In my capacity as a publicly appointed and sworn translator for the English language for Baden-Wuerttemberg, I hereby certify this translation from the German document presented to me to be correct and complete to the best of my knowledge and belief. A copy of the German document is attached.

Tübingen, 14th July 2022

MARK BANGERT
Öffentlich bestellter u. beeidigter Urkundenübersetzer der englischen Sprache für Baden-Württemberg
TÜBINGEN

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ENVIRONMENTAL PRODUCT DECLARATION

in accordance with *ISO 14025* and *EN 15804+A2*

Owner of the declaration	Bundesverband der Deutschen Ziegelindustrie e.V.
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-BDZ-20210066-ICG1-DE
Issue date	04/08/2021
Valid to	03/08/2026

Clay blocks (unfilled)

Bundesverband der Deutschen Ziegelindustrie e.V.

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

Institut Bauen und Umwelt e.V.

ZIEGEL

1. General Information

Bundesverband der Deutschen Ziegelindustrie e.V.

Programme holder
IBU – Institut Bauen und Umwelt e.V.
Panoramastrasse 1
10178 Berlin
Germany

Declaration number
EPD-BDZ-20210066-ICG1-DE

This declaration is based on the following product category rules:
Clay blocks, 11/2017
(PCR tested and approved by the independent advisory board (SVR))

Issue date
04/08/2021

Valid to
03/08/2026

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

Dr. Alexander Röder
(Executive Director Institut Bauen und Umwelt e.V.)

Clay blocks – unfilled

Owner of the declaration
Bundesverband der Deutschen Ziegelindustrie e.V.
Reinhardtstrasse 12-16
10117 Berlin
Germany

Declared product/declared unit
1 m³ clay blocks (unfilled)

Scope of application:
The scope of application of this document is limited to clay blocks which are manufactured in Germany by member companies of the Bundesverband der Deutschen Ziegelindustrie e.V., the German interest group for clay block manufacturers. Data from 2019 was provided by 20 member companies for this declaration. These members represent 90% by number of the manufacturers of clay blocks amalgamated in the federal association. The product volume of these companies is some 90% of the German market by production quantity.

The owner of the declaration is liable for the basic information and supporting evidence; any liability of the IBU in relation to manufacturer's information, LCA data and supporting evidence is excluded. This document is a translation from German to English. It is based on the original declaration number EPD-BSW-20210266-CBA1-DE.
This EPD was compiled in accordance with the requirements of *EN 15804+A2*. In the following the standard is referred to more simply as *EN 15804*.

Verification
The European *EN 15804* standard serves as the core PCR
Independent verification of the declaration and statements by an independent body in accordance with *ISO 14025:2010*

☐ internal ☒ external

Dr. Eva Schmincke,
independent verifier

2. Product

2.1 Company information
The Bundesverband der Deutschen Ziegelindustrie e.V. is an amalgamation of companies which manufacture clay blocks. Data from plants which manufacture unfilled clay blocks was analysed for this EPD.

2.2 Product description/Product definition
Clay blocks are construction products product made of fired clay. A differentiation is made between vertically perforated blocks and moulded parts for load-bearing and non-load-bearing masonry and ready-made walls (block elements as installation parts) for the exterior and interior walls of buildings respectively. Blocks for protected and unprotected masonry are dealt with in this EPD - see also the bulk density range of 550–2000 kg/m³. Porosity agents are added in the manufacture of highly insulating blocks. Clay blocks can be additionally filled with various insulation products. These blocks are dealt with in a separate EPD. The basis of the LCA results in this EPD is the formation of an average for all German plants which was done as a weighted average in relation to the share of the individual production

plants in the total annual production. A clay block with a bulk mass of 575 kg/m³ was selected as a representative product.

EU Regulation no. *305/2011 (CPR)* applies for putting the product on the market in the EU/EFTA (with the exception of Switzerland). The product requires a declaration of performance including *DIN EN 771-1:2015-11 - Specification for masonry units - Part 1: Clay masonry units* and CE labelling.

The respective national regulations apply to use, for example in Germany

- *DIN 20000-401*,
- The Model Administrative Provisions of the Technical Building Regulations (*MVV TB*).
- General building supervisory approval from the German Institute for Construction Technology of the respective manufacturer,
- The respective manufacturer's general building type approval from the German Institute for Construction Technology,
- Internal and external monitoring of products with general building supervisory approval of the respective manufacturer.

2.3 Application

Depending on the design, clay blocks are used for solid building components such as cellar walls, exterior walls and load-bearing and non-load-bearing interior walls.

2.4 Technical data

Relevant civil engineering data

Name	Figures for a representative product	Figures for the overall product portfolio	Unit
Compressive strength in accordance with *DIN EN 772*	4-12	4-28	N/mm²
Bulk density in accordance with *DIN EN 772*	575	550 - 2000	kg/m³
Thermal conductivity strength in accordance with *DIN EN 1745*	0.075 - 0.12	0.075 - 0.96	W/(mK)
Balancing humidity at 23 °C, 80 % in accordance with DIN EN 4108-4	0.5	0.5-1.5	Mass %
Water vapour diffusion resistance level in accordance with *DIN 4108-4*	5/10	5/10	-

Product performance values in accordance with

- *DIN 20000-401*
- The Model Administrative Provisions of the Technical Building Regulations (*MVV TB*)
- The respective manufacturer's general building supervisory approval from the German Institute for Construction Technology
- The respective manufacturer's general building type approval from the German Institute for Construction Technology.
- Internal and external monitoring of products with general building supervisory approval and/or the general type approval of the respective manufacturer

2.5 Delivery status

Geometrical Data

Clay blocks are available in various formats and sizes depending on where they are to be used. The respective dimensions are regulated in the following standards:

- *DIN EN 772-16*
- *DIN 105-100*
- *DIN 4159*
- *DIN 4160*
- *DIN 1053-4*
- *DIN 20000-401*
- and in accordance with the respective manufacturer's notifications of approval and/or general building type approval from the German Institute for Building Technology (DIBt)

2.6 Base materials/ancillary materials

Clay blocks consist of the basic material of clay (around 96%) and mineral additives (around 4%).

Clay:
Untreated earths of various natural mineralogical compositions (aluminium oxide Al_2O_3, silicon dioxide SiO_2, iron(III) oxide FE_2O_3). The raw materials are mined close to the surface in selected deposits.

Other natural clay ingredients:
Clays contain geologically deposited natural components in fluctuating quantities such as colour-giving iron oxides. Yellowy to dark red firing colours can occur depending on the clay deposits. Clays can also contain chalk and dolomite.

Sand:
Is used as a filler with extremely soft (fine-grained) clay to balance the natural fluctuations in the mineralogical composition of the raw clay.

Auxiliary materials: Porosity agents:
Additional porosification is necessary when manufacturing highly insulating blocks. This porosification is achieved by adding polystyrene balls and/or fine cellulose fibres such as untreated sawdust or paper fibres. Suppliers are sawmills and the paper industry.

SVHC:
Does the product contain materials from the ECHA (*REACH*) list of materials which are especially problematic for approval: Substances of Very High Concern – SVHC) (Date: 01/02/2021) above a mass percentage of 0.1: **no.**

CMR substances:
Does the product contain Category 1A or 1B CMR materials which are not on the candidate list at a mass % concentration of above 0.1 in at least one partial product: **no.**

Biocides:
Were biocidal products added to this building product or was it treated with biocidal products (is this therefore a processed product in terms of EU Biocide Product Directive no. 528/2012): **no.**

2.7 Manufacturing

After the clay has been open-cast mined it is transported to the manufacturing site for interim storage. The mechanical processing of the clays such as grinding and mixing is done in pan grinders and rolling mills. The aforementioned basic materials are crushed in certain optimised ratios (prepared), mixed and dampened. They are then stored in the soaking house. Porosification material is added before or after storage in the soaking house. After having passed through the fine grinding mill and the addition of water the blanks are shaped by extrusion presses with corresponding mouthpieces and downstream separator. The material thus shaped enters the dryer which is mainly operated with waste heat from the tunnel furnace. The drying time varies depending on the format and bulk density and is generally 24 hours. Afterwards, the dried blanks are fired at approximately 1000°C in the tunnel furnace within a maximum of 24 hours. The firing of the porosification materials causes fine porosification. Clay blocks are ground level to produce plane blocks. The blocks are stacked, wrapped in recyclable polyethylene (PE) foil or strapped with polyester or steel belts. The energy requirement for block manufacture mainly involves the firing process and the drying. The electrical energy is mainly used in processing.

2.8 Environment and health during use

Health protection during manufacture:
Trade association regulations apply; no special measures need to be taken to protect workers' health.

Environmental protection during manufacture:

Water/Soil:
No direct contamination for water or soil is produced. The process runs free of wastewater. The mixing water used is released again during the drying process as steam. The waste heat from the tunnel furnace is used to dry the block blanks (energy network).

Air:
The emissions from the firing process are below the threshold values of the *Technical Instructions on Air Quality Control (TA Luft)*. Environmental protection measures are oriented towards the lowest possible energy use and low-emission exhaust air. If necessary, a reduction in emissions can be achieved by afterburning the low temperature carbonisation gas, the operation of limescale packed bed filters and the selection of fuels which contribute to reducing CO_2, for example natural gas. Computer-aided optimisation also improved the firing management.

Noise:
Due to noise protection measures, the measurement values (workstation and indoors) are far below the required values.

2.9 Product processing/installation

Processing recommendations:
The clay blocks are joined to one another and with other standardised building materials with mortar (ordinary, light, medium- or thin-bed mortar) or Dryfix plane block adhesive. When selecting the mortar, care should be taken that it does not negatively affect the clay block's health and environmental compatibility as described (see the manufacturer's recommendation available on request).

Occupational safety/Environmental protection:
The weights of individual blocks are below the 25kg recommended by the building trade association. Filled clay blocks can be laid by hand and become heavy when filled with concrete. Occupational safety measures in accordance with trade association regulations and in compliance with manufacturer recommendations must be adhered to when laying the blocks. Wet procedures are normally prescribed for cutting and severing work. A dust mask (P3/FFP3) should be worn during dry cutting work.

Residual material:
The remains of clay blocks which accrue on the building site are to be collected separately. Correctly sorted block remains can be taken back by manufacturing plants and used as raw material or in other ways (for details see 2.15).

2.10 Packaging

The polyethylene foil is recyclable. Non-contaminated PE foil (which should be sorted correctly) and reusable wooden pallets are taken back via the building materials trade (reusable pallets against a refund in the deposit system) and thus returned to the brickworks; they pass on the PE foil to specialist disposal companies via a contractual agreement.

2.11 Condition of use

Ingredients:
As described in 2.6 Basic materials, clay blocks mainly consist of clay and sand. Block ingredients are bound as solid substances during their service life (ceramic binding). The air-filled pores of the fine porosification produce significantly better insulation properties than non-porosified clay blocks.

Durability during service life:
Clay blocks do not change once they leave the tunnel furnace. They are unlimitedly durable if used as intended. Clay blocks are resistant against vermin, rotting, vegetation, acid and alkalis.

2.12 Environment and health during use

Clay blocks emit no substances which are hazardous to health or the environment. The naturally ionising radiation of clay blocks is extremely low and not a hazard for health.

2.13 Reference period of use

The reference period of use if installed in accordance with the current rules of technology is 150 years (European block industrial association PCR document: *TBE PCR document*).

Buildings which are built with clay blocks can be operated for just as long.

2.14 Extraordinary influences

Fire
No toxic gases and vapours which obstruct sight can arise in case of fire. The products specified fulfil the requirements of building materials class A in accordance with *DIN 4102-4* (and/or *DIN EN 13501-2*) noncombustible

Fire protection

Name	Value
Building material class	A1
Flaming droplets	-
Flue gas development	-

Water

No ingredients hazardous to water can be washed out under the influence of water (e.g. flooding) due to the fixed ceramic bond.

Mechanical destruction
No risks for the environment and living organisms is known of in case of unforeseen mechanical destruction.

2.15 End-of-life phase

Reuse and further use:
Correctly sorted clay blocks from demolition can be taken back by block manufacturers and reused in manufacturing ground up as filler. This has already been practiced for decades. Opportunities for further use exist as an additive for block chippings concrete, as a filling or bulk material in road construction and underground engineering, material for refilling pits and quarries, the construction of noise protection embankments and also as meal and sand for tennis courts.

2.16 Disposal

Block remains which collect on the building site and also blocks from demolition can be disposed of without problems as long as the aforementioned recycling options are not practicable and represent no extraordinary impact for the environment. Due to the chemically neutral, inert and immobile behaviour of clay blocks they can be stored on Class I waste sites in accordance with landfill class I in accordance with the Landfill Ordinance or used in pits and quarries as in Z1.1. The European Waste Catalogue code is 17 02 01 Bricks.

2.17 Further information

Further information is available at www.ziegel.de

3. LCA: Calculation rules

3.1 Declared unit

The declaration refers to one cubic metre of clay block with a bulk density of 575 kg/m³ (average of the bulk density class 600 kg/m³). The basis of the LCA results in this EPD is the formation of an average for all German plants which was done as a weighted average in relation to the share of the individual production plants in the total annual production.

Declared unit

Name	Value	Unit
Declared unit	1	m³
Bulk density	575	kg/m³
Conversion factor to 1 kg	575	-
Conversion factor to 1 t	1.739	

3.2 System boundary

EPD type: Cradle to factory gate with options. The LCA includes obtaining raw materials, raw material transport and actual product manufacturing including the packaging materials (Modules A1–A3). Transport to the building site (Module A1) and the treatment of the packaging materials in waste incineration plants after installation of the product (Module A5) are also part of the system boundary. The product is dismantled after the end of the period of use (Module C1). Disposal in inert matter landfill (Module C4) is provided for for around 6% of the blocks after transport of the dismantled product (Module C4); 94% can be used further. Credits as a result of recycling broken clay blocks are declared in Module D. Credits for electricity and thermal energy as a result of the thermal recycling of the packaging within Module A5 are also included in Module D.

3.3 Estimations and assumptions

The *GaBi 9* database does not contain data for all raw materials or pre-products. The processes for some materials were estimated from pre-products which are similar in terms of production and environmental impact. The raw material clay was, for example, substituted with clay data. Assumptions were made with regard to the cumulative production-related emissions. An estimate is made based on data from the remaining companies for companies which are not subject to monitoring by the competent authorities and thus cannot provide measurement values. CO_2 emissions from sawdust and biogenic additives are mapped on the input side with a dataset and the previously stored CO_2 is completely released on the output side.

3.4 Cut-off rules

All data from company data collection is included, i.e. all initial materials used according to the formulations and the thermal and electrical energy used. Material and energy flows with a share of less than 1% were therefore also included. All data stated was integrated into the LCA model. Transport costs were calculated in for all basic materials, the shipping of products (A4) and in the end-of-life scenario (C2). The wear factor for wooden pallets and also machines, equipment and infrastructure required for manufacture were ignored. It can be assumed that the ignored processes would have contributed less than 5% each to the impact categories included.

3.5 Background data

thinkstep's *GaBi 9* software system for integrated lifecycle assessment was used to model the clay blocks. The consistent data in the GaBi database is documented online in the GaBi documentation. The base data in the GaBi database was used for energy, transport and auxiliary materials. The LCA was compiled for the supply area of Germany. This means that those pre-stages relevant for Germany such as electricity or energy carrier provision are used in addition to the production processes. The electricity mix and electricity from hydro-electric power, thermal energy from natural gas, heating oil and biomass for Germany for the reference year 2016 is used. Emissions from the firing process are collected as primary data based on measurements by Bundesverband der Deutschen Ziegelindustrie member companies.

3.6 Data quality
Data for the production year of 2019 is used to model the product stage of the clay blocks. All other relevant background data was taken from the database behind the *GaBi 9* software. The database was last updated in 2020. Data for the products examined is collected directly in the plants by Bundesverband der Deutschen Ziegelindustrie e.V. member companies. The majority of the data for the upstream supply chains originates from industrial sources which was collected under consistent temporal and methodical boundary conditions. Great importance is given to the completeness of the recording of environmentally relevant material and energy flows. The data quality can therefore be described as good.

3.7 Period under review
The period under review is 2019. The data represents an annual average across 12 months.

3.8 Allocation
A variety of materials such as sawdust are used as additives. The sawdust is a by-product of the sawing process. An economic allocation is applied here in the corresponding background data to separate the impacts of the sawdust from that of sawn timber. The carbon dioxide content for sawdust and biogenic additives is included via the corresponding absorption of CO_2. These materials burn during the manufacturing process. The CO_2 emissions which occur are calculated in accordance with the theoretically complete transformation of carbon into carbon dioxide.

A variety of secondary materials such as sludge from paper recycling, paper fibre waste, secondary polystyrene and filter cake are used in the manufacture of the blocks. In the model, these materials are introduced into the system free of impacts.

The production process produces no ancillary products. There is therefore no allocation integrated into the applied LCA model. Broken blocks from production can be reused in production but can equally be used in various areas (road construction, tennis sand, etc.). The internally used broken clay blocks remain within A1-A3 (closed loop).

3.9 Comparability
Generally, a comparison or evaluation of EPD data is only possible if all data to be compared was created in accordance with *EN 15804* and the building context and product-specific features are taken into account.

The background data comes from service pack 39 of the *2019 GaBi 9* database.

4. LCA: Scenarios and further technical information

Characteristic product properties of biogenic carbon
The total mass of biogenic carbon materials and the associated packaging make up less than 5 % of the product's total mass. The mass of packaging which contains biogenic carbon is 0.00031 kg.

Transport to the building site (A4)

Name	Value	Unit
Litres of fuel	1.16	l/100 km
Transport distance	109	km
Capacity utilisation (including empty runs)	85	%
Bulk density of the products transported	550–2000	kg/m^3

Installation into the building (A5)

Name	Value	Unit
Output materials as a result of	0.6	kg
Waste treatment on the building site		
Material loss	See information below	

The LCA results do not include environmental impacts through installation losses as these depend on the building project and therefore vary. The LCA results can be calculated for a specific installation loss (e.g. Installation loss 3%, multiplication of the LCA results by 1.03) to calculate additional environmental impacts which occur through manufacture and disposal. Should the user have no specific figure available for installation losses, a quota of 3% can be used for calculation (*TBE PCR document*).

Reference period of use

Name	Value	Unit
Service life (minimum according to BBSR)	50	a
Service life according to manufacturer specifications	150	a

The reference period of use if installed in accordance with the current rules of technology is 150 years.

End-of-life (C1-C4)

Name	Value	Unit
As mixed building waste	575	kg
To recycling	539.35	kg
To landfill	35.65	kg

The basic material clay contains limescale and dolomite which are broken down during the firing process and CO_2 is released (which is included in A1 to A3). A large proportion of the calcium and magnesium oxides is siliceously bonded. However, a smaller proportion exists as free alkaline or earth alkaline oxides in firing shards. These free oxides recarbonise with the aid of atmospheric CO_2. This process begins after leaving the furnace. Full recarbonisation of the free alkaline and earth alkaline oxides takes place during processing in the dismantling phase at the latest; these provide on average 2 mass % CO_2 per kg fired blocks as a credit in Module C3 (*recarbonisation*)

Reuse, recovery and recycling potential (D), relevant scenario information
See information in Chapter 3
Scenario D: Credits due to recycling processed building rubble
Scenario D1: Credits due to recycling the packaging materials (from Module A5) are shown in Module D1.

5. LCA: Results

The following tables show the results of the indicators of the impact assessment, resource use and also waste and other output flows relating to one cubic metre of clay blocks. To convert the results to apply to one tonne of clay blocks, the results can be divided by the specific density (575 kg/m³) of the clay block and multiplied by 1,000. The LCA results do not include environmental impacts through installation losses as these depend on the building project and therefore vary. The LCA results can be calculated for a specific installation loss (e.g. installation loss 3%, multiplication of the LCA results by 1.03) to calculate additional environmental impacts which occur through manufacture and disposal.

Important:
EP fresh water: This indicator was implemented in co-ordination with the characterisation module (EUTREND model, Strujis et al., 2009b, as implemented in ReCiPe; http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml) calculated as "kg P eq".

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

Production stage			Construction process stage		Use stage							End of life stage				Credits and loads beyond the system boundary
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use/application	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction/demolition	Transport	Waste processing	Disposal	Reuse, recovery or 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 in accordance with *EN 15804+A2*: 1 m³ clay blocks (575 kg/m³)

Core indicator	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D	D/1
Total GWP	[kg CO_2 eq.]	1.13E+2	4.15E+0	8.24E-1	3.52E-1	9.42E-1	-1.01E+1	5.00E-1	-1.46E+0	-1.06E+0
GWP fossil	[kg CO_2 eq.]	1.13E+2	4.13E+0	8.30E-1	3.66E-1	9.38E-1	1.44E+0	5.41E-1	-1.45E+0	-1.05E+0
GWP biogenic	[kg CO_2 eq.]	1.80E-1	1.66E-3	-3.90E-3	-1.56E-2	3.77E-4	-1.15E+1	-4.29E-2	-9.09E-3	-4.39E-3
GWP luluc	[kg CO_2 eq.]	5.18E-2	1.73E-2	-1.32E-3	1.47E-3	3.92E-3	5.29E-3	1.56E-3	-4.84E-3	-1.35E-3
ODP	[kg CFC11 eq.]	4.91E-13	1.01E-15	-1.59E-14	8.61E-17	2.30E-16	6.11E-15	2.03E-15	-2.07E-14	-1.61E-14
AP	[mol H^+ eq.]	9.24E-2	3.83E-3	-8.66E-4	1.73E-3	8.71E-4	1.35E-2	3.88E-3	-4.61E-3	-1.16E-3
EP fresh water	[kg PO_4 eq.]	9.27E-5	8.99E-6	-2.17E-6	7.64E-7	2.04E-6	3.43E-6	9.32E-7	-4.41E-6	-2.20E-6
EP marine	[kg N eq.]	2.69E-2	1.19E-3	-3.29E-4	8.16E-4	2.71E-4	6.64E-3	9.99E-4	-1.75E-3	-3.75E-4
EP terrestrial	[mol N eq.]	3.41E-1	1.45E-2	-2.65E-3	9.04E-3	3.29E-3	7.30E-2	1.10E-2	-1.92E-2	-4.00E-3
POCP	[kg NMVOC eq.	7.65E-2	3.15E-3	-8.81E-4	2.28E-3	7.17E-4	1.93E-2	3.02E-3	-4.14E-3	-1.01E-3
ADPE	[kg Sb eq.]	9.90E-6	3.43E-7	-2.25E-7	2.92E-8	7.79E-8	1.58E-6	4.88E-8	-3.14E-7	-2.28E-7
ADPF	[MJ]	1.15E+3	5.48E+1	-1.49E+1	4.66E+0	1.25E+1	2.71E+1	6.90E+0	-1.91E+1	-1.51E+1
WDP	[m³ world eq. extracted]	2.37E+0	1.78E-2	1.61E-1	1.51E-3	4.04E-3	2.42E-1	5.65E-2	-3.55E-2	-1.20E-2

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

RESULTS OF THE LCA – INDICATORS TO DESCRIBE THE USE OF RESOURCES in accordance with *EN 15804+A2*: 1 m³ clay blocks (575 kg/m³)

Indicator	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D	D/1
PERE	[MJ]	2.15E+2	3.19E+0	5.59E-2	2.71E-1	7.25E-1	2.28E+0	1.70E+0	-5.45E+0	-3.78E+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]	2.15E+2	3.19E+0	5.59E-2	2.71E-1	7.25E-1	2.28E+0	1.70E+0	-5.45E+0	-3.78E+0
PENRE	[MJ]	1.18E+3	5.48E+1	2.92E-1	4.66E+0	1.25E+1	2.71E+1	1.29E+1	-1.91E+1	-1.51E+1
PENRM	[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
PENRT	[MJ]	1.18E+3	5.48E+1	2.92E-1	4.66E+0	1.25E+1	2.71E+1	1.29E+1	-1.91E+1	-1.51E+1
SM	[kg]	1.42E+2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	5.39E+2	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	[m³]	1.71E-1	2.86E-3	4.05E-3	2.43E-4	6.50E-4	7.09E-3	3.26E-3	3.54E-3	2.06E-3

Key	PERE = Renewable primary energy as energy carrier; PERM = Renewable primary energy as material utilisation; PERT = Total use of renewable primary energy resources; PENRE = Non- renewable primary energy as energy carrier; PENRM = Non- renewable primary energy as material utilisation; PENRT = Total use of non-renewable primary energy resources; SM = Use of secondary materials; 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 in accordance with *EN 15804+A2*: 1 m³ clay blocks (575 kg/m³)										
Indicator	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D**	**D/1**
HWD	[kg]	1.47E-6	2.05E-6	2.28E-10	1.74E-7	4.66E-7	5.70E-7	1.08E-7	-3.60E-7	-7.95E-9
NHWD	[kg]	1.71E+0	9.62E-3	7.61E-3	8.18E-4	2.19E-3	8.15E-3	3.57E+1	-1.12E+1	-7.12E-3
RWD	[kg]	1.71E-2	5.77E-5	8.10E-6	4.91E-6	1.31E-5	2.17E-4	7.96E-5	-7.12E-4	-5.48E-4
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	5.39E+2	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	3.42E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
EET	[MJ]	0.00E+0	0.00E+0	7.88E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Key	HWD = Hazardous waste disposal; NHWD = Non-hazardous waste disposal; RWD = Radioactive waste disposal; CRU = Components for reuse; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy EET = Exported thermal energy									

RESULTS OF THE LCA – additional impact categories in accordance with *EN 15804+A2*-optional: 1 m³ clay blocks (575 kg/m³)										
Indicator	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D**	**D/1**
PM	[Cases of illness]	ND	ND	ND	ND	ND	ND	ND	ND	ND
IR	[kBq U235 eq.]	ND	ND	ND	ND	ND	ND	ND	ND	ND
ETP-fw	[CTUe]	ND	ND	ND	ND	ND	ND	ND	ND	ND
HTP-c	[CTUh]	ND	ND	ND	ND	ND	ND	ND	ND	ND
HTP-c	[CTUh]	ND	ND	ND	ND	ND	ND	ND	ND	ND
SQP	[-]	ND	ND	ND	ND	ND	ND	ND	ND	ND
Key	PM = Potential Occurrence of Diseases due to Particle Emissions; IR = Potential Effects through Human Exposure to U235; ETP-fw = Potential Toxicity Comparison Unit for Ecosystems; HTP-c = Potential Toxicity Comparison Unit for Humans (carcinogenic effect); HTP-nc = Potential Toxicity Comparison Unit for Humans (non-carcinogenic effect); SQP = Potential Soil Quality Index									

*GWP in Module C3 contains -20 kg CO_2 eq./t through carbonation.

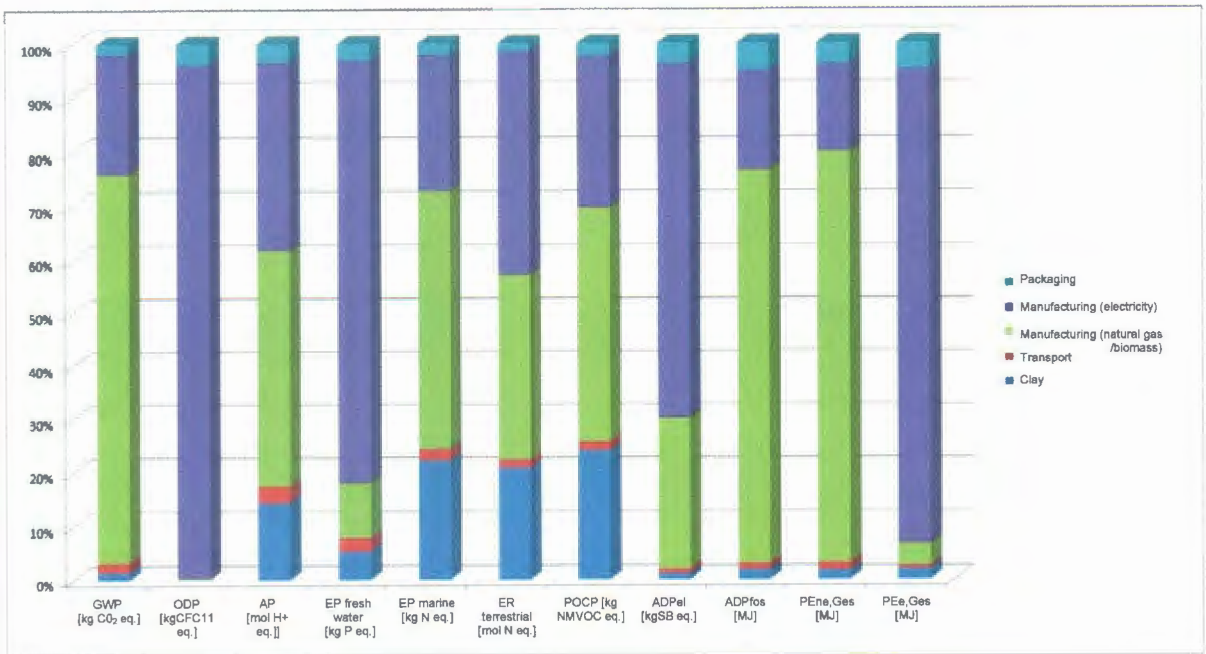
The impact assessment results show relative statements/potentials which give no information on concrete environmental impacts (endpoint); no exceeded limits or risk analyses can be derived from this.

Below are the restriction notices for the declaration of core and additional environmental impact indicators:

Restriction notice 2:
ILCD classification = ILCD Type 3, Indicator: ADP minerals and metals, ADP fossil, WDP Water Deprivation Potential

Restriction notice 2 – The results of this environmental impact category must be applied with care as uncertainties with these results are high or because there is a lack of experience with the indicator.

6. LCA: Interpretation



The analysis of the lifecycle assessment indicators for unfilled clay blocks shows that the environmental impacts are specifically dominated in all environmental categories by energy consumption during the manufacturing process (electricity and thermal energy) in the plant and the associated emissions due to the firing process.
Process-related emissions are to a large extent related to raw materials. The quality of the clays used therefore also play a not insignificant role. Packaging and transport take on only a very subordinate role.

Deviation of the impact assessment results from declared average values is low.

The data quality for modelling Bundesverband der Deutschen Ziegelindustrie e.V. unfilled clay blocks can be regarded as good. Corresponding data was present in the *GaBi* database for all relevant basic and auxiliary materials used. The processes for some materials were estimated from pre-products which are similar in terms of production and environmental impact.

7. Requisite evidence

Research and assessments show that the natural radioactivity of clay blocks permit unlimited use of this building material from a radiological point of view. Clay blocks do not contribute to a relevant increase in radon concentration in rooms; their contribution to the inhalation dose is negligible compared to the amount of radon in the ground. *(Information leaflet: Natural radionuclides in building materials)*

8. References

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DIN EN 772- 13:2000- 09, Methods of test for masonry units - Part 13: Determination of net and gross dry density of masonry units (except for natural stone).

DIN EN 772-16
EN 772- 16:2011- 07, Methods of test for masonry units.

DIN 1053-4
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DIN EN 1745
DIN EN 1745:2020-10, Masonry and masonry products - Methods for determining thermal properties.

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DIN 4160
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DIN EN 13501-2
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Federal Office for Radiation Protection, 2012.

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PCR Part A
Product category rules for building-related products and services. Part A: Calculation rules for the LCA and requirements of the background report. Berlin: Institut Bauen und Umwelt e.V.(Ed.), Version 1.8, 04/07/2019.

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

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

EU Regulation no.305/2011
EU Regulation no 305/2011 Ordinance of the European Parliament and Council of 9th March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC.

EC Regulation no. 1907/2006 (REACH)
EU chemicals ordinance which came into effect on 1st June 2007. REACH stands for Registration, Evaluation, Authorisation and Restriction of Chemicals.

REACH
EC Regulation no. 1907/2006/ EU chemicals ordinance which came into effect on 1st June 2007. REACH stands for Registration, Evaluation, Authorisation and Restriction of Chemicals, German: Registration, Evaluation, Authorisation and Restriction of Chemicals.

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