ENVIRONMENTAL PRODUCT DECLARATION

Polyurethane (PU) board:
Foam without facing
R=1
Product name:

PU Board without facing (R1)

Company name:

PU Europe

For the verification process, the following report is needed to complete the information about the LCA-model and is available at IBU (Institut für Bauen und Umwelt e.V.):

“Background Report for Polyurethane Insulation Board EPD Generator"
Version: "Update March 2014"
1 How to use this EPD- and LCA-tool for PU boards and sandwich elements

This tool enables the user to generate Environmental Product Declarations (EPDs) and LCAs for Polyurethane boards and sandwich elements with different recipes and facings. The tool uses the input values to calculate the environmental impact figures that are required for EPDs and/or LCAs.

In order to get the EPDs verified, all the used data must be mentioned including their origin. The plausibility of the data must be demonstrated and the average breakdown must be explained. This is to be filled in into the part "Handbook" at the end of this report. There you can find more detailed instructions what to fill in. The input values themselves are filled in automatically in a table at the end of the handbook.

With this tool you can also calculate the environmental impacts of the use stage (which is not part of the EPD) including climate adaption, heating energy sources and prices, as well as the End of Life (EoL) including transport to EoL but this is not part of the EPD and does not lead to a verified EPD.

GaBi Envision and the EPD- and LCA-tool

On left side of the tool-window in GaBi Envision, all values for the parameters have to be entered.

On the right side of this tool, you will then find:

1) EPD: automatically generated results for an IBU European Core EPD

2) Report: a customized report for detailed information for the members of PU Europe (not part of the verified EPD)

3) Handbook: the handbook explains in part A which limitations there are for the tool for generation of verified EPDs and in part B what to enter for the input parameters. Furthermore, there is a table in part C where the data sources have to be entered and the table in part D shows automatically all entered input values.
ENVIRONMENTAL PRODUCT DECLARATION
as per ISO 14025

Owner of the Declaration
PU Europe – PU Board without facing (R1)

PU Board without facing (R1)
PU Europe

Summary
PU Europe – PU Board without facing (R1)

Programme holder
PU Europe
Av. E. Van Nieuwenhuyse 6
Brussels, Belgium

Declaration number

This Declaration is based on the PCR document:
Insulating materials made of foam plastics, 7-2013 (PCR tested and approved by the independent expert committee)

Validity date
05/08/2019

Date of issue
06/08/2014

Owner of Declaration
PU Europe
Av. E. Van Nieuwenhuyse 6
Brussels, Belgium

Declared Product / Declared Unit
1 m² PU thermal insulation board without facing and a thickness of 2.8 cm. The data presented here provide a complete picture of the performance during production, installation and end-of-life.

Scope:
This EPD is a generic association EPD covering PU insulation boards produced by PU Europe members. These members represent 90% of this market segment and use similar production techniques across Europe. The EPD therefore represents an average of these producers. 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.

Verification
CEN standard EN 15804 serves as core PCR

Third party independent verification of the declaration according to ISO 14025:
[ ] Internal [ ] External

Signature

Input field

Input field

Input field

Product

Product description
Polyurethane (PU) is a high performance thermal insulation material offering the lowest thermal conductivity of all insulation products commonly available in the market. It offers excellent compressive strength at low densities. PU includes both PUR (polyurethane) and PIR (polyisocyanurate) products.

The product covered by this EPD is a factory-made, closed-cell PU foam board without facing.

Application
The PU board covered by this EPD is used for the thermal insulation of residential and commercial buildings according to /EN 13165/ (e.g. interior and exterior insulation for roofs, floors, ceilings and walls).

Technical Data
In this Life Cycle Assessment, a PU insulation board with the following properties has been regarded:
- thickness = 2.8 cm
- thermal conductivity = 0.028 W/m*K
- foam density = 31 kg/m³
- total weight per m² = 0.868 kg/m²

This provides a thermal resistance R = 1 m² K/W.

Base materials / Ancillary materials
Closed-cell polyurethane foam made from MDI (60.5 %), polyols (29 %), pentane (5 %) and additives (5.5 %).

The PU board for insulation does not contain substances which are included in the "Candidate List of Substances of Very High Concern for Authorisation".

EPD – PU Europe – PU Board without facing (R1)
Default values on packaging (use and waste), production waste, air emission and energy used are arithmetic averages of the inputs and outputs per ton produced over one reference year from different PU Europe manufacturers. Since the same machinery and similar process conditions are applied across Europe, using same base chemicals, they can be considered valid.

Reference service life
The reference service life is 50 years.
LCA: Calculation rules

Declared unit
The declared unit is 1 m² of PU thermal insulation board without facing and with the following specifications:

- A thickness of 2.8 cm,
- A declared thermal conductivity of 0.028 W/m*K,
- A density of the foam of 31 kg/m³
- Weight of declared unit: 0.868 kg/m²
- Conversion factor to 1 kg: 1.15 m²/kg

This provides a thermal resistance \( R = 1 \text{ m}^2 \text{ K/W} \)

The LCI (Life Cycle Inventory) data used in this report is the weighted average of the data supplied by individual members of PU Europe, who manufacture products meeting this specification. The product is manufactured in accordance with /EN 13165/ “Thermal insulation products for buildings – Factory made rigid polyurethane foam (PUR) products – Specification”.

System boundaries
This life cycle assessment for the production of the polyurethane insulation board considers the life cycle from the supply of raw materials to the manufacturer’s gate (cradle-to-gate with options). It also includes the transport to the construction site, the installation and the end-of-life stage of the used PU thermal insulation board. The life cycle is split into the following individual phases:

- A1 - Raw material formulation (foam materials)
- A2 - Raw material transport
- A3 - Production of the polyurethane insulation board (energy demands, waste, auxiliaries etc.) and packaging material
- A4 - Transport system house to warehouse and from warehouse to the construction site
- A5 - Emissions during installation and packaging disposal
- C2 - Transport of the used product from the building site to the waste management site
- C3/C4 - End-of-Life: waste management (thermal recovery)
- D - Benefits and loads beyond system boundary

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.
### LCA: Scenarios and additional technical Information

<table>
<thead>
<tr>
<th>Transport to the construction site (A4)</th>
<th>Reference service life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Litres of fuel [Diesel]: [Consumption] 0.00159 kg/l/100 km</td>
<td>Reuse [waste type] [quantity] 0 kg</td>
</tr>
<tr>
<td>Transport distance [Distance] 500 km</td>
<td>Recycling [waste type] [quantity] 0 kg</td>
</tr>
<tr>
<td>Capacity utilisation (including empty runs) 85%</td>
<td>Energy recovery [waste type] [quantity] 0.911 kg</td>
</tr>
<tr>
<td>Installation in the building (A5)</td>
<td>Landfilling [waste type] [quantity] 0 kg</td>
</tr>
<tr>
<td>Material loss (cuttings): [per cent] 5%</td>
<td>Waste processing (power from grid for shredding) 0.173</td>
</tr>
<tr>
<td>Packaging waste [per cent] 0.35 kg/m²</td>
<td></td>
</tr>
</tbody>
</table>
LCA: Results

**DESCRIPTION OF THE SYSTEM BOUNDARY (1 = INCLUDED IN LCA, MND = MODULE NOT DECLARED)**

<table>
<thead>
<tr>
<th>PRODUCT STAGE</th>
<th>CONSTRUCTION PROCESS STAGE</th>
<th>USE STAGE</th>
<th>END OF LIFE STAGE</th>
<th>BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw materials supply</td>
<td>Transport</td>
<td>Manufacturing</td>
<td>Transp ort</td>
<td>Constr uction-in stallation process</td>
</tr>
<tr>
<td>A1</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

1) The modules Replacement (B4) and Refurbishment (B5) are normally not relevant on the produc tion reasons, those two modules have been deleted in the following tables. If one or both modules are declared respective columns can be inserted.

**RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 m² installed PU insulation board**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>A1-A3</th>
<th>A4</th>
<th>A5</th>
<th>B</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>GWP</td>
<td>[kg CO₂-Aq.]</td>
<td>2.67</td>
<td>0.0669</td>
<td>0.133</td>
<td>0</td>
<td>0.0126</td>
<td>0.0232</td>
<td>1.91</td>
<td>-1</td>
</tr>
<tr>
<td>ODP</td>
<td>[kg CFC11-Aq.]</td>
<td>4.5E-06</td>
<td>1.17E-02</td>
<td>2.24E-02</td>
<td>0</td>
<td>2.19E-03</td>
<td>2.08E-01</td>
<td>1.91E-01</td>
<td>-3.79E-01</td>
</tr>
<tr>
<td>AP</td>
<td>[kg SO₂-Aq.]</td>
<td>0.00607</td>
<td>0.000391</td>
<td>4.93E-05</td>
<td>0</td>
<td>7.34E-05</td>
<td>0.00011</td>
<td>0.00079</td>
<td>-0.0024</td>
</tr>
<tr>
<td>EP</td>
<td>[kg PO₄³⁻-Aq.]</td>
<td>0.000914</td>
<td>9.31E-05</td>
<td>1.09E-05</td>
<td>0</td>
<td>1.75E-05</td>
<td>5.78E-06</td>
<td>0.00195</td>
<td>-0.00164</td>
</tr>
<tr>
<td>POC</td>
<td>[kg Ethen Aq.]</td>
<td>0.00182</td>
<td>0.000155</td>
<td>3.32E-06</td>
<td>0</td>
<td>2.92E-05</td>
<td>6.46E-06</td>
<td>5.27E-05</td>
<td>-0.000198</td>
</tr>
<tr>
<td>ADPE</td>
<td>[kg Sb Aq.]</td>
<td>4.36E-06</td>
<td>2.49E-06</td>
<td>5.1E-09</td>
<td>0</td>
<td>4.68E-06</td>
<td>3.19E-09</td>
<td>1.33E-08</td>
<td>-7.91E-08</td>
</tr>
<tr>
<td>ADPF</td>
<td>[MJ]</td>
<td>58.5</td>
<td>0.921</td>
<td>0.042</td>
<td>0</td>
<td>0.173</td>
<td>0.263</td>
<td>0.472</td>
<td>14.3</td>
</tr>
</tbody>
</table>

Caption: GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POC = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non fossil resources; ADPF = Abiotic depletion potential for fossil resources.

**RESULTS OF THE LCA - RESOURCE USE: 1 m² installed PU insulation board**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>A1-A3</th>
<th>A4</th>
<th>A5</th>
<th>B</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>PERE</td>
<td>[MJ]</td>
<td>2.06</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PERM</td>
<td>[MJ]</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PERT</td>
<td>[MJ]</td>
<td>2.06</td>
<td>0.0362</td>
<td>0.00544</td>
<td>0</td>
<td>0.00681</td>
<td>0.068</td>
<td>0.0297</td>
<td>-1.23</td>
</tr>
<tr>
<td>PENRE</td>
<td>[MJ]</td>
<td>40.5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PENRM</td>
<td>[MJ]</td>
<td>21.7</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PENRT</td>
<td>[MJ]</td>
<td>62.2</td>
<td>0.924</td>
<td>0.0535</td>
<td>0</td>
<td>0.174</td>
<td>0.409</td>
<td>0.533</td>
<td>-6.9</td>
</tr>
<tr>
<td>SM*</td>
<td>[kg]</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>RSF</td>
<td>[MJ]</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NRSF</td>
<td>[MJ]</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>FW*</td>
<td>[m³]</td>
<td>not declared</td>
<td>not declared</td>
<td>not declared</td>
<td>not declared</td>
<td>not declared</td>
<td>not declared</td>
<td>not declared</td>
<td>not declared</td>
</tr>
</tbody>
</table>

Caption: PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of non 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, not declared (decision of IBU advisory board 2013-01-07)

EPD – PU Europe – PU Board without facing (R1)
RESULTS OF THE LCA - OUTPUT FLOWS AND WASTE CATEGORIES: 1 m² installed PU insulation board

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>A1-A3</th>
<th>A4</th>
<th>A5</th>
<th>B</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>HWD*</td>
<td>[kg]</td>
<td>not declared</td>
<td>not declared</td>
<td>not declared</td>
<td>not declared</td>
<td>not declared</td>
<td>not declared</td>
<td>not declared</td>
<td></td>
</tr>
<tr>
<td>NHWD*</td>
<td>[kg]</td>
<td>not declared</td>
<td>not declared</td>
<td>not declared</td>
<td>not declared</td>
<td>not declared</td>
<td>not declared</td>
<td>not declared</td>
<td></td>
</tr>
<tr>
<td>RWD*</td>
<td>[kg]</td>
<td>not declared</td>
<td>not declared</td>
<td>not declared</td>
<td>not declared</td>
<td>not declared</td>
<td>not declared</td>
<td>not declared</td>
<td></td>
</tr>
<tr>
<td>CRU</td>
<td>[kg]</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>MFR***</td>
<td>[kg]</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>MER</td>
<td>[kg]</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.911</td>
</tr>
<tr>
<td>EE [power]</td>
<td>[MJ]</td>
<td>0</td>
<td>0</td>
<td>0.206</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2.82</td>
</tr>
<tr>
<td>EE [thermal energy]</td>
<td>[MJ]</td>
<td>0</td>
<td>0</td>
<td>0.567</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>7.76</td>
</tr>
</tbody>
</table>

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; EE = Exported energy per energy carrier

* Waste cannot be declared (decision of IBU advisory board 2013-01-07)

**SM: Only the foreground system is considered.

***MFR: No credit is given for the amount of recycled steel entering the system without loads.

*FW, HWD, NHWD, RWD: Not all of the used inventories for the calculation of the LCA support the methodological approach for the declaration of water and waste indicators. The material amounts, displayed with these inventories contribute to 29% to the production. This is significant, as > 3% (referring to the mass of the declared unit). The indicators are not declared (decision of IBU advisory board 2013-01-07).

**SM: Only the foreground system is considered.

***MFR: No credit is given for the amount of recycled steel entering the system without loads.
References

Institut Bauen und Umwelt 2011
Institut Bauen und Umwelt e.V., Königswinter (pub.): Generation of Environmental Product Declarations (EPDs); General principles for the EPD range of Institut Bauen und Umwelt e.V. (IBU), 2011-06
www.bau-umwelt.de

General principles
for the EPD range of Institut Bauen und Umwelt e.V. (IBU), 2013-04
www.bau-umwelt.de

PCR Part A
Institut Bauen und Umwelt e.V., Königswinter (pub.): Product Category Rules for Construction Products from the range of Environmental Product Declarations of Institut Bauen und Umwelt (IBU), Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Background Report. April 2013
www.bau-umwelt.de

PCR Part B
PCR Guidance-Texts for Building-Related Products and Services; Part B: Requirements on the EPD for insulating materials made of foam plastics; Institute Construction and Environment e.V. (IBU). Version 1.4, 7th July 2013
https://epd-online.com

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

EN 15804
EN 15804:2012-04: Sustainability of construction works – Environmental Product Declarations – Core rules for the product category of construction products

EN 13165

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|                   | mail           | info@pe-international.com |
|                   | web            | www.pe-international.com |