

TILE'S ROLE IN THE GREEN BUILDING INDUSTRY

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ABSTRACT

As green building initiatives have evolved, so too have expectations for the sustainability of building products. While environmental responsibility is still at the heart of all green endeavors, other concepts ranging from human health to social responsibility also play a role in what is considered green, especially in North America. "Tile's Role in the Green Building Industry" explains today's sustainability demands as they relate to the North American building industry.

The contribution of the tile industry to the North American green building movement is reviewed. With a focus on green building standards and rating systems, including Leadership in Energy and Environmental Design (LEED) and the International Green Construction Code (IGCC), strategies for incorporating the use of tile to meet certain design criteria are explored.

Additionally, a review of ANSI A138.1, a North American tile product sustainability standard intended to meet the demands of the greater green building community, is provided. This standard is compared to standardization initiatives of competitive industries, all of which are in alignment with the philosophical concepts that drive today's leading sustainability initiatives.

1. INTRODUCTION

In today's dynamic and ever evolving green building world, it is important to gain familiarity with the core sustainability principles from which today's demands evolved. With an understanding of these principles, it is easier to understand the positive impact tile can have on green building projects. Thus, it becomes easier to communicate such concepts among architects, specifiers, and green building professionals. This paper endeavors to communicate green building principles and how they pertain to the tile industry and new tile standardization efforts.

2. THE GENESIS OF GREEN BUILDING IN THE UNITED STATES

While the leading principles behind sustainable architecture and design have been in existence for hundreds, perhaps thousands of years, the emergence of the green building industry as we know it today has a recent origin. Many believe that today's green building roots can be traced back to historical events in the United States in the mid-late 20th century.

In 1969, United States federal green initiatives followed the Santa Barbara oil spill and the Cuyahoga River fire which occurred within months of each other. Tragedies such as these encouraged Senator Gaylord Nelson to push for action and establish the first Earth Day in the spring of 1970. After more than 20 million Americans participated in a celebration of the first United States Earth Day, President Richard Nixon and Congress established the Environmental Protection Agency (EPA) to form initiatives to reverse environmental damage already incurred and to create an environment in the United States which was safe and sustainable ^[1].

While the first Earth Day and the formation of the EPA helped spark the environmental movement, the concept didn't receive much traction within the building community until the OPEC oil embargo three years later. Until this point, the United States relied on the availability and low cost of fossil fuels with energy efficiency a low priority. The OPEC oil embargo introduced new realization that the availability of such resources was out of the control of the United States ^[2].

Fast forwarding 20 years later to Earth Day 1993, President Bill Clinton announced the "Greening of the White House." This plan addressed the building envelope, lighting, waste, indoor environmental quality and landscaping. By increasing resource and energy efficiency and reducing waste, the program has saved an estimated \$300,000 per year and reduced emissions by 845 tons of carbon per year since 1996 ^[3]. Along with the monetary savings and alleviation of environmental burdens, the upgrades improved overall indoor air quality and building comfort for occupants. This improvement to such an iconic building brought attention to developing concepts of sustainability.

Also taking place in 1993 was the formation of the United States Green Building Council (USGBC). Two years later in 1995, USGBC decided to take on the task of creating a sustainability rating system for buildings modeled closely after the principles followed during the “Greening of the White House.” This draft rating system, known as Leadership in Energy and Environmental Design (LEED), was intended to be a tool for certifying sustainable buildings, and it would undergo many refinements over the next three years until late 1998 when LEED 1.0 was introduced. Within a year, a pilot program was launched and over one million square feet of building space was certified. As momentum around the LEED program began to build rapidly, USGBC launched LEED 2.0 in the spring of 2000, providing a tiered approach so that buildings could be classified as Bronze, Silver, Gold, or Platinum. This expanded opportunities for building certification and the overall footprint of the LEED program.

In summary, between 1993 and 2000, the USGBC transformed green building principles and laid the foundation on which a new sustainability marketplace would be built.

3. MARKETPLACE TRANSFORMATION

To date USGBC has certified more than 35,000 projects totaling over 4.5 billion square feet ^[5]. Outside of the United States, LEED certification is now offered in over 90 countries, and USGBC is endeavoring to increase global awareness of its green building initiatives by providing international outreach and training ^[7]. From this outreach, a more globally consistent understanding of today’s green building principles has resulted.

Moreover, in the past decade USGBC’s creation of the LEED program inspired several other organizations to launch similar programs, including the ICC-700—a standard rating system for single and multi-family homes, the Collaborative for High Performance Schools (CHPS)—a set of criteria designed to enhance the learning experience while reducing operating costs and environmental impacts, and Green Globes—a rating system based on an online assessment tool. Additionally, the International Green Construction Code (IGCC) will launch in early 2012. This Code, similar in concept to North American Plumbing Codes, Electrical Codes, and other Building Codes, will be administered by Code officials and available for adoption by national, regional, or local municipalities. Where adopted, the IGCC will be law for how buildings shall be constructed ^[8]. For the first time, green building will no longer be voluntary, and many believe that the introduction of IGCC to the architectural marketplace will introduce a turning point in community expectations for how buildings shall be constructed, especially in North America.

What does this architectural marketplace transformation mean for building products? A report released by the Freedonia Group estimated that in 2010 \$38.7 billion were spent on green building materials due to LEED and similar green build-

ding programs. It is expected that a 13% annual expansion will occur until 2015, resulting in over \$70 billion in spending on green building products ^[6].

4. THE PROMOTION OF TILE IN GREEN BUILDING

In an effort to increase its share amidst today's booming green product marketplace, tile manufacturers as a whole are touting several environmental benefits of their products, most of which are aligned with generic industry messaging.

4.1. Durability

As one of the most important contributors to sustainability, product lifespan is a common subject to which manufacturers refer when communicating the green building contributions of their products. Comparison of tile industry Reference Service Life (RSL) values to those of competitive surface covering industries presents an opportunity for superiority in the field of Life Cycle Assessment (LCA) studies. The objective of service life planning is to assure, as far as possible, that the estimated service life of the building or component will be at least as long as its design life ^[9]. With an accurate RSL, LCA studies can yield better insight into a product's true environmental impact potential. LCA is arguably today's most talked-about topic in the green building movement ^[10]. With efforts to better incorporate product LCA into LEED and service life declaration into Building Codes, it is critical that tile product sustainability data be based on accurate RSLs for comparison with competitive products.

4.2. Recycled Content

From the inception of environmental product demands, manufacturers of building materials have strived for increased levels of recycled content in their products. A strong premise for these endeavors relates to the general desire to optimize product contribution to overall building recycled content. This, in turn, helps achieve compliance with LEED Materials and Resource (MR) criteria. LEED's model of overall building recycled content standardization has been followed by most other green building rating systems, further increasing the general demand for and awareness of recycled content. Thus, recycled content has long been in the forefront for consumers when evaluating the "greenness" of a product.

While manufacturers have for a long time aimed to produce products with post-consumer recycled content and traditionally lesser valued pre-consumer recycled content, more consideration is being given to the true value of each of these recycled material categories. Additionally, more positive attention is being given to waste materials which are reincorporated into the same processes that created them—a type of "recycling" that has not been considered pre-consumer recycled content by ISO or US Federal Trade Commission (FTC) definitions. This type of waste reclamation is important to minimize waste and maximize resources.

Many believe that reducing waste to zero and fully utilizing all inputs is paramount to sustainability, regardless of whether responsibly used materials are considered pre-consumer, post-consumer, or non-categorized. This notion is becoming more widespread throughout the North American green building community, and the following was stated by proponents of this concept at the 2011 IGCC Public Hearing.

- “Recycled content claims should be based on materials that have been diverted from the waste stream either during manufacturing processes or after consumer use. Regardless of the type of diverted material, it will still occupy landfill space unless diverted and recycled. Therefore, the clearly stated bias against recycled manufacturing waste should be alleviated . . . Such a disruption in the marketplace could shift attention away from the need to reduce waste materials from entering landfills and cause a new influx of manufacturing waste into the landfills.” ^[11]

In fact, the IGCC will likely consider pre-consumer and post-consumer recycled content to be equal in contribution to sustainable architecture. This, along with general support garnered around the above statement at the IGCC hearing, is indicative of new views towards recycling and waste diversion, and it introduces an opportunity for the tile industry to tout its many closed loop manufacturing facilities.

4.3. Indoor Air Quality

In recent history, consumer-driven demands for products contributing to good indoor air quality have been very high, especially in North America. The global market for products which do not emit Volatile Organic Compounds (VOCs) has grown, especially with the worldwide exposure of LEED and comparable green building standards and rating systems. It has long been known throughout the tile industry that ceramic products have zero VOCs (because they are manufactured at high temperatures) and easily meet the requirements of commonly referenced emission specifications. However, it wasn't until recently that tile and other zero VOC products were exempted from VOC emissions testing in most green building standards and rating systems, including Leadership in Energy and Environmental Design (LEED).

- LEED Addendum to IEQ 4.3—“Mineral-based finished flooring products such as tile, masonry, terrazzo, and cut stone without integral organic-based coatings and sealants . . . qualify for credit without any IAQ testing requirements.” ^[12]
- LEED 2012 Draft EQ Credit, Low-emitting interiors—“Inherently non-emitting sources: Products that are inherently non-emitting sources of VOCs, specifically stone and ceramic, powder-coated, plated or anodized metals, glass without integral organic-based surface coatings, binders, or sealants, concrete without sealers or coatings, and clay brick are considered fully compliant without any VOC emissions testing.” ^[13]

- CHPS 2009 EQ2.2.3, Flooring Systems—"For the purposes of this option, it is assumed that ceramic tile, organic-free mineral-based flooring, and concrete flooring are negligible sources of VOCs and are available for credit without any testing requirements." [14]
- IGCC 804.4, Flooring VOC Requirements—"Where post manufacture coatings or surface applications have not been applied, the flooring listed in Table 806.4(1) shall be deemed to comply . . ." [15]

Today, with such exemptions, it is clear that there is an increased awareness of the VOC-free nature of the tile industry, and tile products are more widely acknowledged by the green building community as positive contributors to good indoor air quality.

4.4. Energy

As the present-day focus on building environmental footprint yields greater consideration of building lifespan characteristics, a more holistic view of the energy properties of building products is required. In the context of its LCA impacts, tile is well aligned with energy conservation objectives of green building projects. Additionally, technological improvements in manufacturing have led to even lower production energy requirements.

For example, the LEED Energy and Atmosphere (EA) Energy Performance Credit presents an opportunity for the industry to be integrally involved in "increasing levels of energy performance beyond the prerequisite standard to reduce environmental and economic impacts associated with excessive energy use." [16] Some are finding that the thermal mass properties of tiles, the use of tile in ventilated façades, and the use of photovoltaic technologies on some products can serve an integral role in satisfying LEED's requirement for design professionals to demonstrate percentage improvements to baseline building energy performance ratings. Furthermore, attention is being given to product longevity as a component of embodied energy reduction. Evidenced by "LCA into LEED" initiatives, experts believe that building energy footprint investigations are becoming more comprehensive, requiring that whole building energy models reflect a product's embodied energy each time a changeover of that product is required within the lifespan of a building. [17]

4.5. Other Commonly Promoted Green Aspects of Tile

Today, there are several other sustainability aspects of tile which are being promoted. Some of these are driven by the need for manufacturers to satisfy green building project specifications (i.e. projects designed to LEED and other green building standards and rating systems), and others are driven by the general public's perception of green products.

- **Cleanliness, Sterility, and Low Maintenance:** North American manufacturers are commonly promoting the cleaning and maintenance advantages of tile in comparison with competitive surfacing products. Additionally, building on tile's inherent inhospitality to dust mites, mold, germs and bacteria, manufacturers of tiles and installation materials are inventing new coatings which inhibit microbial growth. In fact, the Tile Council of North America (TCNA) now routinely runs tests and performs research to evaluate the antibacterial activity on such products, and is also evaluating the durability of these coatings ^[18].
- **Exterior Contribution:** Today's green building specifications, pioneered to a large extent by LEED, are more commonly requiring hardscaping materials which reduce urban heat island effect. One of the criterion in the LEED credit for Sustainable Sites (SS) Heat Island Effect-Nonroof involves the use of products with solar reflectance index (SRI) values greater than or equal to 29 ^[16]. As a result, North American manufacturers are finding more opportunities to promote the use of light-colored tiled surfaces in exterior hardscaping.

Today's booming green product marketplace has sparked environmental innovation among building material industries. Manufacturers of tile and installation materials continue to create new products that lower energy usage, reduce material consumption, improve human health, and lower other environmental burdens.

5. MODERN-DAY SUSTAINABILITY DEMANDS

In the past decade and a half, expectations and promotion around building products were influenced largely by the green building marketplace which was based predominately on building standards and rating systems such as LEED. While it is likely that building product demands will continue to be influenced by building standards and rating systems, there is growing consumer awareness and interest which is influencing the greater sustainability picture. Therefore, a broader array of issues is being considered in the overall evaluation of sustainable building products.

As defined in ASTM E2114, Terminology for Sustainability Relative to the Performance of Buildings, "sustainability" and "sustainable development" involve being able to meet the needs of the present without compromising the ability of future generations to meet their own needs ^[19]. With such a broad definition, it is clear that the North American interpretation of sustainability deals with much more than the natural environment. Today more than ever, sustainability has three primary considerations: environmental, economic and social issues.

Such views on sustainability are consistent with global perceptions. For example, the Dow Jones Indexes, one of the worldwide leaders in corporate and industrial assessment, launched the Dow Jones Sustainability Index (DJSI) in 1999 in partnership with Sustainable Assessment Management (SAM) to assess the sus-

tainability of leading companies worldwide. As evidenced by the criteria DJSI uses to evaluate corporate sustainability, today's global expectations around sustainability are extensive ^[20]:

Dimension	Criteria
Economic	Codes of Conduct / Compliance / Corruption&Bribery
	Corporate Governance
	Risk & Crisis Management
	Industry Specific Criteria
Environment	Environmental Reporting
	Industry Specific Criteria
Social	
	Corporate Citizenship/ Philanthropy
	Labor Practice Indicators
	Human Capital Development
	Social Reporting
	Talent Attraction & Retention
	Industry Specific Criteria

Figure 1: DJSI Corporate Sustainability Assessment Criteria

So, what is a sustainable building product? It is clear that today's expectations involve an aggregate of multi-attribute concepts and transparency in corporate and industrial activity. As a result, building standards and rating systems which have traditionally driven the demand for such products are already evolving.

In 2011, USGBC announced the addition of a new pilot credit for the Materials and Resources chapter of LEED. This credit requires that building projects utilize products certified to multi-attribute standards for social and environmental sustainability or products for which corporate or industrial environmental product declarations (EPDs) have been made. According to USGBC, the intent of this credit is "to increase the use of products and materials with life cycles, ingredients, and attributes understood and optimized to improve overall environmental, economic, and social performance." USGBC further states, "We want LEED buildings to have more products that we know more about, and fewer products that we don't know very much about." ^[5]

In LEED pilot credit 43, partial acknowledgement is given to products with single attribute or self-declared sustainability achievements, full acknowledgement is given to products with industry-recognized achievements (multi-attribute sustainability or industry-wide declarations), and exemplary acknowledgement is given to products which declare everything, including sustainability achievements and shortcomings (product specific reporting).

Pathway A: Products with certification(s)	
A: Single Attribute Certification	Weight = 50%
B: Type I Environmental Label (Multi-Attribute Certification)	Weight = 100%
C: Type I label based on Type III EPD	Weight = 200%

Pathway B: Products with environmental product declarations (EPDs)	
A: Self-Declared LCA	Weight = 50%
B: Third Party Certified Type III EPD: Industry-Wide	Weight = 100%
C: Third Party Certified Type III EPD: Product-Specific	Weight = 200%

Figure 2: LEED pilot credit 43 compliance pathways

LEED pilot credit 43 demonstrates that USGBC is moving away from the old system of single attribute criteria and towards two important new ways of thinking about sustainability: one which requires compliance with multi-attribute life cycle-based criteria, and another which requires EPDs or standardized sustainability reporting in general. As has historically been the case with USGBC, it is likely that such principles will permeate the greater architectural community. In fact, in the United States, some state, local, and federal mandates for the use of products meeting industry multi-attribute sustainability criteria are already in effect. As part of the Recovery Act of October 2009, United States Executive Order 13514 requires that governmental construction projects give preferential treatment to products meeting industry multi-attribute sustainability criteria. ^[21]

6. NEW ERA OF MULTI-ATTRIBUTE PRODUCT STANDARDS

Today, the architecture and design community finds itself conflicted between manufacturers' product sustainability claims in the absence of standards and green building specifications and requirements. Therefore, some North American industries have authored product sustainability standards. These standards serve as valuable tools for architects and designers in the assessment of overall product sustainability, and they also give various product industries the opportunity to define their own views on sustainability. As discussed earlier, such standards are already being referenced by LEED and other green building programs.

The North American carpet industry established the standard, NSF/ANSI 140 Sustainable Carpet Assessment Standard, which is divided into the following sections: Public Health and the Environment, Energy and Energy Efficiency, Bio-based Materials, Recycled Content or Environmentally Preferable Materials, Manufacturing, Reclamation and End of Life Management, and Innovation [22]. Similarly, the North American resilient flooring industry established the standard, NSF/ANSI 332 Sustainability Assessment of Resilient Floor Coverings, which is divided into the

following sections: Product Design, Product Manufacturing, Long-Term Value, End of Life Management, Corporate Governance, and Innovation [23]. With the establishment of these standards and the diverse sustainability criteria in which they cover, it is clear that the demands for industry defined multi-attribute sustainability criteria are in full effect. The tile industry is currently at a competitive disadvantage with U.S. government project requirements for sustainable construction and the requirements of other green building programs until an all encompassing multi-attribute sustainability standard is in place.



NSF/ANSI 140 and NSF/ANSI 332 are multi-attribute sustainability standards for carpet and resilient flooring products. A similar standard for tile, reflecting the sustainability demands of the North American marketplace, is nearing completion.

The North American ceramic tile industry drafted a multi-attribute standard, ANSI A138.1, named Green Squared. Written by the Tile Council of North America (TCNA), North American tile industry members, and members of the greater green building community, this standard is modeled after other well-respected multi-attribute standards, and it will likely be used as a tool by the North American architectural community to define and specify sustainable tiles and installation materials.

Green Squared covers porcelain, pressed floor, mosaic, quarry, and glazed wall tiles. It also covers mortar, grout, membranes, backerboards, and other installation material products. In fact, it is the first sustainable building material standard to encompass a full range of products within an industry and is intended to assist design professionals in specifying sustainable floor and wall systems.

Ceramic Tile	Porcelain, Pressed Floor, Quarry, Mosaic, Glazed Wall
Glass Tile	Cast, Fused, Low Temperature-Coated
Dry Powder Installation Goods	Cementitious Mortars and Grouts, Etc.
Liquid/Paste Installation Goods	Mastics and Reactive Resin Adhesives, Reactive Resin Grouts, Pourable or Trowelable Membranes, Latex Additives, Etc.
Rolled Sheet Installation Goods	Sheet-Applied Membranes and Underlayments, Etc.
Panel Installation Goods	Backerboards, Panel Underlayments, Etc.

Figure 3: Products covered by Green SquaredSM

Following North American green building industry practices, expectations, and leading initiatives, Green Squared sets criteria throughout a product's life-cycle, from raw material extraction through manufacturing, use, and end of life management.

Green Squared consists of the following sections: General Environmental Characteristics (product characteristics), Environmental Product Manufacturing (including raw material extraction), End of Product Life Management, Progressive Corporate Governance, and Innovation.

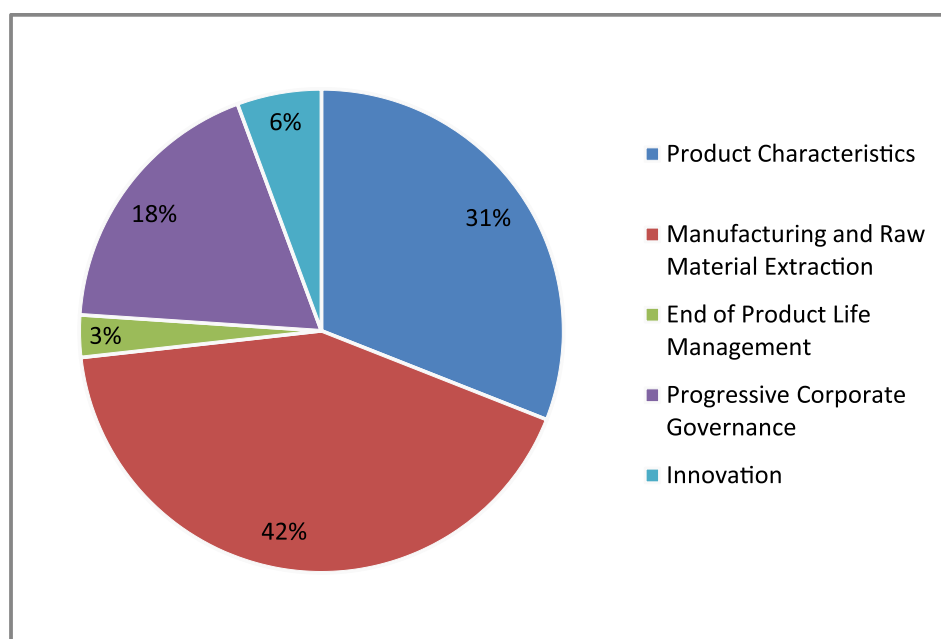


Figure 4: Green Squared areas of standardization as a percentage of total sustainability criteria

Reflecting the latest environmental thinking and to meet today's multi-attribute sustainability expectations, the first section of Green Squared, General Environmental Characteristics, includes the following environmental criteria:

- Recycled content/reclaimed content
- Indigenous raw goods
- Environmental Packaging
- Durability
- Low Emissions
- Environmental maintenance
- Solar reflectance index (SRI)
- Light reflectance value (LRV)
- Sound abatement
- 3rd Party LCA and EPD
- Participation in LCA database initiatives

The second section of Green Squared, Environmental Product Manufacturing and Raw Material Extraction, lays the foundation for environmental manufacturing. It covers these subjects:

- Particulate emissions
- Combustion and fuel usage
- Raw goods sourcing and extraction
- Outsourced packaging and manufacturing services
- Environmental management plans and systems
- Utility usage
- Renewable energy
- Manufacturer waste diversion/minimization
- Shipping material waste minimization

The third section of Green Squared, End of Product Life Management, reflects that tile products are durable, inert, and intended to last as long as the buildings in which they are installed. Tile and related installation materials are engineered to serve as permanent finishes capable of outliving several generations of building occupants. Because end of life management is most pertinent to building demolition waste and waste generated during construction, the following areas are evaluated:

- Availability of manufacturer guidelines on clean fill usage and the eligibility of their products
- Availability of end of product life collection options by manufacturers

The fourth section of Green Squared, Progressive Corporate Governance, sets corporate social responsibility criteria for the workplace and for community involvement. The following areas are covered:

- Social responsibility strategy
- Baseline labor law compliance
- Baseline environmental regulation compliance
- Baseline health and safety regulation compliance
- Participation in voluntary health and safety programs
- Baseline FTC Green Guides compliance
- Continuous community involvement
- Public disclosure
- Sustainability reports
- Certified “green” facilities

The final section of Green Squared, Innovation, gives manufacturers the opportunity to achieve product sustainability recognition through exceptional performance beyond the requirements set forth in the standard and/or for innovative performance in categories not specifically addressed. The following areas are evaluated:

- “Above and Beyond” standardized criteria (exemplary conformance)
- Innovative technologies
- Carbon footprint awareness and greenhouse gas reduction strategies

7. CONCLUSION

Green Squared, a standard for sustainable tiles and installation materials, reflects the principles and demands of today’s green building world. These principles have been largely influenced by historical events and architectural initiatives over the last half century. As product sustainability demands have evolved, the era of single attribute promotion and self-declared sustainability is ending as a new era of prescribed multi-attribute requirements begins. Going forward, Green Squared provides a means for manufacturers, specifiers, and consumers to consider tile’s role in the green building industry.

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