Sustainability for Competitive Advantage

US DOE SSL R+D WORKSHOP 2021

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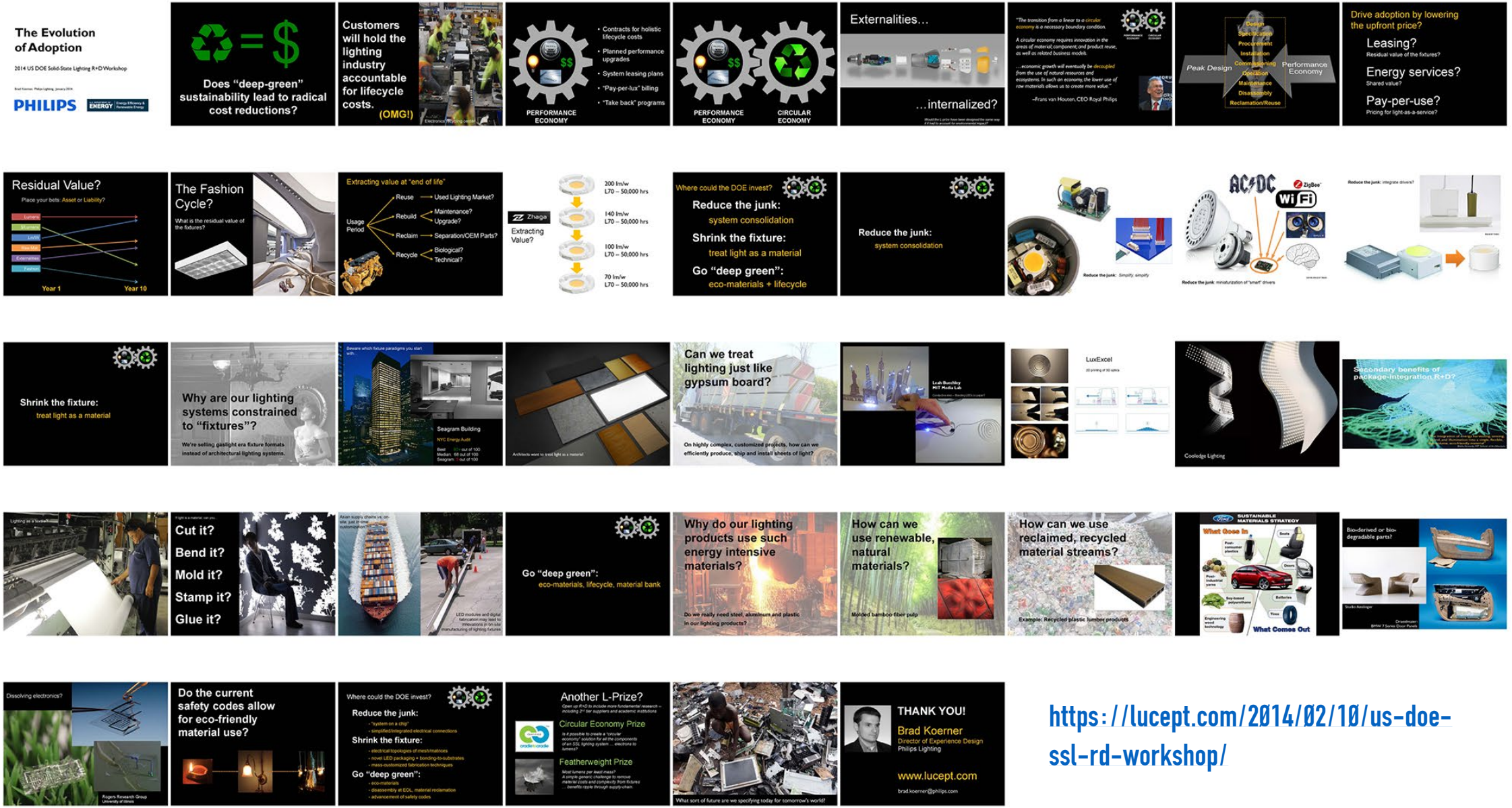
Does “deep green” sustainability lead to radically reduced costs?

6 years ago...

2014 US DOE Solid State Lighting R+D Workshop



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

Performance Economy <> Circular Economy:

Where could the US DOE invest?

Reduce the junk:

➡ system consolidation

Shrink the fixture:

➡ treat lighting as an arch. material

Go "deep green":

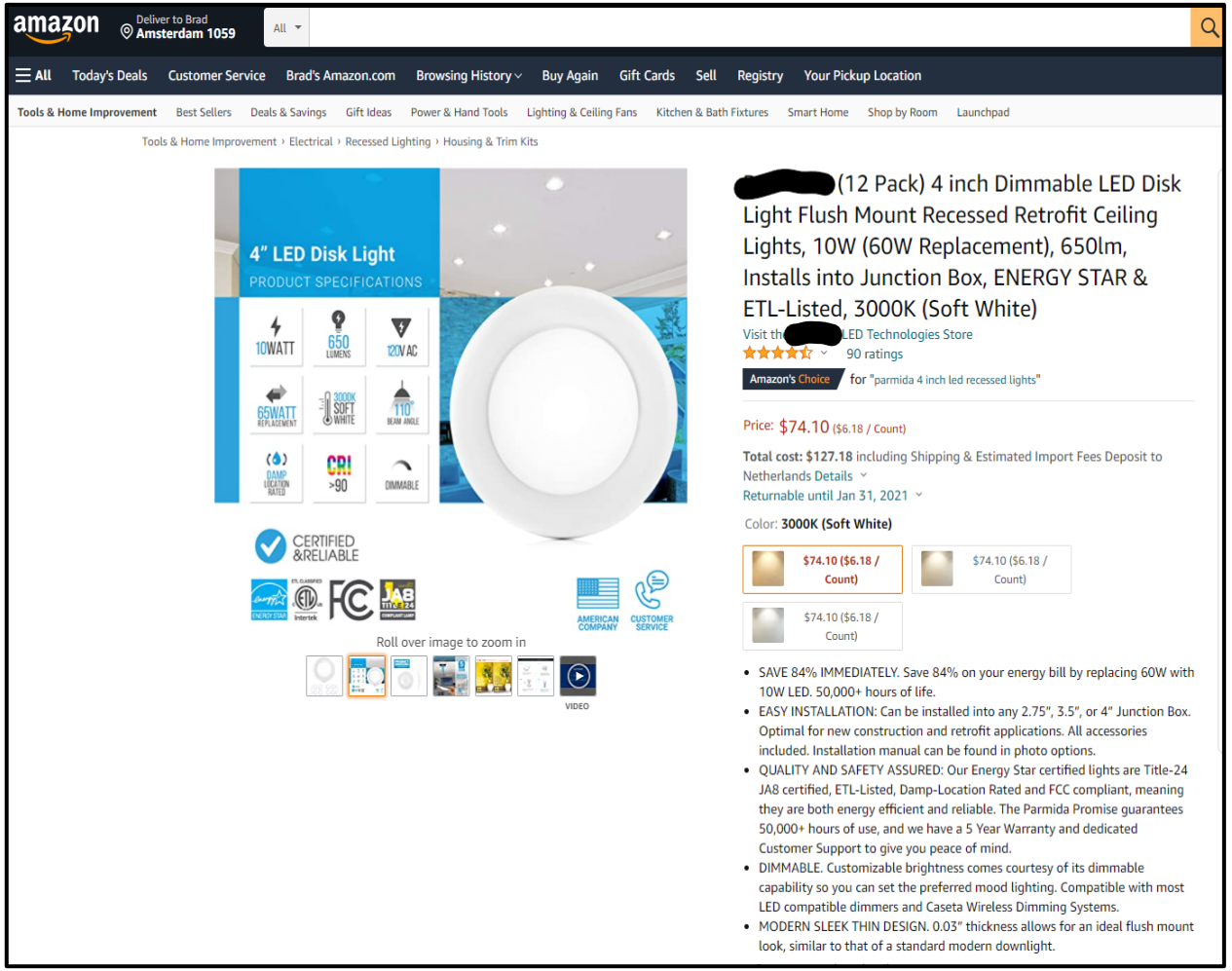
➡ eco-materials + lifecycle

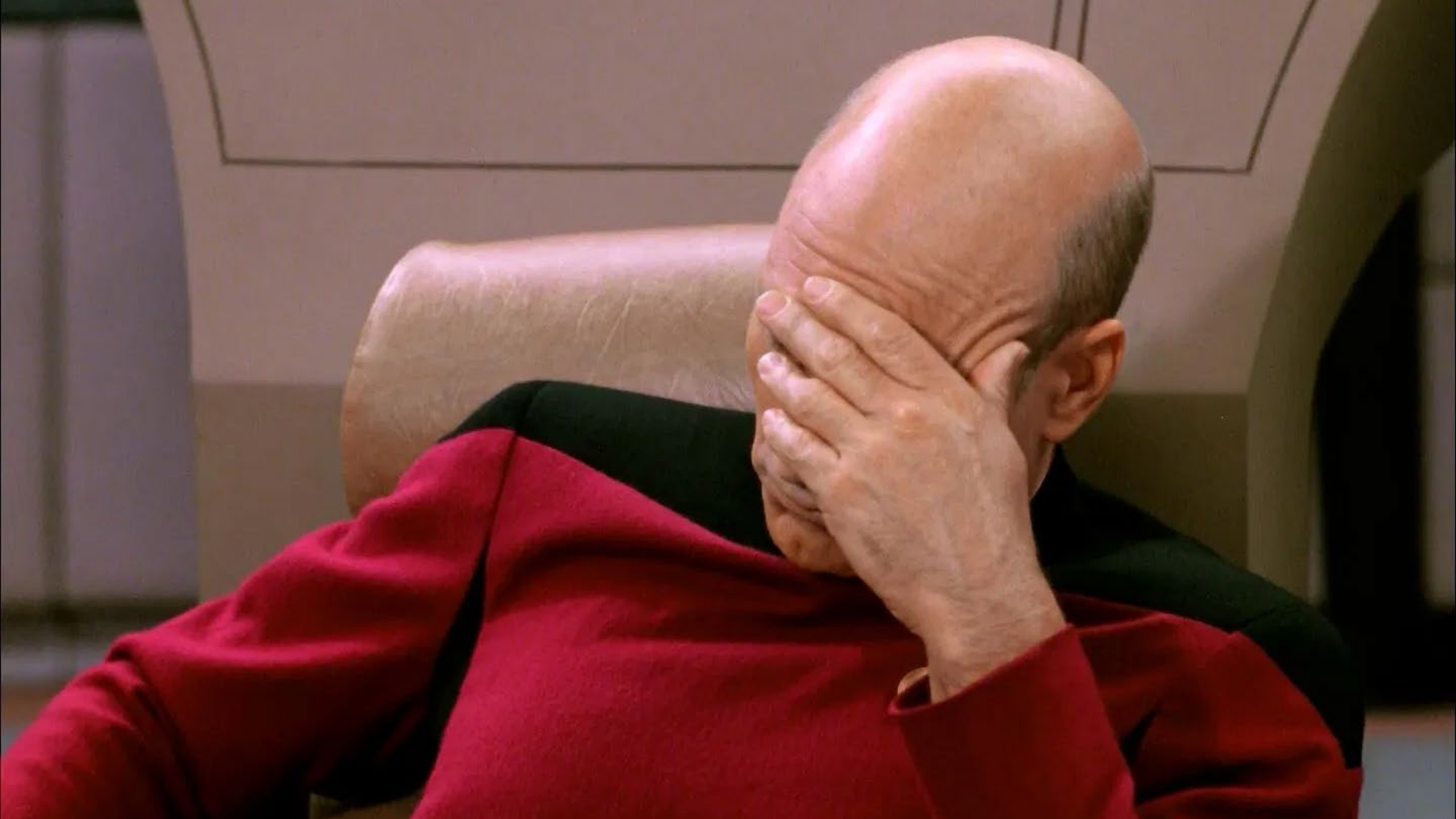
Our industry progress the past 6 years?

12-PACK FOR $74.10?

$6.18 RETAIL????

WHERE DOES THIS END?





Deep green?

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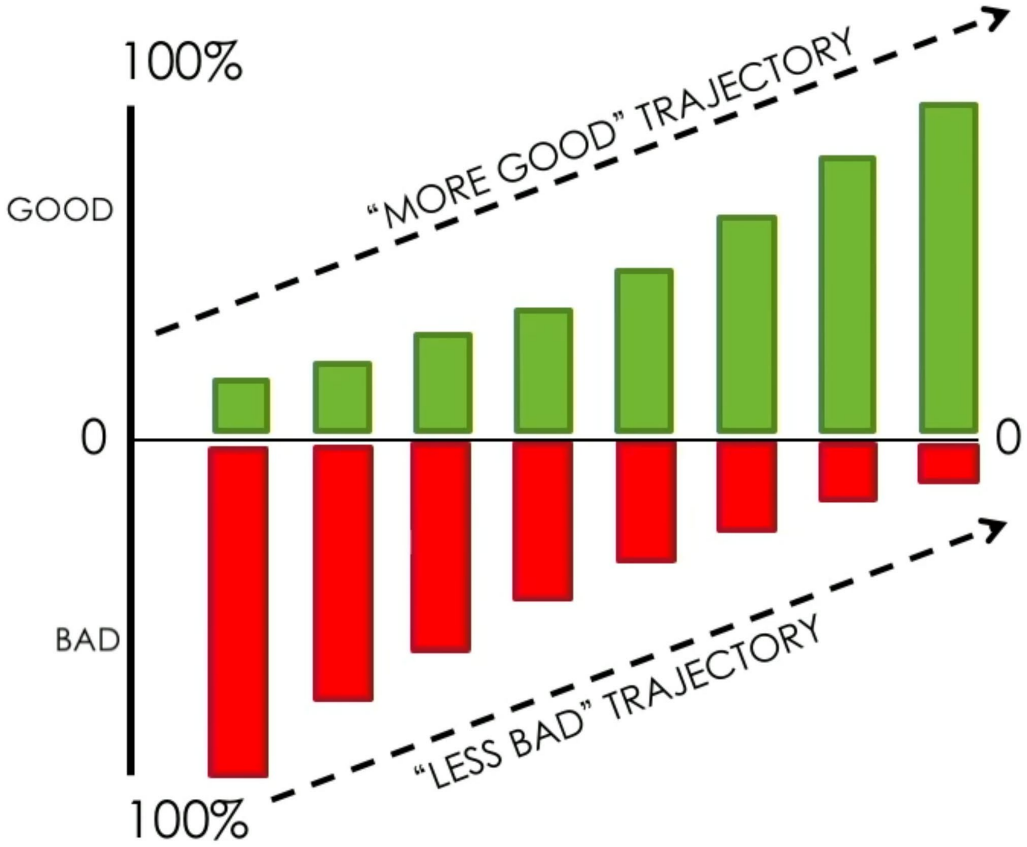
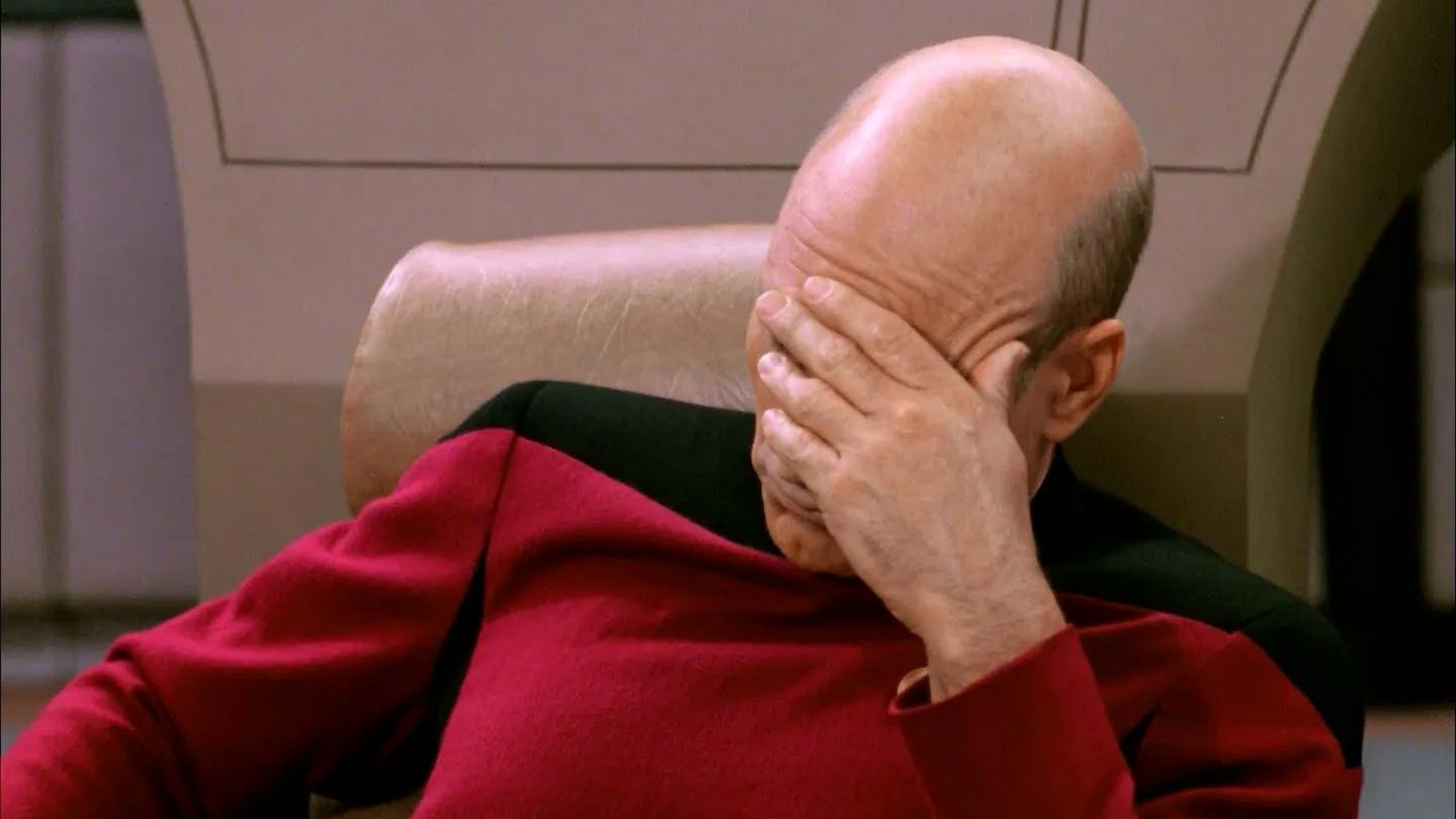


"Being less bad is not also being good."

–William McDonough

Pure greenwashing!!!!!!



What does the US lighting industry need?

A genuine R&D challenge

(not just an easy layup for more product-marketing greenwashing)

Sustainability
= Local Advantage

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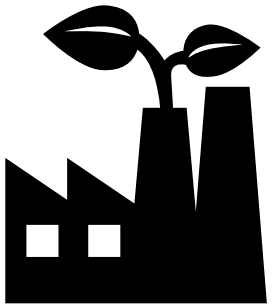
SUSTAINABILITY = LOCAL ADVANTAGE

REPAIRABLE FIXTURES

SMART MAINTENANCE



BEAUTIFUL FACTORIES

BIO-FRIENDLY MATERIALS

LOCAL SERVICE REVENUE STREAMS

LOCALIZED SUPPLY CHAIN

Sustainable design rating?

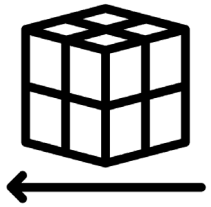
For competitive local advantage?

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

The fusion of lighting and architecture?

The DC Power Revolution

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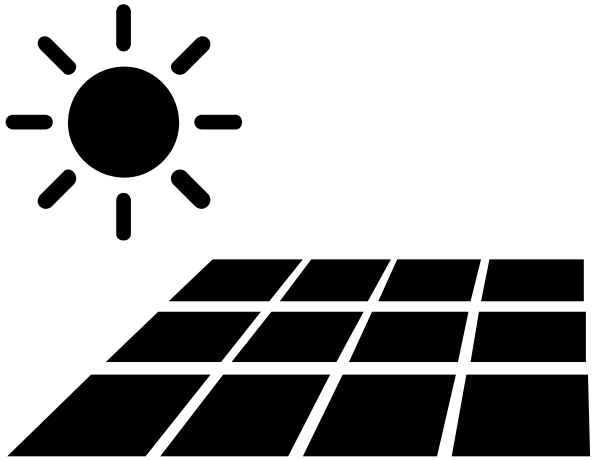
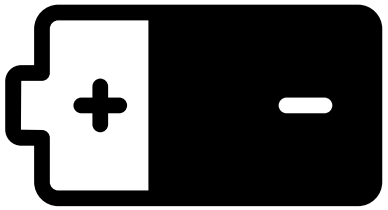
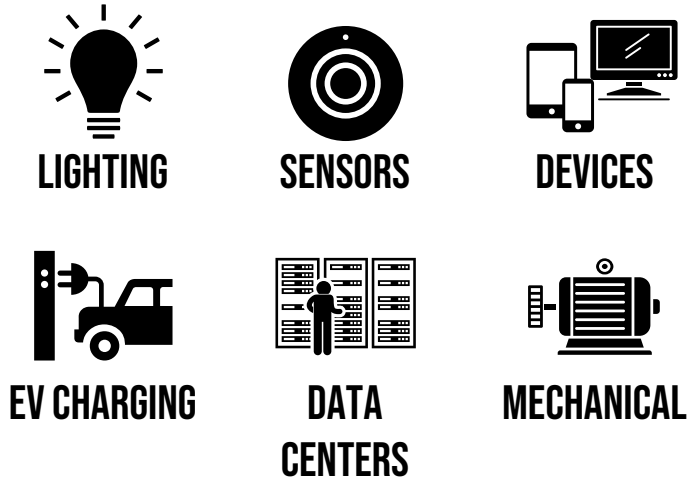
WHAT WILL BE THE IMPACT OF NET-ZERO BUILDINGS?



SOLAR PARITY WITH GRID



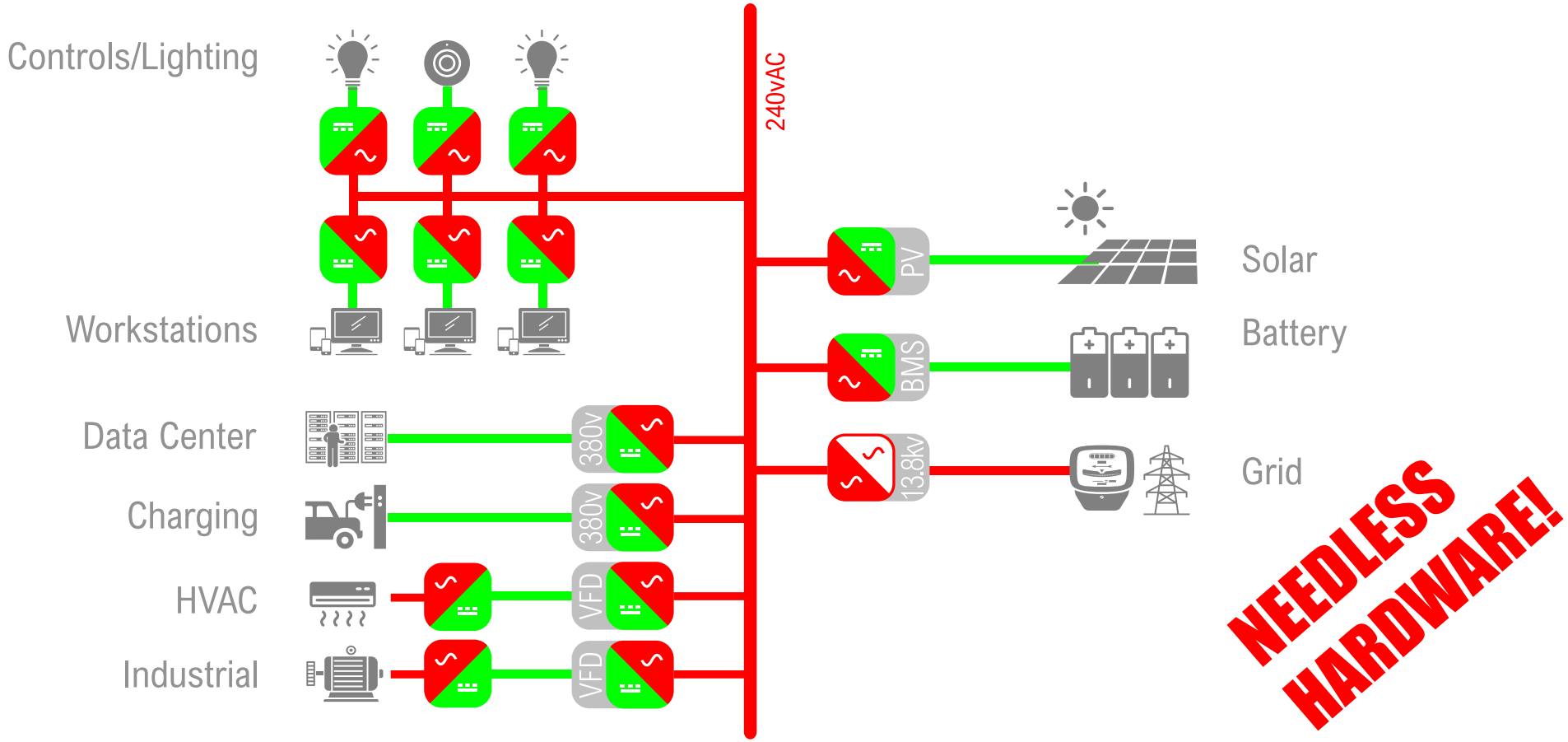
PLUNGING STORAGE COST



EVERYTHING IS DC POWER

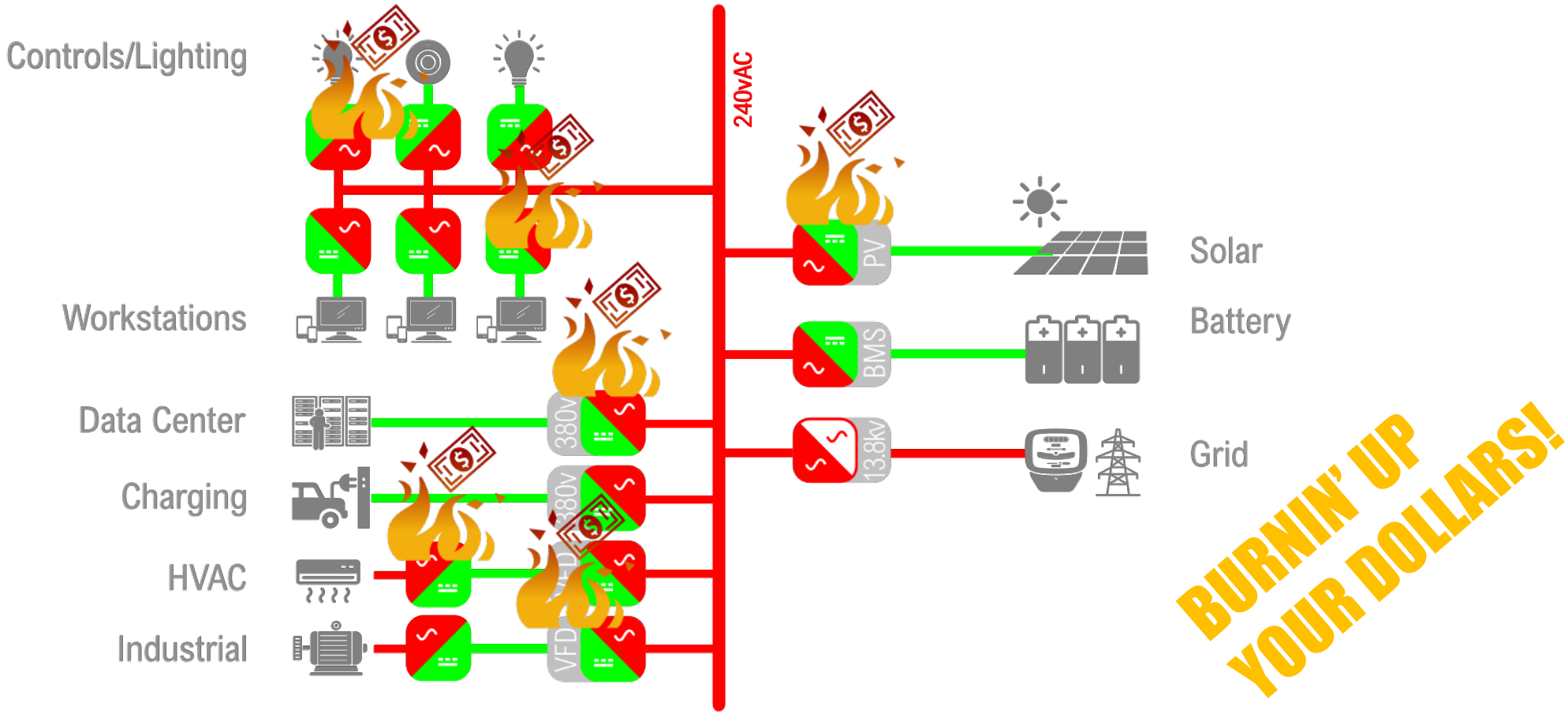
SO WASTEFUL, SO DUMB

NEEDLESS DC-AC-DC CONVERSIONS ADD UNNEEDED HARDWARE THROUGHOUT A BUILDING



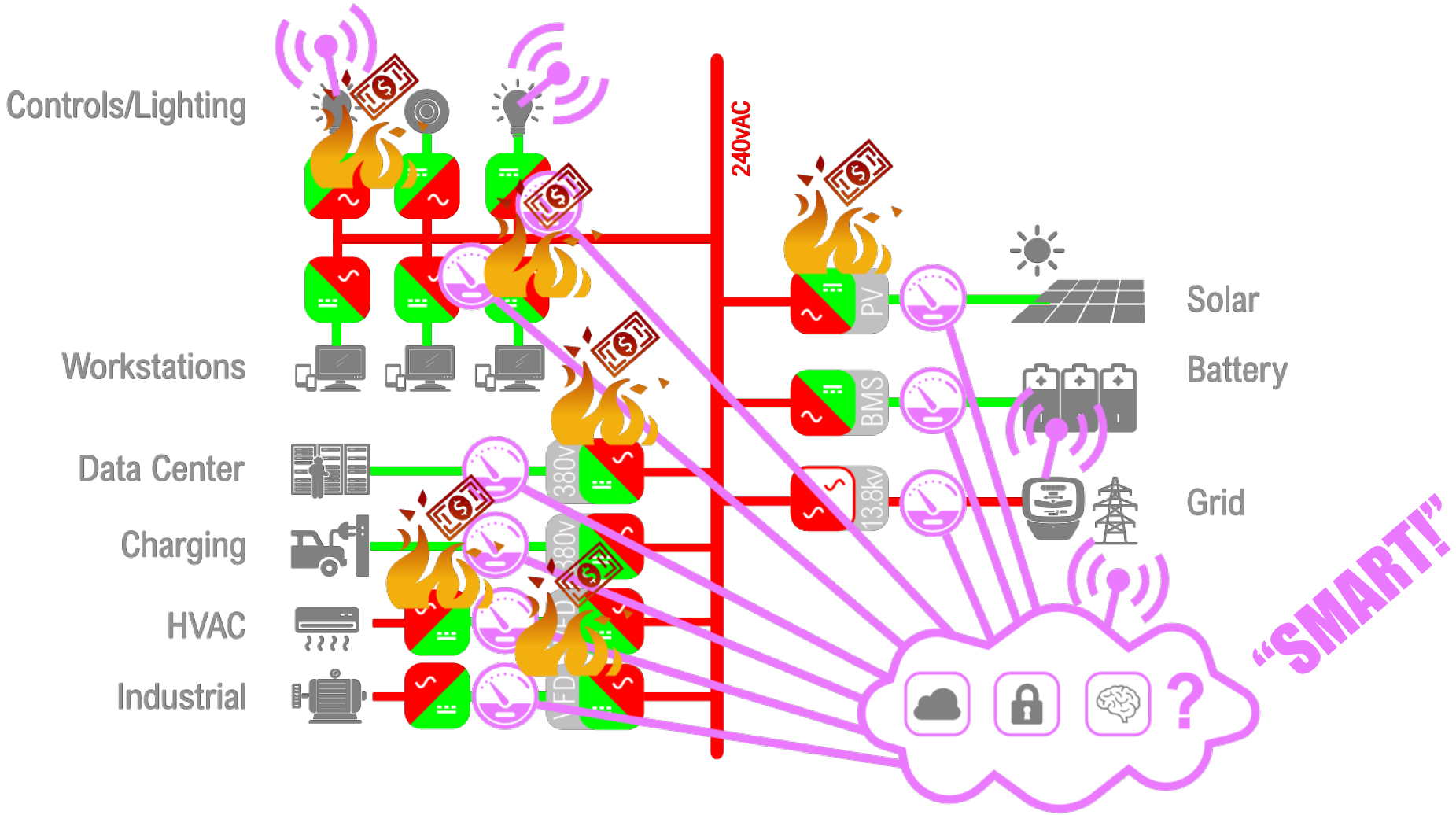
SO WASTEFUL, SO DUMB

NEEDLESS DC-AC-DC CONVERSIONS WASTE 15% OF THE TOTAL POWER OF A NET-ZERO-ENERGY BUILDING



SO WASTEFUL, SO DUMB

COMPANIES ARE SLATHERING ON COMPLICATED DIGITAL/DC CONTROLS ON TOP OF OUTDATED AC GRID



So. Much. Junk.

DC microgrids eliminate thousands of wasteful converters from commercial buildings

Solar inverters

LED drivers

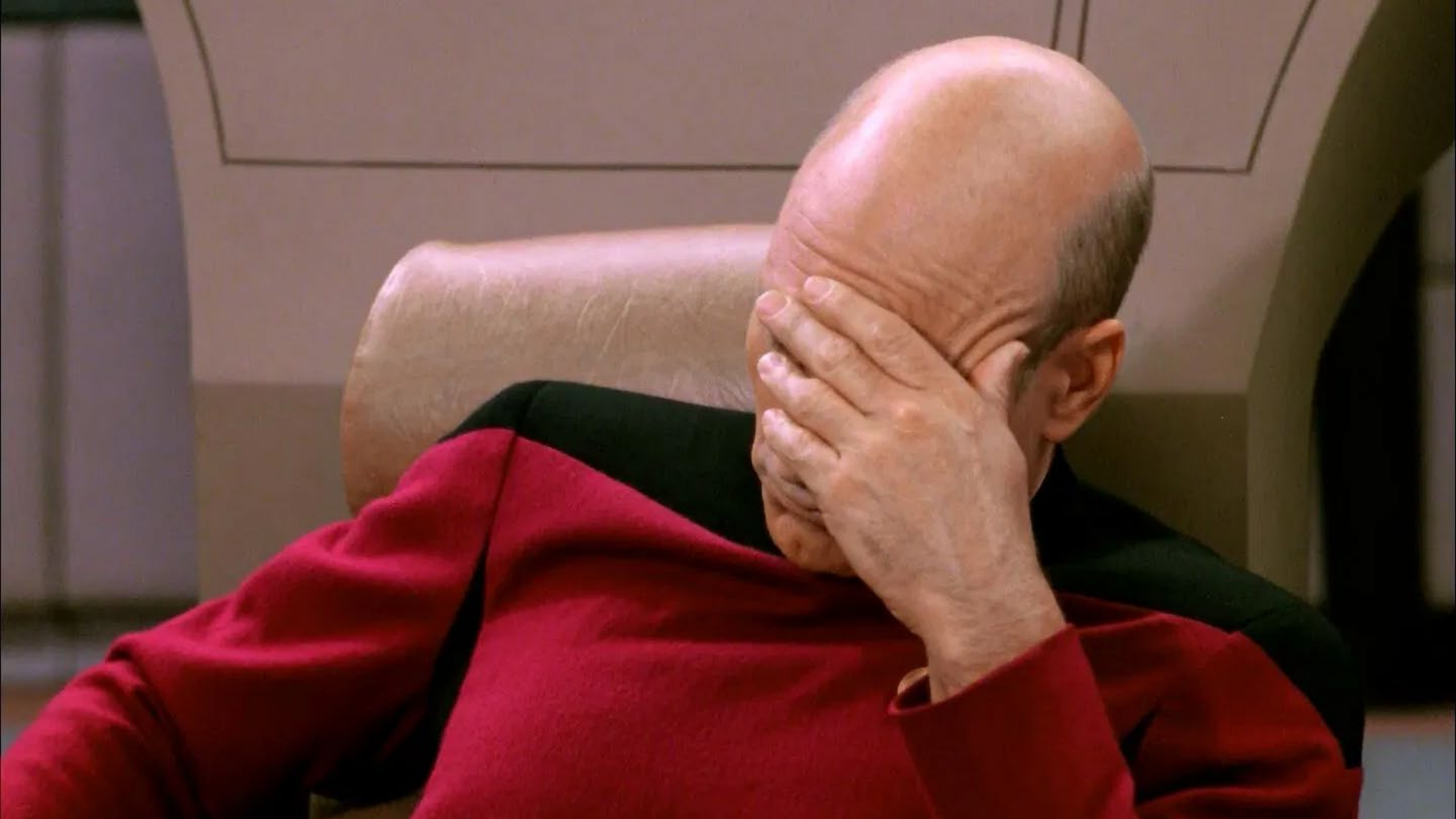
Data center PSUs

Battery inverters

Variable frequency drive inverters

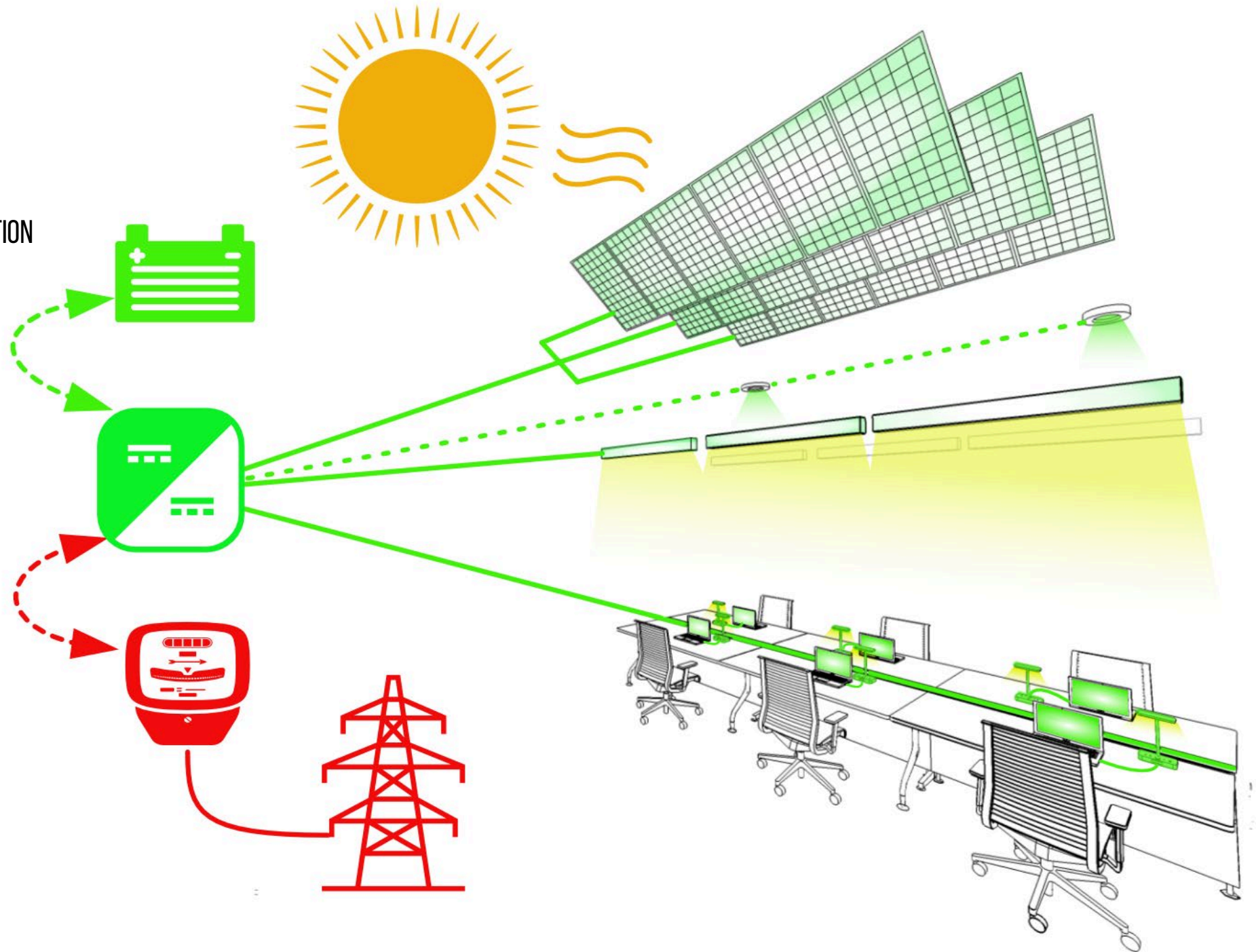
AC meters, breakers

Chargers



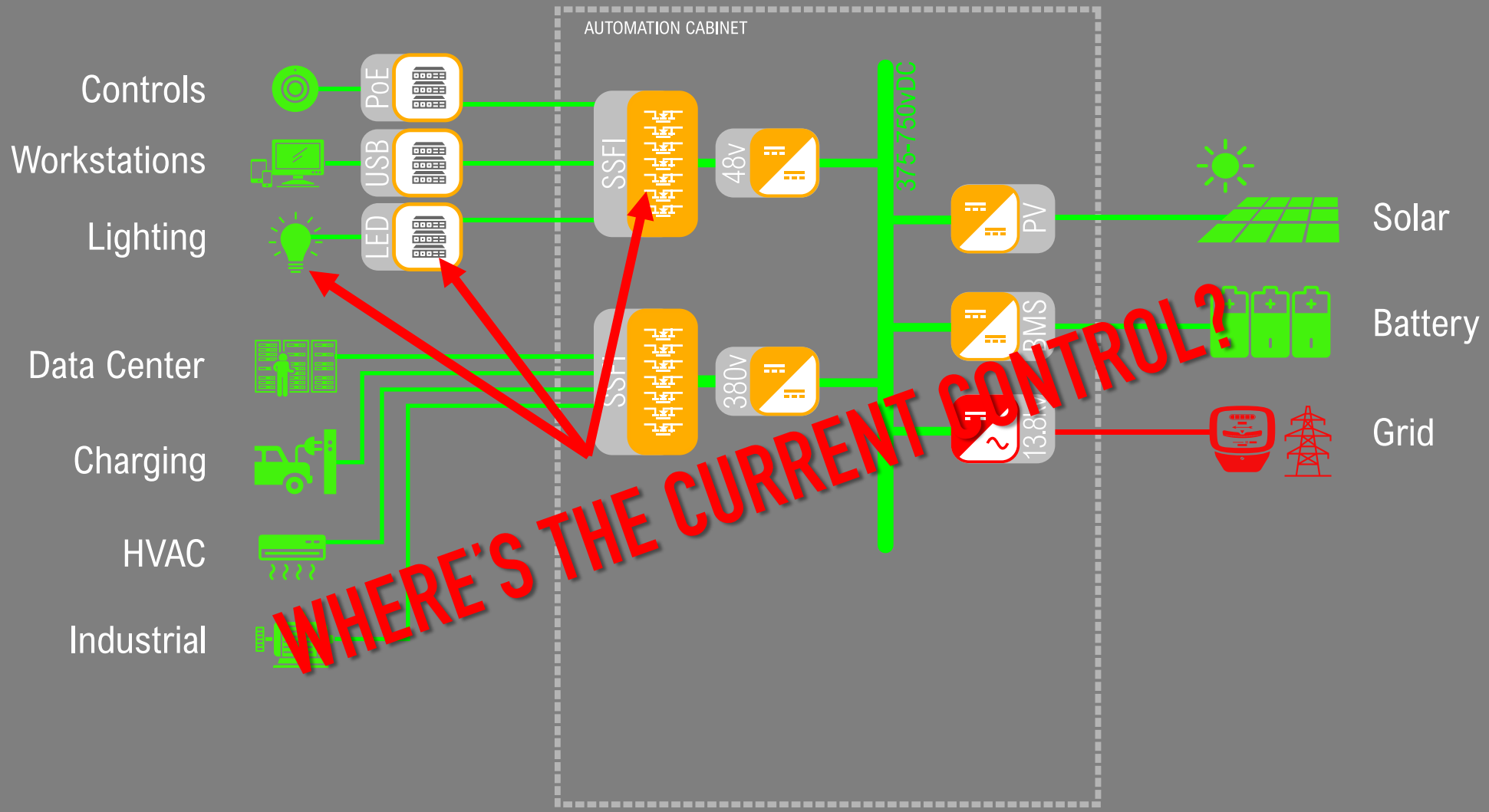
NET-ZERO ENERGY BUILDINGS

ARE LEADING US TO A DC POWER REVOLUTION



SIMPLIFYING LIGHTING SYSTEMS

DC-BUS WITH DIGITAL SOLID-STATE SWITCHING, FAULT INTERRUPTION AND CONVERSION




SMALL SAVINGS ARE A
BIG DEAL
TARGET
CVS pharmacy

Sustainable Luminaire Innovation

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BAMBOO PENDANT

ENVISIONING A CLEAN, GREEN FUTURE FOR LIGHTING
AND ELECTRIC INFRASTRUCTURE

U.S. DEPARTMENT OF ENERGY

WINNER OF THE 2019 MANUFACTURING INNOVATOR CHALLENGE:

SUSTAINABLE MANUFACTURING OF LUMINAIRES

KOERNER DESIGN

A CLASSIC FORMAT, MADE SUSTAINABLE

Simple design, natural materials

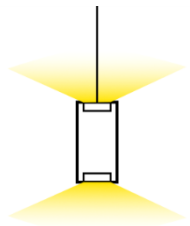
- A radically simplified design in support of the circular economy
- Low embodied-energy using bio-derived and biodegradable, low-toxicity, sustainable materials
- Simple construction, fast disassembly, radically reduced toxicity = dramatically reduced lifecycle costs & liabilities

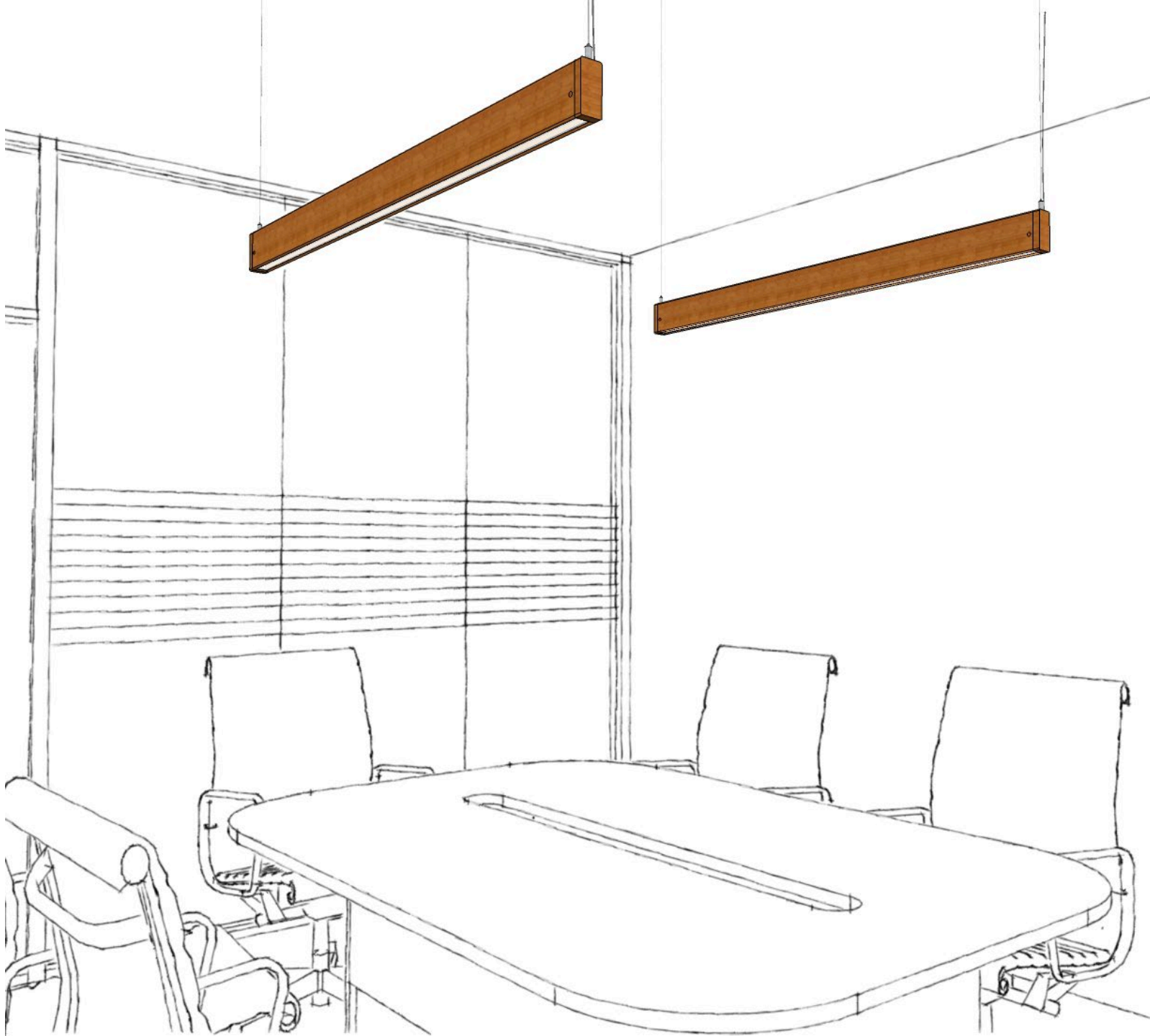
Anticipating centralized DC power

- Net-zero-energy buildings with onsite solar PV and battery storage can save 15% overall system efficiency by skipping DC-AC-DC conversions
- Centralized DC/DC conversion with solid-state switching, solid-state fault interruptions and Class 2 topologies allow us to create SELV-compliant fixtures

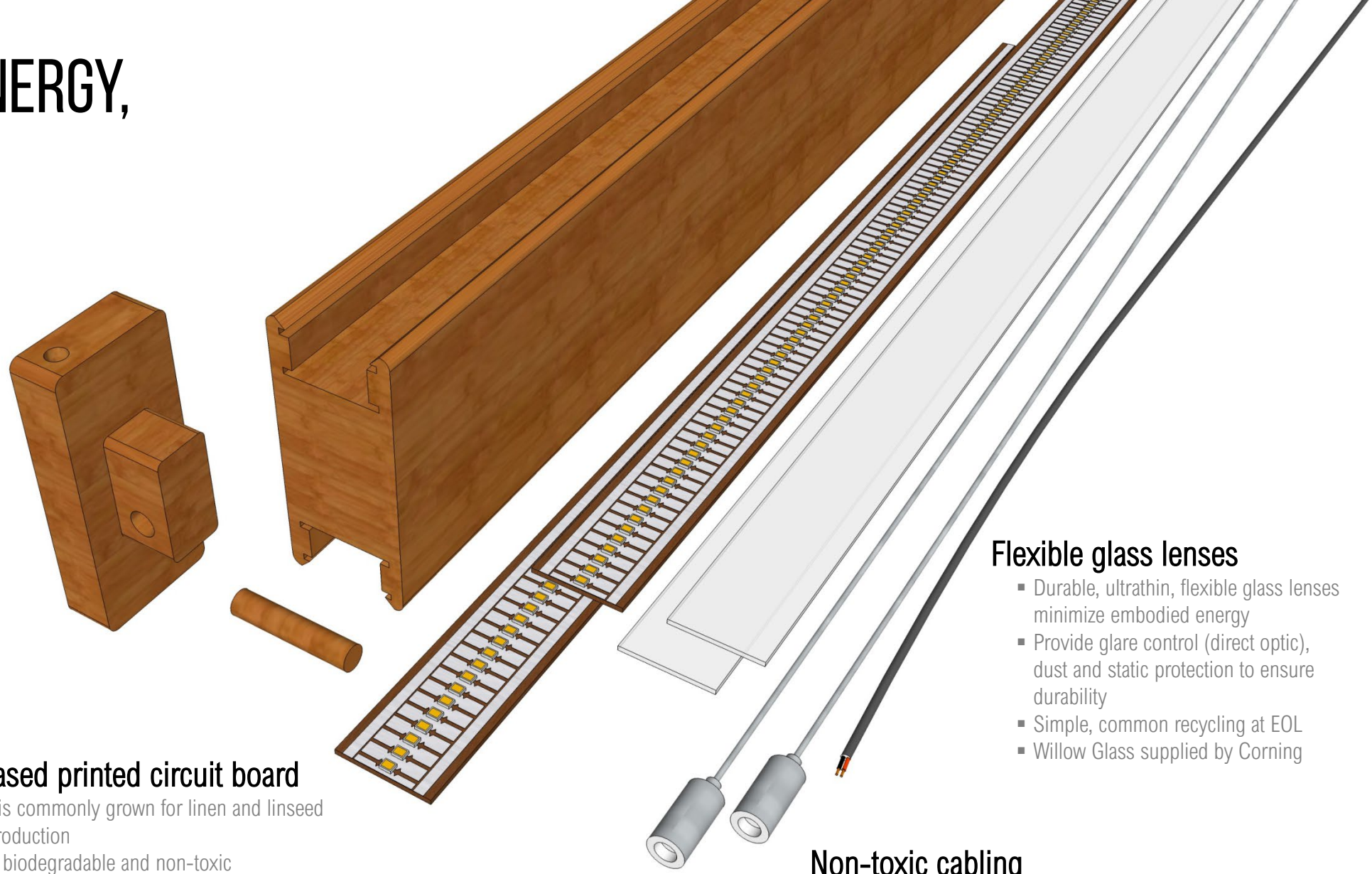
The target specs

- Direct/indirect Lambertian distribution
- 6.5 watt/linear foot (split 50/50 up/down)
- 150 lm/w (minimum fixture efficacy)
- Designed to meet 0.6 w/sqft for LEED applications
- Various CCT/CRI combinations available
- Full range dimming & digital control integral to centralized DC/DC system
- Additional optical distributions in the future





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

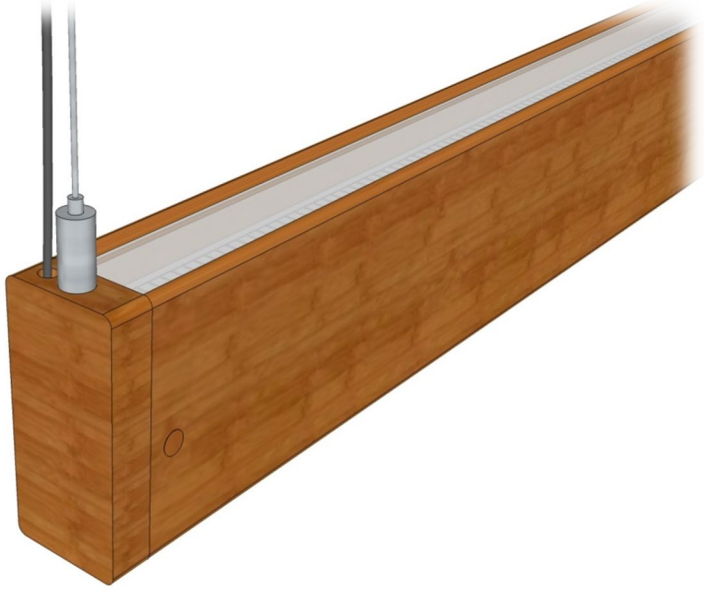
Flexible glass lenses

- 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

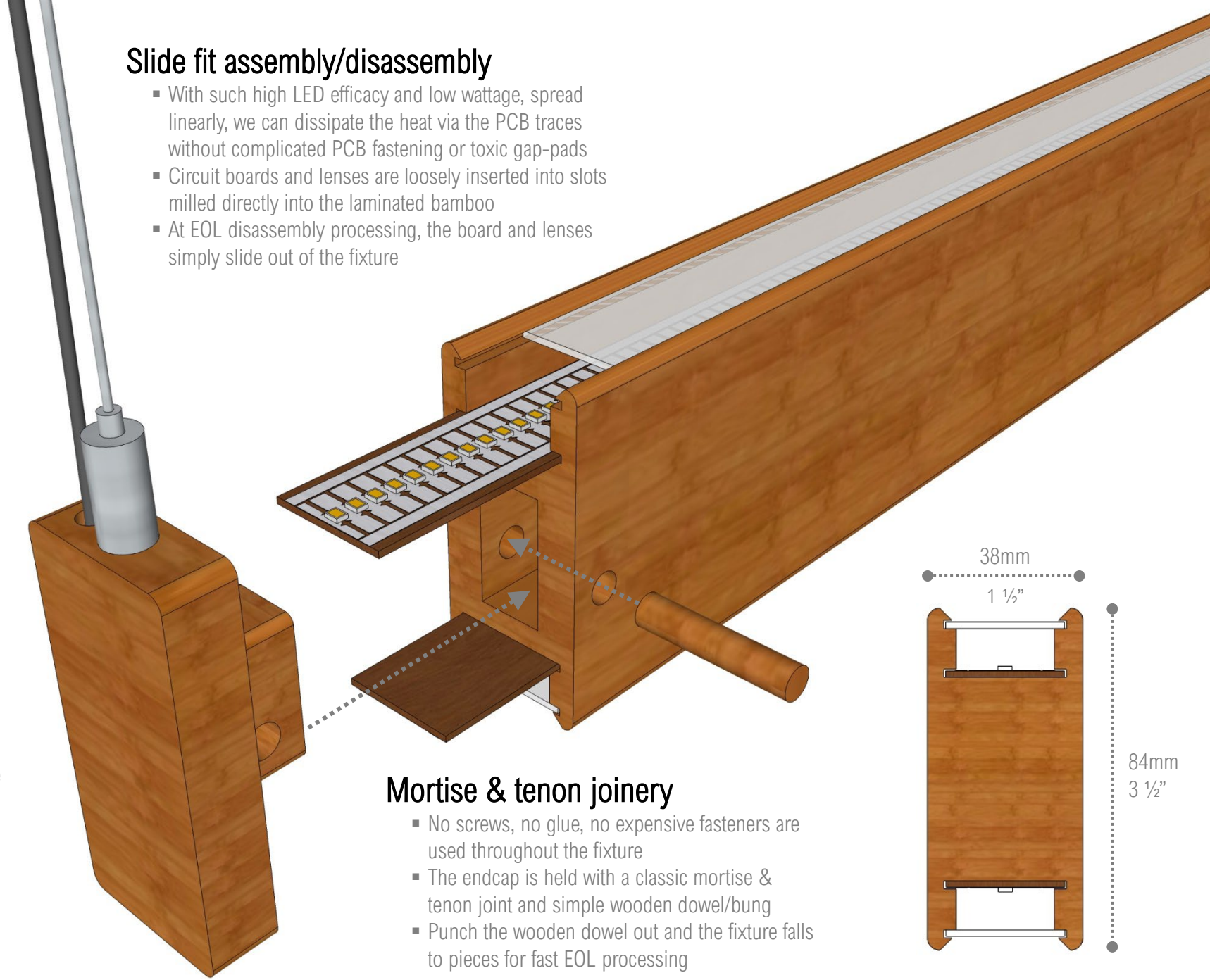


Endcap concept

- 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

BEAUTIFUL FACTORIES

ALUMINIUM VS. BAMBOO
WHICH IS "MORE SUSTAINABLE"?

Do you 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?

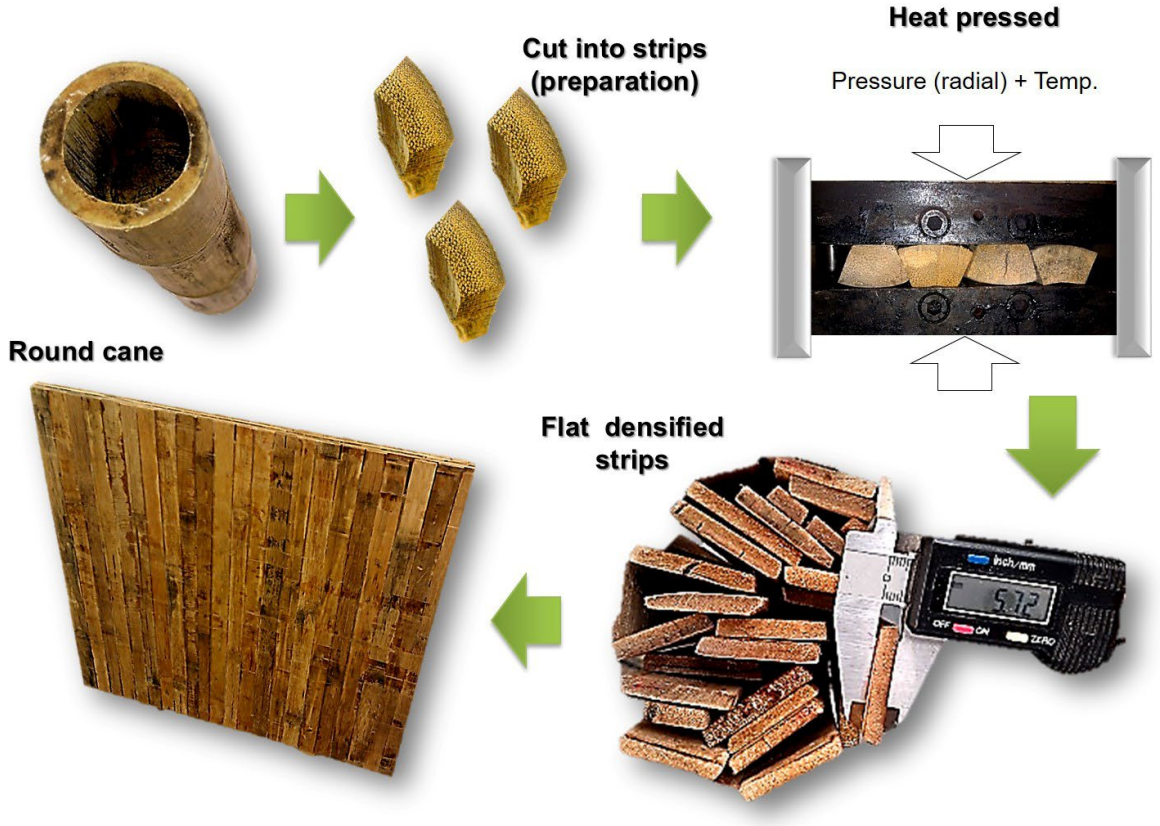
- Instead of merely “mitigating our impact” we want to help correct excess CO2 levels
- The laminated bamboo in our fixture sequesters 10.72 lbs of CO2 per 4’ length (even after considering CO2 released during manufacturing processes of laminated product)

Safe

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

LEED v4 Credits

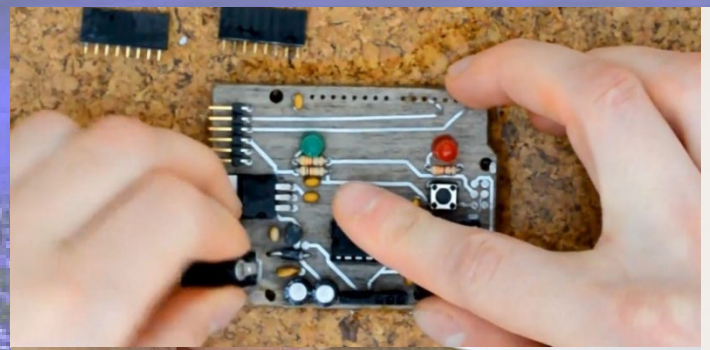
- Our products may offer the following LEED Credits:
  - MRc3: Sourcing of Raw Materials
  - EQc2: Low Emitting Materials (No added formaldehyde)
  - INc1: Innovation in Design (Life Cycle/Environment Impact)

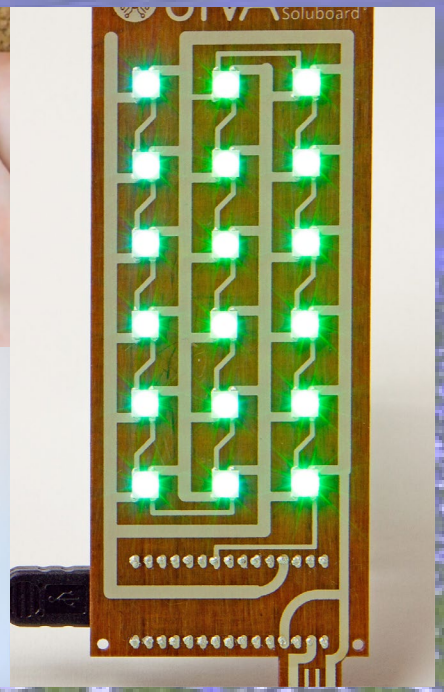


BIO-BASED PRINTED CIRCUIT BOARDS

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?





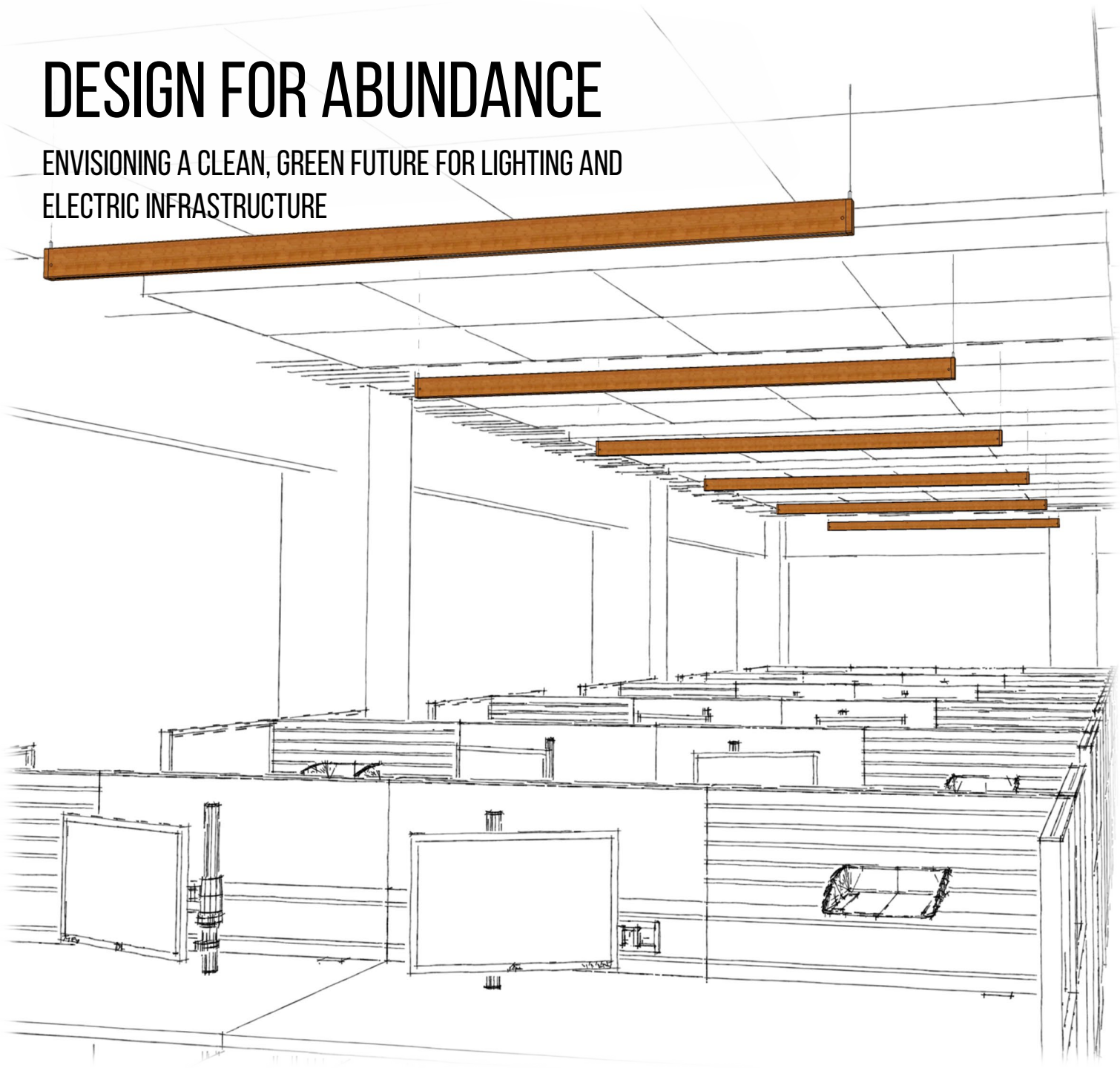
Jiva Materials SOLUBOARD
Flax-based compostable circuit board

OUR SUPPLY CHAIN:
Flax-fields in bloom

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

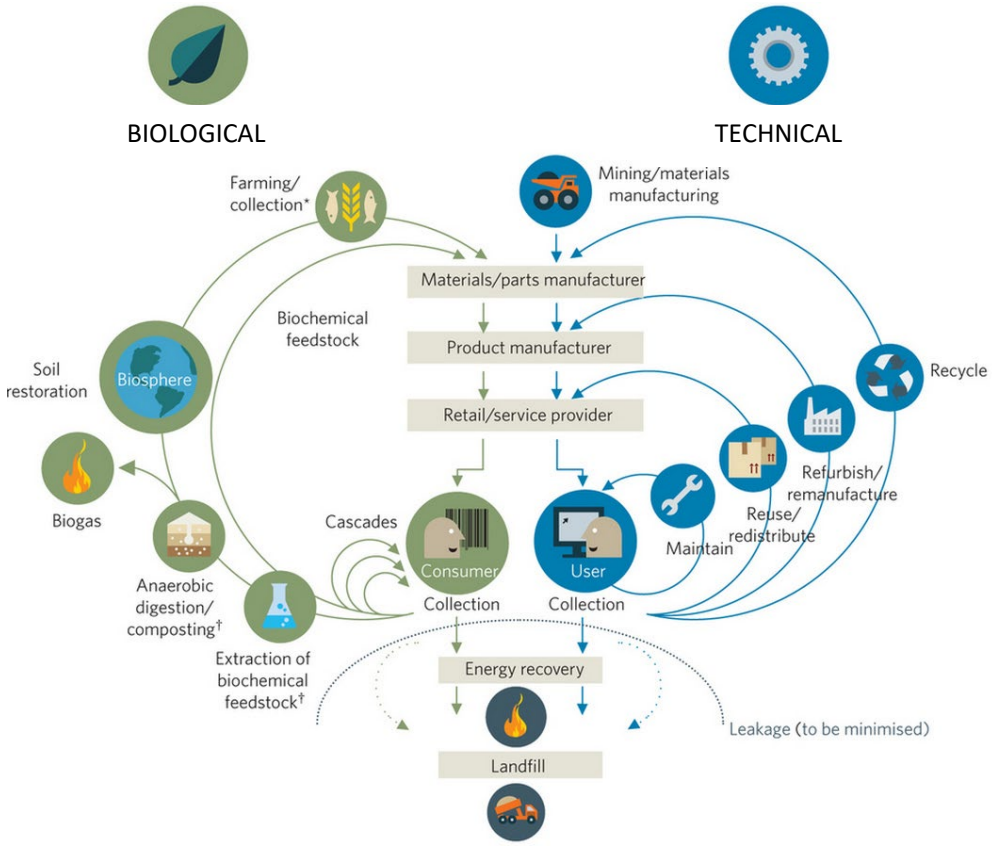
DESIGN FOR ABUNDANCE

ENVISIONING A CLEAN, GREEN FUTURE FOR 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

We are creating this future today.

What is holding the lighting industry back?

Thanks!

Brad Koerner
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bkoerner@cimanetwork.com

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luminous concepts

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