



Baksteenfederatie

Environmental Product Declaration (EPD)

Clay roof tiles

1 Declaration of general information

Introduction

The Belgian brick and clay roof tile sector deems it important to have an insight into the integral environmental aspects, encountered during the life-span of particular clay products. With this framework in mind, the sector has set up a project with various partners: the Flemish Institute for Technological Research (VITO), the Department for Architecture, Town Planning and Spatial Planning at the Catholic University of Leuven (KULeuven - ASRO) and the Belgian Building Research Institute (BBRI). The aim of this joint project is to carry out a sustainability analysis on the entire life cycle of four important clay products. One of the outcomes of this project is this EPD for clay roof tiles, which outlines the various environmental aspects from the primary extraction of raw materials up to and including the end of life (EoL) treatment after its technical life time.

Contact name and address

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Clay roof tile's functional unit

This EPD concerns an average clay roof tile produced in a representative Belgian production plant. Environmental indicators are expressed for the complete life cycle, from the cradle to the grave. The functional unit is defined as "the annual environmental impact related to the production, packaging, transport to the building site, construction, use, maintenance, demolition at the end of the technical service life, transport of the demolished materials to the waste processing plant and the end of life treatment of one tonne of clay roof tiles".

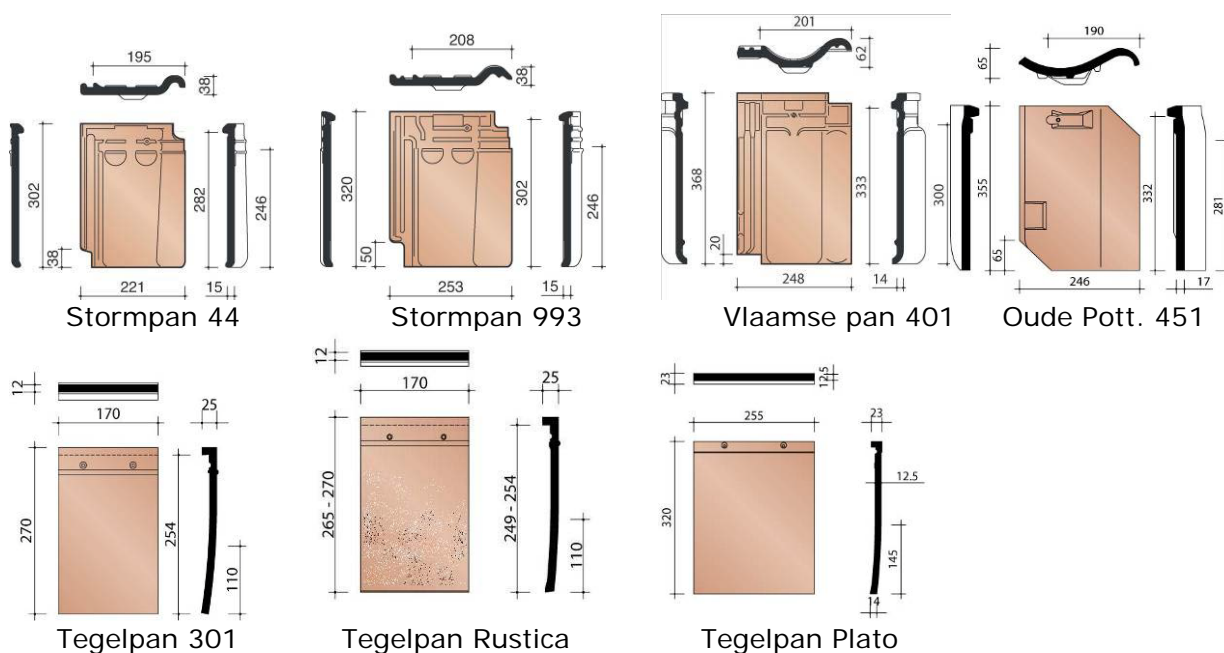
The conversion factor 'tonne → m² roof or wall' depends of the type of clay pan and the inclination of the roof.

Model		Weight /pc (kg)	Weight / m ² (kg/m ²)
Stormpan 44		2,00	42
Stormpan 993		2,30	46

Vlaamse pan 401		3,05	50,63
Oude Pottelbergse pan 451		2,65	49,55
Tegelpan 301		1,15	62,10 (35°) / 75,90 (25°)
Tegelpan Rustica		1,20	64,80
Tegelpan Plato		2,3	62,10 (35°) / 66,70 (25°)

Product name & graphic display of product

Average Belgian clay roof tile.



Description of the product

Ceramic clay tiles and fittings are used for the covering of pitched roofs (straight or curved) and for wall claddings (straight or curved). The tiles are produced by extrusion and/or moulding (=shaping) of a plastic clay mixture (with or without additives) followed by a drying and firing process.

Their technical life time is 150 years.



Model	Usefull length (mm)	Usefull width (mm)	Min. roofpitch (°)	Pcs /m ²
Stormpan 44	246	195	22	21
Stormpan 993	246	208	20	20
Vlaamse pan 401	300	201	22	16,6
Oude Pottelbergse pan 451	281	190	25	18,7
Tegelpan 301	110 / 90	170	35 / 25	54 / 66
Tegelpan Rustica	110	170	35	54
Tegelpan Plato	145 / 135	255	35 / 25	27 / 29

EPD programme and programme operator

The present EPD is in line with the ongoing standardization work by CEN/TC 350 (EN15804 and EN15942). A programme operator related to the CEN/TC 350 has not been established yet.

Furthermore, this EPD contains the impact categories that are recommended by the MMG project (Environment-related material performance of Building elements) commissioned by OVAM (the Public Waste Agency of Flanders) and proposed in an environmental decree under development by Federal Public Agency of Health and Environment.

Date of declaration and validity

December, 2012

The EPD has a 5 year validity period (till December, 2017)

Comparability

Please note that EPDs of construction products may not be comparable if they do not comply with the CEN/TC 350 (EN15804 and EN15942) standards.

EPD of an average clay roof tile produced in a representative Belgian production plant

The present EPD outlines various environmental aspects, which accompany an average clay roof tile produced in a representative Belgian production plant, from the primary extraction of raw materials up to and including the end of life (EoL) treatment after its technical life time of 150 years.

Data source

Specific data for an average clay roof tile produced in a representative Belgian production plant. Data from a specific quarry and factory were used (data for the clay roof tile which best represented the industry average). Further, wherever possible, data from the Belgian brick and clay roof tile sector were evaluated against data from literature and available databases. The more generic data are derived from public LCA databases (primarily the Swiss Ecoinvent database, 2010).

Group of manufacturers

This EPD is representative for Belgian facing bricks produced by the member companies of the BBF. For an overview of these Belgian companies we refer to page 14 of this EPD.

Retrieve information

Further information can be found in the third-party report, by contacting the BBF (info@baksteen.be)

2 Declaration of the material content

The clay roof tile does not contain any substances as such or in concentration exceeding legal limits, which can adversely affect human health and the environment in any stages of its entire life cycle.

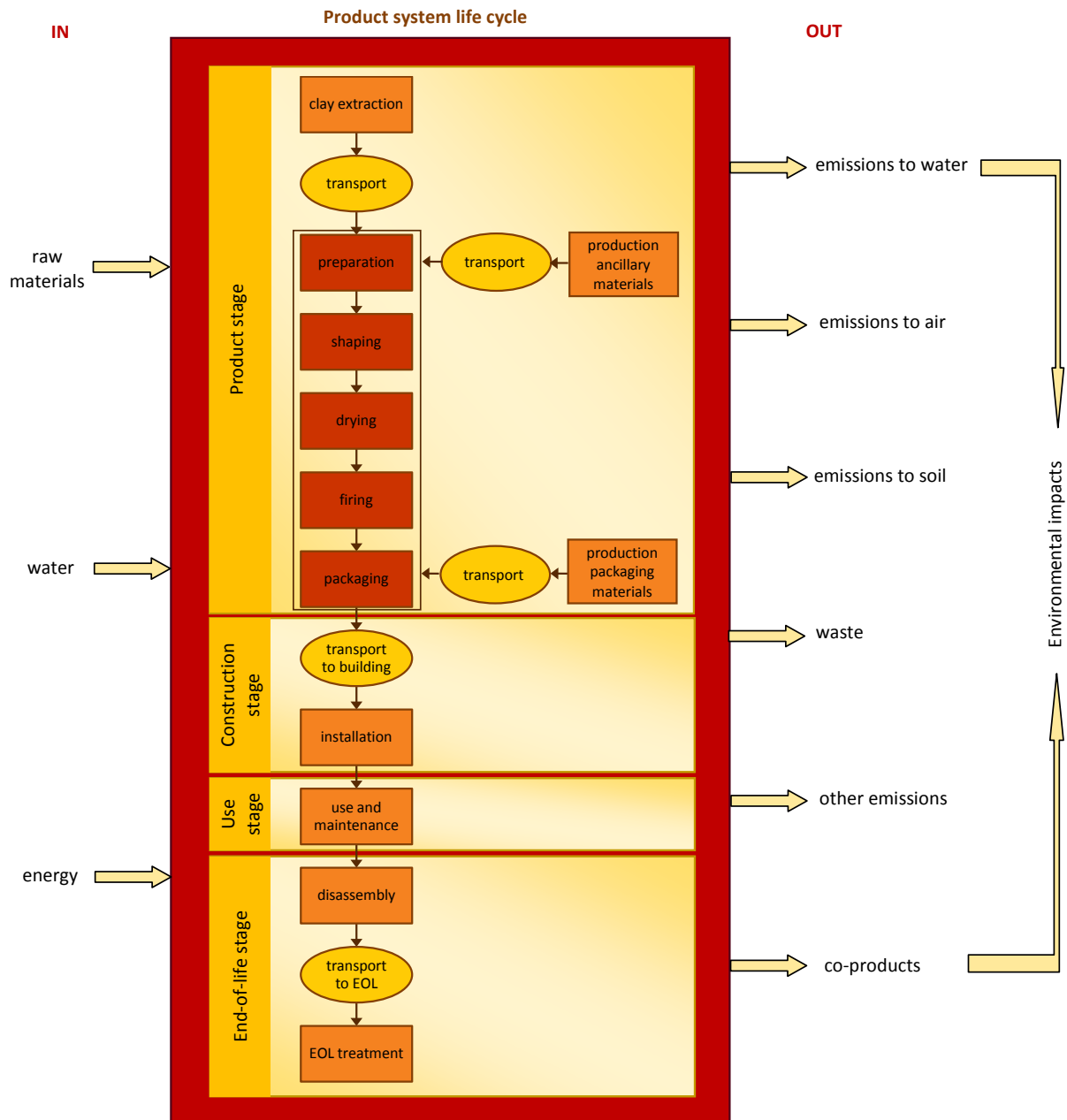
3 Declaration of the environmental parameters derived from LCA

3.1 Life cycle flow diagram

The EPD refers to an average clay roof tile produced in a Belgian production plant, from the cradle to the grave, including product stage, transport to construction site and construction process stage, use stage and end of life stage.

- **Product stage:** raw material extraction and processing, recycling processes for recycled material input, transport to the manufacturer, manufacturing (including all energy provisions, waste management processes during the product stage up to waste for final disposal).
 - The clay extraction;
 - The transport of the clay to the representative tile factory;
 - The extraction and/or production of additives and packaging;
 - The transport of these additives and packaging to the representative tile factory;
 - The production process (preparation, shaping, drying, firing);
 - Production waste and corresponding waste treatment;
- **Construction process stage:** including all energy provisions, waste management processes during the construction stage up to waste for final disposal.
 - The transport of the clay roof tiles to the building site;
 - The installation into the building;
- **Use stage** (maintenance and operational use): including transport and all energy provisions, waste management processes up to waste for final disposal during this use stage.
 - Operational use and maintenance are not relevant for the clay roof tiles.
- **End of life stage:** including all energy provisions during the end of life stage.
 - The disassembly at the end of the technical life time;
 - The transport to the waste treatment facility;
 - The processes at the end of life (recycling, reuse or landfilling).

All steps of the life cycle related to the packaging materials of the clay roof tiles are also taken into account, and the results are reported separately ('total including packaging'). These steps are the production of packaging materials (A1), the transport of packaging materials to the representative production site of the roof tiles (A2), the packaging process (A3) and the transport and treatment of packaging waste released at the construction site (A5).



3.2 Parameters describing environmental impacts

The following environmental parameters are expressed with the impact category parameters of the life cycle impact assessment (LCIA).

Impact category		Climate change	Ozone depletion	Terrestrial acidification	Eutrophication	Photochemical oxidation	Abiotic depletion - non fossil	Abiotic depletion - fossil	
Life cycle stage	Information module	kg CO ₂ eq	kg CFC-11 eq	kg SO ₂ eq	kg PO ₄ ³⁻ eq	kg C ₂ H ₄	kg Sb eq	MJ, net calorific value	
Product stage	Raw material supply	A1	1,06E-01	2,45E-08	7,68E-04	2,18E-04	3,09E-05	1,00E-06	1,36E+00
	Raw material supply - incl. packaging	A1	1,53E-01	1,66E-08	9,67E-04	2,77E-04	4,37E-05	1,07E-06	2,53E+00
	Transport	A2	1,40E-01	1,92E-08	9,22E-04	2,29E-04	2,35E-05	3,90E-07	2,04E+00
	Transport - incl. pack.	A2	1,42E-01	1,95E-08	9,35E-04	2,32E-04	2,39E-05	4,05E-07	2,07E+00
	Manufacturing	A3	2,07E+00	2,64E-07	1,95E-02	5,15E-04	1,03E-03	1,54E-07	3,74E+01
	Manufacturing - incl. pack.	A3	2,07E+00	2,64E-07	1,95E-02	5,15E-04	1,03E-03	1,54E-07	3,74E+01
Construction stage	Transport	A4	2,02E-01	3,28E-08	1,17E-03	2,88E-04	3,88E-05	9,07E-07	3,19E+00
	Installation process	A5	0	0	0	0	0	0	0
	Installation process - incl. packaging	A5	2,87E-03	4,43E-10	1,45E-05	3,96E-06	6,76E-07	1,50E-08	4,44E-02
Use stage	Use and operation	B	0	0	0	0	0	0	0
End of life stage	De-construction demolition	C1	0	0	0	0	0	0	0
	Transport	C2	5,63E-02	8,85E-09	3,06E-04	7,92E-05	1,03E-05	3,37E-07	8,75E-01
	Waste processing	C3	0	0	0	0	0	0	0
	Disposal	C4	2,37E-03	7,09E-10	1,47E-05	3,43E-06	5,18E-07	4,89E-09	6,33E-02
Benefits and loads beyond the system boundaries	Re-use, recovery, recycling potential	D	-6,13E-03	1,39E-10	-5,07E-05	-2,94E-05	-3,46E-06	-1,04E-07	-3,10E-02
Total (excl. Module D)			2,57E+00	3,41E-07	2,27E-02	1,33E-03	1,13E-03	2,79E-06	4,50E+01
Total incl. packaging (excl. Module D)			2,63E+00	3,43E-07	2,29E-02	1,40E-03	1,14E-03	2,89E-06	4,62E+01

Additional impact categories:

Impact category		Human toxicity	Particulate matter formation (Belgium)	Ionising radiation, human health	Terrestrial ecotoxicity	Fresh-water ecotoxicity	Marine ecotoxicity	
Life cycle stage	Information module	DALY	DALY	DALY	kg 1,4-DB eq	kg 1,4-DB eq	kg 1,4-DB eq	
Product stage	Raw material supply	A1	2,44E-08	2,59E-07	3,74E-10	1,14E-05	7,12E-04	7,50E-04
	Raw material supply - incl. packaging	A1	3,33E-08	3,33E-07	5,30E-10	1,74E-05	9,44E-04	9,66E-04
	Transport	A2	1,14E-08	3,62E-07	2,11E-10	1,50E-05	3,44E-04	3,78E-04
	Transport - incl. pack.	A2	1,16E-08	3,68E-07	2,17E-10	1,55E-05	3,50E-04	3,87E-04
	Manufacturing	A3	7,21E-08	4,32E-06	7,52E-09	5,03E-05	1,28E-03	1,81E-03
	Manufacturing - incl. pack.	A3	7,21E-08	4,32E-06	7,52E-09	5,03E-05	1,28E-03	1,81E-03
Construction stage	Transport	A4	1,59E-08	4,88E-07	2,90E-10	2,49E-05	4,81E-04	5,17E-04
	Installation process	A5	0	0	0	0	0	0
	Installation process - incl. packaging	A5	3,53E-10	6,33E-09	6,60E-12	4,55E-07	1,03E-05	1,18E-05
Use stage	Use and operation	B	0	0	0	0	0	0
End of life stage	De-construction, demolition	C1	0	0	0	0	0	0
	Transport	C2	5,66E-09	1,32E-07	1,31E-10	1,03E-05	1,67E-04	2,07E-04
	Waste processing	C3	0	0	0	0	0	0
	Disposal	C4	1,61E-10	7,06E-09	3,58E-12	2,71E-07	5,63E-06	5,44E-06
Benefits and loads beyond the system boundaries	Re-use, recovery, recycling potential	D	-6,88E-09	5,57E-09	-6,28E-10	-4,73E-07	-2,09E-04	-1,95E-04
Total (excl. Module D)			1,30E-07	5,57E-06	8,52E-09	1,12E-04	2,99E-03	3,67E-03
Total incl. packaging (excl. Module D)			1,39E-07	5,65E-06	8,69E-09	1,19E-04	3,24E-03	3,91E-03

Impact category			Agricultural land occupation	Urban land occupation	Natural land transformation	Transformation tropical rain forest	Water depletion
Life cycle stage	Information module		species.yr	species.yr	species.yr	species.yr	m ³
Product stage	Raw material supply	A1	1,75E-11	2,58E-10	3,60E-10	3,10E-11	2,06E-03
	Raw material supply - incl. packaging	A1	9,75E-09	4,40E-10	4,78E-10	6,99E-11	2,48E-03
	Transport	A2	6,38E-12	8,17E-11	1,35E-10	2,44E-12	5,09E-04
	Transport - incl. pack.	A2	6,50E-12	8,27E-11	1,36E-10	2,50E-12	5,19E-04
	Manufacturing	A3	3,42E-11	2,62E-11	3,33E-10	1,20E-11	4,92E-03
	Manufacturing - incl. pack.	A3	3,42E-11	2,62E-11	3,33E-10	1,20E-11	4,92E-03
Construction stage	Transport	A4	8,27E-12	4,17E-11	1,08E-10	4,82E-12	7,83E-04
	Installation process	A5	0	0	0	0	0
	Installation process - incl. packaging	A5	1,43E-13	1,03E-12	1,51E-12	6,81E-14	1,14E-05
Use stage	Use and operation	B	0	0	0	0	0
End of life stage	De-construction, demolition	C1	0	0	0	0	0
	Transport	C2	2,87E-12	2,25E-11	2,98E-11	1,39E-12	2,38E-04
	Waste processing	C3	0	0	0	0	0
	Disposal	C4	1,16E-12	6,42E-12	-2,44E-11	5,47E-14	5,70E-05
Benefits and loads beyond the system boundaries	Re-use, recovery, recycling potential	D	-6,07E-12	-5,14E-11	-1,54E-10	-2,19E-12	-8,92E-03
Total (excl. Module D)			7,04E-11	4,37E-10	9,42E-10	5,16E-11	8,56E-03
Total incl. packaging (excl. Module D)			9,81E-09	6,20E-10	1,06E-09	9,06E-11	9,00E-03

3.3 Parameters describing resource use

The following environmental parameters apply data based on the life cycle inventory (LCI).

Parameter			Use of renewable primary energy resources			Use of non renewable primary energy resources		
			excluding renewable primary energy resources used as raw materials	used as raw materials	total (primary energy and primary energy resources used as raw materials)	excluding non renewable primary energy resources used as raw materials	used as raw materials	total (primary energy and primary energy resources used as raw materials)
Life cycle stage	Information module		MJ, gross calorific value	MJ, gross calorific value	MJ, gross calorific value	MJ, gross calorific value	MJ, gross calorific value	MJ, gross calorific value
Product stage	Raw material supply	A1	4,78E-02	0	4,78E-02	1,63E+00	0	1,63E+00
	Raw material supply - incl. packaging	A1	8,29E-02	2,07E+00	2,16E+00	3,01E+00	0	3,01E+00
	Transport	A2	2,70E-02	0	2,70E-02	2,18E+00	0	2,18E+00
	Transport - incl. pack.	A2	2,78E-02	0	2,78E-02	2,22E+00	0	2,22E+00
	Manufacturing	A3	1,59E-01	0	1,59E-01	4,41E+01	0	4,41E+01
	Manufacturing - incl. pack.	A3	1,59E-01	0	1,59E-01	4,41E+01	0	4,41E+01
Construction stage	Transport	A4	3,92E-02	0	3,92E-02	3,38E+00	0	3,38E+00
	Installation process	A5	0	0	0	0	0	0
	Installation process - incl. packaging	A5	8,72E-04	0	8,72E-04	4,87E-02	0	4,87E-02
Use stage	Use and operation	B	0	0	0	0	0	0
End of life stage	De-construction, demolition	C1	0	0	0	0	0	0
	Transport	C2	1,72E-02	0	1,72E-02	9,59E-01	0	9,59E-01
	Waste processing	C3	0	0	0	0	0	0
	Disposal	C4	4,88E-04	0	4,88E-04	6,60E-02	0	6,60E-02
Benefits and loads beyond the system boundaries	Re-use, recovery, recycling potential	D	-8,18E-02	0	-8,18E-02	-4,10E-01	0,00E+00	-4,10E-01
Total (excl. Module D)			2,90E-01	0	2,90E-01	5,23E+01	0	5,23E+01
Total incl. packaging (excl. Module D)			3,27E-01	2,07E+00	2,40E+00	5,37E+01	0	5,37E+01

Parameter			Use of secondary material	Use of renewable secondary fuels	Use of non renewable secondary fuels	Net use of fresh water
Life cycle stage	Information module		kg	MJ, net calorific value	MJ, net calorific value	m ³
Product stage	Raw material supply	A1	0	0	0	2,06E-03
	Raw material supply - incl. packaging	A1	0	0	0	2,48E-03
	Transport	A2	0	0	0	5,09E-04
	Transport - incl. pack.	A2	0	0	0	5,19E-04
	Manufacturing	A3	0	0	0	4,92E-03
	Manufacturing - incl. pack.	A3	0	0	0	4,92E-03
Construction stage	Transport	A4	0	0	0	7,83E-04
	Installation process	A5	0	0	0	0
	Installation process - incl. packaging	A5	0	0	0	1,14E-05
Use stage	Use and operation	B	0	0	0	0
End of life stage	De-construction, demolition	C1	0	0	0	0
	Transport	C2	0	0	0	2,38E-04
	Waste processing	C3	0	0	0	0
	Disposal	C4	0	0	0	5,70E-05
Benefits and loads beyond the system boundaries	Re-use, recovery, recycling potential	D	0	0	0	-8,92E-03
Total (excl. Module D)			0	0	0	8,56E-03
Total incl. packaging (excl. Module D)			0	0	0	9,00E-03

3.4 Other environmental information describing different waste categories and output flows

The parameters describing waste categories and other material flows are output flows derived from the life cycle inventory (LCI)

Other environmental information describing waste categories

Parameter			Hazardous waste disposed	Non-hazardous waste disposed	Radioactive waste disposed
Life cycle stage	Information module		kg	kg	kg
Product stage	Raw material supply	A1	2,32E-06	1,13E-02	3,28E-06
	Raw material supply - incl. packaging	A1	2,77E-06	1,39E-02	4,66E-06
	Transport	A2	1,74E-06	9,81E-03	1,79E-06
	Transport - incl. pack.	A2	1,77E-06	1,00E-02	1,84E-06
	Manufacturing	A3	3,65E-05	1,13E-02	6,62E-05
	Manufacturing - incl. pack.	A3	3,65E-05	1,13E-02	6,62E-05
Construction stage	Transport	A4	2,88E-06	2,20E-02	2,42E-06
	Installation process	A5	0	0	0
	Installation process - incl. packaging	A5	2,85E-07	2,73E-04	5,53E-08
Use stage	Use and operation	B	0	0	0
End of life stage	De-construction, demolition	C1	0	0	0
	Transport	C2	2,11E-06	5,86E-03	1,09E-06
	Waste processing	C3	0	0	0
	Disposal	C4	2,42E-08	3,33E-01	3,00E-08
Benefits and loads beyond the system boundaries	Re-use, recovery, recycling potential	D	-7,89E-07	-1,78E-02	-5,07E-06
Total (excl. Module D)			4,56E-05	3,93E-01	7,48E-05
Total incl. packaging (excl. Module D)			4,64E-05	3,97E-01	7,62E-05

Other environmental information describing output flows

Parameter	Components for re-use	Materials for recycling	Materials for energy recovery	Exported energy
	kg	kg	kg	MJ per energy carrier
Total	0	6,33	0	0
Total incl. packaging	0	6,47	0	0,13

4 Scenarios and technical information

4.1 Construction process stage

Transport from the production gate to the construction site

Parameter	Parameter unit expressed per functional unit
Fuel type consumption of vehicle or vehicle type used for transport e.g. long distance truck, boat etc.	The clay roof tiles are transported from the producers to clients inside Belgium over an average distance of 105 km (73,7% of clay roof tiles) and to foreign clients over an average distance of 300 km (26,3% of clay roof tiles), both by means of a truck. Environmental burdens associated with this kind of transport are calculated by means of the Ecoinvent V2.2 data record "transport, lorry 20-28t, fleet average/tkm/CH".
Capacity utilisation (including empty returns)	
Bulk density	
Volume capacity utilisation factor (factor: =1 or <1 or ≥1 for compressed or nested packaged products)	

Construction (installation into building)

Parameter	Parameter unit expressed per functional unit
Ancillary material for installation	Not relevant
Other resource consumption	Not relevant
Quantitative description of energy type (regional mix) and consumption during the installation process	Not relevant (The environmental impact resulting from the energy use during installation is considered negligible, taking into account the technical lifespan of 150 years).
Waste on the building site, generated by the product's installation	0,0854 kg of wood packaging waste; 0,0074 kg of paper packaging waste and 0,0124 kg of plastic waste are transported to end of life

Output materials as result of waste management processes at the building site e.g. of collection for recycling, for energy recovery, final disposal	treatment and recycled. Environmental burdens of the transportation are calculated by means of the Ecoinvent v2.2 datarecords "Transport, lorry >16t, fleet average/RER U", "Transport, lorry 3.5-16t, fleet average/RER U" and "Transport, van <3.5t/RER U".
Emissions to ambient air, soil and water	No direct emissions at the building. Emissions are related to the upstream processes (quarrying of clay and sand, transportation processes and mechanical energy) and downstream processes (waste management and treatment) and are included in the Ecoinvent datarecords that are used for modelling the environmental impacts.

4.2 Use stage: operation and maintenance

Operation

Operational use is not relevant for the roof tiles EPD, since it falls outside the system boundaries of the LCA project.

Maintenance

Maintenance is not relevant for the roof tiles. Sometimes clay roof tiles are cleaned, yet this is done for esthetical reasons and will therefore not be taken into account.

4.3 End of life

The following end of life scenarios have been taken into account:

- Estimated technical life time of 150 years
- EoL approach for landfill (impacts and credits are assigned to the life cycle that generates the waste flows)
- Recycled content approach for recycling and use of recyclates (= impact of recycling and credits for recyclates, because less virgin materials are needed is assigned to the life cycle that uses the recyclates)

Processes	Parameter unit expressed per functional unit
Collection process	After a technical life time of 150 years the clay roof tiles are disassembled, transported to the end of life treatment, and recycled/reused (95%) or landfilled (5%). Environmental burdens associated with transportation are calculated by means of the following Ecoinvent v2.2 datarecords "Transport, lorry >16t, fleet average/RER U", "Transport, lorry 3.5-16t, fleet average/RER U" and "Transport, van <3.5t/RER U". Environmental burdens of landfill are calculated by means of the Ecoinvent V2.2 datarecord "Disposal, inert waste, 5% water, to inert material landfill/CH U".
Recycling system	
Final deposition	

5 Additional information on emissions to indoor air, soil and water during use stage

Emissions to indoor air:

The harmonized European standards concerning the test methods are still being developed by CEN/TC 351. According to the actual state of the art, emissions to indoor air due to the use of clay roof tiles are not relevant.

Emissions to soil and water:

The harmonized European standards concerning the test methods are still being developed by CEN/TC 351.

Despite there is no approved European measurement method available, we can confirm that Belgian facing bricks do not contain any substances mentioned on the REACH-list.

6 Other additional information

Product certification, conformity, marking

The Belgian clay roof tiles are conform to NBN EN 1304, '*Clay roofing tiles and fittings - Product definitions and specifications*'.

Clay roof tiles have a CE marking and a declaration of conformity. The BENOR-certification and KOMO-certification attest the conformity with the National product requirements in respectively Belgium and The Netherlands.

Other technical product performances

For the full overview of the environmental benefits of facing bricks we refer to the website: www.baksteen.be, www.brique.be.

Belgian producers (members of the BBF)

Desta nv

Dumoulin Bricks nv

Floren nv

Hove bvba

Nelissen Steenfabrieken nv

Briqueteries de Ploegsteert sa

S.V.K nv

Vande Moortel nv

Vandersanden Steenfabrieken nv

Wienerberger nv

References

ASRO Third Party Report (2008) - Allacker, K. and De Troyer, F. - ArDuCoKlei-project: Levenscyclusanalyse (LCA) van "wieg-tot-graf" binnenwand en buitenwand

Ecoinvent (v2.2 - 2010)

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

EN 15942:2011 - Sustainability of construction works - Environmental product declarations - Communication format business-to-business

ISO 14025 (2006), Environmental labels and declarations - Type III environmental declarations - Principles and procedures

ISO 14040 (2006), Environmental management – Life cycle assessment – Principles and framework

ISO 14044 (2006) Environmental management – Life cycle assessment – Requirements and guidelines

ISO 21930 (2007) - Sustainability in building construction - Environmental declaration of building products

OVAM (2012) - Milieugerelateerde Materiaalprestatie van Gebouwelementen

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