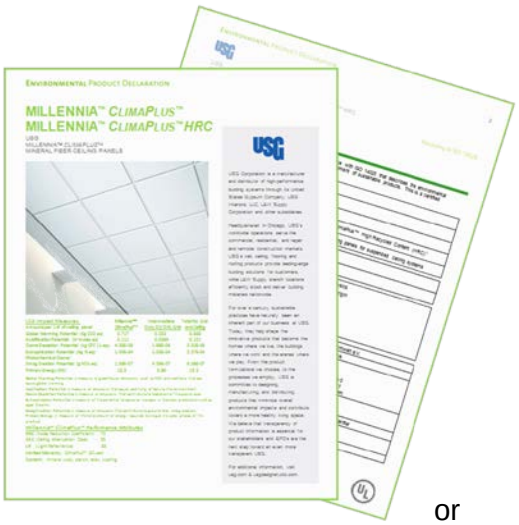
UNDERSTANDING THE ALPHABET SOUP OF SUSTAINABILITY

Environmental Product Declarations



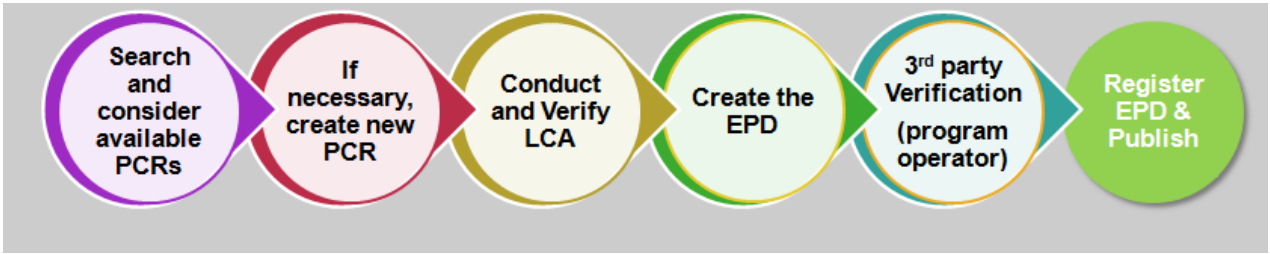
Sustainable design is becoming increasingly important. But there is no one definition of what qualifies as sustainable. Therefore guidelines are constantly being established and modified to help understand claims and performance. The Federal Trade Commission has established guidelines and rules for sustainability and environmental claims as well as standard product claims. In addition, a new standard was created to identify environmental performance of products and services (ISO 14025). ISO 14025 identifies the rules and procedures for developing environmental declarations and claims or an ISO Type III. ISO Standard 14020 establishes the ground rules for labels and declarations. ISO Standard 14021 establishes the rules for self-declared environmental claims, also known as green claims or ISO Type II labels. ISO Standard 14024 established the rules for third party verified environmental-labels or ISO Type I.

	Self-Declared	Verified
Environmental Labels	14021 (Type II)	14024 (Type I)
Environmental Claims	14021 (Type II)	
Environmental Product Declaration		14025 (Type III)

An ISO Type III Environmental Product Declaration or EPD provide a complete picture of the environmental impact of the products you use. EPDs are the executive summary of a scientific study of all environmental impacts of a product or service across its life cycle, known as a Life Cycle Assessment for that product or service. ISO 14040 defines the rules and guidelines for conducting a LCA. LCAs are the modeling of a product and service across every stage of that product's or service's life. There are assumptions made when creating these models, therefore rule on how the assumptions are chosen need to be created if the LCA is used to establish public disclosed claims or performance. These rules are called Product Category Rules (PCR) or Service Category Rules (SCR). These rules will vary from region to region as parts of the world will have different values and needs. For example, a PCR in Europe may be modified in North America with different assumptions or reporting criteria from your LCA. They should also be open to all related industry parties during their creation and modifications! If previous PCR for a product or service is available, it must be reviewed for local suitability.

ISO suggests the following impacts, shown on the left, should be reported by your LCA; but a local PCR, the list on the right is per the North American PCR for drywall, may eliminate some of these impacts, as shown.

Once the PCR is created an LCA can be conducted. If an EPD is desired to make third-party verified claims, the following steps are undertaken:



For architects and designers, EPDs help maximize the sustainability of your design and enable you to create the best possible spaces. EPDs can also help you decrease you designs carbon footprint or other environmental impacts and building a more sustainable future for all.

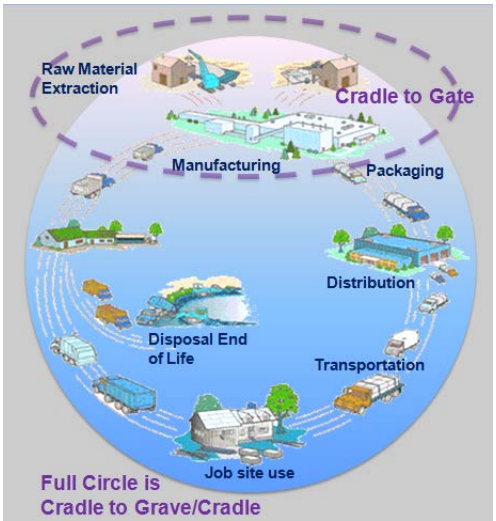
As our world evolves, it's become increasingly important to design with the future in mind. Sustainable design has become more than just a trend; it's a staple in our society. For example, 9 out of 10 architects and designers have researched, sourced, or purchased a green product in 2013. 4 out of 10 architects and

designers have indicated that 50% or more of their projects in 2013 involved specifying or purchasing green products.

So as an architect or designer we need to consider the environmental impact of the spaces we create. Do you actually know what's in the products you specify? How can you make a difference without a complete picture of each product's impacts? Well, this is where an environmental product declaration or EPD provides a detailed description of the environmental impact of selected products.

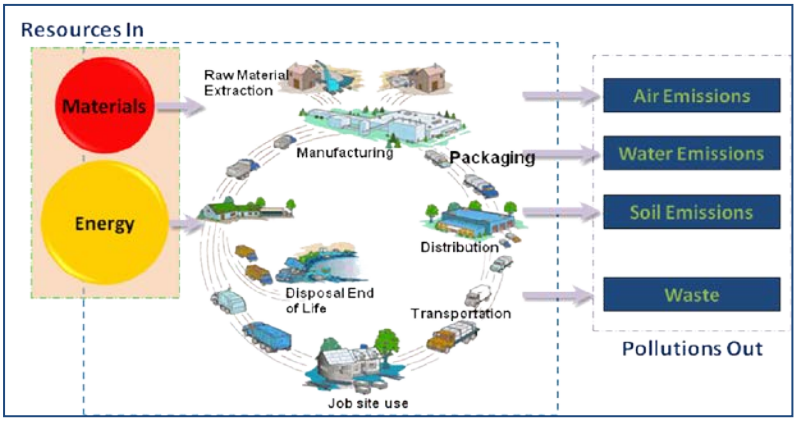
The EPD is much more comprehensive than any report we've used in the past. It covers everything from fossil fuel depletion to effects on human health (see discussion below), and there's already a growing list of industry organizations that recommend using the EPDs. So let's look behind an EPD and into the LCA.

Life Cycle Assessment (LCA)



All products have positive and negative impacts on the environment and future generations. The scientific review of these impacts is referred to as the Life Cycle Assessment (LCA) of that product. LCI (Life Cycle Inventory) is the inventory of all inputs and outputs across all stages of a product. The product can be as simple as a building product, system or whole building. This review must be analyzed throughout all stages of the product's life (shown to the right) from first creation or extraction of all raw materials, raw material transportation, manufacturing, packaging, distribution, service life and maintenance, end-of-life removal, disposal or recycling or reuse of this product.

A simpler way to say this is that LCA is the scientific method to review everything going into the production, use and disposal of a product, all its impact on the environment along the way, and what is left over and their impacts.



The impacts that are evaluated are selected from the list of LCA Impacts based on the product type and can change from one product type to another. For example with most building materials ***Primary Energy***

(Embodied Energy)***, Wastes, Global Warming*** (Carbon Footprint)***, Ground Level Ozone*** (Smog)***, Acidification*** (increased acid to air, water or soil,) ***and Eutrophication*** (increased fertilizers and detergents into our water supplies) are usually the key reviewed Impacts and are a must for all construction material, systems, service, of whole building LCA.

Other impacts may be selected based on how much effect the product will have on the value or not. For example a drywall LCA may not select Mineral Depletion since Gypsum, the main raw material used in the production of drywall, is defined as a "***Perpetual Resource***" per ASTM E2114. A ***Perpetual Resource*** is a resource that is virtually inexhaustible on a human time scale or at a minimum will last over 700 years of consumption. Examples include: solar energy, tidal energy, and wind energy. Mineral examples include: gypsum, salt, and lime.

The review of a product through the raw material and manufacturing stages is referred to as ***Cradle to Gate***, as illustrated in the Product Life Cycle above. This type of particle LCA is very useful for comparison by manufacturers to evaluate impacts or raw materials or components used within the production of and individual products or assemblies. The review across the complete (all) stages of product's life is referred to Cradle to Grave or Cradle to Cradle. This study is outlined in ISO 14040 *Life Cycle Assessment - Principles and Guidelines* and is very useful by many parties having interest in that product, from the manufacturer, end users, architects and Specifiers, occupants, installers, many others.

Scopes of LCAs

In most cases, the impacts contributed from each stage of the LCA are uneven, i.e. one or two of the stages may dominate the assessment. For example, in the manufacture of aluminum products it is acquisition of materials (mining), purification of the ore, and chemical reduction of the aluminum into metal that create environmental impacts. Subsequent usage of aluminum products by consumers contributes very few impacts, although the facilitation of recycling of aluminum is an important step in avoiding the consumption of primary materials and energy. In contrast, for internal combustion-powered automobiles, usage by consumers creates 70-80% of the life cycle impacts. Thus, it is not always necessary that the LCA include all stages of analysis; in many cases it is only a portion of the product/service chain that is of interest, and often there is not enough information to include all stages anyway. For this reason there are certain characteristic terminologies for various "scopes" of LCAs that have emerged:

Cradle-to-grave**:** includes the entire material/energy cycle of the product/material, but excludes recycling/reuse.

***Cradle-to-cradle*:** includes the entire material cycle, including recycling/reuse.

***Cradle-to-gate*:** includes material acquisition, manufacturing/refining/fabrication (factory gate), but excludes product uses and end-of-life.

***Gate-to-gate*:** a partial LCA looking at a single added process or material in the product chain.

Defining VOCs

The term volatile organic compound (VOC) is poorly defined because measuring volatility is subjective. In addition, there are numerous standardized tests designed to determine VOC content, Total VOCs (TVOC), and VOC Emissions each with an implied method to determine volatility. The parameters (time, temperature, reference material, column polarity, etc.) used in the definitions and the associated test methods were created without a significant evaluation of volatilization characteristics in real world settings. But let's review the most common types of VOC terms used in the construction industry: VOC Content, TVOC, and VOC Emissions.

VOC Content

Volatile Organic Compounds (VOC) Content is the emissions of a non-solid during manufacturing and while in that non-solid state. For example paint in the bucket can off-gas VOCs and that off-gas while it is still liquid is called Content. If the paint is applied to the wall the off-gassing is still content until it hardens then it is called Emissions as the material ages. Therefore the VOC Content is an occupational hazard for workers in the manufacturing, and installing the material. VOC Content is also classified as one of the main causes of smog, emitted from the manufacturing or burning of non-solid materials. LEED has been concerned with Content for some time and require reporting of VOC Content of non-solid materials per the following methods:

- All paints and coatings wet-applied on site must meet the applicable VOC limits of the California Air Resources Board (CARB) 2007, Suggested Control Measure (SCM) for Architectural Coatings, or the South Coast Air Quality Management District (SCAQMD) Rule 1113, effective June 3, 2011.
- All adhesives and sealants wet-applied on site must meet the applicable chemical content requirements of SCAQMD Rule 1168, July 1, 2005, Adhesive and Sealant Applications, as analyzed by the methods specified in Rule 1168. The provisions of SCAQMD Rule 1168 do not apply to adhesives and sealants subject to state or federal consumer product VOC regulations.
- For projects outside the U.S., all paints, coatings, adhesives, and sealants wet-applied on site must either meet the technical requirements of the above regulations, or comply with applicable national VOC control regulations, such as the European Decopaint Directive (2004/42/EC), the Canadian VOC Concentration Limits for Architectural Coatings, or the Hong Kong Air Pollution Control (VOC) Regulation.

- If the applicable regulation requires subtraction of exempt compounds, any content of intentionally added exempt compounds larger than 1% weight by mass (total exempt compounds) must be disclosed.
- If a product cannot reasonably be tested as specified above, testing of VOC content must comply with ASTM D2369-10; ISO 11890, part 1; ASTM D6886-03; or ISO 11890-2.
- For projects in North America, methylene chloride and perchloroethylene may not be intentionally added in paints, coatings, adhesives, or sealants.

There are several current VOC test/calculation methodologies, including: SCAQMD Method 313 (M313), ASTM Standard Test Method E 1868-10 (E1868) and U.S. EPA Reference Method 24 (M24).

Total VOC

TVOCs are Total Volatile Organic Compounds that only include carbon based chemicals with 5-carbon atoms through 17-carbon atoms (C5-C17), good and bad. This is misleading and possibly liable or harmful to the public as it doesn't include many dangerous chemical emissions such as formaldehyde and other harmful chemicals with carbon (C) atoms outside this range. The establishment of any artificial TVOC limit such as 500 or 1000ug/m3 lacks scientific merit. No human health effects have been correlated to TVOC's; rather exposure limits to individual chemical emissions have been establish through science as defined in

CA/DHS/EHLB/R-174. The TVOC sum weights all chemicals (C5-C17) with equal severity regardless of their known individual human health impact.

Per LEED Manufacturers' claims of compliance with the above requirements must also state the range of total VOCs after 14 days (336 hours), measured as specified in the CDPH Standard Method v1.1:

0.5 mg/m3 or less;
between 0.5 and 5.0 mg/m3; or
5.0 mg/m3 or more.

Projects outside the U.S. may use products tested and deemed compliant in accordance with either (1) the CDPH standard method (2010) or (2) the German AgBB Testing and Evaluation Scheme (2010). Test products either with (1) the CDPH Standard Method (2010), (2) the German AgBB Testing and Evaluation Scheme (2010), (3) ISO 16000-3: 2010, ISO 16000-6: 2011, ISO 16000-9: 2006, ISO 16000-11:2006 either in conjunction with AgBB, or with French legislation on VOC emission class labeling, or (4) the DIBt testing method (2010). If the applied testing method does not specify testing details for a product group for which the CDPH standard method does provide details, use the specifications in the CDPH standard method. U.S. projects must follow the CDPH standard method.

VOC Emissions

VOC Emissions is the off-gassing during service life time of a material and is the concern for occupant health and wellbeing. Building products VOC Emissions claims must be tested and determined compliant in accordance with California Department of Public Health (CDPH) Standard Method v1.1–2010, using the applicable exposure scenario. The default scenario is the private office scenario. The manufacturers or third-party certification must state the exposure scenario used to determine compliance. Claims of compliance for wet-applied products must state the amount applied in mass per surface area.

USG has conducted third-party volatile organic compound (VOC) emissions tests on most of our products per ASTM D5116 -Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions From Indoor Materials/Products- and the California Department of Health Section 01350 (California Department of Department of Health ***Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers*, including 2010 addendum**).

The VOC emissions test results show the VOC emissions of most of our products are well below the levels established in the following standards:

- All **LEED** rating systems
- All **GREENGUARD™** standards (Both GreenGuard Certification and GOLD)
- **Collaborative for High Performance Schools** (CHPS) Best Practice Manual, 2006,Low Emitting Materials (LEM) Table
- **South Coast Air Quality Management District** (SCAQMD) Rules for VOC Limits.
- **FEMA** Procurement Specifications –Formaldehyde and VOC Levels
- **MAS** Certified Green
- **UL** Environment
- All **Scientific Certification Systems** (SCS) programs
- **ANSI/BIFMA** M7.1-2007 and X7.1-2007
- **CARB** Formaldehyde
- Environmental Technology Verification (**ETV**) Large Chamber Test Protocol for Measuring Emissions of VOCs and Aldehydes, effective September 1999.
- **CRI** Green Label Plus
- The **Blue Angel** low-emission materials.

In fact, in acknowledgement that Sheetrock® Brand Gypsum Panels are so low in emissions it is one of the approved substrates for test emissions of other building products, as demonstrated in the except below :

STANDARD METHOD FOR THE TESTING AND EVALUATION OF VOLATILE ORGANIC CHEMICAL EMISSIONS FROM INDOOR SOURCES USING ENVIRONMENTAL CHAMBERS VERSION 1.1

*(Emission testing method for **California Specification 01350.** Supersedes the previous version of STANDARD PRACTICE FOR THE TESTING OF VOLATILE ORGANIC EMISSIONS FROM VARIOUS SOURCESUSING SMALL-SCALE ENVIRONMENTAL CHAMBERS)*

3.2 Preparation of Paint Test Specimens

3.2.1 Apply "flat" and "eggshell" wall paints to conditioned standard 5/8" thick gypsum board (e.g., USG Sheetrock brand or equivalent). The substrate size shall be appropriate to achieve the specified loading factor (Table 3.1). Just prior to painting, accurately weigh (±0.1 g) substrate, mask borders ¼" on all sides with tape (e.g., 3M Scotch-Blue™ Painter's masking tape, or equivalent) to avoid paint dripping on edges. Accurately measure (±2 mm) the dimensions of the area to be painted. Alternative approaches for protecting the edges may be acceptable and shall be reported if used.

Inherently nonemitting sources. Products that are inherently nonemitting sources of VOCs (stone, ceramic, powder-coated metals, plated or anodized metal, glass, concrete, gypsum plaster, clay brick, and unfinished or untreated solid wood flooring) are considered fully compliant without any VOC emissions testing if they do not include integral organic-based surface coatings, binders, or sealants.

Health Product Transparency

Human Health is an impact just starting to be evaluated from a scientific evaluation and will continue to evolve over the next several years. We need to not only better understand the effect of material exposure, but also understand various absorption rates per types of exposure and safe harbor limits of trace elements. Health product transparency is the reporting of building product and material content and the contents' potential impacts on human health. These documents do not replace the need or use of OSHA Safety Data Sheets (SDS) and the U.S. Consumer Product Safety Commission (CPSC) product labeling regulations. While some information may be duplicated, each includes information not covered in the other.

The USGBC's LEED v4, Living Building Challenge, Healthy Product Declaration Collaborative, and many other guidelines now call for reporting of health related ingredients in all building materials. As we spend more time indoors where we live, work, and play, we increase the duration of our exposure to many chemicals in products which make up the building's shell, interiors, and furnishings. . A LEED v4 compliant transparency document references an extensive, but finite, group of authoritative chemical hazard lists for hazards screening. Every hazard that might be identified through an exhaustive review of all available scientific literature is not necessarily disclosed. Authoritative chemical hazard lists to be referenced in scanning of product ingredients for hazards are primarily selected based upon criteria developed for the GreenScreen for Safer Chemicals and/or others.

Conclusion

Hopefully, this brief discussion gives a brief introduction and insight of the alphabet soup of sustainability claims and product performance. The bottom line is that this is still a very immature science of building product impacts on occupants and modeling all impacts and factors for these materials across their life (from extraction, manufacturing, transportation, service life, deconstruction, disposal/reuse/recycle). As the science and modeling matures, so will reporting and the understanding of what is being reported or needed.