Environmental Product Declaration

Porcelain Tile

FOR U.S. MANUFACTURED TILE PRODUCTS

From our progressive manufacturing practices, to our award-winning green tile innovations, to our commitment to improving the everyday experiences of our employees, customers and partners, Crossville is—and always has been—the industry leader in sustainability.

CROSSVILLE®
ELEVATE YOUR SPACE

Founded in 1986, Crossville Inc. is a U.S.- owned and operated manufacturer and supplier of porcelain, glass, and stone tile collections for residential and contract applications. The company is the first U.S. tile manufacturer to achieve the following:

- production of large format porcelain tile on site,
- manufacturing porcelain tile with certified recycled content
- development of the Tile Take- Back® Program for recycling fired porcelain tile
- SCS third party certification of its fired and wet waste recycling programs
- TCNA's Green Squared certification for all of its U.S.- produced porcelain tile lines,
- became a net consumer of waste.

For more information, on Crossville, visit www.crossvilleinc.com

UL CERTIFIED
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ENVIRONMENTAL PRODUCT DECLARATION

CROSSVILLE
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According to ISO 14025, EN 15804 and ISO21930:2017

Porcelain Tile

EPD PROGRAM AND PROGRAM OPERATOR NAME, ADDRESS, LOGO, AND WEBSITE	UL Environment 333 Pfingsten Road Northbrook, IL 60611	https://www.ul.com/ https://spot.ul.com/
GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER	General Program Instructions v.2.4 July 2018	
MANUFACTURER NAME AND ADDRESS	Crossville Inc 346 Sweeney Dr, Crossville, TN 38555	
DECLARATION NUMBER	4788863727.101.1	
DECLARED PRODUCT & FUNCTIONAL UNIT OR DECLARED UNIT	Porcelain Tile, (1) m2 of floor covering	
REFERENCE PCR AND VERSION NUMBER	UL Part B: PCR for Flooring v.2.0 September 2018	
DESCRIPTION OF PRODUCT APPLICATION/USE	Porcelain Tiles	
PRODUCT RSL DESCRIPTION (IF APPL.)	75 Years	
MARKETS OF APPLICABILITY	North America and Europe	
DATE OF ISSUE	April 1, 2019	
DATE OF EXPIRATION	March 31, 2025	
EPD TYPE	Product-Specific	
RANGE OF DATASET VARIABILITY	N/A	
EPD SCOPE	Cradle-to-Grave	
YEAR(S) OF REPORTED PRIMARY DATA	2018	
LCA SOFTWARE & VERSION NUMBER	GaBi Database Version 8.7, Service Pack 36	
LCI DATABASE(S) & VERSION NUMBER	GaBi Database Version 8.7, Service Pack 36	
LCIA METHODOLOGY & VERSION NUMBER	TRACI v2.1 & CML	

This PCR Review was conducted by:	UL Environment PCR Review Panel epd@ulenvironment.com
This declaration was independently verified in accordance with ISO 14025: 2006. ☐ INTERNAL ☒ EXTERNAL	Grant R. Martin Grant R. Martin, UL Environment
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Thomas P. Gloria Thomas P. Gloria, Industrial Ecology Consultants

LIMITATIONS

Exclusions: EPDs do not indicate that any environmental or social performance benchmarks are met, and there may be impacts that they do not encompass. LCAs do not typically address the site-specific environmental impacts of raw material extraction, nor are they meant to assess human health toxicity. EPDs can complement but cannot replace tools and certifications that are designed to address these impacts and/or set performance thresholds – e.g. Type 1 certifications, health assessments and declarations, environmental impact assessments, etc.

Accuracy of Results: EPDs regularly rely on estimations of impacts; the level of accuracy in estimation of effect differs for any particular product line and reported impact.

Comparability: EPDs from different programs may not be comparable. Full conformance with a PCR 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. Product Definition and Information

1.1. Description of Company/Organization

As the first tile manufacturer in Tennessee (est. 1986), Crossville Inc. is the leading American manufacturer of beautiful, sustainable solutions that advance the frontiers of tile design.

From introducing the nation's first large-format porcelain tiles, to developing cutting-edge performance innovations that turn mere surfaces into "breathing" living environments—we are committed to pioneering products and practices that change the way the world views tile.

1.2. Product Description

Product Identification

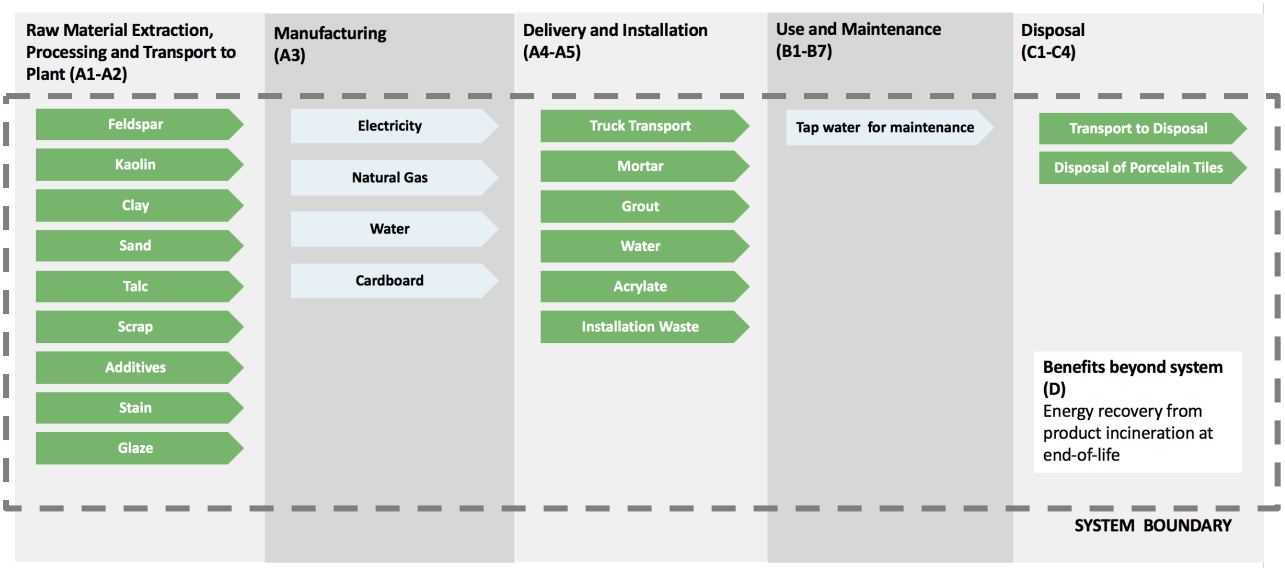
This EPD is for a representative porcelain tile derived from Crossville's line of products. The study is based on a medium colored product. Porcelain tiles are primarily made up of sand, clays and other additives and then molded into shape followed by firing into a kiln. Porcelain tiles can be glazed or unglazed, the former being the popular choice today. There are several advantages to porcelain tiles. They are impervious to moisture, resistant to tread wear, permanence of color and easy cleaning opportunities. They are also slip resistant if an abrasive glaze is added to the surface. The UNSPSC code for this flooring product is 301617 and the CSI code is 09 30 13.

This EPD represents all colors available within the following collections: Alaska, Altered State, Argent, Basalt, Bluestone, Color Blox, Color Blox Mosaics, Cross Colors Mingles, EcoCycle Americana, Familiar Territory, Gotham, Java Joint, Main Street, Moonstruck, Nest, Notorious, Physics, Ready to Wear, Reformation, Retroactive 2.0, Retroactive 2.0 Patterned, Shades, Speakeasy, State of Grace, Story Teller, Structure.

Product Specification

The product is described using the specifications outlined in Table 1.

Flow Diagram



Product Average

The raw materials used for the study are for an average weight based on raw materials purchased in the year 2018 and 2018 annual production. This was considered representative of Crossville's line of porcelain tiles.

1.3. Application

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

1.4. Application Rules

The products considered in this EPD meet or exceed the following Technical Specification:

- ANSI A137.1 – American National Standard Specifications for Ceramic Tile
- ISO 13006 – International Organization for Standardization Specificications for Ceramic Tile

Fire Testing:

- Classification: A
- Flame Spread: 0
- Smoke Development: 0

1.5. Declaration of Methodological Framework

This LCA is a cradle-to-grave study. A summary of the life cycle modules can be found in Table 14.

The reference service life is outlined in Table 10 and is only applicable if all manufacturing guidelines are followed regarding site-selection and installation.

The cut-off criteria are described in Section 2.4 and allocation procedures are described in Section 2.8. Infrastructure flows have been excluded.

1.6. Technical Requirements

The following technical data describe the average product undergoing the life cycle assessment.

Table 1: Porcelain Technical Data

NAME	TEST METHOD	VALUE	UNIT
Product Thickness	-	8-10.5	mm
Scratch Hardness	Mohs	6-7	-
Breaking Strength	ASTM-C648	≥350	lbf
Coefficient of Friction	ANSI-A137.1	≥0.42	-
Bond Strength	ASTM-C482	>200	psi

*The Mohs scale of mineral hardness is a qualitative ordinal scale characterizing scratch resistance of various minerals through the ability of harder material to scratch softer material.

1.7. Properties of Declared Product as Delivered

Crossville Porcelain tile products are packaged in cardboard boxes prior to shipping.

1.8. Material Composition

The materials that make up the flooring product are indicated in Table 2.

Table 2: Material Composition (Average)

COMPONENT	MATERIAL	MASS %
Body	Feldspar	50.6%
	Kaolin	0.8%
	Clay	36.5%
	Sand	0.9%
	Talc	1.2%
	Scrap	5.5%
	Additives	1.2%
Surface	Stain	2.4%
	Glaze	0.5%

The product does not contain hazardous substances per the applicable regional-specific legislation, as indicated in Section 2.8.6 of *Part A: Life Cycle Assessment Calculation Rules and Report Requirements* from UL Environment.

1.9. Manufacturing

The manufacturing process begins with the mining of raw materials, which is a mixture composed mostly of clay and minerals. These raw materials are listed in Table 2. The raw materials are batched and mixed to a powder according to the type of tile. Water is then added to form a wet slurry called slip. This slurry is then pumped into a large spray dryer.

Next, the clay is pressed into a tile shape. After that, the tiles are dried to remove some of their moisture.

The glaze is sprayed onto the surface of the tile while being passed on a conveyer belt. Finally, the tiles are fired in a kiln at extremely high temperatures (2,000 °F). After this, the tiles are sent for inspection and sorting. Any defected tiles are sent to the fired tile waste processing section and then re-used in the batching and mixing process.

Any unfired scrap during the manufacturing process is returned to the clay mixing and slip production step in the manufacturing process thus minimizing waste production.

1.10. Packaging

Once the tiles are manufactured and inspected for quality, they are packaged in cardboard boxes.

Table 3: Packaging

Packaging Type	Material	Amount (kg)	Disposal Pathway
Cardboard	Corrugated Cardboard	0.917	Landfill, incineration, recycle

1.11. Transportation

It is assumed that all raw materials are distributed by truck, based on global region (domestic raw materials travel by truck, Italian Stains travel via truck and cargo ship). An average distance using this information was calculated and used in the model. Transport of raw material from supplier to the manufacturing facility was calculated for each raw material.

An average shipping distance from the manufacturing location to the customer was utilized and was calculated from sales records. The transportation distance for all waste flows is assumed to be 161 km based on best available data.

1.12. Product Installation

Crossville references Tile Council of North America (TCNA) and American National Standards Institute (ANSI) installation instructions for guidance. These are provided online. While installation equipment is required to install the flooring product, it is not included in the study as these are multi-use tools and the impacts per declared unit is considered negligible. Some materials are required to install tiles on the floor at the site, namely, grout and mortar. Cement mortar acts as the adhesive that binds the tile to the ground. It has been calculated that 4.07 kg/m^2 of mortar is required to install 1 m^2 of tile. During installation, 4.5% total material is lost as waste which is then sent to the landfill. Cement grout acts as the filler for the spaces in between the tiles. It was determined that 0.212 kg of grout is required to fill an area of 1m^2 of porcelain tiles. Along with cement and mortar, installation solution made up of acrylate and water is also used in the installation process. All waste generated during installation, including packaging waste, is disposed of according to the tables found in Section 2.8.5 of *Part A: Life Cycle Assessment Calculation Rules and Report Requirements* from UL Environment.

1.13. Use

The floors are regularly cleaned with tap water. It has been determined that the floors are cleaned using a dust mop every day and using a damp mop 4 times a year for residential and 36 times a year for commercial applications as recommended by the Tile Council of North America (TCNA).

Table 4: Use Phase Assumptions

TYPE	VALUE	UNIT
Cleaning per Week (Dust mop)	7	#
Cleaning per Week (Damp mop) Commercial	0.69	#
Cleaning per Week (Damp mop) Residential	0.076	#
Weeks per Year Where Cleaning Occurred	52	#

Table 5: Use Phase Inputs

INPUT	VALUE	UNIT
Tap water	0.783	$l/m^2/yr$

Porcelain tile products are traditionally not repaired or refurbished and are only replaced if the product fails or a new look is desired.

1.14. Reference Service Life and Estimated Building Service Life

According to Part A of the PCR, 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. The reference service life assumes the product was installed according to the manufacturer's recommendations.

1.15. Reuse, Recycling, and Energy Recovery

Crossville has developed a proprietary recycling process to turn fired tile back into the porcelain powder that is used in manufacturing new tile. This Tile Take-Back Program® was established in 2009. This program accepts not only previously installed tiles from the Crossville distribution network, but post-consumer tiles from other manufacturers as well. To find out more about the Tile Take-Back Program® or to participate in the program, please visit https://www.crossvilleinc.com/Resources/Sustainability/Tile-Take-Back .

1.16. Disposal

Disposal pathways in the EPD are modeled in accordance with disposal routes and waste classification referenced in Sections 2.8.5 and 2.8.6 of *Part A: Life Cycle Assessment Calculation Rules and Report Requirements* from UL Environment. This indicates an end-of-life split amongst landfill, recycling, and incineration pathways.

2. Life Cycle Assessment Background Information

2.1. Functional or Declared Unit

The functional unit of the flooring product is one (1) m^2 of floor covering, as indicated in Table 6.

Table 6: Functional Unit

NAME	VALUE	UNIT
Functional Unit	1 m^2	
Mass	24.4133	kg

2.2. System Boundary

The type of EPD is cradle-to-grave. All LCA modules are included and are summarized in Table 7

Table 7: System Boundary

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	2017	Shipping from supplier to manufacturing site. Fuel use requirements estimated based on product weights and estimated distance.
A3	Product Stage: Manufacturing	2017	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	2017	Shipping from manufacturing site to project site. Fuel use requirements estimated based on product weights and mapped distance.
A5	Construction Process Stage: Installation	2018	Installation adhesives, installation waste and packaging material waste.
B1	Use Stage: Use	2018	Use of the product.
B2	Use Stage: Maintenance	2018	Cleaning energy, water, and materials, including refinishing the product.
B3	Use Stage: Repair	N/A	Porcelain tile is typically replaced and not repaired.
B4	Use Stage: Replacement	N/A	Total materials and energy required to manufacture a replacement.
B5	Use Stage: Refurbishment	N/A	Porcelain tile is typically not refurbished.
B6	Operational Energy Use	N/A	Operational Energy Use of Building Integrated System During Product Use
B7	Operational Water Use	N/A	Operational Water Use of Building Integrated System During Product Use
C1	EOL: Deconstruction	2018	No inputs required for deconstruction.
C2	EOL: Transport	2018	Shipping from project site to landfill. Fuel use requirements estimated based on product weight and mapped distance.
C3	EOL: Waste Processing	2018	Waste processing not required. All waste can be processed as is.
C4	EOL: Disposal	2018	Assumes all products are sent to landfill. Landfill impacts modeled based on secondary data.
D	Benefits beyond system	2018	Credits from energy or material capture.

2.3. 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. 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. As there are different products produced at this facility, it is assumed all products are using the same amount of energy. Another assumption is that the installation tools are used enough times that the per square meter impacts are negligible.

2.4. Cut-off Criteria

All inputs in which data was available were included. 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.

2.5. Data Sources

Primary data were collected by facility personnel and from utility bills and was used for all manufacturing processes. 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 utilized from GaBi Database Version 8.7, Service Pack 36.

2.6. Data Quality

The geographical scope of the manufacturing portion of the life cycle is Crossville, Tennessee. All primary data were collected from the manufacturer. The geographic coverage of primary data is considered excellent. The primary data provided by the manufacturer represent all information for calendar year 2017. Using this data meets the PCR requirements. Time coverage of this data is considered very good. Primary data provided by the manufacturer is specific to the technology that Crossville Inc. uses in manufacturing their product. It is site-specific and considered of good quality. It is worth noting that the energy and water used in manufacturing the product includes overhead energy such as lighting, heating and sanitary use of water. Sub-metering would improve the technological coverage of data quality. Data necessary to model cradle-to-gate unit processes was sourced from GaBi LCI datasets. Improved life cycle data from suppliers would improve technological coverage.

2.7. Period under Review

The period under review is calendar year 2018.

2.8. 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, thermal energy and water, allocation based on total production in square meters was adopted. Allocation was most prevalent in the secondary GaBi datasets used to represent upstream processes. As a default, GaBi datasets use a physical mass basis for allocation. Throughout the study recycled materials were accounted for via the cut-off method. 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.

3. Life Cycle Assessment Scenarios

Table 8. Transport to the building site (A4)

NAME	TRUCK	UNIT
Fuel type	Diesel	
Liters of fuel	39.0625	l/100km
Vehicle type	Heavy Duty Truck	-
Transport distance	904.45	km
Capacity utilization	0.65	%
Weight of products transported	22679.619	kg
Capacity utilization volume factor	1	-

Table 9. Installation into the building (A5)

NAME	VALUE	UNIT
Mortar	4.07	kg
Grout	0.212	kg
Acrylate	0.043	kg
Net freshwater consumption specified by water source and fate	0.0004 m^3 tap water, installation solution	m^3
Product loss per functional unit	0.03	kg
Waste materials at the construction site before waste processing, generated by product installation	0.95	kg
Packaging waste, cardboard	0.917	kg
Biogenic carbon contained in packaging	3.25	kg CO_2
VOC content of flooring	N/A	µg/m^3

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. Maintenance (B2)

NAME	VALUE	UNIT
Maintenance process information	Use phase parameters as recommended by TCNA guidelines	
Dust mop	19,500	Cycles/ RSL
Dust mop	19,500	Cycles/ ESL
Damp mop (Commercial)	2,700	Cycles/ RSL
Damp mop (Commercial)	2,700	Cycles/ ESL
Damp mop (Residential)	300	Cycles/ RSL
Damp mop (Residential)	300	Cycles/ ESL
Net freshwater consumption specified by water source and fate	0.05 m3 tap water, evaporated	m^3
Energy input, specified by activity, type and amount	0	kWh/m^2 floor/yr
Direct emissions to ambient air, soil and water	-	kg
Further assumptions for scenario development	Floor cleaned with dust mop daily and with damp mop 36 times/year for commercial applications and 4 times/year for residential applications	

Table 12. 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	26.33	kg
	Collected with mixed construction waste	0	kg
Recovery	Reuse	0	kg
	Recycling	0	kg
	Landfill	26.33	kg
	Incineration	0	kg
	Incineration with energy recovery	0	kg
	Energy conversion efficiency rate	84-94	%
Disposal	Product or material for final deposition	26.33	kg
Removals of biogenic carbon (excluding packaging)		0.073	kg

Table 13. Reuse, recovery and/or recycling potentials (D), relevant scenario information

NAME	VALUE	UNIT
Net energy benefit from energy recovery from waste treatment declared as exported energy in C3 (R>0.6)	0	MJ
Process and conversion efficiencies	84-94	%

4. Life Cycle Assessment Results

Table 14. Description of the system boundary modules

	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 During Product Use	Building Operational Water Use During Product Use	Deconstruction	Transport	Waste processing	Disposal	Reuse, Recovery, Recycling Potential
EPD Type	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X

4.1. Life Cycle Impact Assessment Results

Table 15. North American Impact Assessment Results

TRACI v2.1	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
AP [kg SO_2 eq]	5.28E-02	5.24E-03	5.37E-03	0.00E+00	2.61E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.40E-03	0.00E+00	5.11E-03	0.00E+00
EP [kg N eq]	3.78E-03	4.41E-04	4.99E-04	0.00E+00	1.61E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.14E-04	0.00E+00	2.59E-04	0.00E+00
GWP [kg CO_2 eq]	2.39E+01	1.31E+00	2.47E+00	0.00E+00	1.88E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.03E-01	0.00E+00	1.11E+00	0.00E+00
ODP [kg CFC 11 eq]	7.07E-12	4.49E-14	3.40E-10	0.00E+00	2.20E-15	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.04E-14	0.00E+00	2.04E-13	0.00E+00
Resources [MJ]	4.09E+01	2.47E+00	1.55E+00	0.00E+00	1.15E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.73E-01	0.00E+00	2.22E+00	0.00E+00
POCP [kg O_3 eq]	7.31E-01	1.71E-01	7.67E-02	0.00E+00	4.64E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.64E-02	0.00E+00	1.01E-01	0.00E+00

Table 16. EU Impact Assessment Results

CML 2001-JAN 2016	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
$ADP_{element}$ [kg Sb-eq]	1.00E-05	2.39E-07	4.96E-06	0.00E+00	2.57E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.53E-08	0.00E+00	4.79E-07	0.00E+00
ADP_{fossil} [MJ, LHV]	3.50E+02	1.85E+01	1.46E+01	0.00E+00	1.04E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.27E+00	0.00E+00	1.73E+01	0.00E+00
AP [kg SO_2 eq]	5.23E-02	3.93E-03	4.90E-03	0.00E+00	1.92E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.05E-03	0.00E+00	4.72E-03	0.00E+00
EP [kg PO_4^{-3} eq]	5.64E-03	1.06E-03	6.70E-04	0.00E+00	9.41E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.80E-04	0.00E+00	6.10E-04	0.00E+00
GWP 100 [kg CO_2 eq]	2.41E+01	1.31E+00	2.48E+00	0.00E+00	1.88E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.04E-01	0.00E+00	1.11E+00	0.00E+00
ODP [kg CFC-11 eq]	7.07E-12	4.49E-14	2.65E-10	0.00E+00	2.20E-15	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.04E-14	0.00E+00	2.04E-13	0.00E+00
POCP [kg ethene eq]	3.96E-03	3.99E-04	8.23E-04	0.00E+00	1.55E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.05E-04	0.00E+00	3.97E-04	0.00E+00

4.2. Life Cycle Inventory Results

Table 17. Resource Use

PARAMETER	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
RPR_E [MJ, LHV]	3.17E+01	4.59E-01	2.05E+00	0.00E+00	5.75E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.06E-01	0.00E+00	1.25E+00	0.00E+00
RPR_M [MJ, LHV]	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
$NRPR_E$ [MJ, LHV]	3.17E+01	4.59E-01	2.05E+00	0.00E+00	5.75E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.06E-01	0.00E+00	1.25E+00	0.00E+00
$NRPR_M$ [MJ, LHV]	3.78E+02	1.86E+01	1.59E+01	0.00E+00	1.08E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.30E+00	0.00E+00	1.77E+01	0.00E+00
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	0.00E+00
RSF [MJ, LHV]	3.78E+02	1.86E+01	1.59E+01	0.00E+00	1.08E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.30E+00	0.00E+00	1.77E+01	0.00E+00
NRSF [MJ, LHV]	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
RE [MJ, LHV]	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
FW [m^3]	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

Table 18. Output Flows and Waste Categories

PARAMETER	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
HWD [kg]	2.47E-07	1.44E-07	7.15E-08	0.00E+00	1.94E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.34E-08	0.00E+00	6.10E-08	0.00E+00
NHWD [kg]	2.63E-01	6.97E-04	2.69E-01	0.00E+00	5.69E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.62E-04	0.00E+00	2.52E+01	0.00E+00
HLRW [kg] or [m^3]	1.36E-05	4.92E-08	4.67E-07	0.00E+00	2.36E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.14E-08	0.00E+00	2.30E-07	0.00E+00
ILLRW [kg] or [m^3]	1.13E-02	4.08E-05	3.59E-04	0.00E+00	1.65E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.44E-06	0.00E+00	1.82E-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
MR [kg]	0.00E+00	0.00E+00	6.88E-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	0.00E+00
MER [kg]	0.00E+00	0.00E+00	4.59E-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, LHV]	0.00E+00	0.00E+00	7.93E-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

Table 19. Carbon Emissions and Removals

PARAMETER	PARAMETER	PORCELAIN TILE	UNIT
BCRP	Biogenic Carbon Removal from Product	0.073	kg CO_2
BCEP	Biogenic Carbon Emission from Product	0.0533	kg CO_2
BCRK	Biogenic Carbon Removal from Packaging	3.25	kg CO_2
BCEK	Biogenic Carbon Emission from Packaging	1.5	kg CO_2

5. LCA Interpretation

Overall for Crossville's porcelain tile products, Global Warming (GWP) and Abiotic Depletion of fossil fuels are the impact categories of most significance. Within these impact categories, the vast majority of impacts are aggregated in the A1-A3 phase of the life cycle of the product. The second largest life cycle module is A5 in terms of global warming impacts. The A5 module represents transport of product to the customer.

For porcelain tiles, in the sourcing and extraction stage, the largest contributors to the impacts in terms of raw materials are clay powder (6.7%) and feldspar (6%). Within manufacturing, electricity contributes to 23% of overall GWP impacts while thermal energy from natural gas contributes to 42.4%.

Shipping to customer contributes around 3.8% of total GWP impacts, while, mortar used during installation contributes around 6.8% of GWP impacts. Finally, disposal of the product to landfill contributes 4.7% to total GWP impacts.

6. Additional Environmental Information

6.1. Environment and Health During Manufacturing

Because sustainability is at the core of Crossville's approach to business and manufacturing, the company provides quick access to relevant information of the range of policies and practices on its website at http://crossvilleinc.com/sustainability/. This section of the Crossville website is a transparent offering of pertinent aspects of how the company proactively seeks to be the leader in sustainability for the U.S. tile industry.

6.2. Environment and Health During Installation

All recommended personal protective equipment (PPE) should be utilized during installation, as indicated on the SDS (Safety Data Sheet) and installation guidelines, found online. Tile is fired at temperatures above 2000F. At those temperatures, any organics in clays or binders are burned away completely. As a result, the final product is inert and has no VOCs that can be emitted. A technical update is available on Crossville's website.

6.3. Extraordinary Effects

Fire

During production, the tiles are fired at a temperature that exceeds 2200 degrees F (1200 degrees C), at which point it begins to become liquid. During the cooling stage, the materials fuse together and solidify again, to gain strength and hardness. The end product is stable to a temperature that equals the firing temperature, at which point the material would again become liquid, but at no point would it become combustible. More information about Crossville Porcelain Tile's fire rating can be found in the technical resource section of Crossville's website.

Water

Should the product become flooded, the water should be removed through means of extraction and drying and the product should behave as originally intended. There are no environmental impacts associated with the product being flooded.

Mechanical Destruction

If the product is mechanically destroyed, it should be disposed of using standard procedures and replaced in a timely manner.

6.4. Environmental Activities and Certifications

Crossville® has earned Green Squared^{SM} certification from the Tile Council of North America (TCNA) for its entire U.S.-manufactured porcelain product line-up, as well as its manufacturing processes. The company is among the first ever recipients of this certification standard for the tile industry. TCNA developed the Green Squared certification under American National Standards Institute (ANSI) process. The multi-attribute program (ANSI A138.1) scores products in five categories of performance: product characteristics, manufacturing, corporate governance, innovation and end-of-life. Crossville's certified products and processes received stringent evaluation from Scientific Certification Systems (SCS), the green building industry's longest standing third-party certifier.

7. Supporting Documentation

The full text of the acronyms found in Section 4 are found in Table 20.

Table 20. Acronym Key

Acronym	Text	Acronym	Text
LCA Indicators			
ADP-elements	Abiotic depletion potential for non-fossil resources	GWP	Global warming potential
ADP-fossil	Abiotic depletion potential for fossil resources	OPD	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	RPR_M	Use of renewable primary energy resources used as raw materials
$NRPR_E$	Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	$NRPR_M$	Use of non-renewable primary energy resources used as raw materials
SM	Use of secondary materials	FW	Net use of fresh water
RSF	Use of renewable secondary fuels	NRSF	Use of non-renewable secondary fuels
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	ILLRW	Intermediate- and low-level radioactive waste, conditioned, to final repository
CRU	Components for reuse	EE	Exported energy
RE	Recovered Energy		

8. References

1. Life Cycle Assessment, LCA Report for Crossville Porcelain Tile. WAP Sustainability Consulting. February 2019.
2. Product Category Rule (PCR) for Building-Related Products and Services, Part A: Life Cycle Assessment Calculation Rules and Report Requirements UL 10010. Version 3.2, December 12, 2018.
3. Part B: Flooring EPD Requirements. UL Environment. V2.0. 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.
7. European Standard DIN EN 15804: 2012.04+A1 2013. Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products (includes Amendment A1:2013)