ENVIRONMENTAL PRODUCT DECLARATION

CERAMIC TILE

INDUSTRY-WIDE REPORT
PRODUCTS MANUFACTURED IN NORTH AMERICA

This Environmental Product Declaration is provided by Tile Council of North America (TCNA) and its members and contains a comprehensive environmental analysis of over 95% of the ceramic tile produced in North America.

This is an industry-wide EPD facilitated by TCNA with participation from the following companies:

- Arto
- Crossville
- Dal-Tile Corporation
- Florim USA
- Florida Tile
- Interceramic
- Ironrock
- Porcelanite Lamosa
- Quarry Tile Company
- StonePeak Ceramics
- Vitromex de Norteamérica

Established in 1945 as Tile Council of America (TCA), TCNA is recognized for its leadership role in promoting the use of ceramic tile, conducting independent research and product testing, and facilitating the development of industry standards.

For more information visit:
www.TCNAtile.com.
100 Clemson Research Blvd., Anderson, SC 29625

CERTIFIED
ENVIRONMENTAL
PRODUCT DECLARATION
UL.COM/EPD

ENVIRONMENTAL PRODUCT DECLARATION

North American Ceramic Tile, including Mosaic, Quarry, Pressed Floor, Glazed Wall,
and Porcelain as defined by ANSI A137.1 American National Standard Specifications for Ceramic Tile **According to ISO 14025**

This declaration is an environmental product declaration (EPD) in accordance with ISO 14025. EPDs rely on Life Cycle Assessment (LCA) to provide information on a number of environmental impacts of products over their life cycle. 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, and the level of accuracy in estimation of effect differs for any particular product line and reported impact. Comparability: EPDs are not comparative assertions and are either not comparable or have limited comparability when they cover different life cycle stages, are based on different product category rules or are missing relevant environmental impacts. EPDs from different programs may not be comparable.

PROGRAM OPERATOR	UL Environment
DECLARATION HOLDER	Tile Council of North America, Inc.
DECLARATION NUMBER	4786483078.101.1
DECLARED PRODUCT	Ceramic Tile
REFERENCE PCR	NSF Product Catergory Rule for Flooring: Carpet, Resilient, Laminate, Ceramic, Wood
DATE OF ISSUE	October 24, 2014
PERIOD OF VALIDITY	5 Years
CONTENTS OF THE DECLARATION	Product definition and information about building physics Information about basic material and the material's origin Description of the product's manufacture Indication of product processing Information about the in-use conditions Life cycle assessment results Testing results and verifications

The PCR review was conducted by:	NSF International
	Accepted by PCR Review Panel
	ncss@nsf.org
This declaration was independently verified in accordance with ISO 14025 by Underwriters Laboratories ☐ INTERNAL ☒ EXTERNAL	
	James Mellentine, Sustainable Solutions Corp.
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	
	Wade Stout, UL Environment

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Tile Council of North America (TCNA)

TCNA is a trade association representing manufacturers of ceramic tile, tile installation materials, tile equipment, raw materials, and other tile-related products. Through its Green Initiative, TCNA and its members are industry leaders in distinguishing and communicating the sustainability and environmental attributes of ceramic tile and related installation materials by conducting research, developing educational programs, and providing a forum through which TCNA members can be active in the green building community.

Information in this document has been coordinated by TCNA's technical staff based on information submitted by leading North American tile manufacturers. The life cycle data and product information presented herein are representative of a range of ceramic tile products from the following manufacturers:

ARTO has been handcrafting unique ceramic and concrete tiles in Southern California since 1966. Our styles range from rustic to modern plus we offer pavers, wall caps, pool coping, and custom fabrication. ARTO products include locally sourced raw materials, recycled content, and many other sustainable characteristics so we are proud to participate in the inaugural EPD developed by the TCNA.

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. Crossville is dedicated to sustainability practices throughout its operations and is constantly striving to improve its commitment to better environmental practices.

Dal-Tile is the largest manufacturer and marketer of ceramic tile and natural stone products used in residential and commercial design and construction across North America. The company, a division of Mohawk Industries, was founded in 1947 and has expanded to include the four leading brands in the tile industry: Daltile, American Olean, Marazzi USA and Ragno USA. Dal-Tile is committed to providing extensive product collections, innovative product development and distinguished style through each of its premier tile brands. Together, Dal-Tile's total residential and commercial offerings complement each other and can satisfy every requirement and customer segment in the ceramic tile market.

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Florida Tile, Inc., located in Lexington, KY, is a world-class manufacturer and distributor of porcelain and ceramic wall tile, as well as natural stone and decorative glass and metal tiles. For over 50 years, Florida Tile has consistently taken the lead as an innovator by implementing new technology, delivering high quality products and protecting our indoor and outdoor environments.

Florim USA is dedicated to the development of eco-compatible products for the building trade. Through continuous investments in the factory and its people, Florim has developed an avant-garde production process which minimizes the company's environmental footprint.

INTERCERAMIC, a ceramic tile manufacturer with the most innovative technology at the time. With 35 years in the market, INTERCERAMIC has become one of the largest tile manufactures in North America.

Ironrock, is a manufacturer of ceramic quarry tile (Metropolitan Ceramics®), and architectural thin brick (METROBROCK®) located in Canton, Ohio. Since the inception of the company as a brick paver manufacturer over one hundred forty years ago, Ironrock has had a commitment of stewardship toward the land and its resources. We pride ourselves on our effort to reduce waste and incorporate resource saving practices into everyday work practices - www.ironrock.com.

Porcelanite Lamosa has a long history, dating back more than 120 years, we are proud to participate in an EPD, that includes the US and Mexican ceramic tile industry.

All our Eco-Tile family of products are made from locally sourced materials at our state-of-the-art Spokane factory, which, along with our dedication to sustainable business practices, earns LEED certification as well as the tile industry's demanding Green Squared certification for most of what we make.

For more information please visit us at www.quarrytile.com

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Nestled in the hills of Tennessee's Smoky Mountains, is a company with a uniquely American character that honors the time-proven tradition of fine Italian porcelain ceramics. Respecting and protecting nature is a vital part of our philosophy. In StonePeak's state-of-the-art production facility, we produce sustainable, green, environmentally friendly porcelain tile with a process that reduces, reuses, and recycles – www.stonepeakceramics.com

Vitromex, a leading manufacturer of ceramic and impervious porcelain tile, has always embraced environmentally-friendly industrial practices. A commitment to the sustainability of our planet's resources is a cornerstone of the values Vitromex upholds. For over 50 years, we have incorporated strict international practices for safety, quality, energy efficiency and protection of the environment.

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Product Definition

Product Classification and Description

Ceramic tile produced in North America is a mixture of multiple mineral-based natural materials, including but not limited to clay, sand, feldspar, talc, nepheline and shale. The tiles are either pressed or extruded into the desired shape and fired in kilns at high temperatures. Ceramic tile is fire resistant, non-combustible, durable (lasts a lifetime) and extremely easy to maintain.

As floor and wall coverings, ceramic tile products provide dual functions. They serve an aesthetic function as a design component, and a technical function as a building finishing material. As a building material, ceramic tile is capable of withstanding a wide range of environmental stresses.

Ceramic tiles are classified by their production method, either dry pressed or extruded, and the level of water absorption measured as a percentage. Based on water absorption, a ceramic tile is characterized as impervious, vitreous, semi-vitreous, or non-vitreous. There are five main types of ceramic tile according to ANSI A137.1 American National Standard Specifications for Ceramic Tile:

- Porcelain Tile: Impervious (water absorption less than or equal to 0.5%), and may be pressed or extruded.
- Pressed Floor Tile: Vitreous, semi-vitreous or non-vitreous, and must be manufactured by having the body of the tile formed by pressing. Primarily intended for use on floors, but also suitable for use on walls and countertops. Only includes tiles which have a facial area of 9 square inches or more.
- Mosaic Tile: Impervious, vitreous, semi-vitreous, or non-vitreous, and may be pressed or extruded. Only includes tiles which have a facial area less than 9 square inches. Typically mounted in sheets or strips to facilitate installation.
- Quarry Tile: Includes impervious, vitreous, and some semi-vitreous tiles (up to 5%) which must be formed by the extrusion process from natural clay or shale.
- Glazed Wall Tile: Usually non-vitreous and typically pressed, intended for use on walls.

Performance criteria for each of the above classifications of tile, including but not limited to minimum breaking strength, dimensional consistency, bond strength, crazing resistance, thermal shock resistance, freeze/thaw resistance, chemical resistance, stain resistance and coefficient of friction are defined by ANSI A137.1.

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Figure 1: Image of Porcelain Tile

Figure 2: Image of Pressed Floor Tile

Figure 3: Image of Mosaic Tile

Figure 4: Image of Quarry Tile

Figure 5: Image of Glazed Wall Tile

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Range of Applications

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

Product Standards

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

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

Additionally, many of the tiles considered in this EPD have been certified to meet the following Sustainability Specification:

- ANSI A138.1 – Green Squared® American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials

Fire Testing:

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

Product Characteristics

Table 1: Specifications of Tiles Included in This EPD

	Nominal Value	Minimum Value	Maximum Value
Class	The full range of forming processes and water absorption classifications as defined by Table 1, Section 4.0 of ANSI A137.1	N/A	N/A
Tile type	Pressed or Extruded Floor, Porcelain, Mosaic, Ceramic, Quarry, Pressed Wall	N/A	N/A
Grade	Standard and Second	N/A	N/A
Nominal facial area	N/A	12.7mm x 12.7mm	609.6mm x 609.6mm and planks up to 914.4mm
Nominal thickness	N/A	7.3mm	11mm
Product weight	18.1 kg/m^2	17.0 kg/m^2	34.2 kg/m^2
Dimensional categories	Natural, Calibrated, or Rectified	N/A	N/A
Sustainable certification	Some tiles Green Squared Certified® to meet ANSI/A138.1	N/A	N/A

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Material Content

Table 2: Average Material Content of the Products Included in This EPD

Component	Material	Mass %	Availability			Origin of raw materials
			Renewable	Non-renewable	Recycled	
Body	Clay	70.3%		Mineral perpetual		US, Mexico, Europe
	Feldspar	5.3%		Mineral perpetual		US, Mexico, Europe
	Sand	4.8%		Mineral perpetual		US, Mexico, Europe
	Scrap	4.2%			Pre-Consumer Post-Consumer	US, Mexico, Europe
	Kaolin	3.2%		Mineral perpetual		US, Mexico, Europe
	Granite	1.3%		Mineral perpetual		US, Mexico, Europe
	Lime	1.1%		Mineral perpetual		US, Mexico, Europe
	Other Additives	4.0%		Mineral perpetual		US, Mexico, Europe
Surface	Glaze & Stain	5.4%		Mineral perpetual		US, Mexico, Europe

Production of Main Materials

Clay

Clay is an earthen material comprised of extremely fine particles of minerals, organic matter, and trace amounts of naturally occurring metal oxides. It can be molded when wet and hardened into shape by heating at high temperatures. Clay is mined directly from the earth and can be used in the production of ceramic tiles with minimal processing. While clay is the primary ingredient in any tile, it is often blended with fluxing minerals to achieve the desirable characteristic of the tile product.

Silicate minerals

Tile production uses various silicate minerals. Minerals are categorized as *silicate* when any combination of *SiO*—silicon and oxygen—appear in its molecular composition. Silicate minerals used in products included in this EPD are as follows: Feldspar, Nepheline, Granite, Pyrophyllite, Wollastonite, Talc, and Kaolin.

Sand

Sand is a granular material made of fine mineral particles. While sand does not have a defined mineral composition, most commonly it is comprised of silica in the form of quartz. Sand is a common additive in tile production to give the fired tiles size stability.

Granite

Granite is an igneous rock, composed of mainly quartz, mica, and feldspar.

Lime

Lime is a calcium-containing mineral used in the production of tile.

Glaze

Glaze is a smooth, protective coating commonly applied to tile products. Color and other aesthetic qualities can be given to the tiles through a glaze coating. Glazing materials are comprised of glass frits, minerals, opacifiers, pigments, and water. It is sprayed, rolled or poured onto the tile, and fired to form an inseparable top coating.

Stain

Stain is a mixed metal oxide colorant or pigment used to change the color of ceramic tile's aesthetic and/or appearance.

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Production of the Floor Covering

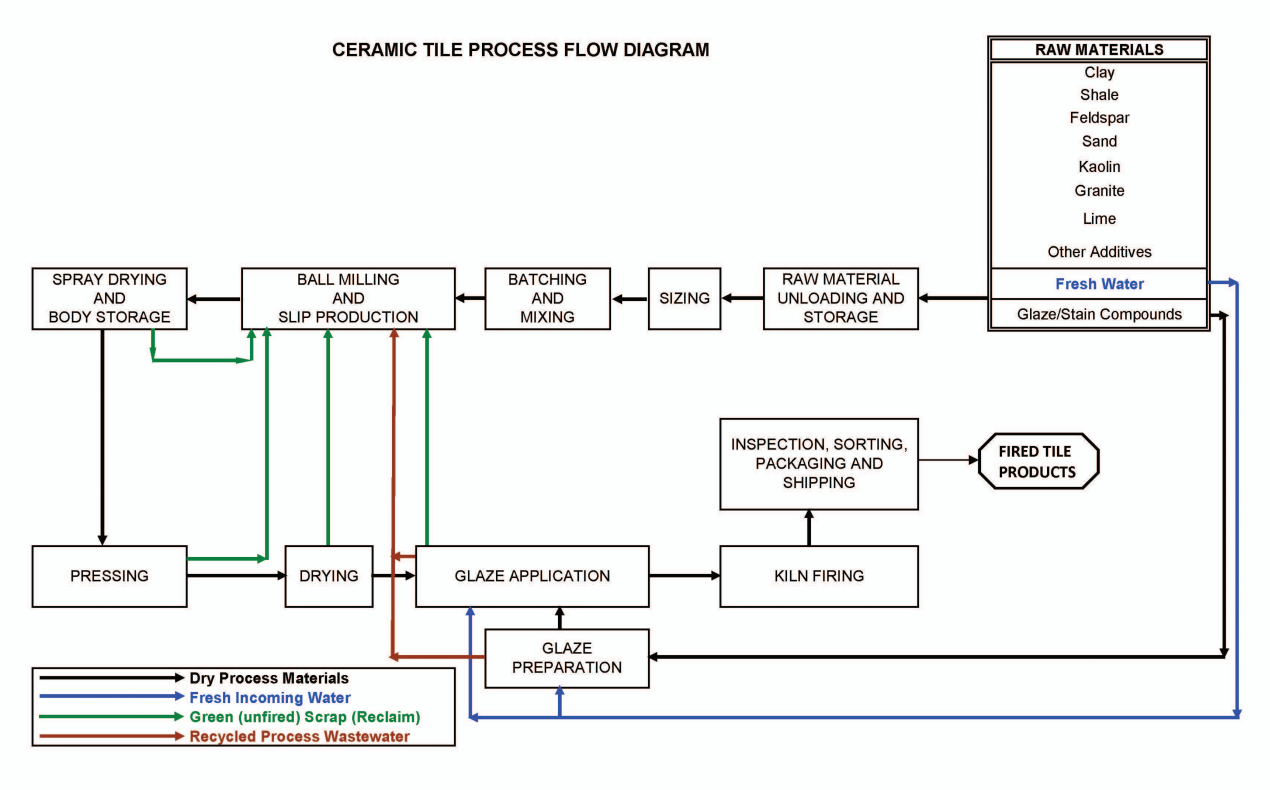

Figure 6: Process flow diagram for tile manufacturing – no fired scrap

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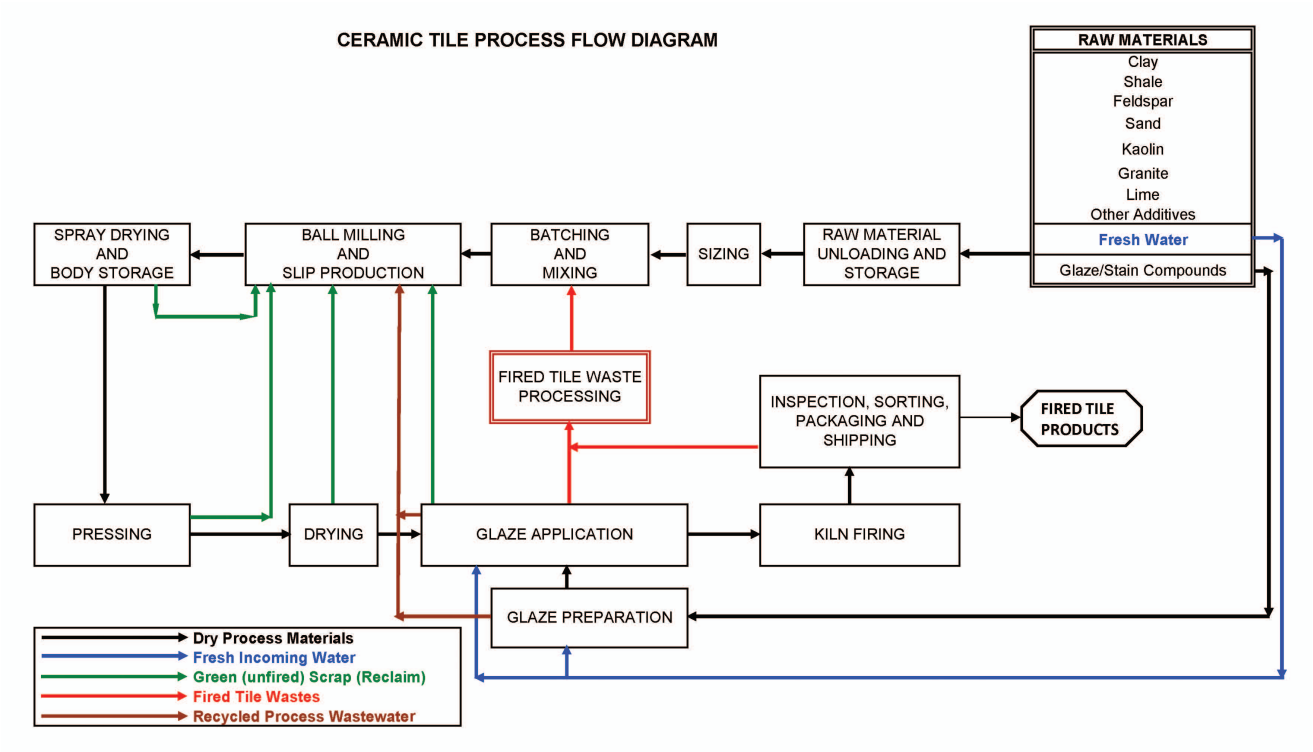

Figure 7: Process flow diagram for tile manufacturing – with recycled fired scrap

Tile body ingredients are combined with water, mixed, and milled into the desired consistency. The resulting slurry is then spray dried to achieve the optimal moisture content. The milled and dried ingredient, called "body material" or "prill", is then pressed to the desired shape. Glaze is applied, as well as decorative treatment, and fired in a high temperature kiln. Process flow diagrams with and without recycled scrap are shown in Figure 6 and Figure 7.

Production Waste

Most scrap and waste is recycled back into the product, but the different sites produce a small amount of waste (typically between 0 and 1 kg of waste per m^2 of tile) which is sent offsite to a landfill.

Tile manufacturers offer wide varieties of products with pre- and post-consumer recycled content. This can contribute to overall building recycled content and help achieve compliance with recycled content targets in green building projects. Additionally, high levels of responsibly recovered waste, including dust, powder, unfired scrap and water are commonly reincorporated into tile manufacturing. Waste reclamation in such processes is a vital component to minimizing waste and maximizing resources. In fact, many tile factories are so efficient at waste reclamation, they are effectively closed loop facilities. Reducing waste to zero and fully utilizing all inputs is paramount to efficient manufacturing.

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Delivery and Installation of the Floor Covering

Delivery

For purposes of this study, the average transport distance from manufacturing to construction site was assumed to be 500 miles by truck. LCA impacts associated with installation of the tile products in the building project are included.

Installation

Mortar is required (0.833 lbs / ft^2) for product installation. Sanded grout is also required (0.043 lbs / ft^2). During installation, approximately 4.5% of the total material is lost as waste. Though some of this waste could be recycled, this scrap is modeled as being disposed of in a landfill.

Waste

Based on current best information a small amount of installation waste is incinerated for energy recovery, but for the purposes of this EPD 100% of all such waste is assumed to be disposed of in a landfill.

Packaging

Primary packaging is 100% cardboard, but secondary/tertiary packaging are film and pallets. 100% of the packaging waste is recyclable. However, for this study, no documentation is available to quantify the percentage of packaging which is actually recycled, therefore all packaging waste is assumed to be sent to a landfill. Landfill emissions from cardboard packaging are allocated to installation. Electricity generated from landfill gas (produced from the decomposition of bio-based packaging) is ignored since the cut-off approach is applied to recycled materials.

Use stage

The service life of ceramic tile is unique in that it's not dependant on the amount of floor traffic and the type and frequency of maintenance. The level of maintenance is dependent on the actual use and desired appearance of the floor. For the NSF Flooring PCR, the building's Reference Service Life (RSL) is assumed to be 60 years. Since ceramic tile is expected to last at least as long as the building itself, the product will also have an RSL of 60 years.

Since the EPD must present results for both one-year and 60-year time periods, impacts are calculated for both time horizons. In the case of one-year results, the use phase impacts are based on the cleaning and maintenance model for one year. In the case of 60-year results, use phase impacts are scaled to represent maintenance for 60 years.

Cleaning and Maintenance

Tile products should be cleaned routinely with tap water. For the purposes of this EPD, average maintenance is presented based on a mix of residential and commercial installations.

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Table 3: Cleaning Process

Level of use	Cleaning Process	Cleaning Frequency	Consumption of energy and resources
Commercial / Residential	Dust mop	Daily	None
	Damp mop	36 times / year (Commercial) 4 times / year (Residential)	Tap water

This cleaning process translates to:

Table 4: Cleaning Inputs

	Amount	Units
Tap Water	0.783	L / m^2 / yr.

Prevention of Structural Damage

Interior floor covering should not be installed until any and all structural damage has been adequately repaired and determined to be code compliant. Surfaces must be structurally sound, stable and rigid enough to support the ceramic, porcelain, quarry and/or mosaic tile finishes.

Health Aspects During Usage

Since tile is fired in kilns at high temperatures, there are no volatile organics in the finished product that can be released into the air we breathe. There are also adhesives, grouts, and backer boards available that contain zero, or very low VOCs. Additionally, tile is inhospitable to dust mites, mold, germs, and bacteria and often the preferred floor covering for people with allergies or asthma. Tile grouts and backer boards with built-in mold and mildew protection complement tile's inherent resistance to mold and mildew growth.

End of Life

Because these tile products are comprised primarily of naturally occurring mineral based materials and no hazardous ingredients are added during the manufacturing process, they are basically inert and can be used in multiple applications: e.g., clean fill material in land reclamation/contouring projects, base or substrate material for roadways and/or parking lots, replacement for raw materials used in cement or brick kilns, etc. Some manufacturers of products included in this EPD also have the ability to "take-back" tile at the end of its useful life.

However, for purposes of this EPD, we have taken the most conservative approach and assumed that 100% of all tile removal waste is disposed of in a landfill.

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Life Cycle Assessment

A full Life Cycle Assessment has been carried out according to ISO 14025, 14040 and 14044, per the Product Category Rules (PCR) for Flooring: Carpet, Resilient, Laminate, Ceramic, Wood, as published by NSF International (2012).

The following life cycle stages are considered:

- Sourcing / Extraction
- Manufacturing
- Delivery & Installation
- Use stage
- End-of-life stage

The main purpose of EPDs is for use in business-to-business communication. As all EPDs are publicly available via the Program Operator and therefore are accessible to the end consumer, they can also be used in business-to-consumer communication.

Functional Unit Description

The declaration refers to the functional unit of 1m² installed floor covering. 1m² is equivalent to 10.76 ft².

Cut-off Criteria

No cut-off criteria were applied in this study. All reported data was incorporated and modeled using best available Life Cycle Inventory (LCI) data.

Background Data

As a general rule, specific data derived from specific production processes or average data derived from specific production processes shall be the first choice as a basis for calculating LCA results.

For life cycle modeling of the considered products, the GaBi 6 Software System for Life Cycle Engineering, developed by PE INTERNATIONAL AG, has been used to model the product systems considered in this assessment. All relevant background datasets are taken from the GaBi 2013 software database. The datasets from the GaBi database are documented in the online documentation / GaBi 6 2013D/. To ensure comparability of results in the LCA, the basic data of GaBi database were used for energy, transportation and auxiliary materials.

Data Quality

A variety of tests and checks were performed throughout the project to ensure high quality of the completed LCA. Checks included an extensive review of project-specific LCA models as well as the background data used.

Temporal Coverage

Primary data collected from TCNA members are based on 12 month averaged data representing the calendar year of 2012. Background datasets are all based on data from the last 3 years (since 2010), with the majority of datasets based on data from 2012.

Technological Coverage

Data on material composition and manufacturing are primary data from TCNA members. The raw material inputs, energy, waste, and emisisons in the calculation for this LCA are based on annual total purchases divided by annual production during the reference year. One notable limitation is that clay and kaolin, which are sometimes dried before delivery to tile manufacturing, are modeled only with the burdens of extraction.

Geographical Coverage

This background LCA represents TCNA products produced in the United States and Mexico.

Manufacturing energy was representative for each country included, but proxy datasets were used as needed for raw material inputs to address lack of data for a specific material or for a specific geographical region. These proxy datasets were chosen for their technological representativeness of the actual materials.

System Boundaries

The scope of the study includes raw material sourcing / extraction, manufacturing, installation, use, and disposal of ceramic tile.

Table 5 summarizes major components being considered for inclusion and exclusion from the study and have been shaped by the need to accurately reflect the environmental burden associated with the functional unit.

Table 5: System Boundaries

Included	Excluded
✓ Raw materials production (chemicals, minerals, etc.) ✓ Use of auxiliary materials, water, and energy during manufacturing, installation, and use ✓ Packaging of finished products ✓ Emissions to air, water, and soil during manufacturing ✓ Transport of raw materials and finished products ✓ Disposal	× Construction of capital equipment × Packaging of raw materials × Human labor and employee commute × Internal transportation (within a manufacturing facility)

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Allocation

Co-Product Allocation

No co-product allocation occurs in the product system.

Multi-Input Processes Allocation

No multi-input allocation occurs in the product system.

Reuse, Recycling, and Recovery Allocation

The cut-off allocation approach is adopted in the case of any post-consumer recycled content, which is assumed to enter the system burden-free. Only environmental impacts from the point of recovery and forward (e.g., collection, sorting, processing, etc.) are considered.

Product and packaging waste is modeled as being disposed in a landfill rather than incinerated or recycled. Plastic and other construction waste is assumed to be inert in landfills so no system expansion or allocation is necessary as landfill gas is not produced. In the case of landfill gas generated by the decay of bio-based packaging after installation, the cut-off approach is used; no credit is given for capture or utilization of the landfill gas.

Impact Categories

The impact assessment results are calculated using characterization factors published by the University of Leiden's CML 2001 – Apr. 2013.

Abbreviations for the impacts described here are used in the results tables below.

- Environmental Impact Categories (CML 2001):
  - Abiotic Depletion, Elements (ADP-e) [kg Sb-eq];
  - Abiotic Depletion, Fossil (ADP-f) [MJ];
  - Acidification Potential (AP) [kg SO2 eq];
  - Eutrophication Potential (EP) [kg Phosphate eq];
  - Global Warming Potential (GWP) [kg CO2 eq];
  - Ozone Depletion Potential (ODP) [kg R 11 eq];
  - Photochemical Oxidant Formation Potential (POCP) [kg Ethene eq];
- Environmental Indicators:
  - Primary Energy of non-renewable resources [MJ];
  - Primary energy of renewable resources [MJ];
  - Secondary materials [kg];
  - Non-renewable material sources [kg];
  - Output flows [kg]

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Results

Results for one square meter installed ceramic tile are presented in the sections below. Note that ranges of impact have not been included due the confidentiality concerns regarding company-specific data.

Life Cycle Inventory Analysis

Primary Energy Demand

Primary energy resources and water use are presented below.

Table 6: Primary energy, non-renewable for 1 square meter of ceramic tile for 1 year Use [MJ]

	Total	1. Sourcing / extraction	2. Manufacturing	3. Delivery & Install	4. Use stage	5. End of Life
Non renewable energy resources	225	53.9	148	9.95	0.03	12.9
Crude Oil	49.8	31.2	4.55	6.92	0.0115	7.05
Hard Coal	17.8	5.93	10.3	0.641	0.00497	0.933
Lignite	3.42	1.95	0.444	0.672	0.00257	0.353
Natural Gas	146	12.1	129	1.37	0.00858	4.18
Peat	0.00825	0.00767	0.000415	8.73E-005	2.21E-006	8.32E-005
Uranium	7.22	2.74	3.73	0.34	0.00241	0.406

Table 7: Primary energy, renewable for 1 square meter of ceramic tile for 1 year Use [MJ]

	Total	1. Sourcing / extraction	2. Manufacturing	3. Delivery & Install	4. Use stage	5. End of Life
Renewable energy resources	10.4	6.77	2.77	0.296	0.00159	0.597
Geothermal	0.639	0.0428	0.59	0.0022	2.11E-006	0.00342
Hydro	2.02	0.574	1.33	0.0457	0.000299	0.0794
Solar	6.91	5.78	0.512	0.179	0.000727	0.431
Primary energy from waves	5.38E-013	3.03E-013	3.39E-014	9.6E-014	2.71E-017	1.05E-013
Wind	0.865	0.375	0.337	0.0689	0.000565	0.0831
Primary forest	4.65E-011	2.59E-011	3.43E-012	8.18E-012	2.6E-014	8.96E-012

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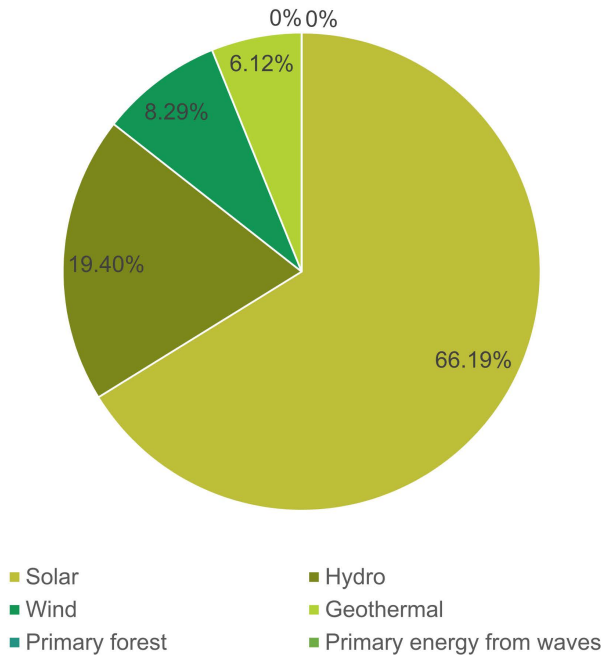
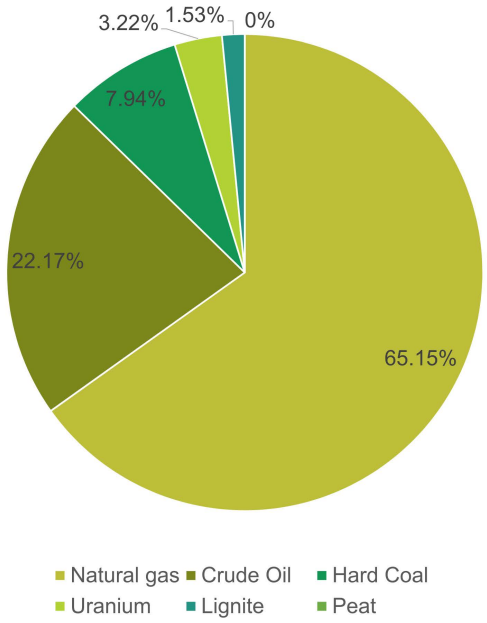
Renewable Primary Energy



Non-Renewable Primary Energy



Other Resources and Wastes

Secondary material and secondary fuel (fossil and renewable) consumption are presented below.

Table 8: Other resources and wastes for 1 square meter of ceramic tile for 1 year Use [kg]

	Total	1. Sourcing / extraction	2. Manufacturing	3. Delivery & Install	4. Use stage	5. End of Life
Non renewable elements.[kg]	0.072	0.014	0.026	0.0064	8.4E-005	0.027
Non renewable resources [kg]	51	36	3.5	6.9	0.0041	4.2
Hazardous waste [kg]	0.0028	0.0011	0.0015	0.00013	9.9E-007	0.00016
Non-hazardous waste [kg]	41	16	3.4	3	0.0047	19
Non-renewable material sources [kg]	51	36	3.5	6.9	0.0042	4.3
Secondary fuel (fossil) [MJ]	1.4	0.022	0.055	1.3	0.00039	0.033
Secondary fuel (renewable) [MJ]	0.15	0.0021	0.0054	0.12	3.7E-005	0.014

According to ISO 14025

North American Ceramic Tile, including Mosaic, Quarry, Pressed Floor, Glazed Wall,
and Porcelain as defined by ANSI A137.1 American National Standard Specifications for Ceramic Tile

Life Cycle Impact Assessment

The impact assessment results are calculated using characterization factors published by the University of Leiden's CML 2001 – Apr. 2013 methodology.

Table 9: CML Impact assessment results of 1 square meter for 1 year use

	Total	1. Sourcing / extraction	2. Manufacturing	3. Delivery & Install	4. Use stage	5. End of Life
ADP-e [kg Sb-Equiv.]	1.21E-005	6.88E-006	3.47E-006	1.41E-006	1.68E-009	3.21E-007
ADP-f [MJ]	217	51.2	144	9.61	0.0276	12.5
AP [kg SO2-Equiv.]	0.0561	0.0254	0.0242	0.00277	7.54E-006	0.00371
EP [kg Phosphate-Equiv.]	0.00566	0.00266	0.00196	0.000584	6.53E-006	0.000437
GWP [kg CO2-Equiv.]	14.9	3.75	9.39	0.958	0.00203	0.826
ODP [kg R11-Equiv.]	7.43E-010	3.01E-010	4.12E-010	1.24E-011	1.15E-012	1.71E-011
POCP [kg Ethene-Equiv.]	0.00514	0.00197	0.00254	0.00027	9.55E-007	0.000361

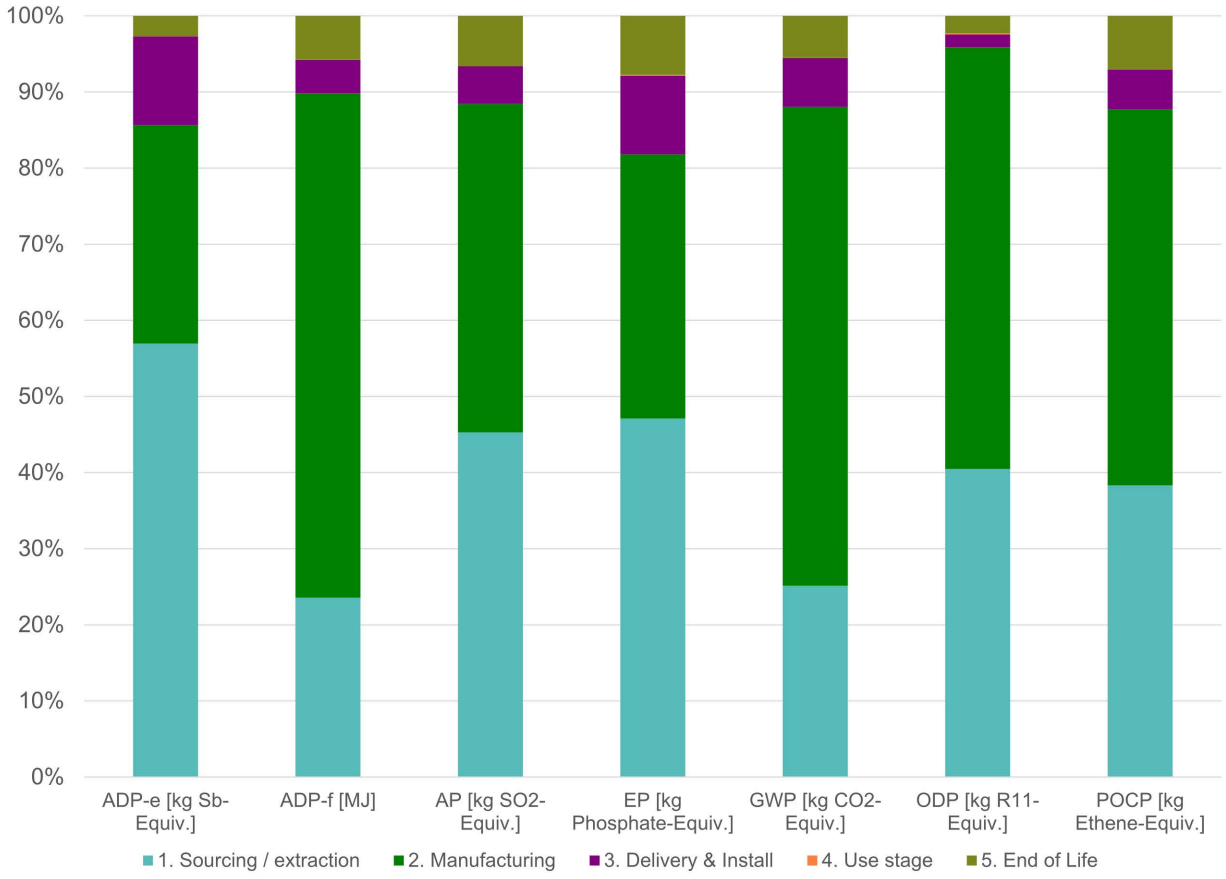
Table 10: CML Impact assessment results of 1 square meter for 60 year use

	Total	1. Sourcing / extraction	2. Manufacturing	3. Delivery & Install	4. Use stage	5. End of Life
ADP-e [kg Sb-Equiv.]	1.22E-005	6.88E-006	3.47E-006	1.41E-006	1.01E-007	3.21E-007
ADP-f [MJ]	219	51.2	144	9.61	1.65	12.5
AP [kg SO2-Equiv.]	0.0565	0.0254	0.0242	0.00277	0.000452	0.00371
EP [kg Phosphate-Equiv.]	0.00604	0.00266	0.00196	0.000584	0.000392	0.000437
GWP [kg CO2-Equiv.]	15.1	3.75	9.39	0.958	0.122	0.826
ODP [kg R11-Equiv.]	8.11E-010	3.01E-010	4.12E-010	1.24E-011	6.92E-011	1.71E-011
POCP [kg Ethene-Equiv.]	0.0052	0.00197	0.00254	0.00027	5.73E-005	0.000361

According to ISO 14025

North American Ceramic Tile, including Mosaic, Quarry, Pressed Floor, Glazed Wall,
and Porcelain as defined by ANSI A137.1 American National Standard Specifications for Ceramic Tile

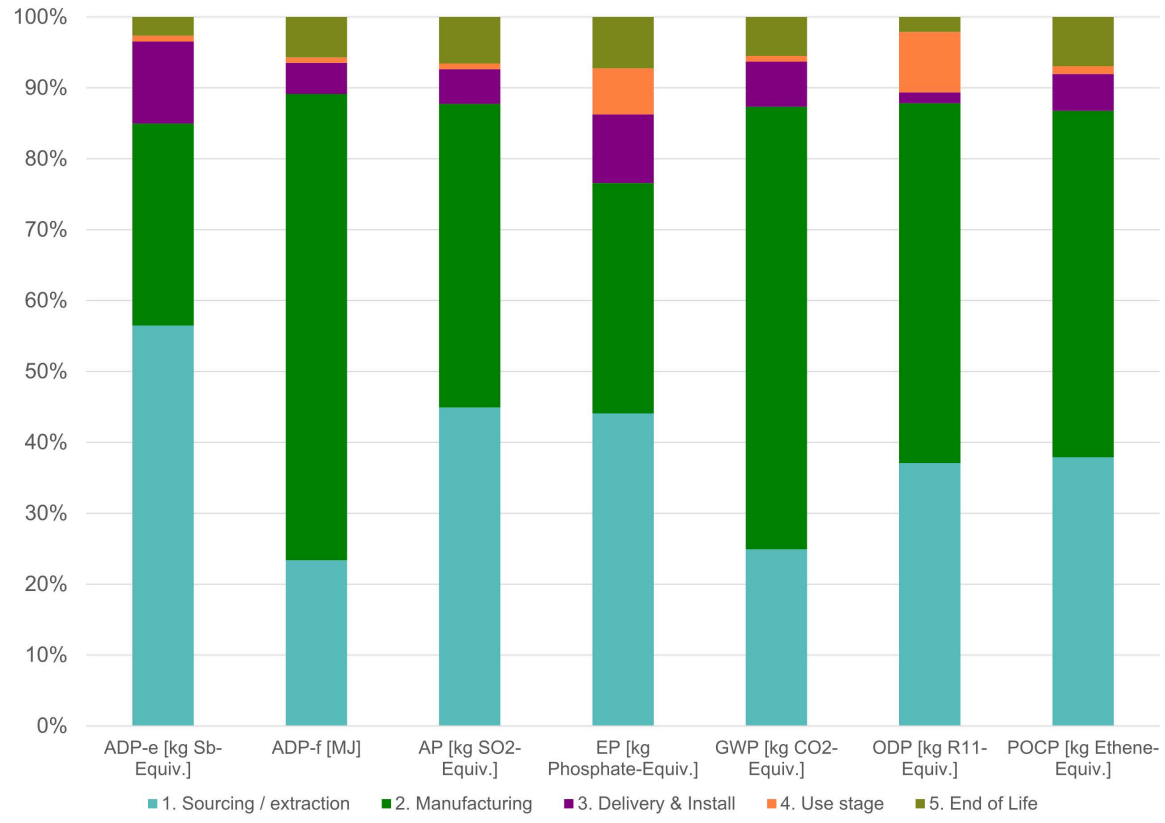
Figure 3: CML Impact assessment results of 1 square meter for 1 year use



According to ISO 14025

North American Ceramic Tile, including Mosaic, Quarry, Pressed Floor, Glazed Wall, and Porcelain as defined by ANSI A137.1 American National Standard Specifications for Ceramic Tile

Figure 4: CML Impact assessment results of 1 square meter for 60 year use



Interpretation

When considering a 60-year product life, energy for manufacturing and production of raw materials are the two largest contributors in all impact categories considered. Maintenance during use also represents a small but relevant fraction of the Eutrophication and Ozone Depletion categories.

When considering a 1-year product life, production of raw materials and energy for manufacturing are by far the two largest contributors in all impact categories considered. The transportation and installation of tile is also a small but relevant contributor to Abiotic Depletion (fossil) and Eutrophication.

According to ISO 14025

North American Ceramic Tile, including Mosaic, Quarry, Pressed Floor, Glazed Wall,
and Porcelain as defined by ANSI A137.1 American National Standard Specifications for Ceramic Tile

References

GaBi 6 2013	PE INTERNATIONAL AG; GaBi 6: Software-System and Database for Life Cycle Engineering. Copyright, TM. Stuttgart, Echterdingen, 1992-2013.
GaBi 6 2013D	GaBi 6: Documentation of GaBi 6: Software-System and Database for Life Cycle Engineering. Copyright, TM. Stuttgart, Echterdingen, 1992-2013. http://www.gabi-software.com/support/gabi/
ISO 14025	ISO 14025:2011-10 Environmental labels and declarations - Type III environmental declarations - Principles and procedures
ISO 14040	ISO 14040:2009-11 Environmental management - Life cycle assessment - Principles and framework
ISO 14044	ISO 14044:2006-10 Environmental management - Life cycle assessment - Requirements and guidelines
NSF PCR 2012	NSF Product Category Rule for Flooring: Carpet, Resilient, Laminate, Ceramic, Wood