lightly

How to evaluate the sustainability of architectural products

about the course:

This course helps designers cut through the noise and focus on two key frameworks for evaluating architectural product sustainability. First, the International Living Future Institute has provided a framework for evaluating the toxicity of products with its Declare Label. Second, Environmental Product Declarations have become the gold standard in measuring the carbon footprint of products. Attendees will learn how to leverage these frameworks to design healthier and more environmentally friendly spaces, as well as a look at some of the first architectural lighting sustainability documentation.

learning objectives:

- Understand which materials are classified as toxic by the International Living Future Institute, and where they are found
- Understand embodied carbon, and how it is measured
- Learn how to read and interpret a Declare Label from the International Living Future Institute
- Learn how to read and interpret a Life-Cycle-Analysis (LCA) as part of an Environmental Product Declaration (EPD)
- Understand different approaches for measuring sustainability
- Learn about existing sustainable architectural materials

problem: toxic materials are still everywhere

120
known carcinogens

200
probable carcinogens

The International Agency for Research on Cancer (IARC) identifies over ***120 substances*** that are known carcinogens and over ***200 substances as probable carcinogens.***

toxic material highlight: VOCs

Volatile organic compounds (VOC) means any compound or carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, which participates in atmospheric photochemical reactions.

common VOCs include:

Acetone: Found in nail polish remover, furniture polish and wallpaper
Benzene: Found in paint, glue, carpeting, and in aluminum production
Butanal: Found in emissions from barbecues, burning candles, stoves and cigarettes
Carbon Disulfide: Found in chlorinated tap water
Dichlorobenzen: Found in mothballs and deodorizers
Ethanol: Found in glass cleaners, dishwasher detergents and laundry detergents
Formaldehyde: Found in floor lacquers and certain molded plastics
Terpenes: Found in fragrant products such as soap or laundry detergents
Toluene: Found in paint
Xylene: Found in traffic emissions and idling cars

toxic material highlight: polyvinyl chloride (PVC)

PVC's vinyl chloride monomer building block is a known human carcinogen, according to the US Department of Health and Human Services. In addition, PVC is a Persistent Organic Pollutant Source Material. Due to its chlorine content, PVC often contains other Red List ingredients, such as cadmium, lead, and phthalates.

common products with PVC:

Luxury Vinyl Tile (LVT)
Carpet
Furniture
Siding and Windows
Wiring and Cables
Water Pipes
Rain Coats and Rubber Boots
Toys
Shower Curtains

regulatory agencies for toxic materials:

FDA U.S. FOOD & DRUG ADMINISTRATION

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

RoHS

International Agency for Research on Cancer

World Health Organization

CALIFORNIA AIR RESOURCES BOARD

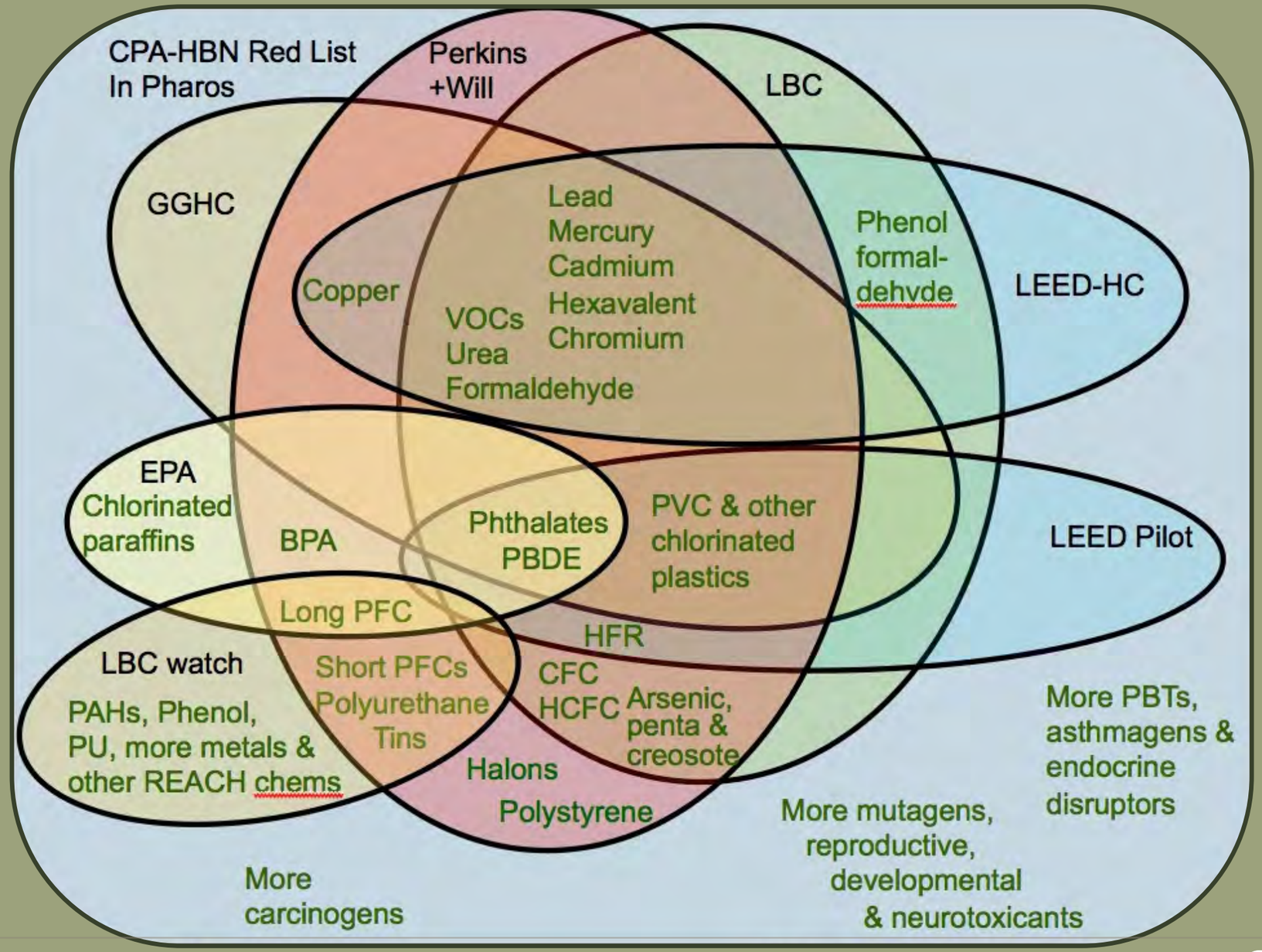
U.S. GREEN BUILDING COUNCIL USGBC

Red List Free

INTERNATIONAL LIVING FUTURE INSTITUTE

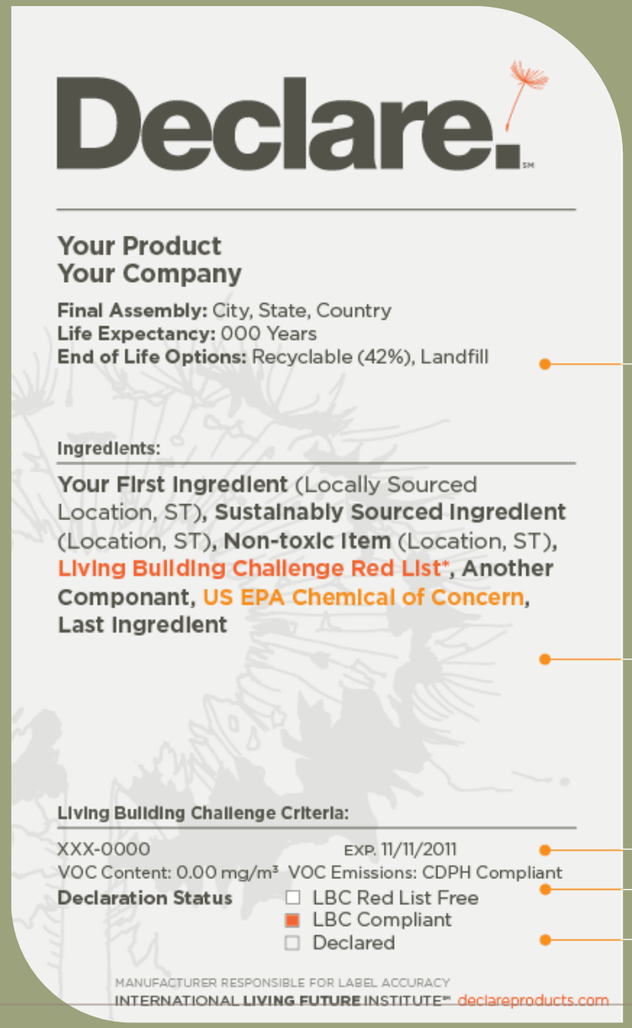
Red List:

The most complete list for toxic materials in buildings



Courtesy of Healthy Building Network

Declare label: ingredient list for products



end-of-life options: take-back programs, salvageable or resuable in its entirety, recyclable (%); landfill; hazardous waste

ingredient are reported by component: ingredients without restriction appear in grey; Red List chemicals appear in dark orange; EPA COC and REACH chemicals appear in light orange. (reported raw material extraction locations are listed in perenthesis.)

Declare identifier for company and product, valid for 12 months
VOC information and CDPH Compliance
Verification that product complies with Living Building Challenge Red List

Declare considerations for lighting:

Declare.

Lightly - Fixture - Boothwyn PA
Lightly

Final Assembly: Boothwyn, Pennsylvania, USA
Life Expectancy: 10+ Year(s)
End of Life Options: Biodegradable/Compostable (95%), Recyclable (3%), Landfill (2%)

Ingredients:

Frame: Poplar; **Plywood:** Wood, Various; 4,4'-Methylenediphenyl diisocyanate; Polyvinyl alcohol; Soy; **ECOS Atmosphere Purifying Paint:** Water; Titanium dioxide; Calcium Carbonate; 1,2,3-Propanetriol; 2-Propenoic acid, homopolymer ammonium salt; 2-Propenoic acid, homopolymer, sodium salt; 9-Octadecenoic acid (Z)-; Benzaldehyde, 4-hydroxy-3-methoxy-; Cellulose, 2-hydroxyethyl ether; Ceramic materials and wares, chemicals; Cutting Oils; Fatty acids, C12-18, Me esters, sulfonated, sodium salts; Fatty acids, C32-36-branched; Fatty acids, tallow, potassium salts; Glycine, N-methyl-N-(1-oxododecyl)-, sodium salt; Hectorite; Xanthan gum; Zeolites, NaA; Zinc pyrithione; **Flex LED Module:** Copper; Tin, Organic; Methyl methacrylate; Glass, oxide, chemicals; Iron; Polyamide 9T; Silver; Vinyl silicone polymer; Polyimide; 2-Propenoic acid, 2-methyl-, polymer with methyl 2-methyl-2-propenoate; Phenol, 4,4'-(1-methylethylidene)bis[2,6-dibromo-, polymer with (chloromethyl)oxirane and 4,4'-(1-methylethylidene)bis[phenol]; 2-Propenenitrile, polymer with 1,3-butadiene; Phenol, 4,4'-(1-methylethylidene)bis-, polymer with 2,2'-[(1-methylethylidene) bis(4,1-phenyleneoxymethylene)]bis[oxirane]; Aluminum hydroxide; Dapsone; Rosin; **Wire:** Copper; Polyphenylene Ether; **Stain:** Water; Propanoic acid, 2-methyl-, monoester with 2,2,4-trimethyl-1,3-pentanediol; **Wood Gelatin Glue:** Gelatins; Water; **Connector:** Carbonic acid, polymer with 4,4'-(1-methylethylidene)bis[phenol]; Copper; **Wool Felt:** Wool; Pigment; **Hemp Cord:** Hemp; **Glue:** 2-Propenoic acid, 2-cyano-, ethyl ester; **Birch Dowel:** Birch

Living Building Challenge Criteria: Compliant

I-13 Red List:
■ LBC Red List Free
□ LBC Red List Approved
□ Declared

% Disclosed: 100% at 100ppm
VOC Content: Not Applicable

I-10 Interior Performance: Not Applicable
I-14 Responsible Sourcing: Low Risk Wood

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INTERNATIONAL LIVING FUTURE INSTITUTE™ living-futures.org/declare

How far is the final product travelling? How far did the components have to travel?

How long will this luminaire last?

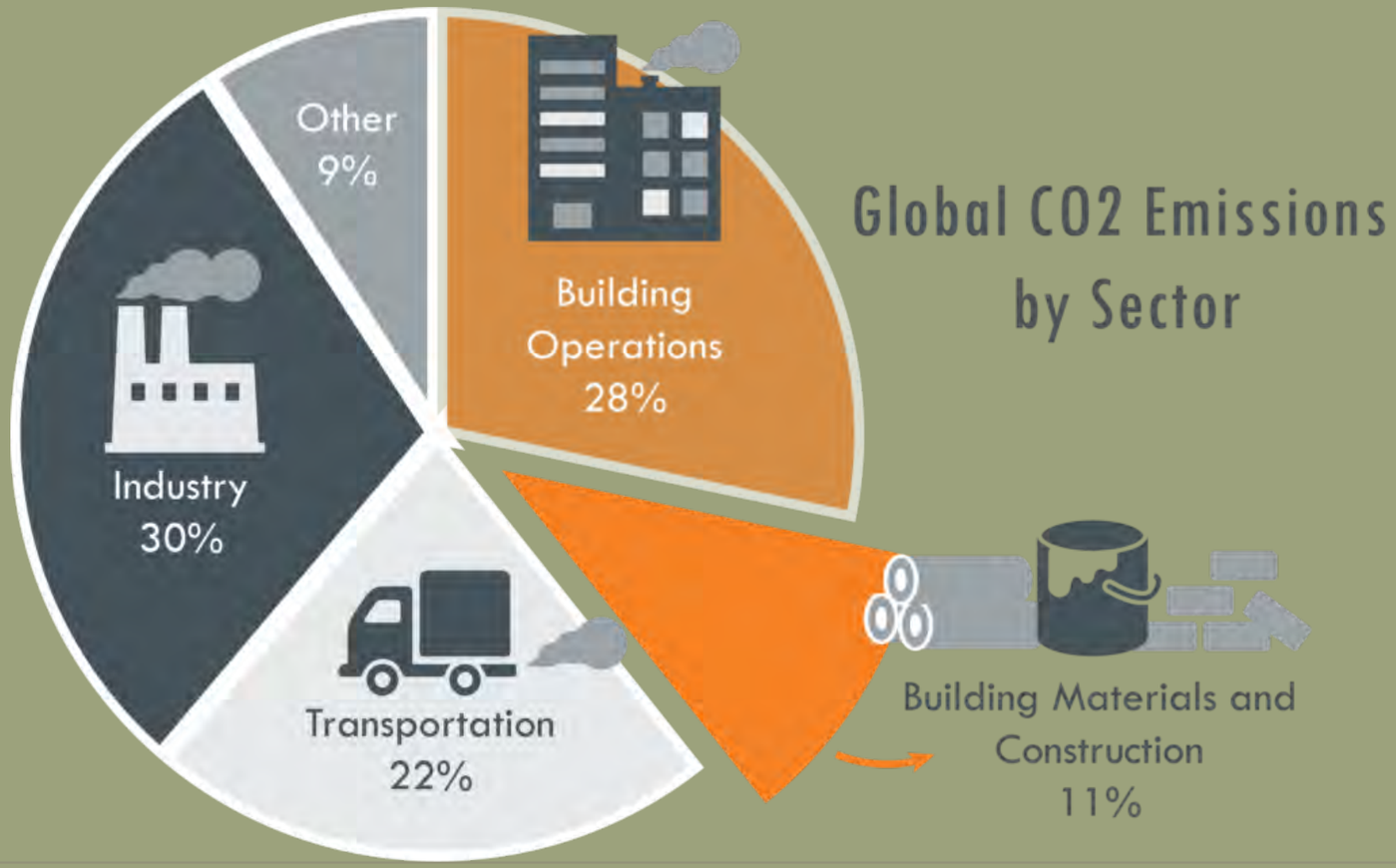
What % is biodegradable and recyclable?

Are the core ingredients bio-based or petroleum-based? How toxic is the manufacturing of these ingredients?

Is the luminaire Red List Free or simply approved or declared?

Are there any VOCs in the product?

problem: embodied carbon in buildings makes up 11% of Global Carbon Emissions



heavy-carbon material highlight: concrete

Cement accounts for 7% of global emissions, with the majority being used in concrete in buildings.

Concrete is cheap and plentiful, but requires intensive energy to manufacture

ways to reduce the carbon footprint of concrete:

1. Optimize Mix: Using more fly ash (probable carcinogen) reduces the energy intensity, but also weakens the product

2. Plant-Based Additives: Adding hemp fibers or Starch lowers the Carbon Footprint

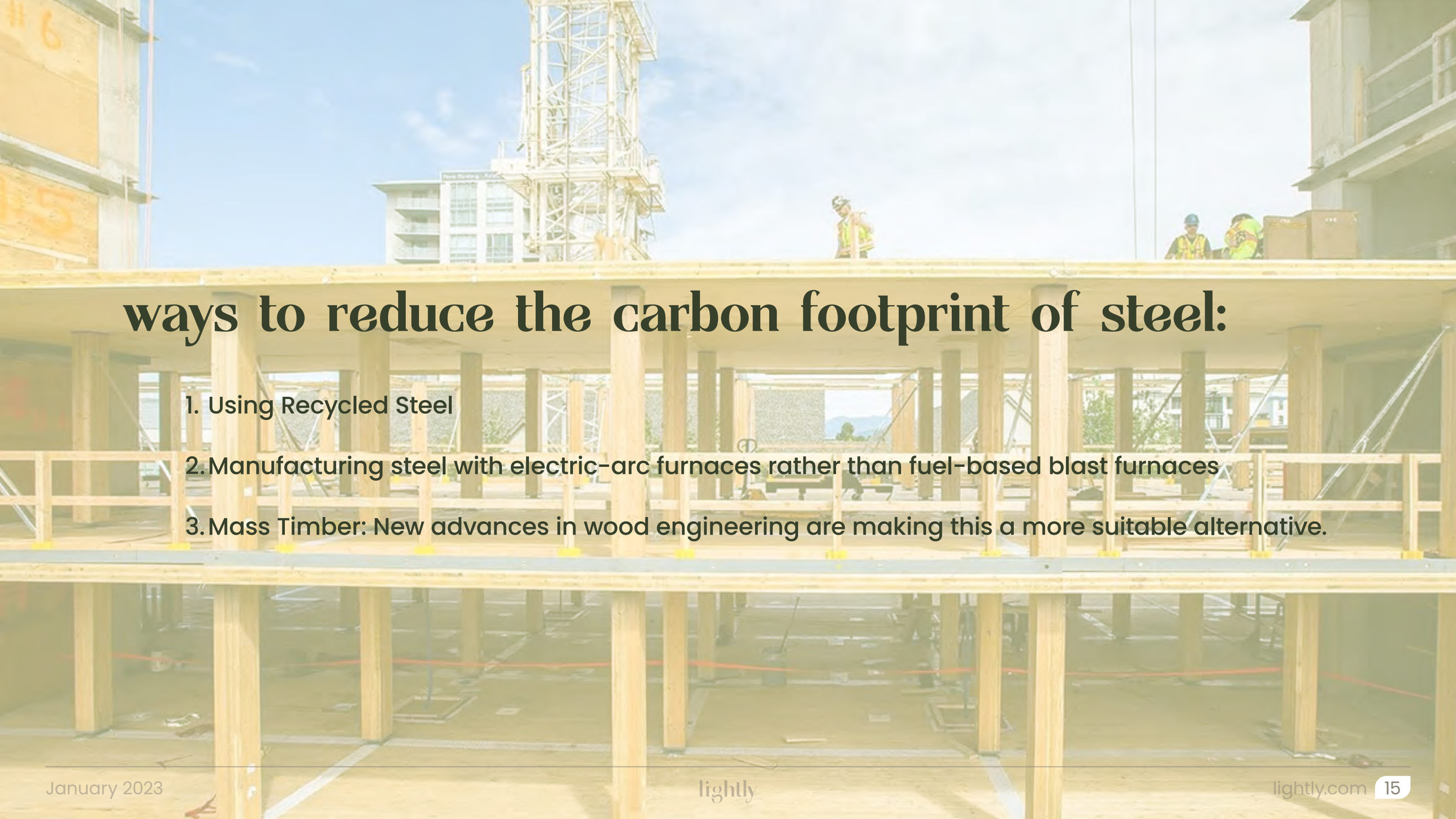
3. CO2 Injection: Startups such as CarbonCure are taking CO2 from flue gas and permanently storing it inside the concrete.

4. Mass Timber: New advances in wood engineering are making this a more suitable alternative.

heavy-carbon material highlight: steel

Steel accounts for 7% of global emissions, with the majority being used in buildings.

Steel is cheap and plentiful, but requires intensive energy to manufacture



ways to reduce the carbon footprint of steel:

1. Using Recycled Steel
2. Manufacturing steel with electric-arc furnaces rather than fuel-based blast furnaces
3. Mass Timber: New advances in wood engineering are making this a more suitable alternative.

heavy-carbon material highlight: aluminum

Aluminum accounts for 3% of global emissions, with heavy usage in buildings

Aluminum is cheap and plentiful, but requires intensive energy to manufacture

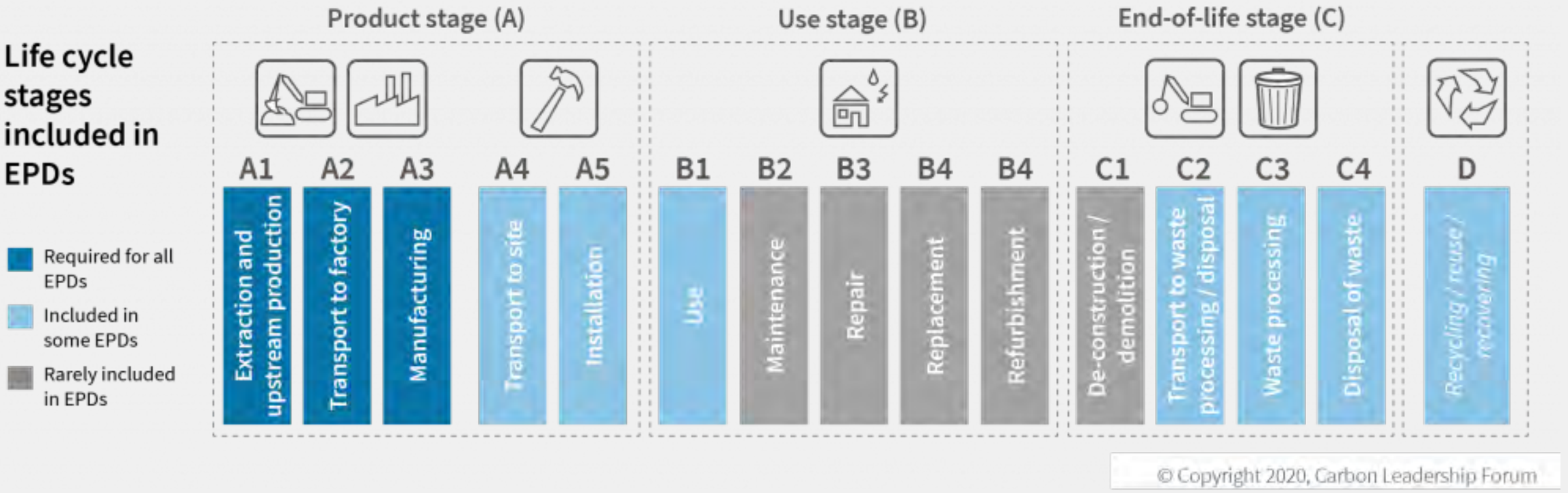
ways to reduce carbon footprint of aluminum:

1. Using Recycled Aluminum

2. Using Alternative Materials

environmental product declarations:

measuring the carbon footprint of products



environmental product declarations:

how to read

3. LCA Calculation Rules

3.1 Declared Unit

For a full cradle-to-grave study as specified by the PSR the functional unit is “Provide lighting that delivers an outgoing artificial luminous flux of 1,000 lumens during a reference lifetime of 35,000 hours”. This scope of this EPD is “cradle-to-gate” therefore the reasonable declared unit is for the manufacture of a single lighting fixture produced at Lightly’s manufacturing facility. This EPD is developed to support a future cradle-to-grave study for the specified fixture.

note the Declared Unit to compare apples-to-apples

Table 3: Description of the System Boundary (x: included in LCA; mnd: module not declared; mnr: module not reported)

Product			Construction Installation		Use							End-of-Life				Benefits Beyond the System Boundary		
Raw Material Supply	Transport	Manufacturing	Transport	Construction / Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	De-Construction/ Demolition	Transport	Waste Processing	Disposal	Reuse	Recovery	Recycling
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D	D	D
x	x	x	mnd	mnd	mnd	mnd	mnr	mnr	mnr	mnd	mnd	mnd	mnd	mnd	mnd	mnd	mnd	mnd

note the system boundary

Table 4. LCIA Results for Cradle-To-Gate Production of Butterfly Linear Pendant

Environmental Indicator	Abbreviation	Units	Total	A1	A2	A3
Core Mandatory Impact Indicator						
Global warming potential	**GWP**	kg CO_2-eq	2.64E+01	2.58E+01	5.35E-01	4.95E-02
Depletion potential of the stratospheric ozone layer	**ODP**	kg CFC-11-eq	9.63E-07	9.60E-07	2.03E-11	3.29E-09
Acidification potential of land and water	**AP**	kg SO_2-eq	1.35E-01	1.28E-01	6.94E-03	1.35E-04
Eutrophication potential	**EP**	kg PO_4-eq	1.49E-01	1.48E-01	3.78E-04	2.87E-04
Formation of tropospheric ozone	**SFP**	kg O_3-eq	1.60E+00	1.40E+00	2.00E-01	1.36E-03
Abiotic depletion potential for fossil resources	**ADPf**	MJ Surplus	2.29E+02	2.22E+02	6.84E+00	5.69E-01
Fossil fuel depletion	**FFD**	MJ Surplus	1.60E+01	1.49E+01	1.02E+00	5.22E-02

compare products by looking at GWP total

how to encourage your favorite manufacturers to invest in sustainability

toxic materials

- Do you have a Declare Label or similar?
- Are you Red-List Free or similar?

low-carbon

- Do you have an EPD?
- What is your GWP?

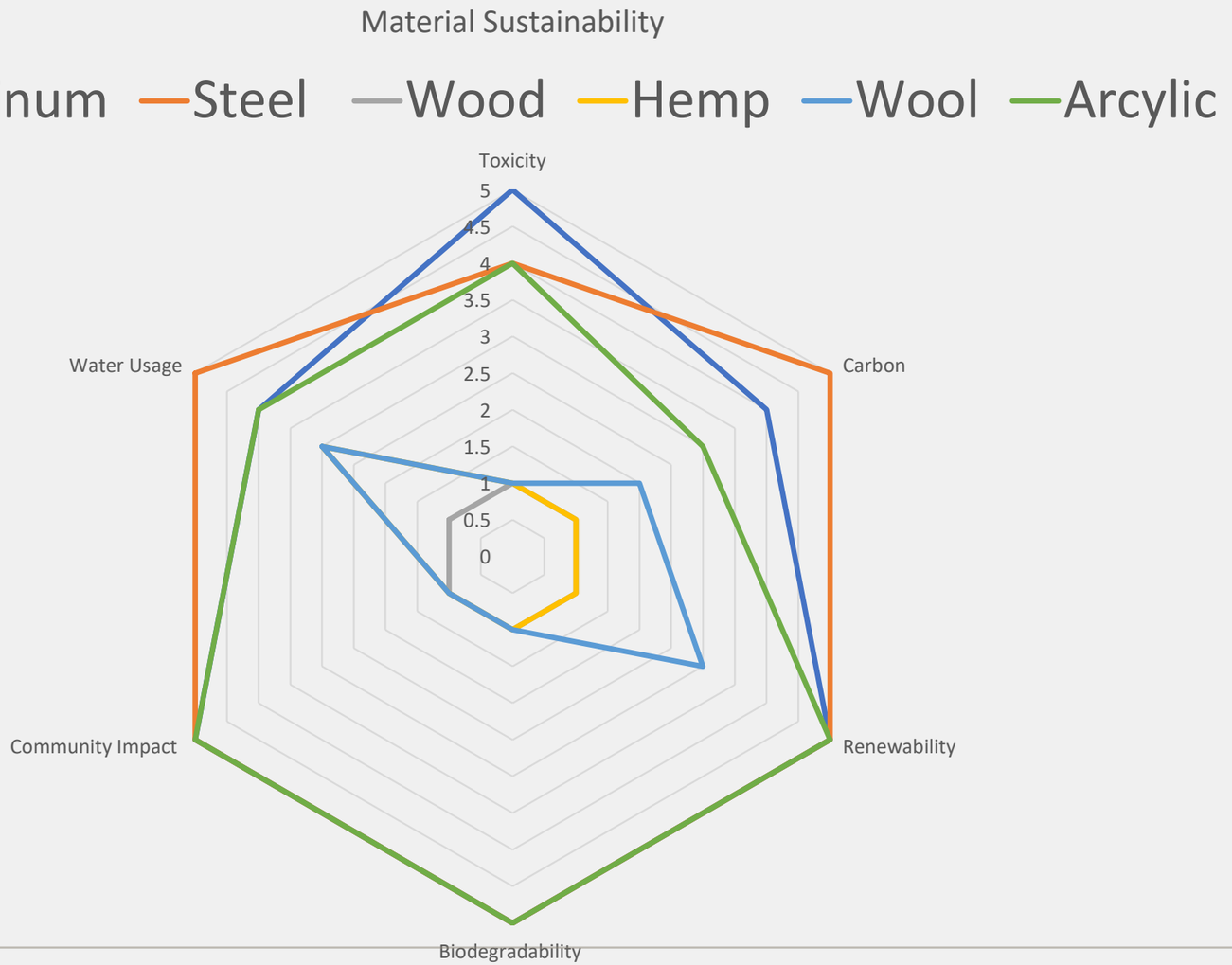
additional considerations

- Performance
- Aesthetic
- Price
- Leadtime

factors to consider in sustainability

- Renewability: Mother Earth has limited resources, some are renewable (plants, trees) and some are not (petrochemical-based materials, minerals).
- Recyclability: Recycled Aluminum and Steel can create significant energy savings. However, today it is unlikely that a large number of luminaires are recycled due to their complexity. Recycled plastic has overall very low recycling rates and often ends up in a landfill or incinerated.
- Community Impact: Does the manufacturing of the product create a healthy and safe environment for workers and those that live nearby?
- Water Usage: How much fresh water is required in manufacturing?

sustainability of materials summarized



materials palette

innovative bio-based materials that sequester carbon with the goal of creating a positive impact on our planet.

Pennsylvania proud

The wood is sourced sustainably in compliance with AHEC (American Hardwood Export Council) regulations from the State of Pennsylvania and has the optional ability to be provided with FSC certified chain of custody.

natural fiber

Right off the back of the sheep 100% wool felt custom dyed in a beautiful array of colors.

natural fiber

Hemp is of the most common and fastest growing plants on earth, and can be processed mechanically without chemical treatments.

pure paint

Air purifying paint is water-based, eco-friendly, and formulated without the harsh chemicals found in conventional paints. The protective finish dries to a hard, washable, durable film. This paint absorbs and neutralizes chemicals, pollutants and VOCs for improved indoor air quality.

CASE STUDY: SHP NEW OFFICE

Lighting Design

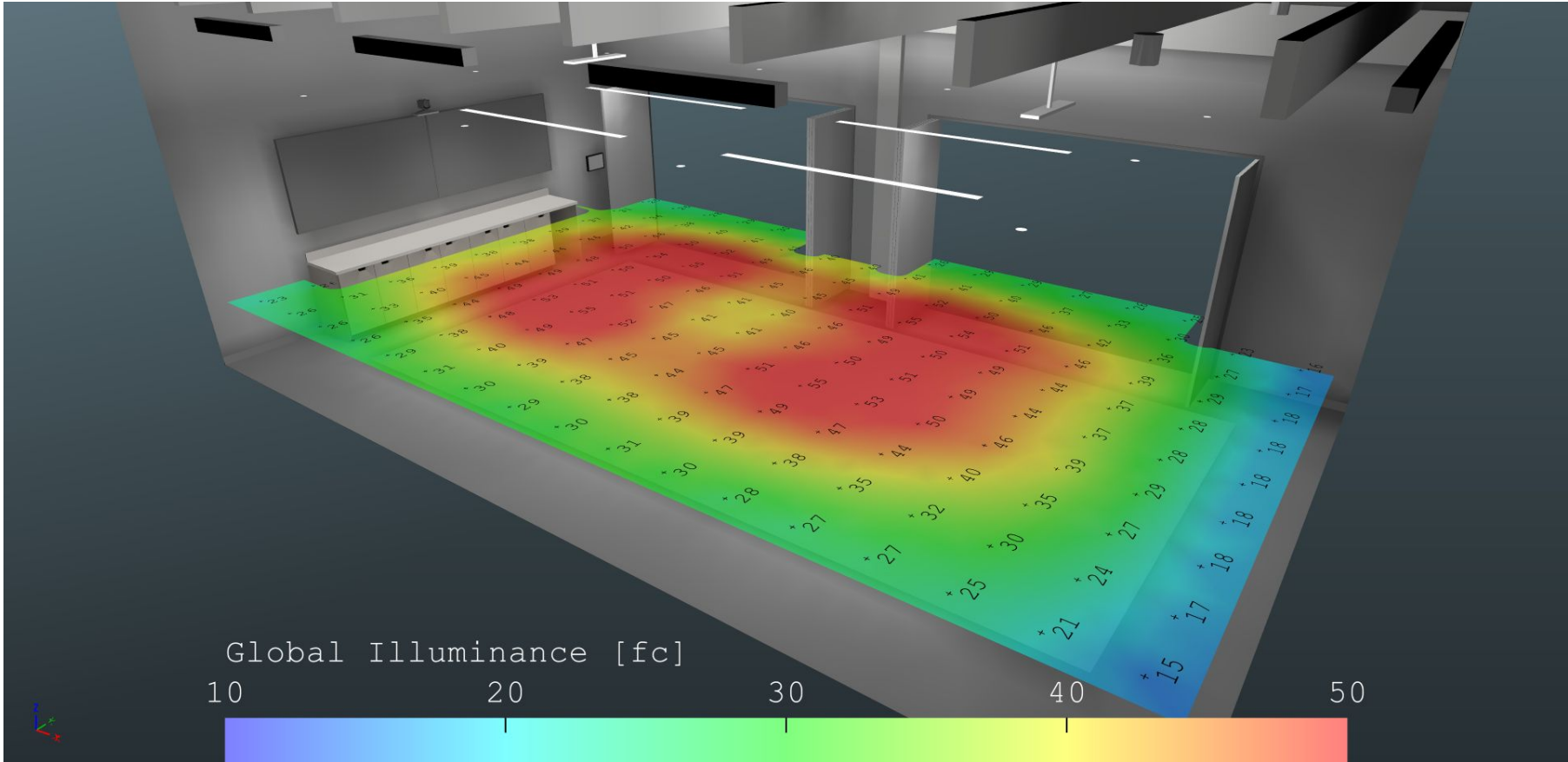
SHP

DESIGN CONSIDERATIONS:
Large Conference Room

1. Lighting Performance
2. Visual Comfort / Low Glare
3. Visual Interest
4. Multi-Zone Control
5. Energy Efficiency / Sustainability

SHP

PHOTOMETRIC CALCULATIONS



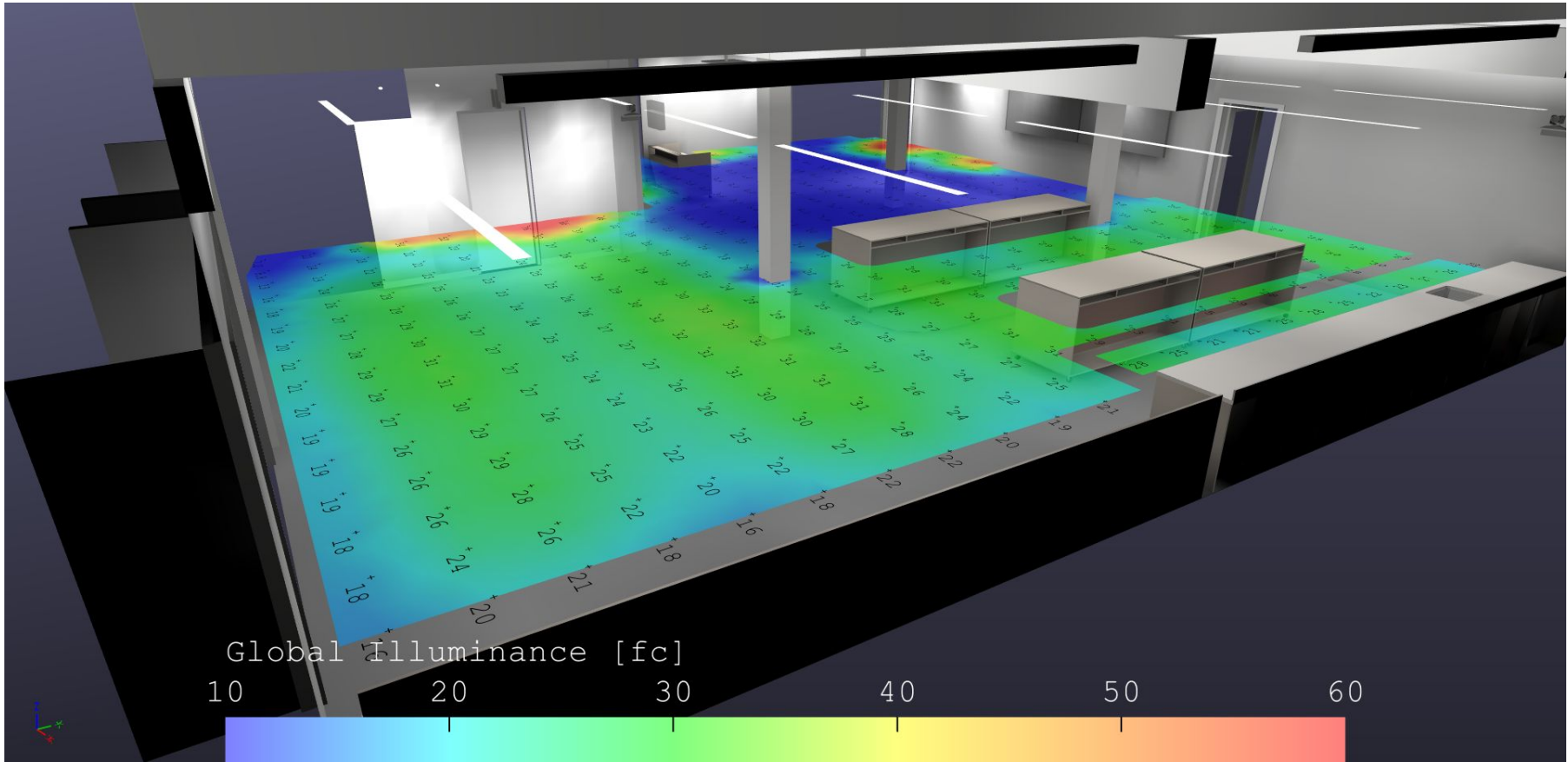

SHP

DESIGN CONSIDERATIONS:
Large Gathering Space

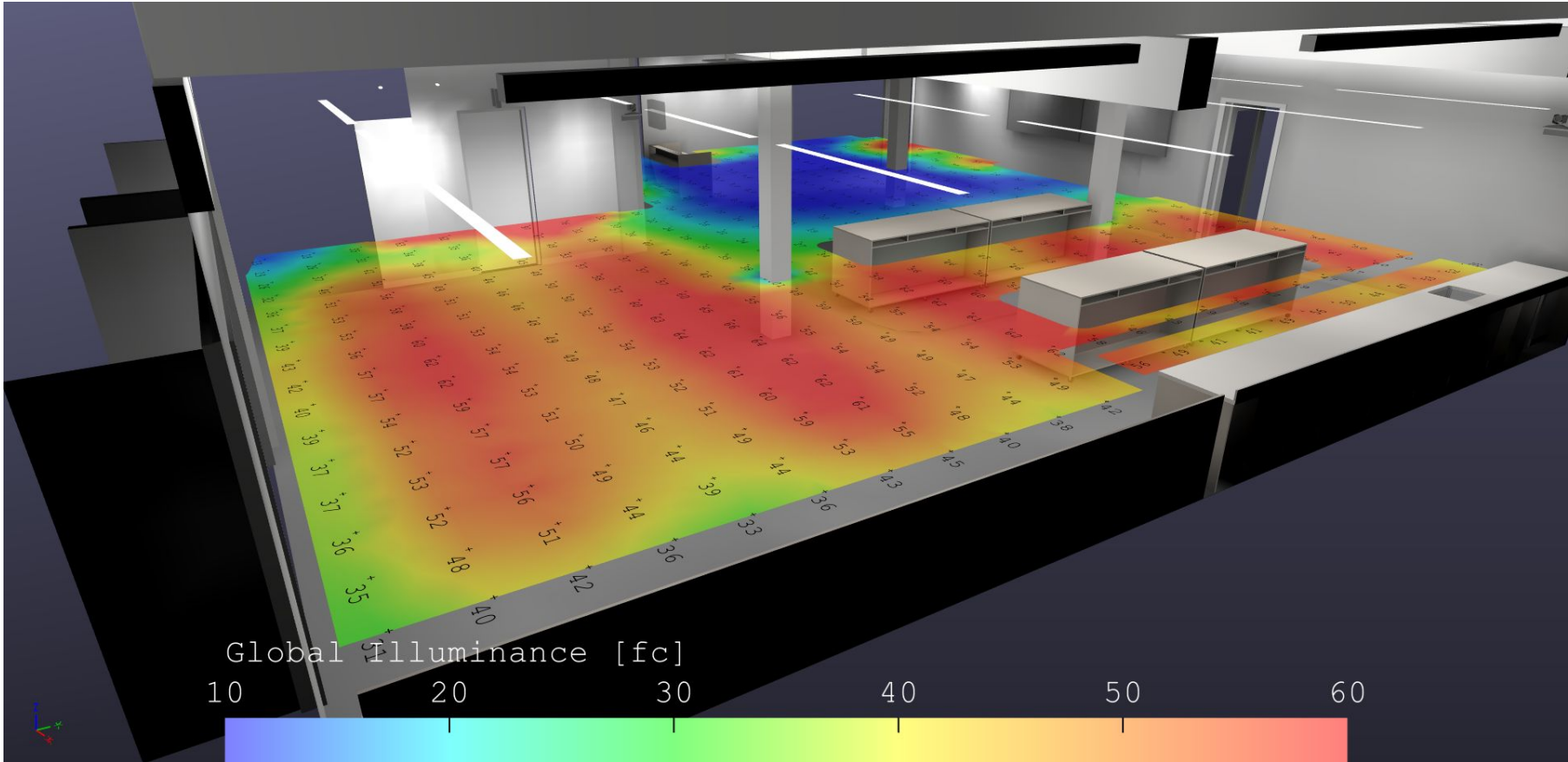
1. Lighting Performance
2. Visual Comfort / Low Glare
3. Visually Unobtrusive
4. Flexibility
5. Energy Efficiency / Sustainability

SHP

PHOTOMETRIC CALCULATIONS - 50% Output (Automatic-On Controls)



PHOTOMETRIC CALCULATIONS - 100% Output (Wall Dimmer)




EXIT
SHP