ENVIRONMENTAL PRODUCT DECLARATION

as per *ISO 14025* and *EN 15804+A2*

Owner of the Declaration	IVPU - Industrieverband Polyurethan-Hartschaum e.V.
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
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Issue date	22.09.2022
Valid to	21.09.2027

PU thermal insulation boards made of block foam

IVPU e.V.

Institut Bauen und Umwelt e.V.

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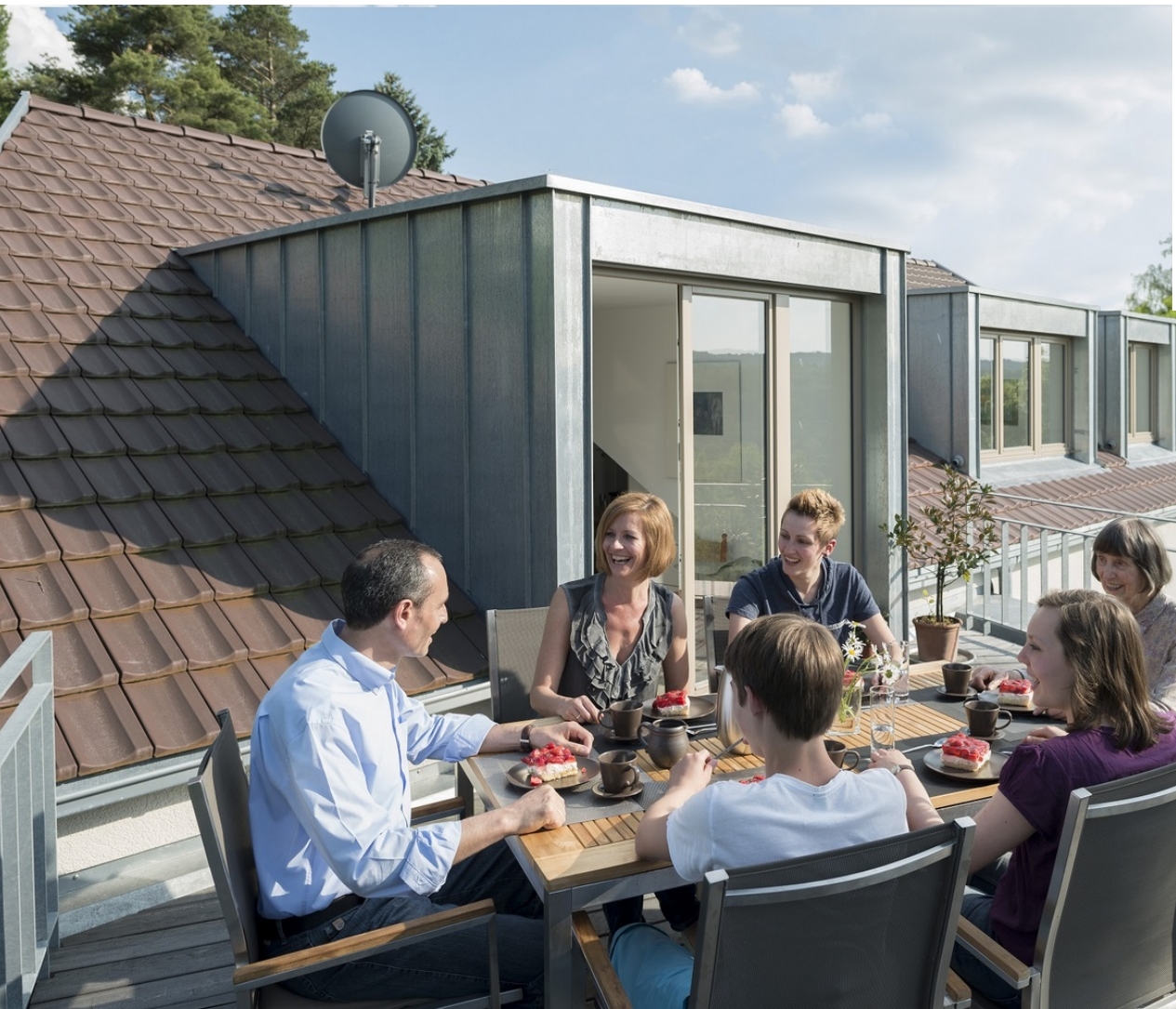

1. General Information

IVPU e.V.

Programme holder

IBU – Institut Bauen und Umwelt e.V.
Hegelplatz 1
10117 Berlin
Germany

Declaration number

EPD-IVP-20220220-IBE1-EN

This declaration is based on the product category rules:

Insulating materials made of foam plastics, 01.08.2021
(PCR checked and approved by the SVR)

Issue date

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Valid to

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PU thermal insulation boards made of block foam

Owner of the declaration

IVPU - Industrieverband Polyurethan-Hartschaum e.V.
Heilbronner Str. 154
70191 Stuttgart
Germany

Declared product / declared unit

1 m^3 installed PU thermal insulation board with a thermal conductivity of 0,023 to 0,027 W/(m·K)

Scope:

This Environmental Product Declaration applies to polyurethane insulation boards made of block foam as manufactured by the IVPU-members Paul Bauder GmbH & Co. KG, puren gmbh and Kingspan Insulation B.V. These IVPU-members represent the majority of companies within the Polyurethane block foam market in Germany and Belgium. This EPD is based on weighted averages which have been determined on the basis of the single values originating from the factories of the above-mentioned manufacturing companies.
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*.

Verification

The standard EN 15804 serves as the core PCR
Independent verification of the declaration and data according to ISO 14025:2011
☐ internally ☒ externally

Prof. Dr. Birgit Grahl,
(Independent verifier)

2. Product

2.1 Product description/Product definition

Polyurethane rigid foam (PU) is a closed-cell foam and factory-made thermal insulation material, which is used in the form of insulation boards in building construction, as well as for insulation of building equipment and industrial installations. The polyurethane insulation material (PU) product family comprises the product variants polyurethane (PUR) and polyisocyanurate (PIR) - see EN13165. This Product Declaration covers PU insulation boards without facings made of block foam.
For marketing purposes within the EU/EFTA (except for Switzerland) the EU Regulation 305/2011 (CPR) applies. The products require a declaration of performance based on specification DIN EN 13165:2016-09, Thermal Insulation Material for Buildings – Factory-produced Products made of Polyurethane (PU) – specification, as well as the CE label. The applications of the products fall under the particular national regulations of the respective countries. For applications in buildings within Germany the required values are listed under DIN 4108-10. Values for thermal- and moisture proofing for technical applications are listed under DIN 4108-4.

2.2 Application

Areas of application for PU rigid foam for thermal insulation in building construction can be found, for example, in tapered insulation for flat roofs. Furthermore, PU rigid foam is used for insulating building equipment and industrial installations.

2.3 Technical Data

The technical specifications of the products within the scope of the EPD shall be listed, including the reference to the test methods/test standards for each specification.

For products with CE marking, the technical specifications must be specified in accordance with information in the declaration of performance. The properties relevant to the product should be specified in the table below. If no information is given for properties, an explanation must be given in the background report to the EPD as to why the property is not relevant to the product.

Constructional data

Name	Value	Unit
Gross density	33.6	kg/m^3
Compressive strength EN 826	≥ 100	N/mm^2
Tensile strength EN 1607	40	N/mm^2
Modulus of elasticity EN 826	≥ 4	MPa
Design value thermal conductivity (Germany)	0,024-0,028	W/(m·K)
Nominal thermal conductivity DIN EN 13165 EN 13165	0,023-0,027	W/(m·K)
Water vapour diffusion resistance factor ISO 10456	40 - 200	-
Creep behaviour or perma-nent compression strength EN 1606	≥ 20	kPa
Maximum service temperature EN 14706	bis +200	°C
Minimum service temperature EN 14308 - Section 4.3.3	bis -200	°C

For determining technical data, testing methods as stated in DIN EN 13165 and DIN EN 14308 are used. The gross density of PU-thermal insulation boards made of block foam for building construction is approximately 32–35 kg/m^3. It is possible to manufacture boards for special applications with a gross density rating of up to 200 kg/m³. At a gross density value of approx. 32 – 35 kg/m^3 the design value thermal conductivity is 0,024 to 0,028 W/(m·K). Nominal compressive stress or nominal compressive strength at 10% deformation is 100 to 150 kPa. Higher compressive strength values of up to 3.000 kPa can be achieved with higher gross density levels. Nominal tensile strength is 100 kPa. Higher tensile strength is possible. The water vapour diffusion resistance factor μ of polyurethane rigid foam is between 40 and 200 according to ISO 10456. Maximum moisture absorption of polyurethane rigid foam at diffusion and condensation is approx. 6 % by volume. Moisture absorption after a freezing and thawing cycle is between 2 % and 7 % by volume.
PU rigid foam products for building equipment and industrial installations are suitable for very low or very high temperatures with some special products ranging from – 200 °C or up to + 200 °C. Polyurethane rigid foam is a distinctive thermos-setting material and therefore cannot be melted.

2.4 Delivery status

Polyurethane insulation boards made of block foam are manufactured with plane-parallel surfaces or as tapered insulation boards as per EN 13165 in a thickness range of 20 to 300 mm. The format of the boards depends on the intended use. The width can be up to 1.250 mm and the length up to 5.000 mm. For building equipment and industrial applications according to EN 14308 Polyurethane insulation can, for example, be manufactured in the shape of a pipe shell.

2.5 Base materials/Ancillary materials

PU rigid foam is formed as a result of a chemical reaction of Poly Methylenediphenyl Diisocyanate (PMDI, approx. 63%) and Polyol (approx. 22%) and by adding low boiling blowing agents (approx. 4%) to the mix.
This Product Declaration refers to insulation boards made of block foam that have been foamed using Pentane, a hydrocarbon. Due to the closed cell structure the blowing agent remains within the foam cells.
The following additives are added: water (approx. 0,4 %), foam stabilisers (surfactants) and catalysts (approx. 3 %), as well as flame retardants (chlorinated or non-chlorinated phosphoric acid esters, approx. 4 - 6 %). The raw materials needed to produce polyurethane rigid foam are mainly extracted from crude oil, while passing through several production stages. Polyols can, as an alternative method, also be produced from plant-based renewables or recycling material. Renewable resources are not part of the life-cycle assessment referred to here.
Polyurethane rigid foam does not contain volatile isocyanates.
The product / at least one sub-product contains substances of the ECHA-list for the approval of substances of very high concern (SVHC) from 01.09.2022 above 0,1 weight percent (w%):
None
The product / at least one sub-product contains further CMR-chemicals from category 1A or 1B, which are not on the candidate list (REACH), above 0.1 weight perpercent (w%) in at least one sub-product:
None
Biocidal products were either added to the building material at hand or the material was treated with biocidal products (thus turning the material into a treated substance under the Biocidal Product Act (EU) Nr. 528/2012):
None

2.6 Manufacture

Polyurethane rigid foam insulation boards made of block foam are produced on block units. In this manufacturing process, the polyurethane reaction mixture pours from a mixing head onto a paper base in a circulating mould (closed on three sides) over a metal conveyer belt where it foams up to a height of approx. 90 cm. After the cooling phase, the rigid foam blocks are cut to boards in the desired dimensions.

Quality control

The declared products (DIN EN 13172) carry the quality seal of the 'Überwachungsgemeinschaft Polyurethan-Hartschaum'. Quality assurance is based on supervision and certification by independent Notified Bodies.

2.7 Environment and health during manufacturing

No additional health protection measures beyond the legally mandated health and safety regulations for industrial businesses are required during the entire manufacturing process. No special environmental protection measures are required besides the laws already in place.

2.8 Product processing/Installation

Polyurethane rigid foam boards can be cut, sawed, milled, and abraded with conventional construction tools and portable power tools. They can be fastened either mechanically or by gluing. It is possible to glue the boards by using either hot-setting or cold-setting adhesives following the manufacturer's recommendations. Alternatively, PU rigid foam boards can be laid loosely, e.g. on floors.
While sawing, abrading, and milling insulation boards, dust is generated. When working on an industrial scale, workers who carry out these processes are to protect themselves by wearing an appropriate dust filter mask (see leaflet of the 'Berufsgenossenschaft der Chemischen Industrie' on respiratory protection). Dust concentration in the air (general limit of dust concentration as per TRGS 900, Technische Regeln für Gefahrstoffe) must not exceed the following values:
- 10 mg/m³ (measured as inhalable fraction)
- 1.25 mg/m³ (measured as alveolar fraction).

Offcuts can be thermally utilised in waste incineration plants or be turned over for recycling.

2.9 Packaging

The insulation material made of PU blocks is stacked on wooden pallets and wrapped in plastic foil. Plastic foils and pallets can be recycled.

2.10 Condition of use

Under normal conditions of use, the material does not undergo any changes in terms of substance during its service life. Polyurethane is resistant to most chemicals used in construction and does not rot.

2.11 Environment and health during use

The requirements of the Committee for Health-related Evaluation of Building Products (AgBB) have been met. Measurements of emissions using testing chambers in accordance with the relevant testing norms EN 16516 showed that volatile organic substances (VVOC, VOC) are only emitted in small quantities. The foam formulations contain no SVHC substances regarding the current REACH candidate list (see section 2.5) Polyurethane insulation materials are odourless.

2.12 Reference service life

When used properly, the service life of polyurethane rigid foam corresponds to the service life of the insulated construction components, however, it is at least 40 years. The insulating performance stays the same throughout the entire service life.

The insulating performance stays the same throughout the entire service life.

2.13 Extraordinary effects

Fire

Polyurethane insulating materials are classified as E, D, or C according to EN 13501-1.
Roof structures with polyurethane insulation on top,according to DIN 18234-2, fulfil fire protection requirements in the industrial building code, even in fire zones or firefighting sections with a roof area of over 2.500 m^2.
Polyurethane rigid foam does not tend to smoulder. When subjected to heat, PU rigid foam carbonises without dripping off burning droplets.
When burning, sooty products, water vapour, carbon monoxide, carbon dioxide, nitrogen oxides, as well as traces of hydrogen cyanide are formed. The composition of the smoke gas is the same as with other nitrogen-containing organic substances. The toxicity of the fire gases mainly depends on the amount of burned material in relation to the size of the room in which the gases are distributed, and it also depends on the ventilation conditions in the affected area.

fire protection

Name	Value
Building material class reaction to fire	E-C
Burning droplets	d0, none
Smoke gas development	s1 - s3

Water

Due to the predominantly closed-cell structure, insulating materials made of polyurethane rigid foam absorb water only in small quantities. They are not hygroscopic, i.e. they do not absorb water vapour from the air. When unexpectedly exposed to water (e.g. flood), only very small amounts of soluble substances are emitted.

Mechanical destruction

If the product is mechanically destructed, there are no relevant effects on the environment.

2.14 Re-use phase

Dismantling polyurethane insulating materials as well as sorting and waste identifying can be done without difficulties if they were mounted mechanically or laid loosely. Clean and undamaged polyurethane insulation boards can be re-used, re-utilised from material recycling, or recycled as raw material (glycolysis). Glycolysis means that at approx. 200°C, polyurethane rigid foam waste is transformed into a fluid called glycolysis polyol, which can be used again as raw material in the production of polyurethane. When re-utilised from material recycling, polyurethane rigid foam waste is used to produce press boards. In this process, cutting and mounting leftovers, as well as construction waste, are mechanically shredded and subsequently pressed into board-shaped products while adding binding agents. PU pressed adhesive boards are a high-quality material which are used to insulate window frames, thermal bridges et al.

2.15 Disposal

According to the Kreislaufwirtschaftsgesetz (Closed Substance Cycle Waste Management Act) and the Regulation in the EWL (European Waste List) of Materials (German Version: AVV=Abfall-Verzeichnis-Verordnung), polyurethane insulating material shall not be disposed of without prior treatment. The waste disposal code for construction waste is 170604. With thermal treatment, the energy content of the insulating material can be recovered.

2.16 Further information

Please visit www.ivpu.de and www.daemmtbesser.de for further information on PU insulating materials.

3. LCA: Calculation rules

3.1 Declared Unit

The declared unit is 1m³ of installed PU thermal insulation board made of block foam and has the following specifications:

Declared Unit

Name	Value	Unit
Declared unit	1	m^3
Gross density	33.6	kg/m^3
Thermal conductivity	0,024	W/(m·K)

The LCA results can be converted linearly for other gross density or board thickness values.

This EPD is based on weighted averages, which have been determined on the basis of the single values originating from the factories of the three IVPU-member companies Paul Bauder GmbH & CO. KG, Kingspan Insulation B.V., and puren gmbh. Energy consumption and the quantity of production waste have been weighted according to the quantities of produced PU rigid foam in m³. Raw Material consumption has been weighted according to produced quantities in kg.
The life cycle assessment data are robust in view of the variability of the production process, the geographical representativeness, and the impact of background data and precursors in comparison to the environmental integrity caused by the actual production.

3.2 System boundary

Type of EPD: cradle to gate – with options.
The life cycle assessment considers the following modules of the life cycle:

- production and provisioning of raw materials (A1)
- transportation of raw materials (A2)
- production incl. packaging (A3)
- transportation to construction site (A4)
- installation in buildings (recycling or thermal treatment of offcuts and packaging waste) (A5)
- manual dismantling (C1)
- transportation upon reaching End-of-Life (C2)
- waste treatment: energy for shredders (C3)
- thermal utilisation in waste-to-energy plant [MVA] (C4)
- utilisation potential beyond the system's boundary due to energy substitution in the MVA (D)

3.3 Estimates and assumptions

For all input, specific GaBi ts-data sets were available. Currently, waste from PU rigid foam production and cutting scrap from construction sites can be handled using mainly material recycling (see 2.15). In this EPD, however, following the 'worst-case' approach, the incineration and the resulting energy benefit beyond the system boundary shall be considered and be declared in module D.

3.4 Cut-off criteria

In this study, all available data from the production are taken into account, i.e., all used raw materials, used thermal energy, as well as electrical power consumption. Therefore, even materials and power consumption levels that have a share of less than 1% are considered and the cut-off limit of 5% according to PCR Part A is met. The manufacturers have provided data on transportation expenditures for all relevant material flows. Machinery and installations required for the production are neglected.

3.5 Background data

Background data originates from the GaBi- software database from sphera Solutions GmbH GaBi ts Doku. The German and Belgian electrical power mix is used for production, while the European power mix is used for the use potentials in module D. The last revision of the used data was less than five years ago.

3.6 Data quality

The data used are primary data originating from the industry and were gathered by the IVPU in 2021. Three IVPU-members (see above) participated in this data acquisition. These IVPU-members represent the majority of companies within the German and Belgian polyurethane block foam market. This EPD is based on weighted averages, which have been determined on the basis of the single values originating from the factories of the aforementioned manufacturing companies. The data's quality as well as its technological, geographical, and chronological significance can be classified as very good.

3.7 Period under review

The data basis is based on production data from 2021, considering a time span of 12 months.

3.8 Geographic Representativeness

Land or region, in which the declared product system is manufactured, used or handled at the end of the product´s lifespan: Germany

3.9 Allocation

When thermally treated in municipal waste incineration plants (MVA), recycling as well as use potentials beyond the system boundary for power and thermal energy in module D are taken into account in an input-specific manner, considering elemental composition as well as calorific values. Because the distribution area covers all of Europe, the substitution processes in module D apply Europe-wide.

3.10 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. The background database used is GaBi ts.

4. LCA: Scenarios and additional technical information

Characteristic product properties of biogenic carbon

Because of low bio-based content in the raw materials, the product contains very small amounts of biogenic carbon (under 5%). The biogenic carbon of the packaging is listed below.

Information on specifications of biogenic carbon content at the gate

Name	Value	Unit
Biogenic carbon content in product	-	kg C
Biogenic carbon content in accompanying packaging	0.49	kg C

The following technical information serves as the basis for the declared modules. If modules are not declared (MND), it may also be used for developing specific scenarios in the context of a building assessment.

Transport to construction site (A4)

Name	Value	Unit
Transport distance	500	km
Capacity utilisation (including empty runs)	53	%
Gross density of products transported	33.6	kg/m^3

Installation in buildings (A5)

Name	Value	Unit
Material loss	5	%
Wooden pallet (packaging waste) (Verpackungsabfälle)	1,269	kg
Polyethylene foil (packaging waste) (Verpackungsabfälle)	0,064	kg

End of life cycle (C1 – C4)

Name	Value	Unit
Reuse	-	kg
Energy recovery	33.6	kg
Landfilling	-	kg

Reuse, recovery, and recycling potentials (D) relevant scenario data 100% waste-to-energy in an incineration plant (MVA).

5. LCA: Results

In Table 1 "Description of the system boundary", all declared modules shall be indicated with an "X"; all modules that are not declared shall be indicated with "MND" (As default the modules B3, B4, B5 are marked as MNR – module not relevant). In the following tables, columns can be deleted for modules that are not declared. Indicator values should be declared with three valid digits (eventually using the exponential form (e.g. 1,23E-5 = 0,0000123). A uniform format should be used for all values of one indicator.
If several modules are not declared and therefore have been deleted from the table, the abbreviations for the indicators can be replaced by the complete names, while the readability and clear arrangement should be maintained; the legends can then be deleted.
If due to relevant data gaps, an indicator cannot be declared in a robust way, then the abbreviation “IND” (indicator not declared) should be used for this indicator.

- 0 - calculated value is 0
- 0 - value falls under the cut-off
- 0 - assumption which exclude any flows (e.g. exported electricity A1-A3)
- IND – in cases where the inventory does not support the methodological approach or the calculation of the specific indicator IND shall be used.

If no reference service life is declared (see chapter 2.13 "Reference Service Life"), the LCA results of the modules B1-B2 and B6-B7 shall refer to a period of one year. This shall then be indicated as an explanatory text below the tables. In addition, the formula for the quantification of such B-modules over the total life cycle shall be provided.

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = 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	MND	MND	MNR	MNR	MNR	MND	MND	X	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: 1 m³ installed PU thermal insulation board with a thermal conductivity of 0,023 to 0,027 W/(m·K)

Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
GWP-total	kg CO_2 eq	1.02E+02	4.03E+00	1.15E+01	0	7.74E-01	7.49E+01	0	-3.16E+01
GWP-fossil	kg CO_2 eq	1.04E+02	4.01E+00	9.6E+00	0	7.71E-01	7.49E+01	0	-3.14E+01
GWP-biogenic	kg CO_2 eq	-2.12E+00	0	1.94E+00	0	0	5.5E-03	0	-1.59E-01
GWP-luluc	kg CO_2 eq	6.63E-02	2.24E-02	4.5E-03	0	4.29E-03	1.82E-04	0	-3.39E-03
ODP	kg CFC11 eq	6.06E-11	2.4E-13	3.96E-12	0	4.61E-14	1.3E-11	0	-2.07E-10
AP	mol H^+ eq	1.75E-01	3.61E-03	1.17E-02	0	6.93E-04	4.49E-02	0	-4.08E-02
EP-freshwater	kg P eq	3.56E-04	1.2E-05	1.92E-05	0	2.3E-06	1.81E-06	0	-4.22E-05
EP-marine	kg N eq	5.06E-02	1.05E-03	3.81E-03	0	2.02E-04	2.15E-02	0	-1.11E-02
EP-terrestrial	mol N eq	5.18E-01	1.3E-02	4.09E-02	0	2.5E-03	2.47E-01	0	-1.19E-01
POCP	kg NMVOC eq	2.05E-01	3.05E-03	1.69E-02	0	5.86E-04	5.53E-02	0	-3.12E-02
ADPE	kg Sb eq	1.66E-05	3.35E-07	8.98E-07	0	6.44E-08	2.41E-07	0	-4.67E-06
ADPF	MJ	2.6E+03	5.36E+01	1.39E+02	0	1.03E+01	3.54E+01	0	-5.34E+02
WDP	m^3 world eq deprived	1.29E+01	3.6E-02	1.28E+00	0	6.91E-03	7.36E+00	0	-3.27E+00

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 installed PU thermal insulation board with a thermal conductivity of 0,023 to 0,027 W/(m·K)

Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
PERE	MJ	1.21E+02	3.05E+00	2.19E+01	0	5.85E-01	5.69E+00	0	-1.43E+02
PERM	MJ	2E+01	0	-1.5E+01	0	0	0	0	0
PERT	MJ	1.41E+02	3.05E+00	6.87E+00	0	5.85E-01	5.69E+00	0	-1.43E+02
PENRE	MJ	1.69E+03	5.37E+01	1.42E+02	0	1.03E+01	9.43E+02	0	-5.34E+02
PENRM	MJ	9.1E+02	0	-2.56E+00	0	0	-9.08E+02	0	0
PENRT	MJ	2.6E+03	5.37E+01	1.39E+02	0	1.03E+01	3.55E+01	0	-5.34E+02

SM	kg	0	0	0	0	0	0	0	0
RSF	MJ	0	0	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0	0	0
FW	m^3	5.75E-01	3.45E-03	4.44E-02	0	6.62E-04	1.75E-01	0	-1.38E-01

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 installed PU thermal insulation board with a thermal conductivity of 0,023 to 0,027 W/(m·K)

Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
HWD	kg	1.42E-06	2.57E-10	7.39E-08	0	4.94E-11	3.8E-09	0	-7.32E-08
NHWD	kg	1.77E+00	7.7E-03	1.38E-01	0	1.48E-03	3.77E-01	0	-2.65E-01
RWD	kg	3.69E-02	6.62E-05	2.01E-03	0	1.27E-05	3.5E-03	0	-4.11E-02
CRU	kg	0	0	0	0	0	0	0	0
MFR	kg	0	0	0	0	0	0	0	0
MER	kg	0	0	1.68E+00	0	0	3.36E+01	0	0
EEE	MJ	0	0	9.71E+00	0	0	1.28E+02	0	0
EET	MJ	0	0	1.74E+01	0	0	2.29E+02	0	0

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 installed PU thermal insulation board with a thermal conductivity of 0,023 to 0,027 W/(m·K)

Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
PM	Disease incidence	1.74E-06	2.26E-08	8.62E-08	0	3.95E-08	1.61E-07	0	-4.04E-07
IR	kBq U235 eq	3.7E+00	9.7E-03	2.1E-01	0	2.26E-03	5.58E-01	0	-8.35E+00
ETP-fw	CTUe	1.17E+03	3.72E+01	6.3E+01	0	8.68E+00	1.44E+01	0	-1.37E+02
HTP-c	CTUh	2.74E-08	7.5E-10	1.5E-09	0	1.76E-10	7.81E-10	0	-6.42E-09
HTP-nc	CTUh	1.34E-06	3.87E-08	7.31E-08	0	9.89E-09	2.84E-08	0	-2.48E-07
SQP	SQP	5.64E+02	1.84E+01	1.59E+01	0	4.3E+00	1.02E+01	0	-1.12E+02

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

Restriction Note 1 – In reference to the Parameter IPR 'Potential effect on a person after exposure to U235'. This category of effect deals mainly with the possible effects of low intensity ionising particles on human health in the nuclear fuel cycle. It does not consider any effects attributable to possible nuclear accidents and occupational exposure, nor does it refer to the disposal of radioactive waste in underground facilities. The potential ionising radiation emanating from the soil, from radon, and from building materials was also not measured within this parameter.
Restriction Note 2 – In reference to the following parameters: 'Potential for the scarcity of abiotic resources – non-fossil resources', 'Potential for the scarcity of abiotic resources – fossil fuels', 'Water abstraction potential (Users)', 'Potential toxicity reference value for ecosystems', 'Potential toxicity reference value for humans – carcinogenic effect', 'Potential toxicity reference value for humans – non-carcinogenic effect', 'Potential soil quality index'. The results of this environmental effect parameter must be applied carefully, because the uncertainties with these results are high, or because there is only little experience with the parameter. This EPD was created using a software tool.

6. LCA: Interpretation

Modules A1 – A3: Impacts on the environment of the production stage are mainly determined by raw material production and processing in A1. In almost all impact categories, upstream processes prior to the production of isocyanate have significant effects. In addition, there is a certain impact caused by the upstream processes in the production of polyol, and to a small extent to the use of flame retardants. For example, within the impact category Global Warming Potential (GWP), isocyanate has a significant effect (approx. 50%), while polyols and flame retardants have only a moderate share in the overall result (approx. 10% respectively). Non-renewable primary energy consumption (PENRT) can mainly be attributed to the upstream processes within the production of isocyanate and polyol (approx. 70% in total).
Module C3: The environmental load in C3 is caused by the combustion of PU insulation boards.
Module D: The utilisation potential for the next product system originates from substituting primary energy for the generation of power and steam in MVAs that thermally treat PU insulation boards. Life-cycle analysis results for the various locations are all in the same range. Deviances occur in view of differences in the utilisation of available energy sources. However, since the results are influenced significantly by the raw materials used and not by the available energy source, the life-cycle energy results for the three locations are in the same range (<10%).

7. Requisite evidence

As a general rule, all statements must be documented with measured data (presented by the corresponding test certificates). The methods of evidence and the test conditions have to be described together with the results.

If substances are not detected, the limit of detection must be included in the declaration.

Interpreting statements such as "… free of …" or "… are entirely harmless …" are not allowed.

If evidence required by the specific PCR part B is not provided, this has to be justified under the respective title for the required evidence.

If relevant for the scope of application of the declared product, or if derivable from its material composition, it is recommended to provide additional adequate evidence.

Information and explanation on the representativeness of requisite evidence have to be given in the project report for all members of the association.

7.1 VOC-Emissionen

Emission tests on PU boards made of block foam found that the VOC-28-day values are significantly below the limits determined by the AgBB scheme PU Europe Technical Dossier. 3-day values have no significance in insulation materials, because the time period between production and installation / utilisation in a building is usually more than 7 days. The tests were conducted by the research organisations Eurofins / Denmark, VTT / Finland and WKI / Germany, among others.

VOC emissions

Name	Value	Unit
Overview of Results (28 days)	-	µg/m^3
TVOC (C6 - C16)	0 - 100	µg/m^3
Sum SVOC (C16 - C22)	0 - 10	µg/m^3
R (dimensionless)	0 - 0.5	-
VOC without NIK	0 - 100	µg/m^3
Carcinogenic Substances	-	µg/m^3

7.2 Isocyanate emission

In the analysis conducted by the Fraunhofer Institut für Holzforschung, Wilhelm-Klauditz-Institut WKI (1998), no isocyanate emission could be detected in the 1m³ test chamber. SUPELCO cartridges were used for detecting MDI. The detection limit is at 10 ng/m³.

AgBB-Overview of results (3-day [µg/m³])

Name	Value	Unit
TVOC (C6 - C16)	-	µg/m^3
Sum SVOC (C16 - C22)	-	µg/m^3
R (dimensionless)	-	-
VOC without NIK	-	µg/m^3
Carcinogenic Substances	-	µg/m^3

7.3 Formaldehyde

Emission tests on PU boards made of block foam detected formaldehyde-levels <3 µg/m^3 (PU Europe Technical Dossier and Eurofins Test Report), which are significantly below the threshold value of 120 µg/m³ (Class E1).

8. References

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

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The literature referred to in the Environmental Product Declaration must be listed in full.Standards already fully quoted in the EPD do not need to be listed here again.
The current version of PCR Part A and PCR Part B of the PCR document on which they are based must be referenced.

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