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)
Declaration number	EPD-IVP-20240422-IBE1-EN
Issue date	29.11.2024
Valid to	28.11.2029

PU thermal insulation boards with 50 µm aluminium facing

IVPU e.V.

Institut Bauen und Umwelt e.V.

ECO PLATFORM EPD VERIFIED

www.ibu-epd.com | https://epd-online.com

1. General Information

IVPU e.V.

Programme holder

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

Declaration number

EPD-IVP-20240422-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

29.11.2024

Valid to

28.11.2029

Dipl.-Ing. Hans Peters
(Chairman of Institut Bauen und Umwelt e.V.)

Florian Pronold
(Managing Director Institut Bauen und Umwelt e.V.)

PU thermal insulation boards with 50 µm aluminium facing

Owner of the declaration

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

Declared product / declared unit

1 m² of installed PU thermal insulation board with 50 µm aluminium facing (on both sides), a thickness of 12 cm, and a nominal thermal conductivity of 0,022 W/(m·K) and delcared value of thermal resistance of R_d = 5,45 (m²•K)/W

Scope:

This EPD applies to all declared products of the IVPU's member companies Karl Bachl GmbH & Co KG, Paul Bauder GmbH & Co KG, IKO Insulation BV, Kingspan Insulation GmbH & Co KG, Linzmeier Bauelemente GmbH, puren gmbh, Recticel NV/SA, Soprema GmbH, Steinbacher Dämmstoff-GmbH, Unilin Insulation bv. The IVPU represents more than 90% of the companies within the German polyurethane insulation products market. This EPD is based on weighted averages, which have been determined on the basis of the single values originating from the aforementioned manufacturing companies' factories (see section 3.1).
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

Factory made rigid polyurethane foam (PU) products are used for the thermal insulation of buildings. PU includes both PIR and PUR products. The products are manufactured in the form of boards without or with flexible facings.
This Product Declaration covers PU insulation boards with 50 µm aluminium facings on both sides. For the placing on the market of the 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 *EN 13165:2016-09* Thermal insulation products for buildings - Factory made rigid polyurethane foam (PU) products - Specification and the CE-marking.

For the application and use the respective national provisions apply. In Germany, the design values for application in building construction are specified in *DIN 4108-10*. Hygrothermal design values are regulated in *DIN 4108-4*.

2.2 Application

The scope of application of PU rigid foam insulation materials includes thermal insulation in building construction (e.g. pitched roofs, flat roofs, floors, ceilings and exterior walls (inside and outside).

2.3 Technical Data

For determining technical data, testing methods as stated in *DIN EN 13165* are used. The gross density of PU insulation boards with 50 µm aluminium facings for building construction is approx. 31 - 32 kg/m³.
The nominal thermal conductivity is 0.022 W/(m.K), the thermal conductivity design value which is used for calculating the thermal performance of insulation layers in buildings is 0.023 W/(m.K). In addition, the nominal value of the thermal resistance of R_D = 5.45 (m²·K)/W and the thickness of 22 mm of the insulation board at R_D = 1 (m²·K)/W can be specified.
The Nominal compressive stress at 10% deformation or compressive strength is 100 kPa (dh) or 150 kPa (ds) acc. to *DIN 4108-10*. Higher compressive strength is possible. Nominal tensile strength perpendicular to the insulation board plane is 40 kPa. Higher tensile strength is possible. PU insulation boards with 50 µm aluminium facings are impermeable to water vapour and do not absorb moisture. Polyurethane rigid foam is a distinctive thermosetting material and therefore cannot be melted.

Constructional data

Name	Value	Unit
Gross density	31 - 32	kg/m³
Compressive strength acc. to DIN EN 826	100 – 150	kPa
Tensile strength to DIN EN 1607	≥ 40	kPa
Modulus of elasticity acc. to DIN EN 826	≥ 4	N/mm²
Calculation value for thermal conductivity	0.023	W/(mK)
Water vapour diffusion resistance factor acc. to EN 12088	∞	-
Dimensional stability under defined temperature and humidity conditions DS(TH)i	DS(70/90)3 and DS(-20,-)1	Class
Limiting dimensions of thickness Ti	T2	Class
Thermal conductivity acc. to DIN EN 13165	0.022	W/(mK)
Calculation value for thermal conductivity (Deutschland)	0.023	W/(mK)
Creep behaviour or permanent compressive strength acc. to DIN EN 1606	≥ 0.02	N/mm²
Declared value of thermal resistance RD	5.45	(m²•K)/W
Thickness at RD = 1 (m²•K)/W	22	mm

Performance data of the production in accordance with the declaration of performance with respect to its essential characteristics according to *DIN 4108-10: 2021-11* (Table 6).

2.4 Delivery status

Polyurethane insulation boards with 50 µm aluminium facings are manufactured with plane-parallel surfaces or as tapered insulation boards in a thickness range of 20 to 300 mm. This Product Declaration refers to a board thickness of 120 mm. The format of the boards depends on the planned application. The width can be up to 1250 mm and the length up to 12 m. This product declaration refers to a surface area of 1 m².

2.5 Base materials/Ancillary materials

The 12 cm PU board with 50 µm aluminium facings consists of 3.88 kg/m² PU rigid foam and 0.28 kg/m² 50 µm aluminium facings. Polyurethane rigid foam is formed by the chemical reaction of MDI (approx. 58 – 65 %) and polyol (approx. 26 – 31 %), adding low boiling point blowing agents (approx. 3 – 6 %). Insulation boards with flexible facings are foamed exclusively with the hydrocarbon pentane. Due to the closed-cell structure, the blowing agent remains within the foam cells. Water (approx. 0.2 – 1.5 %), foam stabilisers and catalysts (approx. 2 – 6 %), as well as flame retardants (Phosphoric acid ester; approx. 2 – 5 %) are added as ancillary materials.

The raw materials used for the production of polyurethane rigid foam are mainly obtained from crude oil, undergoing several production stages. Alternatively, polyols and MDI can be produced, in part, from renewable, plant-based raw materials or recycled materials. This is not part of this EPD.

Polyurethane rigid foam does not contain volatile isocyanates. Under the current Regulation on the Registration, Evaluation, Authorisation and Restriction of Chemicals (*REACH*) polyurethane rigid foam is declared as follows:

- Polyurethane rigid foam contains substances listed in the Candidate List for authorization on 23 January 2024

exceeding 0.1 percentage by mass: **no**.
- Polyurethane rigid foam contains other carcinogenic, mutagenic, reprotoxic (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**

50 µm aluminium facings consist of lacquered aluminium foil.

2.6 Manufacture

Polyurethane rigid foam insulation boards with flexible 50 µm aluminium facings are produced in a continuous process on a double belt line. In this process, the polyurethane reaction mixture pours from a mixing head onto the bottom aluminium facing where it foams up and glues – still within the line's pressure area – with the top aluminium facing. After passing the double belt line, the foam boards are cut to the desired dimensions.

Quality assurance

The declared products are subject to quality controls. Quality assurance is based on surveillance and certification by independent Notified Bodies.

2.7 Environment and health during manufacturing

No health protection measures extending beyond the legally-mandated work protection measures for industrial businesses are required during the entire manufacturing process. No special environmental protection measures apart from the legal provisions are required.

2.8 Product processing/Installation

Polyurethane insulation boards can be cut, sawed, milled, and abraded with conventional construction tools and portable machines. In general, the boards are fixed mechanically (pitched and flat roofs, cavity core insulation). Alternatively, PU insulation boards can be laid loosely, e.g. on floors. Observing the manufacturer's recommendations, it is also possible to glue the boards together by using either hot-setting or cold-setting adhesives. Joints between cut insulation boards on roof ridges, hips or valleys are to be sealed with polyurethane in-situ foam without thermal bridges.

While sawing, abrading, and milling insulation boards, dust is generated. If there is no sufficient ventilation, workers who carry out these processes have 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)

These limits are time-weighted averages assuming an 8-hour exposure per day, 5 days a week, during working lifetime. Cutting leftovers can be treated in a municipal waste incernation plant with energy recovery or they can be subject to a separate collection and a mechanical recycling process.

2.9 Packaging

Mainly, plastic foils and EPS or PU wedges are used as packaging material. The plastic foils can be recycled whereas the PU wedges can be reused in the form of PU press plates.

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 time. 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*) are 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.

Regarding the current *REACH* candidate list, the foam formulations contain no SVHC substances (see section 2.5).

Polyurethane insulaton products are odourless.

2.12 Reference service life

When used properly, the service life time of polyurethane rigid foam corresponds to the service life time of the insulated construction component or building. The performance of the insulation boards stays the same throughout the entire service life time.
Description of the influences on the ageing of the product when applied in accordance with the rules of technology.

2.13 Extraordinary effects

Fire

According to national approvals, polyurethane insulaton materials are classified either as class E or class C acc. to *EN 13501-1*. Pitched roof constructions with polyurethane insulation over rafters that comply with the classification report of *IBS 316052507-A* are classified as REI 30 (fire-retardant). Roof structures with top-side polyurethane insulation acc. to *DIN 18234-2* meet the fire-protection requirements stated in the Industrial Building Guideline even for fire containment or fire fighting sections with a roof surface of more than 2500 m².

In case of fire, PU rigid foam does not tend to smoulder. When exposed to heat, PU rigid foam carbonizes without dripping off burning droplets. When burning, sooty products, water vapour, carbon monoxide, carbon dioxide, nitrogen oxides, as well as hydrogen cyanide are formed as it is the case e. g. for sheep wool.
The toxicity of the combustion gases mainly depends on the amount of burned material in relation to the size of the room in which the gases are distributed. It also depends on the ventilation conditions in the affected area.

Fire protection

Name	Value
Building material class acc to EN 13501	E - C
Burning droplets	d0, none
Smoke gas development	s1 - s3

Water

Due to the predominant closed-cell structure, insulation 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

The disintegration of the poduct by mecanical processes does not have relevant effects on the environment.

2.14 Re-use phase

Dismantling polyurethane insulation products as well as sorting and waste identifying can be done without difficulties, since they are usually mounted mechanically or laid loosely.

Clean and undamaged polyurethane insulation boards can be reused as well as recycled mechanically or chemically (glycolysis). Glycolysis means that polyurethane rigid foam waste is transformed into a fluid substance called glycolysis polyol, which can be used again as raw material in the production of polyurethane.

When reutilised from mechanical 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 that are used, among others, to insulate window frames or thermal bridges.

2.15 Disposal

According to the Waste Catalogue Ordinance, polyurethane insulating material shall not be disposed of without prior treatment. The waste code for construction waste is 170604. During thermal treatment, the energy content of the insulation material can be recovered.

2.16 Further information

Please visit www.ivpu.de and www.daemmt-besser.de for further information on PU insulation products.

3. LCA: Calculation rules

3.1 Declared Unit

The declared unit is 1 m² of installed PU thermal insulation board with 50 µm aluminium facing (on both sides) and has the following specifications:

Declared unit

Name	Value	Unit
Declared unit	1	m^2
Gross density of PU foam	32.29	kg/m^3
Grammage	4.15	kg/m^2
Layer thickness	0.12	m
Design value of thermal conductivity	0.023	W/(m•K)
Thermal resistance (R-value)	5.45	m²·W/K

Other declared units are allowed if the conversion is shown transparently.

This EPD is based on weighted averages, which have been determined on the basis of the single values originating from the factories of the IVPU members. Average energy consumption for producing PU boards has been weighted according to the quantities of produced PU rigid foam in m^3. Raw material consumption has been weighted according to used quantities in kg. Rigid foam waste is weighted according to the quantities of produced PU rigid foam in m^3 whereas facing waste is weighted according to used quantities of facings in m^2.

3.2 System boundary

The type of EPD according to *EN15804* is cradle to gate with options, modules C1–C4, and module D.
Life cycle assessment considers the following steps of the life cycle:

- Production and supply of raw materials (A1)
- Transporting raw materials (A2)
- Production expenses including packaging (A3)
- Transport to construction site (A4)
- Installation in buildings (thermal treatment of packaging waste) (A5)
- Transport to End-of-Life (C2)
- Waste treatment: energy for shredders (C3)
- Thermal treatment (PU foam) (C3)
- Recycling or use potentials beyond the system's boundary (D).

3.3 Estimates and assumptions

For all inputs, specific *Sphera LCA FE (GaBi ts)* datasets were available.
Currently, waste from PU foam production generated in construction sites are handled using mainly material recycling (see 2.15).

Using a worst-case approach, only the incineration and the consequent energy benefits beyond the system boundary have been considered in this EPD.

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.

It can be assumed that all neglected processes put together account for no more than 5 % of total power and mass consumption. The manufacturers have provided data on transport expenditures for all relevant material flows. Machinery and installations required for production are neglected.

3.5 Background data

Background data originates from the *Sphera LCA FE (GaBi ts)* software database CUP 2023.2 from Sphera. The power mix with different countries has been used. The last revision of the used data was less than 6 years ago.

3.6 Data quality

The data used are primary data originating from the industry and were gathered by the IVPU in 2018. 9 IVPU members participated in this data gathering. The IVPU represents more than 90 % of the companies within the German polyurethane insulation products 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 afore-mentioned manufacturing companies.
The data's quality as well as its temporal, technological and geographical representativeness significance can be classified as good.

3.7 Period under review

The data basis is based on production data from 2018.
The used quantities of raw materials, energy, as well as ancillary materials and fuels are averages compiled over 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 waste incineration plants, 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 thermal values. Due to manufacturing locations and

distribution throughout all of Europe, the substitution processes refer to reference area EU-27.

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 used background database is *Sphera LCA FE (GaBi ts)*, CUP 2023.2.

4. LCA: Scenarios and additional technical information

Characteristic product properties of biogenic carbon

The biogenic carbon content declared is provided below. No biogenic carbon content exists in the product, only packaging materials.

Information on describing the biogenic carbon content at factory gate

Name	Value	Unit
Biogenic carbon content in product	-	kg C
Biogenic carbon content in accompanying packaging	0.0744	kg C

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

The following technical scenario information is used to calculate the declared modules.The values refer to the declared unit of 1 m² of installed PU thermal insulation board with 50 µm aluminium facing.

Transport to construction site (A4)

Name	Value	Unit
Litres of fuel	0.027	l/100km
Transport distance	500	km
Gross density of products transported	32.29	kg/m^3
Capacity utilisation (including empty runs)	85	%

Installation in buildings (A5)

Name	Value	Unit
Packaging waste	0.68	kg

End of life cycle (C1-C4)

Name	Value	Unit
Waste processing (C3) energy for shredders	0.83	MJ
Reuse	-	kg
Recycling (aluminium)	0.28	kg
Energy recovery	3.87	kg
Landfilling	-	kg

Module C1 considers a manual demolition (without any burden). Upon removal from the building, products are assumed to be transported 100 km (module C2) to a recycling facility. The foam waste in the EoL phase is sent to a waste incineration plant.

The waste is shredded and incinerated. These processes are grouped to module C3. Resulting potential benefits for electricity and thermal energy due to the incineration are grouped to module D.

Aluminum facings are recycled. The recycling including the recycling effort and the potential benefits are addressed in module D.

5. LCA: Results

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 m² of installed PU insulation board with 50 µm aluminium facing

Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
GWP-total	kg CO_2 eq	1.44E+01	4.57E-01	1.86E-01	0	8.97E-02	8.64E+00	0	-4.37E+00
GWP-fossil	kg CO_2 eq	1.44E+01	4.52E-01	1.83E-01	0	8.86E-02	8.64E+00	0	-4.36E+00
GWP-biogenic	kg CO_2 eq	-5.92E-02	1.06E-03	3.03E-03	0	2.07E-04	1.14E-03	0	-1.44E-02
GWP-luluc	kg CO_2 eq	1.11E-02	4.27E-03	1.95E-07	0	8.38E-04	2.18E-05	0	-3.69E-04
ODP	kg CFC11 eq	1.25E-11	4.04E-14	9.07E-15	0	7.92E-15	2.06E-12	0	-2.67E-11
AP	mol H^+ eq	3.4E-02	6.01E-04	2.15E-05	0	1.18E-04	5.2E-03	0	-8.15E-03
EP-freshwater	kg P eq	5.03E-05	1.68E-06	2.19E-09	0	3.3E-07	4.65E-07	0	-5.77E-06
EP-marine	kg N eq	7.97E-03	2.12E-04	5.66E-06	0	4.15E-05	2.48E-03	0	-1.94E-03
EP-terrestrial	mol N eq	8.28E-02	2.54E-03	1.04E-04	0	4.99E-04	2.85E-02	0	-2.09E-02
POCP	kg NMVOC eq	4.26E-02	5.19E-04	1.6E-05	0	1.02E-04	6.38E-03	0	-5.54E-03
ADPE	kg Sb eq	1.4E-06	3E-08	8.44E-11	0	5.88E-09	1.81E-08	0	-2.81E-07
ADPF	MJ	3.46E+02	6.27E+00	2.32E-02	0	1.23E+00	3.83E+00	0	-7.48E+01
WDP	m^3 world eq deprived	2.2E+00	5.32E-03	1.68E-02	0	1.04E-03	8.61E-01	0	-3.73E-01

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 m² of installed PU insulation board with 50 µm aluminium facing

Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
PERE	MJ	2.76E+01	4.44E-01	2.68E+00	0	8.71E-02	1.36E+00	0	-2.25E+01
PERM	MJ	2.68E+00	0	-2.68E+00	0	0	0	0	0
PERT	MJ	3.03E+01	4.44E-01	5.79E-03	0	8.71E-02	1.36E+00	0	-2.25E+01
PENRE	MJ	2.28E+02	6.29E+00	2.14E+01	0	1.23E+00	1.01E+02	0	-7.49E+01
PENRM	MJ	1.18E+02	0	-2.14E+01	0	0	-9.71E+01	0	0
PENRT	MJ	3.46E+02	6.29E+00	2.32E-02	0	1.23E+00	3.83E+00	0	-7.49E+01
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	1.15E-01	4.89E-04	3.95E-04	0	9.59E-05	2.06E-02	0	-2.44E-02

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 m² of installed PU insulation board with 50 µm aluminium facing

Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
HWD	kg	1.04E-07	2.33E-11	6.4E-13	0	4.56E-12	7.71E-11	0	-3.71E-09
NHWD	kg	9.44E-01	9.06E-04	7.91E-04	0	1.78E-04	4.43E-02	0	-2.9E-01
RWD	kg	6.15E-03	8.13E-06	1.36E-06	0	1.59E-06	3.42E-04	0	-5.78E-03
CRU	kg	0	0	0	0	0	0	0	0
MFR	kg	0	0	0	0	0	2.67E-01	0	0
MER	kg	0	0	0	0	0	0	0	0
EEE	MJ	0	0	3.8E-01	0	0	1.48E+01	0	0

EET	MJ	0	0	6.76E-01	0	0	2.65E+01	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 m² of installed PU insulation board with 50 µm aluminium facing

Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
PM	Disease incidence	3.22E-07	4.99E-09	1.14E-10	0	9.8E-10	1.53E-08	0	-7.74E-08
IR	kBq U235 eq	8.1E-01	1.17E-03	2.19E-04	0	2.3E-04	5.61E-02	0	-1.02E+00
ETP-fw	CTUe	1.16E+02	4.42E+00	8.94E-03	0	8.66E-01	1.1E+00	0	-1.23E+01
HTP-c	CTUh	4.58E-09	8.9E-11	1.18E-12	0	1.75E-11	8.19E-11	0	-1.13E-09
HTP-nc	CTUh	1.57E-07	3.93E-09	1.03E-11	0	7.71E-10	1.25E-09	0	-2.58E-08
SQP	SQP	4.71E+01	2.62E+00	7.13E-03	0	5.13E-01	1.11E+00	0	-1.24E+01

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 or radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, 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 as there is limited experience with the indicator.

6. LCA: Interpretation

Modules A1-A3: The environmental impacts during the production stage are mainly determined by raw material production and processing in Module A1. For nearly all categories, these impacts can mostly be attributed to the PU foam (60 % - 90 %) and to a lesser extent to the 50 µm aluminium facings (10 % - 30 %). More specifically, the results are mainly driven the production of MDI and polyols in almost all indicators except for ODP and POCP, where the impacts can mainly be attributed to the power mix and the other production expenses, respectively.

Module D: The utilization potential for the next product system originates from using primary energy generated from MVAs which burn PU cores in order to generate power and steam. Additionally, Module D possesses the recycling potential of the aluminium used.

The LCA results show high robustness since the primary data, they are based on, do not show any outliers in terms of energy consumption and product's composition while comparing the contributing companies and sites. All background data are sourced from Sphera LCA FE (GaBi ts) databases. With the used data sets a good overall representativity with regards to completeness, geographical coverage and technological coverage is ensured.

7. Requisite evidence

7.1 VOC emissions

Emission tests on PU boards with 50 µm aluminium facings found that the VOC values are significantly below the limits determined by the AgBB scheme (PU Europe Technical Dossier). The tests were conducted by the research organisations Eurofins (Denmark), VTT (Finland) and Fraunhofer WKI (Germany), Test report No. MAIC-2016-3308, among others.

VOC emissions

Name	Value	Unit
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 *(Test report No. 861-98)*, no isocyanate emission could be detected in the 1m³ test chamber. SUPELCO cartridges have been used for detecting MDI. The detection limit is at 10 ng/m³.

7.3 Formaldehyde

Emission tests on PU insulation boards only detected very small quantities of formaldehydes (< 3 µg/m³ (PU Europe Technical Dossier)). This is significantly below the threshold value of 120 µg/m³ (Class E1).

8. References

Standards

DIN 18234-2

DIN 18234-2:2018-05, Fire safety of large roofs for

buildings - Fire exposure from below - Part 2: List of roofs which fulfil the requirements of DIN 18234-1; roof areas without openings.

DIN 4108-4
DIN 4108-4:2020-11, Thermal insulation and energy economy in buildings - Part 4: Hygrothermal design values.

DIN 4108-10
DIN 4108-10:2021-11, Thermal insulation and energy economy in buildings - Part 10: Application-related requirements for thermal insulation materials - Factory-made products.

EN 12091
EN 12091:2013-06, Thermal insulating products for building applications - Determination of freeze-thaw resistance.

EN 13165
EN 13165:2016-09, Thermal insulation products for buildings – Factory-made rigid polyurethane foam (PU) products - Specification; German version EN 13165:2012. (This norm covers polyurethane rigid foam (PUR) and polyisocyanurate rigid foam (PIR)).

EN 13501-1
EN 13501-1:2019-05, Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests; German version EN 13501-1:2007+A1:2010.

EN 14308
EN 14308:2016-03, Thermal insulation products for building equipment and industrial installations - Factory made rigid polyurethane foam (PUR) and polyisocyanurate foam (PIR) products.

EN 15801
EN 15801:2010-04, Conservation of cultural property - Test methods - Determination
of water absorption by capillarity.

EN 1606
DIN EN 1606:2013-05, Thermal insulating products for building applications - Determination of compressive creep.

EN 1607
EN 1607:2013-05, Thermal insulating products for building applications -
Determination of tensile strength perpendicular to faces.

EN 16516
EN 16516:2020-10, Construction products: Assessment of release of dangerous substances - Determination of emissions into indoor air.

EN 29052-1
EN 29052-1:1992-08, Acoustics; determination of dynamic stiffness; part 1: materials used under floating floors in dwellings.

EN 826
EN 826:2013-05, Thermal insulating products for building applications - Determination of compression behaviour.

EN 12088
EN 12088:2013, Thermal insulating products for building applications - Determination of long term water absorption by diffusion.

EN 15804
EN 15804:2012+A2:2019+AC:2021, Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products.

prEN 16783:2022-12 - draft
Thermal insulation products - Environmental Product Declarations (EPD) - Product Category Rules (PCR) complementary to EN 15804 for factory made and in-situ formed products

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

Further References

AgBB
Evaluation scheme for VOCs from construction products; approach for assessing health risks caused by volatile organic compounds (VOCs and SVOCs) from construction products, version 2021.

Waste Catalogue Ordinance
Waste Catalogue Ordinance of 10 December 2001 (Federal Law Gazette I p. 3379), last amended by Article 2 of the Ordinance of 24 July 2002 (Federal Law Gazette 2833)

CPR
Regulation (EU) No. 305/2011 of the European Parliament and of the Council of 9 March 2011
laying down harmonised condition for the marketing of construction products and repealing Council Directive 89/106/EC.

EXCLI Journal
Hoffmann, Hans-Dieter; Schupp, Thomas: 'Evaluation of consumer risk resulting from exposure against MDI from polyurethane foam,' scientific article, published in the EXCLI Journal in 2009.

IBS 316052507-A
IBS Linz: Test report No. 316052507-A, dated 06.04.2017 (IVPU), "Report on the classification of fire resistance of a rafter roof with PU over-rafter insulation".

IBU 2021
Institut Bauen und Umwelt e.V.: General Instructions for theEPD programme of Institut Bauen und Umwelt e.V., Version2.0, Berlin: Institut Bauen und Umwelt e.V., 2021
www.ibu-epd.com

IVPU news:
Article "Report on emission of volatile components from PUR rigid foam insulation products," no. 64 dated June 1999.

PCR Part A
PCR - Part A: Calculation rules for the Life Cycle Assessment and Requirements on the BackgroundReport, version 1.3, Institut Bauen und Umwelt e.V., 2021.

PCR Part B
PCR - Part B: Requirements of the EPD for foam plastics insulation materials, v8, 2021 www.bau-umwelt.de

PU Europe Technical Dossier
Technical Dossier for amendment to mandate M103 VOC/SVOC emissions, doc. 13/241, 2013.

Ordinance on Biocide Products No. 528/2012
Regulation (EU) No. 528/2012 of the European Parliament and

of the Council of 22 May 2012 concerning the making available on the market and use of biocidal products.

REACH Regulation
(EC) No. 1907/2006 of the European Parliament and of the Council dated 18th December 2006 on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH).

Sphera LCA FE (GaBi ts)
Sphera LCA for Experts, LCA FE, software-system and databases, Managed LCA content MLC (fka GaBi database), University of Stuttgart and Sphera Solutions GmbH, 2023 CUP Version: 2023.2., MLC data set documentation under https://sphera.com/product-sustainability-gabi-data-search/ (March 2024).

Test report No. 861-98
Fraunhofer Institut für Holzforschung, Wilhelm-Klauditz-Institut (WKI): Test report No. 861-98, dated 07.12.1998 (IVPU), "Test reports on emissions of volatile components from polyurethan insulating materials".

Test report No. MAIC-2016-3308
Fraunhofer Institut für Holzforschung, Wilhelm-Klauditz-Institut (WKI): Test report No. MAIC-2016-3308, dated 04.08.2016 (PU Europe), "Evaluation of emissions data from PU insulation on a Commission proposal for the classification of emissions from building products in the European Union".

TRGS 900
Federal Institute for Occupational Safety and Health: Technical Rules for Hazardous Substances (TRGS) 900, Threshold values for workplaces, 2006, last modified 15.01.2024.

Publisher

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

+49 (0)30 3087748- 0
info@ibu-epd.com
www.ibu-epd.com

Programme holder

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

+49 (0)30 3087748- 0
info@ibu-epd.com
www.ibu-epd.com

Author of the Life Cycle Assessment

Sphera Solutions GmbH
Hauptstraße 111- 113
70771 Leinfelden-Echterdingen
Germany

+49 (0)711 341817-0
info@sphera.com
www.sphera.com

Owner of the Declaration

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

+49 711 29 17 16
ivpu@ivpu.de
http://www.ivpu.de/