ENVIRONMENTAL PRODUCT DECLARATION

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

Owner of the Declaration	Confindustria Ceramica
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-COI-20220297-ICG1-EN
Issue date	04/01/2023
Valid to	03/01/2028

Italian Ceramic Tiles

Confindustria Ceramica

Institut Bauen und Umwelt e.V.

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ECO PLATFORM EPD VERIFIED

Ceramics of Italy

CONFINDUSTRIA CERAMICA

1. General Information

Confindustria Ceramica

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

Declaration number
EPD-COI-20220297-ICG1-EN

This declaration is based on the product category rules:
Ceramic tiles and panels, 09.2022
(PCR checked and approved by the SVR)

Issue date
04/01/2023

Valid to
03/01/2028

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

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

Italian Ceramic Tiles

Owner of the declaration
Confindustria Ceramica, Viale Monte Santo 40
41049, Sassuolo, Modena
Italy

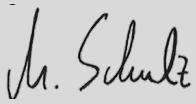
Declared product / declared unit
1 m^2 of installed ceramic tile (average)

Scope:
This document refers to an average installed ceramic tile product manufactured by Confindustria Ceramica's member companies.
This verified EPD is an update of the previous version published in 2016. Part of the LCA data collected in 2014 have been updated within the members' companies of the association.
This study has involved, as primary data 74 companies and 87 plants, that represent 82,6 % of the Italian ceramic tiles production. **The final results are representative of Confindustria Ceramica's member companies.**

The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.
The EPD was created according to the specifications of *EN 15804+A2*. In the following, the standard will be simplified as *EN 15804*.

Verification

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



Matthias Schulz
(Independent verifier)

2. Product

2.1 Product description/Product definition

Ceramic tiles, produced by Confindustria Ceramica's member companies are shaped mainly by dry pressing (but also by extrusion), starting from natural raw materials such as clay, feldspar, sand and kaolin. The main type of ceramic tiles is porcelain stoneware, characterized by a very compact structure and high performances. Other types include single-fired tiles, like monoporosa, double-fired tiles, etc.
For this study an average ceramic tile product, representative of the whole production of Confindustria Ceramica's member companies, has been identified and adopted.

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 14411: 2012* Ceramic tiles - Definitions, classification, characteristics, evaluation of conformity and marking - and the CE-marking.
For the application and use the respective national provisions apply.

2.2 Application

The ceramic tiles under study are intended and applied for both floor and wall coverings, installed both in internal and external environments, for residential, commercial and institutional use.

2.3 Technical Data

Ceramic tiles produced by Confindustria Ceramica's member companies conform to the following standards and specifications. According to *EN 14411* in Europe and *ISO 13006* in the rest of the world ceramic tiles are classified into five main types based on shaping methods (A = Extrusion, B: Dry pressing) and water absorption level.

Ceramic tiles with the lowest water absorption level (≤ 0.5%) can be designated as porcelain tiles (impervious tiles) Mosaic and trim units are included.

Constructional data

Name	Value	Unit
Water absorption acc. to ISO 10545-3	0.0 - 20	%
Modulus of rupture acc. to ISO 10545-4	8 - 35 (min)	N/mm^2
Breaking strength acc. to ISO 10545-4	200 - 1300 (min)	N
Resistance to surface ware – Glazed tiles acc. to ISO 10545-7	0 - 5	Abrasion Class
Coefficient of linear thermal expansion acc. to ISO 10545-8	9 E10-6 (max)	1/K
Thermal shock resistance acc. to ISO 10545-9	Resistant	
Crazing resistance acc. to ISO 10545-11	Resistant	
Frost resistance acc. to ISO 10545-12 (if available)	Declared value	
Non-slip propertie (Refer to national regulation)	Declared value	
Impact resistance acc. to ISO 10545-5	Test method available	
Reaction to fire NO testing (CWT)	A1-A1FL	
Chemical resistance acc. to ISO 10545-13	A - C	
Resistance to staining acc. to ISO 10545-14	GL – Min Class 3 UGL – Dec. Value	
Release of lead and cadmium acc. to ISO 10545-15	If required	
Moisture expansion acc. to /ISO 10545-10/	Declared Value	
Resistance to deep abrasion - acc. Unglazed tiles to ISO 10545-6	2365 for A, 540 for B	nm^3

- Performance data of the product in accordance with the declaration of performance with respect to its essential characteristics according to *EN 14411: 2012* Ceramic tiles - Definitions, classification, characteristics, evaluation of conformity and marking.

- Voluntary data: *EN 14411: 2016* Ceramic tiles - Definition, classification, characteristics, assessment and verification of constancy of performance and marking (not part of CE-marking).

2.4 Delivery status

The measurements of products can vary between different formats, thicknesses range from 3 mm (for ultra-thin tiles) to 30 mm (for thickened tiles).

2.5 Base materials/Ancillary materials

Main raw materials for ceramic tile:

- Clay 42 %
- Sand 13 %
- Feldspar 35 %
- Rhyolite 4 %

Main glaze components:

- Clay powder
- Quartz
- Alumina
- Natural pigments
- Frits

Main auxiliary additives:

- Dispersant
- Binder
- Fluidifying agents
- Pigments

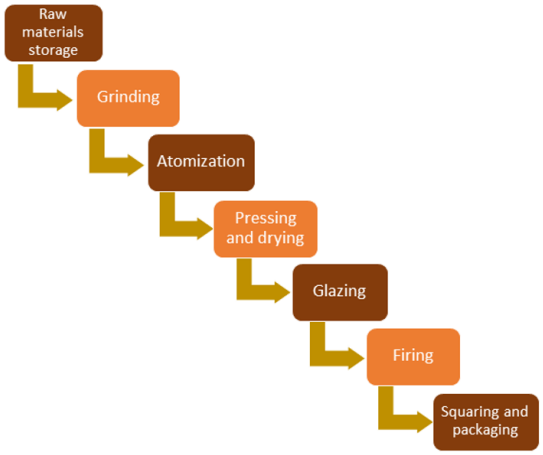
This product contains substances listed in the candidate list of substances of very high concern (*REACH* Regulation, date: 10.06.2022) exceeding 0.1 percentage by mass: no

This product 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

2.6 Manufacture

The typical manufacturing process of the ceramic tile object of this EPD is represented and described below.



The required composition of raw materials, including also recycled wastes, is mixed and grinded in mills, either in a wet or a dry process.
In the wet process, the slurry produced (with around 25-30 % water) is treated in spray driers that use thermal energy from natural gas and high air pressure in order to produce a dry powder with spherical granules of appropriate size distribution, ready to be pressed. In the drying process the production of energy via cogeneration is a widespread practice. In the dry process, without water, no spray driers are used.

Ceramic tiles are generally formed by dry pressing, using special moulds (isostatic pressing). At present new forming techniques have been developed in particular for thin and large size tiles, using special tape compaction procedures. The required formats are obtained by cutting the initial slabs after compaction. Glazing and decoration are performed on dried tile surfaces. Both wet and dry application techniques can be used. Digital glazing and decoration techniques have been introduced and adopted in the ceramic tile industry, and are at the base of very special ceramic tile surfaces.

The firing phase takes place at different temperatures (depending on the ceramic tile produced, between 1000° C and 1300° C) in order to achieve the typical ceramic tile features of abrasion, water and chemicals resistance and durability.
Before selection and packing lines, rectified products are cut and squared at the desired size.
The final product is packed in cardboard boxes, stacked on wooden pallets and protected with PET film. The tiles are stored in a warehouse until the order preparation for customer shipment.

The monitoring of the production performances is implemented mainly by the quality management system (QMS) and process certification in compliance with: *ISO 9001 - ISO 50001 - ISO 14001 - EMAS - OHSAS 18001*

2.7 Environment and health during manufacturing

Workers are informed about physical and chemical risks associated to their job and workplace. They receive an appropriate training and personal protective equipment. Confindustria Ceramica promoted the adoption of health and safety practices agreed with Trade Unions and HSE local authorities. Furthermore Confindustria Ceramica implemented the Social Dialogue agreement (NEPSI) followed by member companies. Confindustria Ceramica also promoted the adoption of studies and guidelines on environmental management to monitor and increase companies' performances.
Water/soil:
Contamination of water and soil does not occur.
Italian ceramic tile companies recycle the total amount of waste water during the drying process in form of steam or release it into the internal waste water treatment and re-use it internally or externally.
Air:
For energy production purposes only natural gas is burned. Emissions from the combustion process are under strict limits and monitored. Environmental protection measures are employed.
A broad number of companies use self-produced electricity via cogeneration and solar panels.

2.8 Product processing/Installation

Tiles are fixed to the walls and floor surfaces using different materials and amounts, for example, dispersion and cementitious adhesives and mortars, sealants or liquid-applied membranes. During the installation, no emissions occur and no health or environmental risks derive from ceramic tile installations.

2.9 Packaging

The tiles are packed in cardboard boxes, wrapped with polyethylene film and plastic straps and stacked on wooden pallets. The amount of packaging material can vary according to the tile size.
The packaging end of life phase includes (according to *Eurostat 2019*):

- Paper: recycling, energy recovery, disposal;
- Plastic: recycling, energy recovery, disposal;
- Wood: reuse, energy recovery, landfill.

2.10 Condition of use

Ceramic tiles are solid and inert due to being burnt at high temperatures. The environmental impacts generated during the B1 phase are very low and therefore can be neglected.

2.11 Environment and health during use

Ceramic is intrinsically inert, chemically stable and therefore, during the use stage, does not emit any pollutants or substances which are harmful to the environment and health such as: Volatile Organic Compounds (VOCs) and Radon.

2.12 Reference service life

The service life of tiles is generally higher than 50 years *BNB 2011*. According also to *US GBC* the service life of tiles could be as long as the life of the building itself. Therefore 60 years can be an alternative tile's life for *U.S. GBC.*
The results reported consider the tile's use of 1 year, therefore multiplying B2 values for 50 or 60, it's possible to obtain B2 values referred to 50 or 60 years.
A reference life according to *ISO 15686* is not reported.

2.13 Extraordinary effects

Fire
According to *EN 13501-1:2007+A1:2009*, ceramic tiles can be classified as A1 class of fire reactions rating, because they do not contribute to fire.

Fire protection

Name	Value
Building material class	A1
Burning droplets	-
Smoke gas development	-

Water
Ceramic tiles cannot react with water because they are water-insoluble.

Mechanical destruction
Ceramic tiles can be smashed mechanically, but no harmful damage to the environment is expected.

2.14 Re-use phase

After the demolition and deconstruction stage, ceramic tiles can be crushed and then used in a range of different applications, like concrete aggregates or road construction.

2.15 Disposal

According to the *European Waste Catalogue* (EWC) ceramic tiles waste belongs to group 17 "Construction and demolition wastes", tiles and ceramic (code:17 01 03).

2.16 Further information

More information can be found at:
www.confindustriaceramica.it
www.ceramica.info

3. LCA: Calculation rules

3.1 Declared Unit

The declared unit is 1 m^2 of installed ceramic tiles for covering walls and floors with an average mass of 21.38 kg and thickness of 1cm.

Declared unit

Name	Value	Unit
Declared unit	1	m^2
Grammage	21.38	kg/m^2

The product classes that were considered for the study are:
- Single-fire
- Double-fired
- Porcelain stoneware
- Rustic terracotta
- Other: Klinker, white body, red stoneware, mosaic and other special pieces

Of these, the type most frequently produced by Confindustria Ceramica member companies is porcelain stoneware.
The data sample used to create the model is representative of the group of associated companies of Confindustria Ceramica (over 85%) and of the Italian situation in the above-mentioned sector, since the associated companies have an annual production that covers the 82.6 % of Italian ceramic tile production. Furthermore, the data used to determine the environmental impacts associated with the production of 1 m^2 of average tile have a high robustness due to the large number of companies participating in the study, the high representativeness of the primary data considered and the datasets selected.

3.2 System boundary

The entire life cycle of the product is considered (Type of EPD: cradle to grave and module D (A + B + C + D) and the modules described below are declared in this EPD.

Modules A1-A3 include those processes that provide energy and material input for the system (A1), transport up to the factory gate of the plant (A2), manufacturing processes as well as waste processing (A3).

Module A4 includes the transport from the production site to the customer or to the point of installation of the tiles (IT: 17.8 % - EU: 54.7 % - WW: 27.5 %).

Module A5 considers all tile installation steps (like adhesives consumption) also packaging waste processing (recycling, incineration, disposal). Credits from energy substitution are declared in module D. During this phase a ceramic material loss of 6,5% has been considered.

Module B1 considers the use of tiles. During the use of ceramic tiles, no hazardous indoor emissions are expected to occur.

Module B2 includes the cleaning of the tiles. Provision of water and cleaning agent for the cleaning of the tiles, incl. waste water treatment are considered.

Modules B3-B4-B5 are related to the repair replacement and refurbishment of the tiles. If the tiles are properly installed no repair, replacement or refurbishment processes are necessary.

Modules B6-B7 consider energy use for operating building-integrated technical systems (B6) and operational water use for technical building-related systems. No operational energy or water use are considered. Cleaning water is declared under B2.

Module C1 regards the demolition and de-construction process of the tiles from the building.

Module C2 considers the transportation of discarded tiles to a recycling or disposal process.

Module C3 considers every process (collection, crushing process etc.) for recycling the tiles.

Module C4 includes all the landfill disposal processes, including pre-treatment and management of the disposal site.

Module D includes benefits from all net flows in the end-of-life stage that leave the product boundary system after having passed the end-of-waste stage. Loads from packaging incineration and resulting energy credits (electricity and thermal energy) are declared within module D.

3.3 Estimates and assumptions

The modules from A5 to C4 are scenarios based on average data
included in the PCR created by the *European Ceramic Tile Manufacturers' Federation CET PCR 2014.*
For those materials, (glaze compost, colourant, and chemical additives) where no primary data were available and an exact chemical composition (coming from a datasheet) was unknown an average composition was used, and assumptions were taken based on common chemicals criteria.

3.4 Cut-off criteria

All known inputs and outputs were considered.

3.5 Background data

Background data for the Life Cycle Modelling have been taken from the last version *Gabi 10* professional database (updated to 2022.2, year 2022). Other sources for background data used are *ELCD/FEFCO*, *Perry's Chemical Engineers' Handbook, Ceramic Glaze Handbook/, European Ceramic Tile Manufacturers' Federation.*

3.6 Data quality

The background data sets used are less than 4 years old. Most information (energy and water consumption, pollutant emissions powder atomized and ceramic production) are measured or directly calculated at company level and declared in the Italian IPPC document called AIA, that is specific and verified for each plant involved in this study. Emissions of carbon dioxide (connected to carbonate's oxidation) are collected using ETS (Emission Trading System) declaration.
Primary data collected with specific company data collection during the previous project (for atomization and glaze production) were considered still valid for the current situation.
The overall data quality can be considered good.

3.7 Period under review

The primary data collected in the study refer to 2020.

Data used by the previous project and referring to 2014 are considered still valid for the year 2020.

3.8 Allocation

Energy and material supplies have been allocated to the product based on (the) annually produced mass of ceramic tiles. No further allocations have been applied within the subsequent module.
Moreover, some ceramic wastes are internally recycled; credits from energy recovery of packaging materials from the end-of-life of the product are taken into account.

3.9 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 *GaBi10* database (2022.2) has been used.

4. LCA: Scenarios and additional technical information

Characteristic product properties
Information on biogenic carbon
The packaging material contains biogenic carbon content which is presented below.

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	0.282	kg C

For the preparation of building life cycle assessments, it must be taken into account that in module A5 (installation in the building) the biogenic amount of CO_2 (0.282 kg C *3.67 = 1.036 kg CO_2-eq.) of the packaging bound in module A1-A3 is mathematically booked out.

Transport to the building site (A4)
Confindustria Ceramica's member companies commercialize their ceramic tiles in Italy, Europe and the rest of the world. Average default transportation scenarios are used and displayed below.

Name	Value	Unit
Litres of fuel	31	l/100km
Capacity utilisation (including empty runs)	0.85	%
National destination Truck with a capacity of 27 tons (17.8 % of tiles sold)	300	km
European destination Truck with a capacity of 27 tons (54.7 % of tiles sold)	1390	km
Transoceanic freight ship (27.5 % of tiles sold)	6520	km

Installation into the building (A5)
For the installation stage, 3 options are defined, where different materials can be used. For option 1, adhesives, mortar and water, for option 2 mortar dispersion adhesives and polysulfides for option 3 also cementitious adhesives (different quantities for different tile formats). These considerations are based on average data from different manufacturers of ceramic tiles in Europe. In this EPD it is assumed that the tiles are installed using cementitious adhesive (option 3).

For the treatment of packaging waste, a European average scenario is used and shown, taken from "*Eurostat, 2019*", therefore the end of life is recycling, energy recovery and landfill.

The ceramic material loss considered is 6.5 %.

Name	Value	Unit
Cementitious adhesive	6	kg

Use or application of the installed product (B1) see section 2.12 "Use"
Ceramic tiles are robust and have a hard, abrasion-resistant surface. There are no impacts on the environment during the use stage

Name	Value	Unit

Maintenance (B2)
Ceramic covering products shall be cleaned regularly, to a greater or lesser degree, depending on the type of building: residential, commercial, or healthcare. Thus, the consumption of water and disinfectant has been considered. The values declared in this stage refer to a time period of 1 year.
Scenario for maintaining ceramic floor and wall tiles:
Residential use: 0.2 ml of detergent and 0.1 l of water are used to wash 1 m^2 of ceramic tiles once a week for floor tiles and once every three months for wall tiles. This stage scenario is based on average data from different manufacturers of ceramic tiles in Europe.

Name	Value	Unit
Water consumption	0.1	l
Detergent	0.0002	l
Floor tile Maintenance cycle	52	Number/year
Wall tile Maintenance cycle	4	Number/year

Repair, replacement and refurbishment (B3, B4, B5)
In general, the service life of ceramic tiles is the same as the building life time. Repair, replacement and refurbishment are not required for ceramic tiles.

Name	Value	Unit

Operational energy use (B6) and Operational water use (B7)
These modules are not relevant for ceramic tiles.

Name	Value	Unit

End of life (C1-C4)

C1: This module considers the use of machinery (diesel consumption of 1.69E-5 per kg) to dismantle the product to enable its subsequent transport

C2: The ceramic tile demolition waste is transported from the building site to a container or treatment plant by truck and an average distance of 20 km is considered. The return trip shall be included in the system. It can be considered an average distance of 30 km from the container or treatment plant to the final destination.

The results for the end-of-life are declared for the 2 different scenarios:

Name	Value	Unit
Scenario No. 1 Recycling percentage	100	%
Scenario No.1 Material to recycling	27.38	kg
Scenario No. 2 Landfill percentage	100	%
Scenario No.1 Material to landfill	27.38	kg

C3: Recycling scenario includes the treatment of the ceramic material for later use as mineral/raw material. It is divided into 2 sub-scenarios:
1) Recycling 100 %
2) Recycling 0 %

C4: Landfill disposal scenarios used is divided in the 2 sub-scenarios:
1) Landfilling 0 %
2) Landfilling 100 %

Reuse, recovery and/or recycling potentials (D), relevant scenario information
Module D includes credits from materials recycling of tiles (only for the recycling scenario) and packaging, and energy credits from thermal recovery of the packaging.

The results for module D are declared for the 2 different scenarios.

5. LCA: Results

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

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: 1 m2 of average ceramic tile

Core Indicator	Unit	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3/1	C3/2	C4/1	C4/2	D/1	D/2
GWP-total	[kg CO_2-Eq.]	1.10E+1	1.22E+0	3.54E+0	0.00E+0	1.17E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.73E-2	4.64E-2	7.11E-2	0.00E+0	0.00E+0	4.11E-1	-2.66E-1	-2.05E-1
GWP-fossil	[kg CO_2-Eq.]	1.21E+1	1.22E+0	2.24E+0	0.00E+0	8.67E-3	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.71E-2	4.60E-2	7.08E-2	0.00E+0	0.00E+0	4.09E-1	-3.06E-1	-2.44E-1
GWP-biogenic	[kg CO_2-Eq.]	-1.04E+0	3.19E-3	1.30E+0	0.00E+0	3.04E-3	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	5.48E-5	1.30E-4	1.21E-5	0.00E+0	0.00E+0	1.27E-3	4.04E-2	3.96E-2
GWP-luluc	[kg CO_2-Eq.]	5.27E-3	5.93E-3	1.54E-3	0.00E+0	1.18E-6	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.14E-4	2.56E-4	3.28E-4	0.00E+0	0.00E+0	7.54E-4	-1.59E-4	-4.58E-5
ODP	[kg CFC11-Eq.]	8.98E-11	7.19E-14	1.05E-11	0.00E+0	3.58E-14	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.66E-15	2.76E-15	1.05E-13	0.00E+0	0.00E+0	9.61E-13	-2.11E-12	-1.51E-12
AP	[mol H^+-Eq.]	2.50E-2	8.91E-3	4.13E-3	0.00E+0	1.53E-5	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	2.25E-4	7.22E-5	3.66E-4	0.00E+0	0.00E+0	2.90E-3	-5.93E-4	-3.24E-4
EP-freshwater	[kg P-Eq.]	9.82E-6	3.20E-6	1.16E-5	0.00E+0	3.56E-6	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	6.03E-8	1.37E-7	2.03E-7	0.00E+0	0.00E+0	6.93E-7	-1.06E-6	-7.79E-7
EP-marine	[kg N-Eq.]	7.93E-3	2.98E-3	1.42E-3	0.00E+0	1.73E-5	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.02E-4	2.85E-5	1.67E-4	0.00E+0	0.00E+0	7.41E-4	-2.05E-4	-1.07E-4
EP-terrestrial	[mol N-Eq.]	8.73E-2	3.30E-2	1.58E-2	0.00E+0	4.37E-5	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.12E-3	3.27E-4	1.85E-3	0.00E+0	0.00E+0	8.14E-3	-2.20E-3	-1.13E-3
POCP	[kg NMVOC-Eq.]	2.22E-2	7.01E-3	3.51E-3	0.00E+0	1.80E-5	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	3.30E-4	6.47E-5	4.55E-4	0.00E+0	0.00E+0	2.25E-3	-6.42E-4	-3.79E-4
ADPE	[kg Sb-Eq.]	6.09E-5	9.41E-8	6.75E-6	0.00E+0	1.20E-9	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.70E-9	3.84E-9	7.85E-8	0.00E+0	0.00E+0	4.19E-8	-5.04E-8	-3.42E-8
ADPF	[MJ]	1.78E+2	1.59E+1	1.90E+1	0.00E+0	1.78E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	2.22E-1	6.15E-1	1.38E+0	0.00E+0	0.00E+0	5.35E+0	-6.25E+0	-5.45E+0
WDP	[m^3 world-Eq deprived]	9.35E-1	9.79E-3	1.65E-1	0.00E+0	1.50E-3	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.89E-4	4.13E-4	1.37E-2	0.00E+0	0.00E+0	4.48E-2	-1.33E-2	-1.08E-2

Caption	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 average ceramic tile

Indicator	Unit	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3/1	C3/2	C4/1	C4/2	D/1	D/2
PERE	[MJ]	1.43E+1	8.14E-1	1.70E+1	0.00E+0	2.06E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.54E-2	3.49E-2	1.11E-1	0.00E+0	0.00E+0	8.03E-1	-1.59E+0	-1.28E+0
PERM	[MJ]	1.06E+1	0.00E+0	-1.06E+1	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	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
PERT	[MJ]	2.49E+1	8.14E-1	6.43E+0	0.00E+0	2.06E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.54E-2	3.49E-2	1.11E-1	0.00E+0	0.00E+0	8.03E-1	-1.59E+0	-1.28E+0
PENRE	[MJ]	1.76E+2	1.60E+1	2.11E+1	0.00E+0	1.78E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	2.22E-1	6.16E-1	1.39E+0	0.00E+0	0.00E+0	5.36E+0	-6.25E+0	-5.45E+0
PENRM	[MJ]	2.12E+0	0.00E+0	-2.12E+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	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
PENRT	[MJ]	1.78E+2	1.60E+1	1.90E+1	0.00E+0	1.78E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	2.22E-1	6.16E-1	1.39E+0	0.00E+0	0.00E+0	5.36E+0	-6.25E+0	-5.45E+0
SM	[kg]	5.12E-1	0.00E+0	3.33E-2	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	0.00E+0	0.00E+0	0.00E+0	0.00E+0	2.64E+1	1.93E-1
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	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	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]	2.68E-2	9.24E-4	6.11E-3	0.00E+0	5.29E-5	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.77E-5	3.95E-5	3.88E-4	0.00E+0	0.00E+0	1.36E-3	-1.03E-3	-8.58E-4

Caption	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 average ceramic tile

Indicator	Unit	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3/1	C3/2	C4/1	C4/2	D/1	D/2
HWD	[kg]	4.40E-7	7.53E-11	6.65E-8	0.00E+0	1.51E-11	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.18E-12	2.95E-12	1.74E-11	0.00E+0	0.00E+0	1.36E-3	-6.51E-9	-8.58E-4
NHWD	[kg]	7.56E-1	2.20E-3	1.62E+0	0.00E+0	6.02E-3	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	3.62E-5	8.83E-5	3.68E-4	0.00E+0	0.00E+0	2.74E+1	-1.11E+0	0.00E+0
RWD	[kg]	5.25E-3	1.95E-5	5.32E-4	0.00E+0	4.25E-6	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	4.13E-7	7.59E-7	1.83E-5	0.00E+0	0.00E+0	2.75E-10	-3.28E-4	-6.46E-9
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	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	3.38E-1	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	2.74E+1	0.00E+0	0.00E+0	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	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	6.56E-1	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	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	9.53E-1	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	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0

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; EEE = Exported electrical energy; EET = Exported thermal energy

RESULTS OF THE LCA – additional impact categories according to EN 15804+A2-optional: 1 m2 of average ceramic tile

Indicator	Unit	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3/1	C3/2	C4/1	C4/2	D/1	D/2
PM	[Disease Incidence]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IRP	[kBq U235-Eq.]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ETP-fw	[CTUe]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
HTP-c	[CTUh]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
HTP-nc	[CTUh]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SQP	[-]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Caption	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” and “water (user) deprivation potential, deprivation-weighted water consumption”. The results

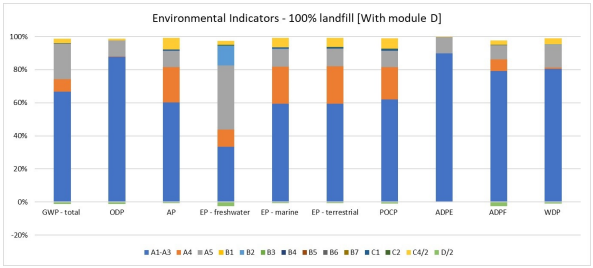
of these environmental impact indicators shall be used with care as the uncertainties on these results are high as there is limited experience with the indicator.

Disclaimer 3 – for the indicators 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. The results of these environmental impact indicators are not declared in the EPD as the uncertainties on these results are high and as there is limited experience with the indicators.

6. LCA: Interpretation

A1-A3 are the modules with the majority of the impacts. Overall, most of the impact categories are dominated by energy processes and raw materials consumption for ceramic mixtures.
Global warming potential (**GWP**), into A1-A3 modules, is generated by the energy process for 72 % and by raw materials for 18 %.
Energy consumption impact also on abiotic fossil depletion (**ADPEf**) for about 68 %.
The ozone layer depletion (**ODP**) is driven by glaze and colourants for 5 2 %, 29 % by energy (mainly electricity) and 15 % by raw materials extraction.
Eutrophication potential (**EP marine-terrestrial**) is distributed between energy consumption (23 %) and extraction of raw material (11 %), transport (24 %) but also direct emission due to an atomize process for about 12 %.
Eutrophication potential **(EP-freshwater)** Is driven by raw material extraction (29 %) and packaging (21 %).
Production of glazes and colourants for mixture results are important for the depletion of abiotic elements (**ADPe**) due to the production of natural elements like oxides of zinc, aluminium and lead.
Energy and transport are also important for **POCP** (26 % and 20 % respectively).
WDP impact is driven by mixture production (almost 26 %), followed by firing emissions (20 %), ATM emissions and energy (16 % both)

The following figure (refer to 1 year of use and end-of-life Scenario 100 % landfill) show how impacts are distributed between the phases considered in this EPD:



The primary data collected during the study constitutes a representative sample of the member companies of Confindustria Ceramica and of the Italian situation in the ceramic tile sector. The primary data used present a certain level of variability from the calculated average, due to an intrinsic unevenness of the different companies induced by the various optimising capabilities of the processes required for tile production. For this reason, this variability is considered acceptable and representative of the current Italian situation.
Using the available primary data, it was possible to calculate a worst-case scenario and a best-case scenario variation of results for the A1-A3 module and the environmental indicator GWP. The results show that for the worst-case scenario, the impact increases by 15% (12.6E+01kgCO_2eq) while in the best-case scenario, the impact decreases by 16 % (9.25+E00kgCO_2eq).
More accurate variations from the average cannot be calculated based on the data collected. More specific results can only be obtained when individual LCA studies are carried out for individual products from individual plants.

7. Requisite evidence

Ceramics is inert, therefore during the use stage, does not emit any pollutants or substances which are harmful to the environment and health. For this reason and according to PCR, evidence is not required because it is not relevant for this product group.

8. References

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Ceramics of Italy is the collective label of the Italian ceramic industry (tiles, sanitaryware and tableware). It stands for tradition, quality, innovation and creativity as well as for a guarantee of Made in Italy production. Ceramics of Italy, promoted by Confindustria Ceramica – the Italian association of ceramics – is a registered trademark of Edi.Cer. SpA, the organizer of Cersaie, the most important international exhibition of ceramic tile and bathroom furnishings held every year in Bologna, Italy (www.cersaie.it).

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

Tel +49 (0)30 3087748- 0
Fax +49 (0)30 3087748- 29
Mail info@ibu-epd.com
Web **www.ibu-epd.com**

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

Tel +49 (0)30 - 3087748- 0
Fax +49 (0)30 – 3087748 - 29
Mail info@ibu-epd.com
Web **www.ibu-epd.com**

Author of the Life Cycle Assessment
Sphera Solutions GmbH
Hauptstraße 111- 113
70771 Leinfelden-Echterdingen
Germany

Tel +49 711 341817-0
Fax +49 711 341817-25
Mail info@sphera.com
Web **www.sphera.com**

Owner of the Declaration
Confindustria Ceramica
Viale Monte Santo 40
41049 Sassuolo (MO)
Italy

Tel +39 0536 818 111
Fax +39 0536 807 935
Mail info@confindustriaceramica.it
Web **www.confindustriaceramica.it**

Ceramics of Italy, the collective brand of the Italian industry of ceramics
Edi.Cer. S.p.A, Via Monte Santo 40
41049 Sassuolo (MO)
Italy

Tel +39 536 804585
Fax +39 536 806510
Mail info@confindustriaceramica.it
Web **www.ceramica.info**