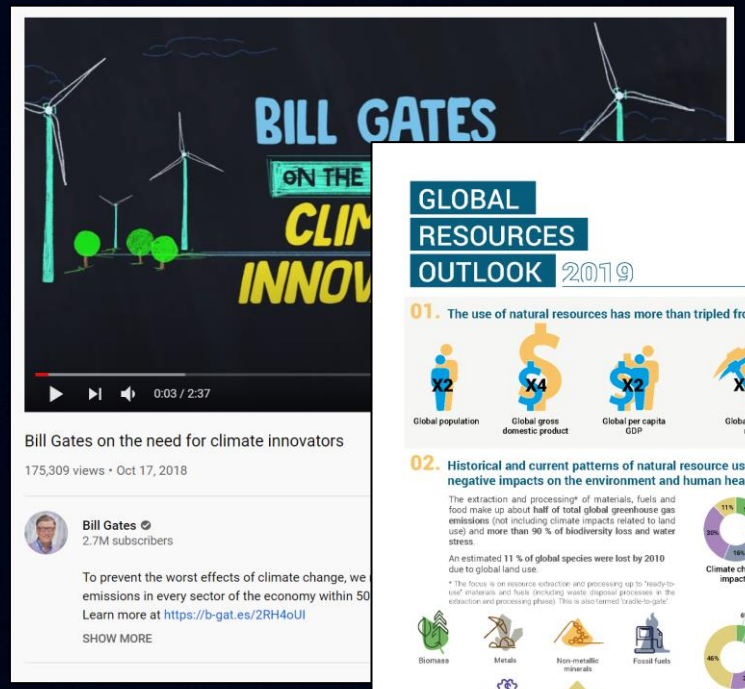
# SPECIFYING A BRIGHT FUTURE:

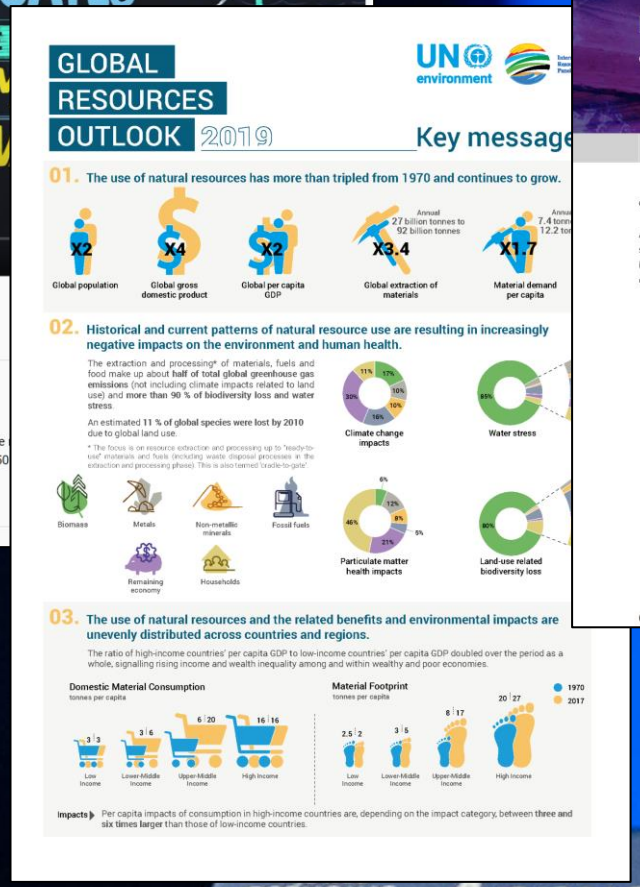
## DECARBONIZING AND DETOXIFYING LIGHTING SYSTEMS

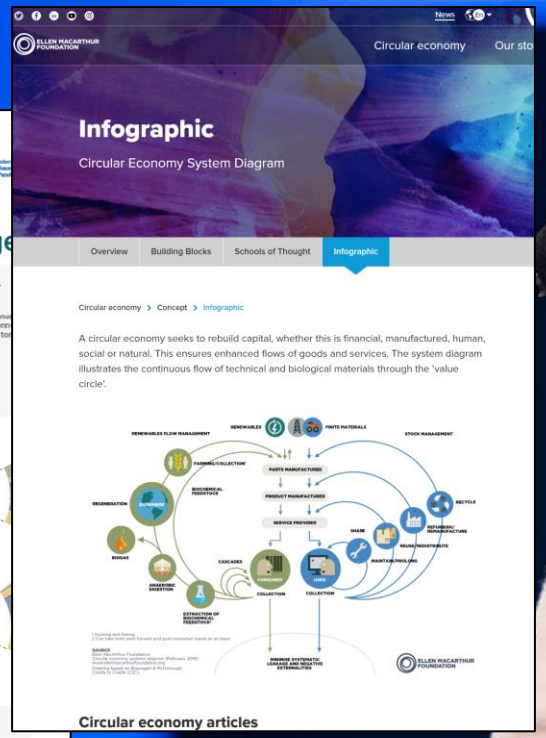
BRAD KOERNER

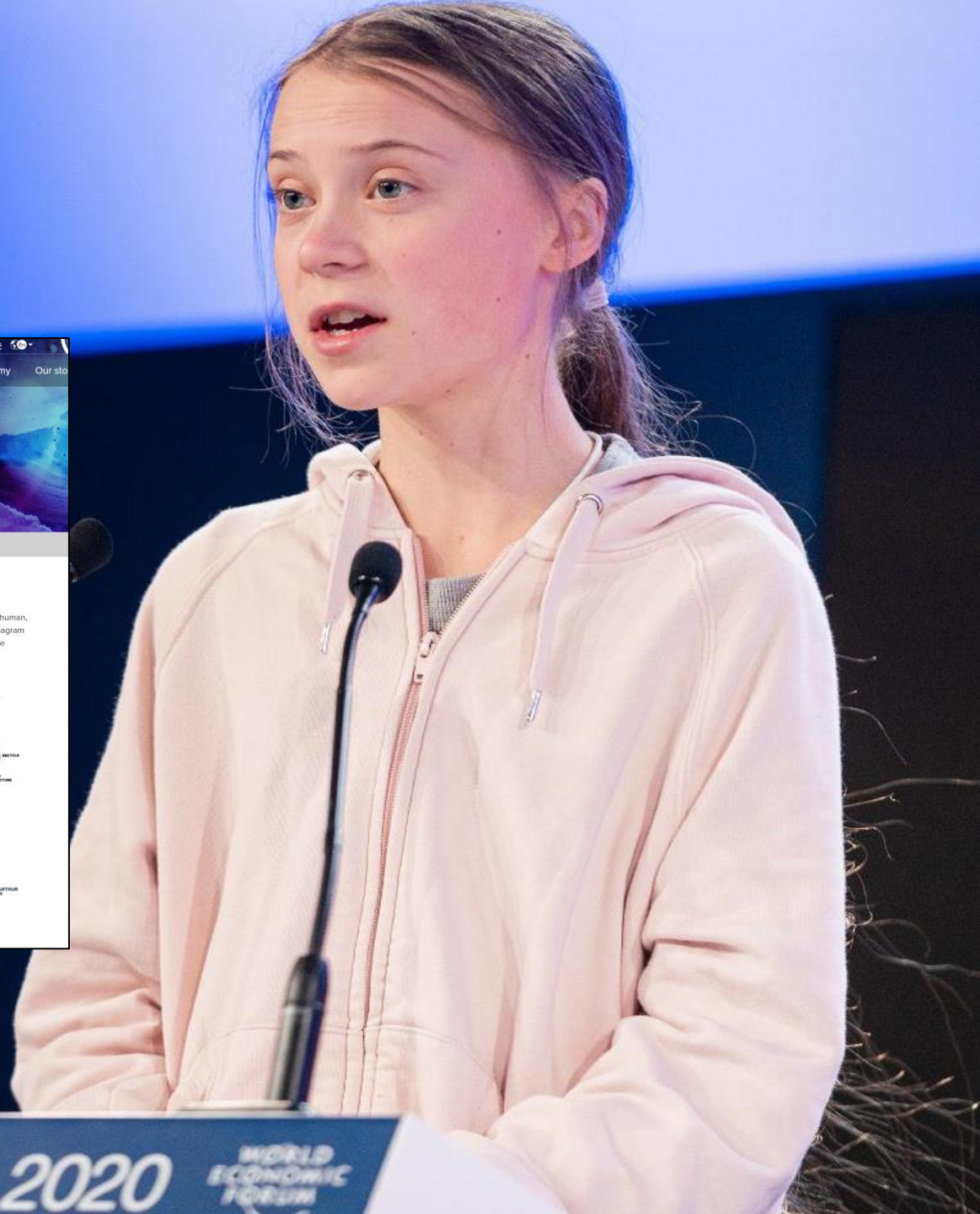
09-FEB-2022

# GLOBAL CARBON ACTION



# A LOUD AND GROWING CHORUS OF DESIGN PROFESSIONALS


Check out this very nicely constructed presentation on engaging with circular economy design principles in architectural lighting projects from Mark Ridler, Head of Lighting Design at **BDP**, a global architecture/engineering design firm. From this year's **LpS Digital Symposium** (associated with industry journal **LEDs Professional**).


Glad to see many of the **core principles I've espoused over the years** coming together in real projects.

## SUSTAINABLE LIGHTING: HOW CAN WE DO BETTER

Published on April 22, 2021

Paul Nulty
Founder: Nulty. Nulty Bespoke, Studio N. London. Dubai. Miami. Bangkok.
Architectural lighting design consultant
84 articles ✓ Following

### ENVIRONMENTAL IMPACT

Words by **Paul Nulty**

The life of a lighting designer is a double-edged sword. On the one hand it's our job to improve the quality of spaces for people. We fill these spaces with emotion, interest and drama; we create more user-friendly environments, improve efficiencies in the workplac help retailers sell more goods, create experiences and destinations, save energy and even assist end-users through improved health and wellbeing.

Yet for all the benefits we bring to a space we have to wrestle with the detriments. Every watt of energy we use on a project is another watt of energy burned. Designing energy-efficient lighting schemes is always a priority, but we also understand that creating an emotional connection between a user and a space isn't always conducive to the most ene efficient solution. (Most energy-efficient schemes often have maximised spacings of luminaires and relatively homogeneous light levels – functionality over design.) So, as designers, we're often using a little more energy to generate a lot more "emotion and connection". But it's still *more* energy, which means *more* cost and does *more* harm to environment.

Like Comment Share 22 · 4 comments

WORKDESIGN MAGAZINE

THE SOURCE FOR NEXT WORK ENVIRONMENTS

Expert Insights

## In Plain Sight: Calculating The Climate-Shifting Carbon Chain

by David Cordell and Jon Penndorf

*Perkins&Will's David Cordell and Jon Penndorf explore how the A&D community can address embodied carbon to help combat climate change in the spaces they design.*

The sources of carbon that fuels climate change range from automobile emissions to volcanic eruptions. But they also hide in plain sight, masquerading as benign construction and furnishing materials like gypsum board and carpeting. Inside the home or office, embodied carbon compromises the future of everyone and everything, from schoolchildren to the American bullfrog in Rock Creek Park. What is embodied carbon? It's the total amount of carbon emissions released during a product's manufacture, transportation, use and disposal.

DESIGNER T

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Ten ways in which architecture is addressing climate change

Lizzie Crook | 19 hours ago | 2 comments

To honour Earth Day, we've rounded up 10 ways architects are reshaping the bu environment to benefit both people and the planet.

Architecture has a large environmental impact, with the built environment accounting for 40 per cent of the UK's carbon emissions in 2019, according to th Green Building Council.

With a 2018 United Nations report warning that humanity now has less than 10 to slow down global warming, the architecture industry is one of many to have b forced to reassess the ways in which it works.

From reducing waste and maximising urban greenery to collaboration and lobb for change, solutions to reduce pressure on the planet are now taking centre sta

Read on for 10 ways in which architects can contribute to a healthier planet:

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## Creating a Better World

Today's business and civic leaders are interested in learning how they can restructure their organizations and communities to become more resourceful, resilient and regenerative. As designers and strategists, we remain committed to providing clients with design solutions that create a better world to live, work and play.

Key Metrics:

600+ million sq ft of sustainable work

188 million sq ft registered for LEED certification

110 million sq ft of LEED certified projects

150 million tons of waste diverted

1.2 billion gallons of water saved annually

700+ USGBC certified projects

1200+ LEED accredited professionals

## Sustainable Leadership

Gensler uses a whole systems view to gain an understanding of our client's context and challenges, applying the appropriate lenses of community, wellness, ecology, materials, water and energy. This approach reveals connections between lenses, enabling design solutions that enhance human wellness, performance, collaboration and experience.



## Leveraging the Power of Design

Sustainable design is producing results that matter to our clients: reduced first-cost and lifecycle energy and operating costs; improved brand recognition; and a quality of life that promotes health and wellness. Our process is tuned for design decision support with robust project information modeling that incorporates computational geometry and performance simulation. A holistic economical-ecological view informs all of our sustainable design solutions.

Learn more about Gensler's Sustainable Design Services to the right.

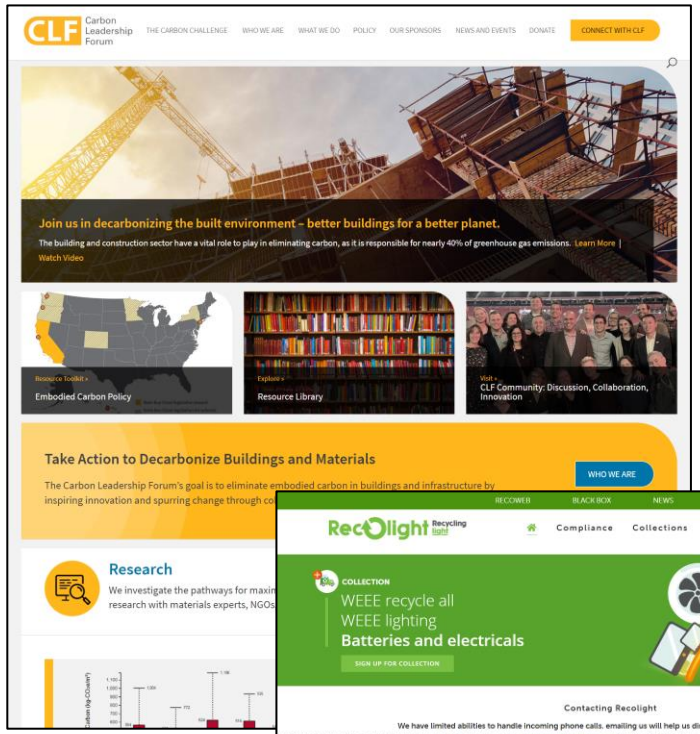
Sustainable Design

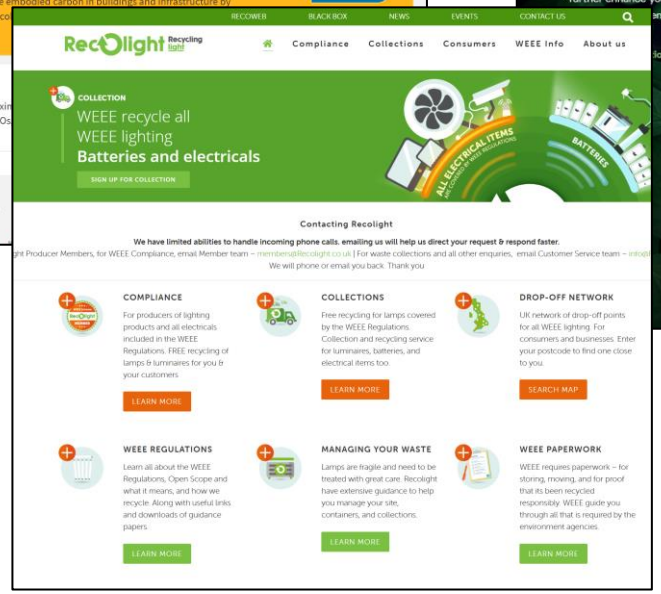
Gensler provides turnkey sustainability support from strategy and planning to implementation and refinement. Our design team provides

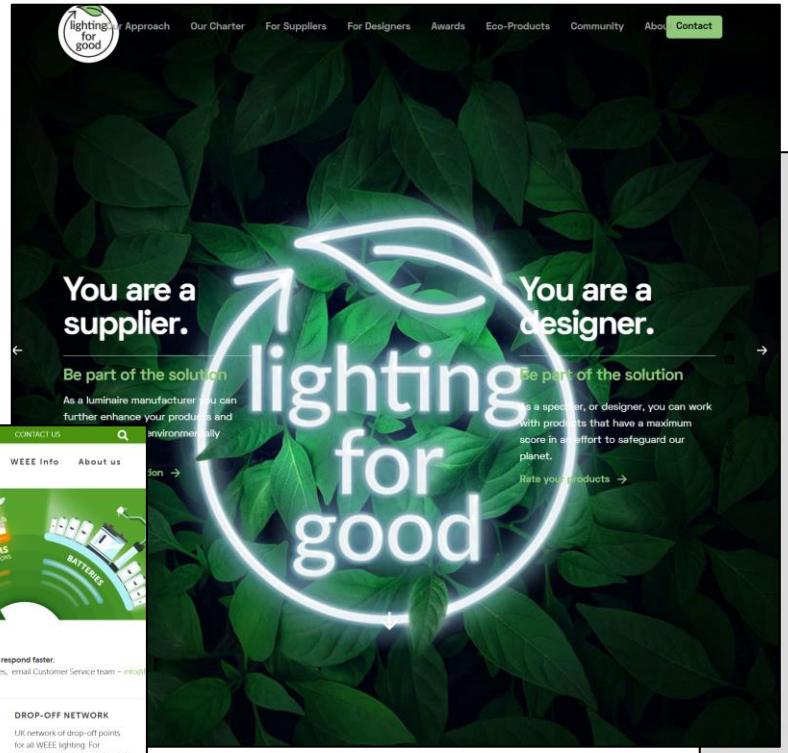
Design Performance

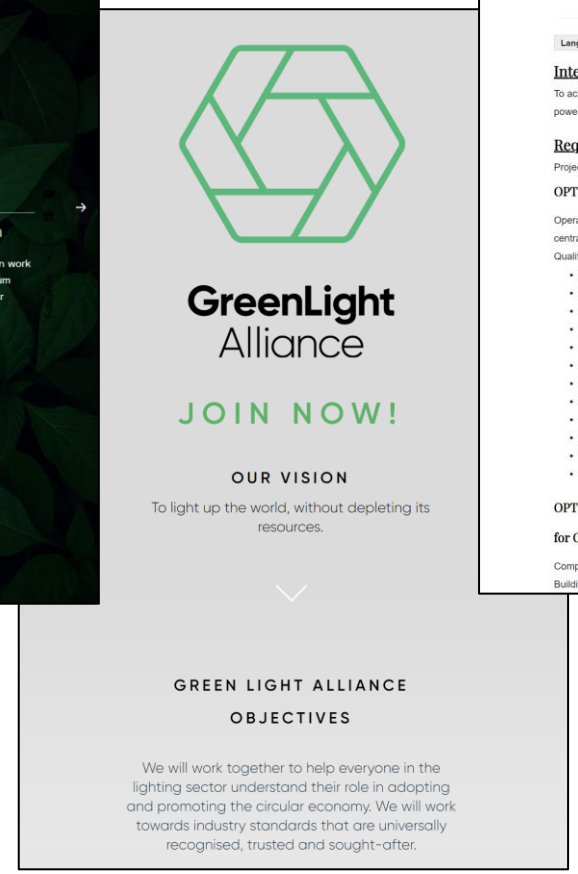
Our integrated sustainability delivery model provides complete sustainable design services including LEED strategy and LEED

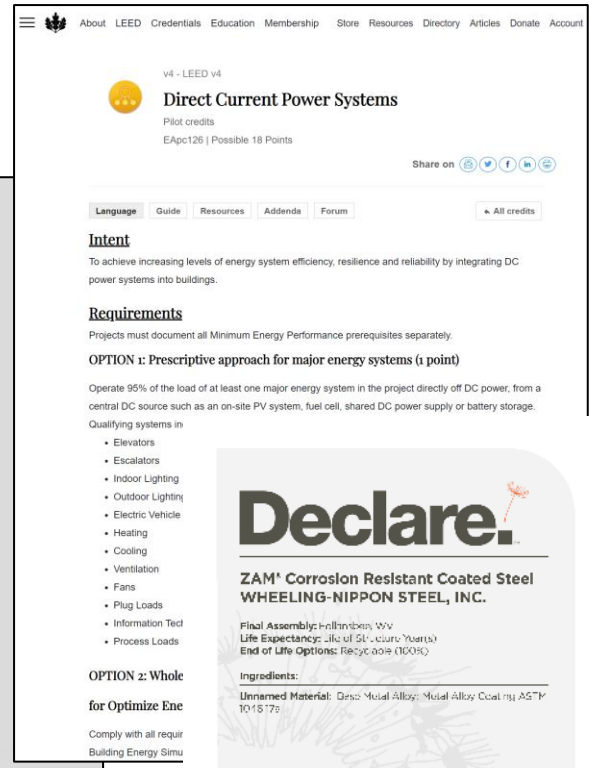
# DECARBONIZED, NET ZERO & CIRCULAR STANDARDS

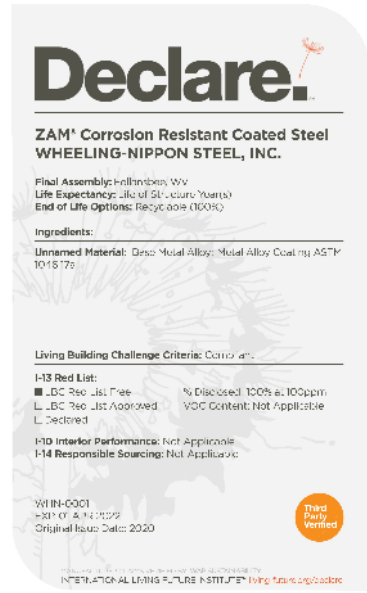


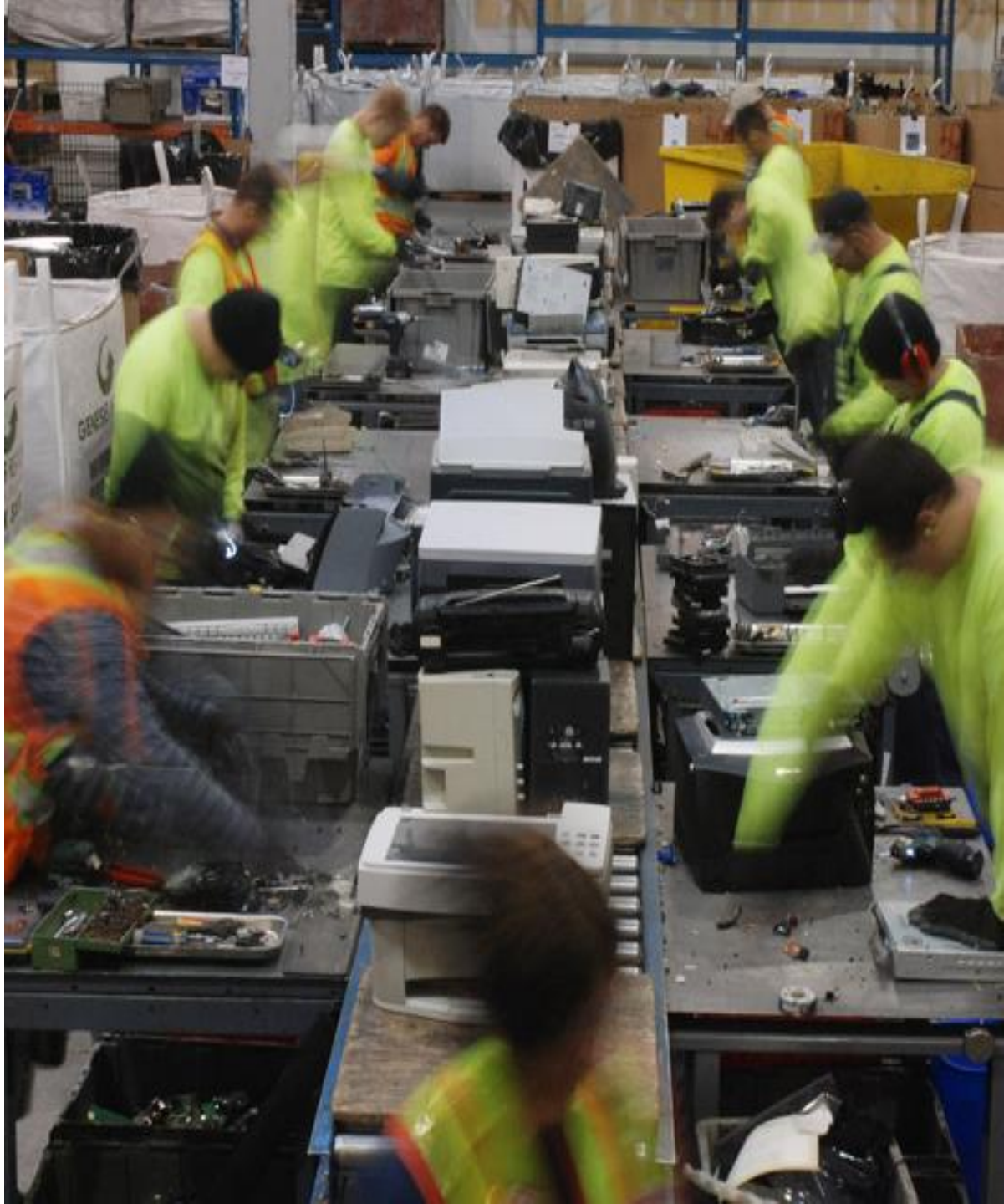




AND YET...
MANUFACTURERS REMAIN FROZEN

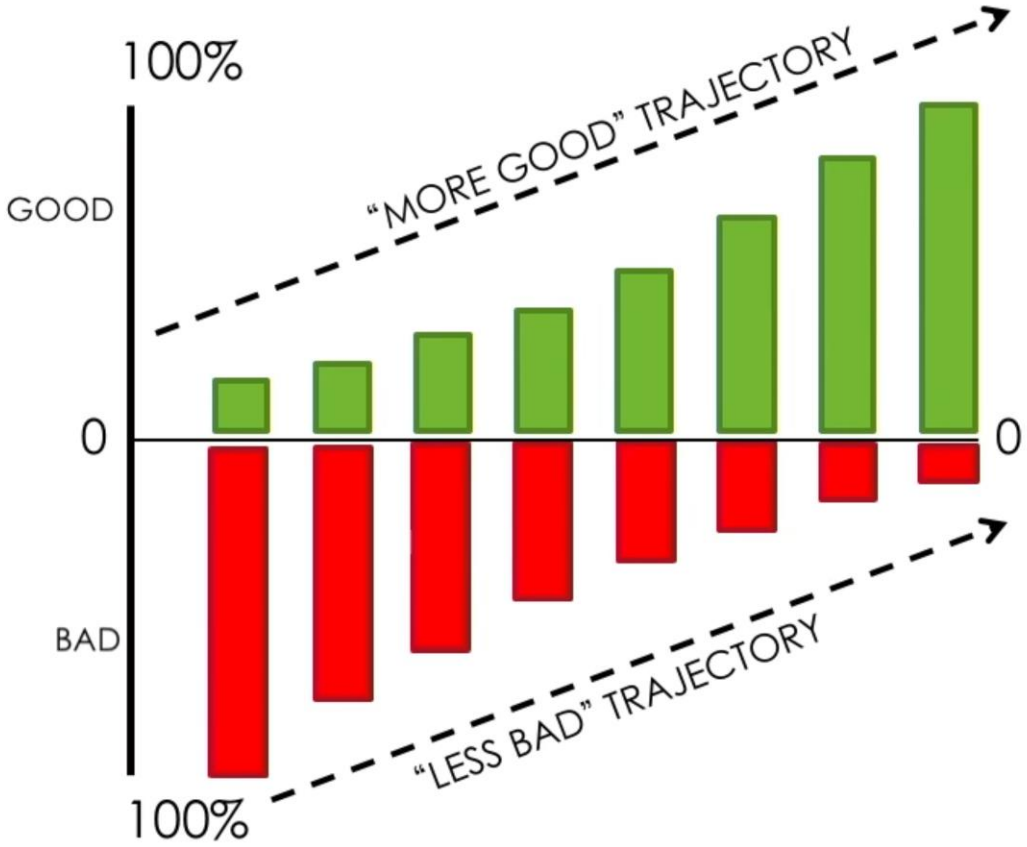

WHY DO OUR LIGHTING PRODUCTS USE SUCH ENERGY INTENSIVE MATERIALS?

# WHY DO OUR LIGHTING PRODUCTS USE SO MANY TOXIC PETROCHEMICALS?

# WHY DON'T PROJECT OWNERS HOLD THE LIGHTING INDUSTRY ACCOUNTABLE FOR LIFECYCLE COSTS?

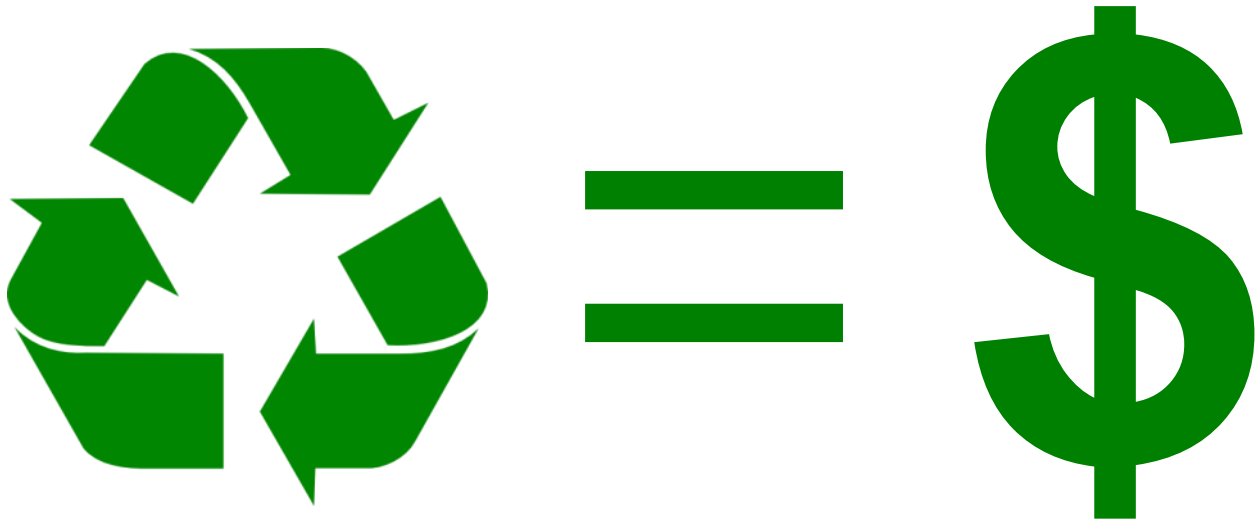



LESS BAD VS MORE GOOD




*"Being less bad is not also being good."*

**–William McDonough**



# DOES “DEEP-GREEN” SUSTAINABILITY LEAD TO RADICAL COST REDUCTIONS?


TREE HUGGING HIPPIES?

# TREE HUGGING HIPPIES?

- ELIMINATING TOXIC MATERIALS
- ELIMINATING OVERSPEC'D MATERIALS
- ELIMINATING NEEDLESS COMPONENTS
- FAST DISASSEMBLY
- REPAIRABLE, MODULAR
- RECLAMATION OF RESIDUAL VALUE

~~TREE HUGGING HIPPIES?~~

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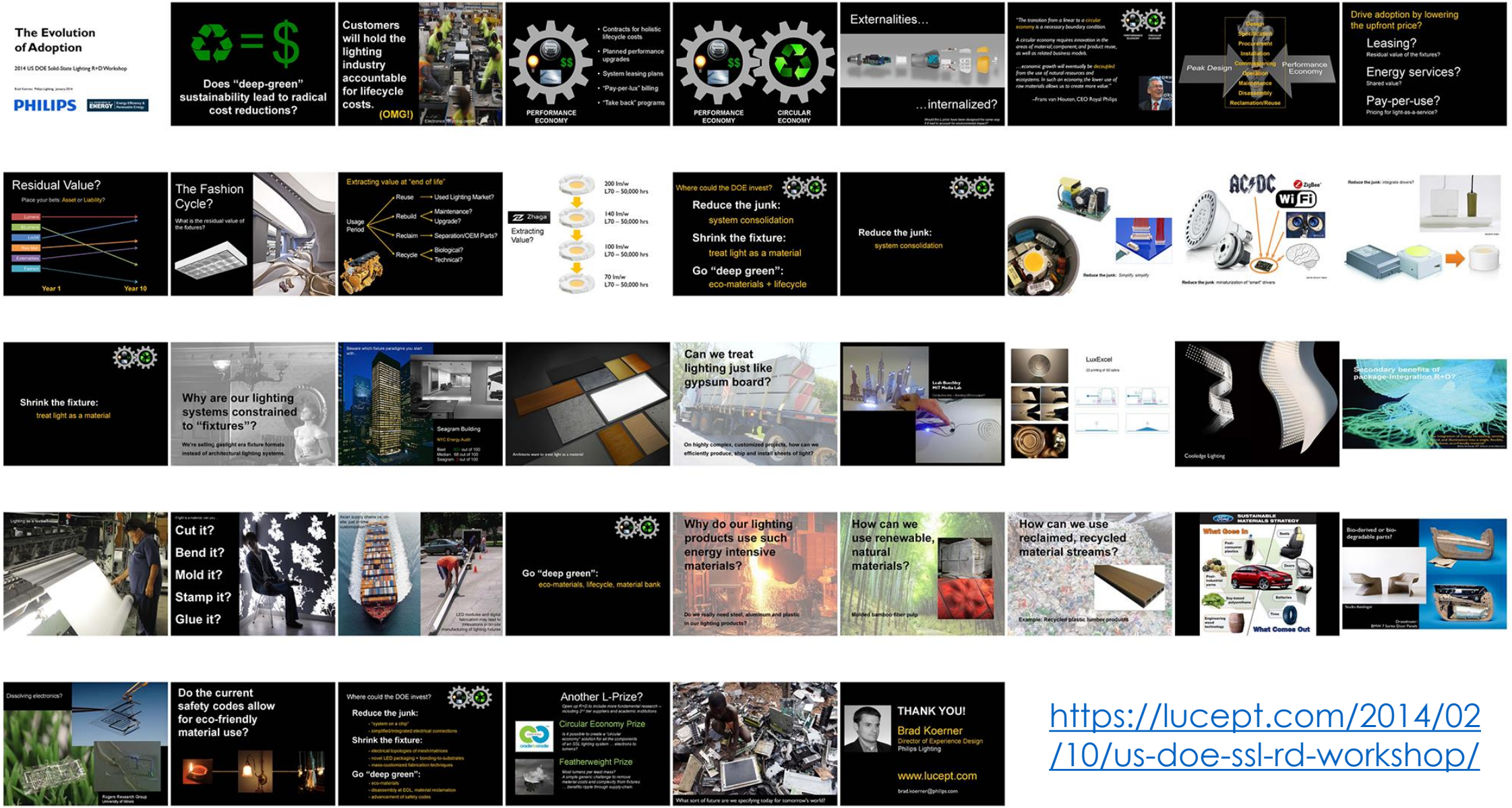
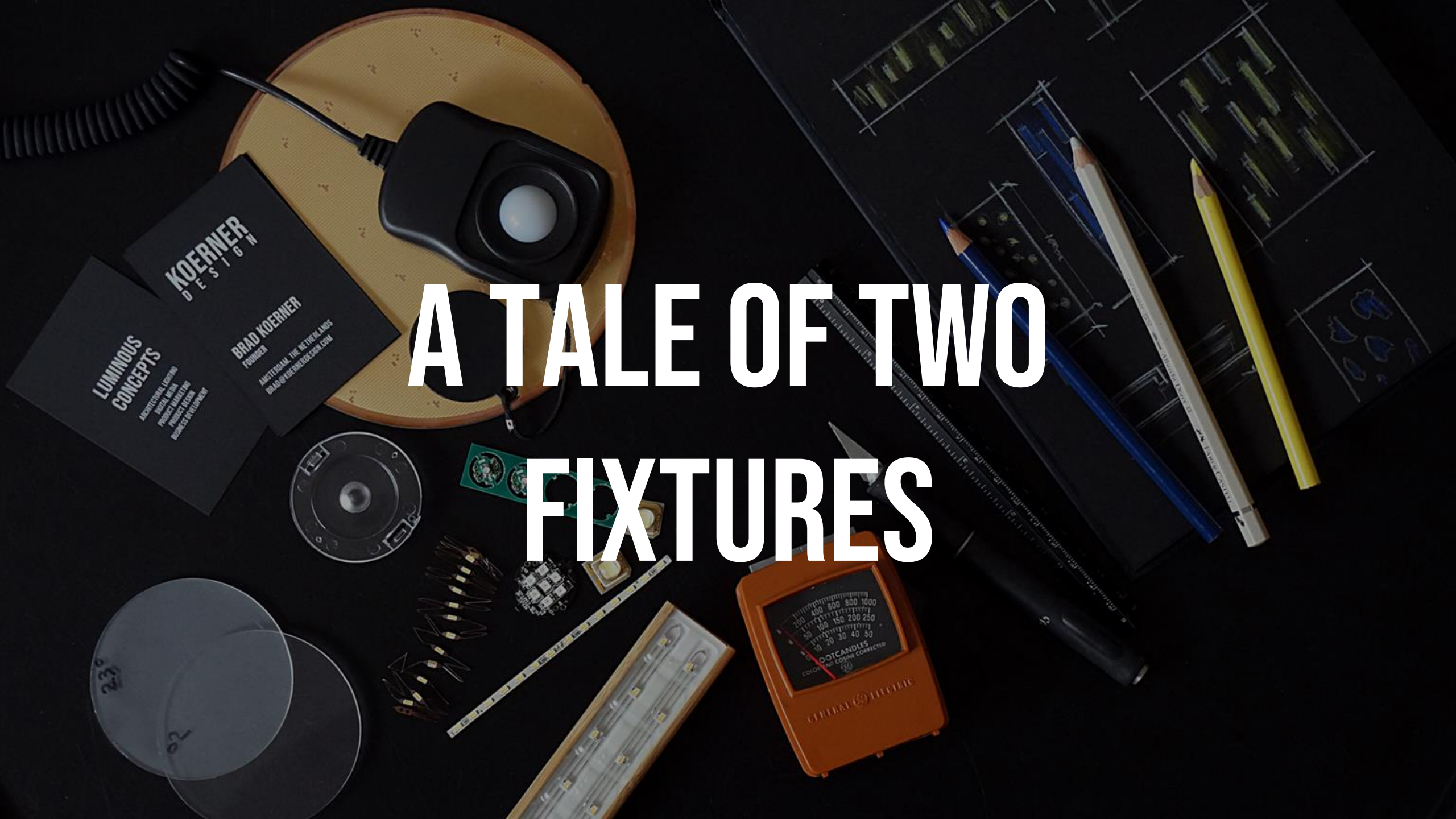
***GREAT SUPPLY CHAIN MANAGEMENT!***

# 8 years ago…

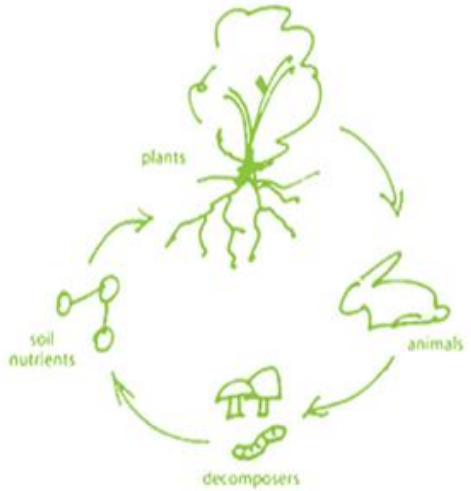
2014 US DOE Solid State Lighting R+D Workshop

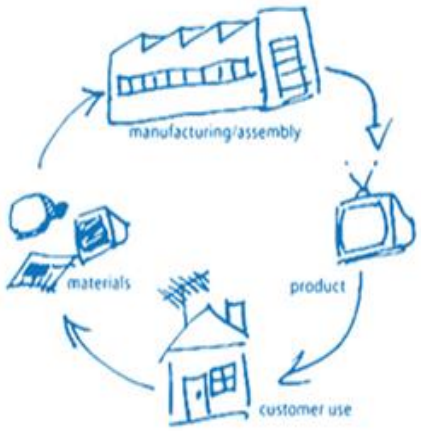



https://lucept.com/2014/02/10/us-doe-ssl-rd-workshop/


KOERNER
DESIGN
LUMINOUS CONCEPTS
BRAD KOERNER
FOUNDER
A TALE OF TWO FIXTURES


SHURE
15



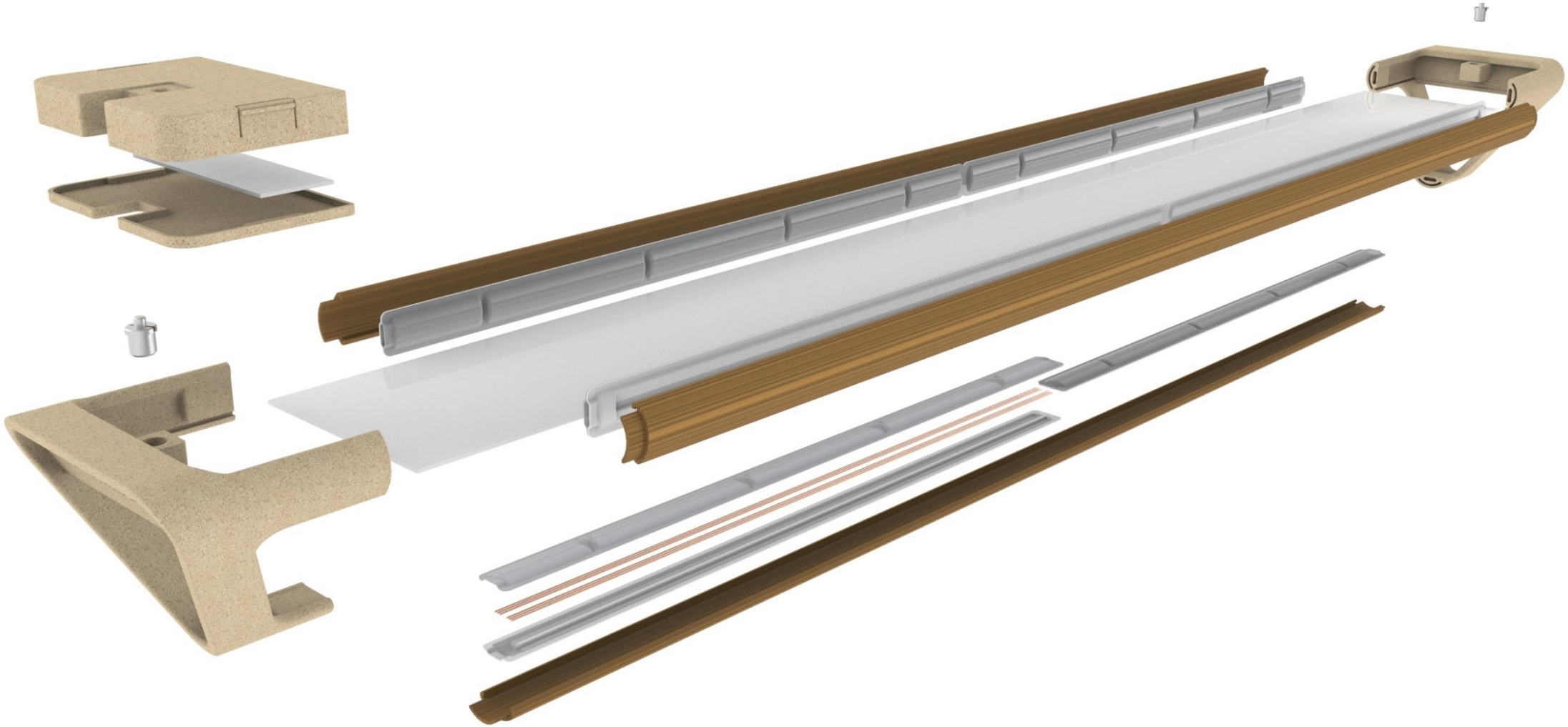



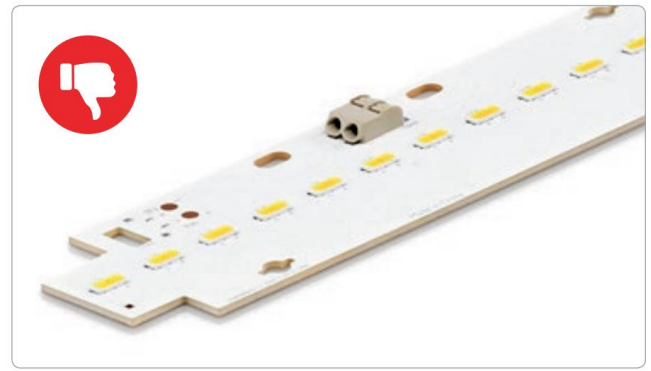

cradletocradle

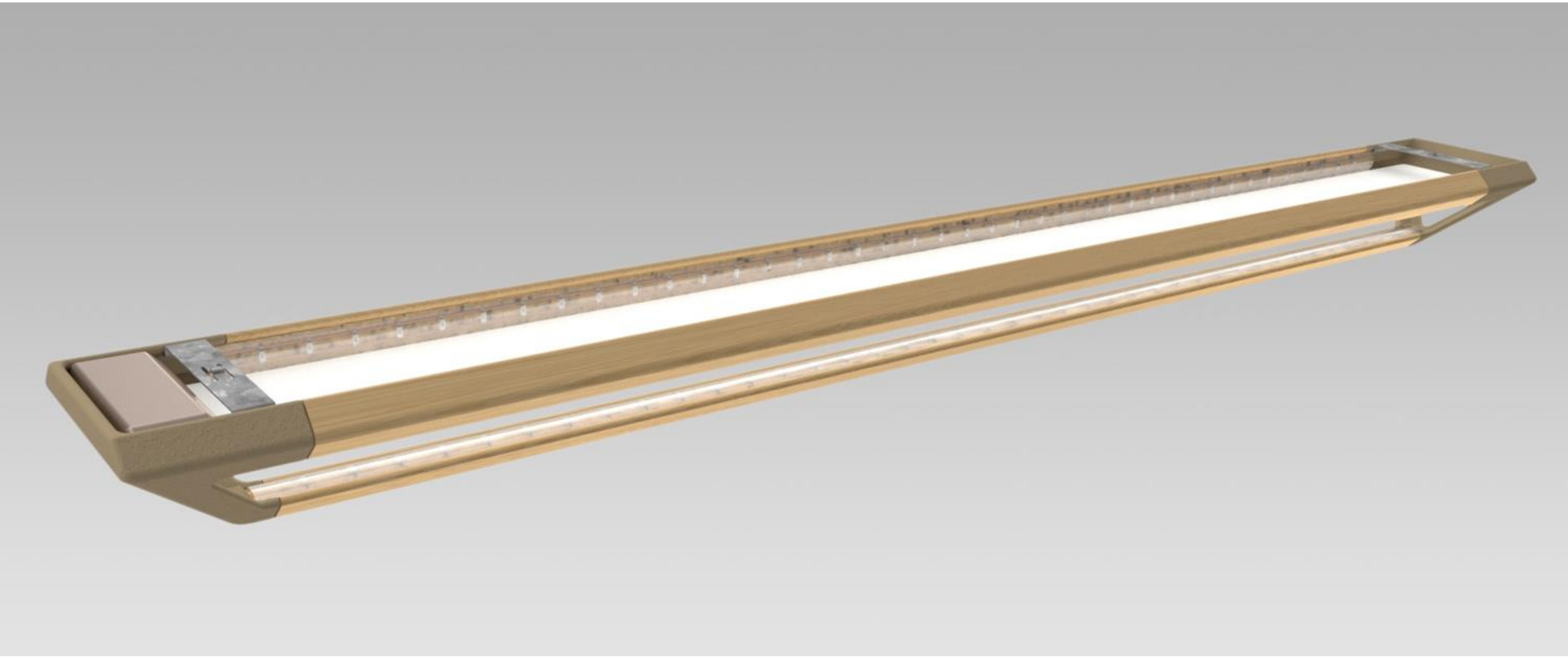
*Cradle to Cradle*® is a trademark of McDonough Braungart Design Chemistry, LLC.

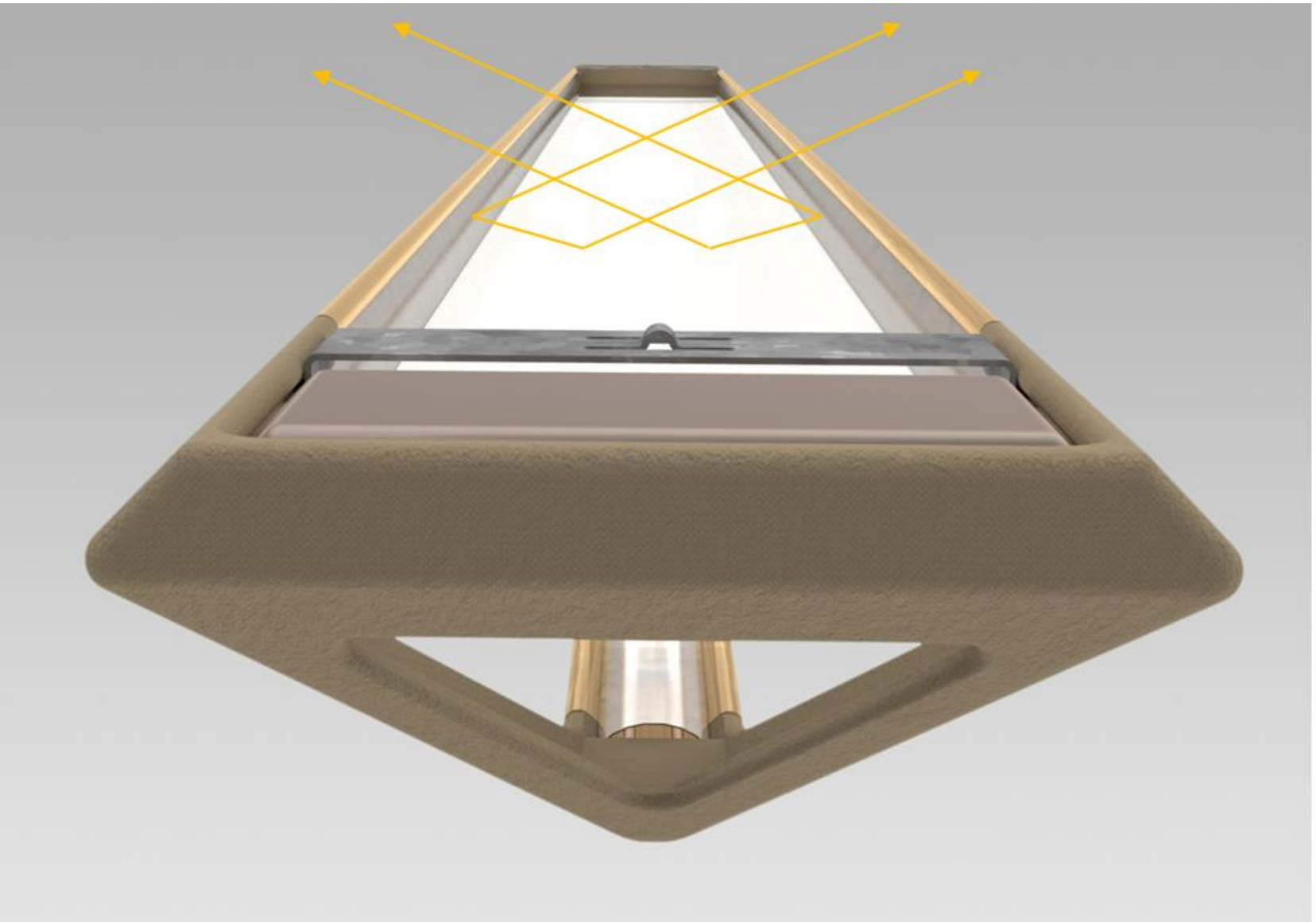
William McDonough + Partners
Architecture and Community Design

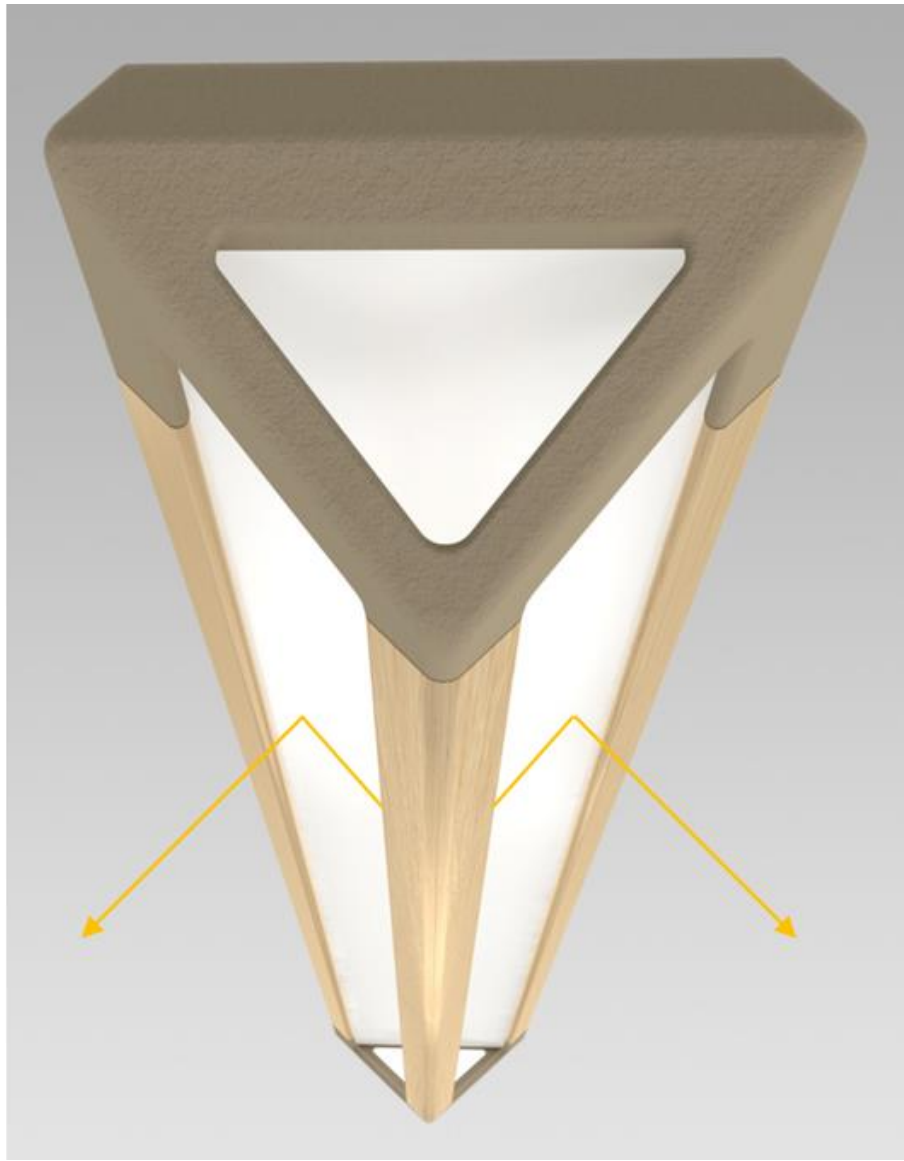

EQ.9
Welkom

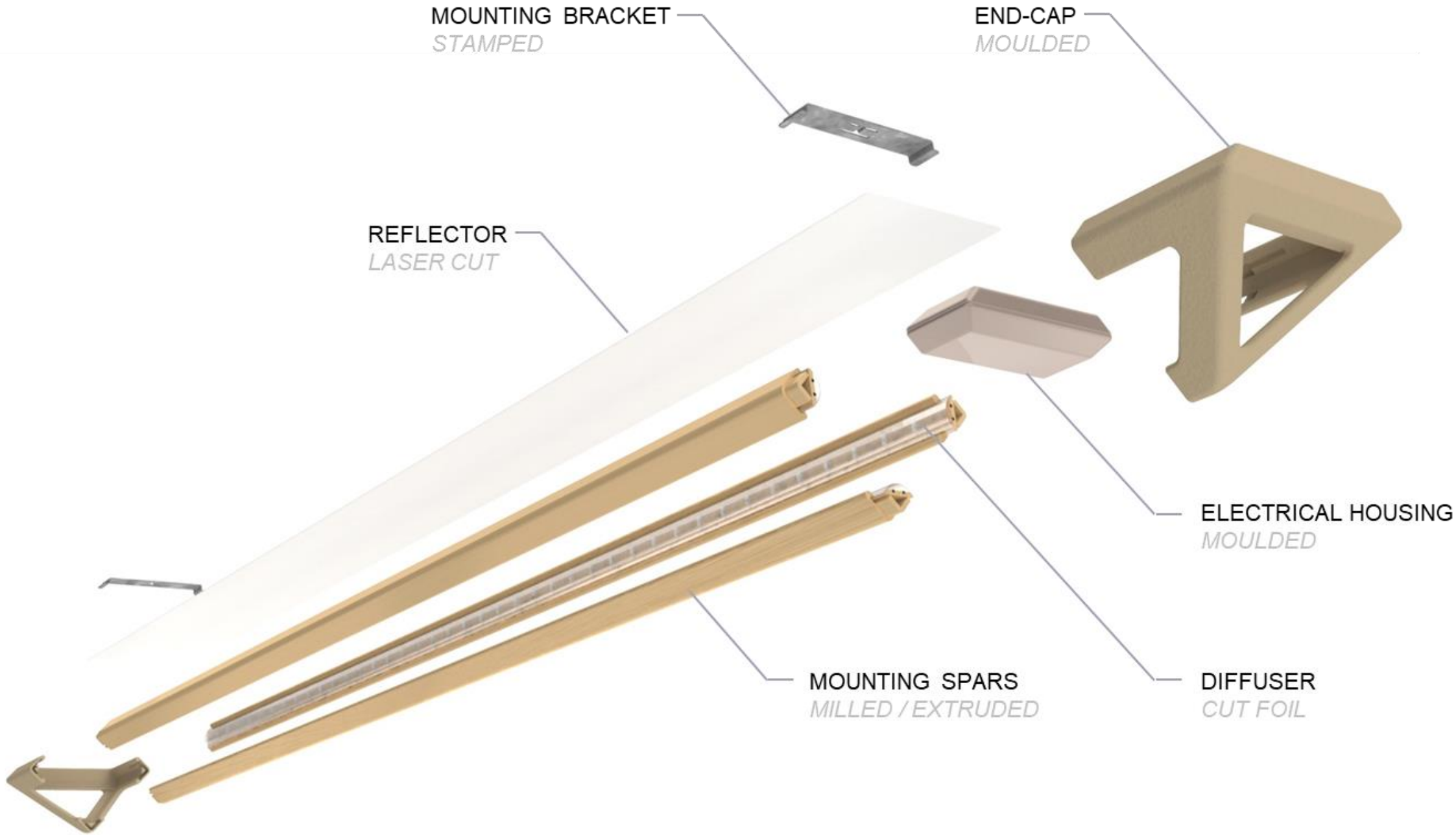











MOUNTING BRACKET
STAMPED
END-CAP
MOULDED
REFLECTOR
LASER CUT
ELECTRICAL HOUSING
MOULDED
MOUNTING SPARS
MILLED / EXTRUDED
DIFFUSER
CUT FOIL

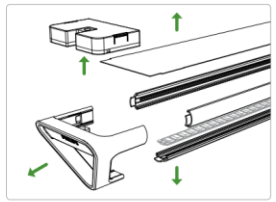
# What does it mean to be **green**?

## Circular Economy Office Luminaires

## Radical approach in luminaire construction

### Design for disassembly

Push-fit construction = easy disassembly



### Dramatically reduced part count

80% less weight than existing luminaires

90% less components used

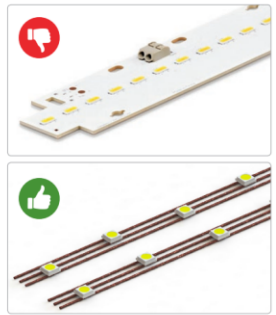
No secondary coatings/ finishings

## Super-green light engine design

### Eliminate printed circuit boards

Common printed circuit boards use energy intensive materials and chemically intensive production processes, plus recycling circuit boards is nearly impossible.

We are striving to reduce and eliminate our use of printed circuit boards where possible.

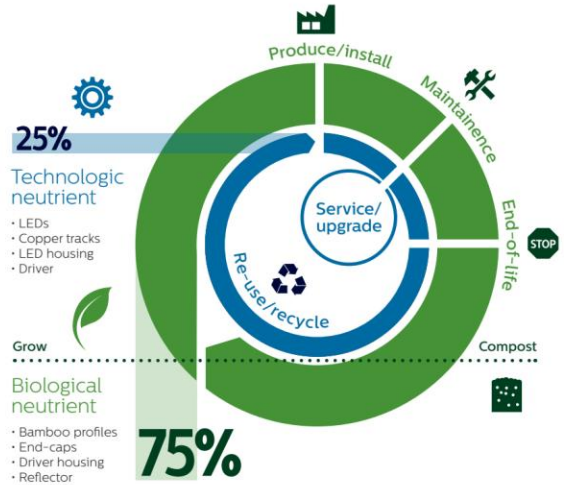


## Design for a circular economy

### Closed cycle

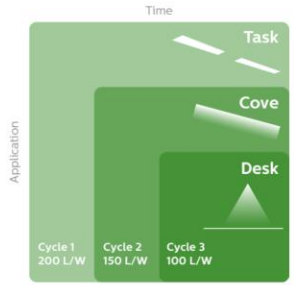
The luminaire comprises of 2 main types components:

- Natural compostable materials with low embodied energy (bamboo profiles, bioplastic end-caps)
- Electronic components that can be re-used or replaced easily (other applications, state-of -the-art energy efficient components)




### LEDs are durable

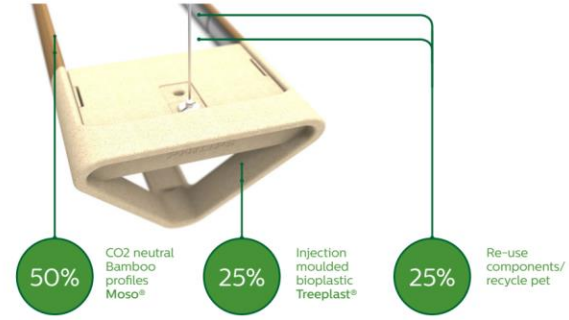
As LED efficiency increases, so does their long term value. With LEDs demonstrating efficacy of 200 lm/w, even after several 50k usage periods those LEDs are still highly efficient light sources that could be reused in lower-value applications




## Beautiful factories

### Natural, bio-degradable, raw materials

Think a material is 'green'? Would you want to live next to the factory?




We are striving to increase our use of natural materials with low-embodied energy, such as fast-growth woods and agriculture waste products

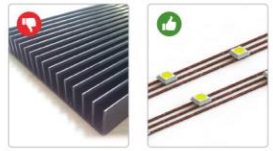
## Maximizing the benefits of LED technology

### LEDs are safe

LEDs enable use of innovative materials

### LEDs are efficient

We no longer need material-intensive heat sinks




“SUSTAINABILITY DOESN’T SELL HERE IN EUROPE”

# BAMBOO PENDANT

## GRAND PRIZE WINNER

2019 MANUFACTURING INNOVATOR CHALLENGE:

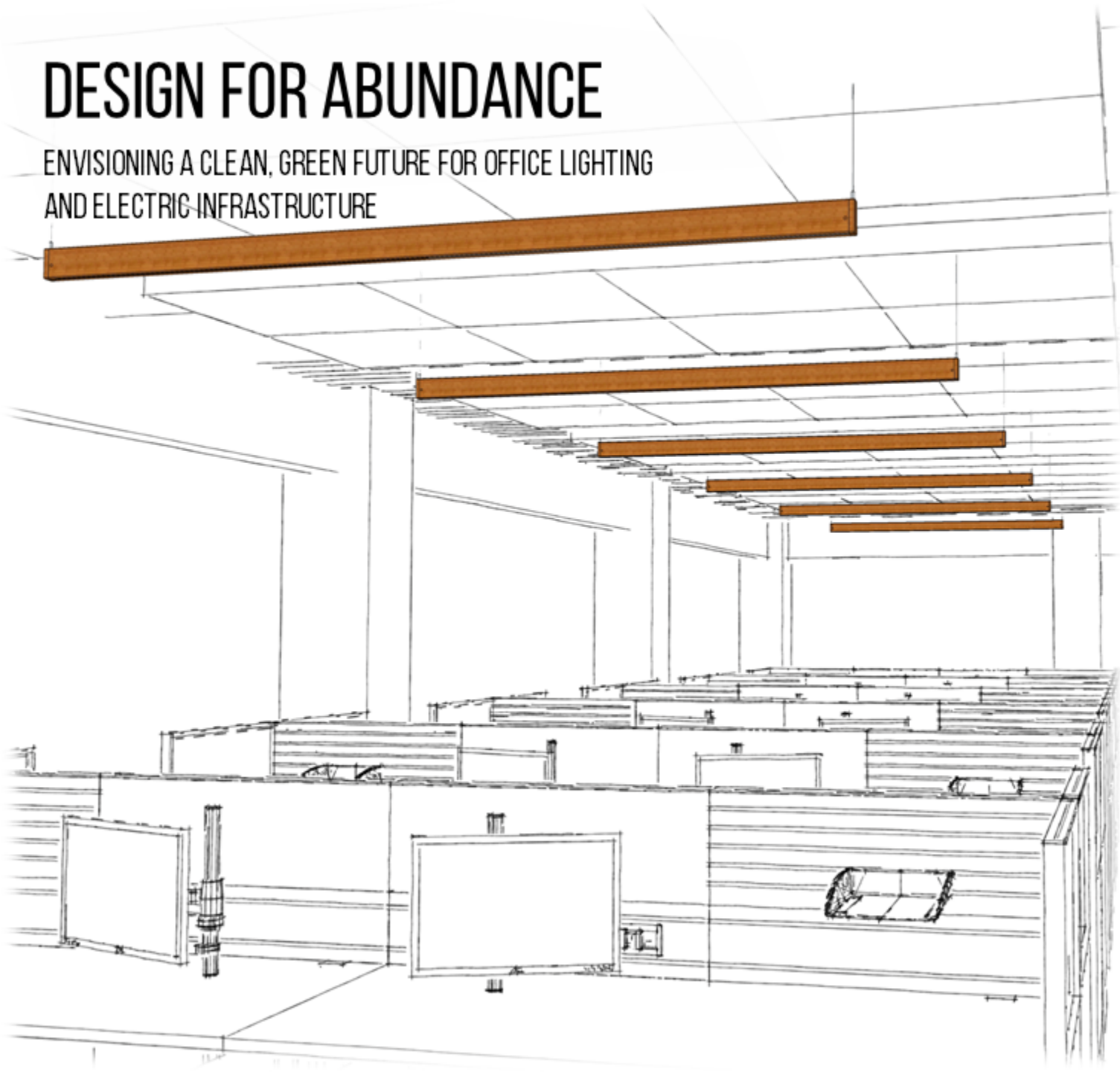
## SUSTAINABLE MANUFACTURING OF LUMINAIRES

KOERNER DESIGN

U.S. DEPARTMENT OF ENERGY

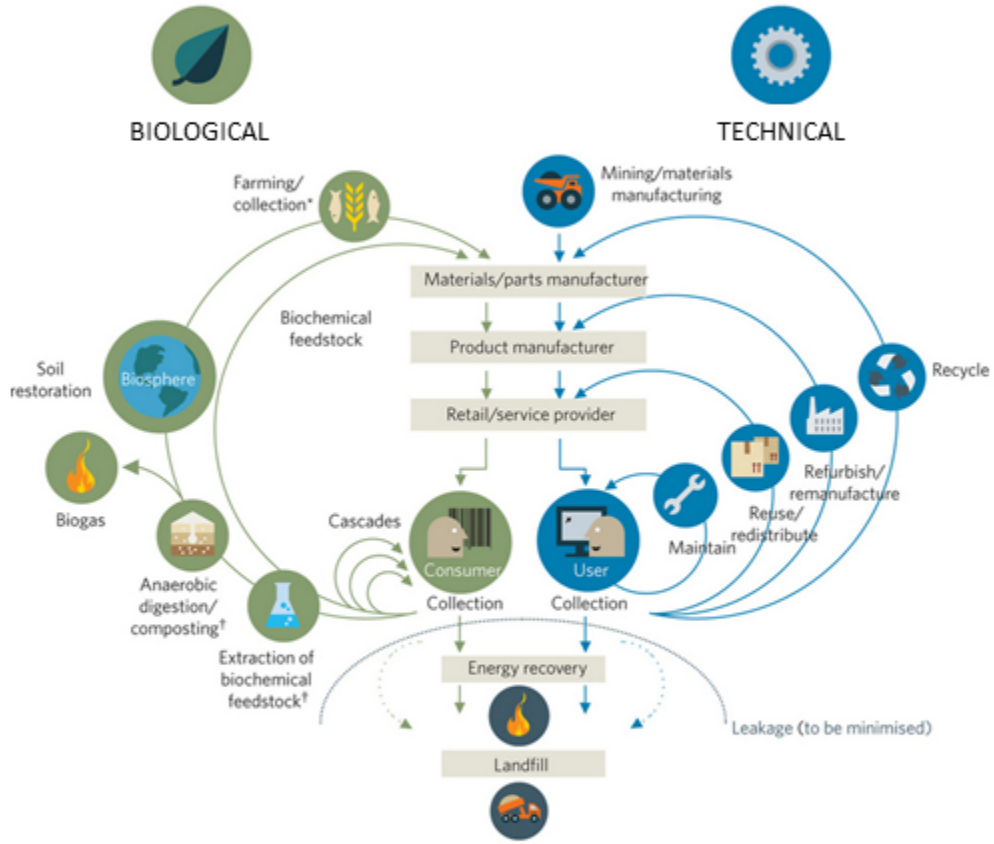
# DESIGN FOR ABUNDANCE

ENVISIONING A CLEAN, GREEN FUTURE FOR OFFICE LIGHTING AND ELECTRIC INFRASTRUCTURE



## Design for the circular economy:

Our design aims to reduce the lighting industry's dependence on "technical" materials and increase our use of "biological" materials




## Directly supporting sustainability initiatives:

Lighting hardware as a positive to be celebrated, not minimized

# BEAUTIFUL FACTORIES

**ALUMINIUM VS. BAMBOO**
**WHICH IS "MORE SUSTAINABLE"?**

Do <u>you</u> want to live next to any part of the supply chain?

**VS**

# BAMBOO

## Fast growing and plentiful resource

- Bamboo is one of the most rapidly renewing resources on the planet
- Laminated structural bamboo is a low-embodied energy, non-toxic, durable material

## Can light fixtures make the world a better place?

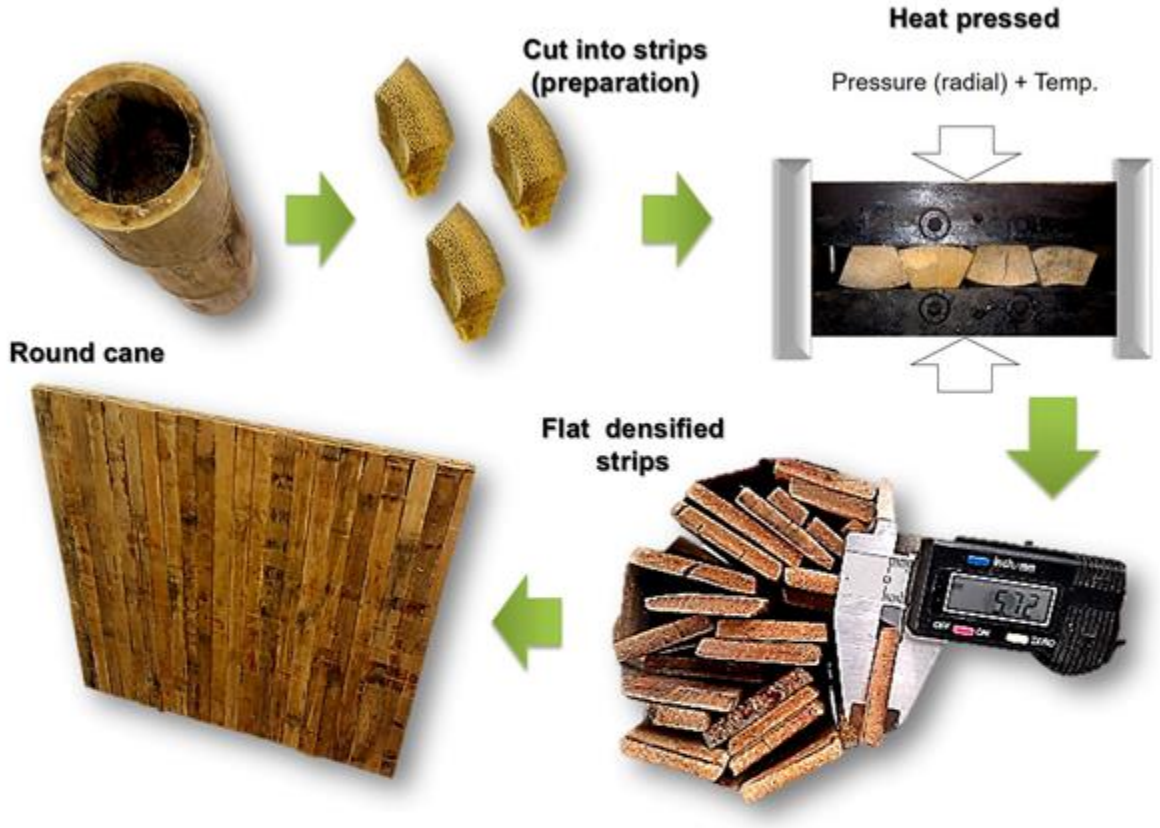
- Instead of merely "mitigating our impact" we want to help correct excess CO2 levels
- The laminated bamboo in our fixture sequesters 10.72 lbs of CO2 per 4' length (even after considering CO2 released during manufacturing processes of laminated product)

## Safe

- Class B Fire Rating per ASTM E84 testing standards for standard product (not treated with flame retardants)

## LEED v4 Credits

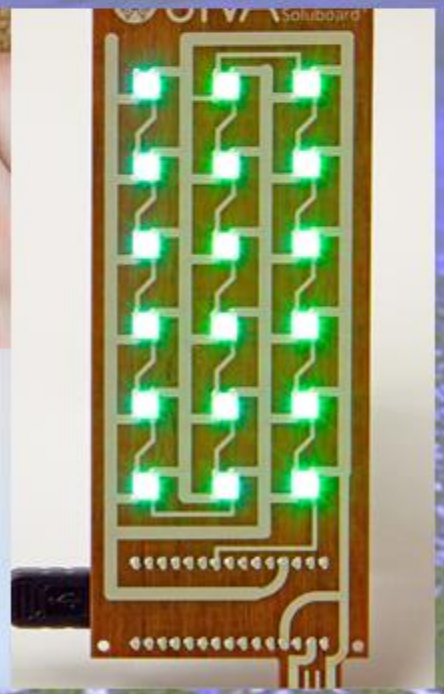
- Our products may offer the following LEED Credits:
  - MRc3: Sourcing of Raw Materials
  - EQc2: Low Emitting Materials (No added formaldehyde)
  - INc1: Innovation in Design (Life Cycle/Environment Impact)




# BIO-BASED
# PRINTED CIRCUIT BOARDS

ELIMINATING THE TOXIC LEGACY OF FIBERGLASS, EPOXY RESINS
AND E-WASTE FROM THE LED REVOLUTION

Will this be the legacy of LEDs? Poisoning children in Ghana?

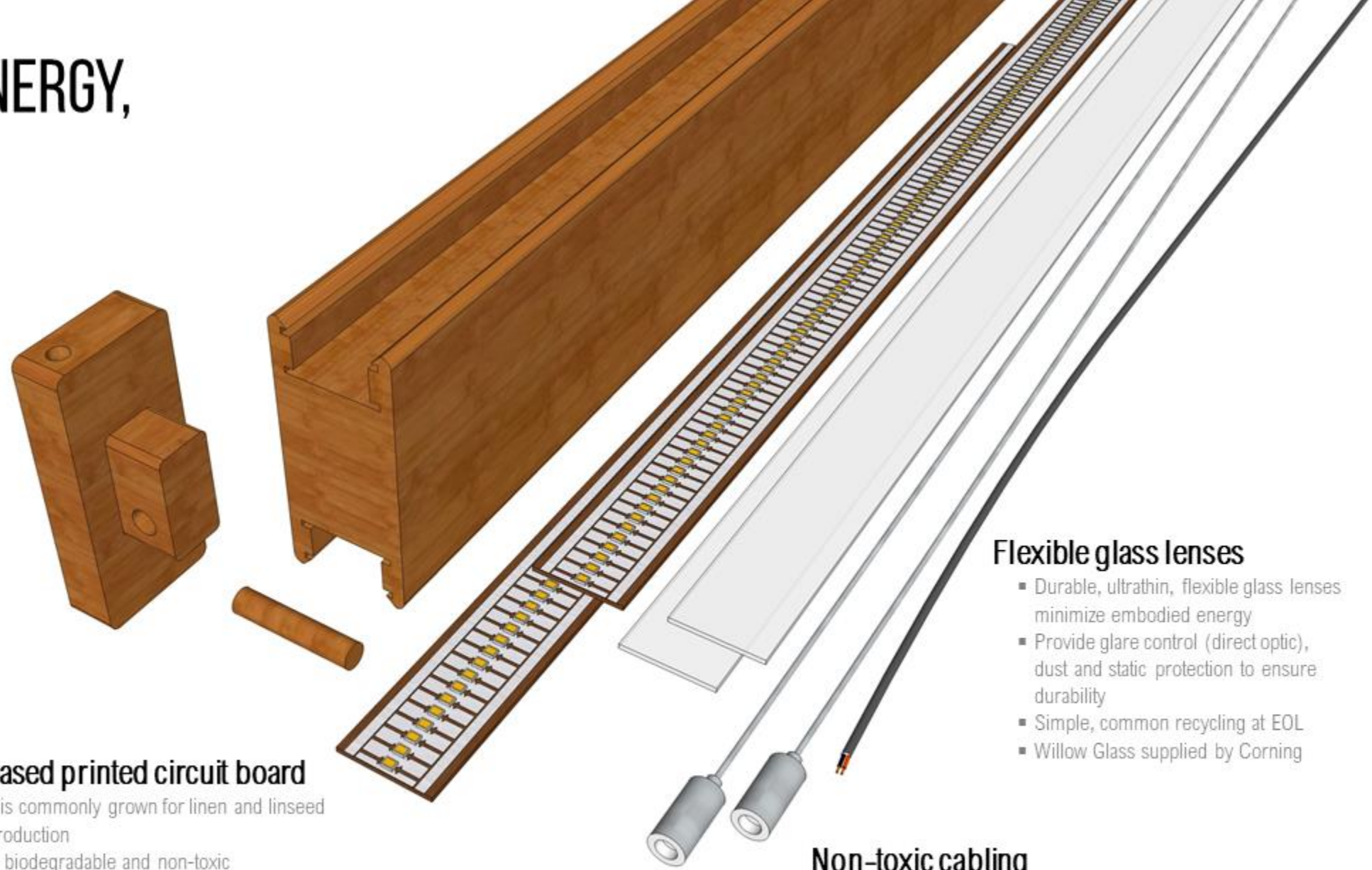


Jiva Materials SOLUBOARD
Flax-based compostable circuit board

## OUR SUPPLY CHAIN:
## Flax-fields in bloom

And our circuit boards can compost back into the fields from which they were grown

# LOW EMBODIED ENERGY, LOW TOXICITY



## Laminated bamboo body

- Bamboo is one of the fastest growing, most renewable resources on the planet
- Fully biodegradable and non-toxic adhesives and finishes
- Dimensionally stable, non-sagging across lengths up to 12'-0"
- Standard 2"x4" profile easily channeled to precise profiles on 5-axis moulder
- Elements supplied by Lamboo Technologies

## Flax-based printed circuit board

- Flax is commonly grown for linen and linseed oil production
- Fully biodegradable and non-toxic
- At end of life, traces and electronic components dissolve away from substrate
- Substrate is compostable
- Soluboard supplied by Jiva Materials

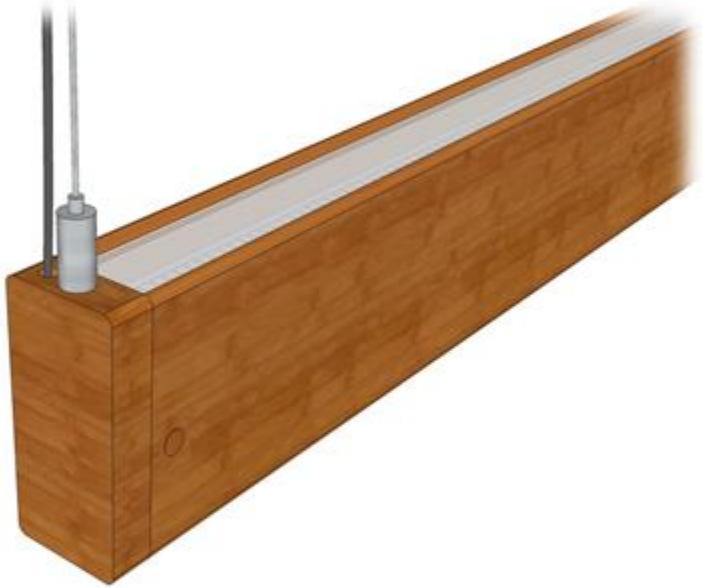
## Flexible glass lenses

- Durable, ultrathin, flexible glass lenses minimize embodied energy
- Provide glare control (direct optic), dust and static protection to ensure durability
- Simple, common recycling at EOL
- Willow Glass supplied by Corning

## Non-toxic cabling

- Small gauge low-voltage DC wire minimizes copper consumption
- Free of halogen, chlorine, bromine, fluorine
- EcoAcePlus supplied by Furukawa Electric

# OLD SCHOOL SIMPLICITY

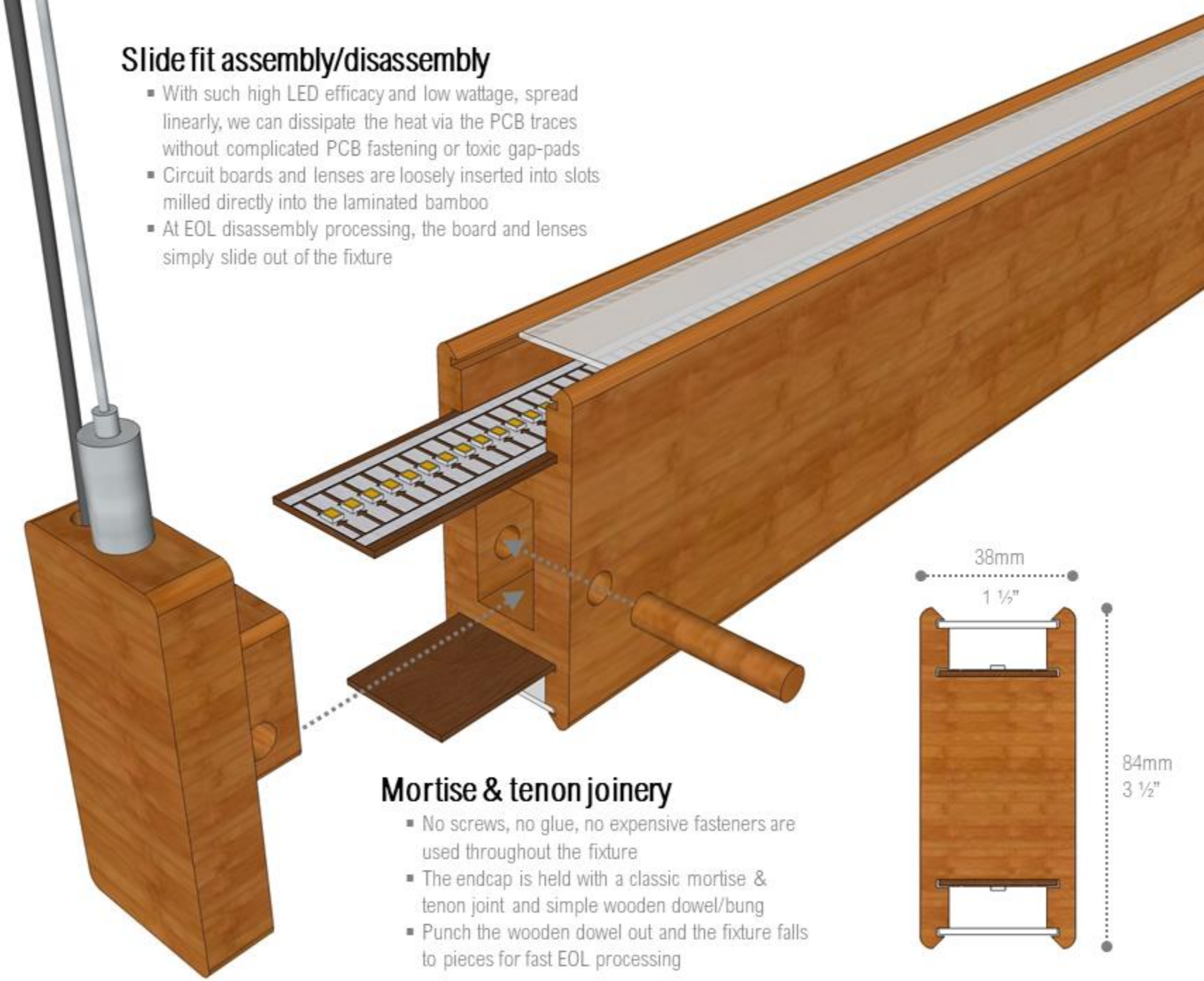


## Endcap concept

- To ensure fast assembly and later disassembly for circular economy processing, the end caps hold the fixture components captive
- The aircraft cable support for the fixture and wire strain relief are simply drilled into the end cap, without requiring additional hardware

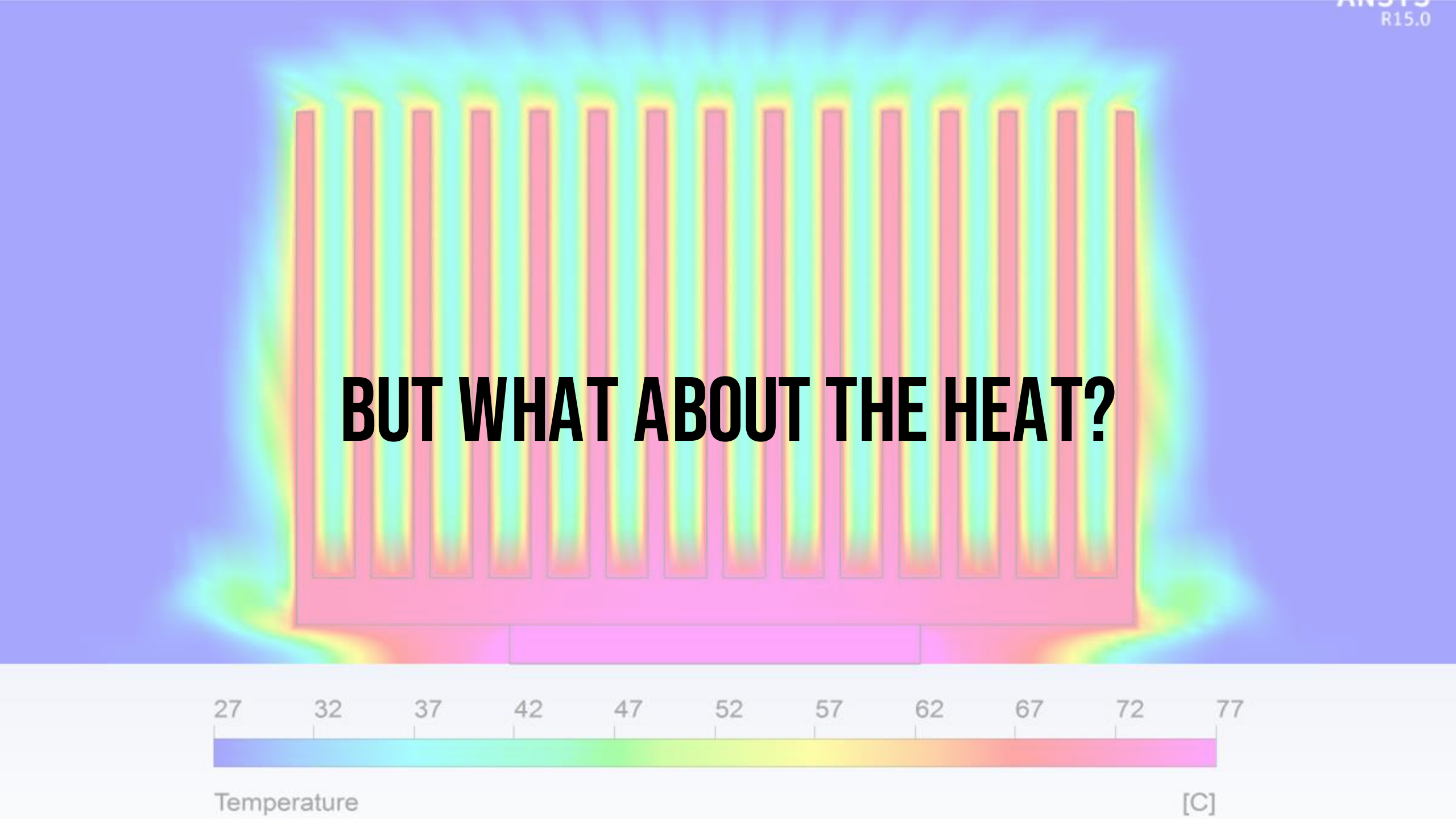
## Slide fit assembly/disassembly

- With such high LED efficacy and low wattage, spread linearly, we can dissipate the heat via the PCB traces without complicated PCB fastening or toxic gap-pads
- Circuit boards and lenses are loosely inserted into slots milled directly into the laminated bamboo
- At EOL disassembly processing, the board and lenses simply slide out of the fixture

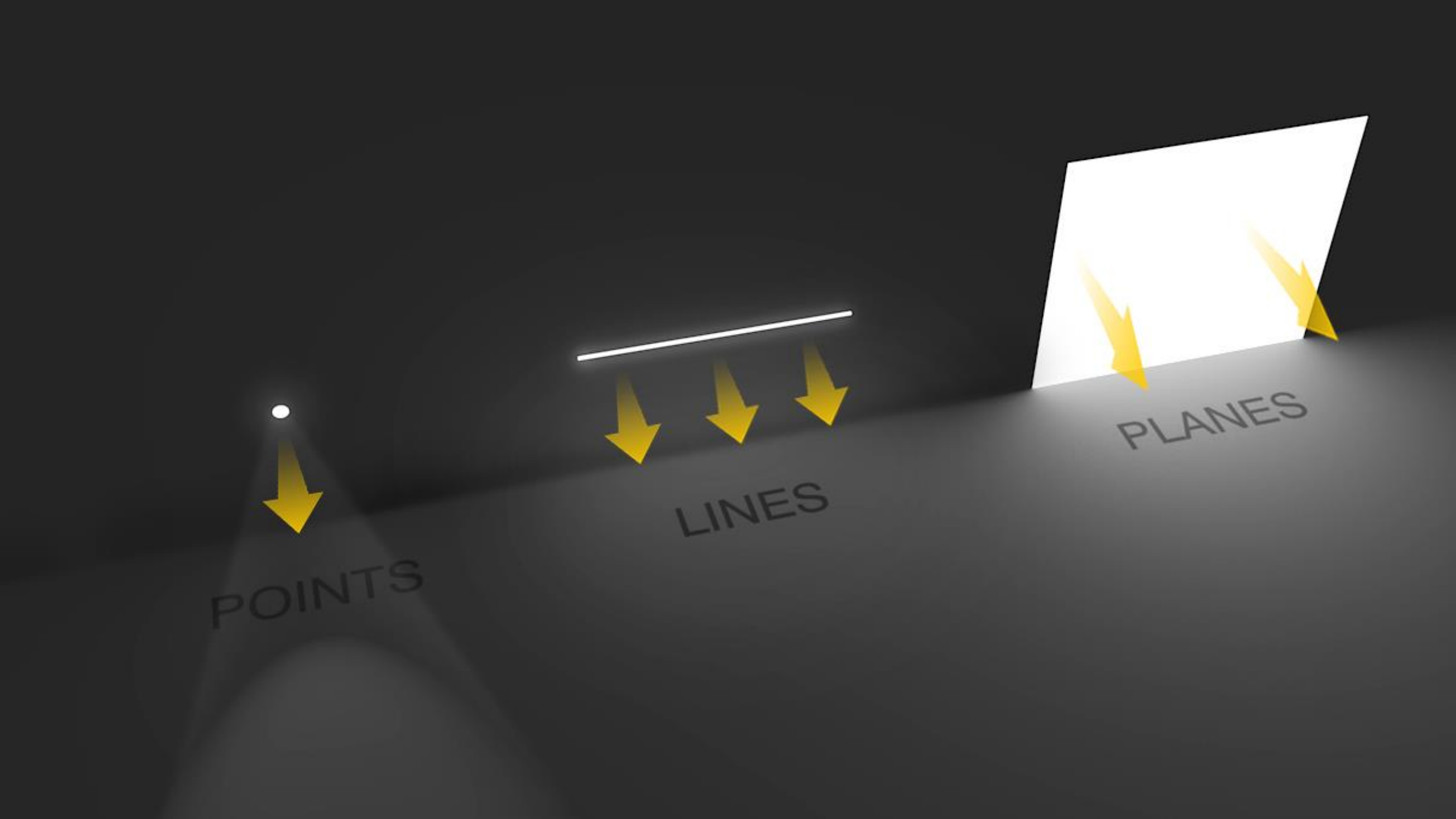


## Mortise & tenon joinery

- No screws, no glue, no expensive fasteners are used throughout the fixture
- The endcap is held with a classic mortise & tenon joint and simple wooden dowel/bung
- Punch the wooden dowel out and the fixture falls to pieces for fast EOL processing

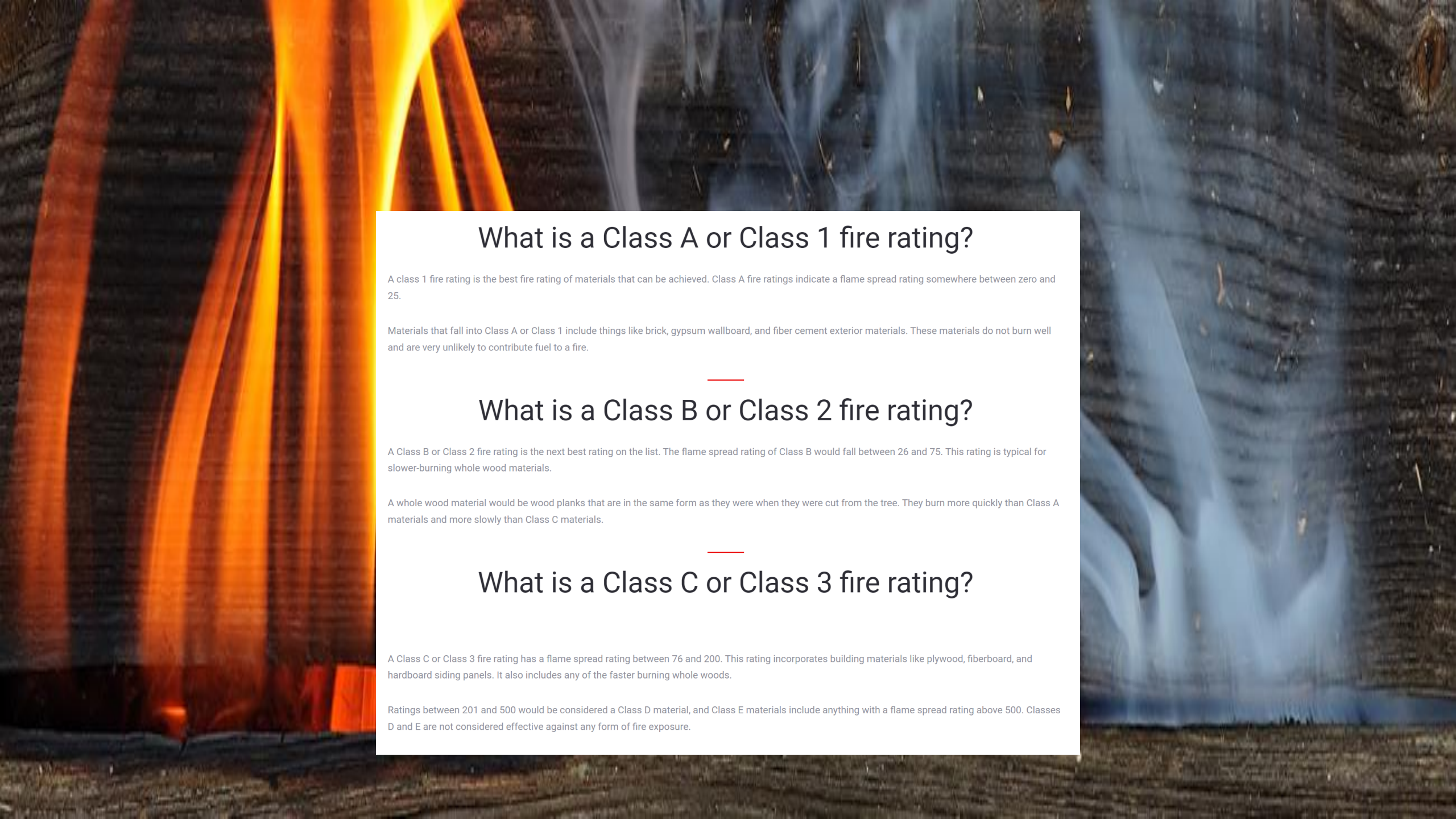

R15.0
BUT WHAT ABOUT THE HEAT?
27
32
37
42
47
52
57
62
67
72
77
Temperature
[C]

# 230+ LUMENS/WATT EFFICACY OFF THE SHELF!


POINTS
LINES
PLANES


THE LIGHTING INDUSTRY NEEDS TO
UNLEARN THERMAL DESIGN
T1 T2 T3 T4
RISEPRO®
Thermocouple
Thermometers
HOLD
MAX
UNIT
MIN
AVG


BUT WHAT ABOUT THE FIRE RATING?



## What is a Class A or Class 1 fire rating?

A class 1 fire rating is the best fire rating of materials that can be achieved. Class A fire ratings indicate a flame spread rating somewhere between zero and 25.

Materials that fall into Class A or Class 1 include things like brick, gypsum wallboard, and fiber cement exterior materials. These materials do not burn well and are very unlikely to contribute fuel to a fire.

## What is a Class B or Class 2 fire rating?

A Class B or Class 2 fire rating is the next best rating on the list. The flame spread rating of Class B would fall between 26 and 75. This rating is typical for slower-burning whole wood materials.

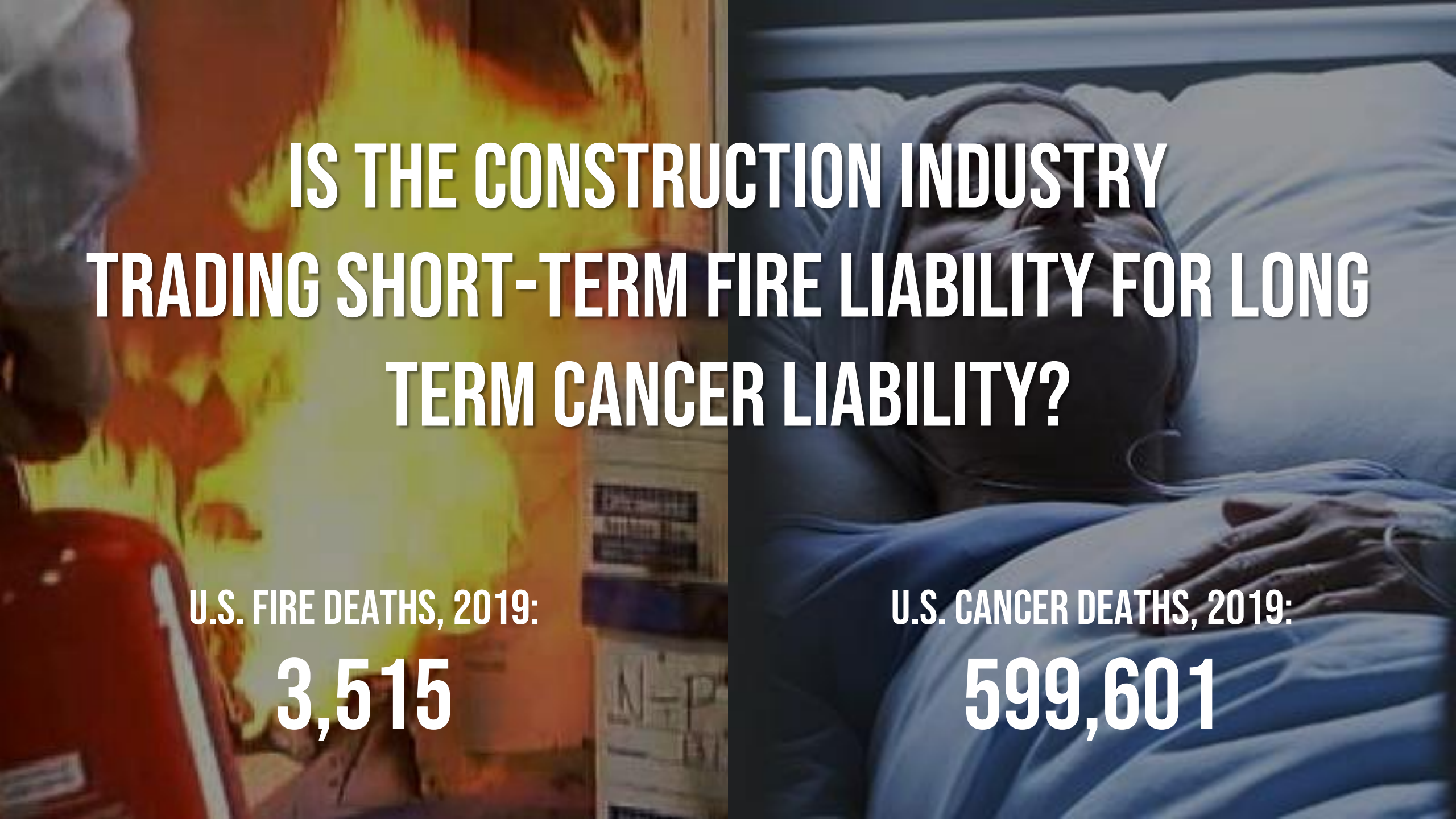
A whole wood material would be wood planks that are in the same form as they were when they were cut from the tree. They burn more quickly than Class A materials and more slowly than Class C materials.

## What is a Class C or Class 3 fire rating?

A Class C or Class 3 fire rating has a flame spread rating between 76 and 200. This rating incorporates building materials like plywood, fiberboard, and hardboard siding panels. It also includes any of the faster burning whole woods.

Ratings between 201 and 500 would be considered a Class D material, and Class E materials include anything with a flame spread rating above 500. Classes D and E are not considered effective against any form of fire exposure.


IS THE CONSTRUCTION INDUSTRY
TRADING SHORT-TERM FIRE LIABILITY FOR LONG
TERM CANCER LIABILITY?



# IS THE CONSTRUCTION INDUSTRY TRADING SHORT-TERM FIRE LIABILITY FOR LONG TERM CANCER LIABILITY?

U.S. FIRE DEATHS, 2019:

3,515

U.S. CANCER DEATHS, 2019:

599,601

BURNBLOCK®

## PRESSURE IMPREGNATION

Impregnation with Burnblock for Solid Wood, Modified Wood, Plywood and more…

## PLYWOOD TREATMENT

Natural fire retardant solutions for industrial manufacturing of plywood.

## EN45545 PUBLIC TRANSPORT

R10; HL1/HL2/HL3 (flooring); R1; HL1/HL2 (walls); R7; HL1/HL2 (exterior walls)

## TEXTILES AND FABRICS

Textiles and Fabrics for End Use and Industrial Purposes.

## COATINGS

Matched Lacquer and Paint for Burnblock treated products.

## FIBER BOARDS

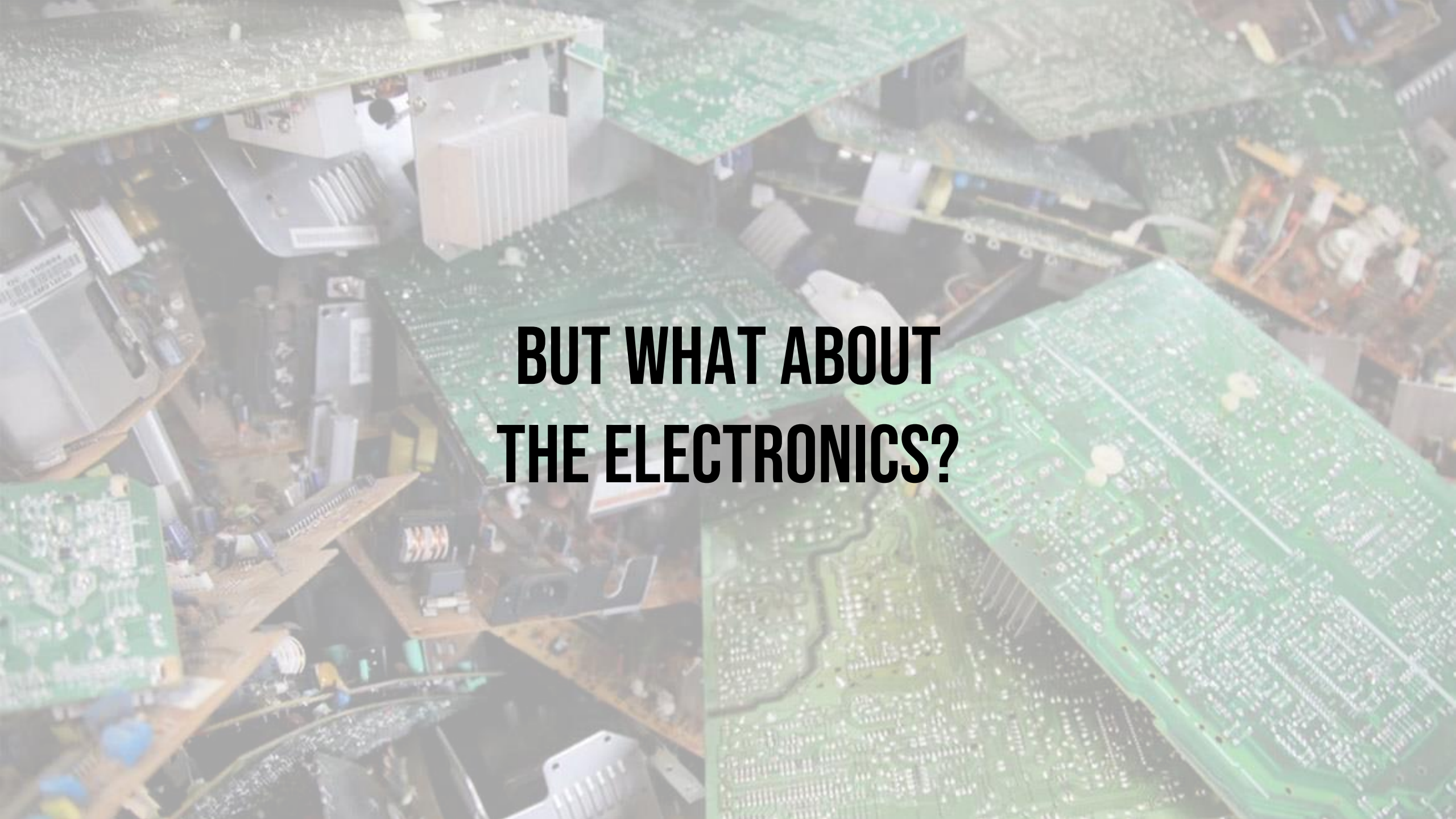
Naural fire retardant solutions for OSB, MDF and other fiber boards.

## NATURAL FIBERS

Natural fire retardant solutions for natural fibers and natural fiber products.

## FIT TO PURPOSE

Tailor made natural fire retardant solutions for special products.


BUT WHAT ABOUT
THE ELECTRONICS?

# SO. MUCH. JUNK.

SOLAR INVERTERS

BATTERY INVERTERS

VARIABLE FREQUENCY DRIVE INVERTERS

LED DRIVERS

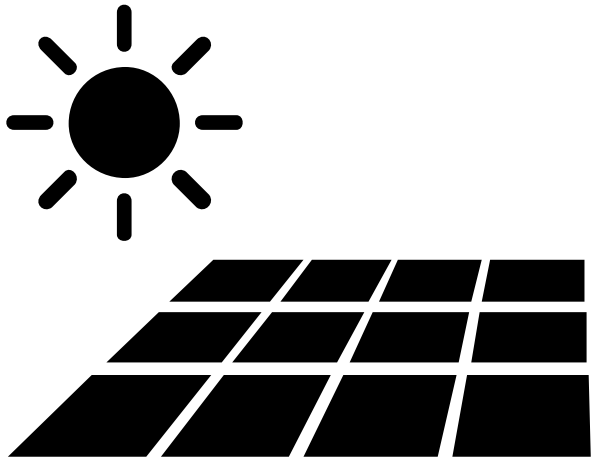
AC METERS, BREAKERS


DATA CENTER PSUS

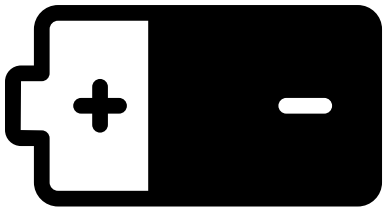
CHARGERS


IKEA

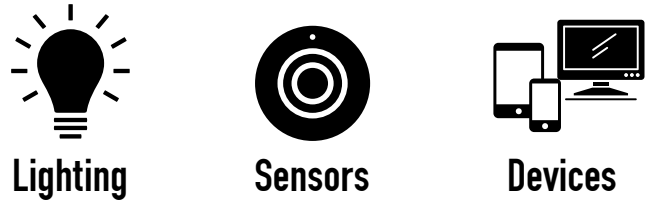
# THE DC POWER STORY



## SOLAR PARITY WITH GRID



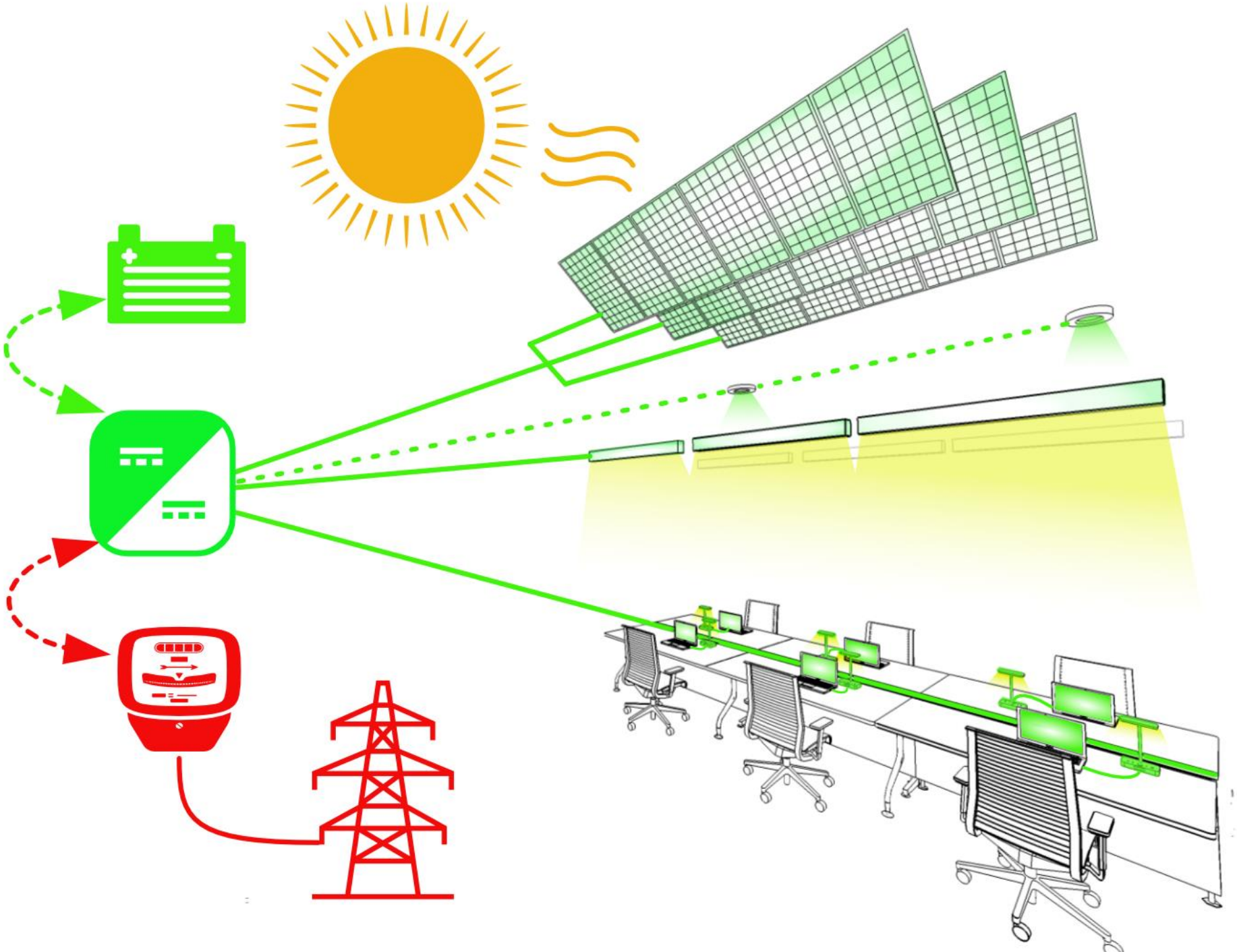
## PLUNGING STORAGE COST





## EVERYTHING IS DC POWER

# GOODBYE LED DRIVERS?



# 48VDC TRACK LIGHTING



DEP
DIRECT ENERGY PARTNERS

## SPOT

PV String-level DC-DC Optimizers

> Learn more

## BOSS

Bi-Directional DC-DC Optimizers for Storage Systems

> Learn more


## CUBE

Monolithic, Buck-Boost DC:DC Converters

> Learn more

## GARD

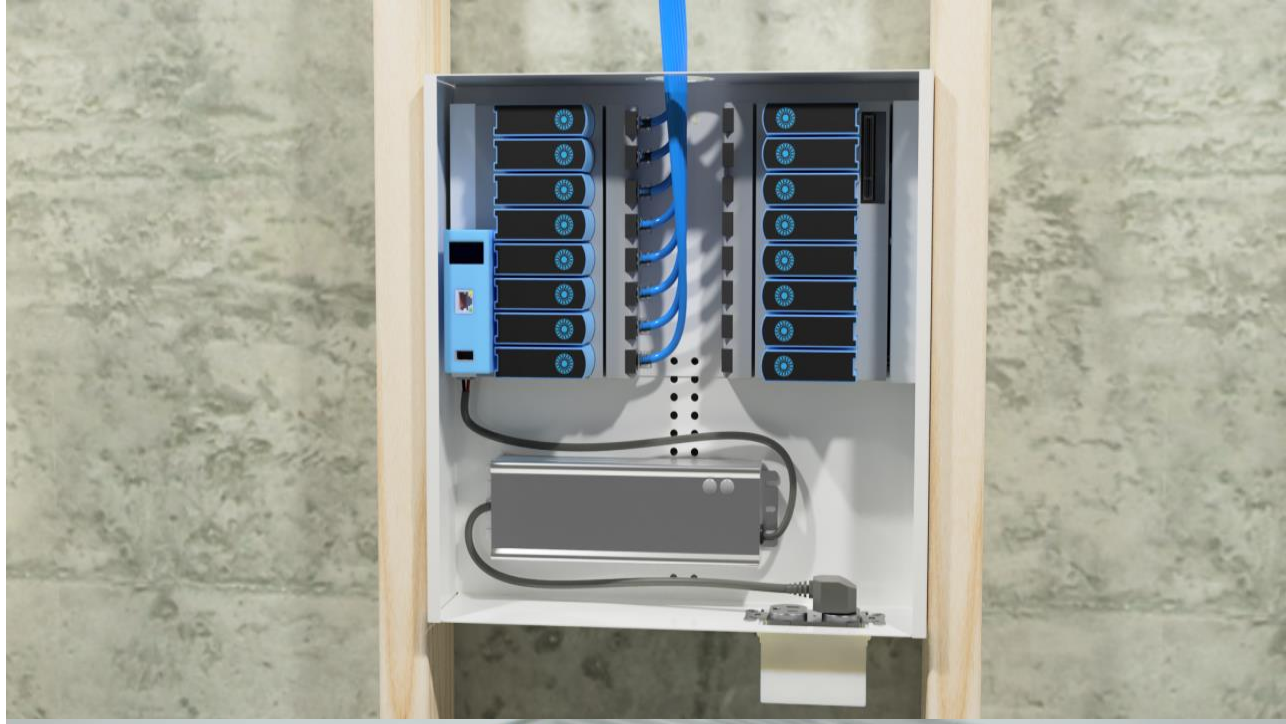
PV String Level ARC and Ground Fault Detection and Disconnect

> Learn more

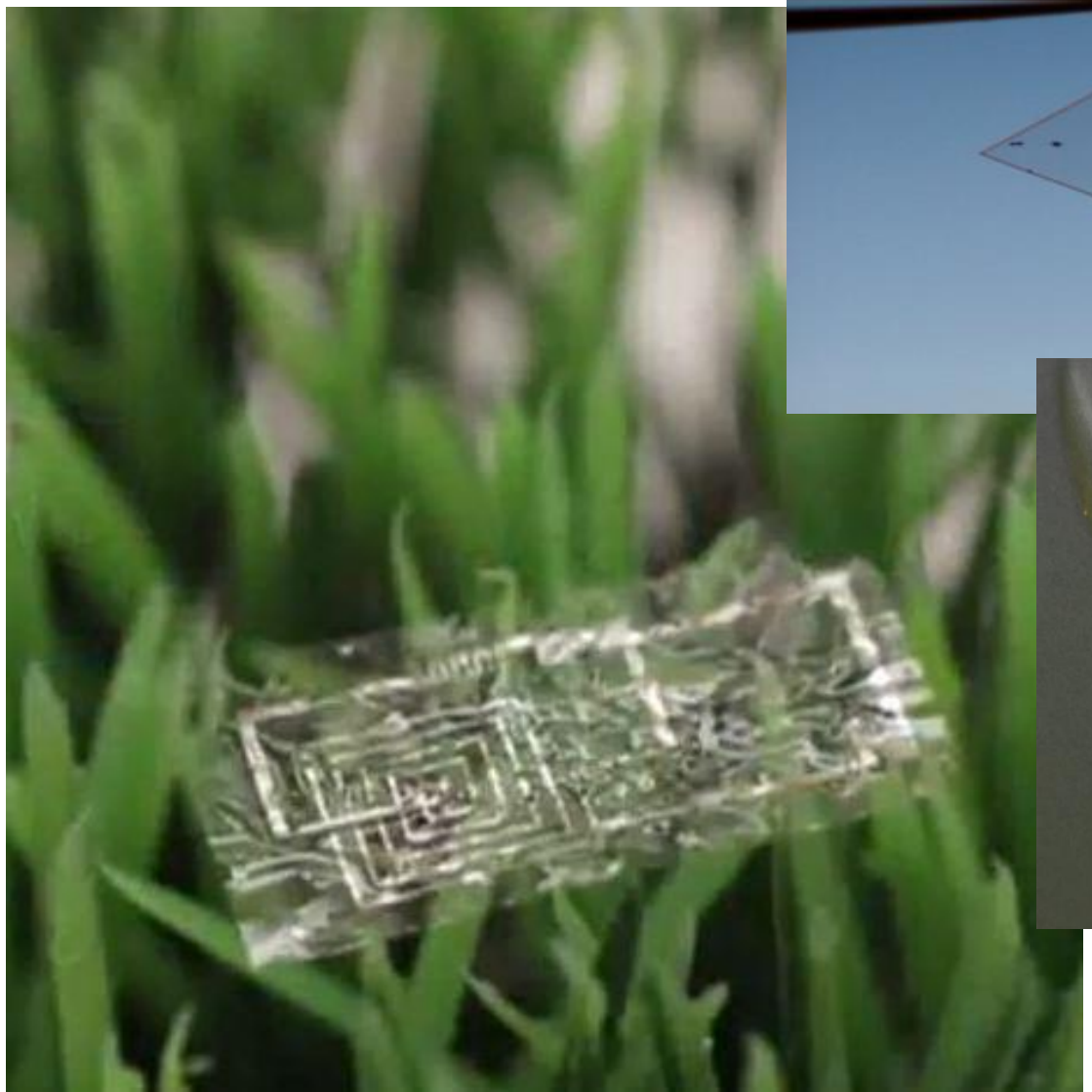

## ACE

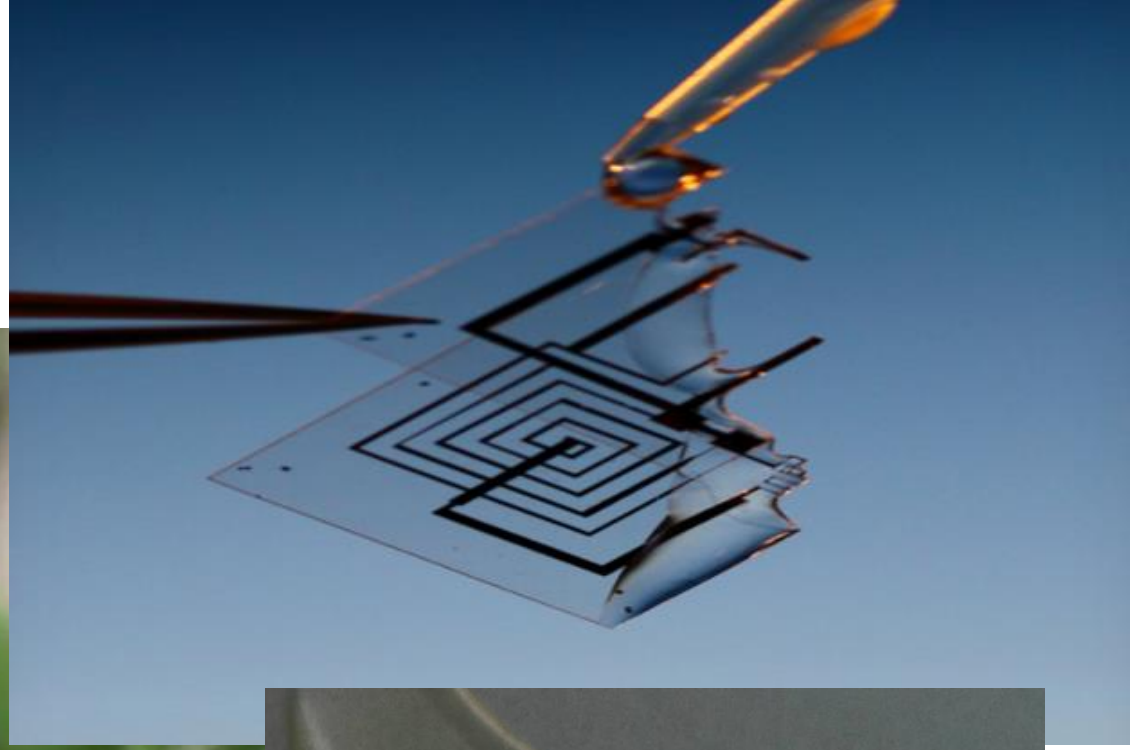
Remote PV-IOT™ Hardware and Software

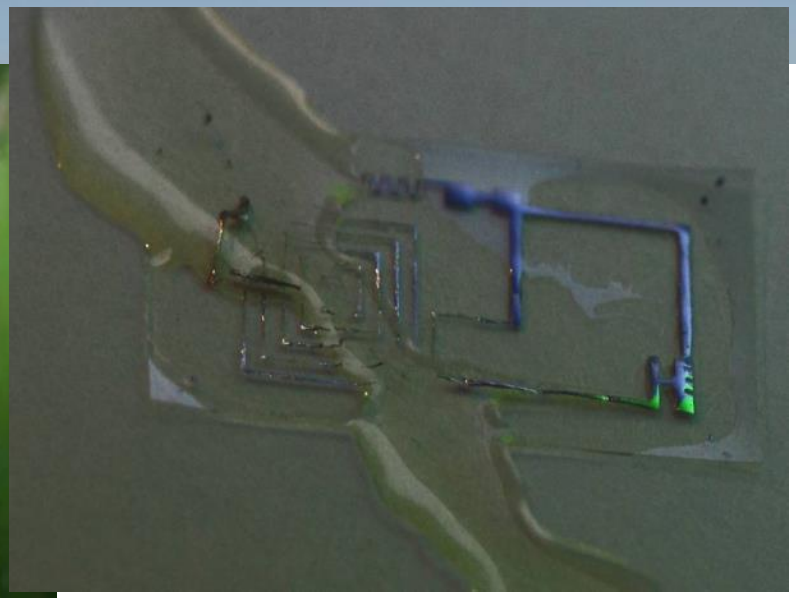
> Learn more



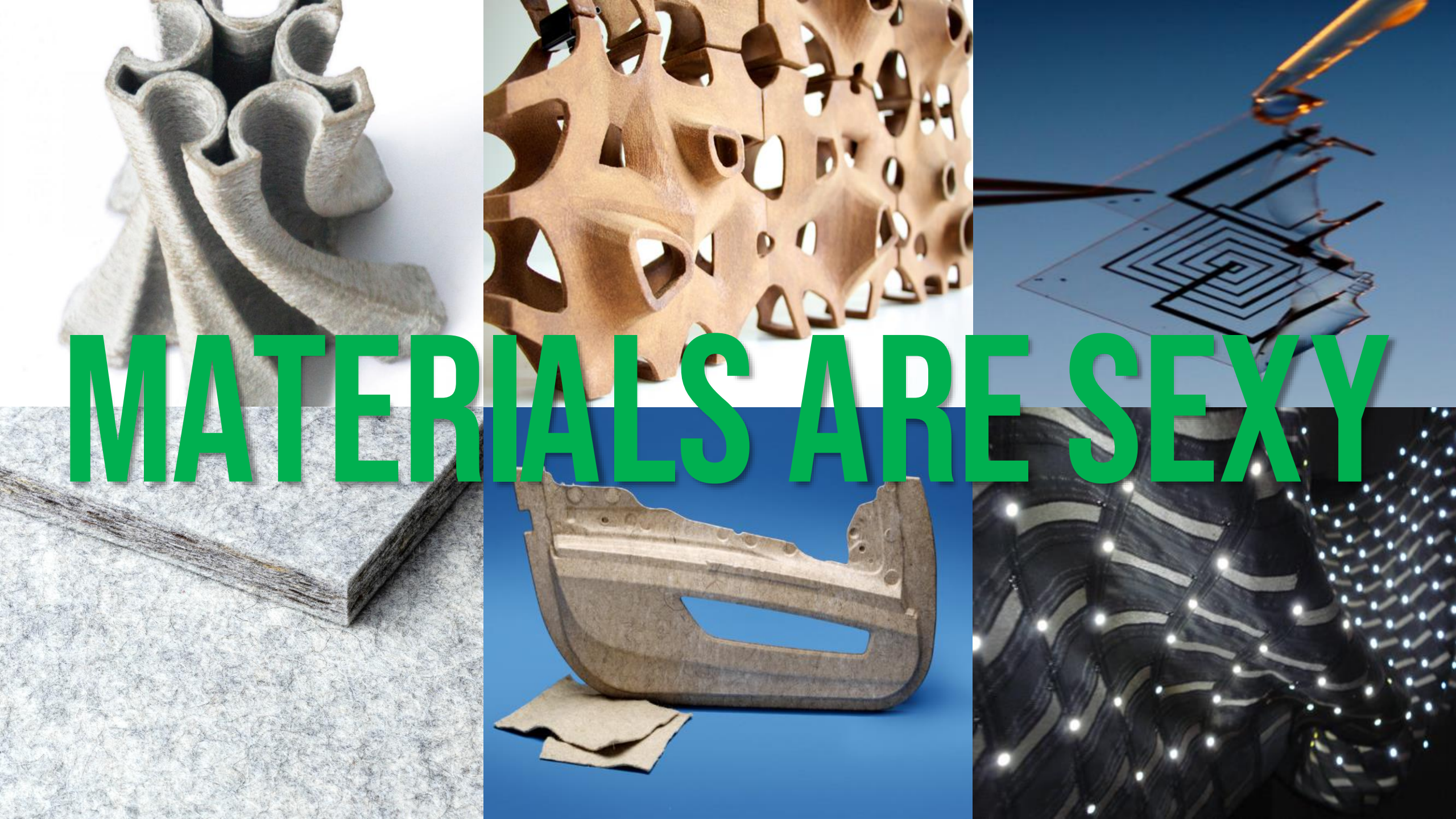
# DISSOLVING ELECTRONICS?







ROGERS RESEARCH GROUP
UNIVERSITY OF ILLINOIS


MATERIALS ARE SEXY

# HARVEST AND CRAFT


Neem plaats
voor de
VR beleving


CircuWall
circulaire producten
SeaWood
VELUX
circular matters
BLUE BLOCKS
ECOR


3D BAKERY


BIOTOPIA
GERMANY
EATTOPIA
GERMAN RESTAURANT


Pavillon
Francophone


Roots
COMBI DEAL
APPLE PIE
€ 6,00
NICE


FOOD & DRINK

# HEMP FIBERS + ACRYLIC BINDERS

STUDIO AISSLINGER

DRAEXLMAIER


LAMP

# BEWARE
# MONSTROUS HYBRIDS


WINK/EYE-BANG HIM 55
LET'S PLAY:
STUMP A SALEPERSON!


WINK/EYE-BANG HIM 55
LET'S PLAY:
STUMP A SALEPERSON!
"PLEASE SEND ME A LIST OF ALL THE SUBSTANCES USED IN YOUR FIXTURE, BY WEIGHT"


Declare.

## Solid Timber Furniture Benchmark

**Final Assembly:** Kintbury, Berkshire, United Kingdom
**Life Expectancy:** 100 Years
**End of Life Options:** Salvageable/Reusable in its Entirety, Biodegradable/Compostable, Recyclable

**Ingredients:**

**Timber: Solid Timber (FSC/PEFC Certified); Finishes: Fatty Acids, Vegetable Oil, Polymers with Isophthalic Acid, Pentaerythritol, Trimellitic Anhydride and Trimethylolpropane, Naphtha (Petroleum), Hydrotreated Heavy, Candelilla Wax, Carnauba Wax, Paraffin Waxes (Petroleum), Hydrotreated, Fatty Acids, Soya, Polymers with Hydroxy-terminated Me Ph Siloxanes, Pentaerythritol and Phthalic Anhydride; Wood Glue: PVA Emulsion Polymer, Water; Fixings: Steel**

**Living Building Challenge Criteria:**

BUK-0001
VOC Content: N/A
**Declaration Status**

EXP. 01 NOV 2020
VOC Emissions: CDPH Compliant
■ LBC Red List Free
☐ LBC Compliant
☐ Declared

MANUFACTURER RESPONSIBLE FOR LABEL ACCURACY
INTERNATIONAL **LIVING FUTURE** INSTITUTE℠ declareproducts.com

# LET'S PLAY:
# STUMP A SALEPERSON!
# **BONUS ROUND**

## Environmental Product Declaration

EPD®

In accordance with ISO 14025 for:

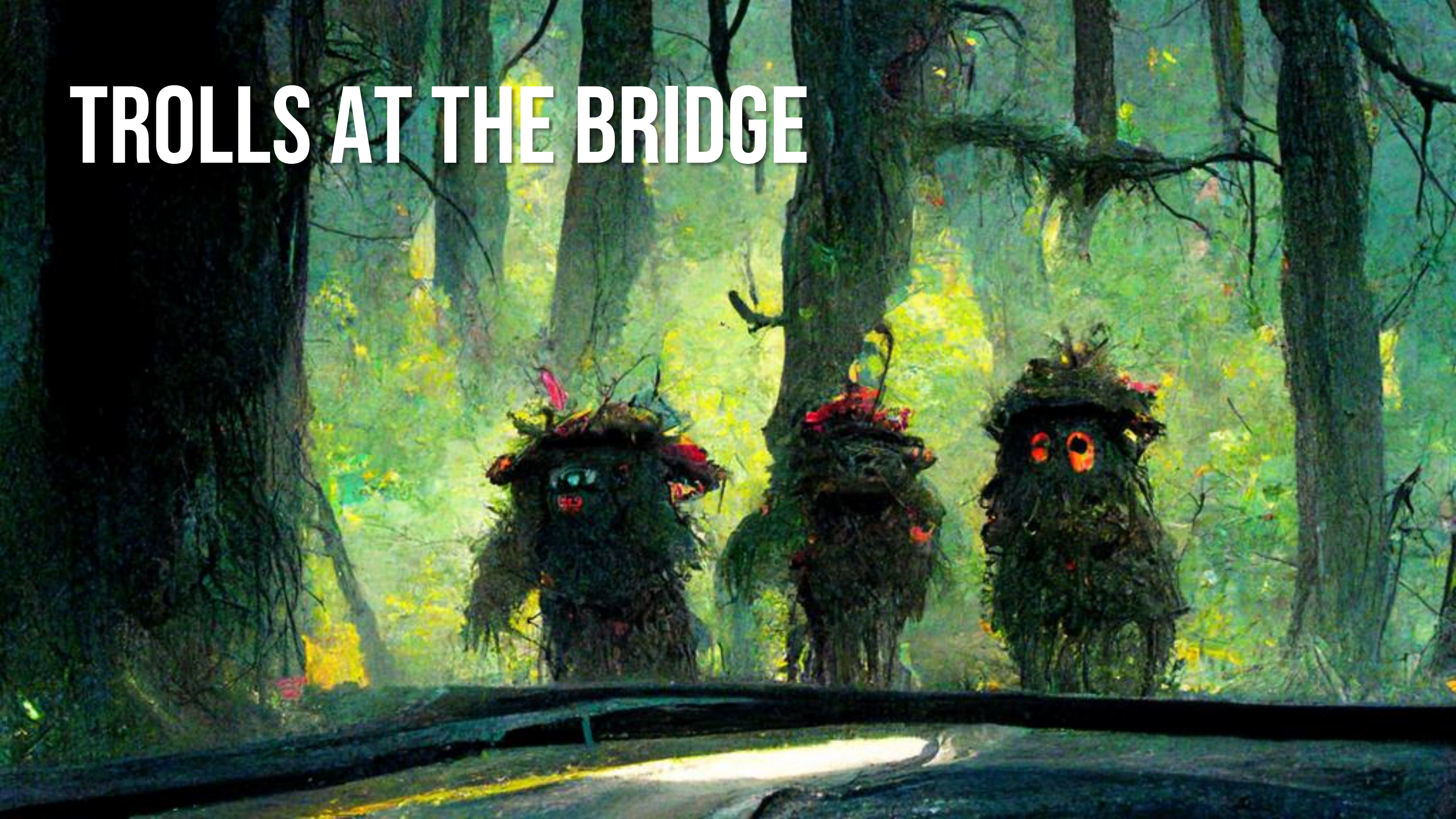
**OVO Table Collection**

from

BENCHMARK

| | |
|---|---|
| Programme: | The International EPD® System, www.environdec.com |
| Programme operator: | EPD International AB |
| EPD registration number: | S-P-01957 |
| Publication date: | 2020-06-09 |
| Valid until: | 2025-05-27 |

# TROLLS AT THE BRIDGE




HEY ALEXA, I NEED A
SUSTAINABLE LIGHTING SPEC...


# NAKED ACCOUNTABILITY

U.S. GREEN BUILDING COUNCIL LEED USGBC

nZEB nearly zero energy buildings

BREEAM®

INTERNATIONAL WELL BUILDING INSTITUTE WELL

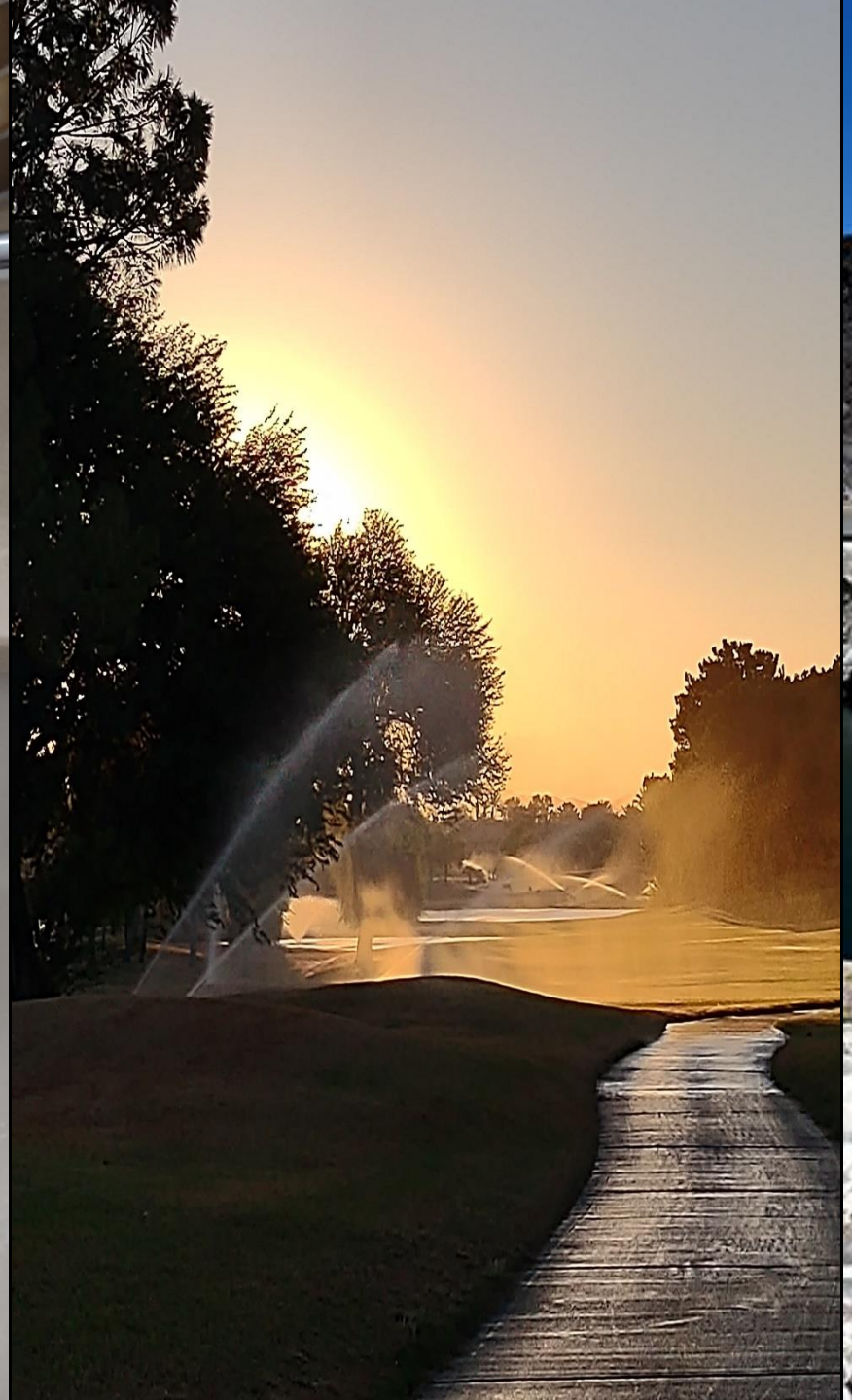
cradle to cradle

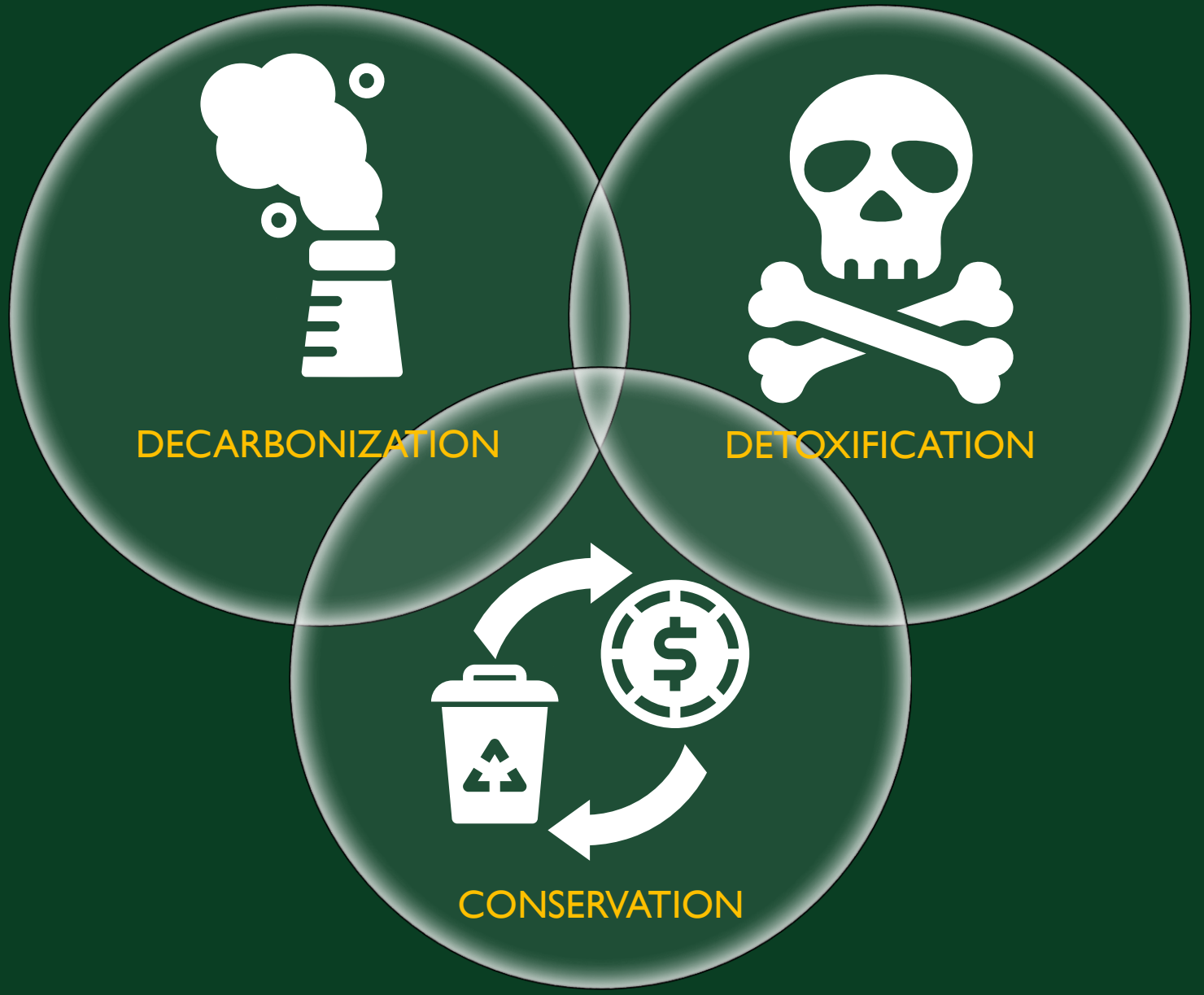
Declare.

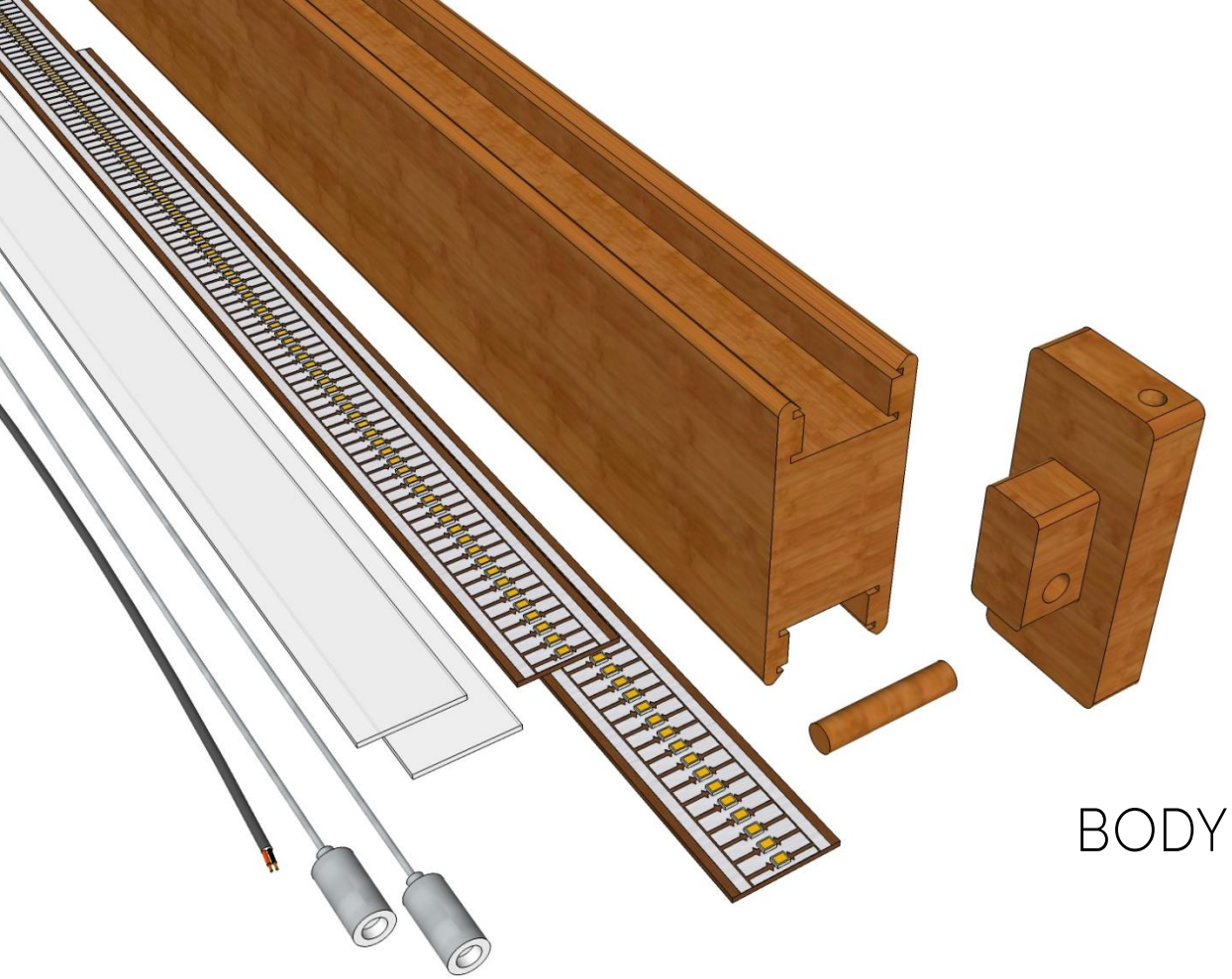
CIRCULARITY INDICATORS

## NOT A PROBLEM IF YOUR FIXTURE IS DESIGNED TRULY SUSTAINABLE!


PERFECT IS THE
ENEMY OF GOOD




DECARBONIZATION
DETOXIFICATION
CONSERVATION



BODY

CARBON CAPTURE

CARBON EMISSION

LENS GLASS
GLUE
FINISH
LED MODULE

DRIVER

POWER WIRE

CARBON NEUTRAL

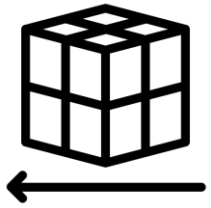
# SUSTAINABLE DESIGN SPECIFICATION?

## SUSTAINABLE MATERIALS AND COMPONENTS:

LOCALLY SOURCED X BIODERIVED X BIODEGRADEABLE X DISTANCE TRAVELED

## EFFICIENT RECYCLING

LOW-LABOR DISASSEMBLY X DISTANCE TRAVELED



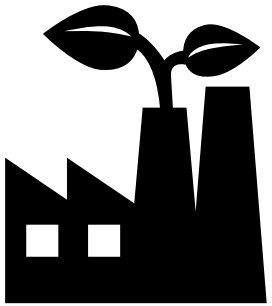
## REDUCTION IN TRANSPORT WASTE:

MASS X VOLUME X DISTANCE TRAVELED

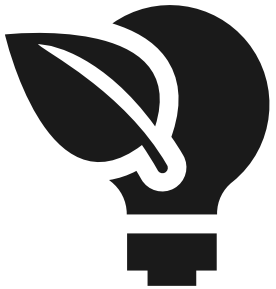
# SUSTAINABILITY = LOCAL ADVANTAGE

REPAIRABLE FIXTURES

SMART MAINTENANCE



BEAUTIFUL FACTORIES



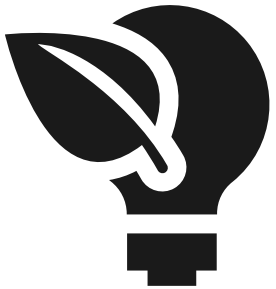
BIO-FRIENDLY MATERIALS

# SUSTAINABILITY = LOCAL ADVANTAGE

REPAIRABLE FIXTURES

SMART MAINTENANCE

BEAUTIFUL FACTORIES



BIO-FRIENDLY MATERIALS

LOCAL SERVICE REVENUE STREAMS

LOCALIZED SUPPLY CHAIN

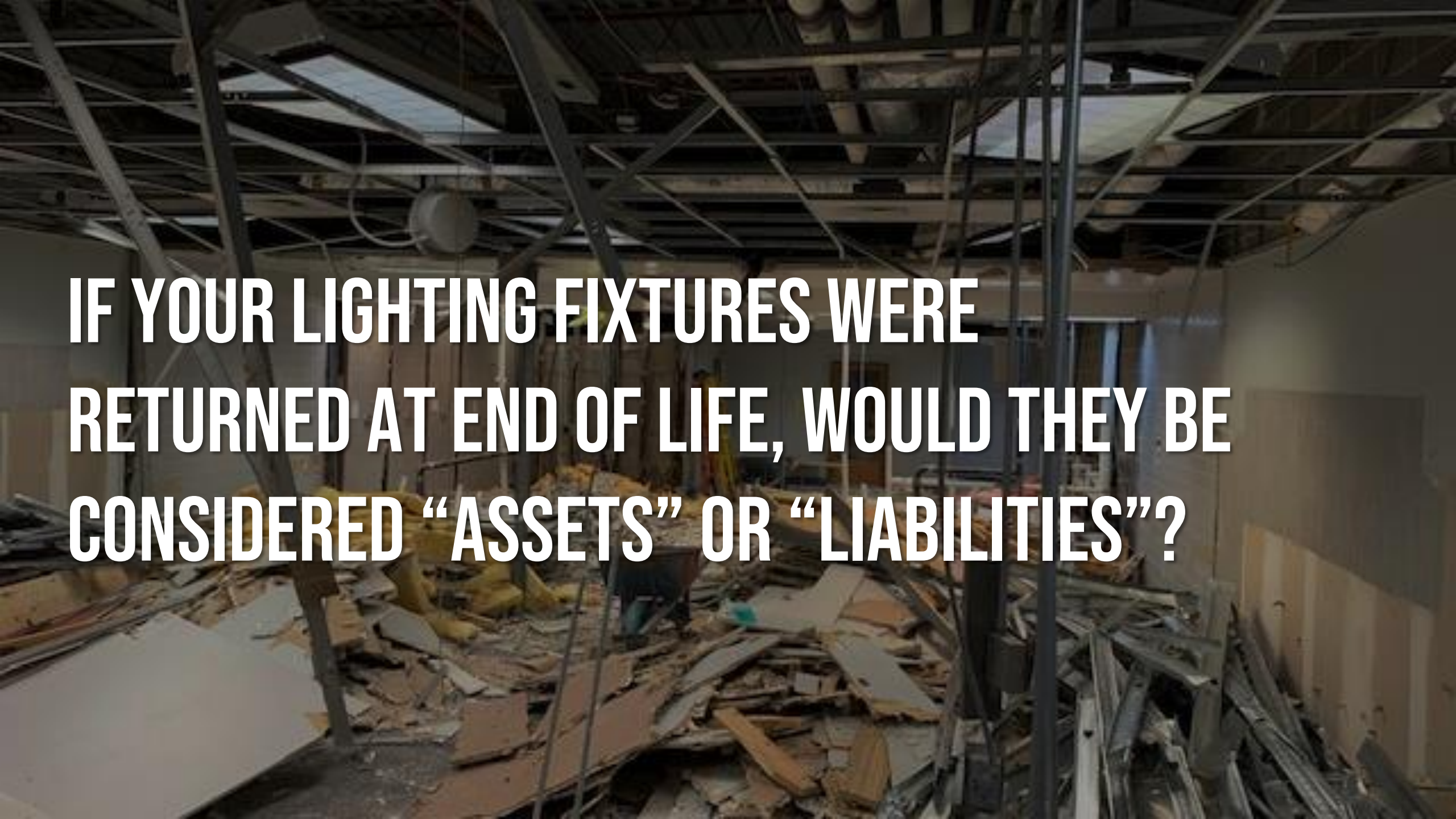
# WHERE'S THE REPS?

# THINK GLOBALLY, ~~ACT~~ INVEST LOCALLY

# WHAT ABOUT LIFECYCLE SOLUTIONS?

# LIGHT-AS-A-SERVICE?

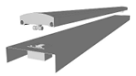
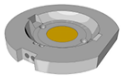
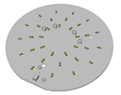
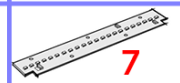
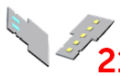
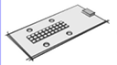
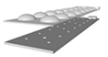
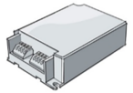
- LEASING PLANS
- PAY-PER-LUX BILLING
- PREDICTIVE MAINTENANCE/IOT
- PLANNED PERFORMANCE UPGRADES
- TAKE-BACK PROGRAMS
- CONTRACTS FOR TOTAL LIFECYCLE COSTS


IF YOUR LIGHTING FIXTURES WERE
RETURNED AT END OF LIFE, WOULD THEY BE
CONSIDERED “ASSETS” OR “LIABILITIES”?

# REPAIRABLE LED FIXTURES?

ZHAGA Consortium

Book 1-25
Overview by application

| | Office & Industry | Retail & Hospitality | Outdoor |
|---|---|---|---|
| Integrated LED light engines |  14  2,8 |  17  16 | |
| LED modules (non-integrated) |  7  21  14 |     12 9 5 3,10 |    4 15 19 |
| Drivers |  13 | LED set 22,23 |  24,25 |
| Sensor and communication modules |  20 | |  18 |


YOU HAVE THE POWER


YOU HAVE THE POWER


WHAT FUTURE ARE WE SPECIFYING TODAY?

# STARTING YOUR OWN JOURNEY?

ELLENMACARTHURFOUNDATION.ORG

MCDONOUGH.COM

WWW.RECOLIGHT.CO.UK

BUILDINGTRANSPARENCY.ORG

LIVING-FUTURE.ORG

LIGHTINGFORGOOD.ORG

CARBONLEADERSHIPFORUM.ORG

MATERIALSPALETTE.ORG


THANKS!
BRAD.KOERNER @ GMAIL.COM
WWW.LUCEPT.COM

ENLIGHTEN AMERICAS 2022

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IALDENLIGHTEN'22