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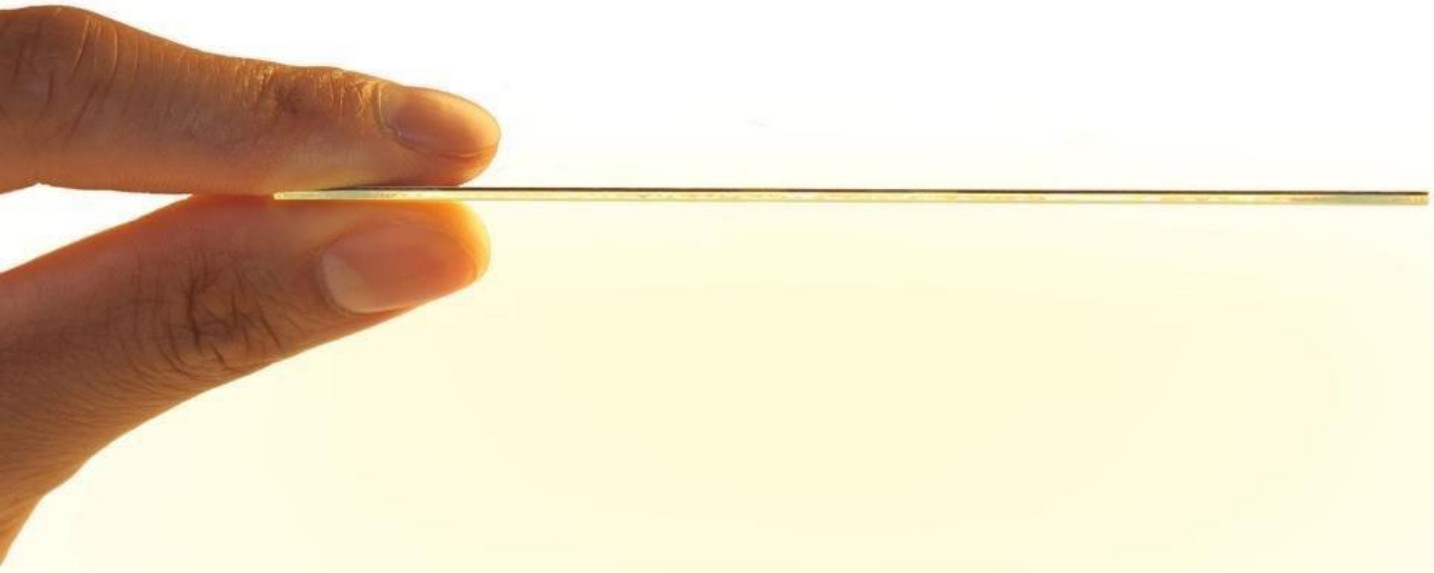
OLED Luminaire Design, Challenges Remain



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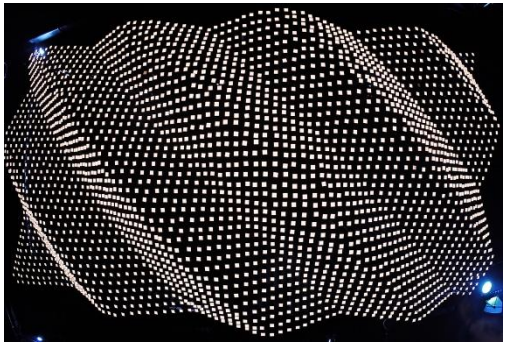
OLED is Still a Niche Technology in Lighting

Today OLED is limited to a few high-end art installations



OLED installations by Blackbody, LG Chem, Konica Minolta

Why So Few Luminaires on the Market?

Unique challenges working with OLED as a light source

Improved since 2016

1. **High cost for OLED panel**
   - High $/klm limits applications
   - Products need to be design driven

2. **Interconnects and mounting**
   - Current interconnects limit design
   - No simple solution to mount panel

3. **Drivers and control system**
   - Unique drive characteristics of OLED
   - Should we use same controls as LED?

OLED is Price Competitive for Mid-market

In 2016 OLED prices have become even more competitive.
But still not sufficiently priced for mass market products.

aere LIGHT

$299 - OK

COSTCO WHOLESALE

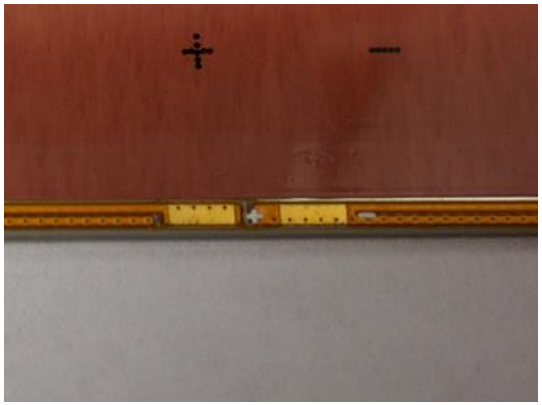
$29.99 – OLED not there yet

Edge lit LED – the competition

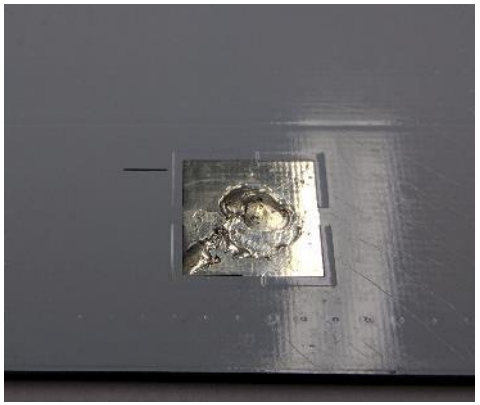
Challenges with Existing Panels/Interconnects

Each panel is different; limited design potential

Panel 1



Panel 2



Panel 3

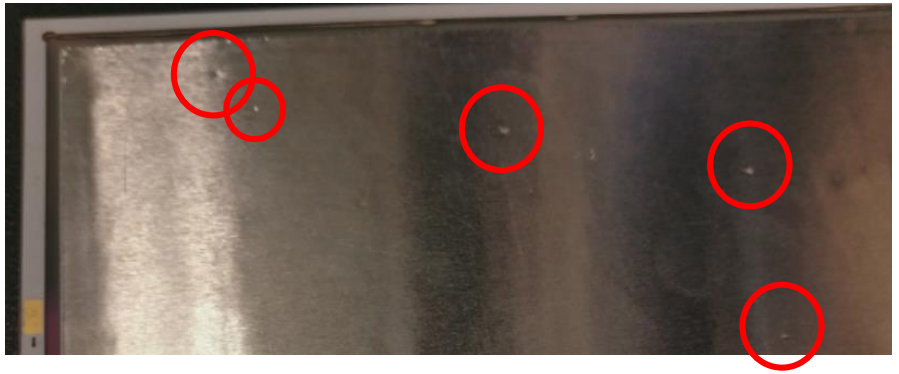
1. Still no uniform standards, no change in 2016
2. Contacts are all different
3. Contacts are not customizable
4. Difficult for designers to work with

Mounting of OLED Panel is Challenging

Issues related to mounting and luminaire manufacturability

Mounting solutions are still thick or highly customized

Solutions need to consider easily punctured encapsulation foils or risk shortened product lifetime



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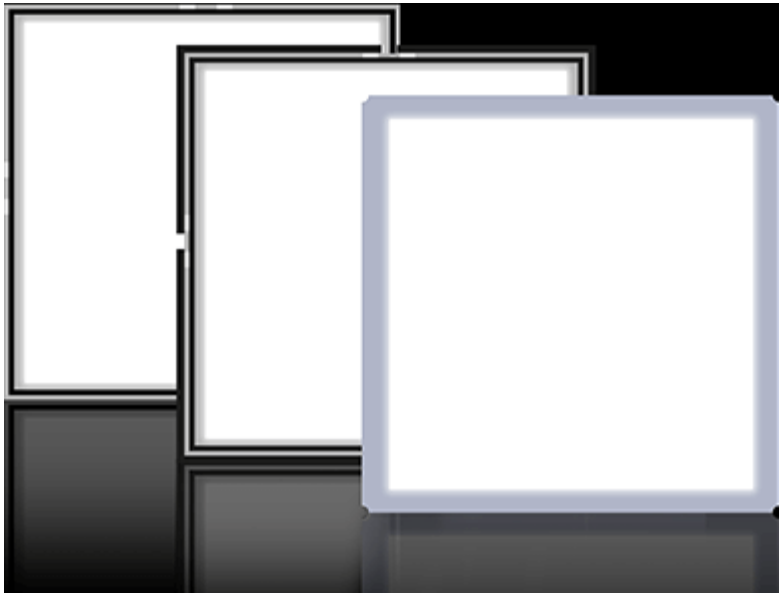
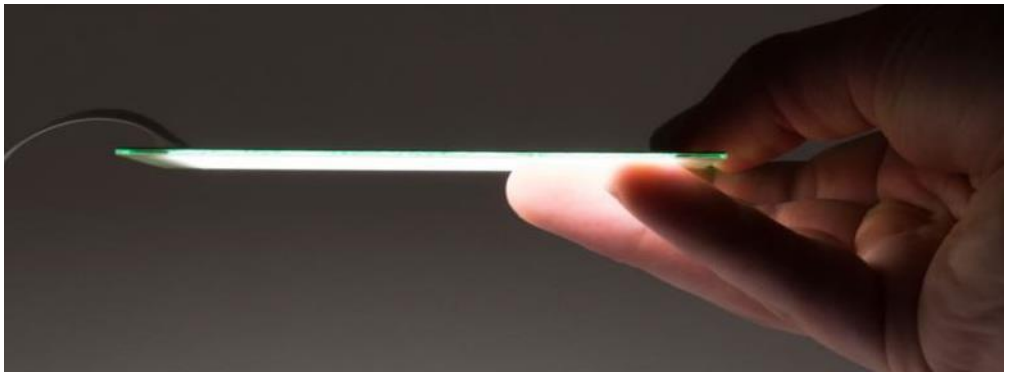




Rigid OLED panels are hard to handle, like glass wafers

Many designers broke OLED panels during initial tests and prototyping, robustness is a key concern.

Challenges with Drivers

Large variability in panels – Still unresolved since 2016

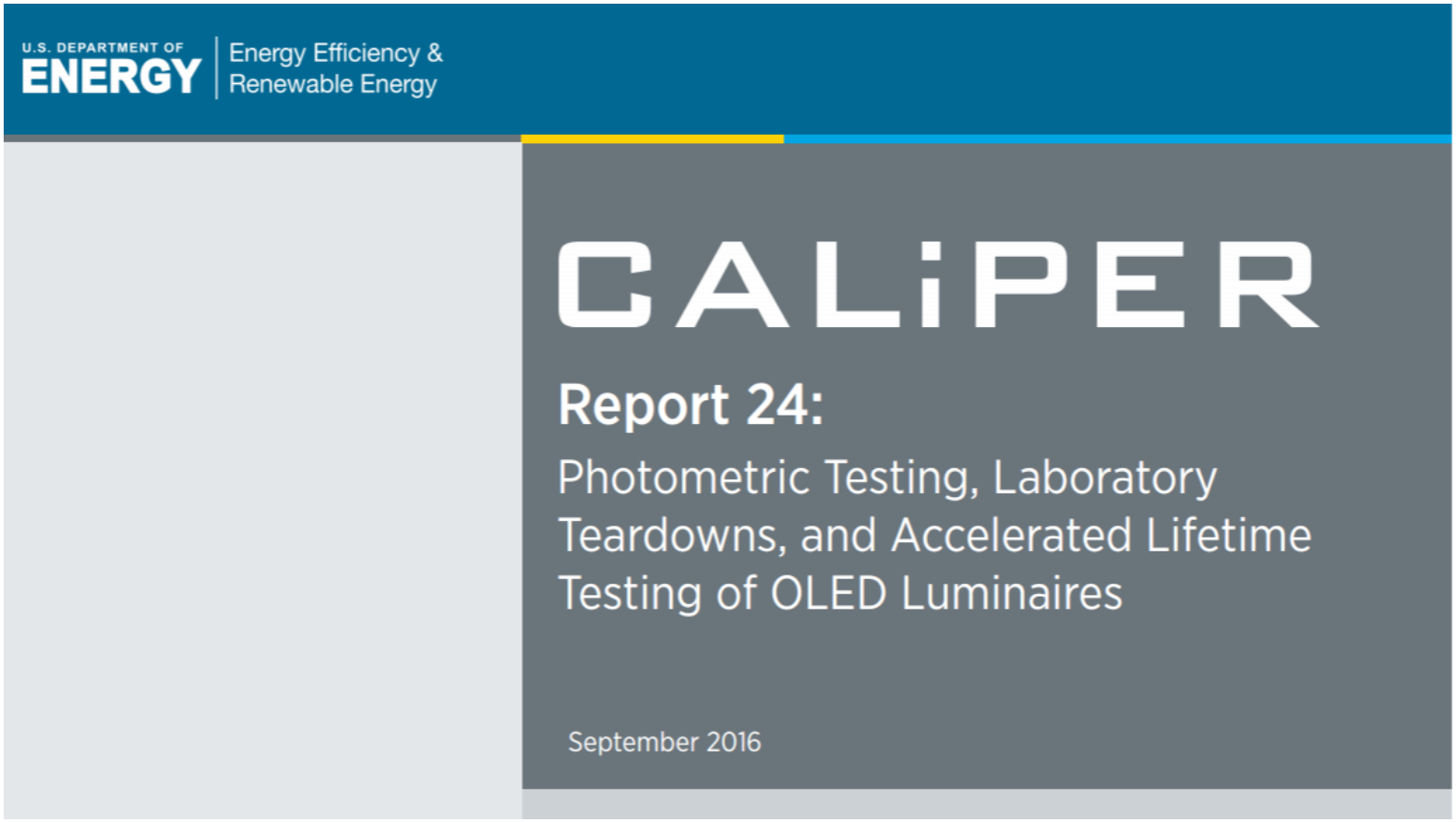
1. Forward voltage
   3 – 24 volts DC
2. Drive current
   50 – 500 mA
3. PWM vs. AM
   Dimming control

No off the shelf solution
(requires custom development)

OLED panels	Operating Voltage (V)	Operating Current (mA)
LG N6SA30	6	230
LG N6SA40	8.5	150
OLEDWorks Brite 2 FL300	20	260
Osram CDW-031	3.4	186
Kaneka KN-P-P4-BF-30	6.8	210
Lumiotec P11B	9.2	590

We Need Testing Standards for OLED Lighting

Recent DOE CALiPER report is first step towards a standard



Key Take Away Message

A number of practical challenges for designers to adopt OLEDs

1. Cost and performance are already good enough for design oriented products, should focus on other areas that enables designers to try OLEDs
2. OLED panels are not sufficiently mechanically robust for prototyping by designers
3. Variability in OLED panels both for interconnects and driver requirements demand more design resources. Standardization of panels would make using OLEDs more attractive for designers
4. No simple, unified, effective mounting solution available, this deters luminaire designers
5. Development of testing standards for OLEDs lighting a strong positive

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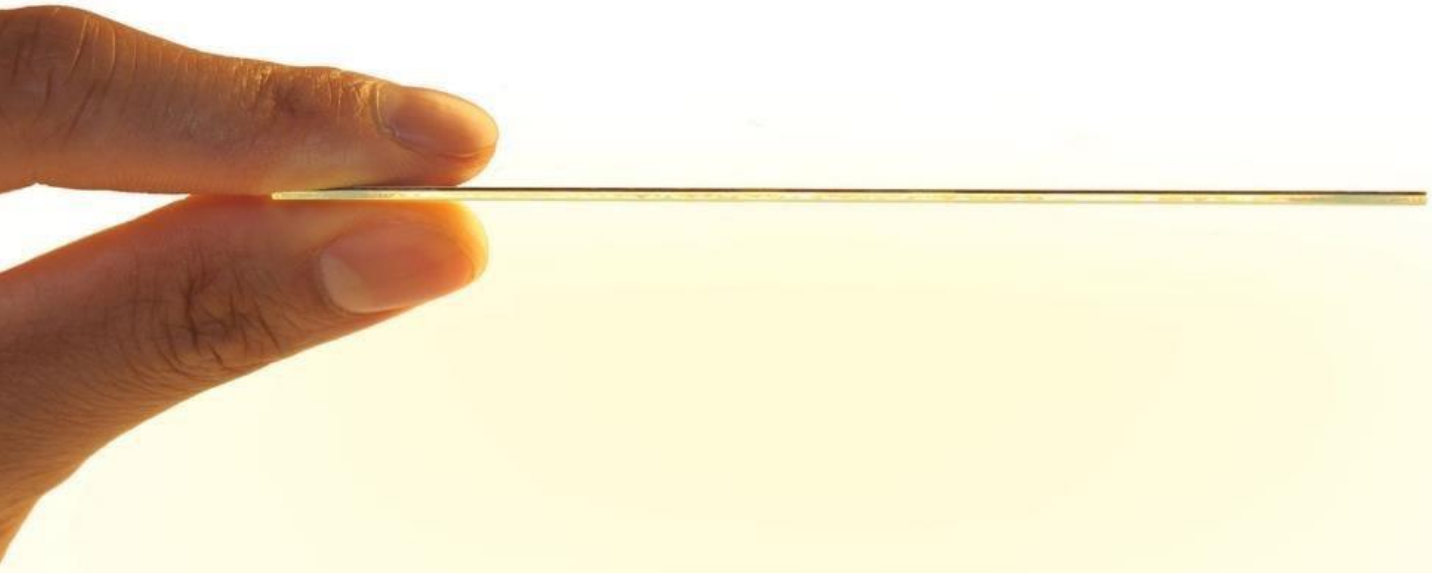
Thank you!



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