

Sustainable Manufacturing

Presented by Aaron Smith
VP of Technology and R&D



Mark Ridler, BDP, <https://youtu.be/kWUAHhfW3V0>

Waste Hierarchy:

Avoid – Remove Harmful chemicals and composites.

Avoid - Increase performance and innovate to use less lighting.

Reduce – Reduce Carbon. Know the life cycle costs and try and improve them.

Reuse – Design for long life and serviceability.

Recycle – Make all components capable of recycling including packaging

Transparency (Avoid)

- Eliminate harmful chemicals
- Drive this through the supply chain

Challenges

- We need material alternatives
 - PVC
 - Phthalates
- Electronics components
- Supply chain traceability
 - Blockchain
 - Smart contracts

Declare.

Product Name
Manufacturer

Final Assembly: First City, State, Country;
Second City, State, Country; Third City, State, Country
Life Expectancy: 50 Years
Embodied Carbon: # kg CO₂-eq —
Declared Unit: # m²
End of Life Options: Recyclable (95%), Landfill (5%),
Take Back Program (Program Name/Location)

Ingredients:

Your First Component: Sustainably Sourced Ingredient;
LBC Red List Ingredient; **Your Second Component:**
LBC Watch List Priority for Inclusion; Non-Toxic Ingredient;
Undisclosed (<0.1%)²

¹LBC Temp Exception RL-009 Formaldehyde
²LBC Temp Exception RL-004var.a Proprietary Ingredients

Living Building Challenge Criteria: Compliant

I-13 Red List:
 LBC Red List Free **% Disclosed:** 99.9% at 100ppm
 LBC Red List Approved **VOC Content:** # g/L
 Declared

I-10 Interior Performance: CDPH Standard Method v1.2-2017
I-14 Responsible Sourcing: Product Available with FSC Chain of Custody

XXX-XXXX
EXP. 01 OCT 2021
Original Issue Date: 20XX

Third Party Verified

MANUFACTURER CLAIMS VERIFIED BY THIRD PARTY VERIFIED ASSESSOR
INTERNATIONAL LIVING FUTURE INSTITUTE™ living-future.org/declare

Final Assembly Locations are collectively represented on a single label.

Embodied Carbon (optional) discloses the cradle-to-gate impacts of manufacturing the product as reported by manufacturer-specific Type III Environmental Product Declarations.

End-of-life options: take back programs; salvageable or reusable in its entirety; biodegradable/compostable (%); recyclable (%); landfill (%); hazardous waste.

Ingredients are reported by component. Ingredients without restriction appear in grey; **Red List chemicals appear in dark orange;** **Watch List Priority for Inclusion chemicals appear in light orange.**

LBC Temporary Exceptions recognize specific market limitations and provide a compliance pathway for products to obtain LBC Compliance recognition.

Declare Identifier for company and product, valid for 12 months.
Original Issue Date indicates how long a product has been a registered product in the program.

LBC Criteria Compliance demonstrates compliance with all Imperatives applicable to the selection of building products within the Living Building Challenge. If a product meets the requirements for all applicable Imperatives, the product is considered fully compliant with the Living Building Challenge, and will be noted as such on the Declare label graphic itself.

I-13 Red List requires that manufacturers disclose the ingredients and VOC content (if applicable) in their products to ensure that they are free of Red List chemicals.

I-10 Interior Performance requires compliance with the California Department of Public Health (CDPH) Standard Method v1.1-2010 (or international equivalent) for all interior building products that have the potential to emit Volatile Organic Compounds (VOCs). The Declare label confirms a product's compliance with CDPH or an equivalent emissions standard.

I-14 Responsible Sourcing requires that manufacturers of wood products demonstrate sustainable extraction through certification with the Forest Stewardship Council, by meeting ILFI's definition of low risk or salvaged wood, or through the use of a formal LBC Exception.

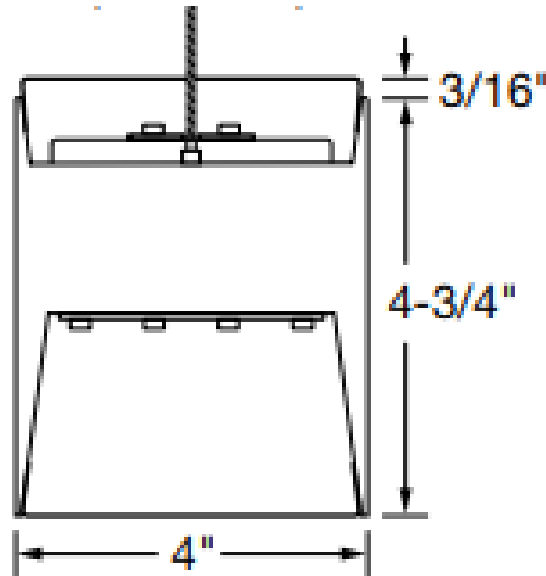
Third Party Verification indicates assessment by a professional third-party assessor to ensure the accuracy of the manufacturer's supply chain, purchasing, ingredient claims, LBC compliance, and embodied carbon if reported.

Eliminate Materials (Avoid)

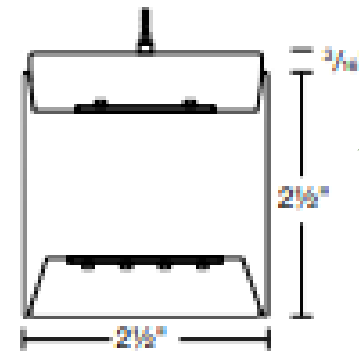
- Less weight
- Higher performance

Challenges

- Component size



1972 lm/ft
106 lm/W
3.4 lb/ft



2046 lm/ft
119 lm/W
2.3 lb/ft

32% Less Weight

Build with Ocean Plastics (Reduce)



Challenges

- Consistent supply
- Consistent performance
- Manufacturing partners
- Compliance
- Cost

Print your trash (Reduce)



- Pick, Clean, Shred and Print
- Distributed Recycling and Additive Manufacturing (DRAM)
 - <https://theconversation.com/how-to-turn-plastic-waste-in-your-recycle-bin-into-profit-147081>

<https://thenewraw.org/>

Natural Materials (Reduce)

Bamboo



Bamboo vs Aluminum

Challenges

- Most bamboo lumber is made outside the US and imported.
- Looking for materials that can be sourced in the US.
- Cost is much higher and much of the value of the lumber is milled away
- Much harder for us to design around and process

Life Cycle Assessment (LCA)

Global warming potential (to produce 1kg of material)

- Bamboo Lumber
 - GWP = 8 – 4kg CO₂
- Standard Aluminum Processes
 - GWP = 8 – 5 kg CO₂
- State of the Art Aluminum Processes
 - GWP = 4 – 2kg CO₂
- Recycled Aluminum (est.)
 - GWP = 1 - 0.5 kg CO₂

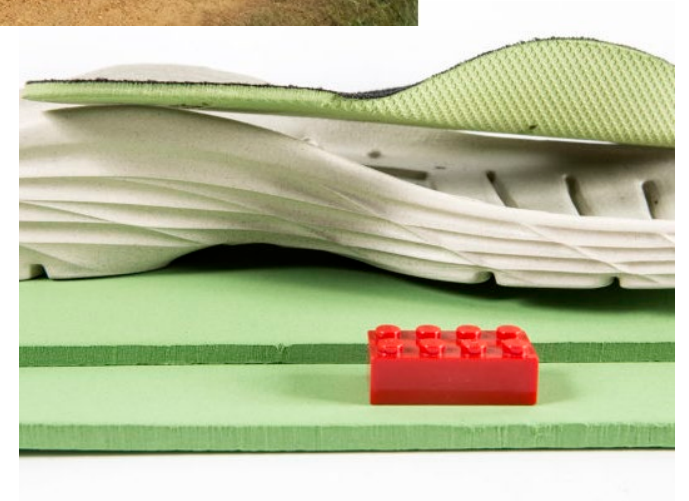
Natural Materials (Reduce)

Algae Foam

- Replace a plastic neoprene gasket with a bioderived alternative
- Algae sourced from waterways with high risk of algae blooms.
- Removes toxic nuisance species and converts into a useful material
- Algae foam is currently a blend of plastic and algae that lowers carbon footprint compared to plastic alone.

Challenges

- Small plastic parts are hard to recycle and likely end up in landfills
- Looking for completely biodegradable alternative.



Natural Materials (Reduce)

Molded Pulp

- Reduces packaging waste
- Equal shipping performance
- Faster to package
- Faster to unpackage

Challenges

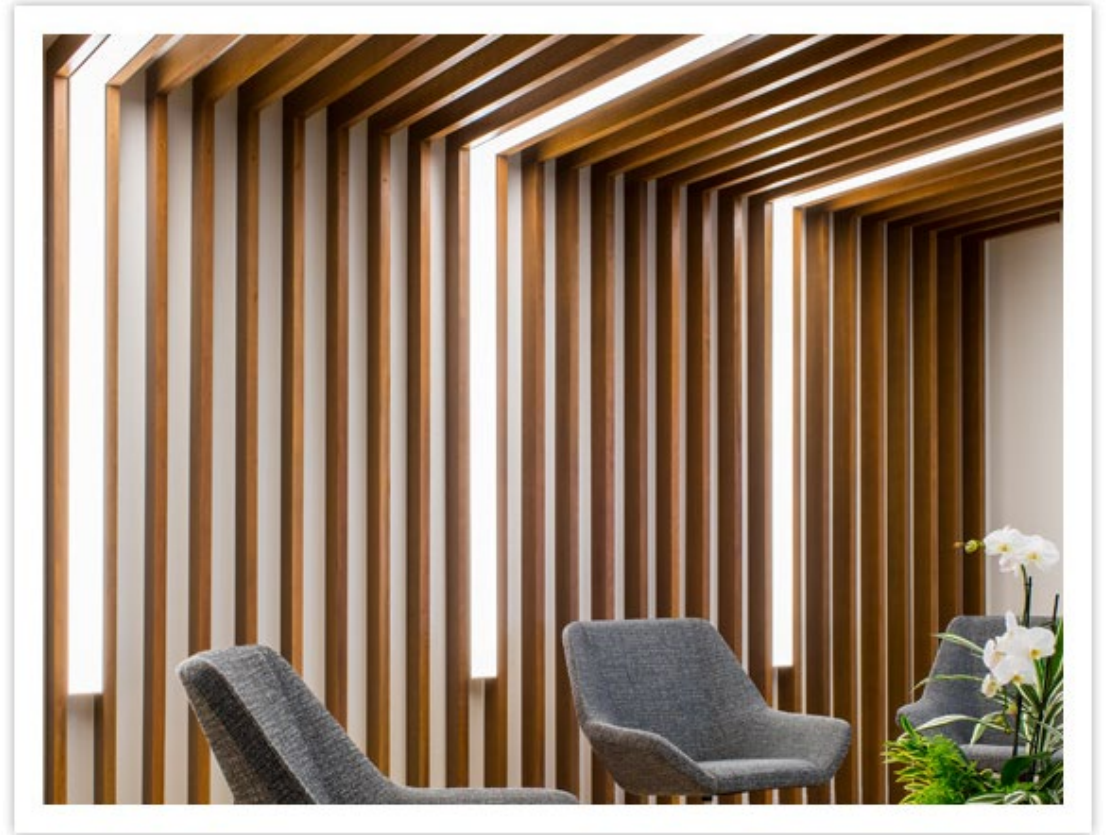
- Lighting market adoption
- Develop for more durable applications



Jump Start New Approaches

Consider adding sustainability requirements to all DOE RFP's and give preference to:

- Developing technology that is recyclable, reusable and free of harmful chemicals.
- Investigating materials and designs that can be used to feed the circular economy at the end of life.
- Make optics, lenses and other components out of ocean plastics.
- Explore trash recovery for large scale 3D printing and extruding.
- Develop US based natural supply chains like bamboo, algae, molded pulp for use in new lighting technologies.



Thank You!