Environmental **P**roduct **D**eclaration

RAK CERAMICS

1990-2020

30TH

MOVING FORWARD

Ceramic & Porcelain Tiles

ASTM INTERNATIONAL

According to
EN 15804
ISO 21930
ISO 14025

1. General Information

Manufacturer Name: RAK Ceramics P.J.S.C
P.O. Box 4714, Ras Al Khaimah, UAE
Sheikh Muhammad Bin Salem Rd, Al Jazirah Al Hamra
Ras al Khaimah, UAE

Program Operator: ASTM International
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West Conshohocken, PA
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Declaration Number: EPD 165

Reference PCR: IBU PCR Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project report according to EN 15804 + A2:2019– Version 1.0
IBU PCR Part B: Requirements on the EPD for Ceramic tiles and panels – Version 1.1

Date of Issuance: January 8, 2021

End of Validity: January 8, 2026

Product Name: Ceramic Tiles / Porcelain Tiles

EPD Owner: RAK Ceramics P.J.S.C.

Product Group: Ceramic and Porcelain Floor and Wall Tiles including Wall Cladding

Declared Unit: 1 m^2 of ceramic tiles

EPD Scope: Cradle-to-gate and End-of-Life (A1, A2, A3, C1, C2, C3, C4, D)

Verification: The CEN Norm EN 15804 serves as the core PCR. Independent verification of the declaration according to ISO 14025 and ISO 21930.
☐ internal ☒ external

LCA Reviewer and EPD Verifier: Timothy S. Brooke
ASTM International
Timothy S. Brooke

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2. Product

2.1 Product Description

The declared products are ceramic tiles and porcelain tiles produced by RAK Ceramics. Since tiles are available in various sizes, this EPD represents two average products. The Ceramic and Porcelain tiles produced by RAK Ceramics are shaped by a dry-pressed process, manufactured by using inorganic natural raw materials such as ball clay, feldspar, silica sand, kaolin, etc. RAK Ceramics produces single fired tiles in various groups (BIa, BIb, BIIa and BIII) as per International Standard ISO 13006 and European Norm EN 14411. Different surface finishes such as glazed, unglazed, glossy, matt, polished, lappato, rustic, wood and antiskid are available to choose from in order to satisfy customers' choice, preference and requirement.

2.2 Application

Ceramic and Porcelain tiles are used for floor and wall coverings in residential, commercial, institutional and other construction areas. Specific products can be used for either internal or external applications.

2.3 Technical Data

Recognized standards such as the International Standard (ISO), European Standard (EN), British Standard (BS), American Standard (ANSI), etc. establish certain parameters to which the characteristics of ceramic and porcelain tiles comply. Similarly, RAK Ceramics manufactures ceramic and porcelain tiles in accordance with the requirements of various International/National Standards. All our tiles are 100% inspected by computer-controlled calibration machines equipped with optical sensor scanning system set to pre-determined tolerance for dimensions, straightness of sides, rectangularity and surface flatness, etc.

Quality Control tests for dimensions and surface quality, physical and chemical properties are performed prior to product delivery. The list of tests in accordance with the requirements of International Standard ISO 13006 and/or European Norm EN 14411 are presented in Table 1. RAK Ceramics maintains more stringent tolerances than the globally recognized standards.

Table 1: RAK Ceramics Quality Tests and Standards	
Test Descriptions	**Standard Test Methods**
Surface Quality	BS EN ISO 10545 - 2
Length and Width	BS EN ISO 10545 - 2
Thickness	BS EN ISO 10545 - 2
Straightness of Sides	BS EN ISO 10545 - 2
Rectangularity	BS EN ISO 10545 - 2
Center Curvature	BS EN ISO 10545 - 2
Edge Curvature	BS EN ISO 10545 - 2
Warpage	BS EN ISO 10545 - 2
Water Absorption	BS EN ISO 10545 - 3
Breaking Strength	BS EN ISO 10545 - 4
Modulus of Rupture	BS EN ISO 10545 - 4
Impact Resistance	BS EN ISO 10545 - 5
Deep Abrasion Resistance	BS EN ISO 10545 - 6
Surface Abrasion Resistance	BS EN ISO 10545 – 7
Coefficient of Linear Thermal Expansion	BS EN ISO 10545 – 8
Resistance to Thermal Shock	BS EN ISO 10545 - 9
Moisture Expansion	BS EN ISO 10545 - 10
Crazing Resistance	BS EN ISO 10545 – 11
Frost Resistance	BS EN ISO 10545 – 12
Resistance to Household Chemicals & Swimming Pool Salts	BS EN ISO 10545 – 13
Resistance to Low Concentrations Acids and Alkalis	BS EN ISO 10545 – 13
Resistance to High Concentrations Acids and Alkalis	BS EN ISO 10545 – 13
Resistance to Stains	BS EN ISO 10545 - 14

2.4 Delivery Status

The measurements of products can vary between different models, type, and thicknesses. Table 2 illustrates the average product weight on delivery, excluding packaging.

Table 2: Average product weight on delivery, excluding packaging.

Product	Average Weight	Unit
Ceramic Tiles	20	KG/M²
Porcelain Tiles	22	KG/M²

2.5 Base Materials

Table 3: Product Ingredients

Product	Ingredient Name	Value	
Ceramic Tile	Qamar Clay	40-65	%
	Limestone	5-20	%
	Silica Red Sand	10-30	%
	Shale Clay	5-20	%
	Bentonite	<5	%
	Green Tiles Scrap Materials	5-20	%
	Glaze & Pigments	5-20	%
	Other	<5	%
Porcelain Tile	Soda Feldspar	40-65	%
	Potash Feldspar	5-20	%
	Ball Clay	40-65	%
	Bentonite 601	<5	%
	Dolomite	<5	%
	Glaze & Pigments	5-20	%
	Other	<5	%

2.6 Manufacture

RAK Ceramics started the production of tiles in 1991 with one production line. At present, the expansion of the organization continues for the production of ceramic wall and floor tiles, porcelain tiles and slabs. Moreover, the organization utilizes small presses and kilns exclusively for the production of special accessories like decors, listellos, skirtings, cappings, etc.

RAK Ceramics is equipped with the world's largest Hydraulic Press (PH 7200), enabling the organization to produce porcelain tiles of various sizes, including slabs measuring up to 180 cm x 120 cm x 2 cm. The organization has also computerized spray driers, computerized granulation plant, remote controlled moveable silos, double feeding system for presses, roll feed system of SACMI Equipment and Engineering, long kilns for firing and large automatic mechanical polishing lines. All production lines are fully equipped with the latest high definition digital printing machines capable of giving the tiles high resolution and natural prints in unlimited designs. The acquisition of a computerized high-pressure water jet cutting machine enables RAK Ceramics to produce infinite number of prestigious and elegant designs such as vanity tops for bathrooms, kitchens and bar counters to personalize every project. With the most modern equipment available at the disposal of experienced and highly qualified technical personnel and operators, the organization has the capability to produce almost any type of ceramic or porcelain tiles.

RAK Ceramics produces tiles in different types of body such as ceramic tiles in red and white body and porcelain tiles in white and colored body. Red body ceramic wall and floor tiles are produced with the utilization of various clays extracted from our own mines in Ras Al Khaimah Emirate. White body ceramic tiles and porcelain tiles are produced by using high quality imported raw materials from Asia, Europe and the Middle East.

Our ceramic and porcelain tiles are produced in accordance with ISO 13006 and/or EN 14411 standards. The products also comply with the specifications of equivalent standards such as American National Standards Institute (ANSI A137.1), French Standard (CSTB – NF UPEC), Saudi Arabian Standards (SASO ISO 13006), SIRIM QAS – Malaysia, Thai Industrial Standards Institute (TISI), Korean Standard and National Standards of Indonesia.

The organization has the capability to design and develop new products and to respond effectively to customers' needs. The organization has opted for a long-term policy which means; to produce high quality products, to mean business, to be a respectable partner and to keep clients and customers satisfied.

The production processes are strictly controlled by experienced, highly competent and professional personnel. All products pass through stringent quality control inspection and testing to ensure that only high quality tiles are delivered to customers. The tiles are continuously tested in the organization's own modern testing laboratories and occasionally by International and Independent laboratories.

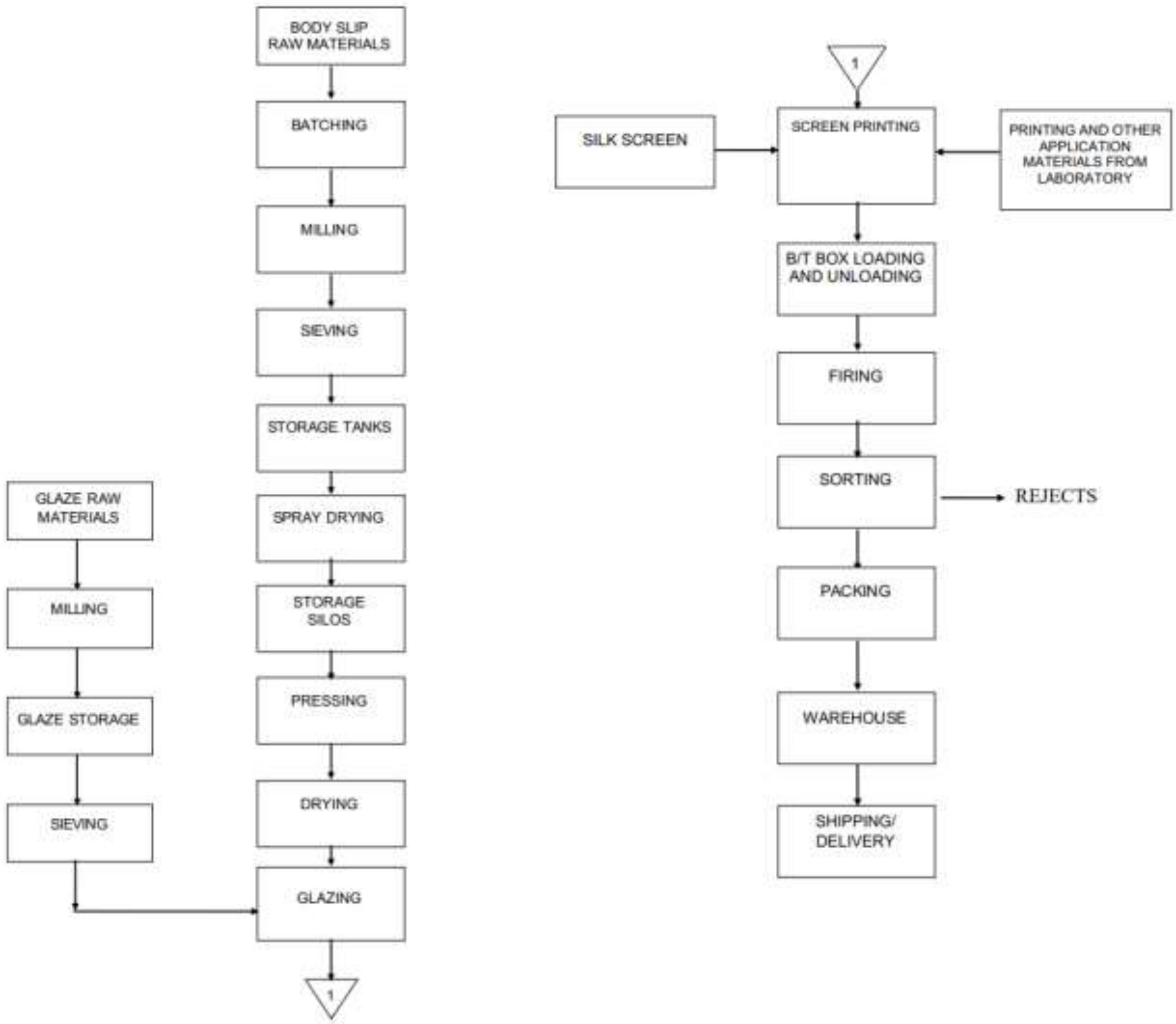

Figure 1a. Process flow chart for Ceramic Tiles.

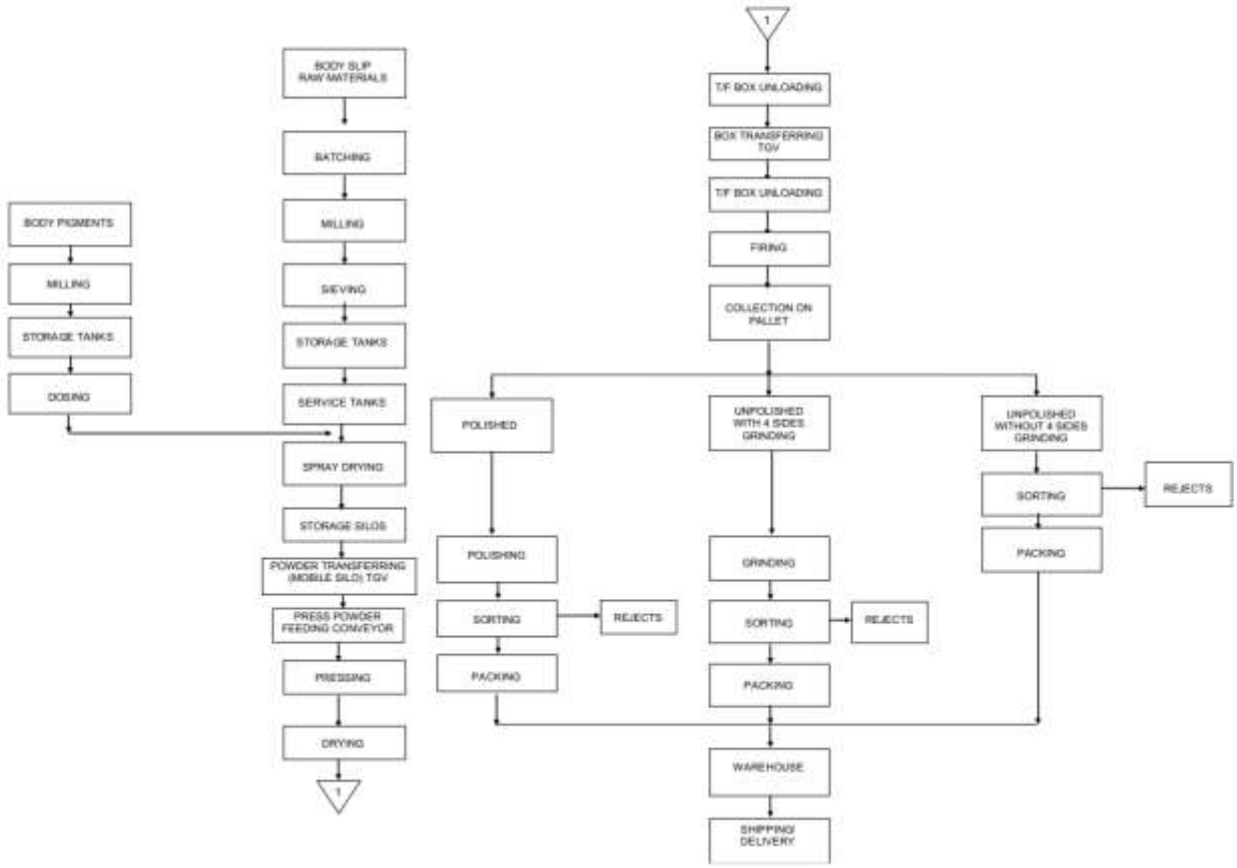

Figure 1b. Process flow chart for Porcelain Tiles.

2.7 Environment and Health Considerations during Manufacturing

The environmental health and safety considerations during manufacturing were the dust emissions, gas emission, spillage, waste, noise, fire hazards, heat stress during summer, mechanical or human factor incident etc. RAK Ceramics manages the activities in order to anticipate and prevent circumstances that might result in occupational injury, ill health, or adverse environmental impacts. RAK Ceramics EHS management are already in place, such as policy and identifying risks assessment and correction.

2.8 Product Processing/Installation

American National Standard and British Standard specifications for the installation of ceramic and porcelain tiles are the most commonly used reference for tiles installation. These standards provide comprehensive information and recognized best-practices for sound and reliable tiles installation system. Adequate PPE are required in the course of tiles installation.

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. Packaging Materials include, polyethylene/LDPE, corrugated boxes/paper cardboard, wooden pallets, and plastic strap belts.

2.10 Conditions of Use

Ceramic and porcelain tiles are fired in the roller kiln at considerably high peak temperatures of 1190 degrees celcius fo ceramic tiles and 1230 degrees celcious for porcelain tiles. The products are highly compact and therefore the environmental impact generated during the use is very low and therefore can be neglected.

Ceramic tiles are recommended for use on internal applications whereas porcelain tiles can be usd for both internal and external applicaions. Porcelain tiles are availble in specialied heavy duty tiles, industrial tiles, antiskid tiles (for external use), antibacterial tiles and can be customized for use as vanity counter tops. Not applicable: End-of-life phase is outside the scope of the underlying LCA.

2.11 Environment and Health Considerations During Use

Ceramic is intrinstically inert, chemically stable and therefore, during the use stage, does not emit any pollutants or substances which are harmful to the environment or human health. Our products achieve “FloorScore” Indoor Air Quality Certification and have also passed the French VOC Regulation achieving an “A+” mark. Not applicable: End-of-life phase is outside the scope of the underlying LCA.

2.12 Reference Service Life

Not applicable: End-of-life phase is outside the scope of the underlying LCA.

2.13 Extraordinary Effects

Fire

Ceramic & Porcelain Tiles is classified as construction product A1 class of fire resistance rating EN 13501-12001+a1:2019.

Water

Ceramic and Porcelain tiles cannot react with water because they are insoluble materials.

Mechanical Destruction

In the event of minor, unforeseen mechanical damage, no harmful damage on the environment is expected

2.14 Re-use Phase

After the demolition and deconstruction phase, the remains of the ceramic and porcelain tiles can be used for landfilling. Not applicable: End-of-life phase is outside the scope of the underlying LCA.

2.15 Disposal

According to the European Waste Catalogue (EWC) ceramic tile waste belongs to group 17 “Construction and Demolition Waste”, tile and ceramic (Code: 17 01 03). Not applicable: End-of-life phase is outside the scope of the underlying LCA.

2.16 Further Information

Additional information available at www.rakceramics.com

3. LCA Calculation Rules

3.1 Declared Unit

The declared unit is one square meter of ceramic/porcelain tile product produced at RAK Ceramics’ Ras Al Khaimah Factory.

3.2 System Boundary

The system boundary for this study includes the following life cycle stages as per the governing PCRs (see also Table 5):

- ***A1 Raw material supply*** (upstream processes): Extraction, handling, and processing of input materials.
- ***A2 Transportation****:* Transportation of all input materials from the suppliers to the gate of the manufacturing facility.
- ***A3 Manufacturing*** (core process): This phase also includes the operations of the manufacturing facility and all process emissions that occur at the production facility.
- ***C1 Deconstruction/Demolition****:* Per the Part B PCR, the environmental impacts generated during the C1 phase are very low and therefore are neglected.
  C2 Transportation*:* The transportation of the product to the treatment plant is assumed to be 50 km total including the return trip as per the Part B PCR.
- ***C3 Waste Processing****:* The waste processing includes the processing (crushing) for the 70% of the product that is assumed to be recycled.
- ***C4 Disposal****:* The disposal module includes the landfilling processing for the 30% of the product that is assumed to be deposited in landfill at end of life.
- ***D Recycling Potential****:* The substitution effect of the recycled material is assumed to avoid the production of crushed aggregate from conventional sources.

3.3 Estimates and Assumptions

All significant foreground data was gathered from the manufacturer based on measured values (i.e. without estimation).

3.4 Cut-off Criteria

The cut-off criteria for all activity stage flows considered within the system boundary conform with ISO14044:2006 and section 6 of the IBU PCR Part A:

- All inputs and outputs to a (unit) process were included in the calculation for which data is available. Data gaps were filled by conservative assumptions with average or generic data. Any assumptions for such choices were documented.
- In case of insufficient input data or data gaps for a unit process, the cut-off criteria were 1% of renewable and non-renewable primary energy usage and 1% of the total mass of that unit process. The total neglected input flows, e.g. per module A1-A3 were a maximum of 5% of energy usage and mass. Conservative assumptions in combination with plausibility considerations and expert judgement were used to demonstrate compliance with these criteria.
- Particular care was taken to include material and energy flows known to have the potential to cause significant emissions into air and water or soil related to the environmental indicators of this standard. Conservative assumptions in combination with plausibility considerations and expert judgement were used to demonstrate compliance with these criteria.

3.5 Background Data and 3.6 Data Quality

Data was gathered for the primary material and energy inputs used in the production of the tile products for calendar year 2019. Table 4 describes each LCI data source for raw materials (A1), transportation by mode (A2) and the core manufacture process (A3). Table 4 also includes a data quality assessment for all secondary data on the basis of the technological, temporal, and geographical representativeness as per the IBU PCR.

Table 4: Secondary Data Sources and Data Quality Assessment

A1: Raw Material Inputs

Inputs	LCI Data Source	Geography	Year	Data Quality Assessment
Qamar Clay **Shale Clay** **Ball Clay**	Clay {RoW}| market for clay | Cut-off, U	Global	2011	**Technology:** very good Process models average global technology **Time:** good Data is <10 years old **Geography:** very good Data is representative of global conditions.
Limestone	Limestone, crushed, washed {RoW}| market for limestone, crushed, washed | Cut-off, U	Global	2011	**Technology:** very good Process models average global technology **Time:** good Data is <10 years old **Geography:** very good Data is representative of global conditions.
Sililca Red Sand	Silica sand {GLO}| market for | Cut-off, U	Global	2011	**Technology:** very good Process models average global technology **Time:** good Data is <10 years old **Geography:** very good Data is representative of global conditions.
Soda Feldspar **Potash Feldspar**	Feldspar {GLO}| market for | Cut-off, U	Global	2011	**Technology:** very good Process models average global technology **Time:** good Data is <10 years old **Geography:** very good Data is representative of global conditions.
Bentonite	Bentonite {GLO}| market for | Cut-off, U	Global	2011	**Technology:** very good Process models average global technology **Time:** good Data is <10 years old **Geography:** very good Data is representative of global conditions.
Dolomite	Dolomite {RoW}| market for dolomite | Cut-off, U	Global	2011	**Technology:** very good Process models average global technology **Time:** good Data is <10 years old **Geography:** very good Data is representative of global conditions.

Glaze	Frit, for ceramic tile {GLO}| market for | Cut-off, U	Global	2014	**Technology:** very good Process models average global technology **Time:** good Data is <10 years old **Geography:** very good Data is representative of global conditions.
A2: Transportation				
Inputs	**LCI Data Source**	**Geography**	**Year**	**Data Quality Assessment**
Truck transport	Transport, freight, lorry 16-32 metric ton, EURO4 {RoW}| transport, freight, lorry 16-32 metric ton, EURO4 | Cut-off, U	Global	2014	**Technology:** very good Process models average global technology **Time:** good Data is <10 years old **Geography:** very good Data is representative of global conditions.
Ocean transport	Transport, freight, sea, transoceanic tanker {GLO}| market for | Cut-off, U	Global	2011	**Technology:** very good Process models average global technology **Time:** good Data is <10 years old **Geography:** very good Data is representative of global conditions.
A3: Manufacturing				
Energy	**LCI Data Source**	**Geography**	**Year**	**Data Quality Assessment**
Grid Electricity	Electricity, high voltage {AE}| market for electricity, high voltage | Cut-off, U	UAE	2014	**Technology**: very good Process models average UAE technology **Time:** good Data is <10 years old **Geography**: very good Data is representative of UAE electricity.
Diesel Electricity	Diesel, burned in diesel-electric generating set {GLO}| market for | Cut-off, U	Global	2011	**Technology:** very good Process models average global technology **Time:** good Data is <10 years old **Geography:** very good Data is representative of global conditions.
Natural Gas	Heat, district or industrial {RoW}| market for heat, district or industrial, natural gas | Cut-off, U	Global	2015	**Technology:** very good Process models average global technology **Time:** very good Data is <5 years old **Geography:** very good Data is representative of global conditions.

Water	LCI Data Source	Geography	Year	Data Quality Assessment
Freshwater	Tap water {RoW}| market for | Alloc Rec, U	Global	2014	**Technology:** very good Process models average global technology **Time:** good Data is <10 years old **Geography:** very good Data is representative of global conditions.
Recycled water	Wastewater from ceramic production {RoW}| treatment of, capacity 5E9l/year | Cut-off, U	Global	2010	**Technology:** very good **Time:** good Data is <10 years old **Geography:** very good Data is representative of global conditions.
Waste	**LCI Data Source**	**Geography**	**Year**	**Data Quality Assessment**
Tiles Scrap Waste	Inert waste, for final disposal {RoW}| treatment of inert waste, inert material landfill | Cut-off, U	Global	2010	**Technology:** very good Process models average global technology **Time:** good Data is <10 years old **Geography:** very good Data is representative of global conditions.
Industrial Waste (Plastic, Wood, Cardboard)	Municipal solid waste {RoW}| treatment of, sanitary landfill | Cut-off, U	Global	2010	**Technology:** very good Process models average global technology **Time:** good Data is <10 years old **Geography:** very good Data is representative of global conditions.
C1-C4 and D: End of Life				
Trucking	Transport, freight, lorry 16-32 metric ton, EURO4 {RoW}| transport, freight, lorry 16-32 metric ton, EURO4 | Cut-off, U	Global	2011	**Technology:** very good Process models average global technology **Time:** good Data is <10 years old **Geography:** very good Data is representative of global conditions.
Recycling process/Substituted	Gravel: Gravel, crushed {RoW}| production | Cut-off, U	Global	2011	**Technology:** very good Process models average global technology **Time:** good Data is <10 years old **Geography:** very good Data is representative of global conditions.
Landfill	Process-specific burdens, inert material landfill {RoW}| market for process-specific burdens, inert material landfill | Cut-off, U	Global	2011	**Technology:** very good Process models average global technology **Time:** good Data is <10 years old **Geography:** very good Data is representative of global conditions.

3.7 Period under Review

Data was gathered for the primary material and energy inputs used in the production for calendar year 2019.

3.8 Allocation

At RAK Ceramics' Ras Al Khaimah factory several ceramic and sanitary ware products are produced. Since the primary data for manufacturing was only available on a facility level, the environmental load among the products produced is allocated according to its mass.

For waste that is recycled, the 'recycled content approach' was chosen. The recycling of waste generated by the product system is cut off.

3.9 Comparability

This LCA was created using industry average data for upstream materials. Data variation can result from differences in supplier locations, manufacturing processes, manufacturing efficiency and fuel types used.

4. LCA: Scenarios and additional technical information

4.1 Biogenic Carbon Content: The product does not contain any biogenic carbon. The packaging includes biogenic carbon in the form of cardboard and this packaging is less than 5% of the combined product and packaging mass, estimated to be 20-40 kg/t.

5. LCA: Results

Life cycle impact assessment (LCIA) is the phase in which the set of results of the inventory analysis – the inventory flow table – is further processed and interpreted in terms of environmental impacts and resource use inventory metrics. As specified in the IBU PCR, Table 5 and 6a/b below summmarizes the LCA results for the product systems.

Table 5: Description of the System Boundary (x: included in LCA; mnd: module not declared; mnr: module not relevant)

Product			Construction Installation		Use							End-of-life				Benefits of Loads Beyond the System Boundary		
Raw Material supply	Transport	Manufacturing	Transport	Construction / Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	De-Construction/ Demolition	Transport	Waste processing	Disposal	Reuse	Recovery	Recycling
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D	D	D
x	x	x	mnd	mnd	mnd	mnd	mnr	mnr	mnr	mnd	mnd	x	x	x	x	x	x	x

Table 6c. Life Cycle Impact Assessment Results for 1 m^2 vitreous ceramicc product											
Environmental Indicator											
Impact Categories	**Abbrev.**	**Units**	**Total**	**A1**	**A2**	**A3**	**C1**	**C2**	**C3**	**C4**	**D**
Global warming potential	**GWP - total**	kg CO2-eq	5.16E+02	5.98E+01	1.53E+02	2.94E+02	0.00E+00	8.61E+00	6.09E+00	8.06E-01	-6.09E+00
Global warming potential - fossil fuels	**GWP - fossil**	kg CO2-eq	4.99E+02	5.94E+01	1.52E+02	2.78E+02	0.00E+00	8.61E+00	6.00E+00	8.03E-01	-6.00E+00
Global warming potential - biogenic	**GWP - biogenic**	kg CO2-eq	1.66E+01	3.45E-01	9.61E-02	1.62E+01	0.00E+00	3.34E-03	7.80E-02	2.18E-03	-7.80E-02
GWP land use & land use change	**GWP - luluc**	kg CO2-eq	1.36E-01	6.09E-02	5.82E-02	1.35E-02	0.00E+00	3.12E-03	7.94E-03	6.82E-05	-7.94E-03
Depletion potential of the stratospheric ozone layer	**ODP**	kg CFC-11-eq	6.41E-05	7.11E-06	2.65E-05	2.84E-05	0.00E+00	1.88E-06	5.44E-07	1.62E-07	-5.44E-07
Acidification potential of land and water	**AP**	kg SO2-eq	1.83E+00	3.08E-01	1.12E+00	3.60E-01	0.00E+00	3.35E-02	3.04E-02	5.80E-03	-3.04E-02
Acidification potential, accumulated exceedance	**AP**	mol H+-eq	2.27E+00	3.57E-01	1.38E+00	4.78E-01	0.00E+00	4.41E-02	3.91E-02	8.06E-03	-3.91E-02
Eutrophication potential	**EP**	kg PO4-eq	4.05E-01	1.04E-01	1.78E-01	1.13E-01	0.00E+00	7.96E-03	1.50E-02	1.36E-03	-1.50E-02
Eutrophication, fraction of nutrients reaching freshwater end compartment	**EP-Freshwater**	kg PO4-eq	4.02E-02	2.09E-02	1.41E-02	4.47E-03	0.00E+00	7.29E-04	3.68E-03	4.55E-05	-3.68E-03
Eutrophication, fraction of nutrients reaching marine end compartment	**EP- Marine**	kg N-eq	5.58E-01	7.38E-02	2.86E-01	1.80E-01	0.00E+00	1.48E-02	8.86E-03	3.45E-03	-8.86E-03
Eutrophication, accumulated exceedance	**EP- Terrestrial**	mol N-eq	5.77E+00	7.98E-01	3.15E+00	1.62E+00	0.00E+00	1.62E-01	1.07E-01	3.78E-02	-1.07E-01
Formation potential of tropospheric ozone photochemical oxidants	**POCP**	kg ethene-eq	8.99E-02	1.37E-02	4.44E-02	3.04E-02	0.00E+00	1.16E-03	1.99E-03	2.36E-04	-1.99E-03
Formation potential of tropospheric ozone photochemical oxidants	**POCP**	kg NMVOC-eq	1.70E+00	2.22E-01	9.05E-01	5.13E-01	0.00E+00	4.61E-02	2.71E-02	1.06E-02	-2.71E-02
Abiotic Depletion Potential for Non-Fossil Resources	**ADPE**	kg Sb eq	8.66E-04	2.31E-04	3.66E-04	3.97E-05	0.00E+00	2.28E-04	6.41E-04	1.17E-06	-6.41E-04
Abiotic Depletion Potential for Fossil Resources	**ADPF**	MJ Surplus	7.75E+03	7.73E+02	2.21E+03	4.63E+03	0.00E+00	1.26E+02	6.72E+01	1.06E+01	-6.72E+01
Water user deprivation potential, deprivation weighted water consumption	**WDP**	m^3 world- Eq deprived	3.35E+01	5.39E+01	7.10E+00	5.52E+00	0.00E+00	4.14E-01	-2.32E+01	1.54E-02	-1.02E+01

Inventory Metrics - Resources	Abbrev.	Units	Total	A1	A2	A3	C1	C2	C3	C4	D
Use of renewable primary energy as energy	**PERE**	MJ	1.00E+02	6.03E+01	2.81E+01	1.04E+01	0.00E+00	1.43E+00	7.82E+00	8.24E-02	-7.82E+00
Use of renewable primary energy as a material	**PERM**	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of renewable primary energy	**PERT**	MJ	1.00E+02	6.03E+01	2.81E+01	1.04E+01	0.00E+00	1.43E+00	7.82E+00	8.24E-02	-7.82E+00
Use of non-renewable primary energy as energy	**PENRE**	MJ	8.62E+03	9.37E+02	2.39E+03	5.15E+03	0.00E+00	1.36E+02	9.29E+01	1.13E+01	-9.29E+01
Use of non-renewable primary energy as a material	**PENRM**	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of non-renewable primary energy	**PENRT**	MJ	8.62E+03	9.37E+02	2.39E+03	5.15E+03	0.00E+00	1.36E+02	9.29E+01	1.13E+01	-9.29E+01
Use of secondary materials	**SM**	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of renewable secondary fuels	**RSF**	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of non-renewable secondary fuels	**NRSF**	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of freshwater resources	**FW**	m3	-2.88E+01	2.45E+00	4.03E-01	1.37E+00	0.00E+00	4.14E-01	-2.32E+01	1.54E-02	-1.02E+01
Inventory Metrics – Waste and Outputs	**Abbrev.**	**Units**	**Total**	**A1**	**A2**	**A3**	**C1**	**C2**	**C3**	**C4**	**D**
Disposed of Hazardous Waste	**HWD**	kg	7.42E+01	0.00E+00	0.00E+00	7.42E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Disposed of Non-Hazardous Waste	**NHWD**	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Disposed of Radioactive Waste	**RWD**	m3	8.07E-06	1.17E-06	5.97E-06	9.34E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Components for Reuse	**CRU**	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for Recycling	**MFR**	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for Energy Recovery	**MER**	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported Electrical Energy (Waste to Energy)	**EEE**	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported Thermal Energy (Waste to Energy)	**ETE**	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 6d. Life Cycle Impact Assessment Results for 1 m^2 fine fire clay product											
Environmental Indicator											
Impact Categories	**Abbrev.**	**Units**	**Total**	**A1**	**A2**	**A3**	**C1**	**C2**	**C3**	**C4**	**D**
Global warming potential	**GWP - total**	kg CO2-eq	4.38E+02	3.60E+01	9.87E+01	2.94E+02	0.00E+00	8.61E+00	6.09E+00	8.06E-01	-6.09E+00
Global warming potential - fossil fuels	**GWP - fossil**	kg CO2-eq	4.22E+02	3.58E+01	9.86E+01	2.78E+02	0.00E+00	8.61E+00	6.00E+00	8.03E-01	-6.00E+00
Global warming potential - biogenic	**GWP - biogenic**	kg CO2-eq	1.65E+01	1.62E-01	9.06E-02	1.62E+01	0.00E+00	3.34E-03	7.80E-02	2.18E-03	-7.80E-02
GWP land use & land use change	**GWP - luluc**	kg CO2-eq	9.64E-02	3.96E-02	4.00E-02	1.35E-02	0.00E+00	3.12E-03	7.94E-03	6.82E-05	-7.94E-03
Depletion potential of the stratospheric ozone layer	**ODP**	kg CFC-11-eq	5.14E-05	4.04E-06	1.69E-05	2.84E-05	0.00E+00	1.88E-06	5.44E-07	1.62E-07	-5.44E-07
Acidification potential of land and water	**AP**	kg SO2-eq	1.75E+00	1.97E-01	1.15E+00	3.60E-01	0.00E+00	3.35E-02	3.04E-02	5.80E-03	-3.04E-02
Acidification potential, accumulated exceedance	**AP**	mol H+-eq	2.12E+00	2.39E-01	1.36E+00	4.78E-01	0.00E+00	4.41E-02	3.91E-02	8.06E-03	-3.91E-02
Eutrophication potential	**EP**	kg PO4-eq	3.44E-01	7.16E-02	1.50E-01	1.13E-01	0.00E+00	7.96E-03	1.50E-02	1.36E-03	-1.50E-02
Eutrophication, fraction of nutrients reaching freshwater end compartment	**EP-Freshwater**	kg PO4-eq	2.97E-02	1.44E-02	1.01E-02	4.47E-03	0.00E+00	7.29E-04	3.68E-03	4.55E-05	-3.68E-03
Eutrophication, fraction of nutrients reaching marine end compartment	**EP- Marine**	kg N-eq	4.50E-01	4.89E-02	2.03E-01	1.80E-01	0.00E+00	1.48E-02	8.86E-03	3.45E-03	-8.86E-03
Eutrophication, accumulated exceedance	**EP- Terrestrial**	mol N-eq	4.63E+00	5.52E-01	2.26E+00	1.62E+00	0.00E+00	1.62E-01	1.07E-01	3.78E-02	-1.07E-01
Formation potential of tropospheric ozone photochemical oxidants	**POCP**	kg ethene-eq	8.48E-02	8.70E-03	4.43E-02	3.04E-02	0.00E+00	1.16E-03	1.99E-03	2.36E-04	-1.99E-03
Formation potential of tropospheric ozone photochemical oxidants	**POCP**	kg NMVOC-eq	1.37E+00	1.48E-01	6.53E-01	5.13E-01	0.00E+00	4.61E-02	2.71E-02	1.06E-02	-2.71E-02
Abiotic Depletion Potential for Non-Fossil Resources	**ADPE**	kg Sb eq	7.10E-04	2.58E-04	1.83E-04	3.97E-05	0.00E+00	2.28E-04	6.41E-04	1.17E-06	-6.41E-04
Abiotic Depletion Potential for Fossil Resources	**ADPF**	MJ Surplus	6.63E+03	4.40E+02	1.42E+03	4.63E+03	0.00E+00	1.26E+02	6.72E+01	1.06E+01	-6.72E+01
Water user deprivation potential, deprivation weighted water consumption	**WDP**	m^3 world- Eq deprived	-6.33E+00	1.67E+01	4.42E+00	5.52E+00	0.00E+00	4.14E-01	-2.32E+01	1.54E-02	-1.02E+01

Inventory Metrics - Resources	Abbrev.	Units	Total	A1	A2	A3	C1	C2	C3	C4	D
Use of renewable primary energy as energy	**PERE**	MJ	7.25E+01	3.78E+01	2.28E+01	1.04E+01	0.00E+00	1.43E+00	7.82E+00	8.24E-02	-7.82E+00
Use of renewable primary energy as a material	**PERM**	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of renewable primary energy	**PERT**	MJ	7.25E+01	3.78E+01	2.28E+01	1.04E+01	0.00E+00	1.43E+00	7.82E+00	8.24E-02	-7.82E+00
Use of non-renewable primary energy as energy	**PENRE**	MJ	7.38E+03	5.33E+02	1.55E+03	5.15E+03	0.00E+00	1.36E+02	9.29E+01	1.13E+01	-9.29E+01
Use of non-renewable primary energy as a material	**PENRM**	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of non-renewable primary energy	**PENRT**	MJ	7.38E+03	5.33E+02	1.55E+03	5.15E+03	0.00E+00	1.36E+02	9.29E+01	1.13E+01	-9.29E+01
Use of secondary materials	**SM**	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of renewable secondary fuels	**RSF**	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of non-renewable secondary fuels	**NRSF**	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of freshwater resources	**FW**	m3	-3.03E+01	1.04E+00	2.48E-01	1.37E+00	0.00E+00	4.14E-01	-2.32E+01	1.54E-02	-1.02E+01
Inventory Metrics – Waste and Outputs	**Abbrev.**	**Units**	**Total**	**A1**	**A2**	**A3**	**C1**	**C2**	**C3**	**C4**	**D**
Disposed of Hazardous Waste	**HWD**	kg	7.42E+01	0.00E+00	0.00E+00	7.42E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Disposed of Non-Hazardous Waste	**NHWD**	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Disposed of Radioactive Waste	**RWD**	m3	5.45E-06	6.84E-07	3.83E-06	9.34E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Components for Reuse	**CRU**	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for Recycling	**MFR**	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for Energy Recovery	**MER**	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported Electrical Energy (Waste to Energy)	**EEE**	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported Thermal Energy (Waste to Energy)	**ETE**	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

6. Interpretation

Figure 2a and 2b shows the relative contribution to the cumulative impacts of the A1 through A3 phases. The C1 through C4 phases and Module D are all relatively insignificant in terms of the overall results and are thus excluded from this contribution analysis. In the cradle-to-gate portion, the manufacturing (A3) is the major contributor to GWP, ODP, POCP and ADPf. Major A3 impacts came from the combustion of natural gas for heat during the drying process. For the indicators AP, EP and ADPe, the major impacts occurred during the raw material supply (A1). Transportation (A2) impacts are insignificant for ceramic tiles.

In the porcelain tiles production, the impact of transportation is much higher and accounts for around 20% of the overall impact. This is due to longer transportation distances.

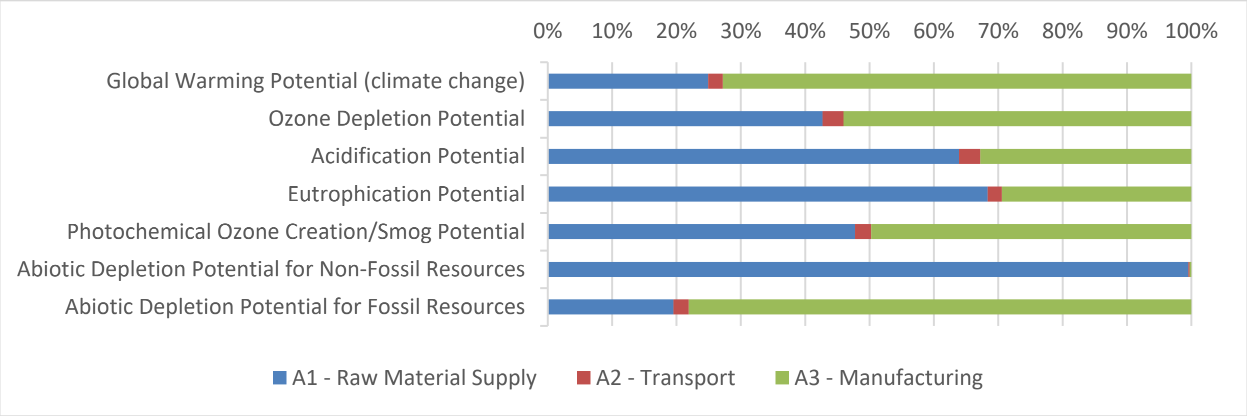

Figure 2a. Contribution analysis for ceramic tiles

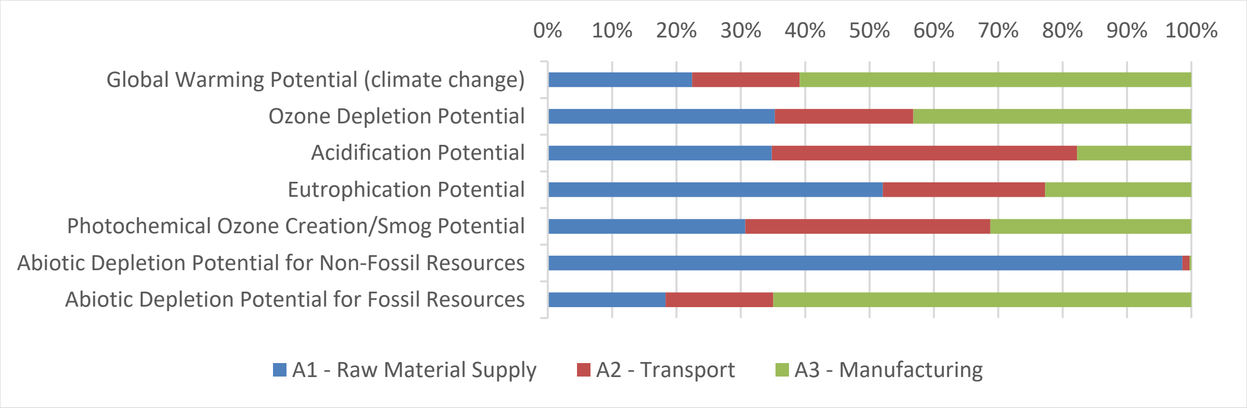

Figure 2b. Contribution analysis for porcelain tiles

7. Requisite Evidence

No environmental claims beyond the LCA results are made in this EPD and thus no additional evidence is required.

8. References

1. A Life Cycle Assessment of Ceramic Tiles and Sanitary Ceramics Manufactured by RAK Ceramics
2. EN 15804 +A1:2013 Sustainability of construction works – Environmental product declarations –Core rules for the product category of construction products.
3. EN 15804+A2:2019 Sustainability of construction works – Environmental product declarations –Core rules for the product category of construction products.
4. IBU PCR Part A: Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project report according to EN 15804+A2:2019 – Version 1.0
5. IBU PCR Part B: Requirements on the EPD for ceramic tiles and panels, Version 1.1
6. ISO 21930: 2017 Building construction – Sustainability in building construction – Environmental declaration of building products.
7. ISO 14025: 2006 Environmental labeling and declarations - Type III environmental declarations - Principles and procedures.
8. ISO 14044: 2006 Environmental management - Life cycle assessment - Requirements and guidelines.
9. ISO 14040: 2006 Environmental management - Life cycle assessment - Principles and framework.