

MODERN-DAY SUSTAINABILITY DRIVERS IN THE BUILT ENVIRONMENT AND THEIR IMPACT ON TILE

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ABSTRACT

Green building principles are rooted in resource conservation, climate change awareness, and biodiversity, and more recently in human wellness. Designers and specifiers are now increasingly focused on building product contents and their impact on human health. Today's green building market not only requires environmental transparency and a standardized evaluation of products' environmental performance, but also transparency pertaining to product ingredients.

It is important to understand green building rating programs, codes, regulations, and purchasing requirements driving the need for this information. This paper provides an in-depth explanation of these drivers and related standards, tools, and initiatives available to the tile industry to satisfy market demands.

The following is an outline of topics which are addressed:

- Evolution of sustainability directives and green building architectural criteria, particularly in North America, and how they impact product selection criteria
- Sustainability performance criteria and tile industry standards and certification programs that can be referenced when specifying ceramic tile and related materials
- Sustainability transparency criteria, including the applicability of environmental product declarations (EPD) for environmental transparency and product ingredient reports for human health transparency
- Tile industry collaboration and opportunities for green building market advancement

As this paper describes, using available tile industry standards and tools to meet modern-day green building architectural requirements facilitates an organized approach to specifying tile industry products. Application of this organized approach throughout the industry can positively influence *the green building market and advantageously position the ceramic tile sector*.

1. INTRODUCTION

Demand for sustainable construction products, driven especially by green and healthy building architectural criteria, has grown significantly over the last ten years. To understand the North American market, it is helpful to review the evolution of today's leading green building rating programs, codes, regulations, and purchasing requirements. Specific to tile, there have been several important North American tile industry initiatives over the past decade, including 1) the release of a material ingredient guide for ceramic tile, mortar, and grout, 2) the development of industry-wide EPDs (Environmental Product Declarations) based on North American product category rules (PCR) for flooring, and 3) national acceptance of Green Squared® standardization and certification of ceramic tile and related installation materials. As society's interest in sustainability and health transparency continues to grow, these initiatives support opportunities for increased specification of tile.

2. EVOLUTION OF ENVIRONMENTAL AND HUMAN HEALTH ASPECTS OF GREEN BUILDING

The emergence of North America's green building industry, as we know it today, can be traced to United States federal initiatives following several environmental disasters in 1969. The first United States Earth Day was established in 1970, and President Richard Nixon and Congress formed the United States Environmental Protection Agency (EPA) shortly thereafter. The aim was to reverse environmental damage already incurred and to create an environment in the United States that was safe and sustainable ^[1].

In the decades that followed, the federal government leveraged its purchasing power to demonstrate preference for environmentally friendly products and services, and the concept of green building as an industry unto itself began gaining traction. Green building prioritization was supported not only by the EPA, but also by the US Department of Energy and some of the largest landholders in the country, including the US General Services Administration, the US Navy, Army, and Airforce, the Forest Service, and the National Park Service ^[2]. In 1993, then President Bill Clinton's "Greening of the Whitehouse" focused on improvements to the building envelope, lighting, waste management, indoor environmental quality, and landscaping to increase the iconic building's resource and energy efficiency and reduce waste ^[3].

Also in 1993, the United States Green Building Council (USGBC), a non-government organization, was founded. USGBC collaborated with the American Institute of Architects to convene representatives from 60 architectural firms and several nonprofit organizations to discuss the development of the green building rating system, LEED (Leadership in Energy and Environmental Design). Rapidly over the next several years, LEED was widely adopted in the public and private sector, and established a means to define, measure, and certify green building projects. Within LEED, objectives pertaining to the environmental sustainability of buildings eventually expanded to also address human health ^[4].

Once developed, LEED's human wellness provisions were increasingly referenced throughout the green building sector, particularly in the state of California. As more attention was given to product VOC (volatile organic compound) emission criteria, in the early 2000s, the California Department of Public Health (CDPH) expanded several sub-sections of state regulations on indoor air quality into a standard practice for testing flooring and furniture products. Around the same time, the Collaborative for High Performance Schools (CHPS) was founded, which involved a standardized rating system and certification program for schools with good lighting, clean air, and comfortable classrooms. CHPS established a credit for low emitting building materials and a "High Performance Products Database" in 2009 and specified CDPH VOC testing provisions. The California Green Building Standards Code (CALGreen), which also specified CDPH VOC testing provisions, was also adopted in 2009 ^{[5][6][7]}.

Elsewhere in the country, efforts toward the development of the International Green Construction Code (IgCC) began in the 2000s. With attention to occupant health and indoor air quality, in addition to a host of resource and energy efficiency provisions, IgCC was released in 2010 as a regulatory baseline for adoption by state and local jurisdictions in the US and Canada ^[9]. Also in 2010, President Obama signed into law the Formaldehyde Standards for Composite Woods Products Act, aimed at reducing exposure to emissions from certain wood products produced domestically or imported into the United States ^[10]. Furthermore, in 2010, the Healthy Building Network (HBN), founded several years earlier in Washington D.C., led efforts to form the Health Product Declaration Collaborative (HPDC) to focus on increased transparency of building product content and associated health information through manufacturer development of product Health Declarations

(HPDs). The first version of the HPD Open Standard was released in 2012 ^{[11][12]}. The architectural community immediately began embracing the concept of HPDs, and 24 leading firms in the US formally requested HPDs from building product manufacturers by January 1st, 2014, each stating that failure to comply could lead to “a number of changes in how the design firm interacts with a manufacturer, from limited or restricted options for presenting materials to designers, to a manufacturer losing preference in specifications ^[13].”

Finally, in 2014, The International WELL Building Institute (IWBI), a public benefit corporation focused on improving human health and wellbeing through the built environment, launched the first version of the WELL Building Standard. Administered by IWBI and supported by USGBC, the WELL Building Standard was intended to coordinate with LEED as a means for “measuring, certifying, and monitoring features of the built environment that impact the health and wellbeing of the people who live, work, and learn in them.” With indoor environmental quality and transparency regarding building product content and associated health information integral to IWBI’s mission, WELL building certification, professional education, and an accredited professional program ensued in 2015 ^[14].

3. TODAY'S CONCERNS AND THE FUTURE OF GREEN BUILDING

By 2020, human health and wellness had already been integrated into the overall green building discussion, and with the onset of the COVID-19 global pandemic healthy and sustainable interior environments have become even more in demand. Today's leading green building programs, including LEED and WELL, are viewed by the design community as important vehicles for further standardization regarding the impact of building surfaces on human health and wellbeing. Furthermore, in the spirit of wellness, whatever can be done to alleviate building occupancy anxiety related to COVID-19, and viruses in general, is of interest. Some possibilities include using psychologically uplifting colors, incorporating natural ambiances, designing open spaces, and integrating surfaces that can be wiped-down and easily maintained per guidelines of health officials ^[15].

In fact, green building codes, standards, and rating systems are already evolving. For instance, LEED now specifies elements of green building and design addressing virus transmission and mitigation on surfaces, cleanability of surfaces, and health and environmental impacts of cleaners. These criteria are specifically addressed by two new LEED credits: Safety First-Cleaning and Disinfecting Your Space, and Safety First-Re-Enter Your Workspace ^[16]. The American Institute of Architects expresses support for the increased use of LEED following the pandemic through its Re-Occupancy Assessment Tool ^[17].

Further elevating the green building conversation in the US today, the Biden administration's views on climate change and energy are putting a spotlight on green building in general. Increased EPA participation in standards development under the current administration and the federal government's actions to promote environmental standards through its building and construction procurement are having an impact on green and healthy building demand throughout the entire real estate market ^[18]. With today's environmental prioritization in government construction, and with the prevalence of health-related issues in society, heightened attention to green and healthy building programs is inevitable ^[19].

To satisfy present and future green and healthy building demand and to facilitate product conformance to rating programs, codes, regulations, and purchasing requirements, the North American ceramic tile industry developed several tools and standards addressing health and environmental transparency and performance.

4. MARKET CRITERIA FOR HEALTH TRANSPARENCY AND TILE INDUSTRY MATERIAL INGREDIENT GUIDE

Regarding health transparency, building product suppliers are increasingly required to disclose the content and chemical makeup of their products in a standardized format. According to HBN, consumers have the “right to know,” and it is “the responsibility of the manufacturer” to provide transparency in product material ingredient reporting. The growth of such material ingredient transparency is largely attributed to its inclusion in major green and healthy building programs, including LEED and WELL ^[20].

In LEED, a building project can receive a point toward certification if a certain minimum number of products are used for which manufacturers have reported the product ingredients using an HPD or other type of material ingredient report. An additional point can be received if the information within the referenced report has been GreenScreen® assessed to fully address health ramifications for at least 75% of the ingredients reported ^[21].

Similarly, in WELL, a building project can receive up to two points toward certification if a specified minimum number of products are used for which manufacturers have reported ingredients; one point if reported to 1000ppm and two if reported to 100ppm. An additional third point can be received if the information within the referenced reports has been certified, and an additional fourth point if the information has been GreenScreen® assessed to fully address health ramifications for at least 75% of the ingredients reported ^[22].

To facilitate ceramic tile, mortar, and grout manufacturer conformance to LEED and WELL product material ingredient reporting criteria, the North American ceramic tile industry developed an industry Material Ingredient Guide. This guide, a first of its kind by any building product industry, provides guidance for manufacturers when they are developing an HPD or other material ingredient report. Additionally, the guide provides information about the material ingredients most commonly used by North American manufacturers, references in-depth chemical assessments of those materials, and provides insights into satisfying healthy building criteria. In developing this guide, 17 manufacturers collaborated on the largest-ever crowdfunded collection of GreenScreen Assessments® to obtain GreenScreen® Benchmark Scores for the vast majority of material ingredients used by ceramic tile, mortar, and grout manufacturers. When manufacturers reference the guide’s GreenScreen Assessments® in their material ingredient reports, that can result in products contributing toward the additional points in LEED and WELL described above, a feat rarely achieved by products from other industries ^[23].

Substance	CASRN Number	Previous GS Score	TCNA GS Score	Substance on the ILFI Red List	Substance on the ILFI Watch List	Substance on the WELL RSL	Substance on Prop 65	Substance listed on Chemical Footprint Project
Aluminum Oxide	1344-28-1	BM - 2	BM-2	No	No	No	No	Yes
Barium Carbonate	513-77-9	LT - UNK	BM-2	No	No	No	No	No
Boron Trioxide	1303-86-2	LT - 1	BM-1	No	No	No	No	Yes
Calcium Carbonate	1317-65-3	LT - UNK	BM-3dg	No	No	No	No	No
Calcium Formate	544-17-2	LT - UNK	BM-3	No	No	No	No	No
Calcium Oxide	1305-78-8	LT - P1	BM-2	No	No	No	No	No
Chrome Ore	1308-31-2	LT - UNK	BM-2	No	No	No	No	No
Gypsum	13397-24-5	LT - UNK	BM-3dg	No	No	No	No	No
Iron Oxide	1309-37-1	BM - 1	BM-3dg	No	No	No	No	No
Magnesium Carbonate	546-93-0	LT - UNK	BM-2	No	No	No	No	No
Magnesium Oxide	1309-48-4	LT - UNK	BM-3dg	No	No	No	No	No
Manganese Dioxide	1313-13-9	LT - P1	BM-1	No	No	No	No	No
Methylethylcellulose	9032-42-2	LT - UNK	BM-2	No	No	No	No	No
Potassium Oxide	12136-45-7	LT - UNK	BM-2	No	No	No	No	No
Quartz	14808-60-7	LT - 1	BM-1	No	No	No	Yes*	Yes
Sodium Oxide	1313-59-3	LT - UNK	BM-2	No	No	No	No	No
Sulfur Trioxide	7446-11-9	LT - P1	BM-2	No	No	No	No	No
Talc	14807-96-6	BM - 1	BM-1	No	No	No	No	No
Titanium Dioxide	13463-67-7	LT - 1	BM-2	No	No	No	Yes*	Yes

Figure 1: Assessment Results of Common Tile Industry Ingredients as Listed in the Material Ingredient Guide

5. TILE INDUSTRY EPDs AND THEIR APPLICABILITY TO GREEN BUILDING

Regarding environmental transparency, quantitative reporting of the environmental impact of products is needed so the environmental footprint of buildings can be calculated. An EPD is a vehicle for reporting product environmental impact data in a standardized manner. Just as nutrition labels inform about food choices, an EPD reports the most important environmental considerations, based on an environmental life cycle assessment (LCA), in a common framework for end users [24].

In LEED, a building project can receive a point if a certain minimum number of products are used for which an EPD has been provided [21]. It is also important to consider green building code and regulatory compliance. The international Green Construction Code requires that at least 10 products installed in a building have an EPD. Also, the US General Services Administration P100 Facilities Standards have similar criteria, meaning that EPDs are often a requirement for US government procurement [25][26].

The North American ceramic tile industry developed industry-wide EPDs for ceramic tile, mortar, and grout made in North America. These EPDs provide a comprehensive overview of how these products, on average, per installed square meter, impact the environment over an estimated building service life of 75 years. To produce each of these EPDs, participating manufacturers provided extensive data on their materials and operations and participated in a cradle-to-grave evaluation of their products, from raw material sourcing and extraction, through manufacturing, delivery, installation, use, and end of life. When comparing EPDs for tile and related products alongside other flooring products' generic EPDs, including those of luxury vinyl tile and luxury vinyl plank, and several other plastic-based flooring materials, it can be seen that ceramic tile has the lowest 75-year environmental impact per square meter. Each EPD has been independently verified by UL Environment, and participating manufacturers can reference the EPDs when such information is required by green building specifiers and procurement officials [24].

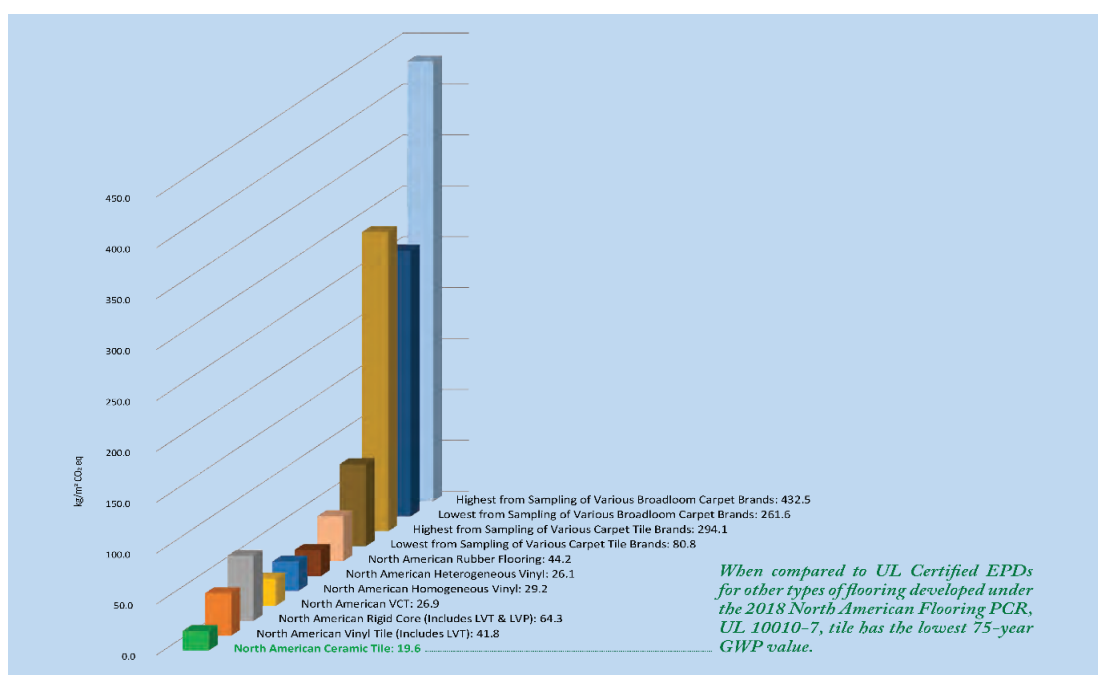


Figure 2: Ceramic Tile Global Warming Potential (GWP)—Results from Industry-Wide EPD Compared to Results from EPDs for Competing Products

6. GREEN BUILDING DEMAND FOR SUSTAINABILITY PERFORMANCE AND TILE INDUSTRY STANDARDIZATION AND CERTIFICATION

Regarding sustainability performance, product standards and certifications are becoming increasingly important in the specification and design of green building projects. A sustainability standard is a set of criteria against which a product can be judged, and 3rd party certification to a standard independently confirms product conformance and can sometimes serve as an incentive to a manufacturer to improve product performance. Some, standards are single-attribute, focusing solely on one environmental aspect such as water, materials, energy, or emissions, while others are multi-attribute, addressing water, materials, energy, and emissions, plus a host of other aspects in order to evaluate the overall environmental performance of a product or system ^[27].

In LEED, a building project can receive a point if a certain minimum number of products are used which have achieved certification to an approved multi-attribute sustainability standard ^[21]. Regarding building code and regulatory compliance, the International Green Construction Code requires the specification of products certified to multi-attribute sustainability standards, as does the US General Services Administration P100 Facilities Standards ^{[25][26]}.

Nearly a decade ago, the North American ceramic tile industry established the world's first multi-attribute standard and certification program for sustainable tiles and tile installation materials, titled Green Squared. The ANSI A138.1 standard on which Green Squared is based contains lifecycle-based multi-attribute sustainability criteria for product performance, manufacturing, end of life, corporate governance, and innovation. A tile or related installation product which bears the Green Squared Certified® mark on its packaging or literature has been independently verified by one of two approved certification bodies, UL Environment or SCS Global, to meet ANSI A138.1. Given the global nature of the tile industry, ANSI A138.1 and the Green Squared certification program were developed specifically to be relevant no matter where in the world products are produced. Developed to meet the sustainability needs of the North American marketplace, the Green Squared standard and certification program provide all producers, foreign and domestic, with a clear benchmark for designing sustainable products that can be accepted by North American green building programs ^[28].

Green Squared continues to serve as an important specification tool for the sustainability performance of tile and related installation materials in North America. In addition to being specifically listed under LEED's credit for certified multi-attribute products and materials ^[21], the US EPA lists Green Squared in its Recommendations of Specifications, Standards, and Ecolabels for Federal Purchasing ^[29].

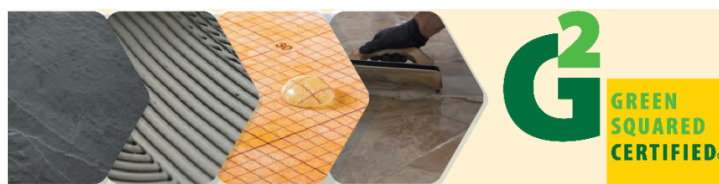


Figure 3: Tiles, mortars, grouts, backer-boards, membranes, and other materials which bear the Green Squared Certified mark have been independently certified as meeting ANSI A138.1.

7. CONCLUSION

Over the past half-century, green building has evolved from governmental preference for environmentally-friendly products and services to an industry with codes, standards, rating systems, and regulations addressing a host of sustainability topics. Today, green building also addresses human health and wellness, which has been especially relevant in light of the COVID-19 pandemic.

In North America, green building products are generally specified based on health transparency, environmental transparency, and multi-attribute sustainability performance. As this report explained, the North American ceramic tile industry has important standards and tools to meet modern-day green building architectural requirements.

The Material Ingredient Guide provides information about the ingredients most commonly used by North American ceramic tile, mortar and grout manufacturers and guidance for manufacturers when developing a health product declaration or other material ingredient report. Industry-wide EPDs for ceramic tile, mortar, and grout provide a comprehensive overview of how these products, on average per installed square meter, impact the environment over an estimated building service life of 75 years. The Green Squared standard and certification program establish thresholds for multi-attribute sustainability performance and a means by which conforming ceramic tiles and related installation materials can be identified and specified.

Concerns about human health and well-being, energy, resources, and climate change, are at an all-time high, and so too are demands for green building products. In North America, the ceramic tile sector is well-positioned to satisfy these demands using available tile industry standards and tools.

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