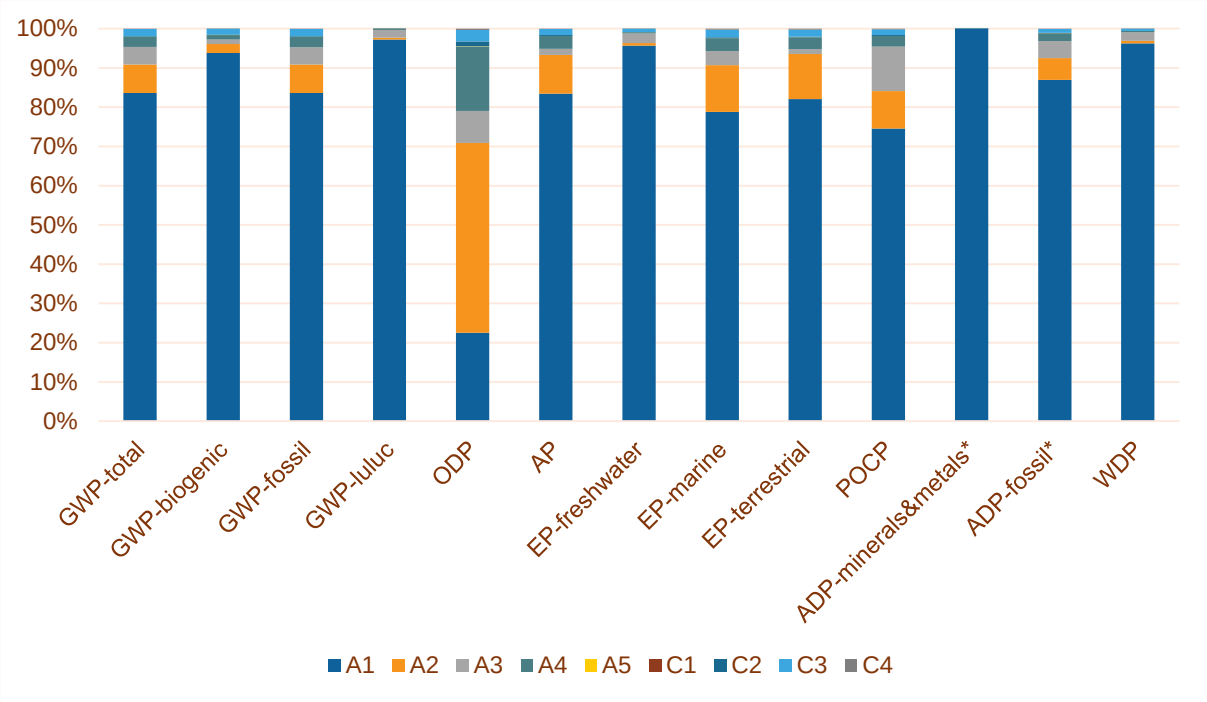
As it can be seen from the graph (Figure 1), the stages A1-A3 are the Life Cycle Stages with the highest impact for all analysed categories. A1 demonstrates the vital influence for majority of ecological indicators, representing up to 94% for Biogenic GWP. Depletion potential of the stratospheric ozone layer (ODP) has the most impact during A2 and A3 stages, accounting for 41%. Eutrophication potential for freshwater (EP-freshwater) has the most significant influence on environment for A3 module – 83%. Almost the same influence has Abiotic depletion potential for non-fossil resources (ADP-minerals&metals) for all the 3 modules of Production stage, however the indicator for Raw Material (A1) stage is slightly lower (19% vs 32%) 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 41% for A2 and 9% 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 1%).

End of life stages (C2, C3, C4) have almost negligible influence on the total life cycle results. The influence of Abiotic depletion potential for non-fossil resources (ADP-minerals&metals) parameter only has a tangible influence, accounting for almost 11%. All the rest parameters have less than 5% impact for XPS boards PENOPLEX® with compressive strength ≤ 200 kPa.

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

Figure 2. XPS boards PENOPLEX® with compressive strength 200-500 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 follows from the graph (Figure 2), the stages A1-A3 are the Life Cycle Stages with the highest impact for all analysed categories for XPS boards PENOPLEX® with compressive strength 200-500 kPa as well. A1 demonstrates the vital influence again, however, being an exception, Depletion potential of the stratospheric ozone layer (ODP) accounts around 23% for A1 stage, while A2 Transportation stage represents around 49% being the most influential during A2 module. The product has the least environmental impact during the A3 module.

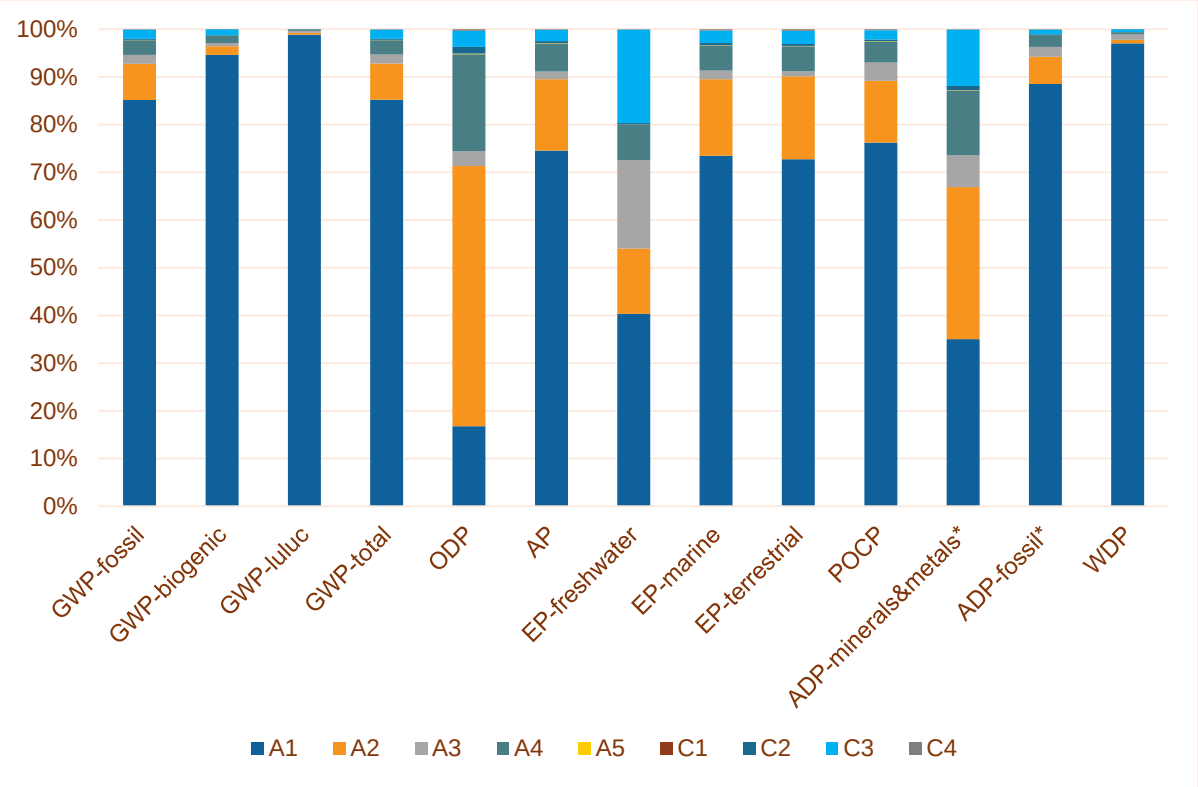
The graph illustrates that the influence of A2 module is vastly superior to A4 module for all analysed categories. Total Global Warming potential (GWP-total) of the A2 module exceeds GWP-total for A4 modules by more than 2 times, accounting 7% and 2.5% respectively. Depletion potential of the stratospheric ozone layer (ODP) for the A4 module has also the vast effect - 16%, and Abiotic depletion potential for non-fossil resources (ADP-minerals&metals) has the least impact during transportation (both A2 and A4) – less than 1%.

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

End of life stages (C2, C3, C4) has almost negligible influence on the total life cycle results. The parameters of C2 and C4 stages have less than 5% impact for XPS boards PENOPLEX® with a compressive strength of 200-500 kPa. During C3 stage almost all the ecological indicators have around 2% environmental impact.

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

Figure 3. XPS boards PENOPLEX® with compressive strength ≥500 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.

Figure 3 demonstrates, that XPS boards PENOPLEX® with compressive strength ≥500 kPa the stages A1-A3 are the Life Cycle Stages with the highest impact for all analysed categories as well. This product type shows the same trend as another XPS boards PENOPLEX® types and shows the huge influence of A1 stage, representing between 35% for Abiotic depletion potential for non-fossil resources (ADP-minerals&metals) and around 85% for Total GWP. Depletion potential of the stratospheric ozone layer (ODP) is an exception and has the maximum impact on the environment in stage A2 (54%).

The graph illustrates that the influence of A2 exceeds by more than 2 times the A4 module. Depletion potential of the stratospheric ozone layer (ODP) has the major influence for both of the stages and the least impact of Water use (WDP) during transportation (both A2 and A4) – less than 1%.

Module A5 has almost no impact on the environment compared to the production stage A1-A3 (less than 1%) as well.

End of life stages (C2, C4) have almost negligible influence on the total life cycle results. All the parameters have less than 5% impact for XPS boards PENOPLEX® with compressive strength ≥500 kPa. During C3 module Eutrophication potential of freshwater (EP-freshwater) has quite a significant impact on surrounding, accounting for almost 20%.

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

ADDITIONAL INFORMATION

The following environmental impact corresponds to the life cycle of m^2 XPS boards PENOPLEX® with a thickness of 50 mm. For PENOPLEX® boards with thickness different from the reference values, the environmental impact can be calculated using the following equation:

$$I_{adap} = I_{ref} \cdot \frac{t_{adap}}{t_{ref}} \qquad (1)$$

I_{adap} - an adaptable indicator of environmental impact;
I_{ref} - reference environmental impact indicator (for a thickness of 50 mm);
t_{adap} – adaptable indicator of board thickness;
t_{ref} - a reference indicator of the thickness of the board (50 mm).

The following table shows the conversion factors required to obtain environmental impact data for each of the commercialized thicknesses:

Thickness (mm)	Ratio (t)
20	0.4
22.5	0.45
30	0.6
40	0.8
50	1
52	1.04
54	1.08
60	1.2
70	1.4
80	1.6
100	2
120	2.4
150	3

Exceptions are categories, which are not mainly driven by raw material consumption respective mass. That applies to photochemical ozone creation potential (POCP) and ozone depletion potential (ODP). These two categories cannot be assessed that way since they are not correlate with the mass of the product.

REFERENCES

ISO 14025:2010 labels and declarations — Type III environmental declarations — Principles and procedures.

ISO 14020:2000 Environmental labels and declarations - General principles.

BS EN 15804:2012+A2:2019. Sustainability of construction works — Environmental product declarations – Core rules for the product category of construction products.

ISO 14040:2006. Environmental management — Life cycle assessment — Principles and framework.

ISO 14044:2006. Environmental management — Life cycle assessment — Requirements and guidelines.

The International EPD® System. PCR 2019:14 Construction products and construction services.

The International EPD® System. PCR 2019:14-c-PCR-005 c-PCR-005 Thermal Insulation products (EN 16783) (2019-12-20)

The International EPD® System. General Programme Instruction v. 3.01 for the International EPD® System.