ENVIRONMENTAL PRODUCT DECLARATION

Porcelain Tiles with Recycled Content

NSF Certified Environmental Product Declaration www.nsf.org

WONDER PORCELAIN™

Program Operator	NSF Certification LLC 789 N. Dixboro, Ann Arbor, MI 48105 www.nsf.org
General Program instructions and Version Number	Part A: Life Cycle Assessment Calculation Rules and Report Requirements, Version 3.2
Manufacturer Name and Address	Wonder Porcelain 5 Wonder Lane Lebanon, TN 37090
Declaration Number	EPD10277
Declared Product and Functional Unit	Porcelain Floor Tile (with recycled content) manufactured at Lebanon, TN 1 square meter of installed flooring and with a building service life of 75 years
Reference PCR and Version Number	Part A: Life Cycle Assessment Calculation Rules and Report Requirements, Version 3.2 Part B: Flooring EPD Requirements. UL 10010-7, September 28, 2018
Product's intended Application and Use	Flooring Applications
Product RSL	75 years
Markets of Applicability	North America
Date of Issue	12/06/2019
Period of Validity	12/06/2019 - 06/30/2025
EPD Type	Product Specific
Range of Dataset Variability	N/A
EPD Scope	Cradle to Grave
Year of reported manufacturer primary data	2018 (original release) 2021 (update)
LCA Software and Version Number	GaBi 9.2.0.58
LCI Database and Version Number	GaBi Database Version 9.2, Service Pack 39
LCIA Methodology and Version Number	TRACI 2.1 CML 2001-Jan 2016
The sub-category PCR review was conducted by:	Jack Geibig (Chair) Thomas Gloria, PhD Thaddeus Owen

This declaration was independently verified in accordance with ISO 14025: 2006. The UL Environment "Part A: Life Cycle Assessment Calculation Rules and Report Requirements" v3.2 (December 2018), based on CEN Norm EN 15804 (2012) and ISO 21930:2017, serves as the core PCR, with additional considerations from the USGBC/UL Environment Part A Enhancement (2017) ☐ Internal ☒ External	Jack Geibig - EcoForm jgeibig@ecoform.com
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	WAP Sustainability Consulting
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Jack Geibig - EcoForm jgeibig@ecoform.com

Limitations:
Environmental declarations from different programs (ISO 14025) may not be comparable.
Comparison of the environmental performance of Flooring Products using EPD information shall be based on the product's use and impacts at the building level, and therefore EPDs may not be used for comparability purposes when not considering the building energy use phase as instructed under this PCR.
Full conformance with the PCR for Products allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible". Example of variations: Different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared.

1. Description of Company

Wonder Porcelain is an American company with international roots. With manufacturing based in Lebanon, Tennessee, the U.S. division operates as a wholly owned subsidiary of one of the largest tile companies in the world. Wonder Porcelain, comprised of a team of tile veterans who have come together from leading organizations within the industry, incorporates proven processes and strategy as well as a new vision for manufacturing, marketing, and selling tile in the United States. The U.S. division is committed to the future of the tile industry in America and believes future growth depends upon increasing domestic manufacturing, adopting new, innovative techniques and spearheading ongoing research and development within the industry.

2. Product Description

a. Product Identification

This EPD includes representative products derived from Wonder Porcelain's line of products produced at the facility located in Lebanon, Tennessee with recycled content. Porcelain tiles are primarily made up of clays, feldspar and other additives and then molded into shape followed by firing into a kiln. Porcelain tiles can be glazed or unglazed. There are several advantages to porcelain tiles. They are fire resistant, non-combustible, durable (lasts a lifetime) and extremely easy to maintain. The UNSPSC code for this flooring product is 301617 and the CSI code is 09 30 00.

Results in this LCA are presented based on a representative product that is based on the total materials purchased during 2018 and annual production data. An updated set of results from 2022 based on body formulation and manufacturing process changes is provided in Appendix A.

3. Product Specification and Application Rules

The products considered in the EPD meet or exceed the following technical specifications:

- ANSI A137.1: American National Standard Specifications for Ceramic Tile

Fire Testing:

- Classification: A, Flame Spread: 0, Smoke Developed: 0

4. Application

Porcelain tile products are commonly used in a variety of applications including commercial, light commercial, institutional, and residential interior and exterior applications.

5. Technical Data

Table 1: Technical Details

Parameter	Wonder Porcelain Tile
Facial Area (mm^2)	92903, 139355, 185806, 371612, 743224.3
Nominal Value Sizes (in)	6x24, 6x36, 12x12, 12x24, 24x24,24x48,6x48

Average Fired Weight (g/m^2)	20,105.15
Average Fired Weight (lb/ft^2)	4.11
Thickness min value (mm)	8.2
Thickness max value (mm)	9.5
Class	P1
Tile Type	Porcelain
Grade	Includes Standard and Second
Dimensional Categories	Calibrated and Rectified

6. Declaration of Methodological Framework

This EPD is considered a Cradle-to-Grave study. A summary of the life cycle stages included in this EPD is presented in Table 8. The reference service life is outlined in Table 10 and is only applicable if all manufacturing guidelines are followed regarding site-selection and installation, found online. No known flows are deliberately excluded from this EPD. Third party verified ISO 14040/44 secondary LCI data sets contribute more than 67% of total impacts in all impact categories required by the PCR.

7. Flow Diagram

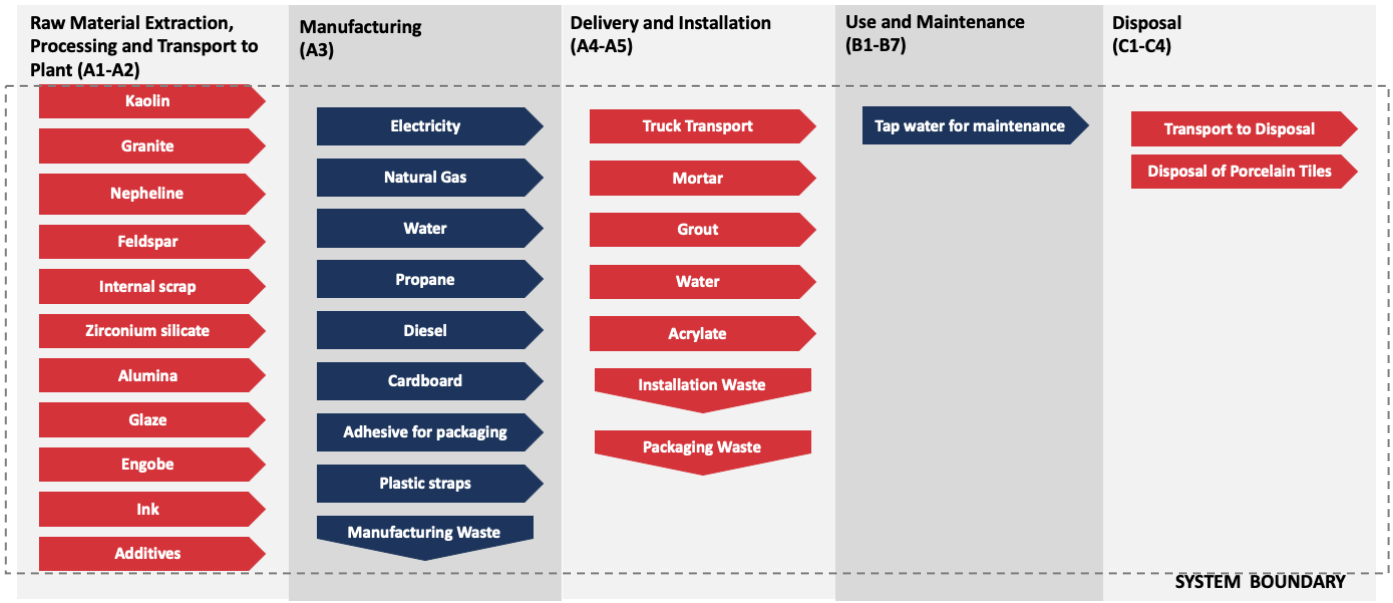

Figure 1: System Boundary

8. Manufacturing

The manufacturing process begins with mining of raw materials such as clay, granite, feldspar and other natural minerals. These raw materials are then mixed with water in a ball mill. The slurry formed in this process is the body slip which will form the bulk of the porcelain tile. Next the slip is pumped to the spray dryer. This device uses burners and gravity to form a powder. The resulting

powder is then pressed into the form of a pre-fired or “green” tile. The green tiles pass through a drying apparatus to further reduce moisture content. From there the tiles proceed down the glaze line for base application, ceramic ink jet decoration, and are finished with a protective top glaze. Tiles are then stored in a buffer area for a short time before proceeding to another dryer. After the final dryer, the product is then fed into the kiln. Inside the kiln thermochemical reactions take place that remove all VOCs and fuse the porcelain tile into the familiar solid and durable product.

The manufacturing process incorporates extensive recycling. All water from municipal sources is reused in the process. Dryer systems utilize hot air from the kiln exhaust. The body formulation recycles wastewater solids, green tile scrap, and materials captured from the dust collection systems as recycled content into the tiles.

Once the tiles are manufactured, they are packaged in cardboard and plastic straps, palletized and if desired by customers, wrapped in plastic film.

9. Material Composition

Table 2: Material Composition

Component	Material	Recycled	Wonder Porcelain
Body	Kaolin	No	44.73%
	Granite	No	26.23%
	Nepheline	No	13.94%
	Feldspar	No	10.27%
	Internal Scrap	Yes	4.58%
	Zirconium silicate	No	0.07%
	Engobe	No	0.04%
	Zinc oxide	No	0.02%
	Frit	No	0.03%
	Additives	No	0.04%
Surface	Ink	No	0.01%
	Glaze	No	0.05%

This product contains no regulated substances.

10. Packaging

Table 3: Packaging Inputs

Input	Disposal Mechanism	Value	Unit
Cardboard	Recycled (75%), Landfilled (20%), Incinerated (5%)	0.887	kg
Plastic Strap	Recycled (15%), Landfilled (68%), Incinerated (17%)	0.05	kg

Packaging waste disposal has been modeled as per guidelines in section 2.8.5 of Part A: Life Cycle Assessment Calculation Rules and Report Requirements.

11. Product Installation

Product installation requirements and procedure are provided in guidelines by Tile Council of North America (TCNA). Mortar is used to adhere tile to the floor substrate while grout is used to fill in gaps between the tiles. 4.5% of waste is assumed for mortar and grout. Apart from these, installation solution made of acrylate and water are also recommended for installation. Installation inputs are detailed in Table 4.

Table 4: Installation Inputs

Material	Amount	Unit	Amount	Unit
Mortar	4.07	kg/m^2	0.83	lb/ft^2
Grout	0.212	kg/m^2	0.043	lb/ft^2
Water	0.37	kg/m^2	0.075	lb/ft^2
Acrylate	0.043	kg/m^2	0.008	lb/ft^2
Waste for mortar	4.5	%	4.5	%
Waste for grout	4.5	%	4.5	%

12. Use Conditions

As recommended by the Tile Council of North America (TCNA), porcelain tile floors are cleaned with dust mops daily and with a damp mop 36 times a year for commercial flooring applications. Damp mopping requires the use of tap water for cleaning. The impacts from the mops itself as multi-use tools are considered to be negligible per functional unit. Since the reference service life of porcelain tiles is 75 years, which is as long as the estimated service life of the building, there are no replacements of tiles over the course of the lifetime of the building. Use phase conditions and inputs are provided in Tables 5 and 6 respectively.

Table 5: Use phase parameters

Use	Cleaning Process	Cleaning Frequency	Consumption of energy and resources
Commercial	Dust mop	365 times/ year	-
	Damp mop	36 times/ year (Commercial)	Tap water

Table 6: Use phase inputs

Input	Amount	Unit
Tap water	0.783	$l/m^2/yr$

13. Product Reference Service and Building Estimated Service Life

According to Part A: Life Cycle Assessment Calculation Rules and Report Requirements, UL Environment, V3.2, 2018, the Estimated Service Life (ESL) of the building is assumed to be 75 years. Since porcelain tiles are expected to last as long as the building itself, the Reference Service Life (RSL) of porcelain tiles is taken to be 75 years.

14. Disposal

All waste has been classified according to regional-specific legislation as laid out in Section 2.8.6 in Part A: Life Cycle Assessment Calculation Rules and Report Requirements from UL Environment. Porcelain being a non-metal, all of it is landfilled at end-of-life as per the aforementioned PCR.

LIFE CYCLE ASSESSMENT BACKGROUND INFORMATION

1. Functional Unit

The functional unit according to the PCR is 1 m^2 of finished flooring. The function of a floor covering is to cover and protect the flooring substrate.

Table 7: Functional Unit

	Wonder Porcelain
Functional Unit [m^2]	1
Average Weight [kg]	20.105

2. System Boundary

This EPD is considered a Cradle-to-Grave study. A summary of the life cycle modules included in this EPD is presented in Table 8. Infrastructure flows have been excluded.

Table 8: Summary of Included Life Cycle Modules

Module Name	Description	Analysis Period	Summary of Included Elements
A1	Product Stage: Raw Material Supply	2018	Raw Material sourcing and processing as defined by secondary data.
A2	Product Stage: Transport	2018	Shipping from supplier to manufacturing site. Fuel use requirements estimated based on product weights and measured and calculated distance.
A3	Product Stage: Manufacturing	2018	Energy, water and material inputs required for manufacturing products from raw materials. Packaging materials and manufacturing waste are included as well.
A4	Construction Process Stage: Transport	2018	Shipping from manufacturing site to project site. Fuel use requirements estimated based on assumed distance recommended by the PCR (Part B).
A5	Construction Process Stage: Installation	2019	Installation materials, installation waste and packaging material waste.
B1	Use Stage: Use	2019	Use of the product.
B2	Use Stage: Maintenance	2019	Cleaning water.
B3	Use Stage: Repair	2019	Ceramic tile typically does not need to be repaired.
B4	Use Stage: Replacement	2019	No inputs required for replacement manufacturing. Ceramic tile does not need to be replaced for over 75 years.
B5	Use Stage: Refurbishment	2019	Ceramic tile is typically not refurbished.
B6	Operational Energy Use	2019	Operational Energy Use of Building Integrated System During Product Use
B7	Operational Water Use	2019	Operational Water Use of Building Integrated System During Product Use
C1	EOL: Deconstruction	2019	No inputs required for deconstruction.
C2	EOL: Transport	2019	Shipping from project site to landfill. Fuel use requirements estimated based on product weight and assumed distance recommended by the PCR (Part B).
C3	EOL: Waste Processing	2019	Waste processing not required. All waste can be processed as is.
C4	EOL: Disposal	2019	Assumes all products are sent to landfill. Landfill impacts modeled based on secondary data.
D	Benefits beyond system	MND	Credits from energy or material capture.

3. Estimates and Assumptions

All estimates and assumptions are within the requirements of ISO 14040/44. The majority of the estimations are within the primary data. Some assumptions made in the study that may have affected the results are:

- The primary data was collected as annual totals including all utility usage and production information. For the LCA, the usage information was divided by the production to create an energy and water use per square meter.
- Installation tools are used enough times that the per square meter impacts are negligible.
- Distance of transport to customer is assumed to be 800km as recommended by the PCR (Part B) due to the unavailability of granular sales data.
- Materials required for installation were assumed to be as recommended by Tile Council of North America (TCNA). In reality, these material quantities and application rates may not be used thus changing the overall impact.
- Use phase scenarios are also taken as per TCNA guidelines from the industry wide EPD. However, use phase scenarios have a high degree of variability based on user preferences which might affect overall results.
- The disposal pathways and the corresponding transportation distances of unused product waste, packaging waste, and post-consumer product waste are assumed in accordance with the PCR.
- The inclusion of overhead energy, water and waste data was determined appropriate due to the inability to sub-meter and isolate manufacturing energy from overhead energy.
- The use and selection of secondary datasets from GaBi – The selection of which generic dataset to use to represent an aspect of a supply chain is a significant value choice. Collaboration between LCA practitioner, Wonder Porcelain associates and GaBi data experts was valuable in determining best-case scenarios in the selection of data. However, no generic data can be a perfect fit. Improved supply chain specific data would improve the accuracy of results, however budgetary and time constraints have to be taken into account.

4. Cut-off Rules

Material inputs greater than 1% (based on total mass of the final product) were included within the scope of analysis. Material inputs less than 1% were included if sufficient data was available to warrant inclusion and/or the material input was thought to have significant environmental impact. Cumulative excluded material inputs and environmental impacts are less than 5% based on total weight of the functional unit. Materials excluded from the study are a few inks and proprietary additives (0.10% of final product) due to the unavailability of adequate datasets to represent the corresponding raw materials. No known flows are deliberately excluded from this EPD.

5. Data Sources

Primary data was collected by Wonder Porcelain associates for onsite energy, water and waste during the course of manufacturing. Whenever available, supplier data was used for raw materials used in the production process. When primary data did not exist, secondary data for raw material production was used from GaBi Database Version 9.2, Service Pack 39. All calculation procedures adhere to ISO14044.

6. Data Quality

The geographical scope of the manufacturing portion of the life cycle is Lebanon, TN. All primary data were collected from the manufacturer. The geographic coverage of primary data is considered excellent. Primary data were provided by the manufacturer and represent all information for calendar year 2018. Primary data provided by the manufacturer is specific to the technology that the company uses in manufacturing their product. It is site-specific and considered of good quality. Data used to allocate energy and water on a per unit of product produced includes overhead energy such as lighting, heating and sanitary use of water. Sub-metering was not available to extract process only energy and water use from the total energy use. Sub-metering would improve the technological coverage of data quality.

7. Period under Review

The period under review is calendar year 2018.

8. Allocation

General principles of allocation were based on ISO 14040/44. There are no products other than porcelain tiles that are produced as part of the manufacturing processes studied in the LCA. Since there are no co-products, no allocation based on co-products is required. To derive a per unit value for manufacturing inputs such as electricity, natural gas and water, allocation based on total production in square meters was adopted. Discussions with Wonder Porcelain staff divulged this was a more representative way than via mass to allocate the manufacturing inputs based on the manufacturing processes used and the types of products created. As a default, secondary GaBi datasets use a physical mass basis for allocation. Throughout the study recycled materials were accounted for via the cut-off method. Under this method, impacts and benefits associated with the previous life of a raw material from recycled stock are excluded from the system boundary. Additionally, impacts and benefits associated with secondary functions of materials at end of life are also excluded (i.e. production into a third life or energy generation from the incineration plant). The study does include the impacts associated with reprocessing and preparation of recycled materials that are part of the bill of materials of the products under study.

9. Comparability and Benchmarking

The user of the EPD should take care when comparing EPDs from different companies. Assumptions, data sources, and assessment tools may all impact the variability of the final results and make comparisons misleading. Without understanding the specific variability, the user is therefore, not encouraged to compare EPDs. Even for similar products, differences in use and end-of-life stage assumptions, and data quality may produce incomparable results. Comparison of the environmental performance of flooring products using EPD information shall be based on the product's use and impacts at the building level, and therefore EPDs may not be used for comparability purposes when not considering the building energy use phase as instructed under this PCR. Full conformance with the PCR for flooring products allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible. Example of variations: Different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared.

Table 9: Transport to building site (A4)

Name	Truck	Unit
Fuel type	Diesel	-
Liters of fuel	39.0625	l/100km
Vehicle type	Heavy duty diesel truck/ 50,000 lb payload	-
Transport distance	800	km
Capacity utilization	65	%
Weight of products transported	20,411.657	kg
Capacity utilization volume factor	1	-

Table 10: Reference Service Life

Name	Value	Unit
RSL	75	years
Declared product properties (at the gate) and finishes, etc.	See Table 1	-
Design application	Installation per recommendation by manufacturer	-
An assumed quality of work, when installed in accordance with the manufacturer's instructions	Accepted industry standard	-
Indoor environment (if relevant for indoor applications)	Normal building operating conditions	-
Use conditions, e.g. frequency of use, mechanical exposure	Normal building operating conditions	-

Table 11: Installation into the building (A5)

Name	Wonder Porcelain	Unit
Net freshwater consumption specified by water source and fate	0.0004 m^3 tap water, installation solution	m^3
Grout	0.212	kg/m^2
Mortar	4.07	kg/m^2
Acrylate	0.043	kg/m^2
Waste materials at the construction site before waste processing, generated by product installation	2.09	kg/m^2
Packaging waste, cardboard	0.887	kg/m^2
Packaging waste, plastic strap	0.0503	kg/m^2
Biogenic carbon contained in packaging	3.14	kg CO_2
Direct emissions to ambient air, soil and water	0	kg

VOC emissions	N/A	µg/m^3

Table 12: Maintenance (B2)

Name	Value	Unit
Maintenance process information	Use phase parameters as recommended by TCNA guidelines	
Dust mop	27,375	Cycles/ RSL and Cycles/ ESL
Damp mop (Commercial)	2,700	Cycles/ RSL and Cycles/ ESL
Net freshwater consumption specified by water source and fate	0.05 m^3 tap water, evaporated	m^3
Further assumptions for scenario development	Floor cleaned with dust mop daily and with damp mop 36 times/year for commercial applications	

Table 13: End of life (C1-C4)

Name		Value	Unit
Assumptions for scenario development		Product is either disposed of with the underlying floor or manually removed via scraping	
Collection process	Collected separately	0	kg
	Collected with mixed construction waste	24.8	kg
Recovery	Reuse	0	kg
	Recycling	0	kg
	Landfill	24.8	kg
	Incineration	0	kg
	Incineration with energy recovery	0	kg
	Energy conversion efficiency rate	84-94	%
Disposal	Product or material for final deposition	24.8	kg
Removals of biogenic carbon (excluding packaging)		0.121	kg CO_2

LIFE CYCLE ASSESSMENT RESULTS

All results are given per functional unit, which is 1 m^2 of installed flooring over an estimated building life of 75 years. Environmental impacts were calculated using the GaBi software platform. Impact results have been calculated using both TRACI 2.1 and CML 2001-Jan 2016 characterization factors. LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks. These six impact categories are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development, however the EPD users shall not use additional measures for comparative purposes.

	PRODUCT STAGE			CONSTRUCT-ION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARY
	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
	Raw material supply	Transport	Manufacturing	Transport from gate to site	Assembly/Install	Use	Maintenance	Repair	Replacement	Refurbishment	Building Operational Energy Use	Building Operational Water Use During Product Use	Deconstruction	Transport	Waste processing	Disposal	Reuse, Recovery, Recycling Potential
Cradle to Grave	X			X	X	X	X	X	X	X	X	X	X	X	X	X	MND

Figure 2: Description of the system boundary modules

Table 14: Biogenic Carbon Uptake and Emissions

Parameter	Parameter	Wonder Porcelain	Unit
BCRP	Biogenic Carbon Removal from Product	0.121	kg CO_2
BCEP	Biogenic Carbon Emission from Product	0.098	kg CO_2
BCRK	Biogenic Carbon Removal from Packaging	3.15	kg CO_2
BCEK	Biogenic Carbon Emission from Packaging	1.45	kg CO_2

See Impact Category Key below for definition of acronyms.

Table 15: Acronym Key

Acronym	Text	Acronym	Text
Impact Categories			
ADP-elements	Abiotic depletion potential for non-fossil resources	**GWP**	Global warming potential
ADP-fossil	Abiotic depletion potential for fossil resources	**ODP**	Depletion of stratospheric ozone layer
AP	Acidification potential of soil and water	**POCP**	Photochemical ozone creation potential
EP	Eutrophication potential	**Resources**	Depletion of non-renewable fossil fuels
LCI Indicators			
RPR_E	Use of renewable primary energy excluding renewable primary energy resources used as raw materials	**SM**	Use of secondary materials
RPR_M	Use of renewable primary energy resources used as raw materials	**RSF**	Use of renewable secondary fuels
$NRPR_E$	Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	**NRSF**	Use of non-renewable secondary fuels
$NRPR_M$	Use of non-renewable primary energy resources used as raw materials	**FW**	Net use of fresh water
HWD	Disposed-of-hazardous waste	**MR**	Materials for recycling
NHWD	Disposed-of non-hazardous waste	**MER**	Materials for energy recovery
HLRW	High-level radioactive waste, conditioned, to final repository	**EE**	Exported energy
ILLRW	Intermediate- and low-level radioactive waste, conditioned, to final repository	**CRU**	Components for reuse
RE	Recovered energy		

1. Wonder Porcelain Tiles

1.1 CML Results

Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
ADP-elements [kg Sb eq]	6.13E-06	2.56E-07	5.57E-06	0.00E+00	2.90E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.68E-08	0.00E+00	4.29E-07	MND
ADP-fossil fuel [MJ]	1.77E+02	1.89E+01	2.60E+01	0.00E+00	1.34E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.20E+00	0.00E+00	1.61E+01	MND
AP [kg SO2 eq]	2.76E-02	4.55E-03	6.09E-03	0.00E+00	2.33E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.03E-04	0.00E+00	4.37E-03	MND
EP [kg Phosphate eq]	3.80E-03	1.28E-03	9.40E-04	0.00E+00	8.54E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.00E-04	0.00E+00	5.75E-04	MND
GWP [kg CO2 eq]	1.16E+01	1.36E+00	3.31E+00	0.00E+00	2.52E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.98E-01	0.00E+00	1.04E+00	MND
ODP [kg CFC 11 eq]	1.97E-08	1.27E-16	1.26E-09	0.00E+00	3.22E-17	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.82E-17	0.00E+00	3.78E-15	MND
POCP [kg Ethene eq]	1.78E-03	-6.49E-04	8.30E-04	0.00E+00	1.96E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-2.39E-04	0.00E+00	3.71E-04	MND

1.2 TRACI Results

Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
AP [kg SO2 eq]	2.87E-02	6.17E-03	6.79E-03	0.00E+00	2.91E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.40E-04	0.00E+00	4.76E-03	MND
EP [kg N eq]	2.83E-03	5.16E-04	6.63E-04	0.00E+00	1.23E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.70E-05	0.00E+00	2.43E-04	MND
GWP [kg CO2 eq]	1.15E+01	1.36E+00	3.29E+00	0.00E+00	2.51E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.98E-01	0.00E+00	1.04E+00	MND
ODP [kg CFC 11 eq]	2.14E-08	-7.21E-15	1.43E-09	0.00E+00	-3.55E-16	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-1.60E-15	0.00E+00	-5.44E-14	MND
Resources [MJ]	1.94E+01	2.53E+00	2.84E+00	0.00E+00	1.50E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.63E-01	0.00E+00	2.08E+00	MND
POCP [kg O3 eq]	4.24E-01	1.44E-01	1.07E-01	0.00E+00	5.62E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.11E-02	0.00E+00	9.52E-02	MND

1.3 Resource Use Results

Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
RPRE [MJ]	2.97E+01	5.89E-01	3.93E+00	0.00E+00	7.62E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.31E-01	0.00E+00	1.26E+00	MND
RPRM [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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
NRPRE [MJ]	2.97E+01	5.89E-01	3.93E+00	0.00E+00	7.62E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.31E-01	0.00E+00	1.26E+00	MND
NRPRM [MJ]	1.99E+02	1.90E+01	2.80E+01	0.00E+00	1.40E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.23E+00	0.00E+00	1.65E+01	MND
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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
RSF [MJ]	1.99E+02	1.90E+01	2.80E+01	0.00E+00	1.40E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.23E+00	0.00E+00	1.65E+01	MND
NRSF [MJ]	1.01E+00	0.00E+00	5.05E-02	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	0.00E+00	0.00E+00	MND
RE [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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
FW [m3]	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND

1.4 Output Flows and Waste Results

Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
HWD [kg]	1.61E-07	1.54E-07	9.02E-08	0.00E+00	2.37E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.43E-08	0.00E+00	5.80E-08	MND
NHWD [kg]	4.96E-01	7.18E-04	1.64E+00	0.00E+00	7.76E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.59E-04	0.00E+00	2.37E+01	MND
HLRW [kg]	1.07E-05	5.09E-08	9.95E-07	0.00E+00	3.47E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.13E-08	0.00E+00	2.01E-07	MND
ILLRW [kg]	8.82E-03	4.21E-05	7.97E-04	0.00E+00	2.34E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.36E-06	0.00E+00	1.60E-04	MND
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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
MR [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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
EE [MJ]	0.00E+00	0.00E+00	7.67E-02	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	0.00E+00	0.00E+00	MND

LIFE CYCLE ASSESSMENT INTERPRETATION

For Global Warming (GWP) of porcelain tiles with recycled content, the vast majority of impacts are aggregated in the A1-A3 phase of the life cycle of the product. A1-A3 includes raw material sourcing, transportation and manufacturing. The second largest life cycle stage is A5 in terms of global warming impacts which is transport of product to customer.
For porcelain tiles with recycled scrap, in the sourcing and extraction stage, the largest contributors to the impacts in terms of raw materials are kaolin (20.7%), granite (12.1%), feldspar (5.2%), and glaze (0.4%). Within manufacturing, electricity contributes to 24.3% of overall GWP impacts while thermal energy from natural gas contributes to 4.4%.
Shipping to customer contributes around 7.8% of total GWP impacts, while, mortar used during installation contributes around 12.8% of GWP impacts. Finally, disposal of the product to landfill contributes 7.6% to total GWP impacts.

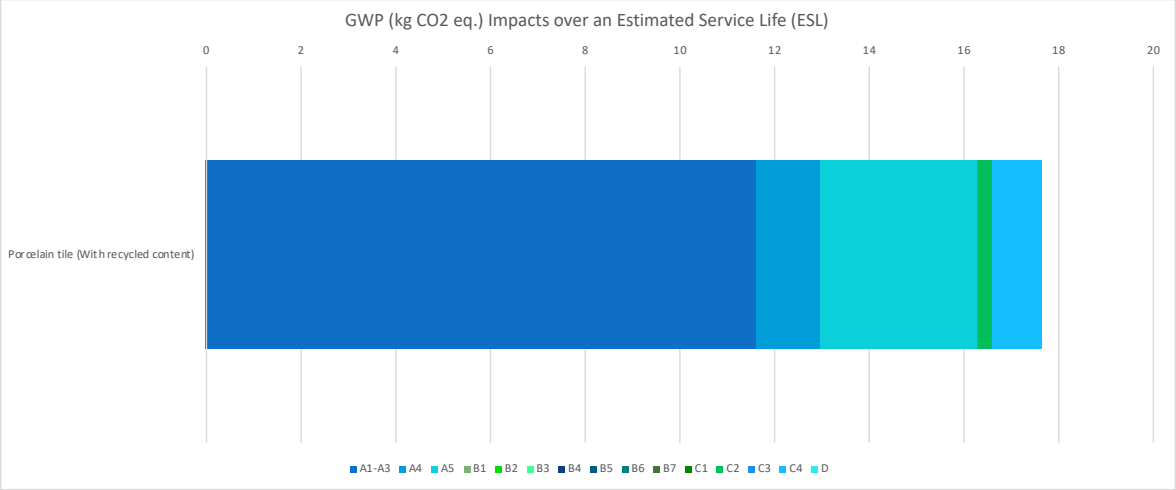

Figure 3: GWP Impacts over the entire lifecycle of a porcelain tile (with recycled content)

Some limitations to the study have been identified as follows:

- Availability of geographically more accurate datasets would have improved the accuracy of the study.
- Since this LCA uses cut-off approach to recycled material in the product, no credit is given to product system but rather is exempted from the burden of extracting virgin material in place of using recycled material.
- Only known and quantifiable environmental impacts are considered.
- Due to the estimates and assumptions listed above, these do not reflect real-life scenarios and hence they cannot assess actual and exact impacts, but only potential environmental impacts.
- Possible credit from Wonder Porcelain's tile take-back program have not been considered in in this study. Instead, all tile is considered to be landfilled at the end of its useful life per PCR Part A.

ADDITIONAL ENVIRONMENTAL INFORMATION

1. Extraordinary Effects

1.1 Fire

Fire testing and performance results are mentioned in Section 3.

1.2 Water

Any excess water from flooding must be removed and tile should be dried as soon as possible

1.3 Mechanical Destruction

Any damaged or broken tiles must be removed and replaced only by a qualified contractor.

REFERENCES

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3. Part B: Flooring EPD Requirements. IBU. Version 2.0, September 2018.
4. ISO 14044: 2006 Environmental Management – Life cycle assessment – Requirements and Guidelines.
5. ISO 14025:2006 Environmental labels and declarations – Type III environmental declarations – Principles and Procedures.
6. ISO 21930:2017 Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services.
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8. Tile Council of North America. (October 29, 2019). Installing Tile. Retrieved from https://www.tcnatile.com/faqs/47-installing-tile.html#faq39
9. CML-IA Characterization Factors. 5 September 2016. https://www.universiteitleiden.nl/en/research/research-output/science/cml-ia-characterisation-factors
10. Bare, J.C., G.A. Norris, D.W. Pennington, and T. McKone (2003). TRACI: The Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts. Journal of Industrial Ecology 6(3), pp. 49-78.

Appendix A: 2023 EPD Update

1. Rationale for EPD Update

Following the publication of the Wonder Porcelain's EPD in 2019, the business underwent several changes to its structure and product. The most public change included altering the company name from "American Wonder Porcelain" to "Wonder Porcelain" which is reflected in this Appendix and in all marketing materials moving forward. Internally, Wonder Porcelain underwent changes to their material composition and manufacturing facility. These are reflected in the tables below (Tables A1 and A2). Notable differences in Wonder Porcelain's material usage include reductions in feldspar and kaolin usage, elimination of granite, increased recycled scrap usage, and the addition of sand. The manufacturing facility changes included acquiring and running two much larger kilns and supporting equipment. Bringing this equipment online while working to scale production accordingly likely accounts for the significant rise in utility usage between the original EPD and this update.

Table A1: Material Composition (per 1 m^2)

Component	Material	Recycled	Wonder Porcelain 2019	Wonder Porcelain 2023 Update
Body	Clay	No	N/A	52.66%
	Kaolin	No	44.73%	0.05%
	Granite	No	26.23%	N/A
	Nepheline	No	13.94%	20.39%
	Feldspar	No	10.27%	3.95%
	Internal Scrap	Yes	4.58%	13.20%
	Zirconium silicate	No	0.07%	0.03%
	Engobe	No	0.04%	0.02%
	Zinc oxide	No	0.02%	0.01%
	Frit	No	0.03%	N/A
	Sand	No	N/A	9.65%
	Additives	No	0.04%	0.033%
Surface	Ink	No	0.01%	0.01%
	Glaze	No	0.05%	0.05%

Table A2: Functional Unit

	Wonder Porcelain	Wonder Porcelain 2023 Update
Functional Unit [m^2]	1	1
Average Weight [kg]	20.105	20.05

2. Results

2.1 CML Results

Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
ADP-elements [kg Sb eq]	6.41E-05	4.45E-07	8.58E-06	0.00E+00	2.17E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.89E-08	0.00E+00	4.46E-07	0.00E+00
ADP-fossil fuel [MJ]	4.63E+02	1.89E+01	4.30E+01	0.00E+00	6.16E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.20E+00	0.00E+00	1.48E+01	0.00E+00
AP [kg SO_2 eq]	5.45E-02	1.56E-03	7.39E-03	0.00E+00	6.90E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.66E-04	0.00E+00	3.98E-03	0.00E+00
EP [kg Phosphate eq]	8.49E-03	5.36E-04	1.11E-03	0.00E+00	5.97E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.03E-04	0.00E+00	5.32E-04	0.00E+00
GWP [kg CO_2 eq]	3.54E+01	1.35E+00	4.87E+00	0.00E+00	5.16E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.00E-01	0.00E+00	9.97E-01	0.00E+00
ODP [kg CFC 11 eq]	1.44E-10	1.45E-13	2.90E-10	0.00E+00	2.47E-14	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.21E-14	0.00E+00	1.85E-12	0.00E+00
POCP [kg Ethene eq]	4.11E-03	-3.46E-04	8.95E-04	0.00E+00	6.33E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-2.40E-04	0.00E+00	3.65E-05	0.00E+00

2.2 TRACI Results

Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
AP [kg SO_2 eq]	6.13E-02	2.05E-03	8.24E-03	0.00E+00	1.00E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.07E-04	0.00E+00	4.31E-03	MND
EP [kg N eq]	5.85E-03	2.89E-04	8.02E-04	0.00E+00	1.16E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.30E-05	0.00E+00	2.40E-04	MND
GWP [kg CO_2 eq]	3.52E+01	1.35E+00	4.84E+00	0.00E+00	5.13E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.99E-01	0.00E+00	9.91E-01	MND
ODP [kg CFC 11 eq]	1.30E-10	2.55E-15	3.62E-10	0.00E+00	4.24E-16	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.68E-16	0.00E+00	3.17E-14	MND
Resources [MJ]	5.44E+01	2.52E+00	4.96E+00	0.00E+00	6.00E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.59E-01	0.00E+00	1.91E+00	MND
POCP [kg O_3 eq]	9.64E-01	4.61E-02	1.22E-01	0.00E+00	1.45E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.07E-02	0.00E+00	7.58E-02	MND

2.3 Resource Use Results

Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D

RPR_E [MJ]	4.79E+01	7.39E-01	6.31E+00	0.00E+00	1.19E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.64E-01	0.00E+00	1.42E+00	MND
RPR_M [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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
RPR_T [MJ]	4.79E+01	7.39E-01	6.31E+00	0.00E+00	1.19E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.64E-01	0.00E+00	1.42E+00	MND
$NRPR_E$ [MJ]	5.30E+02	1.90E+01	4.90E+01	0.00E+00	6.73E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.23E+00	0.00E+00	1.51E+01	MND
$NRPR_M$ [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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
$NRPR_T$ [MJ]	5.30E+02	1.90E+01	4.90E+01	0.00E+00	6.73E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.23E+00	0.00E+00	1.51E+01	MND
SM [kg]	2.20E+00	0.00E+00	1.10E-01	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	0.00E+00	0.00E+00	MND
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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND

2.4 Output Flows and Waste Results

Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
HWD [kg]	4.78E-08	7.90E-11	3.68E-09	0.00E+00	6.13E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.76E-11	0.00E+00	5.66E-10	0.00E+00
NHWD [kg]	2.44E+00	1.63E-03	1.73E+00	0.00E+00	1.67E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.63E-04	0.00E+00	2.36E+01	0.00E+00
HLRW [kg]	3.13E-05	6.25E-08	2.75E-06	0.00E+00	1.96E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.39E-08	0.00E+00	1.51E-07	0.00E+00
ILLRW [kg]	2.63E-02	5.26E-05	2.32E-03	0.00E+00	2.26E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-05	0.00E+00	1.32E-04	0.00E+00
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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
R [kg]	0.00E+00	0.00E+00	7.27E-01	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	1.24E+00	0.00E+00	0.00E+00
MER [kg]	0.00E+00	0.00E+00	4.44E-02	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	0.00E+00	0.00E+00	0.00E+00
EE [MJ]	0.00E+00	0.00E+00	7.67E-02	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	0.00E+00	0.00E+00	0.00E+00

3. Conclusion

This LCA report update reflects changes to Wonder Porcelain's marketing strategy, material inputs, and manufacturing process. In comparison with 2019 results, the 2023 results indicate a significant increase in GWP. This is likely attributable to Wonder Porcelain's increased electricity and thermal energy consumption stemming from the installation and use of new kilns and supporting equipment. Barring any further changes in Wonder Porcelain's production, this report remains valid until November 2024.