

ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804+A2

Owner of the Declaration	Ravago Building Solutions
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-RAV-20220157-CBD1-EN
Issue date	04.01.2023
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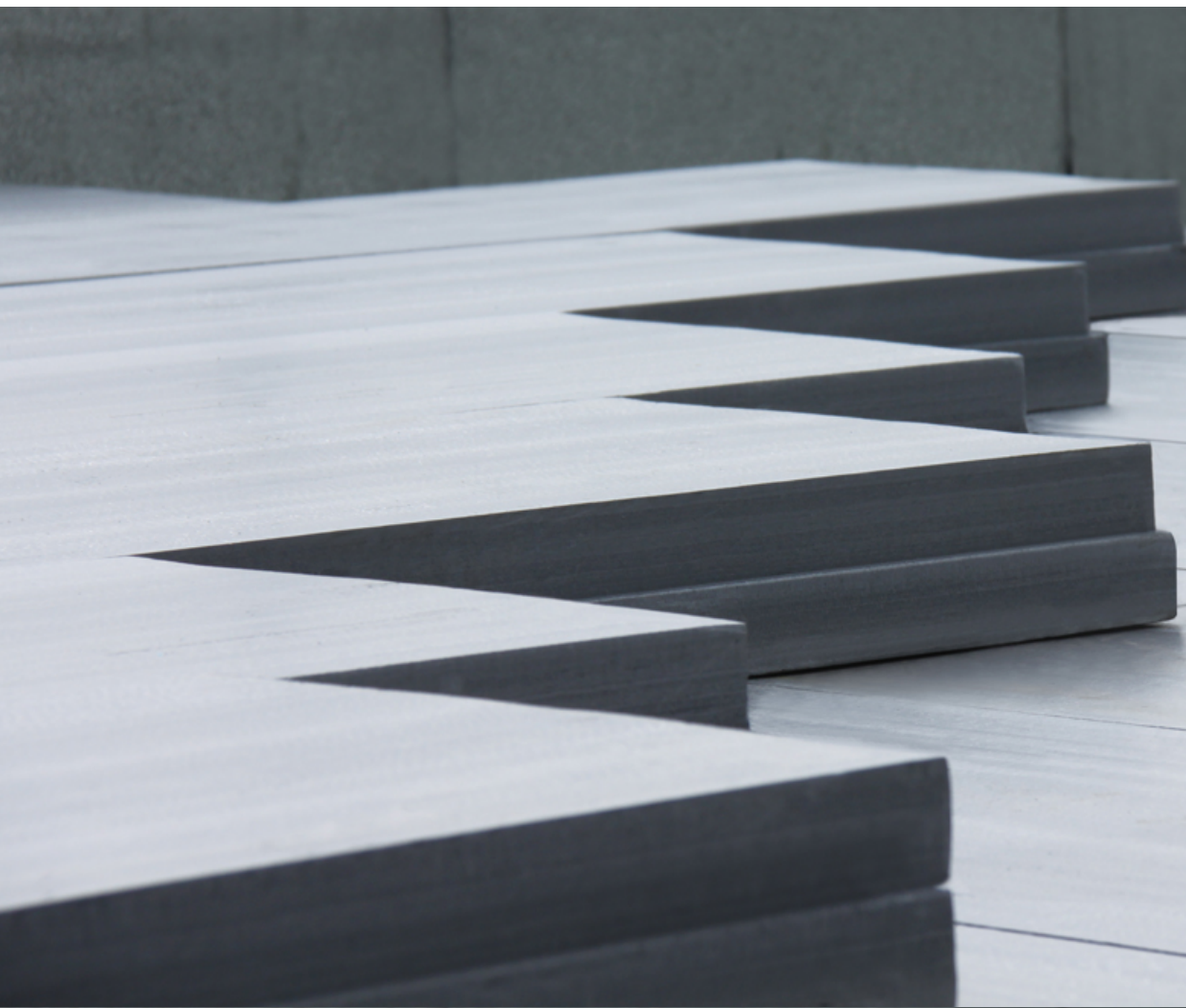
RAVATHERM™ XPS (X) PLUS / ULTRA RAVAGO BUILDING SOLUTIONS

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General Information

RAVAGO BUILDING SOLUTIONS	RAVATHERM™ XPS (X) PLUS/ULTRA						
<p>Programme holder IBU – Institut Bauen und Umwelt e.V. Hegelplatz 1 10117 Berlin Germany</p>	<p>Owner of the declaration Ravago Building Solutions Germany GmbH Value Park Y51 06258 Schkopau Germany</p>						
<p>Declaration number EPD-RAV-20220157-CBD1-EN</p>	<p>Declared product / declared unit RAVATHERM™ XPS (X) PLUS and ULTRA extruded polystyrene foam boards produced by RBS. The EPD applies to 1 m³ of XPS board, with an average density of 41.9 kg/m³.</p>						
<p>This declaration is based on the product category rules: Insulating materials made of foam plastics, 01.2019 (PCR checked and approved by the SVR)</p>	<p>Scope: The data have been provided by the three ISO 14001 certified factories of Ravago Building Solutions producing these products in France, Germany and the UK for the year 2020.</p>						
<p>Issue date 04.01.2023</p>	<p>The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences. The EPD was created according to the specifications of EN 15804+A2. In the following, the standard will be simplified as EN 15804.</p>						
<p>Valid to 03.01.2028</p>	<p>Verification</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="2" style="padding: 2px;">The standard EN 15804 serves as the core PCR</td> </tr> <tr> <td colspan="2" style="padding: 2px;">Independent verification of the declaration and data according to ISO 14025:2011</td> </tr> <tr> <td style="padding: 2px; text-align: center;"><input type="checkbox"/> internally</td> <td style="padding: 2px; text-align: center;"><input checked="" type="checkbox"/> externally</td> </tr> </table>	The standard EN 15804 serves as the core PCR		Independent verification of the declaration and data according to ISO 14025:2011		<input type="checkbox"/> internally	<input checked="" type="checkbox"/> externally
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<div style="text-align: center;">  <hr style="width: 100%;"/> <p style="font-size: small;">Dipl. Ing. Hans Peters (chairman of Institut Bauen und Umwelt e.V.)</p> </div>	<div style="text-align: center;">  <hr style="width: 100%;"/> <p style="font-size: small;">Dr.-Ing. Andreas Ciroth (Independent verifier)</p> </div>						
<div style="text-align: center;">  <hr style="width: 100%;"/> <p style="font-size: small;">Dr. Alexander Röder (Managing Director Institut Bauen und Umwelt e.V.)</p> </div>							

Product

Product description/Product definition

RAVATHERM(TM) XPS PLUS, XPS X PLUS and XPS X ULTRA extruded polystyrene foams (XPS) are thermoplastic insulation foams produced according to /EN 13164/ Building insulation, /EN 14307/ Equipment insulation.

They are available in board shape with a density range from 25 to 50 kg/m³. The boards can be delivered in various compressive strength values from 150 to 700 kPa. To meet the need of various applications the boards are produced with different surfaces: with the extrusion skin, planed, grooved or with thermal embossing. These XPS boards are supplied with different edge treatments such as butt edge, ship lap and tongue and groove. The EPD is related to unfaced XPS products only; Heat lamination of several XPS layers is included. Additional product treatment is not considered.

For the placing on the market of the construction product in the European Union/ European Free

Trade Association (EU/EFTA) (with the exception of Switzerland) *Regulation (EU) No. 305/2011 (CPR)* applies. The product needs a declaration of performance taking into consideration the EN XPS standards (EN 13164/ *Building insulation*, EN 14307 *Equipment insulation*). For the application and use the respective national provisions apply.

Application

The variety of the performance properties of RAVATHERM XPS PLUS, X PLUS and X ULTRA thermal insulation foams make them suitable for use in a large number of applications such as: perimeter insulation, inverted insulation for terrace roofs, insulation of pitched roofs, floor insulation including insulation of highly loaded industrial floors, insulation of thermal bridges for exterior walls, External Thermal Insulation Composite System (ETICS), insulation of cavity walls, agricultural building ceiling insulation, prefabricated elements e.g. building sandwich panels, insulation for building equipment and industrial installations (pipe sections, ...).

Technical Data

Acoustic properties are not relevant for XPS foams. For fire performance these products usually achieve the fire classification Euroclass E according to /EN 13501-1/.

Constructional data

Name	Value	Unit
Gross density	25 - 50	kg/m ³
Compressive strength acc. to EN 826	0.3 - 0.7	N/mm ²
Tensile strength acc. to EN 826	0.2 - 1.2	N/mm ²
Modulus of elasticity acc. to EN 826	20 - 50	N/mm ²
Calculation value for thermal conductivity /EN 12667/ and /EN 13164/ Annex C	0.027 - 0.03	W/(mK)
Water vapour diffusion resistance factor acc. to EN 12088	150	-
Creep behaviour or permanent compressive strength acc. to DIN EN 1606	0.25	N/mm ²
Water absorption after diffusion acc. to EN 12088	1 - 3	Vol.-%

Performance data of the product in accordance with the declaration of performance with respect to its essential characteristics according to /EN 13164:2012+A1:2015/ - Thermal Insulation products for buildings / /EN 14307:2015/ Thermal Insulation products for building equipment and industrial installations.

Base materials/Ancillary materials

RAVATHERMTM XPS (X) PLUS and ULTRA are mostly made of polystyrene (CAS 9003-53-6), blown with fluorinated olefin HFO-1234ze (CAS 29118-24-9), carbon dioxide and halogen-free co-blowing agents

altogether up to 8.5% by weight in relation to the material input.

Basic material	Mass portion
Polystyrene	87 - 90 %
Blowing agents	8 - 10 %
HFO-1234ze	~ 60 %
CO ₂ , and Co-blowing Agents	~ 40 %
Flame retardant	< 2 %
Colorant	< 2 %
Additives (e.g. process aid)	< 1 %

Information that the product does not contain substances listed in the *Candidate List of substances* of very high concern (/REACH/ Regulation) exceeding 0.1%:

This product contains substances listed in the *candidate list* (date:17.01.2022) exceeding 0.1 percentage by mass: no

This product contains other Carcinogenic, Mutagenic, Reptrotoxic (CMR) substances in categories 1A or 1B which are not on the *candidate list*, exceeding 0.1 percentage by mass: no

Biocide products were added to this construction product or it has been treated with biocide products (this then concerns a treated product as defined by the (EU) Ordinance on Biocide Products No. 528/2012): no

Reference service life

The durability of XPS foam is normally at least as long as the lifetime of the building/equipment in/with which it is used or at least 50 years. This is explained by the superior mechanical and water resistance properties of these products.

LCA: Calculation rules

Declared Unit

The declared unit is 1 m³ of the XPS insulation product.

The declared product reflects the average of three of Ravago's sites weighted by production volumes share:

- Rheinmuenster (DE): 43.80 kg/m³ (60%)
- King's Lynn (UK): 40.77 kg/m³ (24%)
- Artix (FR): 36.36 kg/m³ (16%)

The weighted average density of the product is 41.9 kg/m³.

Corresponding conversion factors are listed in the table below.

Declared unit

Name	Value	Unit
Declared unit	1	m ³
Gross density	41.9	kg/m ³

For XPS products with densities or thickness different from the reference density of 41.9 kg/m³, the

environmental impacts may be calculated by linear scaling using the following formular.

$$I_{\text{adap}} = I_{\text{ref}} \times \frac{\rho_{\text{adap}}}{\rho_{\text{ref}}} \times \frac{d_{\text{adap}}}{d_{\text{ref}}}$$

I_{adap} – adapted LCIA indicator or LCI parameter
 I_{ref} – LCIA indicator or LCI parameter for reference density of 41.9 kg/m³

ρ_{adap} – adapted density

ρ_{ref} – reference density of 41.9 kg/m³

d_{adap} – adapted board thickness

d_{ref} – thickness of reference board

System boundary

Type of EPD according to EN 15804: "cradle to gate with options, modules C1–C4, and module D". The following modules are declared: A1–A3, C, D and additional modules: A4 + A5.

Production - Modules A1-A3

The product stage includes:

- Raw material supply (A1)

- Transport to the manufacturer (A2): Transport is considered for up to 92% of the input raw materials
- Manufacturing (A3), including provision of all materials, products and energy, as well as waste processing up to the end-of waste state.

- Transport to EoL (C2)
- Waste processing & disposal (C) with two 100 % scenarios (scenario 1: thermal treatment (C3 and D); scenario 2: landfill (C4))
- Reuse, recovery or recycling potential (D) - beyond system boundary.

Construction stage - Modules A4-A5

The construction process stage includes:

- Transport to the construction site (A4)
- Treatment of packaging material (A5)

End-of-life stage– Modules C1-C4 and D

The end-of-life stage includes

- Manual dismantling (C1)

Comparability

Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to *EN 15804* and the building context, respectively the product-specific characteristics of performance, are taken into account.

Background database: *GaBi ts, CUP2021.2*

LCA: Scenarios and additional technical information

Characteristic product properties Information on biogenic carbon

Information on describing the biogenic Carbon Content at factory gate

Name	Value	Unit
Biogenic carbon content in product	0	kg C
Biogenic carbon content in accompanying packaging	0	kg C

XPS results in benefits, beyond the system boundary, for thermal energy and electricity under European conditions.

The transport to End of Life (C2) is calculated with a distance of 50 km (with 70% utilization).

Name	Value	Unit
Collected separately XPS	41.9	kg
Energy recovery (scenario 1)	41.9	kg
Landfilling (scenario 2)	41.9	kg

The following technical scenario information is required for the declared modules and optional for non-declared modules.

The following technical information is a basis for the declared modules or can be used for developing specific scenarios in the context of a building assessment if modules are not declared (MND). The values refer to the declared unit of 1 m³ XPS product.

Transport to the building site (A4)

Name	Value	Unit
Payload of truck	5	t
Transport distance (weighted average based on production volumes)	476	km
Capacity utilisation (including empty runs)	70	%
Gross density of products transported	41.9	kg/m ³

The transport distance can be modified to project-specific criteria if required by linear scaling.

Installation into the building (A5)

The thermal treatment of the packaging is considered here. The following quantities are produced per m³ of XPS product:

Name	Value	Unit
LDPE packaging film (weighted average based on production volume shares)	0.671	kg

Reuse, recovery and/or recycling potentials (D), relevant scenario information

Module D includes the credits of the thermal and electrical energy generated in Module A5 and C3 due to thermal treatment of packaging and product waste (XPS product).

Avoided burdens have been calculated by the inversion of residual grid mix and thermal energy from natural gas, using European datasets.

A waste incineration plant with R1-value > 0.6 is assumed.

End of life (C1-C4)

For the End of Life stage two different scenarios are considered. One scenario with 100% incineration (scenario 1: C3, D) and one scenario with 100% landfill (scenario 2: C4) are calculated. The incineration of

LCA: Results

The following tables display the environmental relevant results according to /EN 15804/ for 1 m³ XPS board. The two EoL Scenarios are represented in modules C3/1, C4/2, D/1, and D/2. C3/1 and D/1 show the environmental results in case of thermal treatment of XPS product. D/1 covers also the results of the packaging treatment from Module A5. Module C4/2 reflects the landfilling of XPS (for scenario 2 "landfilling" the values in Module D for XPS are 0). Hence. Module D/2 shows only the environmental results of the packaging treatment from module A5.

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; ND = MODULE OR INDICATOR NOT DECLARED; MNR = MODULE NOT RELEVANT)

PRODUCT STAGE					CONSTRUCTION PROCESS STAGE	USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential	
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D	
X	X	X	X	X	ND	ND	MNR	MNR	MNR	ND	ND	X	X	X	X	X	

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: 1 m3 XPS product

Core Indicator	Unit	A1-A3	A4	A5	C1	C2	C3/1	C4/2	D/1	D/2
GWP-total	[kg CO ₂ -Eq.]	1.30E+2	3.28E+0	2.10E+0	0.00E+0	3.36E-1	1.40E+2	2.97E+0	-5.99E+1	-1.09E+0
GWP-fossil	[kg CO ₂ -Eq.]	1.29E+2	3.23E+0	2.10E+0	0.00E+0	3.34E-1	1.40E+2	3.00E+0	-5.96E+1	-1.09E+0
GWP-biogenic	[kg CO ₂ -Eq.]	4.75E-1	-4.15E-3	6.96E-5	0.00E+0	-4.28E-4	4.35E-3	-3.13E-2	-2.95E-1	-1.29E-3
GWP-luluc	[kg CO ₂ -Eq.]	3.78E-2	2.67E-2	1.12E-5	0.00E+0	2.75E-3	7.72E-4	2.51E-3	-4.09E-2	-1.13E-4
ODP	[kg CFC11-Eq.]	4.04E-13	4.16E-16	1.57E-16	0.00E+0	4.29E-17	1.02E-14	7.24E-15	-6.80E-13	-6.23E-15
AP	[mol H ⁺ -Eq.]	2.62E-1	1.01E-2	2.09E-4	0.00E+0	1.04E-3	1.24E-2	8.99E-3	-7.80E-2	-1.21E-3
EP-freshwater	[kg P-Eq.]	1.49E-4	9.66E-6	2.10E-8	0.00E+0	9.97E-7	1.38E-6	5.54E-4	-7.73E-5	-2.53E-7
EP-marine	[kg N-Eq.]	5.97E-2	4.63E-3	4.39E-5	0.00E+0	4.78E-4	2.74E-3	2.04E-3	-2.22E-2	-3.75E-4
EP-terrestrial	[mol N-Eq.]	6.52E-1	5.19E-2	9.80E-4	0.00E+0	5.35E-3	5.82E-2	2.24E-2	-2.37E-1	-4.06E-3
POCP	[kg NMVOC-Eq.]	6.98E-1	9.07E-3	1.31E-4	0.00E+0	9.36E-4	8.06E-3	6.52E-3	-6.22E-2	-1.08E-3
ADPE	[kg Sb-Eq.]	1.29E-5	2.48E-7	2.37E-9	0.00E+0	2.56E-8	1.54E-7	2.06E-7	-9.88E-6	-9.51E-8
ADPF	[MJ]	3.76E+3	4.33E+1	2.56E-1	0.00E+0	4.47E+0	1.63E+1	4.38E+1	-1.04E+3	-2.05E+1
WDP	[m ³ world-Eq deprived]	2.23E+1	2.83E-2	1.93E-1	0.00E+0	2.92E-3	1.14E+1	-3.70E-2	-4.56E+0	-4.44E-2

Caption: GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources; WDP = Water (user) deprivation potential

RESULTS OF THE LCA - INDICATORS TO DESCRIBE RESOURCE USE according to EN 15804+A2: 1 m3 XPS product

Indicator	Unit	A1-A3	A4	A5	C1	C2	C3/1	C4/2	D/1	D/2
PERE	[MJ]	1.14E+2	2.42E+0	5.06E-2	0.00E+0	2.49E-1	3.27E+0	3.18E+0	-2.33E+2	-1.20E+0
PERM	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
PERT	[MJ]	1.14E+2	2.42E+0	5.06E-2	0.00E+0	2.49E-1	3.27E+0	3.18E+0	-2.33E+2	-1.20E+0
PENRE	[MJ]	2.06E+3	4.34E+1	3.11E+1	0.00E+0	4.48E+0	1.69E+3	4.38E+1	-1.04E+3	-2.05E+1
PENRM	[MJ]	1.71E+3	0.00E+0	-3.09E+1	0.00E+0	0.00E+0	-1.68E+3	0.00E+0	0.00E+0	0.00E+0
PENRT	[MJ]	3.77E+3	4.34E+1	2.56E-1	0.00E+0	4.48E+0	1.63E+1	4.38E+1	-1.04E+3	-2.05E+1
SM	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
RSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
NRSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
FW	[m ³]	6.33E-1	2.77E-3	4.52E-3	0.00E+0	2.86E-4	2.68E-1	4.03E-4	-2.29E-1	-2.61E-3

Caption: 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 resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water

RESULTS OF THE LCA – WASTE CATEGORIES AND OUTPUT FLOWS according to EN 15804+A2: 1 m3 XPS product

Indicator	Unit	A1-A3	A4	A5	C1	C2	C3/1	C4/2	D/1	D/2
HWD	[kg]	2.92E-7	2.19E-9	4.56E-11	0.00E+0	2.26E-10	2.92E-9	7.87E-9	-2.32E-7	-3.07E-9
NHWD	[kg]	9.87E-1	6.44E-3	8.30E-3	0.00E+0	6.65E-4	8.06E-1	4.17E+1	-4.83E-1	-4.33E-3
RWD	[kg]	7.89E-2	5.25E-5	1.45E-5	0.00E+0	5.41E-6	9.24E-4	5.08E-4	-7.63E-2	-1.85E-3
CRU	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MFR	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MER	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
EEE	[MJ]	0.00E+0	0.00E+0	4.47E+0	0.00E+0	0.00E+0	2.54E+2	0.00E+0	0.00E+0	0.00E+0
EET	[MJ]	0.00E+0	0.00E+0	7.95E+0	0.00E+0	0.00E+0	4.53E+2	0.00E+0	0.00E+0	0.00E+0

Caption: HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy; EET = Exported thermal energy

RESULTS OF THE LCA – additional impact categories according to EN 15804+A2-optional: 1 m3 XPS product

Indicator	Unit	A1-A3	A4	A5	C1	C2	C3/1	C4/2	D/1	D/2
PM	[Disease Incidence]	2.16E-6	5.40E-8	1.24E-9	0.00E+0	5.57E-9	7.31E-8	8.81E-8	-6.71E-7	-1.11E-8
IRP	[kBq U235-Eq.]	1.18E+1	7.51E-3	2.31E-3	0.00E+0	7.75E-4	1.46E-1	7.29E-2	-1.25E+1	-2.70E-1
ETP-fw	[CTUe]	2.09E+3	3.13E+1	1.16E-1	0.00E+0	3.23E+0	7.83E+0	4.16E+1	-2.18E+2	-3.58E+0
HTP-c	[CTUh]	4.23E-8	6.32E-10	1.34E-11	0.00E+0	6.52E-11	7.75E-10	1.86E-9	-9.82E-9	-1.24E-10
HTP-nc	[CTUh]	1.76E-6	3.70E-8	4.24E-10	0.00E+0	3.82E-9	2.55E-8	1.56E-7	-3.88E-7	-6.01E-9
SQP	[-]	8.08E+1	1.49E+1	7.17E-2	0.00E+0	1.54E+0	4.59E+0	2.98E+0	-1.59E+2	-9.63E-1
Caption	PM = Potential incidence of disease due to PM emissions; IR = Potential Human exposure efficiency relative to U235; ETP-fw = Potential comparative Toxic Unit for ecosystems; HTP-c = Potential comparative Toxic Unit for humans (cancerogenic); HTP-nc = Potential comparative Toxic Unit for humans (not cancerogenic); SQP = Potential soil quality index									

Disclaimer 1 – for the indicator “Potential Human exposure efficiency relative to U235”.

This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

Disclaimer 2 – for the indicators “abiotic depletion potential for non-fossil resources”, “abiotic depletion potential for fossil resources”, “water (user) deprivation potential, deprivation-weighted water consumption”, “potential comparative toxic unit for ecosystems”, “potential comparative toxic unit for humans – cancerogenic”, “Potential comparative toxic unit for humans - not cancerogenic”, “potential soil quality index”.

The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.

References

EN 13164 + A1

EN 13164:2012 + A1:2015 Thermal insulation products for buildings - Factory-made extruded polystyrene foam (XPS) products - Specification

EN 14307

EN 14307:2015 Thermal insulation products for building equipment and industrial installations - Factory-made extruded polystyrene foam (XPS) products - Specification

EN 12667

EN 12667:2001 Thermal performance of building materials and products - Determination of thermal resistance by means of guarded hot plate and heat flow meter methods - Products of high and medium thermal resistance

EN 13501

EN 13501-1:2019-05 Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests

EN 15804

EN 15804+A2:2019+AC:2021 (in press), Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products.

ISO 14025

DIN EN ISO 14025:2011-10, Environmental labels and declarations — Type III environmental declarations — Principles and procedures.

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/PCR Part A/

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/PCR Part B/

PCR – Part B: Requirements of the EPD for Insulating materials made of foam plastics, version 1.7, 2019, Institut Bauen und Umwelt e.V., www.bau-umwelt.com

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