NUOVA RIWAL CERAMICHE SRL
ENVIRONMENTAL PRODUCT DECLARATION

Product Name	Riwal gruppo ceramiche srl tiles 8 mm
Site Plant	Via Giardini 24 Maranello (MO)

In compliance with ISO 14025 and EN 15804+A2:2019

Program Operator	EPDItaly
Publisher	EPDItaly

Declaration number	NR 8MM
Registration number	EPDITALY1254

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Date of validity	25/06/2031

1 | GENERAL INFORMATION

EDP OWNER

Company Name	Nuova Riwal Ceramiche srl
Legal head office	Via Giardini 24 Fiorano Modenese (MO), Italia
Contacts for information on the EDP	info@riwal.it

PROGRAM OPERATOR

EPDITALY www.epditaly.it	Via Gaetano De Castillia n.10 _ 20124 Milano, Italia

INFORMATION ON THE EPD

Product Name	Riwal ceramic tiles 8 mm
Plant involved in the declaration	Via Giardini 24, Maranello (MO)
Functional Unit	1 m^2 of ceramic tile
Application Area	Tiles are used for covering floors and walls of residential buildings and in public spaces and surfaces subject to high stress and heavy traffic.
EPD Type	Average EPD
CPC Code	37370

VERIFICATION INFORMATION

Product Category Rules (PCR)	EN 15804:2012+A2:2019 is the framework reference for PCRs. PCR ICMQ-001/15 rev. 3.2
EPDItaly regulation	General Program Instruction document of EPDItaly v.6
Project Report	Background report for LCA tool for Confindustria Ceramica v.6, 27/11/2023 Nuova Riwal report 8mm del 26/05/2026
Indipendent Check	Independent verification of the declaration and data, according to EN ISO 14025:2010. Internal □ External ☑ Third party verifier: ICMQ SpA, via De Castillia, 10 20124 Milano (www.icmq.it). Accredited by Accredia.
Comparability	Environmental statements published within the same product category, but from different programs, may not be comparable. In particular, EPDs of construction products may not be comparable if they do not comply with EN 15804:2012+A2:2019.
Accountability	Nuova Riwal Ceramiche srl. relieves EPDItaly from any non-compliance with environmental legislation. The holder of the declaration will be responsible for the information and supporting evidence; EPDItaly declines all responsibility for the manufacturer's information, data and results of the life cycle assessment.

ADDITIONAL INFORMATION

Technical Support	Sphera Italian office Thinkstep S.r.L. - Via Bovini 41, 48123, Ravenna, ITALY +39 0544467132 admintsitaly@sphera.com https://www.sphera.com

2 |THE COMPANY

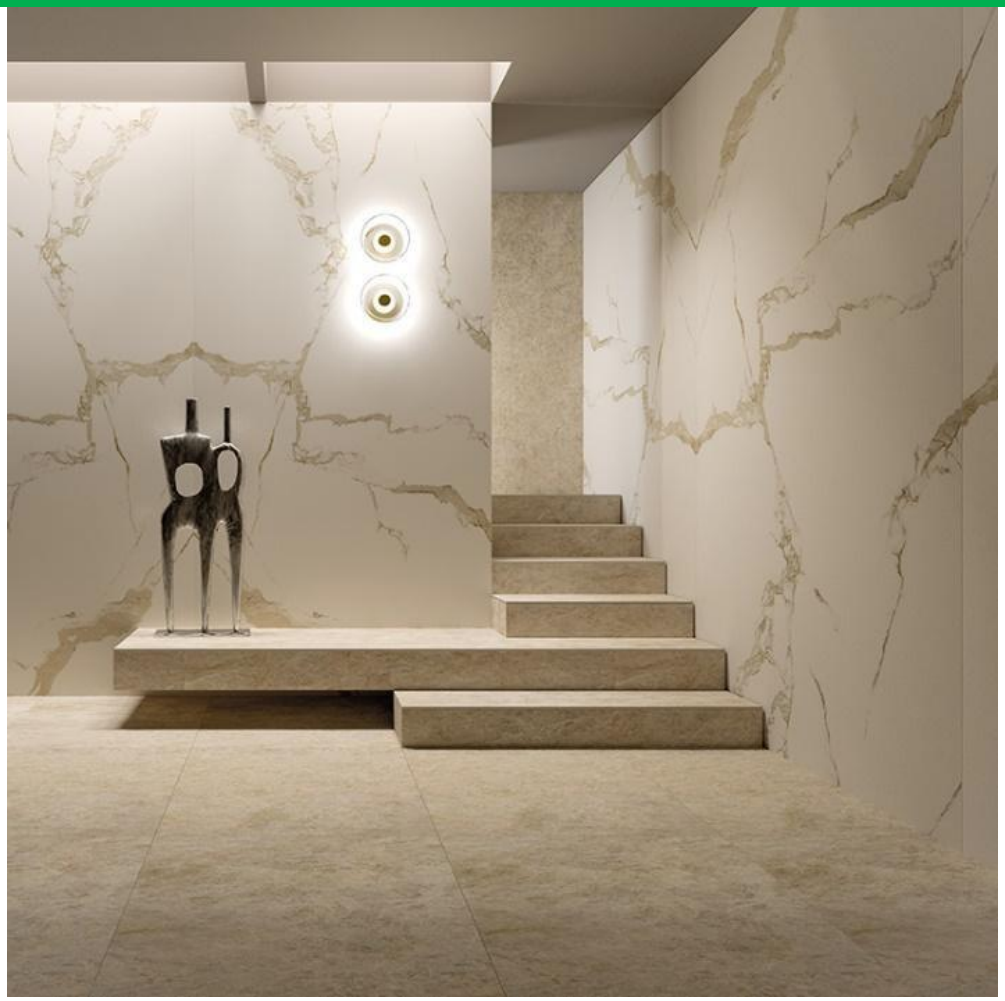


Figure 1 – The company

Riwal has been producing cutting-edge ceramic materials for over 60 years.

Our innovative, environmentally friendly solutions for cladding, flooring and facades are capable of meeting any creative or technological requirements in the world of architecture and design.

A manufacturer of impeccable quality, Riwal industrial policy is firmly orientated towards innovation and respect for the environment as well as intensive research and development, striving for the aim of continuous product improvement in terms of aesthetics and function.

The company's ever-increasing production and sales volumes are the perfect illustration of its ability to interpret new market developments and trends, something also demonstrated by our company data: the group has a workforce of over 400 people operating out of two hi-tech facilities situated in the heart of the most important ceramic district in the world, for a total of 210,000 square metres.

Respect for natural resources, environmental protection and social accountability are intrinsic parts of the company's philosophy. Riwal is constantly striving for excellence in order to ensure it can meet any architectural need.

It also offers first-rate services through its Padana Engineering consulting firm, specialising in providing assistance at any stage of a project, from the selection of materials to the development of the project.

The company's Research Centre is constantly developing innovative products and cutting-edge solutions designed to respond to modern architectural requirements. These range from facades to engineered flooring (raised, floating, heavy duty), solutions designed to make the most of public areas and reduce architectural barriers and tiling for swimming pools.

3 |GOAL AND SCOPE OF EPD

The entire life cycle of the product is considered (Type of EPD: cradle to grave), 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), and 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.

Module A5 considers all tile installation steps and 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, so 1 m^2 of tile surface is the net of material losses.

Module B2 covers cleaning activities which only require water and detergent; no energy is needed for cleaning. The water used for cleaning as part of maintenance will be included in module B2, not in modules B6 and B7. Additionally, the treatment process for the cleaning water will also be accounted for in module B2.

Modules C1 and C2 concern the process of demolition and deconstruction of the tiles from the building. The module considers an excavator (with its fuel consumption) and the transportation of the discarded tile to a recycling or disposal process.

For further operation (C3 and C4), one EoL scenario for the ceramic tiles is considered 100% landfill.

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. Typically, this is classified as either A5 or C3. However, since no incineration scenario is available for C3, this study will only consider scenario A5. Resulting credits for thermal and electrical energy are then declared in module D.

Table 1 - Declared modules

PRODUCTION			INSTALLATION		USE STAGE							END-OF-LIFE				NEXT PRODUCT SYSTEM
Raw material supply	Transport to manufacturer	Manufacturing	Transport to building site	Installation into building	Use / application	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction / demolition	Transport to EoL	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	X	X	X	X	X	X	X	X	X	X	X	X

Modules B1, B3, B4, B5, B6 and B7 can be considered to have no impact (negligible); ceramic tiles are intrinsically inert and therefore do not have environmental impacts during their use to be addressed in module B1 "Use/application". The environmental impacts generated during the B1 phase are therefore negligible. The ceramic tile is a long-lasting product, the repair is not expected to apply to ceramic tiles, and the impacts in module B3 can, therefore, be neglected. Moreover, tiles require neither replacement nor

refurbishment during the use phase, and therefore, no impacts should be declared in modules B4 and B5. Likewise, tiles require no energy and water use once they are installed in a building, so modules B6 and B7 also have no impacts.

Impacts and aspects related to waste are considered in the module in which the waste occurs.

EPD TYPE

The type of EPD is an average EPD for the product "Porcelain stoneware surfaces - tile and slab" produced in RIWAL CERAMICHE SRL plant located in Via Giardini 24 Fiorano Modenese (MO)

All data refer to the 2023 production and sales.

According to the PCR ICMQ-001/15 rev. 3.2 the LCA study and the relative EPD, is "cradle to grave". Modules included are A1, A2, A3, A4, A5, B1-B7, C1, C2, C3, C4 and D. All manufacturing activities and packaging/auxiliary's production are in module A3, while energy production and input materials are in A1. Transport to clients (A4) and installation (A5) are included together with end-of-life scenarios (benefits and loads included according to D module).

PRODUCT NAME

All series (see catalogue)

FUNCTIONAL UNIT and REFERENCE FLOW

The functional unit for this study is 1 m^2 of an average installed ceramic tile produced by RIWAL CERAMICHE SRL covering walls and floors following the normative constraints in terms of installation for 50 years (Short report **BNB (2011)**.

GEOGRAPHICAL VALIDITY

Performance was calculated with reference to the company site (Italy). The reference market is worldwide.

REFERENCE SERVICE LIFE (RSL)

A reference life according to ISO 15686 (2011) is not reported. For this study, the service life is 50 years (NF EN 15804+A2/CN (2022)). The service life of tiles is typically more than 50 years (Short report **BNB (2011)**). Furthermore, according to the US Green Building Council, the useful life of tiles could be the same as the useful life of the building itself.

DATABASE

Managed LCA Content (version 2023.2)

SOFTWARE

LCA for Experts v10.8

4 |DETAILED PRODUCTION DESCRIPTION

PRODUCT DESCRIPTION

Ceramics are inorganic, solid materials. Due to their crystalline structure and compositional variability, they can be used in a large variety of applications. Generally, the main characteristics of ceramics include a high melting temperature, hardness, poor conductivity, low ductility, chemical and abrasion resistance. Porcelain is a particular kind of nonporous vitreous or semi-vitreous ceramic that may be either glazed or unglazed and fired at a high temperature.

MANUFACTURING PROCESS DESCRIPTION

Entry, storage and entry into production of raw materials:

The first stage of the production process consists of the arrival and storage at the plant of raw materials (clays, feldspars, sands and pigments) taken from quarries located in Italy and abroad. All natural raw materials arrive at the plant on wheels. The raw materials for the ceramic body are stored in boxes located in a covered area of the plant and then inside large silos from which they are extracted in the appropriate percentages for the body dosage. The quality of the ceramic mixture and the consistency of its characteristics are ensured by an automatic, computerized and continuous weighing and dosing system, which can guarantee the maintenance over time of the exact percentages of the components according to the predetermined formula.

Raw materials for decoration are stored in covered areas and are dosed for the formulation of different applications.

Manufacturing:

The process begins with the automated batching of the raw materials that make up the various types of ceramic bodies. The raw materials are wet milled, meaning water is added, in continuous mills to obtain a liquid slurry with a water fraction of about 30 percent, called "slip" in ceramic terminology. The slip is then pumped into spray dryers, known as "spray dryer," where it is atomized into very fine droplets of different sizes. These droplets are passed through a flow of air heated to about 600°C, producing "the atomized" mixture—a blend of granules with controlled humidity and an appropriate particle size distribution, ensuring optimal compaction during the subsequent pressing stage. A large battery of silos is set up to store the atomized material, which will later be sent to the pressing stage. The tile is formed by compressing the atomized material using high-powered hydraulic presses, which give it the desired size, thickness, and surface type (smooth, textured, etc.).

The tile formed in this way is then subjected to the drying phase at a temperature of around 200- 220°C, during which it undergoes a drastic reduction in moisture and a significant increase in mechanical strength "in the raw," both necessary factors for the subsequent production stages. The pressed tiles can then undergo glazing and digital decoration applications. The firing stage takes place in industrial kilns that allow for uniform temperature distribution throughout all areas of the kiln, eliminating issues related to color variation and uneven firing. The prolonged exposure to high firing temperatures, up to about 1200-1220°C, leads to the complete vitrification of the material throughout its mass. As a result, ceramic tiles with almost zero porosity are obtained, offering excellent mechanical strength (breaking load, flexural strength, resistance to abrasion and scratching) and resistance to chemical aggressors. Before selection, most of the material

undergoes mechanical processing, such as cutting (to obtain smaller formats), finishing (to achieve tiles with extremely straight and orthogonal edges, allowing for tight grout joints), and polishing (mechanical abrasion of the surface with extremely hard tools to obtain smoother, pleasant- to-the-touch surfaces with varying degrees of shine). In the selection department, each ceramic piece is inspected for dimensions, flatness, orthogonality of the edges, color, and surface quality (absence of defects) by specialized operators and automatic sorting machines. The finished products are packaged in homogeneous batches according to article, selection grade, tone, and "caliber."

Packaging:

The finished ceramic product from RIWAL CERAMICHE SRL is packaged in cardboard boxes containing 100% recyclable paper fibers. The use of recycled cardboard has been optimized to minimize its usage and reduce waste, also thanks to the use of automatic packaging machines.

The corrugated cardboard, practical and eco-friendly, easily disposable and reusable, comes in the form of sheets, boxes, die-cuts, and trays in micro, double, and triple waves, to be used depending on the packaging format. Each product package contains the necessary information in accordance with the main industry standards: ISO 13006, EN 14411, and SASO.

The finished ceramic product from RIWAL CERAMICHE SRL. is stored on pallets, wooden crates, trestles, and supports, primarily made from fir wood.

All wooden packaging complies with the IPCC/FAO and FITOK marks. Some are also FSC and PEFC certified, ensuring proper forest management.

The finished ceramic product from RIWAL CERAMICHE SRL. is protected with plastic films made of recycled polymers up to a maximum of 87%. Thanks to a long-standing partnership with an Italian supplier, scrap caps from the picking process are recovered and returned to the producer, who, after specific treatments and regeneration, resells them, implementing the so-called circular economy.

The plastic films used are shrink hoods, cold elastic Coverpal, and stretch film.

Individual packages of finished products from RIWAL CERAMICHE SRL are bundled together with green PET polyester strapping, which is highly resistant and unaffected by temperature fluctuations, ensuring safe and reliable packaging for the end customer. The strapping comes in various thicknesses and sizes. All strapping is properly recovered through a separate waste collection system.

Shipping warehouse:

The pallets, on which the finished product boxes are placed, are stored in the parking lot outside the plant. The handling of the finished product to the warehouse is managed through a pallet identification barcode label affixed to the final packaging. Once this process is complete, the product is ready for shipment.

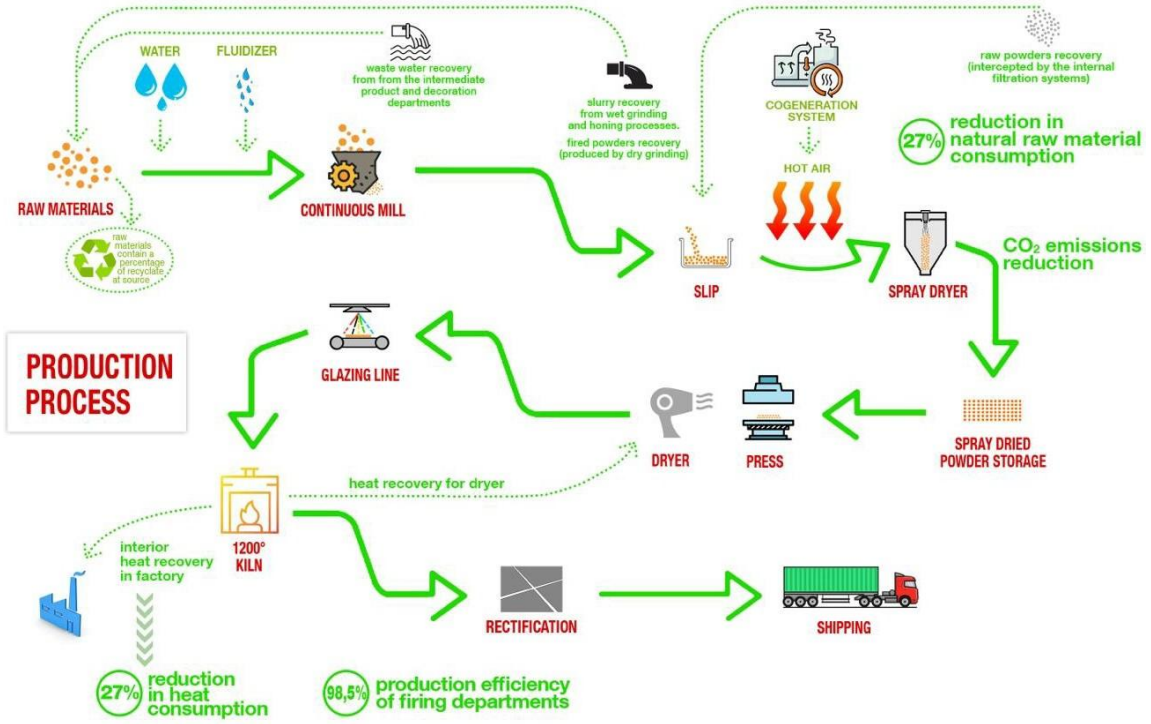


Figure 2 - Manufacturing process

HEALTH AND SAFETY OF WORKERS

The group operates in accordance with current national health and safety regulations.

The Group undertakes to ensure that all internal and external persons are correctly trained and informed in relation to occupational health and safety, guaranteeing a safe, healthy workplace and paying attention to risk management.)

ENVIRONMENTAL PROTECTION

The group operates in accordance with current national environmental regulations.

The plant holds an Integrated Environmental Authorization (AIA), which requires compliance with stringent regulations regarding pollutant emissions into the atmosphere, noise impact, waste management, energy consumption, and water and raw material balances. As defined by the AIA itself, emissions from the production process are continuously monitored and are consistently well below the authorized limits. The plant does not generate wastewater discharges; all process water is reused, either directly or after treatment, within the production cycle, avoiding the use of fresh water. Additionally, all ceramic waste materials from the production cycle (dust, mixes, and raw tiles) are recovered.

In the production process, RIWAL CERAMICHE SRL adopts, where possible, the Best Available Technology (BAT) outlined in the latest revision of the ceramic BREF (Best Available Techniques Reference Documents).

Energy efficiency systems are in place for heat recovery, such as for heating the workspaces, and for thermal recovery in the atomization process. Photovoltaic systems are installed on the plant's roofs to generate electricity from renewable sources.

Technical data: 8 mm ceramic tiles

The products meet the requirements defined by the European standard UNI EN 14411:2016 and the international standard ISO 13006:2018, according to the criteria established by the ISO 10545 testing

methods outlined below.

Table 2 - Technical data

Name	Value	Unit
Shaping acc. to EN14411	B: dry pressing	
Small color differences acc. to ISO1045-16	V2 / V3 / V4	-
Tactility acc to CEN/TS 15209		
Surface quality acc. to ISO 10545-2 § 7	≥ 95	%
Water absorption acc. to ISO 10545-3	≤ 0,1	%
Breaking Strength acc. to ISO 10545-4	≥ 1300	N
Flexural strength acc. to ISO 10545-4	≥ 35	N/mm^2
Resistance to deep abrasion – Unglazed tiles acc. To ISO 10545-6	-	-
Resistance to surface wear– Glazed tiles acc. to ISO 10545-7	Class 3/4/5	-
Coefficient of linear thermal expansion acc. to ISO 10545-8	$6,4 \times 10^{-6}$ $°C^{-1}$	$°C^{-1}$
Thermal shock resistance acc. to ISO 10545-9	Resistant	-
Crazing resistance acc. to ISO 10545-11, glazed tiles	Resistant	
Frost resistance acc. to ISO 10545-12	Resistant	-
Nonslip property (class A, B or C) acc. to. CEN/TS 16165	A+B / A+B+C	-
Bond strength /adhesion acc. to. EN 12004		
Impact resistance acc. to ISO 10545-5	-	-
Reaction to fire NO testing (CWT)	A1FL/A1	
Resistance to low concentrations of acids and alkalis acc. to ISO 10545-13	LA	-
Resistance to household chemicals and swimming pool salts acc. to ISO 10545-13	A	-
Resistance to low and high concentrations of acids and alkalis acc. to ISO 10545-	HA	-
Resistance to staining acc. to ISO 10545-14	Class 5	-
Release of lead and cadmium – Glazed tiles acc. to ISO 10545-15	Pb <0,05 Cd <0,02	mg/L
Moisture expansion acc. to ISO 10545-10	-	-

CONTENT INFORMATION

Main raw materials for ceramic tile:

- Clay - 40 %
- Feldspars - 38 %
- Sand - 15 %
- Waste - 6 %
- Glaze – 1%

Main components of the glaze:

- Clay powder
- Feldspar
- Quartz
- Alumina
- Frits
- Pigments

RELEVANT EFFECTS DURING USE

Fire: In accordance with /EN 13501-1:2007+A1:2009/, ceramic tiles can be classified as fire resistance class A1FL/A1 as they are non-flammable.

Coating ceramic tiles in the event of fire has been shown to reduce the heat input on them and thus the risk of collapse.

Water: Ceramic tiles are insoluble materials and do not react with water.

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 environment and health such as: VOCs and Radon.

5 |LCA RESULTS

The tables below show the results of the LCA (Life Cycle Assessment). Basic information on all declared modules can be found in Chapter 3.

Table 3 – Environmental Impacts

Environmental Impact Indicators for 1m^2 of ceramic tiles														
Indicator	Unit	A1	A2	A3	A4	A5	B1	B2	B3-B7	C1	C2	C3	C4	D
GWP-total	kg CO_2 eq.	3,61E+00	8,06E-01	5,52E+00	6,23E-01	3,99E+00	0	1,18E-02	0	1,63E-02	7,56E-02	4,48E-02	1,14E-01	-3,49E-01
GWP-fossil	kg CO_2 eq.	3,59E+00	7,72E-01	6,84E+00	6,04E-01	2,15E+00	0	8,90E-03	0	1,56E-02	7,23E-02	4,49E-02	1,13E-01	-3,47E-01
GWP-biogenic	kg CO_2 eq.	2,07E-02	3,43E-02	-1,32E+00	1,92E-02	1,84E+00	0	2,85E-03	0	7,12E-04	3,30E-03	-4,64E-04	3,17E-04	-2,26E-03
GWP-luluc	kg CO_2 eq.	7,42E-04	4,97E-05	1,29E-03	2,98E-05	1,08E-03	0	1,34E-06	0	9,76E-07	4,61E-06	3,44E-04	3,57E-04	-1,34E-04
ODP	kg CFC-11 eq.	1,28E-11	2,80E-13	3,42E-12	6,27E-14	5,00E-12	0	4,19E-14	0	1,83E-15	8,66E-15	7,64E-14	2,92E-13	-2,66E-12
AP	mole of H^+ eq.	9,29E-03	2,80E-03	3,51E-03	6,99E-03	3,39E-03	0	1,55E-05	0	7,80E-05	1,08E-04	2,38E-04	8,15E-04	-5,71E-04
EP-freshwater	kg P eq.	3,76E-06	2,04E-07	2,33E-06	1,45E-07	9,48E-06	0	3,56E-06	0	3,76E-09	1,77E-08	1,55E-07	2,31E-07	-9,18E-07
EP-marine	kg N eq.	2,41E-03	1,31E-03	1,58E-03	1,69E-03	1,21E-03	0	1,75E-05	0	3,70E-05	4,33E-05	1,09E-04	2,11E-04	-1,81E-04
EP-terrestrial	mole of N eq.	2,68E-02	1,45E-02	1,75E-02	1,86E-02	1,36E-02	0	4,59E-05	0	4,06E-04	4,77E-04	1,21E-03	2,32E-03	-1,96E-03
POCP	kg NMVOC eq.	7,17E-03	2,63E-03	4,50E-03	4,80E-03	2,93E-03	0	1,94E-05	0	1,05E-04	1,04E-04	2,97E-04	6,36E-04	-6,07E-04
ADPE	kg Sb eq.	2,75E-04	1,04E-08	4,64E-08	6,94E-09	2,07E-05	0	3,96E-10	0	1,92E-10	9,08E-10	4,89E-08	5,31E-09	-2,56E-08
ADPF	MJ	1,55E+02	1,14E+01	1,11E+01	8,35E+00	1,97E+01	0	1,98E-01	0	2,23E-01	1,05E+00	8,99E-01	1,53E+00	-7,72E+00
WDP	m^3 world eq.	2,58E-01	3,46E-03	2,35E-02	1,33E-03	1,55E-01	0	1,56E-03	0	3,74E-05	1,76E-04	8,88E-03	1,26E-02	-2,42E-02

Caption

GWP (tot, fossil, bio and luluc) = Global Warming Potential total, fossil, biogenic and land use and land use change;
ODP = Ozone Depletion Potential;
AP = Acidification Potential;
EP (fresh, marine and terrestrial) = Eutrophication Potential freshwater, marine and terrestrial;
POCP = Photochemical Ozone Creation Potential;
ADPE = Abiotic Depletion Potential (elements, non-fossil resources);
ADPF = Abiotic Depletion Potential (fossil resources);
WDP = Water Depletion Potential

Table 4 – Resource Use

Resource Use Indicators for 1m2 of ceramic tiles													
Indicator	Unit	A1	A2	A3	A4	A5	B1	B2	B3-B7	C1	C2	C3	C4	D
PERE	[MJ]	7,33E+00	1,29E-01	1,41E+01	4,92E-02	0	0	2,42E-02	0	1,44E-03	6,80E-03	8,36E-02	2,49E-01	-1,63E+00
PERM	[MJ]	0	0	6,71E-01	0	-6,71E-01	0	0	0	0	0	0	0	0
PERT	[MJ]	7,33E+00	1,29E-01	1,48E+01	4,92E-02	4,47E+00	0	2,42E-02	0	1,44E-03	6,80E-03	8,36E-02	2,49E-01	-1,63E+00
PENRE	[MJ]	1,55E+02	1,14E+01	1,09E+01	8,38E+00	1,99E+01	0	1,98E-01	0	2,24E-01	1,06E+00	9,01E-01	1,53E+00	-7,72E+00
PENRM	[MJ]	0	0	1,67E-01	0	-1,67E-01	0	0	0	0	0	0	0	0
PENRT	[MJ]	1,55E+02	1,14E+01	1,11E+01	8,38E+00	1,97E+01	0	1,98E-01	0	2,24E-01	1,06E+00	9,01E-01	1,53E+00	-7,72E+00
SM	[kg]	7,34E-01	0	1,38E-01	0	5,67E-02	0	0	0	0	0	0	0	1,74E+01
RSF	[MJ]	0	0	0	0	0	0	0	0	0	0	0	0	0
NRSF	[MJ]	0	0	0	0	0	0	0	0	0	0	0	0	0
FW	[kg]	9,71E-03	1,80E-04	2,15E-03	5,87E-05	4,85E-03	0	5,62E-05	0	1,67E-06	7,91E-06	2,57E-04	3,87E-04	-1,52E-03

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

Table 5 – Waste input/output flows

Waste input/output flows for 1m2 of ceramic tiles													
Indicator	Unit	A1	A2	A3	A4	A5	B1	B2	B3-B7	C1	C2	C3	C4	D
HWD	[kg]	2,47E-07	4,49E-11	1,39E-09	1,84E-11	1,65E-08	0	1,03E-11	0	4,12E-13	1,95E-12	-2,33E-12	3,33E-11	-3,65E-10
NHWD	[kg]	2,67E-01	1,19E-03	9,53E-01	8,16E-04	1,57E+00	0	6,04E-03	0	2,23E-05	1,05E-04	2,37E-04	7,66E+00	-7,25E-01
RWD	[kg]	8,42E-04	8,45E-05	2,38E-04	1,28E-05	3,07E-04	0	4,49E-06	0	3,73E-07	1,76E-06	1,21E-05	1,75E-05	-3,38E-04
CRU	[kg]	0	0	0	0	0	0	0	0	0	0	0	0	0
MFR	[kg]	0	0	3,55E-02	0	5,85E-02	0	0	0	0	0	1,78E+01	0	0
MER	[kg]	0	0	0	0	3,24E-01	0	0	0	0	0	0	0	0
EEE	[MJ]	0	0	0	0	9,36E-01	0	0	0	0	0	0	0	0
EET	[MJ]	0	0	0	0	1,44E+00	0	0	0	0	0	0	0	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;

Table 6 – Biogenic carbon content of product and packaging

Biogenic carbon content of product and packaging for 1m2 of ceramic tiles

Indicator	Unit	A1	A2	A3	A4	A5	B1	B2	B3-B7	C1	C2	C3	C4	D
Biog. C in packaging	[kg	0	0	1,81E-02	0	-1,81E-02	0	0	0	0	0	0	0	0
Biog. C in product	[kg]	0	0	0	0	0	0	0	0	0	0	0	0	0

Caption	**Biog. C in packaging** = Biogenic carbon content in packaging; **Biog. C in product** = Biogenic carbon content in product

Table 7 – Additional environmental impact indicators

Additional environmental impact indicators for 1m2 of ceramic tiles

Indicator	Unit	A1	A2	A3	A4	A5	B1	B2	B3-B7	C1	C2	C3	C4	D
PM	[Disease incidences]	4,06E-07	1,72E-08	1,87E-07	1,17E-07	1,08E-07	0	1,43E-10	0	8,86E-10	1,48E-09	4,52E-09	1,00E-08	-1,40E-08
IR	[kBq U235 eq.]	1,27E-01	1,26E-02	3,01E-02	1,88E-03	3,56E-02	0	6,71E-04	0	5,51E-05	2,60E-04	1,94E-03	2,02E-03	-5,28E-02
ETF-fw	[CTUe]	1,96E+01	7,93E+00	5,18E+00	5,98E+00	5,57E+00	0	2,19E-01	0	1,61E-01	7,59E-01	5,99E-01	8,28E-01	-2,46E+00
HTP-c	[CTUh]	1,09E-09	1,47E-10	1,41E-09	1,10E-10	4,38E-10	0	1,84E-11	0	2,95E-12	1,39E-11	1,32E-11	1,29E-10	-1,95E-10
HTP-nc	[CTUh]	8,96E-08	4,74E-09	8,61E-08	3,53E-09	4,05E-08	0	1,70E-09	0	9,54E-11	4,49E-10	4,80E-10	1,36E-08	-1,51E-08
SQP	[Pt]	5,13E+00	1,26E-01	1,67E+02	4,55E-02	2,40E+01	0	1,74E-02	0	1,39E-03	6,59E-03	2,42E-01	3,72E-01	-1,23E+00

Caption	**PM** = Particulate matter emissions; **IR** = Ionising radiation, human health; **ETF**= Eco-toxicity (freshwater); **HTP-c** = Human toxicity, cancer effects; **HTP-nc** = Human toxicity, non-cancer effects; **SQP** = Soil quality potential/Land use-related impacts

Disclaimer for EN 15804+A2: additional indicators

(1) Potential Human exposure efficiency relative to U235 (IRP): 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 nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator

(2) The results of the environmental impact indicator: ADP, WDP, ETP-fw, HTP-c, HTP-nc, SQP shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

6 |CALCULATION RULES

REFERENCE FLOW

The functional unit for this study is 1 m^2 of an average installed ceramic tile produced by RIWAL CERAMICHE SRL., covering walls and floors in accordance with the normative constraints in terms of installation for 50 year (Short report **BNB (2011)**).

Packaging material for transport to the installation site (plastic, paper-cardboard, wood, and wax) and additional material for the installation (adhesive mortar) have been considered. Material losses of 6,5% during the installation process (A5 phase) have been considered, so 1 m^2 of tile surface is the net of material losses.

Table 8 - Functional unit and reference flow

Name	Value	Unit
Declared unit	1	m^2
Grammage	19,50	kg/m^2
Conversion factor to 1 kg	0,051	-

ASSUMPTIONS

Where it is not possible to know the precise composition of materials in the supply chain (due to commercial or industrial confidential suppliers' reasons or due to missing datasets), these are approximated with LCIs of similar materials, estimated by the combination of available datasets or reconstructed with literature data.

In most cases, a conservative approach has been adopted, overestimating burdens to prove irrelevance. In other cases, proxy data were selected based on scientific experience, to improve the accuracy of the model.

Some materials, like colorants, glaze compounds, inks, and frits, have been used based on composition (instead, for instance, of the single composition of a single colorant) using primary data in terms of absolute quantity and relative percentage of single chemical compound. For these kinds of materials, belonging to the same family (colorant, serigraphy, etc.) where a technical datasheet is not available, the same composition of the other materials of that family compound has been assumed.

Chemical additives have been modelled using compositions available in technical data sheets (in certain safety data sheets).

Quantities of auxiliary materials and packaging of input materials have been estimated according to waste produced by the company of the working group (e.g., lubricating oil, paper/cardboard, wood, plastic packaging, etc). The exact chemical composition of detergent components used for cleaning ceramic tiles depends on user behaviour and the selected supplier. The following assumptions are applied in the current study concerning the composition of detergents:

- Detergents for ordinary cleaning in a water solution are mixed as reported below according to Müller, F. |. (2003):
    - 5% anionic surfactant component: alcohol ethoxy sulfate,
    - 10% non-ionic surfactant component: fatty acid derivate.

For those processes that take place in Italy, electricity Italian residual grid mix was used, instead for those processes for which the place is unknown electricity RER residual grid mix was used.

Below are the emission factors considered for the energy related to production:

- Electricity = kg GWPeq./kWh
- Natural gas = kg GWPeq./MJ

CUT-OFF CRITERIA

No cut-offs have been made in the study.

DATA QUALITY

Geographical and temporal representativeness of primary data:

- **Geographical**: All primary data are collected specifically for the countries/regions studied. Some secondary data represent the German industrial framework or an average European situation. The most important secondary processes for this study, thermal and electrical energy, specifically represent Italian geographical conditions. Processes for which the manufacturing location is unknown (e.g. grinding of some raw materials) use the generic EU28 electricity grid process. When country- or region-specific data are not available, surrogate data are used. Geographical representativeness is considered good.
- **Temporal**: All primary data are collected for the year 2023. All secondary data come from the LCA for Expert 2023.2 databases and are representative of the years 2018-2022. Temporal representativeness is good.
- **Technological**: All primary and secondary data are modelled to be specific to the technologies or technology mixes studied. When technology-specific data are not available, surrogate data are used. Technological representativeness is considered good.

PERIOD UNDER REVIEW

The primary data collected in the study refers to 2023.

ALLOCATION

For all refinery products, the allocation in terms of mass and net calorific value was applied. Two allocation rules are applied:

1. The raw material consumption (crude oil) of the respective steps, which is required for the production of a product or intermediate, is allocated according to the energy (mass of the product * calorific value of the product);
2. The energy consumption (thermal energy, steam, electricity) of a process, e.g. atmospheric distillation, which is required by a product or intermediate, is allocated to the product according to the share of the step's throughput (mass allocation).

7 |SCENARIOS

The following technical information about declared modules and related scenarios is based on average data, according to the "European Ceramic Tile Manufacturers Federation" and subsequently implemented in the PCRb of the IBU program operator "Ceramic tiles and panels".

TRANSPORT (A4)

The environmental costs of transporting the packaged product from the production site to the construction site in Italy and Europe are allocated to Module A4. Having no specific information about the distances of the product's distribution, it was decided to follow what is indicated in **NF EN 15804+A2/CN (2022)**. The transportation settings are:

Table 9 - Transport (A4)

Distribution	Dataset	Distance [km]
National (Italy) – 46,31% of tiles sold	Truck-trailer, Euro 6 A-C, 34 - 40t gross weight / 27t payload capacity (with a consumption of 2,11E-03 kg diesel/kg)	300
Intracontinental (Europe) – 17,80% of tiles sold		1390
Intercontinetal – 35,89% of tiles sold	Bulk commodity carrier, average, deep sea (with a consumption of 1,37E-04 kg HFO/kg)	6520

INSTALLATION TO THE BUILDING (A5)

The installation stage options were based on average data from different manufacturers of ceramic tiles in Europe to define which kind and the amounts of materials used EN 17160:2019 . For this study, it is assumed that the tiles are installed using 6 kg of cementitious adhesive per 1m^2 of tile, on a worst-case scenario approach. The three options indicated in the EN 17160:2019 were compared based on the total score using the EF3.0 methodology. What emerged is that option 3 (cementitious adhesive) is 10% more impactful than option 2 (mortar, dispersion adhesive and polysulfide) and 70% more impactful than option 1 (mortar and water).

During the installation, there is an average tile scrap production of 6,5%, which is considered in module A5, as well as all the impacts generated by the production of the scrap.

For the treatment of packaging waste, the most updated European average scenarios (Eurostat 2020) are used:

Table 10 - Disposal scenarios for packaging materials

Disposal scenarios for packaging materials			
Material	**Recycling (%)**	**Energy recovery (%)**	**Landfill (%)**
Plastic	37,6	38,2	24,2
Paper and board	81,5	9,1	9,4
Wood	31,9	38,9	39,2
Glue-wax*	-	-	100

* Since there are no specific Eurostat statistics for glue or wax packaging, it was decided to consider an end-of-life of 100% landfill, using a conservative approach.

MAINTENANCE (B2)

Over the use modules (B1-B7), only the maintenance module (B2) is considered as generating environmental impacts. During the ceramic tile life cycle, the product has to be regularly cleaned, to a greater or lesser extent, depending on the type of building (residential, commercial, etc.) in which it is installed. If the surface is dirty or greasy, cleaning agents such as detergents or bleach can be added. Thus, the consumption of water and disinfectant chemicals has been taken into account. This scenario is modelled based on EN 17160:2019 . The scenario is made as follows:

Table 11 - Maintenance scenario

Name	Value	Unit
Detergent	0,13	ml/m^2
Water	0,2	l/m^2
Cleaning times in 1 year according to periodicity	26	Done once every two weeks
RSL	50	years
Electricity	-	kWh

END-OF-LIFE (C1-C4)

The EoL phase starts with the demolition process used for representing the C1 module, where the building deconstruction takes place. This process considers an excavator (100kW) with a consumption of diesel of 1.72E-4 per kg of product and all the emissions connected with the fuel-burning process. After the demolition stage, ceramic tiles can be crushed and then used in several applications different from ceramic tiles production:

- Road construction in filled embankment;
- Concrete aggregates;
- Aggregates that can be integrated as partial substitutes for natural aggregate in hot mix asphalt;
- Aggregates which can be used in the construction of landfills;

After the demolition, ceramic tile is transported to the end-of-life processing; this is the C2 module and it is considered an average distance of 30 km.

The product's end-of-life scenario (C4) includes:

- 70% of the product sent for recycling
- 30% of the product sent to landfill.

The worst-case scenario (landfilling) is modelled by the landfill process where admixtures end their life cycle and no credit allocated to module D is considered. The dataset used for the landfill considers 100 years of deposit.

BENEFITS AND LOADS BEYOND THE PRODUCT SYSTEM BOUNDARY (D)

Module D comprises credits from the recycling of packaging and energy credits from the thermal recovery of packaging. For the treatment of packaging waste, the most updated European average scenarios are used (Eurostat 2020):

Table 12 - European scenarios for EoL

Material	Recycle (%)	Incineration with energy recovery (%)	Landfill
Plastic	37,6	38,2	24,2
Paper and cardboard	81,5	9,1	9,4
Wood	31,9	38,9	39,2
Wax	-	-	100

8 |ENVIRONMENT AND HEALTH DURING USE

Ceramic tiles are inert and have minimal environmental impacts during their use, except during cleaning. Cleaning requires only water and detergent, with no energy needed, although it may have a slight impact on the tile's life cycle. The water used for cleaning and its treatment process have also been assessed.

9 | ADDITIONAL ENVIRONMENTAL INFORMATION

Additional environmental parameters relating to the Minimum Environmental Criteria (CAM)
Ministerial Decree of 23 June 2022, paragraph 2.5.10.1 “Hard flooring”

NUOVA RIWAL CERAMICHE slabs and tiles meet the characteristics and requirements set out in the Minimum Environmental Criteria (CAM), developed within the national “Green Public Procurement” (GPP) strategy. These criteria are the tool adopted by the Italian Public Administration to manage procurement for the design and construction of new buildings and the renovation of existing ones.
The CAM are regulated by Article 34, “Energy and Environmental Sustainability Criteria”, of Legislative Decree 50/2016 (“Public Contracts Code”), which made their application mandatory for all contracting authorities.
Casalgrande Padana products comply with the technical specifications for ceramic tiles required by the CAM, as they meet the following criteria included in Commission Decision (EU) 2021/476 for the award of the EU Ecolabel.

COMMON CRITERIA

1.1 MIneral extraction	NUOVA RIWAL CERAMICHE requires all raw material suppliers engaged in extraction activities to provide evidence of the extraction permit, the environmental restoration plan, an environmental impact assessment, and a map showing the geographical coordinates of the site.
1.2 Restricted substances	The product is manufactured using chemical substances or supplied materials that do not contain substances of very high concern (SVHCs), listed on the Candidate List in accordance with Article 59 of Regulation (EC) No 1907/2006, in concentrations exceeding 0.10% (w/w).
1.3 VOC emissions	Ceramic slabs are recognised as an inert material with no harmful emissions.
1.4 Fitness for use	NUOVA RIWAL CERAMICHE products bear the CE marking in accordance with technical standard EN 14411 and Regulation (EU) No 305/2011.
1.5 Information for users	Information on technical characteristics, installation, cleaning and maintenance of the product is available on all the commercial brand websites of the Group.

SPECIFIC CRITERIA FOR CERAMIC PRODUCTS

4.1 Fuel combustion	The specific fuel energy consumption for atomisation processes (production of spray-dried powder), and for drying and firing of the finished product, does not exceed the relevant limits set out in the table.
4.2 CO_2 emissions	The specific CO_2 emissions associated with fuel use and the processes of decarbonation of the raw materials during atomisation, drying and firing do not exceed the relevant limits set out in the table.
4.3 Water consumption	NUOVA RIWAL CERAMICHE plants comply with this requirement as they are equipped with a closed-loop recycling system for wastewater treatment.

4.4 Air pollutant emissions	The specific emissions of dust, HF, HCl and NOx are associated with the production of Casalgrande Padana products do not exceed the relevant limits set out in the table.
4.5 Wastewater management	All the RIVA CERAMICHE plants comply with this requirement as process wastewater from production is treated on site to remove suspended solids and then reintroduced into the production process as part of a zero liquid discharge system.
4.6 Reuse of process waste	All RIVA CERAMICHE companies within the perimeter of this EPD recycle more than 90% by mass of the process waste generated in the production of ceramic products as raw material in the production process, in accordance with the principles of circular economy.

Requirement		Declared value	Limit value complied with	
Fuel consumption	Atomizer	<1,3 MJ/kg	Excellence benchmark*	1,3 MJ/kg
	Dryer and kiln	<4,3 MJ/kg	Mandatory limit *	4,3 MJ/kg
CO_2 emissions	Atomizer	<84 $kgCO_2/t$	Mandatory limit *	84 $kgCO_2/t$
Air emissions	Dust (atomizer)	<90 mg/kg	Mandatory limit	90 mg/kg
	Dust (kiln)	<10 mg/kg	Excellence benchmark	10 mg/kg
	HF (kiln)	<6 mg/kg	Excellence benchmark	6 mg/kg
	NOx (kiln)	<170 mg/kg	Excellence benchmark	170 mg/kg
Reuse of process waste	Reuse of process waste	>99% (in weight)	Mandatory limit	>90%
* Limit values by product family				

Table: Compliance with the Relevant Limits of Criterion 4.4 of Commission Decision (EU) 2021/476 for Products

REFERENCES

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EN 17160:2019	Product category rules for ceramic tiles 2019
EN 15804+A2	EN 15804:2012+A2:2019: Sustainability of construction works -Environmental Product Declarations - Core rules for the product category of construction products
EN ISO 14025	EN ISO 14025:2011-10 Environmental labels and declarations - Type III environmental declarations - Principles and procedures
EN ISO 14040	EN ISO 14040:2009-11 Environmental management - Life cycle assessment - Principles and framework
EN ISO 14044	EN ISO 14044:2006-10 Environmental management - Life cycle assessment - Requirements and guidelines
EN 50693:2019	Product category rules for life cycle assessments of electronic and electrical products and systems
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