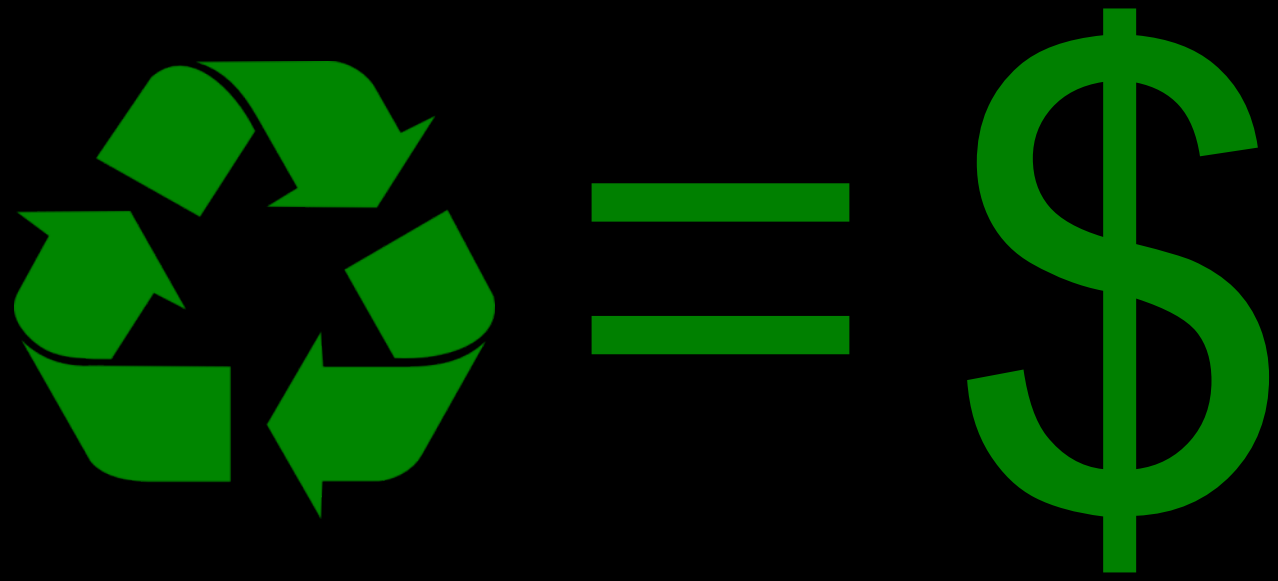
The Evolution of Adoption

2014 US DOE Solid-State Lighting R+D Workshop

Brad Koerner, Philips Lighting, January-2014

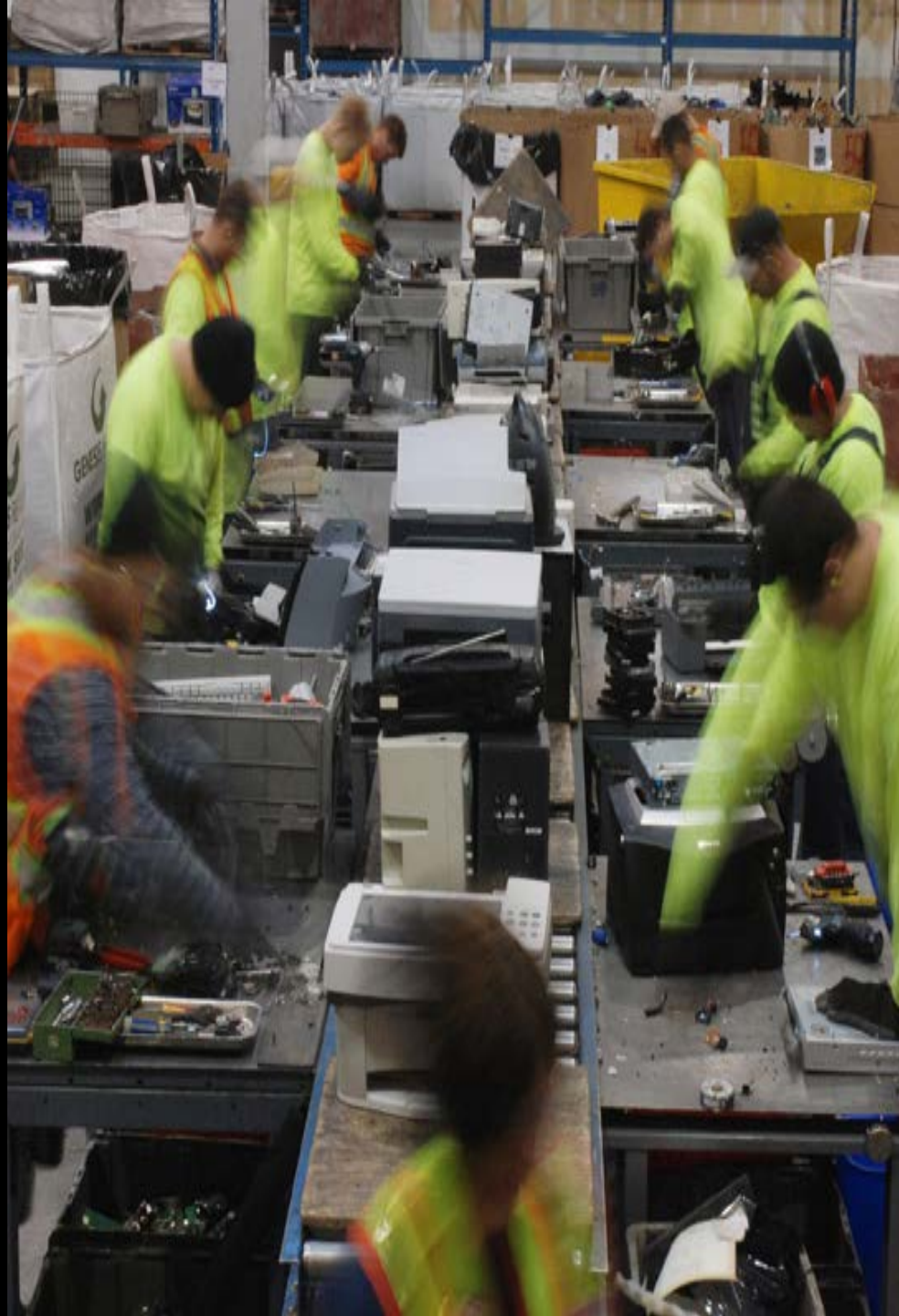
PHILIPS

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy



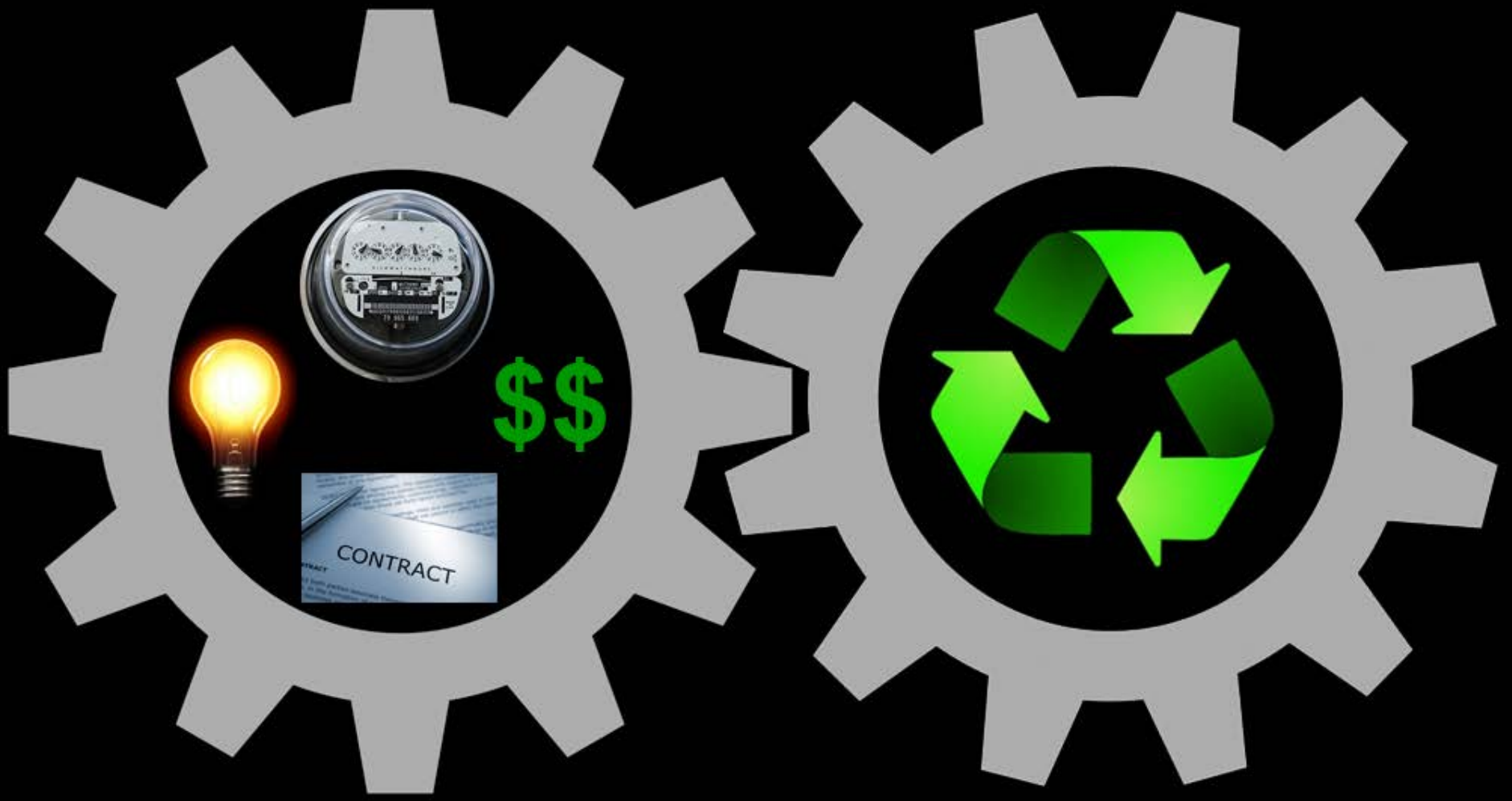
Does “deep-green” sustainability lead to radical cost reductions?

Customers will hold the lighting industry accountable for lifecycle costs.



PERFORMANCE ECONOMY

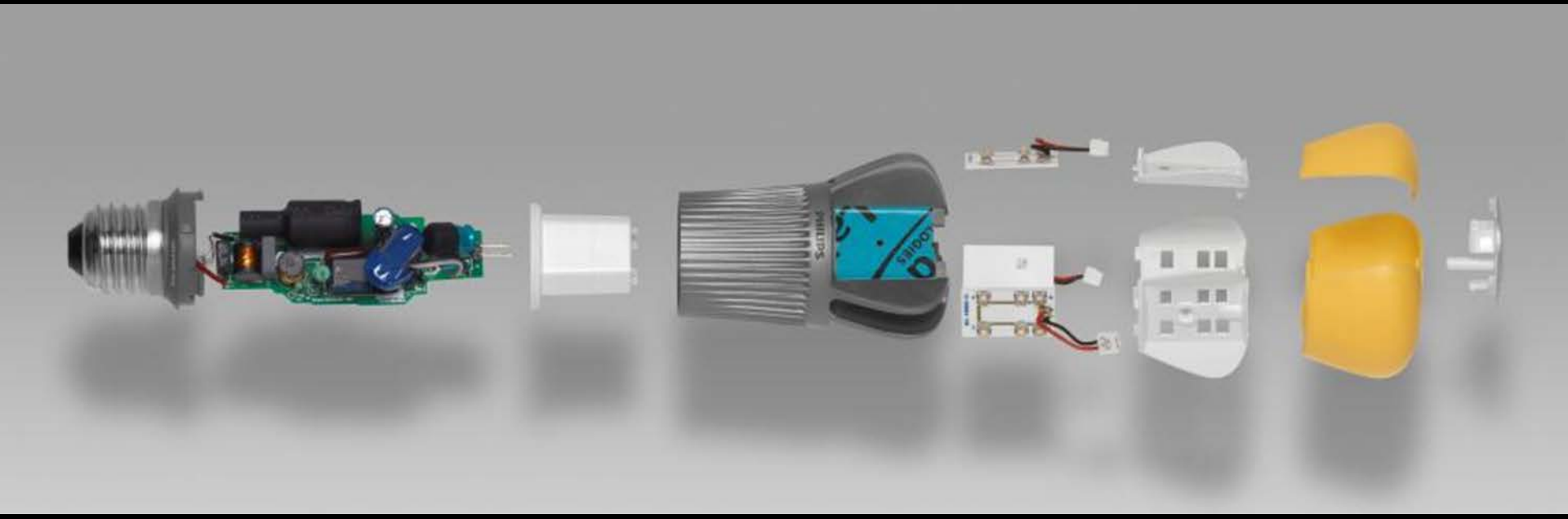
- Contracts for holistic lifecycle costs
- Planned performance upgrades
- System leasing plans
- “Pay-per-lux” billing
- “Take back” programs



PERFORMANCE ECONOMY

CIRCULAR ECONOMY

Externalities…



…internalized?

"The transition from a linear to a circular economy is a necessary boundary condition.

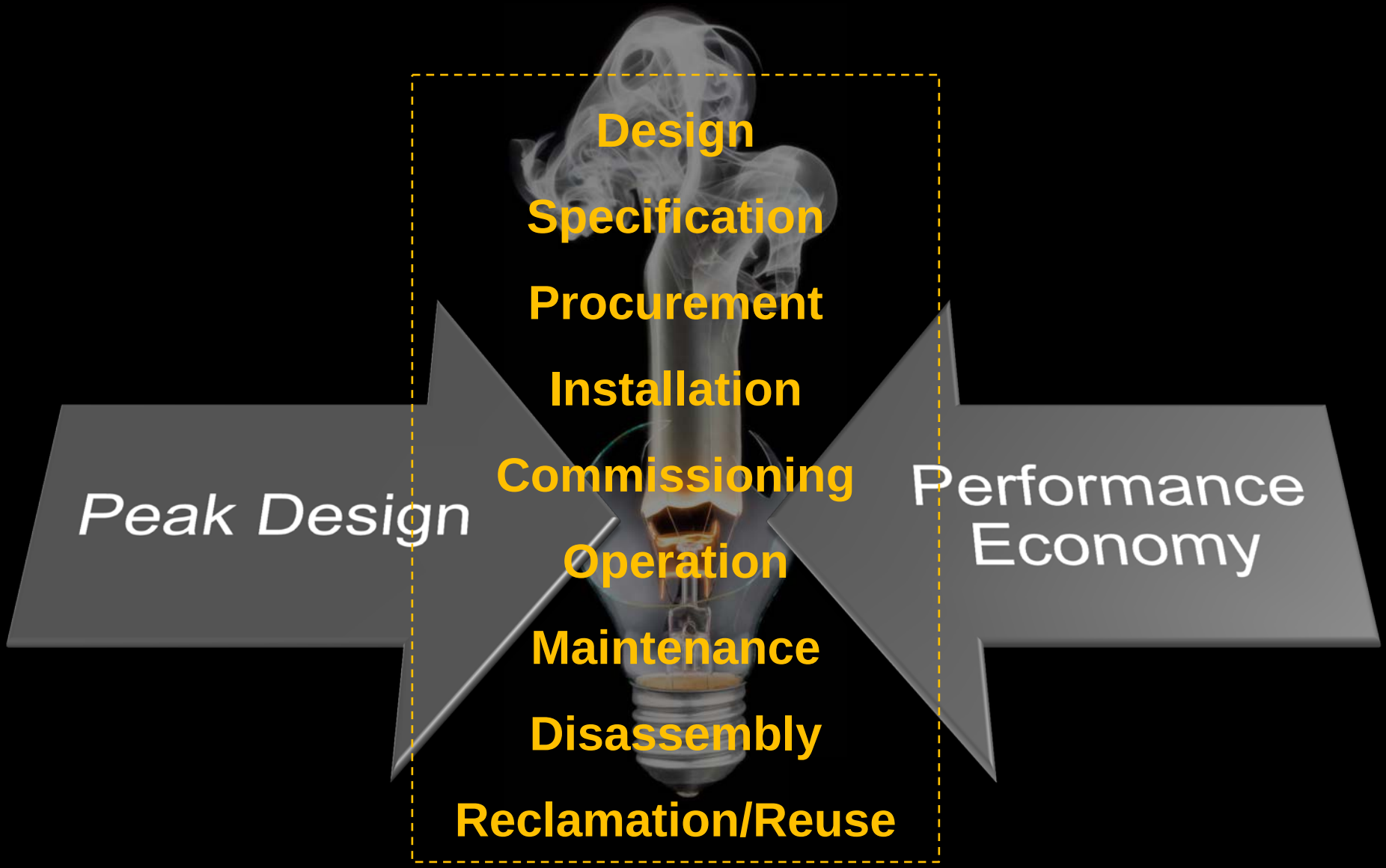
A circular economy requires innovation in the areas of material; component; and product reuse, as well as related business models.

…economic growth will eventually be decoupled from the use of natural resources and ecosystems. In such an economy, the lower use of raw materials allows us to create more value."

--Frans van Houten, CEO Royal Philips

PERFORMANCE ECONOMY

CIRCULAR ECONOMY


Peak Design
Performance
Economy
Design
Specification
Procurement
Installation
Commissioning
Operation
Maintenance
Disassembly
Reclamation/Reuse

Drive adoption by lowering the upfront price?

Leasing?

Residual value of the fixtures?

Energy services?

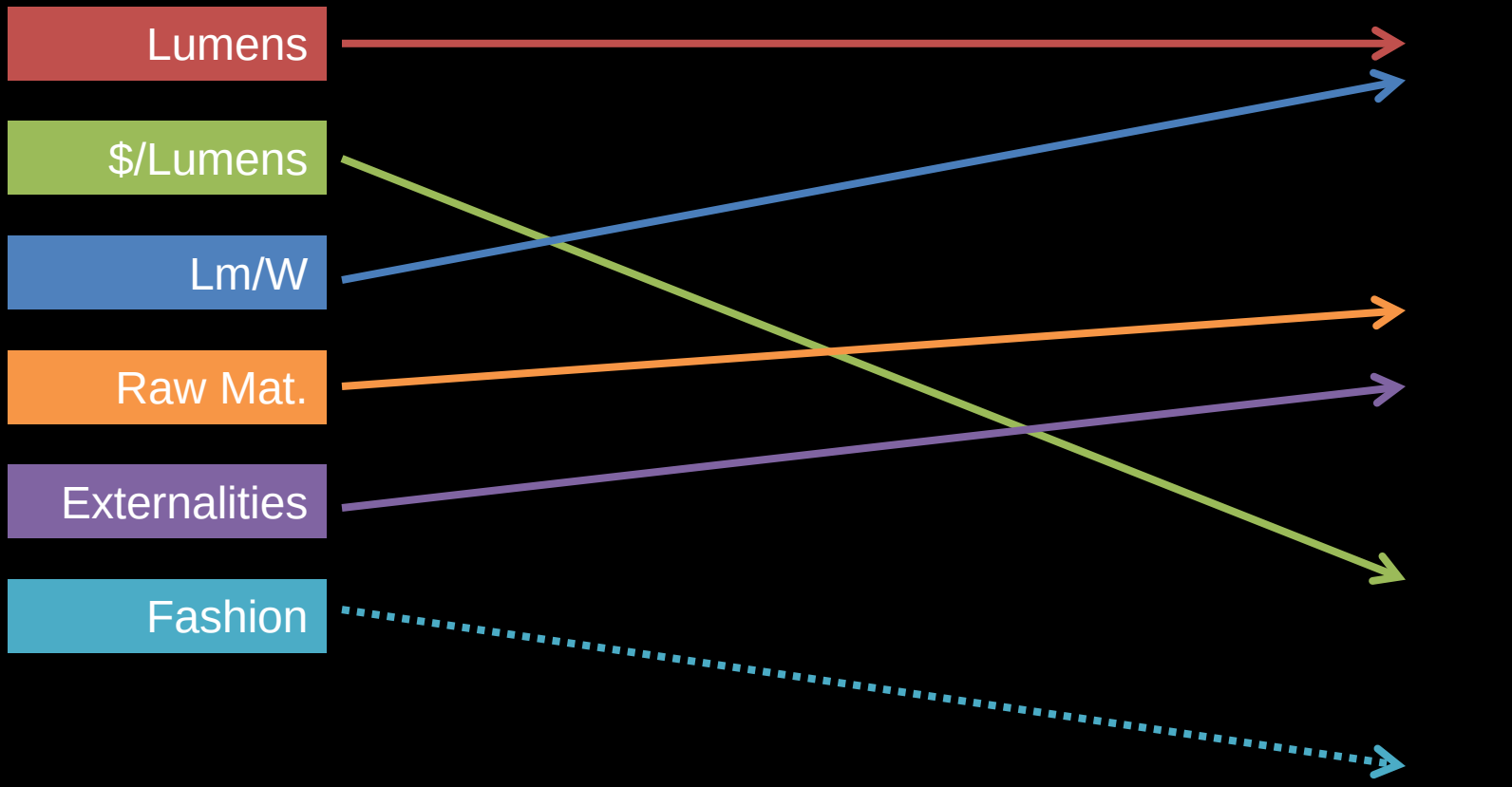
Shared value?

Pay-per-use?

Pricing for light-as-a-service?

Residual Value?

Place your bets: Asset or Liability?



The Fashion Cycle?

What is the residual value of the fixtures?

Extracting value at “end of life”

Usage Period

- Reuse → Used Lighting Market?
- Rebuild
  - Maintenance?
  - Upgrade?
- Reclaim → Separation/OEM Parts?
- Recycle
  - Biological?
  - Technical?

Zhaga

Extracting Value?

200 lm/w
L70 – 50,000 hrs

140 lm/w
L70 – 50,000 hrs

100 lm/w
L70 – 50,000 hrs

70 lm/w
L70 – 50,000 hrs

Where could the DOE invest?

Reduce the junk:

system consolidation

Shrink the fixture:

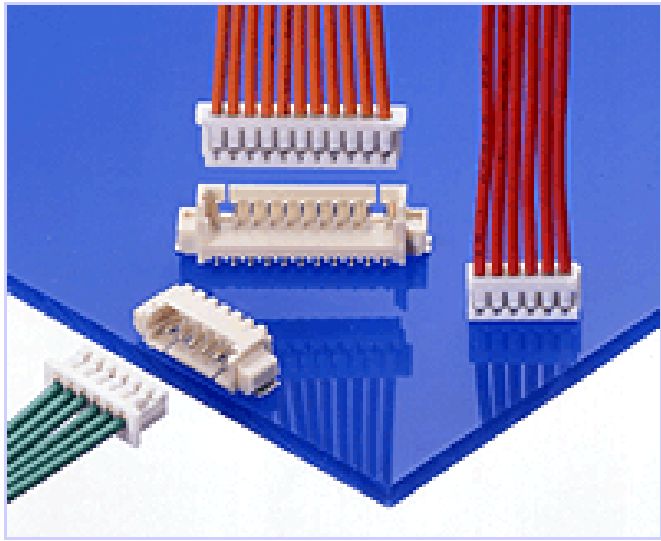
treat light as a material

Go “deep green”:

eco-materials + lifecycle

Reduce the junk:

system consolidation



Reduce the junk: *Simplify, simplify*

DRIVER IMAGE BY FINSIX

Reduce the junk: miniaturization of “smart” drivers

Reduce the junk: integrate drivers?

IMAGE BY FINSIX

Shrink the fixture:

treat light as a material

Why are our lighting systems constrained to “fixtures”?

We’re selling gaslight era fixture formats instead of architectural lighting systems.

Seagram Building

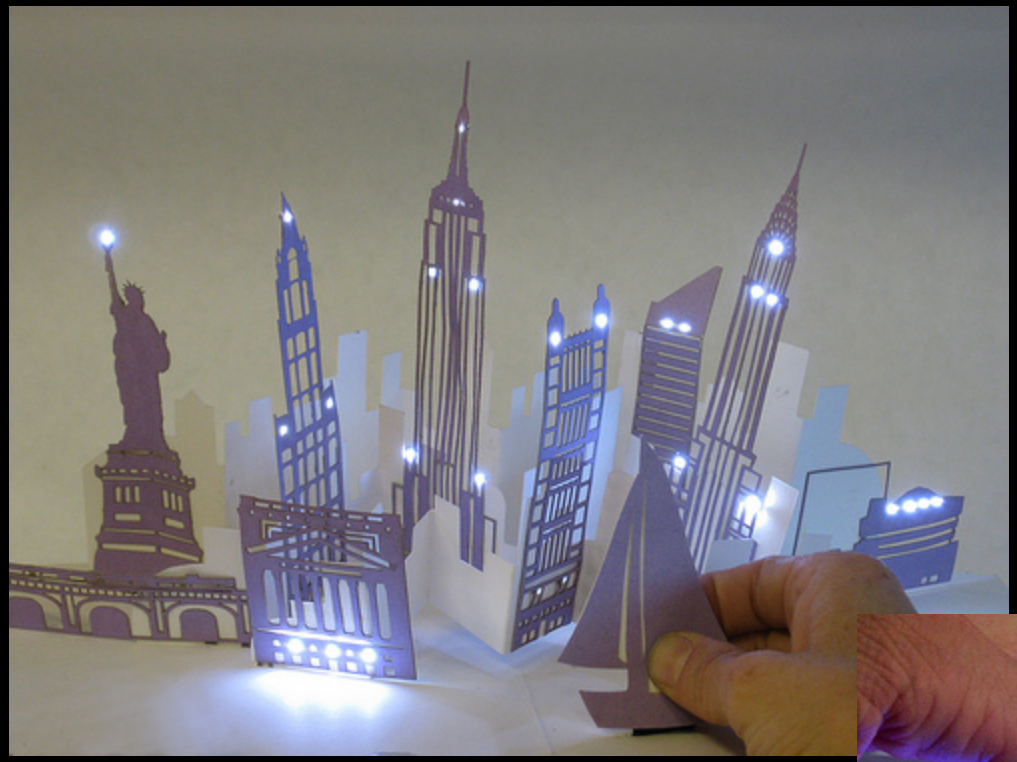
NYC Energy Audit

Median: 68 out of 100
Seagram: 3 out of 100

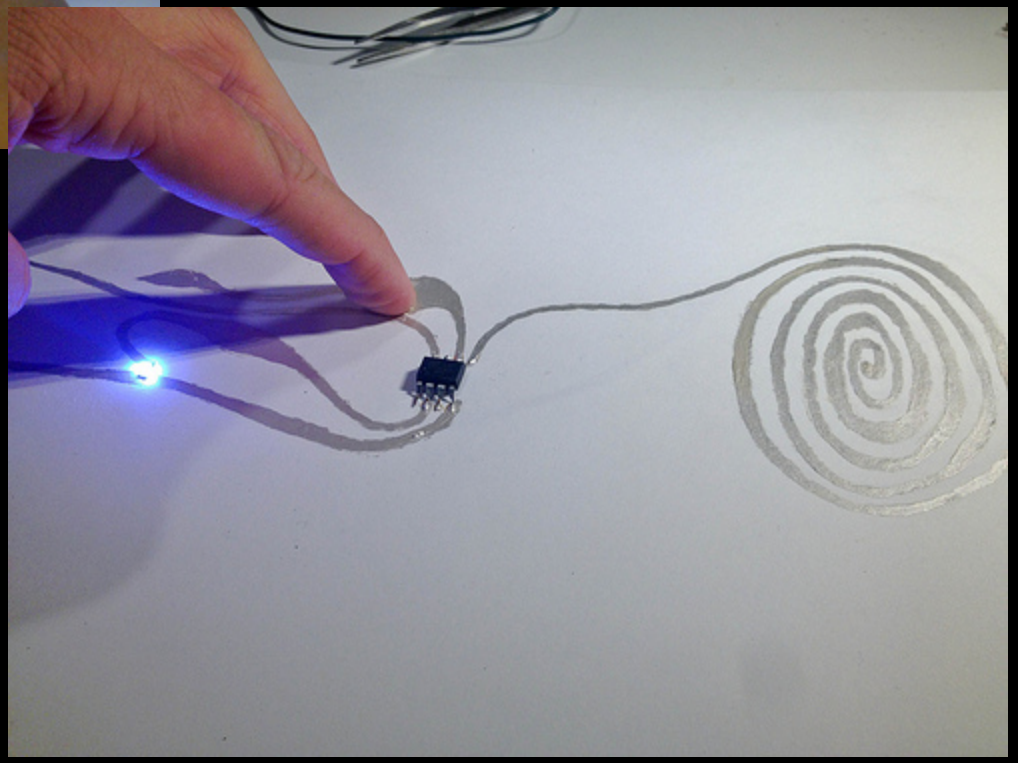
Architects want to treat light as a material

Can we treat lighting just like gypsum board?

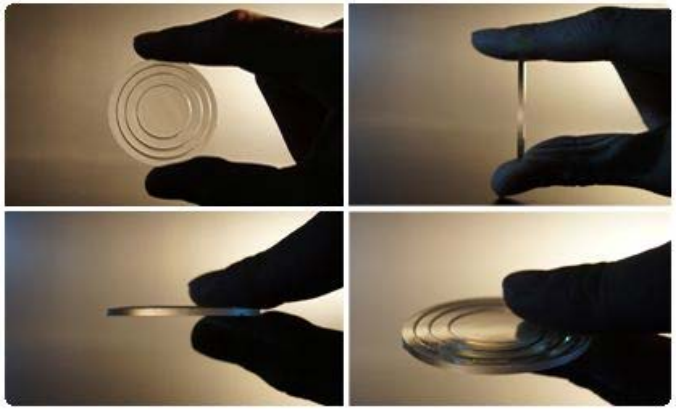
On highly complex, customized projects, how can we efficiently produce, ship and install sheets of light?

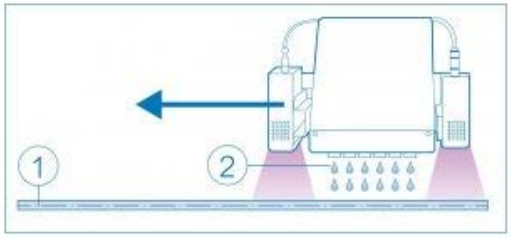


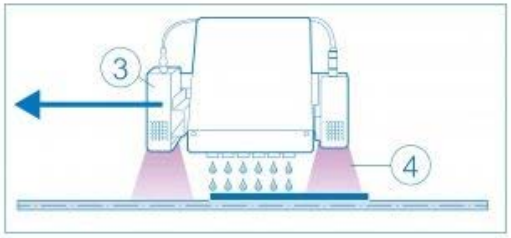
Leah Buechley
MIT Media Lab

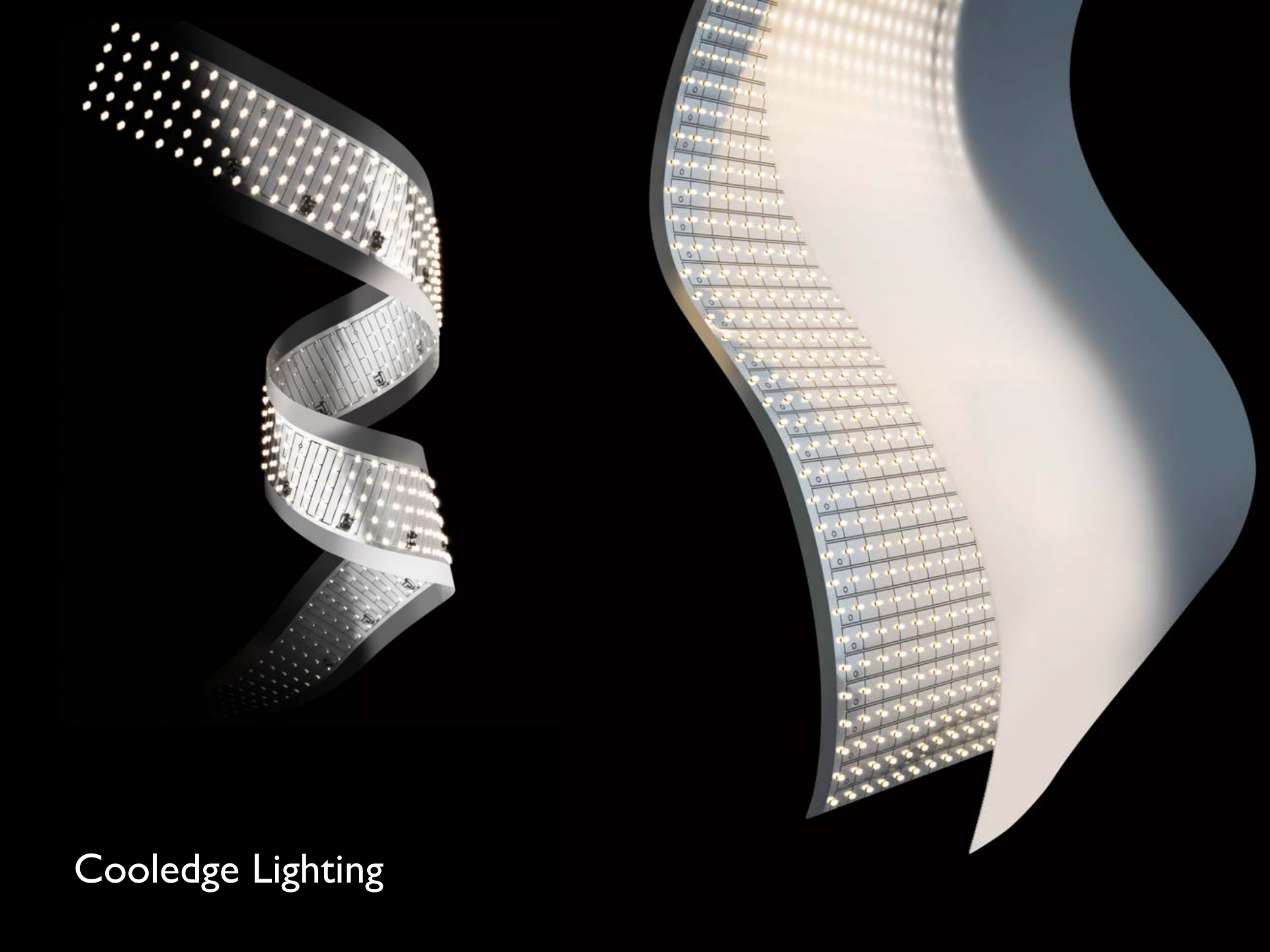


LuxExcel



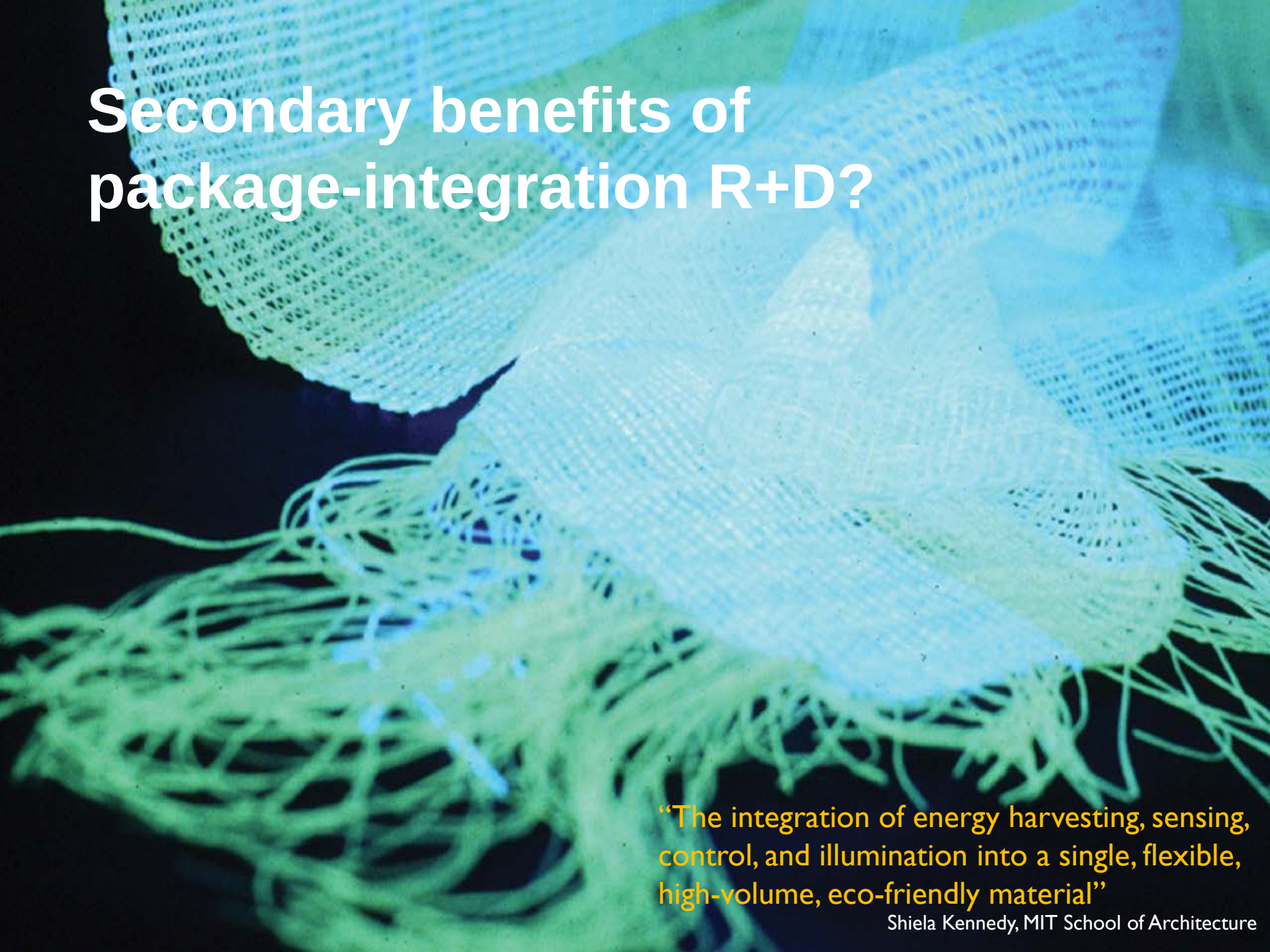






Cooledge Lighting

Secondary benefits of package-integration R+D?



"The integration of energy harvesting, sensing, control, and illumination into a single, flexible, high-volume, eco-friendly material"

Shiela Kennedy, MIT School of Architecture

Cut it?

Bend it?

Mold it?

Stamp it?

Glue it?

Go “deep green”:

eco-materials, lifecycle, material bank

Why do our lighting products use such energy intensive materials?

Do we really need steel, aluminum and plastic in our lighting products?

How can we use renewable, natural materials?

Molded bamboo fiber pulp

How can we use reclaimed, recycled material streams?

Example: Recycled plastic lumber products

SUSTAINABLE MATERIALS STRATEGY

What Goes In

Post-consumer plastics

Post-industrial yarns

Soy-based polyurethane

Engineering wood technology

What Comes Out

Seats

Doors

Batteries

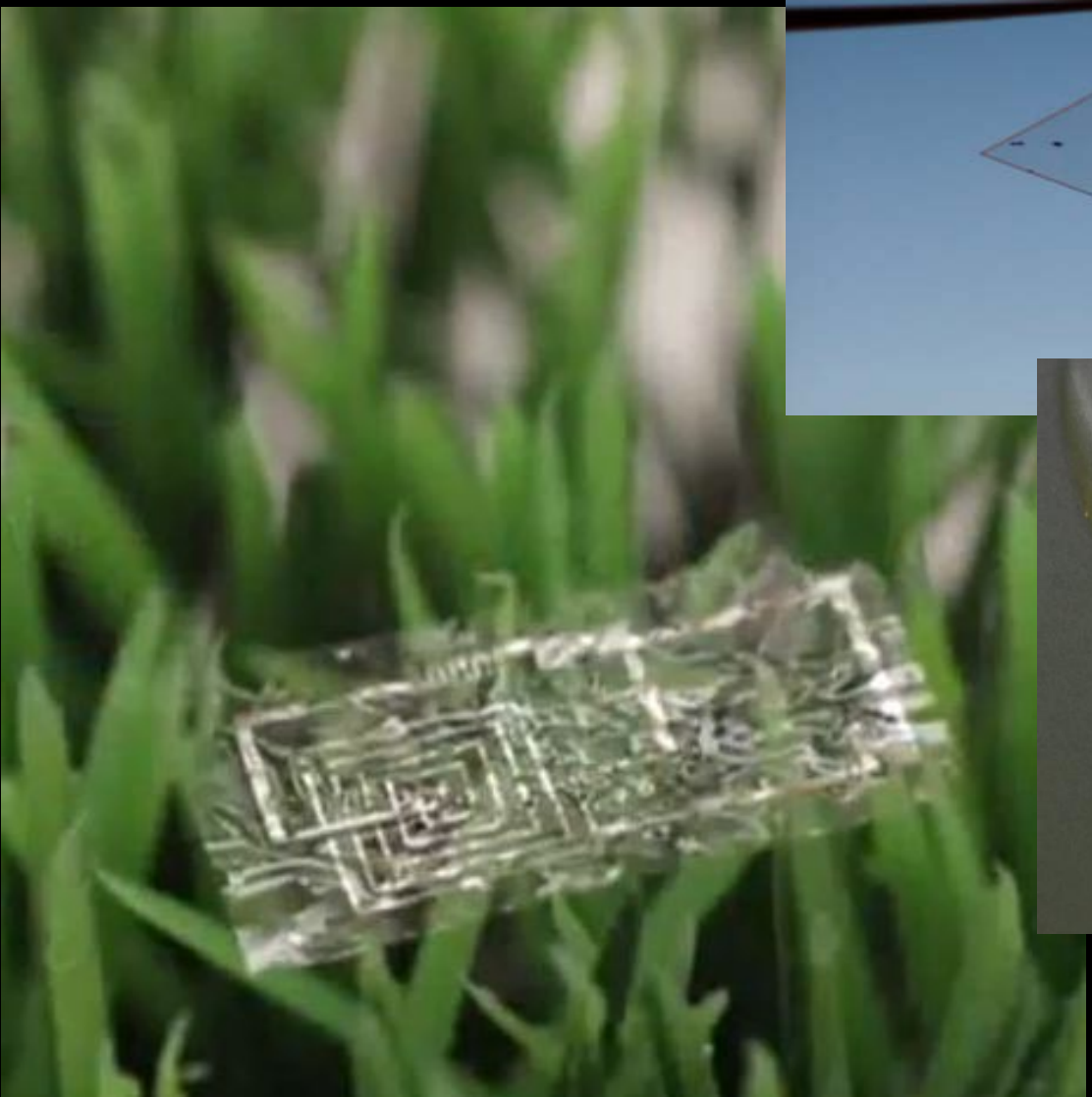
Tires

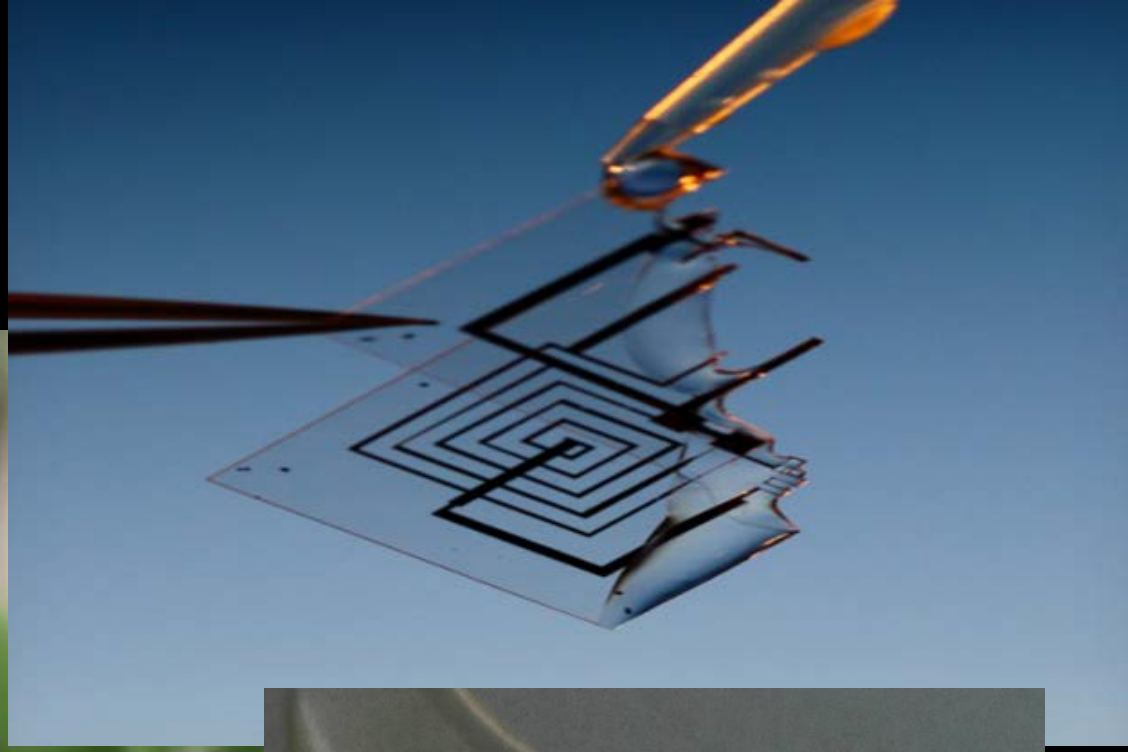
Bio-derived or bio-degradable parts?

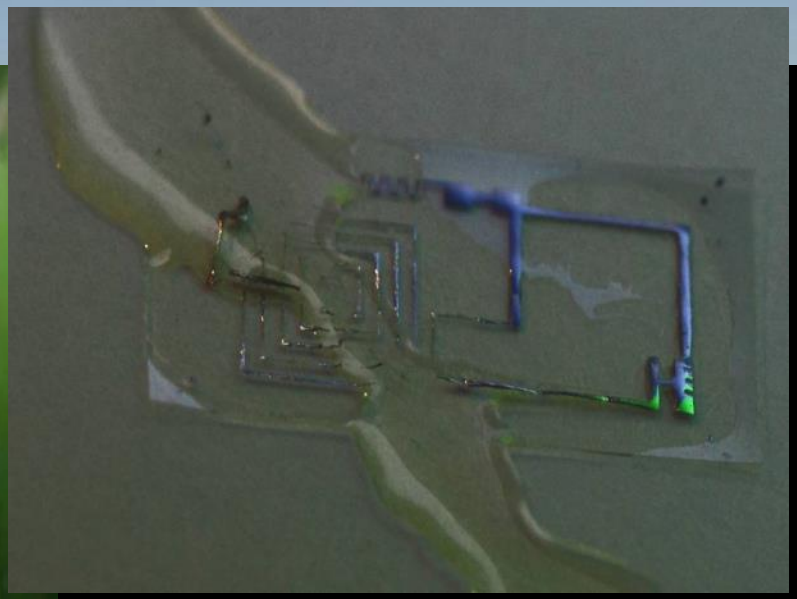
Studio Aisslinger

Draexlmaier:
BMW 7 Series Door Panels

Dissolving electronics?







Rogers Research Group
University of Illinois

Do the current safety codes allow for eco-friendly material use?

Where could the DOE invest?

Reduce the junk:

- “system on a chip”
- simplified/integrated electrical connections

Shrink the fixture:

- electrical topologies of mesh/matrices
- novel LED packaging + bonding-to-substrates
- mass-customized fabrication techniques

Go “deep green”:

- eco-materials
- disassembly at EOL, material reclamation
- advancement of safety codes

Another L-Prize?

Open up R+D to include more fundamental research -- including 2nd tier suppliers and academic institutions

Circular Economy Prize

Is it possible to create a "circular economy" solution for all the components of an SSL lighting system … electrons to lumens?

Featherweight Prize

Most lumens per least mass?
A simple generic challenge to remove material costs and complexity from fixtures … benefits ripple through supply-chain.

What sort of future are we specifying today for tomorrow's world?

THANK YOU!

Brad Koerner

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