BUILDING BETTER:

A Guide to Copper in Green and Healthy Buildings

2025

Cu
Copper Development Association Inc.

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Green and Healthy Buildings:

Copper at the Core

Since the previous publication of this guide, the green and sustainable building movement has matured and expanded and increased its alignment with environmental, social and governance (ESG) issues for its stakeholders. By some measures, buildings still comprise almost 40% of global energy-related carbon emissions (United Nations Environment Programme, 2023). Efforts to decarbonize buildings across their entire life cycle require stakeholder collaboration and coordinated action. If these levers are successfully activated, they could generate $1.8 trillion in value by 2030, resulting from rent premiums vs. "brown discounts" (when non-sustainable real estate assets experience a reduction in rental yield and asset value), new market growth, differentiated value propositions and enhanced talent attraction for building sectors (World Economic Forum & Boston Consulting Group, 2024).

At the same time, consumers are increasingly concerned with the impacts materials they procure may have on human health. In response, governments and voluntary actors are implementing requirements around the disclosure and restriction of chemicals within products. Manufacturers and building owners that do not assess their value chains for potential risks and opportunities may not be prepared for regulatory compliance or legal liability.

With new and emerging priorities constantly evolving, different frameworks to interpret and mobilize sustainable solutions have emerged to guide green building development and evolution.

To support alignment and harmonization as a means toward collective action for the buildings sector, the American Institute of Architects (AIA) issued its **AIA 2030 Commitment**. The actionable climate strategy gives architectural firms and practitioners a set of standards and goals for reaching net zero emissions in the built environment. A core component of the 2030 Commitment is the Architecture and Design Materials Pledge (**AIA Materials Pledge**).

Participating firms commit to supporting five categories of actions to deliver a healthier built environment:

- **Human Health** – prefer products that support and foster life throughout their life cycles and seek to eliminate the use of hazardous substances
- **Social Health and Equity** – prefer products from manufacturers that secure human rights in their own operations and supply chains, positively impacting their workers and the communities where they operate
- **Ecosystem Health** – prefer products that support and regenerate the natural air, water, and biological cycles of life through thoughtful supply chain management and restorative company practices
- **Climate Health** – prefer products that reduce carbon emissions and ultimately sequester more carbon than emitted
- **Circular Economy** – reuse and improve buildings and design for resiliency, adaptability, disassembly, and reuse, aspiring to a zero-waste goal for global construction activities

These firms reported inaugural metrics to the AIA Materials Pledge in 2024, at the Firm-, Project-, and Product-level scales, introducing metrics of achievement for this voluntary initiative (American Institute of Architects, 2024). Annual reporting will establish trends of sustainable specifications data and validate increased demand for sustainable and green building products.

Equally important to the aesthetics of a building are the engineering and operational systems that allow people to work, live, and enjoy it. MEP 2040 is a group of prominent global engineering firms pushing to get more data on embodied carbon from the mechanical, electrical, and plumbing areas that they focus on and specify. One of their stated goals is more environmental product declarations (EPDs) for materials, which contain product carbon footprint data, so they can start making more informed choices (United Nations Environment Programme, 2023).

In response to the articulated goals of the US architecture, engineering, construction, and owner (AECO) industry, the non-profit organization mindful MATERIALS, with the support of boards and working groups representing the breadth of the green and healthy buildings industry, created the **Common Materials Framework (CMF)** to align product manufacturers and the building products industry around the same five impact categories identified in the AIA Materials Pledge.

Within each category, the CMF identifies programs, certifications and standards that have relevance or direct contribution to the goals outlined in the AIA Materials Pledge. While not all identified programs will be relevant to the copper value chain, they form a useful reference point for understanding evolving stakeholder expectations of ESG aspects of their business.

Dairy Market Alan Karchmer / OTTO

Green and Healthy Buildings: Copper at the Core (cont.)

Impact Category (5/5 shown)	HUMAN HEALTH	CLIMATE HEALTH
Sub-Impact Category (10/18 shown)	**Substances**	**Embodied Carbon**
Is the ecolabel/standard providing Transparency, Assessment, Commitment and /or Optimization?	**Transparency**	**Transparency**
	Reporting Threshold Level	LCA/EPD Type
	Third-Party Verified	Uncertainty Variables
	Public Disclosed Inventory	Third-Party Verified
	Optimization	Declared Unit
Factor = The 'question' to drive the Metric (51/~650 shown)	Class-Based Substance Avoidance	Mass per Unit
	Assessment-Based Optimization	Reported GWP (A1-A3) per Unit (kgCO2e)
	Restricted Substance List (RSL) Compliance	**Assessment**
	Certifications for Material Health Optimization	Uncertainty Factor
	VOCs	Uncertainty Assessment Methodology
	Transparency	Uncertainty Adjusted GWP (A1-A3) per Unit (kgCO2e)
	VOC Content (Regulatory)	**Optimization**
	Optimization	CLF Baseline Designation
	VOC Content Compliance	Certification(s) for Reduced Carbon
	VOC Content Standard	
Metric* = the data point(s), how to answer the Factor "question" (*Metrics not shown ~ 1000 total)	VOC Emissions Compliance	
	TVOC Range	
	Furniture – ANSI/BIFMA M7_1-2011 Compliance	
	Composite Wood – Formaldehyde Emissions Compliance (CARB & TSCA Title VI)	

Copper applications and solutions remain critical to building design and operations that reduce environmental impact and promote occupant health and wellbeing. This guide reviews the most recent green building credits, features, requirements and certifications, as they relate to the CMF categories, that can leverage copper products to bridge the connection between owners, tenants, and occupants, and between the AECO sector and product manufacturers. It identifies prerequisites and optional credits within green and healthy building standards that align with the CMF in the Leadership in Energy and Environmental Design (LEED), Living Building Challenge (LBC), or WELL Building Standard™ (WELL) certification, or follow the ASHRAE (formally known as American Society of Heating, Refrigerating and Air-Conditioning Engineers) 189.1 standard. Each program has minimum requirements that are called prerequisites, preconditions, or core requirements; and optional achievements, which are called credits, optimizations, or imperatives

CIRCULAR ECONOMY
Sourcing
Transparency
Final Manufacturing Location
Regenerative & Renewable Content Percentages (%)
Regenerative & Renewable Content Total (%)
Optimization
Certifications for Regenerative & Renewable Content
Certifications for Benchmarks of Regenerative & Renewable Inputs
Certified Wood
End-of-Life
Transparency
Potential Cyclable Content Percentages (%)
Potential Cyclable Content Total (%)
Optimization
Certifications for Optimized End-of-Life
Extended Producer Responsibility (Take Back) Programs
Reintegrated Content (%)

SOCIAL HEALTH + EQUITY
Company Workplace
Transparency
Corporate Social Responsibility (CSR) Reporting
Assessment
Workplace Factors Assessed
Optimization
3rd Party Standards for Company Workplace Optimization
Diverse Business Enterprise
Supply Chain
Transparency
Supplier Human Rights Policy
Assessment
Assessment & Identification of Human Rights Risks
Commitments
Monitoring & Auditing of Supply Chain
Optimization
Verification of Supply Chain Labor Practices

ECOSYSTEM HEALTH
Pollution
Optimization
3rd Party Standards for Environmental Management & Protection
Water Footprint – Product
Transparency
Water Inventory (Footprint)
Water Use Efficiency (Flow Rate)
Optimization
Certifications for Reduced Water Footprint
Biodiversity + Conservation
Transparency
Compliance with Land Use, Habitat, Species Protection Policies
Assessment
Ecosystem Conservation Assessment
Optimization
Certifications for Ecosystem Restoration & Conservation

Voluntary green building programs such as LEED, LBC and WELL continue to provide a blueprint for sustainable design. At Greenbuild 2024, the leading green building standards and their organizations voiced their support and alignment around the CMF (International Living Future Institute, 2023).

Regulatory bodies in the United States are also adopting voluntary green building programs as benchmarks or minimum requirements for building or zoning permits, or to receive government funding for construction projects. State and federal agencies have also developed procurement guidelines that prefer sustainable and non-toxic building products. This guide tracks regulatory trends that characterize the current regulatory landscape and identifies future developments in construction and procurement policies.

Note: This guide references LEED version 4.1 for Building Design and Construction, WELL version 2 (Q3-Q4 2024), Living Building Challenge 4.1, and ASHRAE 189.1-2023.

Copper in

Green Building Standards

Starting in the 1970s, green building was primarily focused on reducing operational energy and resource consumption. Early adopters encouraged improvements in building operations, energy efficient lighting and heating, ventilation, and air conditioning (HVAC) systems, and high-performance building envelopes to improve occupant comfort and reduce heat transfer between the building interior and exterior. Due to the rising adoption of green building principles, sustainability requirements soon entered international building codes and state and federal programs in the United States. Examples include the International Code Council's (ICC) International Green Construction Code (IgCC) and ANSI/ASHRAE/USGBC/IES Standard 189.1 (ASHRAE 189.1) for the Design of High-Performance Green Buildings.

In the late 1990s, the emergence of voluntary green building codes, standards, and rating systems built upon foundational codes and requirements and encouraged designers to swiftly address impacts of the built environment. These model codes and rating systems influenced local and regional governments to revise building ordinances and update procurement guidelines, further expanding sustainability in the built environment.

Green building design principles evolved to bring focus to material health of installed materials and look beyond operational energy and carbon emissions, to the embodied carbon of the building and its materials. The total activity over the useful building lifetime has significantly larger GHG emissions than the year-on-year emissions from building operations. These developments have raised the bar for sustainable design practices, as evidenced by the latest revisions to green building rating systems.

With the alignment of the Common Materials Framework and the AIA Materials Pledge, green building credits potentially supported by copper are presented within each initiative. Credits and features are generally identified for new and existing commercial and institutional buildings.

New England Biolabs Garden Site Facility Expansion
Photo Credit: Robert Benson

Common Materials Framework Category:

Human Health

Human Health | Climate Health | Circular Economy | Social Health and Equity | Ecosystem Health

Substances
Volatile organic compounds (VOCs)
Company human health impacts
Lighting and Shading Controls
Active Transportation

The Human Health category encourages designers to prefer "products that support and foster life throughout their life cycles and seek to eliminate the use of hazardous substances." Product manufacturers must consider the materials and substances in their products, as they may present human health hazards and risk of exposure throughout the product lifetime. This often considers the entire life cycle of a product; from the point of raw material extraction, through refining and manufacturing phases, product installation, as well as considerations of a product's useful lifetime through end-of-life recycling and/or disposal (i.e., full circularity). The CMF identifies three sub-buckets in this category: Substances (generally, chemical substances); volatile organic compounds (VOCs) and company human health impacts. Additional copper-related contributions to the improvement of human and occupant health include lighting and shading controls and active transportation.

Sub-Bucket	Definition	Similar/related terms	Applicable standards
Substances	Substances are defined by the EPA as any organic or inorganic substance of a particular molecular identity, including any combination of such substances occurring in whole or in part as a result of a chemical reaction or occurring in nature. The CMF includes factors in this section such as: the percentage of disclosure, the granularity of disclosure (typically in parts per million or ppm), as well as by whether a product contains substances or chemicals of concern (as identified by commonly referenced restricted substance lists), or if the product has avoided use of specific class-based chemicals.	Similar: chemical transparency, full material disclosure Related: content inventory, Health Product Declaration (HPD), Declare label	LEED v4.1 WELL v2 LBC 4.1 ASHRAE 189.1
Volatile Organic Compounds (VOCs)	Volatile organic compounds (VOCs) refers to chemicals frequently used in interior products and finishes (particularly wet-applied products like paint and sealants), which off gas at room temperature, thus making them more likely to become airborne and enter into the lungs of occupants (or installers) through respiration. The health effects of VOCs vary widely, from respiratory irritants to human carcinogens (such as formaldehyde), which is a concern since they are ingredients in many products in the built environment. The CMF includes factors in this section such as VOC content and emissions testing and optimization.	Similar: volatiles, off-gassing Related: reactive gases, air pollutants	LEED v4.1 WELL v2 LBC 4.1 ASHRAE 189.1
Company human health impacts	Company Human Health impacts consider a company's overall chemical footprint across all their product lines, not just the specific product being evaluated. The CMF includes factors in this section such as: chemical policies and footprints, supply chain disclosures and footprints, chemical impact reduction plans and policies.		LEED v4.1 WELL v2 LBC 4.1 ASHRAE 189.1

Common Materials Framework Category: Human Health (cont.)

Material and chemical transparency, or the voluntary disclosure of product composition by Chemical Abstracts Service Registry Number (CASRN) and associated chemical hazards, allows designers to make specification decisions based on human health impacts. Two popular programs for chemical transparency include the Declare Label from the International Living Future Institute (ILFI) and the Health Product Declaration (HPD). Both programs require disclosure of intentionally added chemicals with registered CASRNs in the final product but have a few notable differences.

	HPD	Declare
Scoring	None -GS scores in the section 2 chemical inventory only	Final score -Red List Free, Red List Approved, Declared
Client Accounts	HPD Builder	3E Exchange (Formerly Toxnot) ILFI
Green Building Certs	https://www.hpd-collaborative.org/manufacturer-guide/ LEED LBC WELL Building Standard	https://www.manula.com/manuals/living-future/declare-manufacturers-guide/1/en/topic/declare-manufacturers-guide LEED LBC WELL Building Standard
Reporting Threshold	1000ppm or 100ppm, at product or material level	100ppm at product level
Maintenance	Every 3 years	Annually

Chemical hazard is typically determined by a specific molecular structure and physical form of the chemical associated with the unique CASRN. However, there are practical limitations to this voluntary disclosure because not all hazards can be assessed and reported through this standard framework. These special cases are discussed separately as emerging best practices and designed to evolve at the pace of industry through HPDC's Special Conditions and Declare's Special CASRN Reporting Requirements (HPD Collaborative, n.d.; (International Living Future Institute, 2024)).

One Special Condition in the HPD program is for Metal Alloys. The reason for this Special Condition is that metal alloys have different intrinsic characteristics than their alloying elements. This is due in part to "the impact of the alloying process on microstructural features including grain size, inclusions, impurities, second phases, porosity, and segregation, which in turn influences physical properties and surface phenomena" (HPD Collaborative, 2023). Similarly, alloys are generally expected to have different hazards than their alloying elements. These differences are driven by the following factors: the elemental composition of the alloy as a metal mixture; the speciation of metals contained within the alloy; and the solubility of, or release of metal ions form, the surface of the alloy. This background supports the use of alternative hazard screening and assessment methods for metal alloys, and the reporting of alloys by the Unified Numbering System (UNS) and similar alloy numbering systems that specify alloy elemental composition.

Human Health in Green Building Codes and Standards

Human Health in Substances

Two primary ideas that have emerged from evaluating chemical substances for their hazards and are broadly recognized by the built environment community are materials transparency and materials optimization. Materials transparency requires product manufacturers to identify and report the chemical and material contents of a final product. Manufacturers need supplier data such as Safety Data Sheets (SDS) and other disclosure of chemicals and hazards, and may need suppliers to provide them data beyond what is publicly available. After the manufacturer accounts for everything in their products, they can target the materials that affect human health for substitutions and safer alternatives, which is the materials optimization strategy.

Human Health in Materials Transparency

Awards points for specifying and installing products that have disclosed chemical content or declared absence of hazardous chemicals through an approved program or certification.

LEED v4.1 BD+C Materials and Resources: Material Ingredients, Option 1

LEED Credit

At least 20 different permanently installed products from at least five different manufacturers that use an approved program to demonstrate the chemical inventory of the product to at least 0.1% (1000 ppm) are used. Relevant programs for copper products include:

- Cradle to Cradle – Material Health Certificate or Cradle to Cradle Certified™
- Declare Label with the following Declaration Status:
  - LBC Red List Free
  - LBC Red List Approved
- Global Green TAG – Product Health Declaration (PHD)
- Health Product Declaration (HPD)
- Living Product Challenge
- Product Lens Certification
- Manufacturer Inventory – The manufacturer has published a complete content inventory for the product following these guidelines:
  - A publicly available inventory of all ingredients identified by name and Chemical Abstract Service Registration Number (CASRN) and/or European Community Number (EC Number).
  - Materials with trade secret or intellectual property must disclose ingredient/chemical role, amount and hazard score/class using either:
    > Greenscreen List Translator (LT) score and/or Full GreenScreen Benchmark (BM)
    > The Globally Harmonized System of Classification and Labeling of Chemicals rev.6 (2015) (GHS)

Additional points are awarded if the report is third-party verified.

Common Materials Framework Category: Human Health (cont.)

LEED v4.1 BD+C Healthcare: Materials and Resources: PBT Source Reduction – Lead, Cadmium, and Copper

LEED Credit

Awards up to two points for healthcare facilities that reduce the release of persistent, bioaccumulative, and toxic (PBT) chemicals associated with the life cycle of building materials. Specify for materials manufactured with copper, as follows.

Copper

- For copper pipe applications, reduce or eliminate joint-related sources of copper corrosion:
  - Use mechanically crimped copper joint systems; or
  - Specify that all solder joints comply with ASTM B828 2002, and specify and use ASTM B813 2010 for flux. *Note: Each of these ASTM standards has a more recent version that should be followed: ASTM B828-23 and ASTM B813-24 for water soluble flux.*

WELL v2: X07: Materials Transparency

WELL Feature

Part 1:

At least 25 different permanently installed products have ingredients disclosed by the manufacturer, a disclosure organization, or a third party are provided. Relevant programs for copper products include:

- Declare Label
- Health Product Declaration (HPD)
- Cradle to Cradle Certified™ product, or a product with a Cradle to Cradle Material Health Certificate
- UL Product Lens Certification™
- Global Green TAG – Product Health Declaration (PHD)
- Manufacturer's Inventory containing CAS numbers of all individual compounds down to 1,000 ppm (0.1%)

Part 2:

At least 15 distinct permanently installed products meet the following requirements:

- All ingredients are disclosed down to 100 ppm.
- All ingredients are publicly disclosed by the manufacturer, a disclosure organization or a third party through one of the following:
  - Declare Label
  - Health Product Declaration (HPD)
  - Manufacturer's disclosure and/or through a third-party materials database platform

WELL v2 X11 – Cleaning Products and Protocols

WELL Feature

Recognizes new and existing commercial and institutional buildings that implement a cleaning plan that identifies surfaces that require disinfection (e.g., high-touch surfaces), applicable governmental regulations and directions of use, and other non-chemical tools used for disinfection.

LBC 4.1: I12 Responsible Materials

Core Imperative

All projects must contain one Declare label product per 200 square meters of Project Floor Area.

LBC 4.1: I13 Red List

LBC Imperative

All projects must avoid chemicals on the LBC Red List, or fulfill the requirements of a published Exception, for 90% of the project's new materials by cost. Accepted product documentation includes Living Product Challenge (LPC) certification, Declare label, Health Product Declaration (HPD), or Manufacturer's Ingredients List (Product Content Inventory); the chemical content above 100 parts per million (ppm) of the final product must be disclosed.

LBC 4.1: I14 Responsible Sourcing

LBC Imperative

All projects must contain one Declare label product per 100 square meters of Project Floor Area, up to twenty distinct products from five manufacturers.

Human Health in Materials Optimization

Awards points for specifying and installing products that have disclosed chemical content through an approved transparency program with the disclosure verified by an approved third party. These products also eliminate the most harmful substances, like chemicals on a regulatory or voluntary restricted substance list, and carcinogenic, mutagenic and reprotoxic chemicals (CMRs) and persistent, bioaccumulative and toxic chemicals (PBTs).

LEED v4.1 Materials and Resources: Material Ingredients, Option 2

LEED Credit

Provides a point when five products from at least three different manufacturers provide a compliant material ingredient report or action plan. Generally, all reports need to be third-party verified. Reports and criteria may include:

- Material ingredient screening and optimization action plan
- Chemical inventory must be reported to 0.01% (100ppm) and with either no GreenScreen LT-1 hazards or GHS Category hazards present, or >75% of the product by weight has a GreenScreen Assessment and associated score.

Common Materials Framework Category: Human Health (cont.)

WELL v2 X08 – Materials Optimization

WELL Feature

Recognizes projects with at least 50% (as measured by cost) of interior finishes and finish materials, furnishings (including workstations) and built-in furniture have some combination of the following material descriptions:

- Declare Label;
- Health Product Declaration (HPD);
- Any method accepted in LEED version 4 "Material Ingredients, Option 1: Material Ingredient Reporting"

LBC 4.1: I13 Red List

LBC Imperative

All projects must avoid chemicals on the LBC Red List, or fulfill the requirements of a published Exception, for 90% of the project's new materials by cost. Accepted product documentation includes Living Product Challenge (LPC) certification, Declare label, Health Product Declaration (HPD), or Manufacturer's Ingredients List (Product Content Inventory); the chemical content above 100 parts per million (ppm) of the final product must be disclosed.

LBC 4.1: I14 Responsible Sourcing

LBC Imperative

All projects must contain one Declare label product per 100 square meters of Project Floor Area. Third Party Verified Declare labels count as 1.5 products. All projects (with exceptions for specific building typologies, see LBC for details) must incorporate one Living Product Challenge certified product per 1,000 square meters of Project Floor Area, up to three products.

Human Health in Volatile Organic Compounds (VOCs) and Indoor Air Quality

The quality of indoor air is critical to maintaining occupant wellbeing and, as such, presents an opportunity to provide owners and occupants with both productivity and health benefits. The 9 Foundations of A Healthy Building study by the Healthy Buildings Program at the Harvard Center for Health and the Global Environment linked improved indoor air quality in office environments with increased cognitive function across nine cognitive domains, including strategy and information usage (Cedeño Laurent et al., 2021). It concluded, "even modest improvements to indoor environmental quality may have a profound impact on the decision-making performance of workers."

Products and materials used in buildings can emit a range of indoor air pollutants, including volatile organic compounds (VOCs), formaldehyde. and other potentially harmful substances. Further, the methods used to clean the building impact indoor air quality. Knowing how building products and materials will need to be cleaned, and whether there are low- or non-emitting options available, should inform decisions made during the building project.

The copper industry shares information about the role copper plays in a healthy indoor environment. Health Product Declarations (HPDs) are available for a variety of copper applications used both behind the wall and for interior applications. For high-touch surfaces inside the building, the broad-spectrum antimicrobial properties of copper alloys – backed by a public health registration with the U.S. EPA – provide uninterrupted defense against infection-causing bacteria including the antibiotic-resistant superbug MRSA. Ventilation also has a major influence on the quality of air inside a building. Due to copper's superior electrical and thermal conductivity, it is a central component of efficient ventilation equipment and the automation, sensors and controls that keep this equipment running optimally and maximize occupant comfort. Finally, because copper is an inherently low-emitting material, it is safe for use in a variety of decorative and interior applications.

The sustainable building community can specify ventilation designs and technologies, as well as building materials, products and interiors contributing to cleaner indoor air and improved comfort for occupants. LEED, WELL and ASHRAE all recognize improved air quality, and serve as benchmarks for any building project team.

LEED v4.1 Indoor Environmental Quality: Minimum Indoor Air Quality Performance

LEED Prerequisite

Requires new or renovated commercial and institutional buildings to meet the requirements of ASHRAE 62.1-2016 (or more recent version) and install air quality (carbon monoxide) monitoring devices for either mechanically or naturally ventilated spaces.

LEED v4.1 Indoor Environmental Quality: Low Emitting Materials

LEED Credit

Awards up to three points for new or renovated commercial and institutional buildings meeting thresholds for 75% of the low-emitting exterior (healthcare and schools building projects only) and interior product categories (see LEED version 4.1 for details). Categories include:

- Paints and coating
- Adhesives and Sealants
- Flooring
- Wall panels
- Ceiling
- Insulation
- Furniture
- Composite Wood

Common Materials Framework Category: Human Health (cont.)

WELL v2: A03 – Ventilation Design

WELL Prerequisite

Part 1: Ensure Adequate Ventilation

Both newly installed and existing ventilation systems meet the supply and exhaust rates set in one or more approved ventilation guidelines for >90% of the project area:

- ASHRAE 62.1-2010 or more recent version
- ASHRAE 62.2-2016 or more recent version
- EN 16798-1
- AS 1668.2-2012 or more recent version
- CIBSE Guide A: Environmental Design, version 2007 or more recent version

WELL v2: A06 – Enhanced Ventilation Design

WELL Feature

Part 1: Increase Outdoor Air Supply

For all occupiable spaces in mechanically ventilated buildings, exceed ASHRAE outdoor air supply rates by 30 percent (1 point) or 60 percent (2 points), or for 90+% of regularly occupied spaces, install a demand-controlled ventilation (DCV) system that regulates the outdoor air ventilation rate to keep CO2 levels less than specified thresholds at the maximum intended occupancy.

Part 2: Improve Ventilation Effectiveness

Projects can receive 1 point by using a displacement ventilation system in 90+% of regularly occupied spaces, with one of the following as a basis for design:

- ASHRAE Guidelines RP-949
- ASHRAE 62.1-2019, "Stratified Air Distribution Systems (Section 6.2.1.2.1)
- REHVA Guidebook No. 01 (Displacement Ventilation in non-industrial premises)

WELL v2: A11 Source Separation

WELL Feature

Recognizes new and existing commercial and institutional buildings with all cleaning and chemical storage units, bathrooms, kitchens, and rooms containing printers and copiers in rooms that are separated from adjacent regularly occupied spaces with self-closing doors and/or vestibules, and utilize exhaust fans that vent to the outdoors rather than recirculate air.

WELL v2: X11 Cleaning Products and Protocols

WELL Feature

Recognizes new and existing commercial and institutional buildings that implement a cleaning plan that identifies surfaces that require disinfection (e.g., high-touch surfaces), applicable governmental regulations and directions of use, and other non-chemical tools used for disinfection.

LBC 4.1: I09 Healthy Interior Environment

Core Imperative

All projects must:

- Comply with the current version of ASHRAE 62.1 or ASHRAE 62.2.
- Prohibit smoking within any buildings or enclosed spaces, and within 25' of any building opening, including air supply vents.
- Develop a Healthy Indoor Environment Plan that addresses cleaning protocols, the prevention of particulates and toxins through an entry approach, and implement at least one strategy to improve air quality.
- Provide direct exhaust for kitchens, bathrooms, and janitorial areas.

LBC 4.1: I10 Healthy Interior Performance

LBC Imperative

All projects must:

- Conduct an Indoor Air Quality test one to six months after occupancy, or provide readings from a continuously monitored indoor air quality system showing compliance with identified thresholds,
- Install products that comply with emissions limits of the CDPH Standard Method v1.2-2017 (or international equivalent) for 90% of interior building products that have the potential to emit VOCs, and
- Use cleaning products that comply with the EPA Safer Choice label or international equivalent.

ASHRAE 189.1-2023: 8.3 - Indoor Air Quality

ASHRAE Provision 8.3

Design the building to comply with ASHRAE 62.1, or 62.2 for residential construction. Provide MERV 8 level air infiltration and monitor the mechanical ventilation system at the outdoor air intake for use in testing and balancing, recommissioning, and outdoor air monitoring.

ASHRAE 189.1-2023: Ventilation Controls for Densely Occupied Spaces

ASHRAE Provision 7.4.3

Promotes codes for new or renovated buildings and new systems and equipment in existing buildings, mandating demand control ventilation (DCV) for densely occupied spaces served by systems with one or more of the following:

- An air-side economizer;
- Automatic modulating control of the outdoor air dampers;
- Design outdoor air flow greater than 1000 cfm (500 L/s).

Common Materials Framework Category: Human Health (cont.)

Human Health in Lighting and Shading Controls

Including natural lighting in buildings helps regulate human circadian rhythms. Natural lighting is known to boost both comfort and productivity, while using less electricity than that required for a conventionally lit building. With the extended periods of time that humans spend indoors, exposure to adequate levels of natural light is increasingly important for promoting human health. External shading systems and automated shading control systems play an important role in guaranteeing light is not too bright, avoiding glare and preventing thermal gains from overloading HVAC systems.

Copper is key to the automation and controls allowing occupants to adjust their space to reliably receive adequate natural light without being uncomfortable in direct sun or distracted by glare. It is also used in architectural design features doubling as exterior shading systems.

The sustainable building community can provide natural light for wellness and productivity, as well as shading for comfort. ASHRAE promotes office space shading and WELL directly recognizes both solar glare and electric light glare control technologies and automated shading controls. In addition, both WELL and LEED support occupant lighting and glare controls to adjust conditions according to tasks and preferences.

LEED v4.1 Indoor Environmental Quality: Daylight

LEED Credit

Awards up to three points for new or renovated commercial and institutional buildings providing manual or automatic (with manual override) glare-control devices for all regularly occupied spaces using one of three options (see LEED version 4.1 for details).

LEED v4.1 Indoor Environmental Quality: Interior Lighting

LEED Credit

For new or renovated commercial and institutional buildings, meet 1 strategy for 1 point; meet 3 strategies total for 2 points:

- Glare Control – Use light fixtures with a luminance of less than 7,000 candela per square meter, or achieve a Unified Glare Rating of less than 19.
- Color Rendering – Use light sources that have a Color Rendering Index of at least 90, or have a Color Fidelity Index greater than or equal to 78 and a gamut index between 97-110.
- Lighting Control – Provide dimmable or multilevel lighting for 90% of regularly occupied spaces.
- Surface Reflectivity - For at least 90% regularly occupied spaces, use interior finishes with a surface reflectance greater or equal to 80% for ceilings and 55% for walls.

WELL v2: L04 Electric Light Glare Control

WELL Feature

Recognizes new and existing commercial and institutional buildings with one of three light output measures, including:

- 100% of light is emitted above the horizontal plane.
- Classified with Unified Glare Rating (UGR) of 16 or lower.
- Luminance that does not exceed 6000 candela per square meter.

WELL v2: L06 Daylight Design Strategies

Part 2

Awards up to two points for new and existing commercial and institutional buildings with controllable manual shading, and automated shading that prevents solar glare.

WELL v2: L08 Electric Light Quality

Awards up to three points for new and existing commercial and institutional buildings with luminaires that meet color rendering requirements and have controls that meet specific flicker requirements (see WELL v2 for details).

WELL v2: L09 Occupant Lighting Control

WELL Feature

Awards up to three points for new and existing commercial and institutional buildings with luminaries that meet ambient lighting requirements and allow occupants to control supplemental light levels (see WELL v2 for details).

LBC 4.1: I09 Healthy Interior Environment

Core Imperative

All projects must provide views outside and daylight for 75% of regularly occupied spaces.

LBC 4.1: I10 Healthy Interior Performance

LBC Imperative

All projects must provide views outside and daylight for 95% of regularly occupied spaces. In addition, all projects must provide two of the following for occupant control:

- Sufficient operable windows to provide natural ventilation for at least six months of the year.
- Ability for the occupants to influence their local airflow and temperature through direct input or controls.
- Flexible options for working and learning such as sit/stand options and/or varied sensory experiences for living, working or learning.

Common Materials Framework Category: Human Health (cont.)

ASHRAE 189.1-2023: 8.10.3 Shading for Offices

ASHRAE Provision

Promotes codes for new or renovated buildings and new systems and equipment in existing buildings, mandating each west-, south- and east-facing façade to be designed with a shading projection factor not less than 0.5 (shading can be external or internal using the interior projection factor). Shading devices can include louvers, sun shades, light shelves and any other permanent device, as well as building self-shading through roof overhangs or recessed windows.

Human Health in Active Transportation

The sustainable building community can promote occupant wellness by tangibly encouraging alternative commuting methods. Green building codes and standards promote infrastructure that encourages occupants to travel to and from the building without the use of a personal vehicle. Two examples of these resources include showers and changing facilities readily available to occupants, which can be enhanced by features that use copper.

Copper is the material of choice in plumbing systems for both showers and sinks in hospitals, schools, retail, and other commercial buildings because it is durable, strong, corrosion resistant and naturally antimicrobial. The high electrical conductivity of copper means it plays an essential role in automated, water-saving controls for showers and sinks. Copper is also fundamental to the electrical systems powering ventilation fans, providing well-lit shower and changing spaces and enabling efficient time and motion sensors for water use and lighting. In a more visible role, copper is a component of brass faucets, shower heads, drains, assistance railings and other restroom fixtures and fittings.

LEED v4.1 Location and Transportation: Bicycle Facilities

LEED Credit

Awards one point for new or renovated commercial and institutional buildings that strategically locate bike entries and storage spaces; install short term bike parking for 2.5% of all peak visitors and long-term biking for at least 5% of all regular building occupants; And, install at least one on-site shower with a changing facility for the first 100 regular building occupants, plus one additional shower for every 150 regular building occupants thereafter. This includes data centers, warehouses and distribution centers, hospitality buildings, schools, retail and healthcare facilities. The requirements are different for residential and missed use projects.

Lubber Run Community Center
Photo Credit: Tom Holdsworth

WELL v2: V04 Facilities for Active Occupants

WELL Optimization

Recognizes new and existing commercial and institutional buildings which, among other requirements, provide minimum bike parking and install one shower with a changing facility for the first 100 regular building occupants, plus one additional shower for every 150 regular building occupants thereafter, onsite or within 200 meters (650 feet) of the building's main entrance.

LBC 4.1: I04 Human-Scaled Living

Core Imperative

Recognizes new and existing commercial and institutional buildings which, among other requirements, provide sufficient storage for human-powered vehicles and facilities to encourage human-powered transport, limit parking to percentage maximums of the project site surface area, and reduce trips made by single-occupancy and/or fossil-fuel based vehicles.

Common Materials Framework Category:

Climate Health

Human Health | **Climate Health** | Circular Economy | Social Health and Equity | Ecosystem Health

- Embodied Carbon
- Reduced Water Use
- Active Transportation
- Electric Vehicles

The Climate Health category of the Common Materials Framework encourages preferring "products that reduce carbon emissions and sequester more carbon than emitted." Beyond product- or material-related emissions, the category recognizes company-level carbon initiatives and reductions, through voluntary reporting programs like the Science Based Targets initiative (SBTi), Carbon Disclosure Project (CDP), and the Global Reporting Initiative (GRI).

Energy efficiency and operational carbon emissions reductions have been the built environment's prevailing sustainability initiatives; however, new and emerging climate health programs encourage companies to assess and reduce emissions from their product supply chains, as well as throughout the company's productive activities and assets. The CMF identifies two sub-impact categories in this category: Embodied Carbon and Company Carbon. No green building programs explicitly require company certifications, but other certifications and regulations are increasingly requiring them. Several other copper-related contributions to the improvement of climate health include: Reduced Water Use; Active Transportation; and Electric Vehicles.

Sub-Bucket	Definition	Similar/related terms	Applicable standards
Embodied Carbon	Embodied carbon refers to the greenhouse gas emissions arising from the manufacturing, transportation, installation, maintenance, and disposal of building materials. Embodied carbon is a significant percentage of global emissions and requires urgent action to address it. The CMF includes factors in this section such as: LCA and/or EPD types, the functional unit based on the product PCR, system boundaries, third party verification, whether a product demonstrates a reduction from the CLF baseline, and whether data is digitally available.	Similar: CO2, CO2e, global warming impact, global warming potential (GWP), greenhouse gases (GHGs), emissions, circularity Related: life cycle assessment (LCA), embodied carbon, operational carbon, environmental product declaration (EPD), product carbon footprint	LEED v4.1 LBC 4.1 ASHRAE 189.1

As with any materials sector, there are carbon reduction opportunities to be realized from the extraction phase of a material to final production and fabrication. Manufacturers and fabricators that engage directly with architects, designers, and contractors have been asked to determine their products' embodied carbon, which represents the emissions equivalents associated with all processes required to extract, refine, process, shape, cast, and finalize materials, among others. The total of these emissions is calculated using life cycle assessment (LCA) and associated international standards that prescribe best practices and reasonable assumptions, to promote a level playing field. They are then often reported through environmental product declarations (EPDs) that provide a communication of the technical LCA data to a wider audience.

Common Materials Framework Category: Climate Health (cont.)

In the context of a building, the term "embodied carbon" refers to emissions associated with the sourcing, construction, and transportation of the building materials.

Building materials are specified for building projects based on comparing the embodied carbon results from EPDs and choosing a best product based on the lowest estimated global warming potential (GWP) expressed as carbon dioxide emissions equivalents (CO2-eq) and other limiting project-specific factors. This selection process incentivized leaders to pursue LCAs and publish EPDs, and many have seen a sufficient return on investment (ROI) to integrate LCA and carbon reductions across product portfolios and more broadly at the corporate level. Materials such as steel, concrete, and glass, represent significant contributors, as much as 85%, to the total embodied carbon associated with a building (Rocky Mountain Institute, 2023). By establishing broad limits for these building product categories, the goal is to encourage carbon-intensive sectors to collectively reduce their embodied carbon and move toward decarbonization.

Climate Health in Life Cycle Assessment and Product Carbon Footprint

LEED v4.1 Materials and Resources: Environmental Product Declarations, Option 1

LEED Credit

Awards one point when providing EPDs for 20 different products sourced from at least five manufacturers that meet one of the disclosure methods below. Product-specific Type III EPDs are valued higher than other disclosure methods.

- LCA and EPDs are valued as one whole product if they are either:
  - Public, critically reviewed LCA confirming to ISO 14044 and have at least a cradle to gate scope;
  - Product-specific Type III EPD that has been internally reviewed and conform to ISO 14071 and has at least a cradle to gate scope; or,
  - Industry-wide Type III EPD that are third party certified and include external verification and the manufacturer is recognized as a participant by the program operator.
- Product-specific Type III EPDs that confirm to ISO 14025 and EN 15804 or ISO 21930 and have at least cradle to gate scope and have external verification can be valued as 1.5 products for this credit.

LEED v4.1 Materials and Resources: Environmental Product Declarations, Option 2

LEED Credit

Awards one point when five products from three different manufacturers have compliant embodied carbon optimization report or action plan separate from the LCA or EPD.

Report Type	Reference Document(s) for the Optimization Report	Report Verification	Valuation
Embodied Carbon/LCA Action Plan	Product-specific LCA or product-specific Type III EPD	Prepared by the manufacturer and signed by the company executive	½ product
Reductions in Embodied Carbon: **<10% reduction in GWP relative to baseline**	Baseline: Product-specific LCA, Product-specific Type III EPD, or Industry-wide Type III EPD Optimized: Product-specific LCA or Product-specific Type III EPD	Comparative analysis is verified by an independent party	1 product
Reductions in Embodied Carbon: **10%+ reduction in GWP relative to baseline**			1.5 products
Reductions in Embodied Carbon: **20%+ reduction in GWP relative and 5%+ reduction in two additional impact categories, relative to baseline**	Baseline: Product-specific LCA, or Product-specific Type III EPD Optimized: Product-specific LCA or Product-specific Type III EPD		2 products

Note: Reference documents for the optimization reports must be compliant with EPD Credit Option 1.

LBC 4.1: I07 Energy and Carbon Reduction

Core Imperative

New Building and Building Renovation projects must demonstrate a 20% reduction in the embodied carbon of primary materials (structural, foundation, and enclosure materials) and exterior materials (including roads, paths, paving, and special surfacing and paving) compared to a baseline building. All projects with interior materials in scope must select interior products with a lower than industry average carbon footprint for product categories for which embodied carbon data are readily available.

LBC 4.1: I15 Living Economy Sourcing

LBC Imperative

20% or more of the materials construction budget must come from within 500 kilometers of the construction site. 75% of the materials construction budget must come from within 5000 kilometers of the construction site.

Common Materials Framework Category: Climate Health (cont.)

ASHRAE 189.1-2023: 9.4 Environmental Product Declarations and Global Warming Potential Reporting

ASHRAE Provision 9.4

Recognizes when the number of third-party verified Type III EPDs represent 25% of the total estimated costs of all building products permanently installed in the building project, or not fewer than 30 EPDs from 20 different building products and 10 different manufacturers. Products that cost 5% or more of the cost of all building products must have an EPD. Additionally, for each product with an EPD, report the GWP and the quantity installed for each product.

ASHRAE 189.1-2023: Product Life Cycle, Industry-Wide Declaration, Product-Specific Declaration or Third-Party Multi-attribute Certification

ASHRAE Provisions 9.4.1.4.1, 9.4.1.4.2 and 9.4.1.4.3

Promotes codes for new or renovated buildings as well as new systems and equipment in existing buildings, mandating the provision of lifecycle data for 10 different products installed in the building project at the time of issuance of certificate of occupancy. Data may be in the form of:

- A Type III industry-wide EPD per ISO 14025 and 21930, for which each product complying is counted as one product toward the 10;
- A product-specific Type III EPD per ISO 14025 and 21930, for which each product complying is counted as two products; or
- An LCA per ISO 14040 and 14044, and critically reviewed by a third-party, for which each product complying is counted as two products.

ASHRAE 189.1-2023: 9.5 Material Section

ASHRAE Provision 9.5

Recognizes new construction and renovation projects that comply with 2 of the following:

- 10%, by cost, products with recycled content and salvaged materials.
- 15%, by cost, products that are extracted/harvested/recovered or manufacturer within 500 miles of the project site.
- 5%, by cost, products' biobased as either: USDA's BioPreferred Program, USDA Certified Biobased Product, or products composed of at least 50% biobased content.
- Material assessment for five products meeting the performance level of the following standards
  - ANSI/BIFMA e3
  - NSF/ANSI 140
  - NSF/ANSI 332
  - NSF/ANSI 336
  - NSF/ANSI 342
  - NSF/ANSI 347
  - NSC 373
  - ANSI A138.1
  - UL 102

Climate Health in Energy Efficiency of Buildings

A sustainable energy future depends on the twin pillars of energy efficiency and renewable energy. Reducing the amount of energy required to provide products and services is among the most cost-efficient and large-scale opportunities to reduce carbon emissions and other pollution. Globally, minimum energy performance standards for air conditioners, refrigeration systems, motors and other applications are driving the design of more efficient equipment. For building owners and tenants, the benefits of installing these types of equipment include lower electricity bills and often less indoor noise.

Copper has the highest electrical conductivity of all non-precious metals, making it the material of choice for wires, cables, and electrical equipment. All other factors being equal, higher electrical conductivity means higher energy efficiency or, for the same efficiency, more compact designs. Without copper, electrical equipment such as motors, transformers and cables would use more material for the same efficiency rate, which would result in them being larger and potentially heavier. Copper also conducts heat better than other metals, which is important for efficient heat exchangers and heat sinks in electronic components.

When it comes to energy efficiency, copper's role extends beyond energy-using products. Energy savings are realized through the copper wires and cables incorporated into energy measurement and control devices, as well as automatic stand-by and shut-off features. Frequently, the energy and CO2 savings associated with these system-level applications are orders of magnitude larger than those seen at the product level.

The sustainable building community can attract owners and tenants interested in saving money and conserving energy while making progress towards climate goals. LEED and ASHRAE both recognize measures to incorporate energy saving designs and technologies into new and renovated buildings.

LEED v4.1 Energy and Environment: Minimum Energy Performance

LEED Prerequisite and Credits

Requires new or renovated commercial and institutional buildings to have a minimum level of whole-building energy performance, as defined by ASHRAE 90.1-2016. Awards up to 10 points to building projects meeting an energy performance target following specific criteria (see LEED version 4.1 for details). More points are awarded for more ambitious targets, according to type of building (e.g., retail, healthcare, school, etc.).

LEED v4.1 Sustainable Sites: Heat Island Reduction

LEED Credit

Awards one point for the area of the site and roof either having a high reflectance or vegetated roof that is greater than the total site area. Allowed measures include:

- Plant material
- Renewable energy generation from solar thermal collectors, photovoltaics, or wind turbines
- Shade from architectural features with an aged solar reflectance (SR) of at least 0.28

Common Materials Framework Category: Climate Health (cont.)

- Shade from vegetation
- Paving materials with a SR of at least 0.33
- Open-grid pavement
- Highly reflective roofing materials that meet the SRI values for low and steep sloped roofs

LBC 4.1: I07 Energy and Carbon Reduction

Core Imperative

All projects must achieve an energy efficiency target over a 12-month period as compared to a typical existing building, and demonstrate improvements against ASHRAE 90.1-2019 or later, IECC 2021 or later. Combustion must be limited and is not allowed in new buildings, with some exceptions. All projects must be designed to be "zero ready" through strategies such as designating areas or pre-installing wiring and connections for both electric vehicle charging and future installation of renewable energy systems.

ASHRAE 189.1-2023: Energy Consumption Management

ASHRAE Mandatory Provision 7.3.3.1

Requires systems in new or renovated buildings and equipment in existing buildings, include remote communication and measurement devices to collect energy consumption data for each energy supply source to the building, including gas, electricity, and district energy, exceeding specified thresholds (see ASHRAE 189.1 for details).

ASHRAE 189.1-2023: Minimum Equipment Efficiencies for the Alternate Renewables Approach

ASHRAE Provision 7.4.1

Procure renewable energy based on the Standard Renewables Approach, per building type—typically between 8-40 kBtu per square foot per year. Depending on the renewables procured, a discount is applied with on-site renewable energy being the best option (see ASHRAE 189.1 for details).

ASHRAE 189.1-2023: Supermarket Heat Recovery

ASHRAE Provision 7.4.7.2

Promotes codes for new or renovated supermarkets (>25,000 square feet or 2500 square meters) and existing supermarkets with new equipment, mandating the recovery of waste heat from the condenser heat rejection on permanently installed refrigeration equipment.

ASHRAE 189.1-2023: Television Control, HVAC Setpoint Control, and Ventilation Control

ASHRAE Provisions 7.4.3.9.2, 7.4.3.9.3 and 7.4.3.9.4

Promotes codes for new and renovated rental and hotel properties mandating the installation of automatic off-, sleep- or standby-mode functions for televisions, heating, and air conditioning equipment (including automated set-points) and ventilation equipment (including automated shut-off for outdoor air supply and exhaust air and an automated preoccupancy purge cycle).

Climate Health in Renewable Energy

A diverse array of renewable energy generation technologies continues to come online around the world. Carbon-free generation sources (hydro, nuclear, and renewables) supplied about 38% of total global energy consumption in 2022, with installed capacity for photovoltaics (PV) in particular growing exponentially (Haegel & Kurtz, 2023). Growth is projected to be the greatest across European countries, followed closely by China and North America. The built environment presents a meaningful opportunity to improve electrical distribution resiliency and optimize supply utilization by integrating renewable energy technologies directly into new-build or renovation designs. Commercial buildings in particular can harness the benefits of on-site renewable energy and its cost-saving advantages for owners and occupants.

Copper is a critical component in solar energy systems due to its exceptional electrical and thermal conductivity and high resistance to both atmospheric and aqueous corrosion. It is used in both the wiring to connect and grounding to protect photovoltaic (PV) systems. Copper is also integral to the electrical generators, connections and protective grounding systems of wind energy technologies. One of the largest challenges to accelerating renewable energy deployment is gaining approvals for interregional transmission infrastructure, for which copper will play a crucial part in the physical infrastructure once approved to build (World Resources Institute, 2024).

The sustainable building community can help bring more renewable energy online while owners benefit from local incentives and attract occupants with reduced electricity costs. Both LEED and ASHRAE promote the inclusion of on-site renewable energy.

LEED v4.1 Energy and Environment: Renewable Energy

LEED Credit

Awards up to five points for providing 1-15% of the building's energy consumption from on or off-site renewable energy systems such as photovoltaics and wind.

LBC 4.1: I08 Net Positive Carbon

LBC Imperative

All projects must supply 105% of the project's energy needs through on-site renewable energy on a net annual basis, without the use of combustion. All projects must sub-meter major energy end uses. All projects must aim below embodied carbon thresholds for the upfront embodied carbon of the project—i.e., life cycle stages A1 (raw material extraction) through A5 (installation/construction).

ASHRAE 189.1-2023 Standard Renewables and Alternate Renewables

ASHRAE Provisions 7.4.1.1.1 and 7.4.1.1.2

Promotes building codes for new or renovated buildings and new systems and equipment in existing buildings, mandating the installation of on-site renewable energy systems meeting specified criteria (see ASHRAE 189.1 for details.

Common Materials Framework Category: Climate Health (cont.)

Climate Health in Reduced Water Use in Buildings

Industrial uses account for over 20 percent of global water use (Boretti & Rosa, 2019). As aging water infrastructure requires replacement, the costs of this water and associated wastewater services rise. Wastewater costs have risen at a rate well above the consumer price index since the early 2000s (Stratton et al., 2016). Using less water means spending less money on water and wastewater treatment, and on energy to heat, store and move water through buildings. The built environment supports water conservation – and increases cost savings – when it incorporates low flow fixtures and efficient water systems.

Utility providers choose copper for water service lines because it is reliable and recyclable and does not allow potentially dangerous contaminants to permeate through or leach from the tube walls – keeping treated water safe. Copper's thermal properties drive its use in the water-saving, closed-loop or air-cooled technologies often incorporated into cooling appliances and equipment. Thermal recovery heat exchangers also use copper to reduce water use in buildings and reclaim heat energy, which would otherwise be lost to the wastewater system, by efficiently transferring energy from one fluid, gas or heated air to another.

The sustainable building community can, by design and with technology, support water conservation. LEED and ASHRAE promote equipment that uses less water and increased metering to better track water consumption in new and renovated commercial buildings.

LEED v4.1 Water Efficiency: Indoor Water Use Reduction

LEED Prerequisite and Credit

Requires new or renovated commercial and institutional buildings to:

- Reduce aggregate water consumption from fixtures and fittings 20% over a baseline value;
- Install appliances, equipment and processes within the project scope meeting specified performance criteria (see LEED version 4.1 for details).

Awards up to six points for going beyond these requirements, including using alternative water sources.

The credit requirements for school, retail, hospitality and healthcare buildings also include reducing the use of appliance and process water.

LEED v4.1 Water Efficiency: Building Level Water Metering

LEED Prerequisite

Requires new or renovated commercial and institutional buildings install permanent water meters measuring the total potable water use for the building and associated grounds, and compile data into monthly and annual summaries (manual or automated).

LEED v4.1 Water Efficiency: Water Metering

LEED Credit

Awards one point to new or renovated commercial and institutional buildings installing permanent water meters for two or more of the following water subsystems: irrigation; indoor plumbing fixtures and fittings; domestic hot water; boilers; reclaimed water or other process water.

The credit requirements for healthcare building projects additionally include installation of water meters in any five of the following: purified water systems (reverse-osmosis, de-ionized); filter backwash water; water use in dietary departments; water use for laundry; water use in laboratories; water use in central sterile and processing departments; water use in physiotherapy, hydrotherapy and treatment areas; water use in surgical suites; closed-loop hydronic system makeup water; cold-water makeup for domestic hot-water systems.

LBC 4.1: I05 Responsible Water Use

LBC Core Imperative

Requires developing and adhering to a water budget reflecting minimum 25% reduction in water usage from interior fixtures relative to baseline and using best-in-class water-consuming equipment.

LBC 4.1: I06 Net Positive Water

LBC Imperative

Projects must supply one hundred percent of the project's water needs through captured precipitation or other natural closed-loop water systems, and/or through recycling used water.

ASHRAE 189.1-2023: Water Consumption Management

ASHRAE Provision 6.3.3.1

Promotes codes for new or renovated buildings and new systems and equipment in existing buildings, mandating the installation of:

- Measurement devices with remote communication capability to collect water consumption data for the domestic water supply to the building;
- Monitors or submeters for both potable and reclaimed water entering the building project;
- Separate submeters for individually leased, rented or other tenant or subtenant space within any building totaling in excess of 50,000 square feet (5,000 square meters);
- Submeters for any project or building, or tenant or subtenant space within a project or building, where consumption is projected to exceed 1,000 gallons per day (3,800 liters per day).

ASHRAE 189.1-2023: Commercial Food Service Operations (Water Use)

ASHRAE Provision 6.4.2.2

Promotes codes for new, renovated and existing (with equipment upgrades) commercial food service operations mandating the installation of:

- Boilerless/connectionless food steamers;
- Combination ovens not consuming more than 10 gallons/hour (38 L/hour) in full operational mode;
- Air-cooled ice machines complying with the requirements of the ENERGY STAR® Program for Commercial Ice Machines;
- Hands-free equipped faucet controllers (foot controllers, sensor-activated or other) for all faucet fittings within the food preparation area of the kitchen and the dish room, including pot sinks and washing sinks;
- High-efficiency pre-rinse spray valves;
- Dishwashers complying with the requirements of the ENERGY STAR® Program for Commercial Dishwashers

Climate Health in Electric Vehicles

Electric vehicle (EV) technology has advanced steadily, with its status evolving from a dream to a practical reality. A current barrier to expanding EV deployment is widespread installation of charging infrastructure. A 2024 report by the Edison Electric Institute estimates that more than 42 million charge ports (including Level 2 home charge ports and publicly-available fast chargers) will be needed to support the 78.5 million EVs expected to be on the road in the United States by 2035 (Edison Electric Institute, 2024). The built environment plays a significant role in meeting this demand when it includes EV charging stations.

Copper has a primary function in both EV charging stations and EVs themselves because of its durability, reliability and superior electrical conductivity. Copper wiring in EV charging stations ensures the fastest possible charging times. Copper is also used in grounding systems, making these stations safe and resilient. Secure cable interconnections, which guarantee efficient performance, are made possible by copper alloys.

The sustainable building community can help advance EV adoption and offer amenities to occupants with EVs. LEED and ASHRAE provide helpful benchmarks for providing EV charging stations in commercial buildings.

LEED v4.1 Location and Transportation: Electric Vehicles

LEED Credit

Awards one point for new or renovated commercial and institutional buildings providing both preferred parking for green vehicles and alternative-fuel fueling stations by:

- nstalling electrical vehicle supply equipment (EVSE) in 2 percent of all parking spaces used by the project; or
- Installing liquid or gas alternative fuel fueling facilities or a battery switching station capable of refueling a number of vehicles per day equal to at least 2 percent of all parking spaces.

The credit requirements for warehouses and data centers include providing an on-site fleet with at least one yard tractor powered by electricity, propane, or natural gas, and providing on-site charging or refueling stations for these vehicles (with liquid or gas refueling stations separately ventilated or located outdoors).

LBC 4.1: I04 Human-Scaled Living

LBC Core Imperative

Recognizes new and existing commercial and institutional buildings which, among other requirements, provide at least two EV charging stations or one per 30 spaces, limit parking to percentage maximums of the project site surface area, and reduce trips made by single-occupancy and/or fossil-fuel based vehicles.

LBC 4.1: I07 Energy and Carbon Reduction

LBC Core Imperative

All projects must be designed to be "zero ready" through strategies such as designating areas or pre-installing wiring and connections for both electric vehicle charging and future installation of renewable energy systems.

ASHRAE 189.1-2023: Site Vehicle Provisions

ASHRAE Mandatory Provision 5.3.7.3

Promotes building codes mandating new and renovated buildings (with an occupant load over 100 and on-site vehicle parking) to have preferred parking spaces or provisions for EV charging infrastructure, where two or more EV charging systems are available to building occupants and located no more than 400 meters (0.25 miles) from the building project.

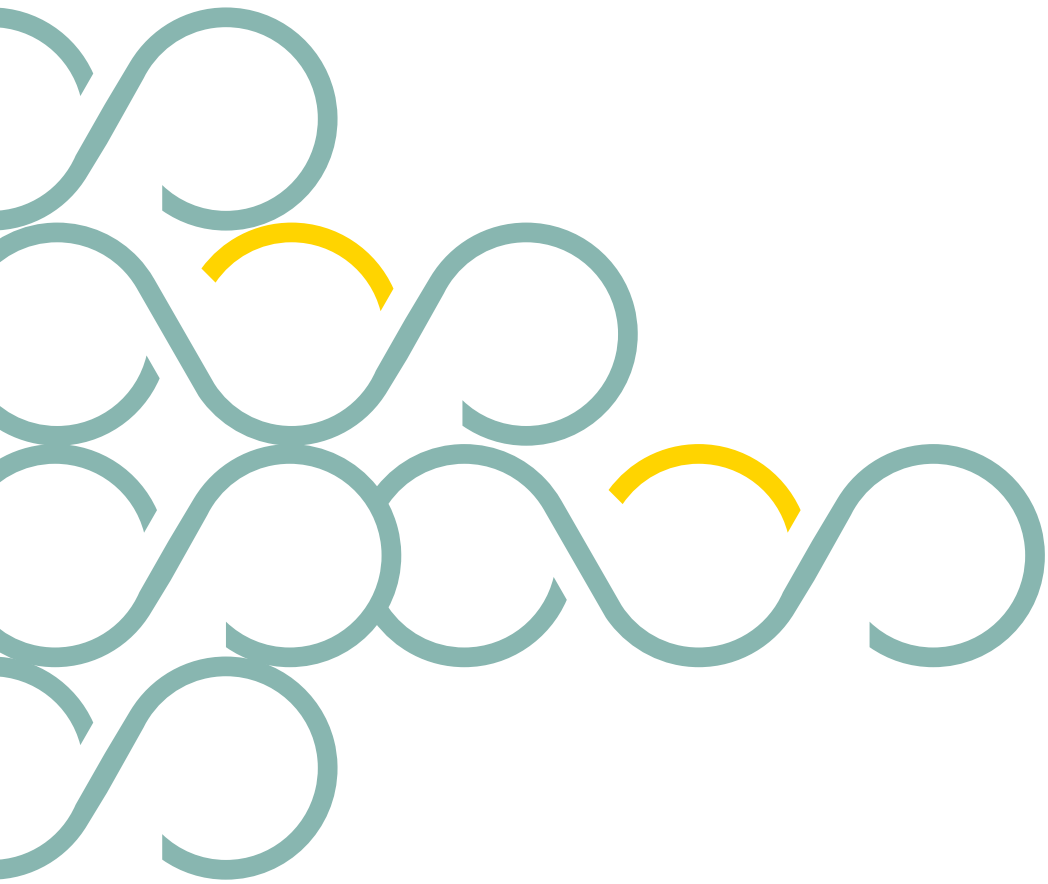
Common Materials Framework Category:

Circular Economy

Human Health | Climate Health | **Circular Economy** | Social Health and Equity | Ecosystem Health

- Sourcing
- End of Life
- Packaging
- Company Circularity
- Waste

The Common Materials Framework encourages materials or products whose design considers its material inputs and end of life streams to "eliminate waste and pollution, circulate products and materials at their highest value, and regenerate nature." Instead of utilizing building products and materials for a short time before sending them to landfills, we should find ways to keep them in circulation, and prioritize products designed with circular principles in mind. The CMF identifies five sub-impact categories in this category: Sourcing, End of Life, Packaging, Company Circularity, and Waste.



Sub-Bucket	Definition	Similar/related terms	Applicable standards
Sourcing	Sourcing refers to where products are manufactured and with what type of inputs. The CMF includes factors in this section such as: salvaged, regenerative, renewable, or recyclable inputs, whether the materials used have social co-benefits (like carbon sequestration, pollution removal of ocean plastics, etc.).	Similar: procurement, purchasing Related: supply chain, value chain, recycled content, circular materials	LEED v4.1 ASHRAE 189.1
End of Life	End of Life refers to where a product or material goes when it is no longer being used. The CMF includes factors in this section such as: pathways for recycling, composting, or reintegration, designed for repair, upgrade, or disassembly, extended producer responsibility programs, material passports.	Similar: end of service life, lifespan, product lifetime, disposal, reverse logistics Related: landfill diversion, recycling, reuse, extended producer	LEED v4.1 LBC 4.1 ASHRAE 189.1
Packaging	Packaging refers to how products are packaged for distribution and sale. The CMF includes factors in this section such as: the type of material is used for packaging, the end of life for the packaging, whether the packaging has been optimized to eliminate unsustainable/harmful materials, and efficient water and energy use in its production.	Related: compostable packaging, reusable packaging, recyclable packaging	LEED v4.1 LBC 4.1
Company Circularity	Company Circularity refers to company-wide (not product specific) circularity considerations. The CMF includes factors in this section such as: sample take-back programs, ongoing assessments and follow-through on recovery and cycling of products that are taken back, company-wide circularity goals, environmentally preferred purchasing policies.	Similar: circular business model, closed-loop economy Related: linear economy, circular economy, corporate sustainability, extended producer responsibility (EPR)	LEED v4.1
Waste	Waste is unwanted or unusable material, substances, or byproducts produced during manufacture of a product or material. The CMF includes factors in this section such as: solid waste inventory (and associated standard and boundaries), total waste diversion rates, auditing and reporting, zero-waste goals, plans, and/or commitments, upstream waste optimization, and third party verification.	Similar: reduced facility and manufacturing waste, zero waste certification Related: solid waste, toxics release, facility emissions, emissions to air and water, circular materials	LEED v4.1 LBC 4.1

Common Materials Framework Category: Circular Economy (cont.)

Climate Health in Sourcing

LEED v4.1 Materials and Resources: Sourcing of Raw Materials

LEED Credit

Awards up to two points for selecting products sourced from at least three (or five for 2 points) different manufacturers that meet at least one of the responsible sourcing and extraction criteria for at least 15% (or 30% for 2 points), by cost, of the total value of permanently installed building products in the project.

- Extended Producer Responsibility (EPR) – Products purchased from a manufacturer (producer) participating in an EPR program or directly responsible for extended producer responsibility;
- Bio-based materials – Bio-based products and materials other than wood must be tested using ASTM Test Method D6866 or equivalent method ISO 16620-2, or be certified to the USDA BioPreferred Voluntary Labeling Initiative that includes verification via ASTM 6866 testing;
- Wood products – Products certified by the Forest Stewardship Council or USGBC-approved equivalent;
- Materials reuse – Products salvaged, refurbished, or reused;
- Recycled content – Product content calculated as the sum of postconsumer recycled content plus half the pre-consumer recycled content, based on cost.

LEED v4.1 Materials and Resources: PBT Source Reduction Mercury

LEED Prerequisite and Credit

As part of the recycling collection system for healthcare facilities, identify:

- The type of mercury-containing products and devices to be collected,
- Criteria governing how they are to be handled by a recycling program; and
- Disposal methods for captured mercury.

For 1 point, specify and install fluorescent lamps with low mercury content and a long lamp life as identified in the table in the rating system.

ASHRAE 189.1-2023: Recycled Content, Reduced Impact Materials

ASHRAE Provision 9.4.1.1 and 9.4.1.2

Promotes codes for new or renovated buildings, as well as new systems and equipment in existing buildings, mandating permanently installed materials have a minimum of 10% recycled content based on cost of the total materials in the building project. (The recycled content of a material shall be the postconsumer recycled content plus one half of the pre-consumer recycled content, determined by weight [mass]. The recycled fraction of the material in a product or an assembly shall then be multiplied by the cost of the product or assembly to determine its contribution to the 10% requirement.)

ASHRAE 189.1-2023 - 9.5 Material Section

ASHRAE Provision 9.5

Recognizes new construction and projects renovation that comply with two of the following:

- 10%, by cost, products with recycled content and salvaged materials.
- 15%, by cost, products that are extracted/harvested/recovered or manufacturer within 500 miles of the project site.
- 5%, by cost, products' biobased as either: USDA's BioPreferred Program, USDA Certified Biobased Product, or products composed of at least 50% biobased content.
- Material assessment for five products meeting the performance level of the following standards
  - ANSI/BIFMA e3
  - NSF/ANSI 140
  - NSF/ANSI 332
  - NSF/ANSI 336
  - NSF/ANSI 342
  - NSF/ANSI 347
  - NSC 373
  - ANSI A138.1
  - UL 102

Climate Health in End of Life, Waste, and Company Circularity

LEED v4.1 Materials and Resources: Construction and Demolition Waste Management

LEED Credit

Recognizes projects that develop and implement a construction and demolition waste management plan, with up to 2 points awarded through waste prevention and/or diversion. Divert at least 50% of all construction and/or demolition waste (1 point) and additionally generate less than 10 pounds per square foot (50 kilograms per square meter) of waste materials from all new construction activities.

LEED v4.1 Materials and Resources: Circular Products

LEED Pilot Credit

Recognizes projects that use products that complete a circular product report, demonstrate zero waste manufacturing (diverting 90+% of waste from landfill and incineration), or are designed for disassembly, repair, or reuse at the end of the useful lifetime.

LBC 4.1: I16 Net Positive Waste

LBC Imperative

All projects must create a Materials Conservation Management Plan to optimize material use and minimize material waste throughout the building lifetime. All projects must feature at least one salvaged material per 500 square meters of project floor area.

Common Materials Framework Category:

Social Health and Equity

Human Health | Climate Health | Circular Economy | **Social Health and Equity** | Ecosystem Health

Supply Chain
Company Workplace
Community

Social Health and Equity Impacts are the ways that individuals involved in the production or living near production or disposal locations of products and materials are affected by these operations. Globally, almost 28 million people are held in servitude for forced labor and 160 million children from the ages of five to 17 are subjected to child labor, and construction and manufacturing are the largest industrialized sectors at the highest risk of forced labor (International Labour Organization, 2020, 2022). The extraction, transportation, and manufacturing of building product can impact the lives of people who work and in manufacturing and construction, or live nearby. Products may consider human rights in operations and in supply chains, positively impacting workers and the communities where they operate. CMF guidance prefers products from manufacturers that secure human rights in operations and in supply chains that positively impact workers and the communities where they operate. The CMF identifies three sub-impact categories in this category: Supply Chain, Company Workplace, and Community.

Sub-Bucket	Definition	Similar/related terms	Applicable standards
Supply Chain	The supply chain is the interconnected journey that raw materials, components, and goods take before their assembly and sale to customers. It includes building material producers, vendors, manufacturers, transporters, retailers, and consumers - essentially all the people and businesses that are involved in extracting, refining, processing, manufacturing, distributing, storing, selling, and installing a material or product into a building. The CMF includes factors in this section such as: supply chain mapping, supplier human rights policies (which can include forced labor), compliance documentation, high-risk materials, monitoring and auditing, supplier commitments, equitable purchasing.	Similar: value chain, procurement, purchasing Related: circular economy, extended producer responsibility (EPR)	LEED v4.1 LBC 4.1
Company Workplace	Company Workplace considers how an organization cares for its employees and addresses their safety, benefits, and health and well-being. The CMF includes factors in this section like: Corporate Social Responsibility (CSR) reporting, Diversity & Inclusion policies, and Diverse Business Enterprise status.	Similar: employee benefits, environment, health and safety (EHS), workplace safety Related: diversity and inclusion, employee resource groups (ERGs)	LEED v4.1 LBC 4.1
Community	Community refers to the local community situated in a given geographical area near an organization's manufacturing location. The CMF includes factors in this section such as: community outreach and engagement, indigenous peoples' rights, community volunteering, public reporting, community impact assessment, community development plans & policies, charitable giving.	Similar: community involvement, workforce development and training Related: charitable giving, corporate responsibility	LEED v4.1 LBC 4.1

Common Materials Framework Category: Social Health and Equity (cont.)

Social Health and Equity in Supply Chain, Company Workplace, and Community

LEED v4.1 Integrative Process: Social Equity

LEED Credit

Review and complete the LEED Project Team Checklist for Social Impact in order to assess and select strategies to address issues of inequity within the project and its community, team, and supply chain.

LEED v4.1 Pilot Credit: Social Equity within the Community

LEED Pilot Credit

This pilot credit rewards 1 point to projects that undertake a process to understand who their community includes, community needs related to equity for vulnerable populations, and develop and implement strategies for the project to assist the community in meeting those needs.

LEED v4.1 Pilot Credit: Social Equity within the Supply Chain

LEED Pilot Credit

This pilot credit rewards 1 point for selecting products that are certified or manufactured by a company that complies with a verified standard that meets all 8 Fundamental Conventions of the International Labour Organization (ILO).

LEED v4.1 Integrative Process: Health and Well-being

LEED Credit

Establish health goals early in the design phase. Identify clear and specific goals to promote the health of building occupants, users, surrounding community, and supply chain. Provide a summary of how the health goals relate to the highest priority health needs for each population.

LBC 4.1: I14 Responsible Sourcing

LBC Imperative

All projects must advocate for the creation and adoption of third-party certified standards for sustainable resource extraction and fair labor practices of extraction of rock, metal, and minerals.

LBC 4.1: I18 Inclusion

LBC Core Imperative

All projects must have a Just label (a certification and label for organizations to disclose social equity information) for at least two project team organizations that are significantly involved in both design and construction phases. In addition, all projects must either include diverse stakeholders through Minority, Women, or Disadvantaged Business Enterprises (MWDBE) organizations or workforce development or similar programs or donate 0.1% of total project cost to a regional community-based nonprofit organization focused on equity and inclusion.

1701 Rhode Island Avenue
Photo Credit: Alan Schindler

Common Materials Framework Category:

Ecosystem Health

Human Health | Climate Health | Circular Economy | Social Health and Equity | **Ecosystem Health**

- Pollution
- Water Footprint (Product)
- Water Footprint (Company)
- Biodiversity + Conservation
- Life Cycle Environmental Footprints

Ecosystem Health Impacts are ways the production of materials affects elements of our natural ecosystems, such as water, air, biodiversity, and wildlife. While climate change caused by greenhouse gas emissions leads to destruction of natural ecosystems, other byproducts of material production do as well, such as overharvesting, habitat destruction, and air and water pollution. Restoring ecosystem health requires the use of products that renew air, water, and global biological cycles, encouraging more thoughtful supply chain management and restorative company practices. The CMF identifies five sub-impact categories in this category: Pollution, Product Water Footprint, Company Water Footprint, Biodiversity + Conservation, and Life Cycle Environmental Footprints.

Sub-Bucket	Definition	Similar/related terms	Applicable standards
Pollution	Pollution is the introduction of harmful materials (pollutants) into the environment. Pollutants can be natural, such as volcanic ash. They can also be created by human activity, such as trash or runoff produced by factories. Pollutants damage the quality of air, water, and land. The CMF includes factors in this section such as: air and water emissions, whether hazardous waste is present, environmental policies, plans, and strategies for environmental protection, and implementation progress of these strategies.	Similar: Related: emissions, toxics release, effluent quality, total organic content (TOC) emissions, environmental compliance, air quality control	LEED v4.1 LBC 4.1
Product Water Footprint	Product Water Footprint refers to the water required to produce a specific product. For plumbing fixtures and products that use water during operation, Product Water Footprint also refers to the water use efficiency of that product during operation. The CMF includes factors in this section such as: water inventory and assessment, water efficiency measures, and water footprint reduction.	Similar: freshwater consumption, greywater recycling and reuse Related: life cycle assessment hotspots, clean water regulations, water quality	LEED v4.1 LBC 4.1 ASHRAE 189.1
Company Water Footprint	Company Water Footprint refers to the total water usage of the company throughout its business operations. The CMF includes factors in this section such as: the scope of the company's direct and indirect water footprint (whether just for manufacture or also for employee operations), the supply chain water footprint, the downstream impacts of a company's water use.	consumption, greywater recycling and reuse Related: life cycle assessment hotspots, clean water regulations	LEED v4.1 LBC 4.1 ASHRAE 189.1
Biodiversity and Conservation	Biodiversity and Conservation refer to how the manufacture of a product impacts animal and plant species and habitats, and protects and improves natural resources according to principles that will ensure their highest economic or social benefits. The CMF includes factors in this section such as: material extraction and harvesting, endangered or vulnerable species protection, land use and habitat protection, organic systems management, and habitat restoration.	Similar: ecosystem protection, habitat or natural resource conservation Related: natural capital	LEED v4.1 LBC 4.1
Life Cycle Environmental Footprints	Life Cycle Environmental Impacts are determined by conducting a Life Cycle Assessment (LCA) - a standardized process for quantifying the inputs, outputs, and potential environmental impacts of a product from cradle to grave. The CMF includes factors in this section such as: the LCA/EPD type and standard, system boundaries, verification, product category rules (PCRs), and TRACI and CML Methodology Impact Categories.	Similar: Related: product environmental footprint, carbon footprint, global warming potential (GWP), embodied carbon	LEED v4.1 LBC 4.1

Common Materials Framework Category: Ecosystem Health (cont.)

Human well-being is dependent on a healthy ecosystem. Water, soil, air, and biodiversity are threatened by human decision around how we manufacture building products for our communities. Considering an ecosystem requires looking at forestry practices, water, land, and air pollution, and other environmental impacts. Revisions of voluntary corporate reporting standards to include increased transparency around biodiversity signals an active market shift. Manufacturing and building construction can positively restore ecosystem health by creating and using products that renew air, water, and the biological lifecycles.

Ecosystem Health in Pollution

LEED v4.1 Sustainable Sites: Construction Activity Pollution Prevention

LEED Prerequisite

All projects must create and implement an erosion and sedimentation control plan for all construction activities associated with the project. The plan must conform to the erosion and sedimentation requirements of the 2017 U.S. Environmental Protection Agency (EPA) Construction General Permit (CGP) or local equivalent, whichever is more stringent.

LBC 4.1: I06 Net Positive Water

LBC Imperative

All projects must address all greywater (wastewater from non-toilet plumbing systems) and blackwater (wastewater from toilets) through on-site treatment and management through reuse, a closed loop systems, or infiltration.

Ecosystem Health in Product Water Footprint, Company Water Footprint, Life Cycle Environmental Footprints

LEED v4.1 Materials and Resources: Environmental Product Declarations, Option 1

LEED Credit

Awards one point when providing EPDs for 20 different products sourced from at least five manufacturers that meet one of the disclosure methods below. Product-specific Type III EPDs are valued higher than other disclosure methods.

- LCA and EPDs are valued as one whole product if they are either:
  - Public, critically reviewed LCA confirming to ISO 14044 and have at least a cradle to gate scope;
  - Product-specific Type III EPD that has been internally reviewed and conform to ISO 14071 and has at least a cradle to gate scope; or,
  - ndustry-wide Type III EPD that are third party certified and include external verification and the manufacturer is recognized as a participant by the program operator.
- Product-specific Type III EPDs that confirm to ISO 14025 and EN 15804 or ISO 21930 and have at least cradle to gate scope and have external verification can be valued as 1.5 products for this credit.

LEED v4.1 Materials and Resources: Environmental Product Declarations, Option 2

Awards one point when five products from three different manufacturers have compliant embodied carbon optimization report or action plan separate from the LCA or EPD.

Report Type	Reference Document(s) for the Optimization Report	Report Verification	Valuation
Embodied Carbon/LCA Action Plan	Product-specific LCA or product-specific Type III EPD	Prepared by the manufacturer and signed by the company executive	½ product
Reductions in Embodied Carbon: **<10% reduction in GWP relative to baseline**	Baseline: Product-specific LCA, Product-specific Type III EPD, or Industry-wide Type III EPD Optimized: Product-specific LCA or Product-specific Type III EPD	Comparative analysis is verified by an independent party	1 product
Reductions in Embodied Carbon: **10%+ reduction in GWP relative to baseline**			1.5 products
Reductions in Embodied Carbon: **20%+ reduction in GWP relative and 5%+ reduction in two additional impact categories, relative to baseline**	Baseline: Product-specific LCA, or Product-specific Type III EPD Optimized: Product-specific LCA or Product-specific Type III EPD		2 products

Note: Reference documents for the optimization reports must be compliant with EPD Credit Option 1.

ASHRAE 189.1-2023: Product Life Cycle, Industry-Wide Declaration, Product-Specific Declaration or Third-Party Multi-attribute Certification

ASHRAE Provisions 9.4.1.4.1, 9.4.1.4.2 and 9.4.1.4.3

Promotes codes for new or renovated buildings as well as new systems and equipment in existing buildings, mandating the provision of lifecycle data for 10 different products installed in the building project at the time of issuance of certificate of occupancy. Data may be in the form of:

- A Type III industry-wide EPD per ISO 14025 and 21930, for which each product complying is counted as one product toward the 10;
- A product-specific Type III EPD per ISO 14025 and 21930, for which each product complying is counted as two products; or
- An LCA per ISO 14040 and 14044, and critically reviewed by a third-party, for which each product complying is counted as two products.

Common Materials Framework Category: Ecosystem Health (cont.)

Ecosystem Health in Biodiversity and Conservation

LBC 4.1: I14 Responsible Sourcing

LBC Imperative

All projects must source 80% or more of all wood, by cost or volume, as either Forest Stewardship Council (FSC) certified, or as salvaged. All projects must advocate for the creation and adoption of third-party certified standards for sustainable resource extraction and fair labor practices of extraction of rock, metal, and minerals.

LBC 4.1: I15 Living Economy Sourcing

LBC Imperative

20% or more of the materials construction budget must come from within 500 kilometers of the construction site.
75% of the materials construction budget must come from within 5000 kilometers of the construction site.

CHUM Auditorium
Photo Credit: Adrien Williams

Burwell Center for Career Achievement
Photo Credit: Frank Ooms

Trends and Future State of

Green Building Requirements

With the emergence of guiding frameworks to align stakeholders, the future of green building standards, certifications, and requirements are turning their attention to establishing standardized definitions and mutual understanding of the concepts discussed above.

LEED v5

USGBC announced the development and public comment period for LEED v5, which will be the next version of the green building standard slated for introduction in early 2025. LEED v5 has been developed around three central areas of impact: decarbonization, quality of life, ecological conservation and restoration. New in this version, every credit has a connection to one or all of these impact areas, which is annotated throughout the rating system. The three impact areas are further elaborated as follows:

- **Decarbonization** by targeting reductions in operational, embodied, refrigerants, and transportation emissions.
- **Quality of life** by improving health, wellbeing, resilience, and equity for building occupants and their communities, making spaces not just environmentally friendly but also people friendly.
- **Ecological conservation** and restoration by emphasizing strategies that limit environmental degradation and contribute to the restoration of ecosystems, ensuring that our built environment exists harmoniously with nature.

These three overarching categories closely resemble the five impact categories articulated by the AIA Materials Pledge and the Common Materials Framework. Indeed, market signals point toward alignment across organizations and relevant stakeholders. USGBC has published a Summary of Changes for the proposed LEED v5, compared to LEED v4/v4.1 (U.S. Green Building Council, 2024).

WELL Building Standard and design centering wellness

The International WELL Building Institute (IWBI) focuses on transforming health and well-being through buildings, organizations, and communities through the WELL Building Standard. The WELL footprint grew by nearly 1 billion square feet by the end of 2023. As of February 2024, WELL is used across more than 5 billion square feet of space in 130 countries (International WELL Building Institute, 2023).

IWBI also announced its commitment to "map existing material features in WELL to the CMF, to conduct a gap analysis to inform new possible CMF-aligned WELL beta features, and to explore ways to support similar alignment with its Works with WELL licensing program" (International WELL Building Institute, 2024). With the rapid and broad adoption of WELL programs by global organizations including nearly a third of Fortune 500 companies.

Living Building Challenge and the net positive building

The Living Building Challenge (LBC) emphasizes regenerative and net positive impact—creating Living Buildings that are self-sufficient and create a positive impact on the human and natural systems that interact with them. Living Future, the organization that stewards the LBC, aims to have regenerative, resilient solutions adopted as the common practice for everyone creating and maintaining buildings by 2030. Through their 2025-2027 Strategic Plan, Living Future is targeting 35 million square feet of projects to be on the path to certification.

To support this scaling, Living Future created a pilot of the Manufacturer's Engagement Initiative, which leverages collective advocacy to demand regenerative solutions. They also target doubling the number of participating product manufacturers and creating two new labels and certifications for sustainable building materials (International Living Future Institute, 2025).

ASHRAE 198.1 and 240P, and code-enforceable requirements

With the development of the 2023 version of the ASHRAE 198.1 Standard, ASHRAE included changes that aid in building decarbonization, including updated requirements for EV charging infrastructure, increased lighting efficiencies, an option for using long-run marginal emissions rates (LRMER) in energy modeling, and requirements for submitting EPDs for a user-chosen set of building products. The 2024 International Green Construction Code (IgCC) will likely feature many of these updated requirements.

ASHRAE and the International Code Council (ICC) have also proposed ASHRAE/ICC Standard 240P – Quantification of Life Cycle Greenhouse Gas Emissions of Buildings, which was open for public comment in early 2024. Standard 240P will provide a methodology to quantify the embodied and operational GHG emissions associated with buildings and their sites. The standard will also provide minimum requirements for documentation of life cycle GHG emissions.

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Green and healthy buildings:

Copper applications

Architecture (exterior, structural)

Facades

Wall cladding

Rain screens

Curtain walls

Copper alloy light fixtures

Window frames

Roofing

Building expansion joints

Flashing

Gutters and discharge scupper

Downspouts

Roof drains

Floor drains

Drain flanges

Elevators

Escalators

Exterior railing systems

Fountains

Statuary

Ornamental

Landscaping

Tubing (to move medical gases)

Fenestrations and openings (e.g., windows and entrances)

Building System Controls

Control panel for building plumbing systems

Low voltage system controls

Lighting system control panel

Air system controls

Emergency system controls

A/V system controls

Control panels for building mechanical systems

Communications system controls

Security system controls

Control panel for fire and smoke suppression systems

Water/plumbing system controls, including water meters

Interiors

Elevators

Interior railing system

Interior wall cladding

Doors

Ceiling tiles

Locks, locksets, closers

Keyboards, mouse covers

Soap dispensers

Sinks

Showers, tubs

Drinking fountains

Bottle filling stations

Flush valves

Access controls

Light fixtures

Furnishings

Range hoods

Wall tiles

Table tops, counter tops

Art, decorative

Door push plates, kick plates

Hydrotherapy tanks

Carts (table, legs, handles)

Floor tiles

Chair armrests, frames

Exercise equipment, handles, bars

Hardware (hinges, door pulls)

Assistance railings (e.g., beds, toilets, stairs)

Hospital furniture (e.g., beds, beside tables)

Plumbing fixtures (water in) and fittings (waste out)

Kitchen design elements (backsplash, cabinet doors, hinges, pulls)

Plumbing (fluid movement)

Piping

Gas distribution

Downspouts

Flashing

Gutters

Faucets and fixtures

Toilet and urinal hardware

Drainage systems

Drain waste heat recovery

Drain covers/drain plates

Floor drain strainers

Drains and flanges

Fire suppression

Sprinklers

Pressure reducing stations

Thermostatic mixing valves

On-demand water heaters

Water heaters/hot water equipment

Temperature modulating stations

Energy Generation and Storage

Photovoltaics

Wind energy

Solar thermal

Thermal energy storage

Direct exchange heat pumps

Heat exchangers

Gas distribution systems

Waste water

Battery for electrical energy storage

Battery storage (interconnect electric vehicles, supply several buildings)

Geothermal heating systems/ direct exchange systems

Thermal energy storage (e.g., ice, chemical)

Mechanical Systems and Appliances

AC equipment

Motor driven systems

Heating equipment

Refrigeration equipment

Printed circuit boards

Computers

Gas combustion equipment

Boilers for heating

Hand dryers

Cooling towers

Electrical Systems

Wiring

Cables

Motors

Microcircuits

Electric vehicle charging

Satellite dishes

Radiant flooring

Lightning protection

Transformers

Power quality monitoring

Receptacles with USB ports

Smart lighting controls

Building power circuits

Lighting circuits

Data/signal transmission and telecommunications

Individual/point of use lighting controls

Electronic lighting management

Automated water controls (auto flush, auto faucets)

Earthing systems (grounding and bonding)

Generators (incl. backup generators)

Electronic thermal management

Security cameras retina scanners, fingerprint readers

Acronyms

AECO:	Architecture, Engineering, Construction, and Owners
AIA:	American Institute of Architects
ANSI:	American National Standards Institute
ASHRAE:	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASTM:	ASTM International (formerly known as the American Society for Testing and Materials)
CDA:	Copper Development Association
CLF:	Carbon Leadership Forum
CMF:	Common Materials Framework
CO2-eq:	Carbon Dioxide (CO2) Equivalent
DOE:	Department of Energy
EPD:	Environmental Product Declaration
ESG:	Environmental, Social and Governance
GWP:	Global Warming Potential
HPD:	Health Product Declaration
HPDC:	Health Product Declaration Collaborative
HVAC:	Heating, Venting, and Air Conditioning
ICMM:	International Council on Mining and Metals
IECC:	International Energy Conservation Code
IES:	Illuminating Engineering Society
ICC:	International Code Council
IgCC:	International Green Construction Code
ILFI:	Living Future (formerly the International Living Future Institute)
IWBI:	International WELL Building Institute
LBC:	Living Building Challenge
LCA:	Life Cycle Assessment
LEED:	Leadership in Energy and Environmental Design
PCR:	Product Category Rule
ROI:	Return on Investment
USDA:	United States Department of Agriculture
USGBC:	United States Green Building Council
WELL:	WELL Building Standard (usually referred to by the acronym)
VOC:	Volatile Organic Compounds

CHUM Auditorium
Photo Credit: Adrien Williams

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