# Where Do OLEDs Fit In?

## DOE SSL Workshop

## Portland, OR

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# Where do OLEDs fit in?

- A solid-state lighting solution that complements LED
- With the SSL advantages you've come to expect:
  - control, efficiency, environmental
- And evolutionary performance trajectory that mirrors LED
  - Efficacy, lifetime, CRI, cost

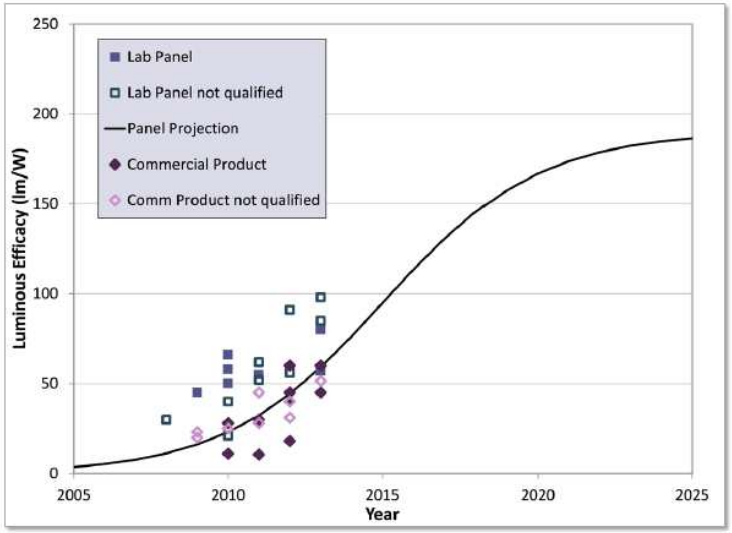


*Fig. 4.2, 2014 SSL Multi-Year Program Plan: www.ssl.energy.gov/techroadmaps.html*

ENERGY Energy Efficiency & Renewable Energy



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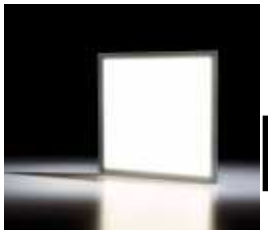
# Where do OLEDs fit in?

- OLED is a different experience
  - Light quality
  - Thinness (<1mm)
  - “something about the light”
  - Cool to the touch
  - Direct view
- Enable new designs

# Global View: OLED light engines

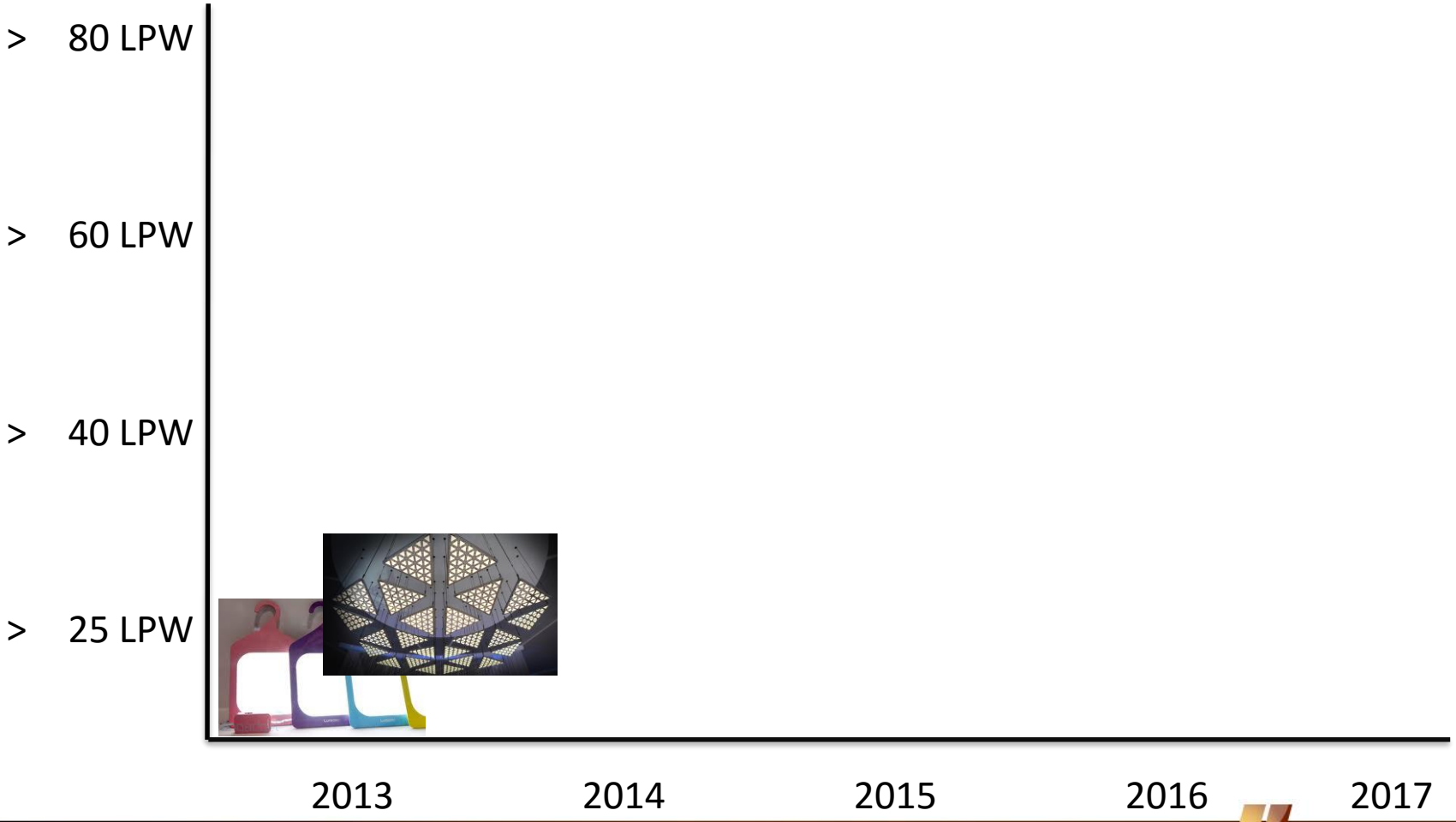






| | Philips | Osram | Kaneka | Konica Minolta | LG | OW |
|---|---|---|---|---|---|---|
| Efficiency lm/W | 45 | 40 | 40 | 45 | 60 (80) | 50 (80) |
| L70 Khrs | 10 @ 9000nits<br>50 @ 4000nits | 20@3000nits | 50 @ 3000nits | 8 @ 1000nits | 40 @ 3000nits | 30 @ 3000nits |
| CRI | >80 | >80 | >80 | >75 | >90 | >84 |
| Notable | High brightness | Transportation | Architectural | Flexible | Broad Portfolio | Versatile Mfg |

- Are OLED lighting panels positioned for market adoption?
- ✓ Yes, surpass threshold for many applications

# OLED Application Evolution



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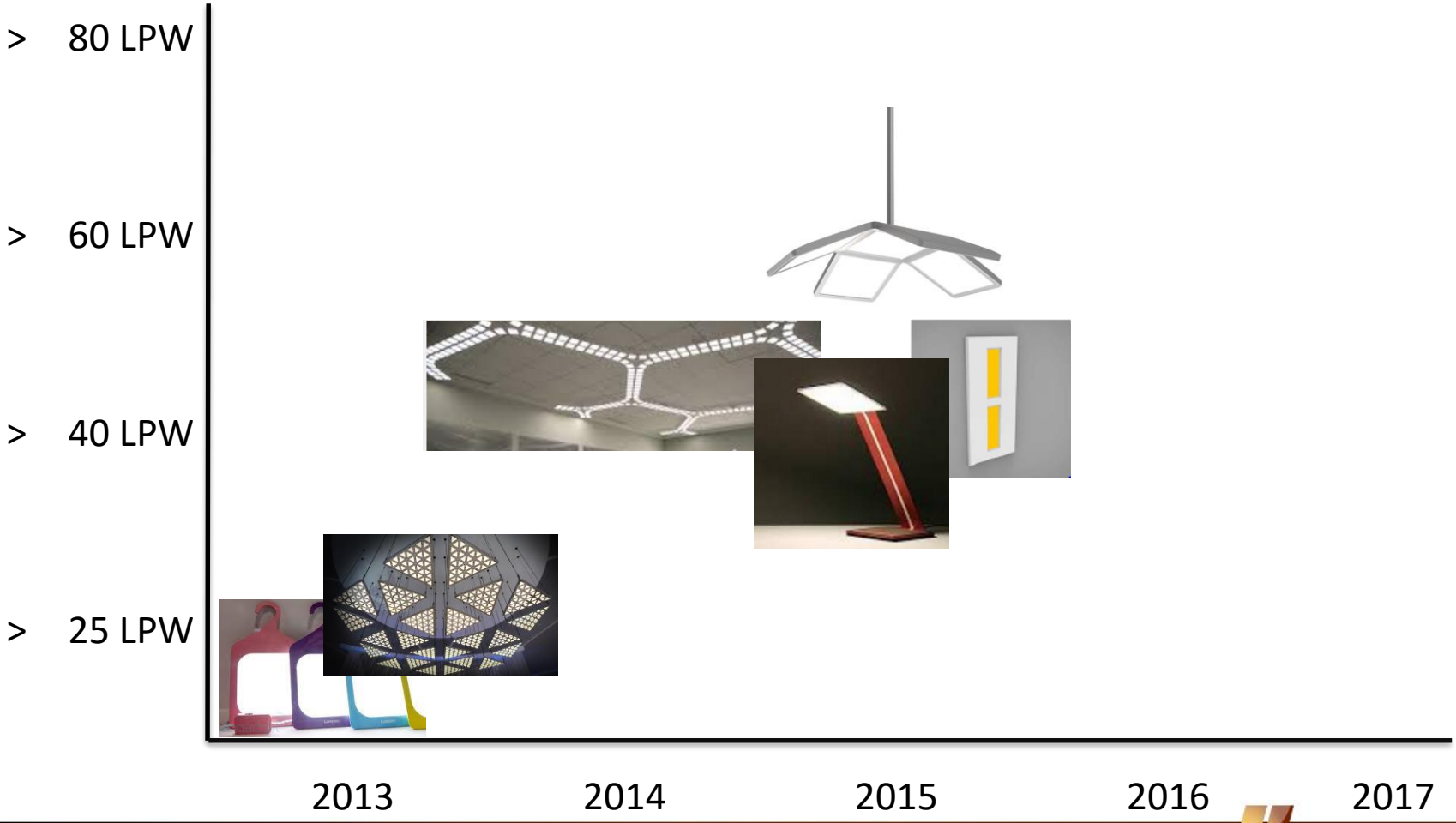
# OLED Application Evolution



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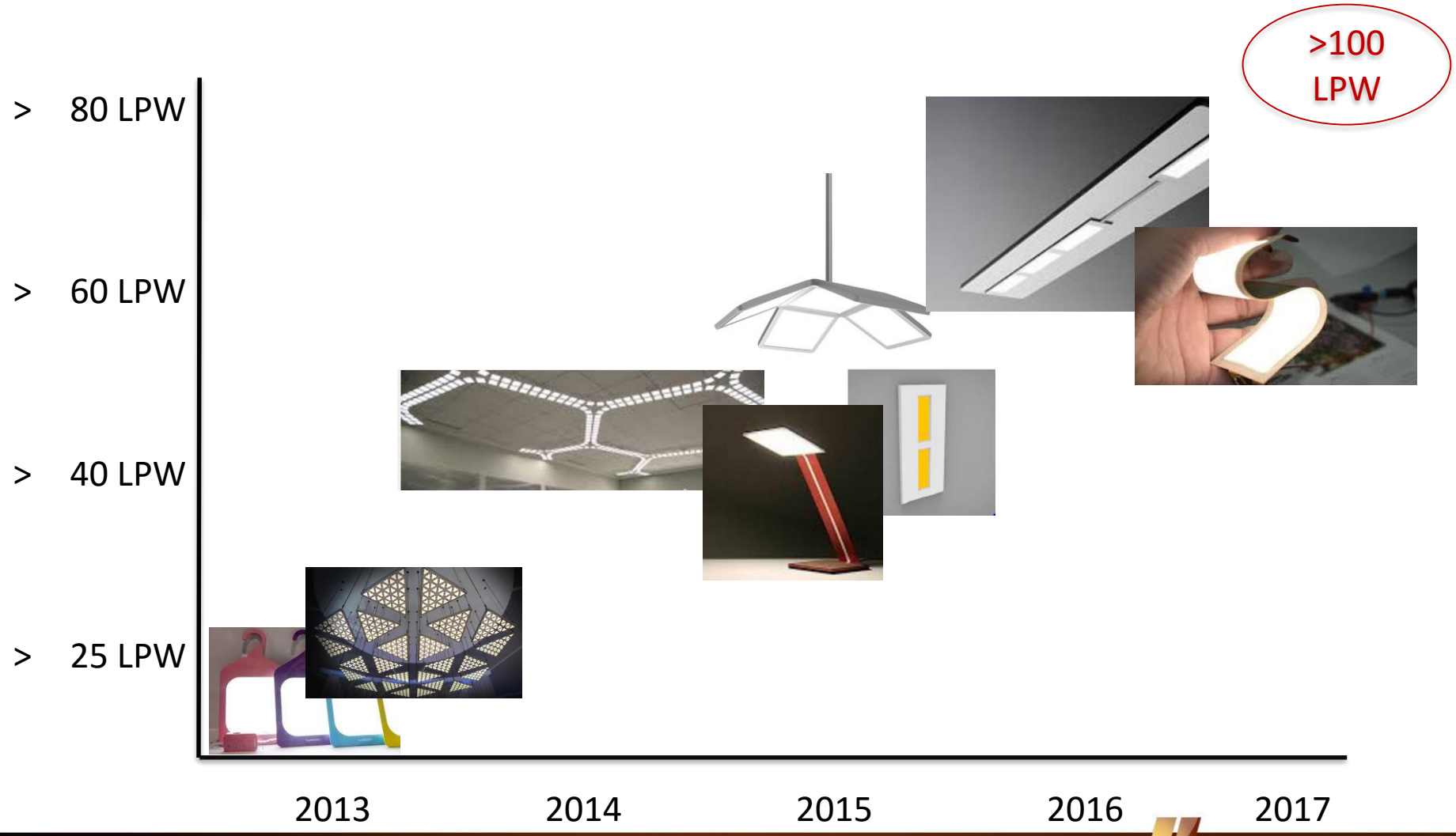
# OLED Application Evolution



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# Efficiency Forecast – Is it real?

- Higher performance materials including blue phosphorescent emitters being developed
- Harnessing all the trapped light – new substrates and extraction techniques
- Big improvements in drivers

- Yes: OLEDs offer an efficient lighting solution for current and future applications

# OLED Designs – An opportunity and a challenge

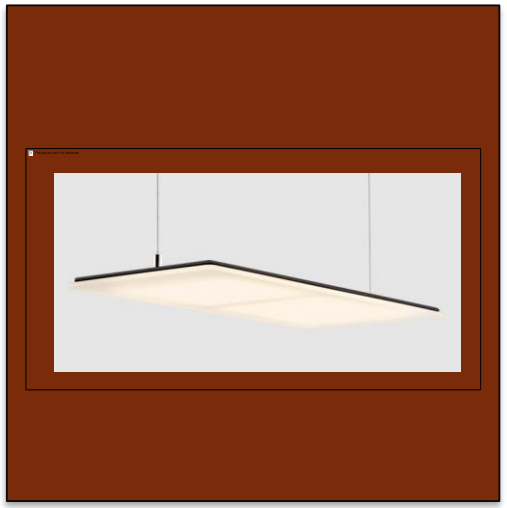
- OLED lighting industry infrastructure
  - Drivers – more challenging as panels get more efficient
  - Cost effective supply
  - Standards
- Design paradigm
  - The very attributes that enable new designs also challenge existing paradigms – no shades, reflectors, etc.
  - Showcase thinness
  - Connectivity – needs to be easy
  - Area source – not competing for the Edison socket
- The 80/20 rule

# OLED Designs – An opportunity and a challenge

- OLED can build on LED, solid-state lighting, expertise including drivers and controls
  - Simpler assembly
  - Fast development time, low development cost
- *Blurs the line between light engine and fixture*


**The OLED Way**

\+ Fixture Design Channel =





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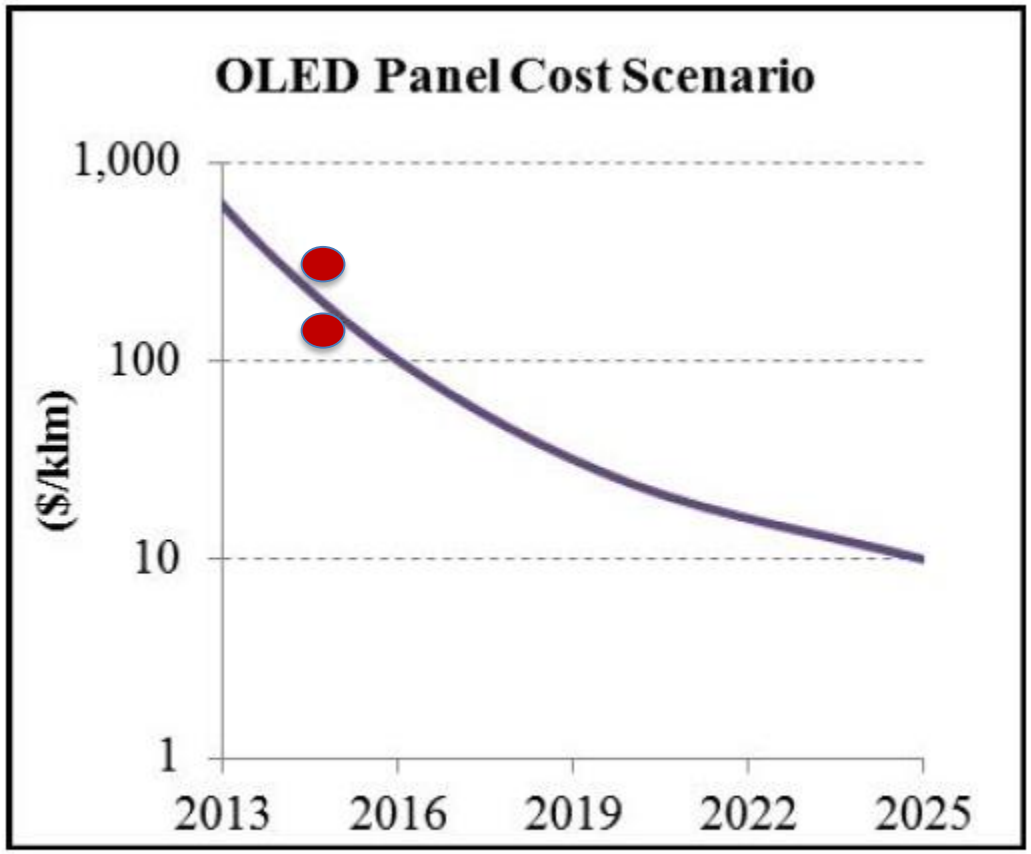
# OLED Cost Reduction




Executive Summary, 2014 SSL R&D Manufacturing Roadmap: www.ssl.energy.gov/techroadmaps.html

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

# Cost Forecast – Is it real?

- Cost decrease with volume increase – efficiency in production
  - OLED as lamp, building material, electronic component…
- Higher yields
- Material costs – display and lighting demand drives efficiency in supply
- Device and finishing engineering improvements

- Yes: OLEDs offer an affordable lighting solution for current and future applications

# Real World Application: OLED World Summit 2014 Panel Discussion; Road to Commercialization

## OLED LUMINAIRE LAYOUT COMPARISONS
## ("STANDARD" VS. "APPLICATION EFFICIENT" LAYOUTS)

### 9' CEILING HEIGHT; 80-50-20 REFLECTANCE

|   | 3500K OLED LUMINAIRE ("STANDARD" LAYOUT) | 3500K OLED LUMINAIRE ("APPLICATION EFFICIENT") LAYOUT |
|---|---|---|
| Luminaire Quantity / Mounting Height | 112 (Surface-Mounted) | 88 (15 Surface; 73 Pendant) |
| Total System Watts | 849 W | 685 W |
| Luminaire Spacing | 6' x 6' o.c. | VARIES |
| Average Initial Work Zone Illuminance at 30' AFF (FC) | 34 FC | 35 FC |
| Average Initial Circulation Area Illuminance at 30' AFF (FC) | 22 FC | 16 FC |
| Avg. Horizontal Uniformity (Max/Min; Avg/Min) – Work Zone | 1.5 (Max/Min); 1.3 (Avg/Min) | 2 (Max/Min); 1.6 (Avg/Min) |
| Avg. Horizontal Uniformity (Max/Min; Avg/Min) – Circulation | 2.5 (Max/Min); 1.7 (Avg/Min) | 2.7 (Max/Min); 1.7 (Avg/Min) |
| Average Initial Wall Illuminance (FC) | 16 FC | 11 FC |
| Lighting Power Density (W/sq.ft) | 0.8 W/sq.ft | 0.65 W/sq.ft |

P. Ngai, Acuity Brand Lighting

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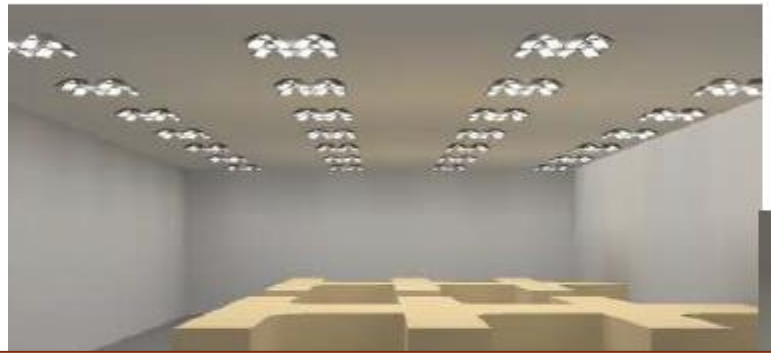
OLED LUMINAIRE LAYOUT COMPARISONS
**("STANDARD" VS. "APPLICATION EFFICIENT" LAYOUTS)**



But you have to Experience It!

P. Ngai, Acuity Brand Lighting

"APPLICATION EFFICIENT" LAYOUT – VARYING LOCATIONS & HEIGHTS

# Where do OLEDs fit in?

- Expanding design space while embracing the SSL imperatives of efficient, affordable, high light quality lighting solutions.

A superb lighting experience.