A young child is smiling and holding a glowing light stick high in the air. The background is a dark night scene with many colorful, out-of-focus lights, suggesting a festival or fair. The child is wearing a light-colored t-shirt with a graphic on it. The overall mood is joyful and celebratory.

# Organische Leuchtdioden – Eine Lichtquelle der Zukunft

ZUKUNFT LICHT, Lippstadt

Volker van Elsbergen

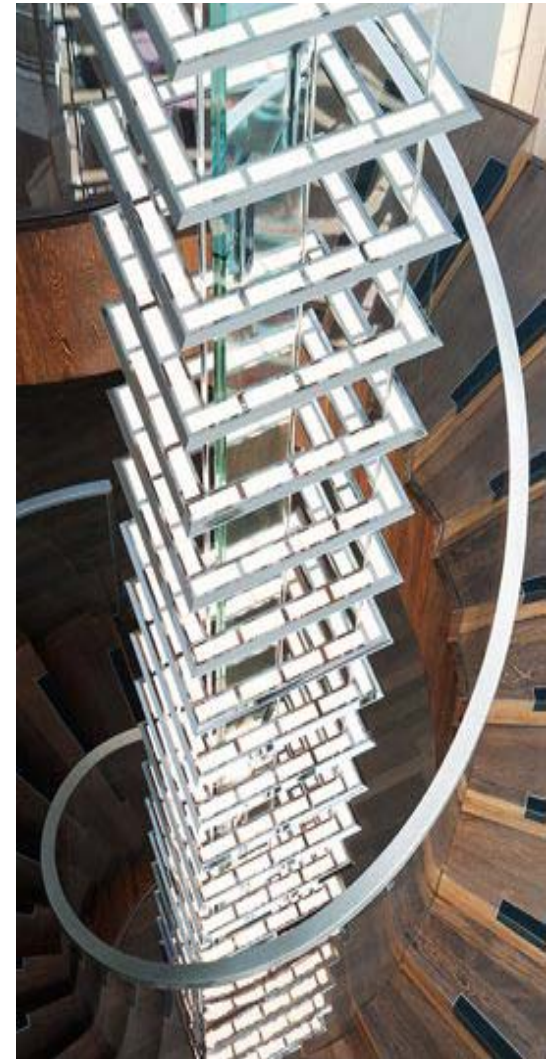
Philips Research, Microsystems & Devices

April 14, 2015

**PHILIPS**

# Outline

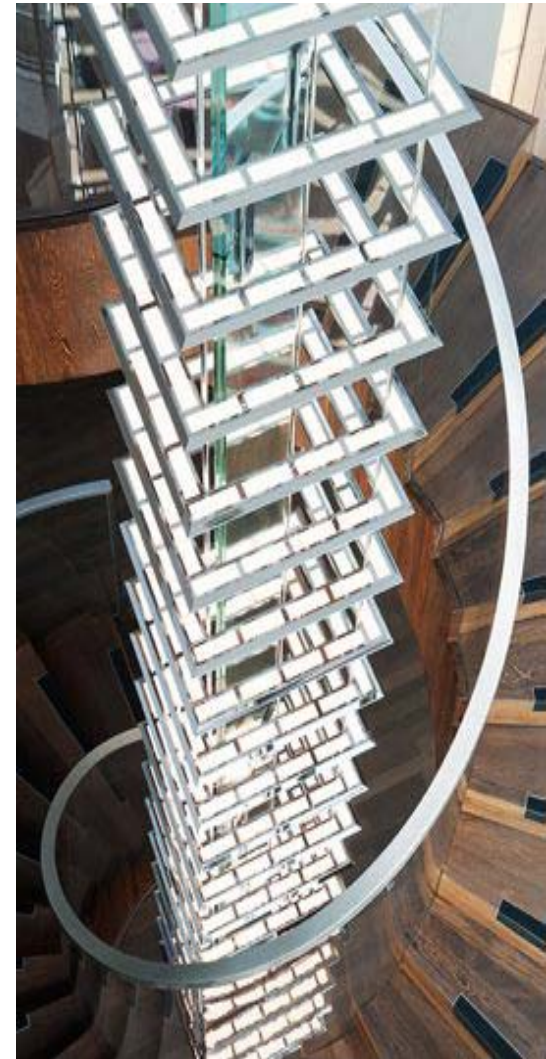
- Introduction to OLED technology
- Today's OLED lighting status
- The future of OLED lighting
- Conclusions



OLED Installation,  
Deutsche Bank, Berlin office  
([www.lumiblade.com](http://www.lumiblade.com))

# Outline

- Introduction to OLED technology
  - Why OLEDs?
  - The OLED attributes
  - OLED technology in a nut shell
- Today's OLED lighting status
- The future of OLED lighting
- Conclusions



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# OLEDs are flat light



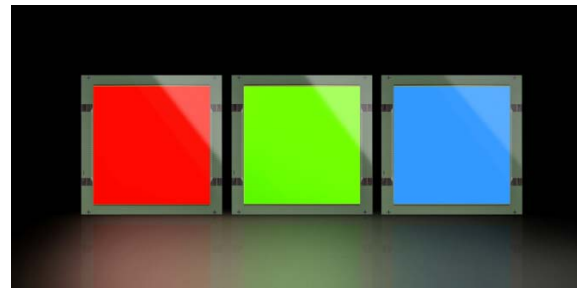
OLEDs are flat and directly emit light over the complete surface.  
The effect is a large area of homogenous light.



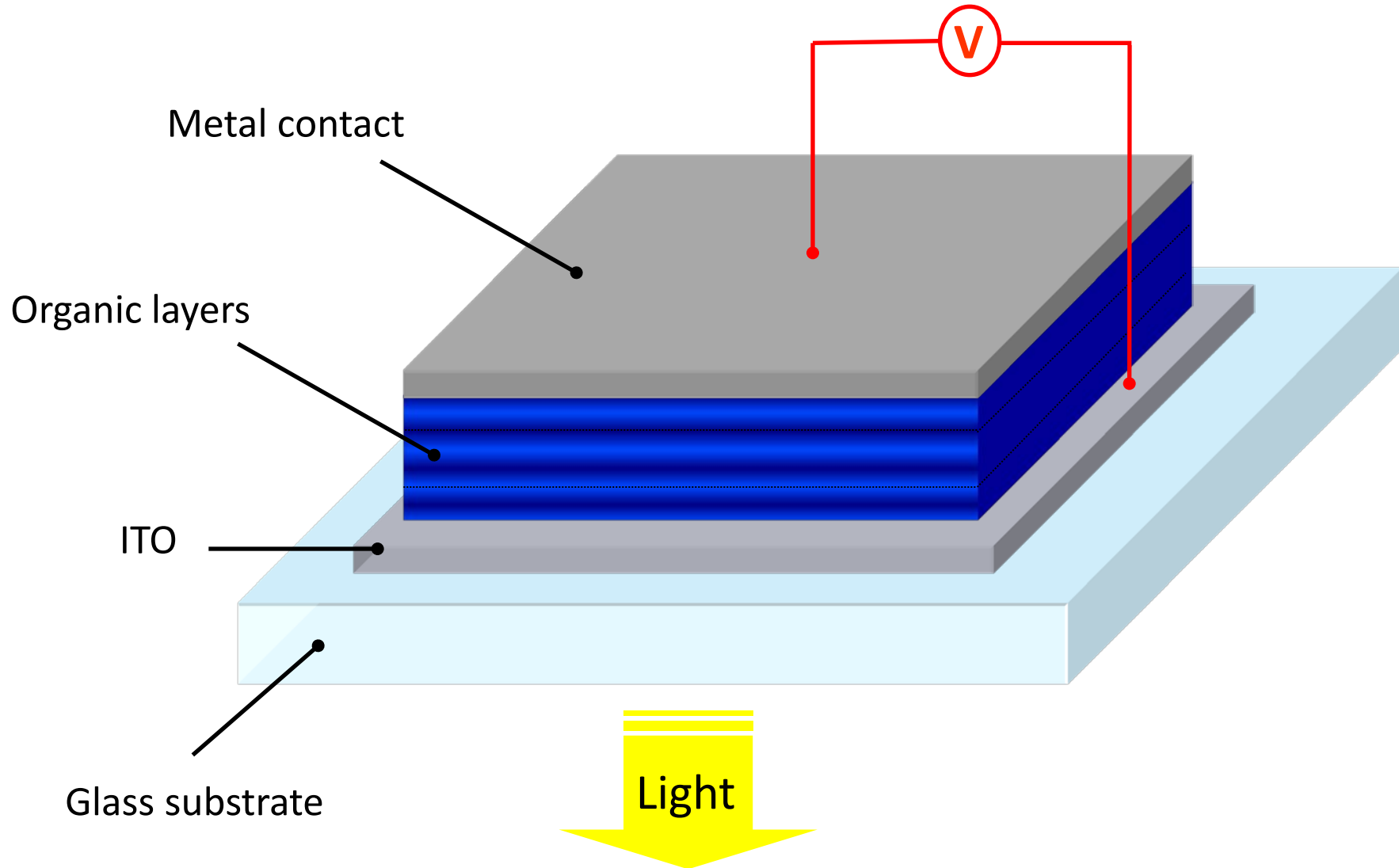


# OLED attributes

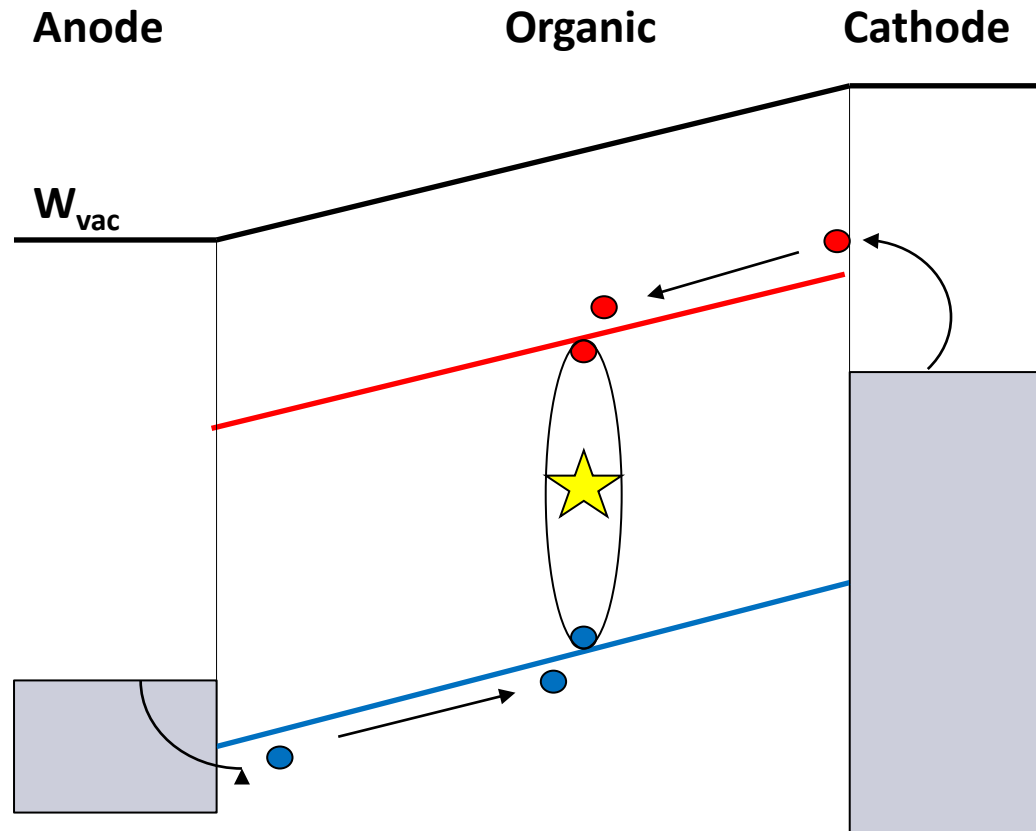
- Thin
- Light weight
- Bendable
- Flexible
- Freedom in 2D
- All colors
- High quality light
- Diffuse light
- Dimmable
- Reflective



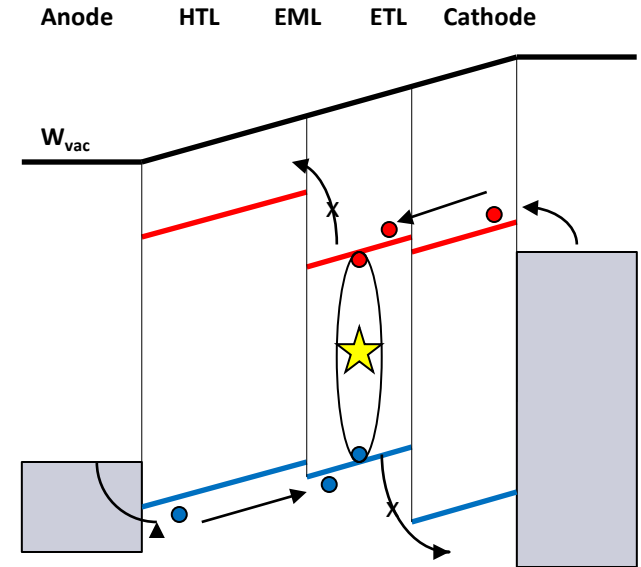
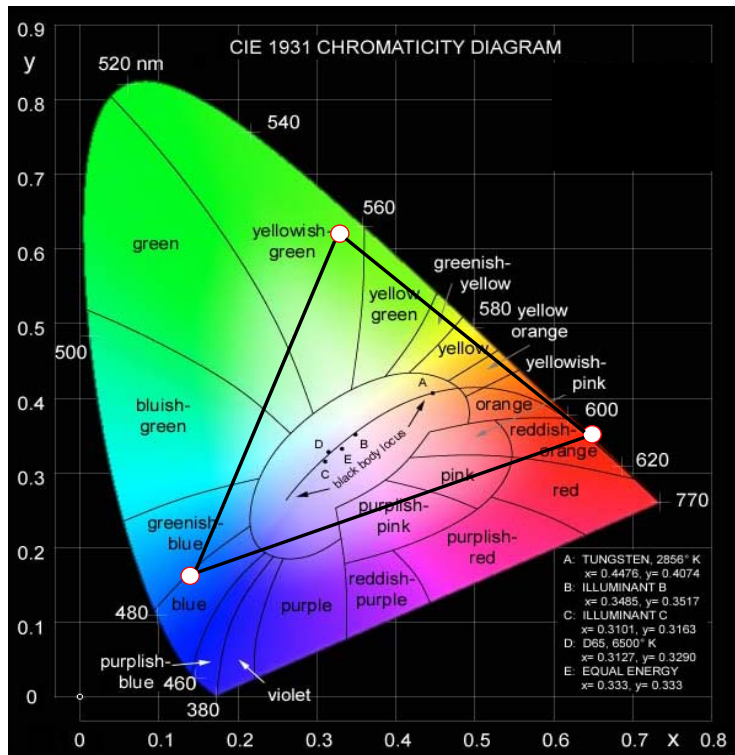
# OLED principle



# OLED principle

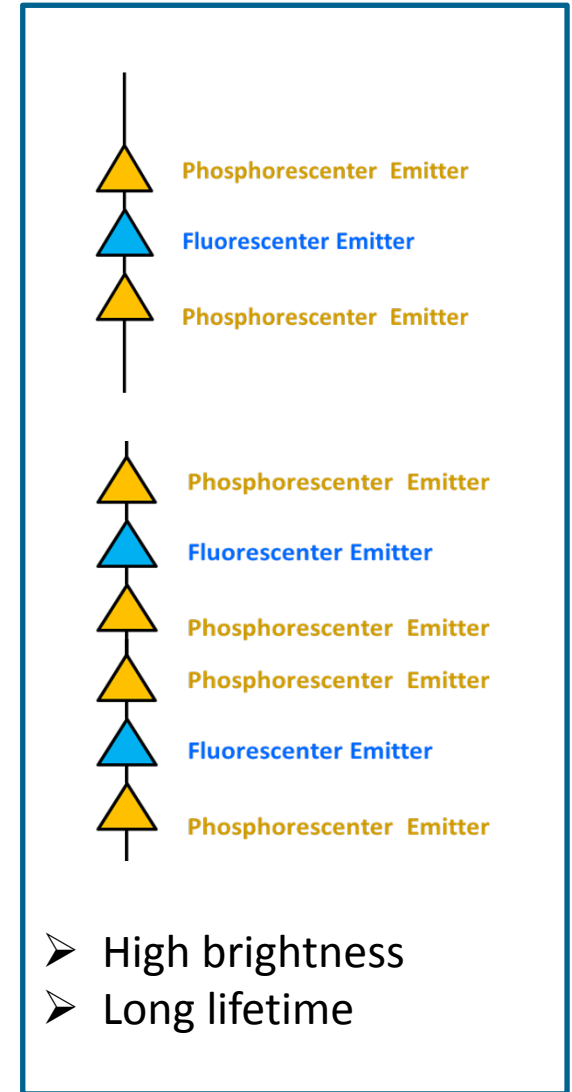
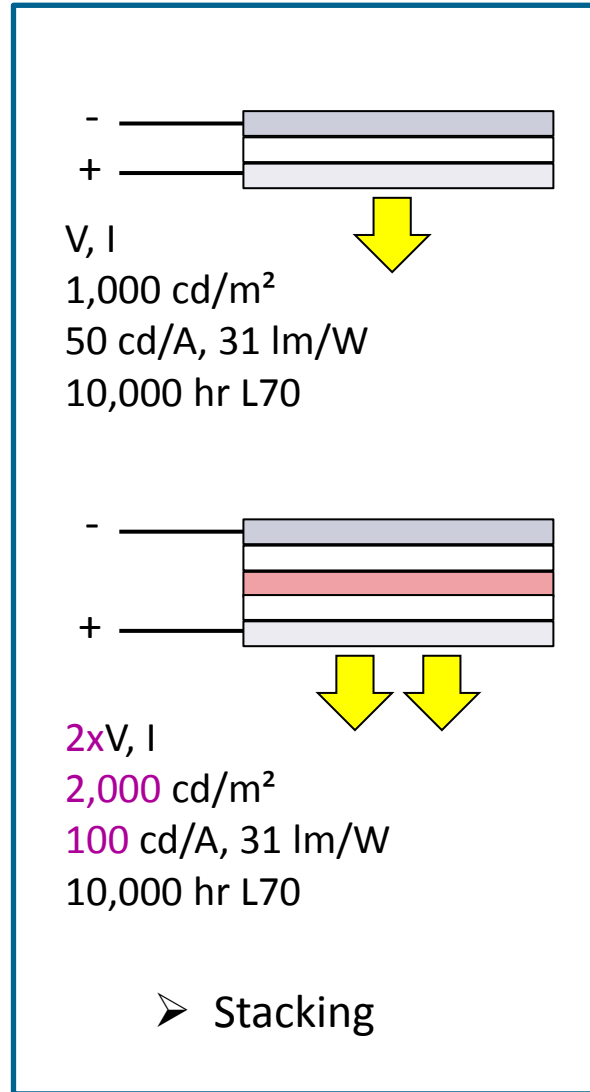
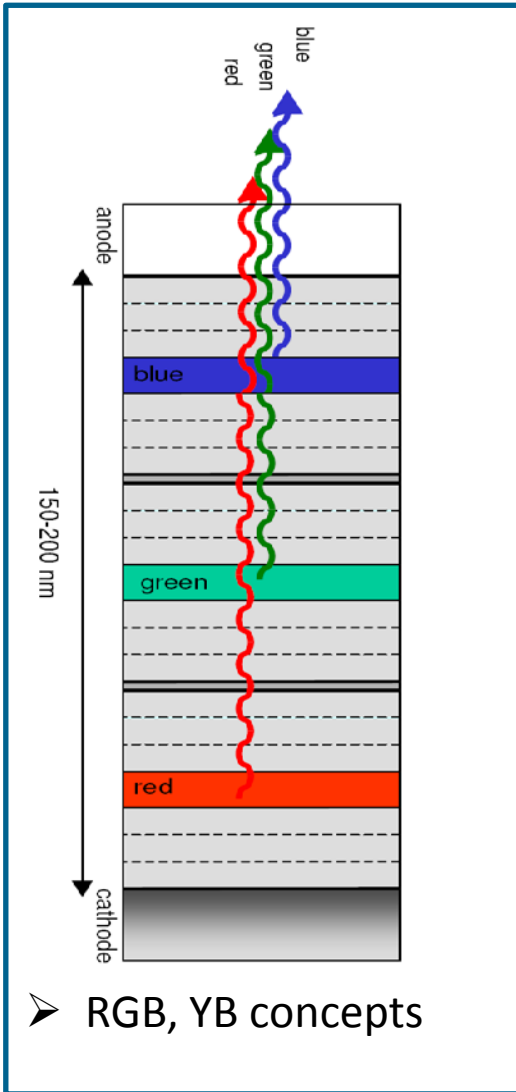


# OLED principle

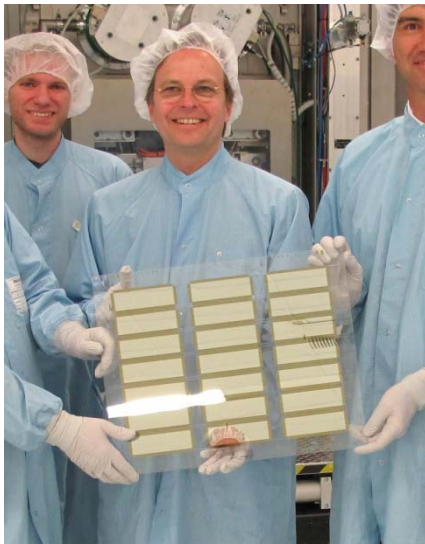
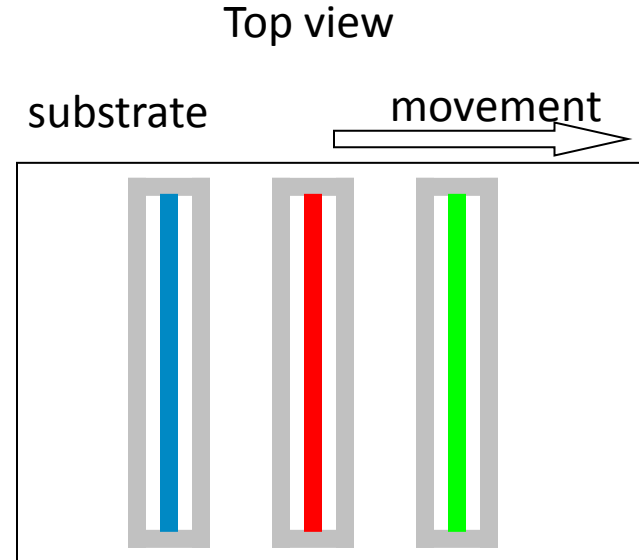
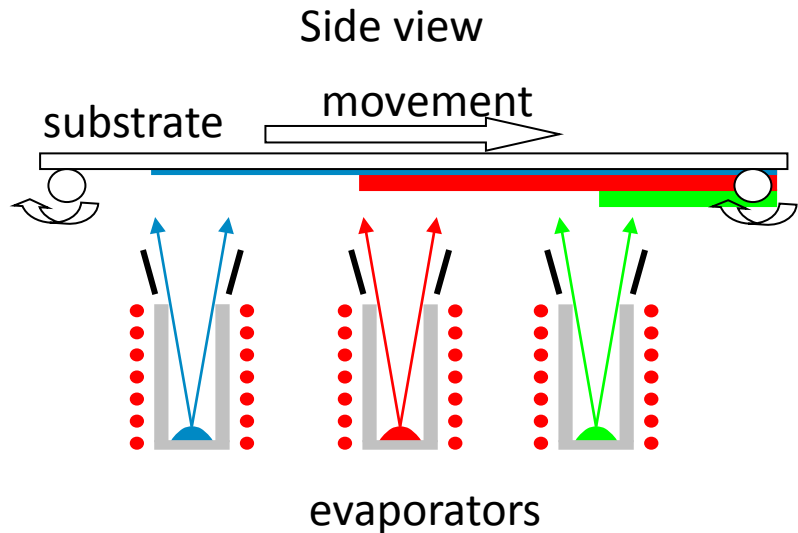




# Commercial OLED device build-up



# Vacuum Thermal Evaporation (VTE)



- In-line tools with integrated cleaning line and encapsulation
- Substrate size: Gen2.5 = 40x50 cm<sup>2</sup>
- Typical organic layer thickness: 10-100 nm
- Organic layer stack: several 10 organic layers
- Up to 4 organic materials within each layer

# Outline

- Introduction to OLED technology
- Today's OLED lighting status
  - Today's OLED differentiators
  - From decorative to functional
- The future of OLED lighting
- Conclusions



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# Lighting market

- High volume / cost sensitive / multiple segments
  - General lighting (illumination)
  - Decorative lighting (luminance)
  - Automotive lighting
  - Special lighting
- Lifetime & reliability
  - Use life > 10,000 hr
    - 70% initial brightness (L70)
    - $C_{10}$  (time to 10% devices failed)
  - Shelf life > 5 year
- Efficacy
  - Depends on market segment
  - Minimal 30 lm/W
- Color
  - CRI > 80 for illumination
  - All colors for luminance



# Tipping point triggers



Price



Super thin  
form



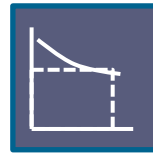
Uniform,  
diffused



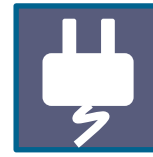
Diverse  
shapes



Lumen  
output



Lifetime



Energy  
efficiency



Flexibility



See-  
through

# The “Exclusive” phase

Driven by high-price, artistic installations



Price	Super thin form	Uniform, diffused	Diverse shapes	Lumen output	Lifetime	Energy efficiency	Flexibility	See-through
Too high	Unique and superior to other technology			Minimal	Minimally better than conventional		Limited availability	



- Showcase structure, luxury environment, exclusiveness appeal
- Impressive design enabled by OLED thin profile

- Lighting controls entertainment
- Distinct decoration for high-end retail, hospitality, and office space with high-tech, innovative look to enhance ambience

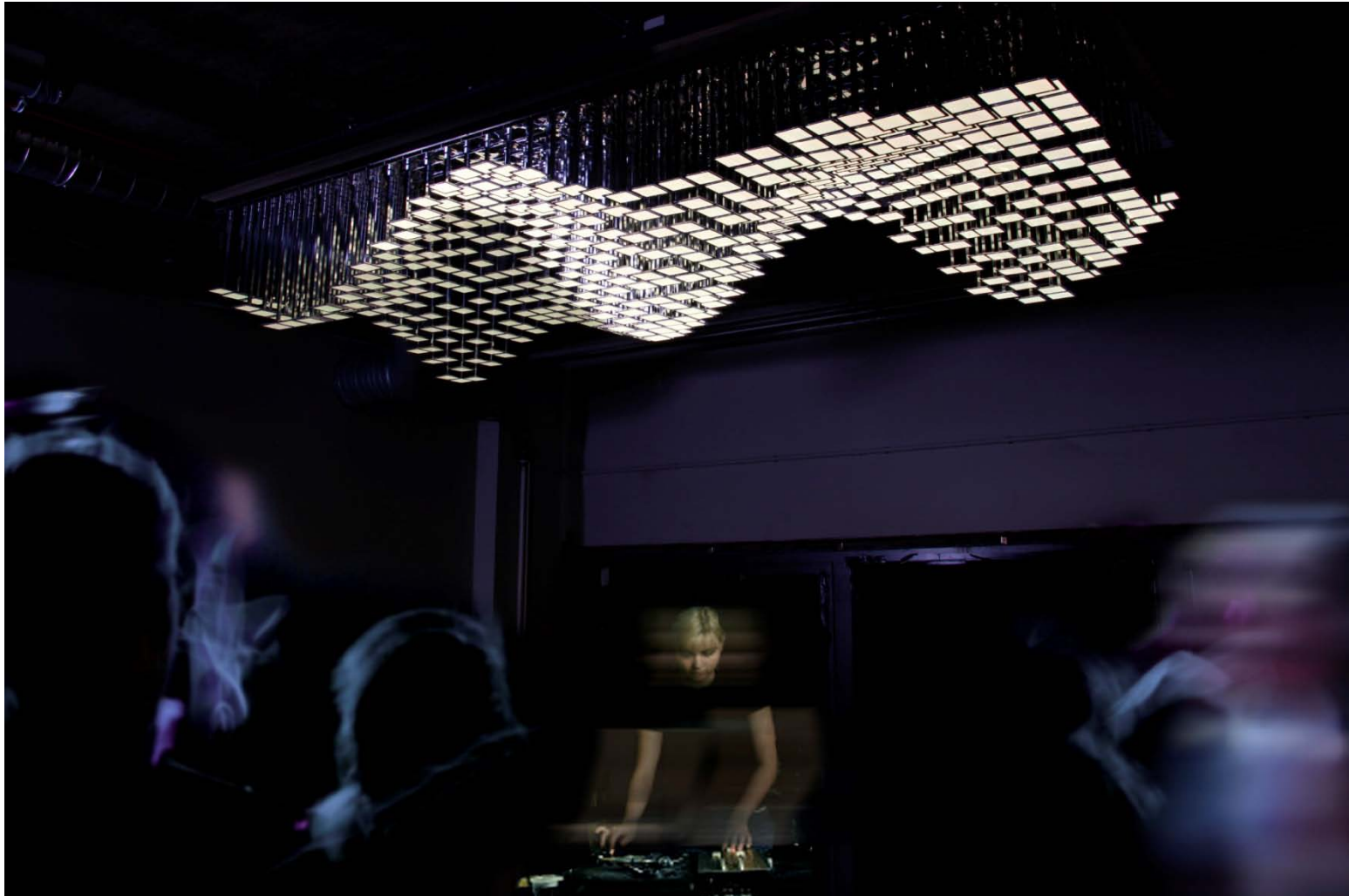


# Jason Bruges Studio

Aston Martin: engulfing the One-77



# LivingSculpture 3D Module System

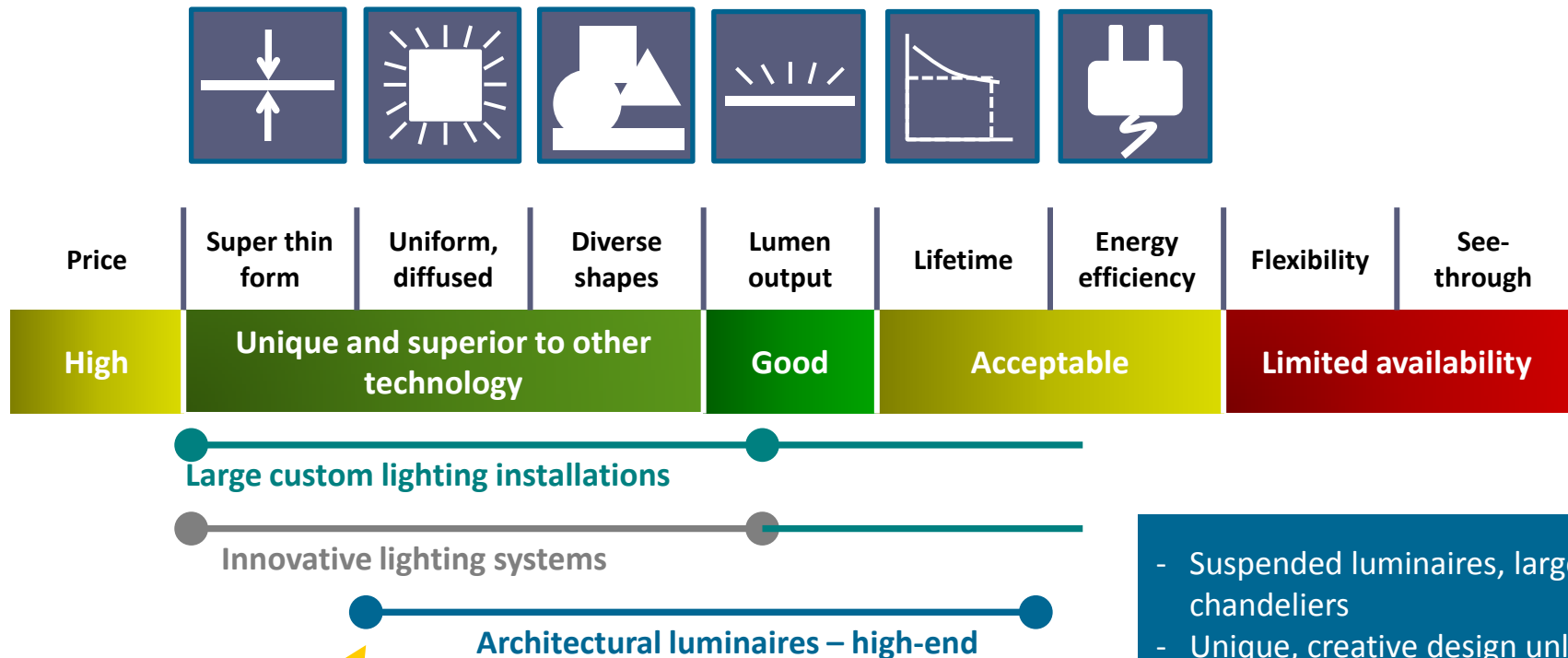


# LivingShapes Interactive Wall



# The “Early adopter” phase

Driven by high-end, differentiated look



- Suspended luminaires, large chandeliers
- Unique, creative design unlike any other luminaire based on previous technology

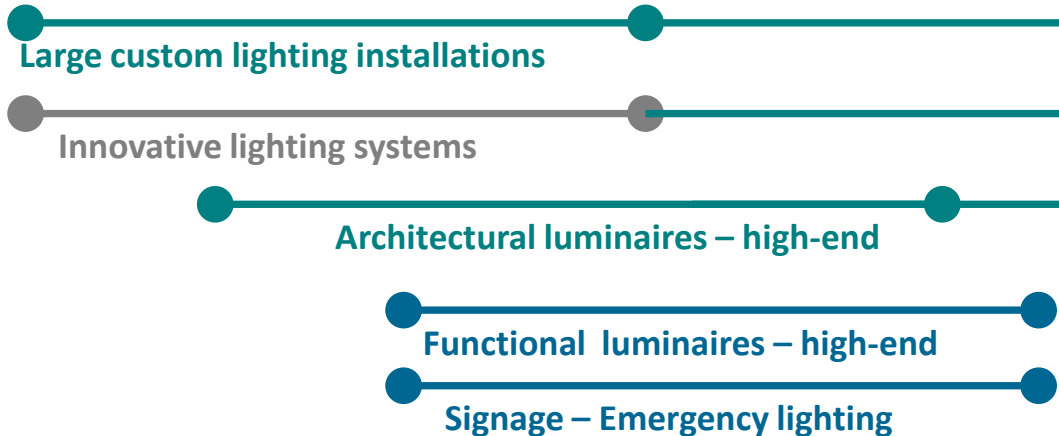
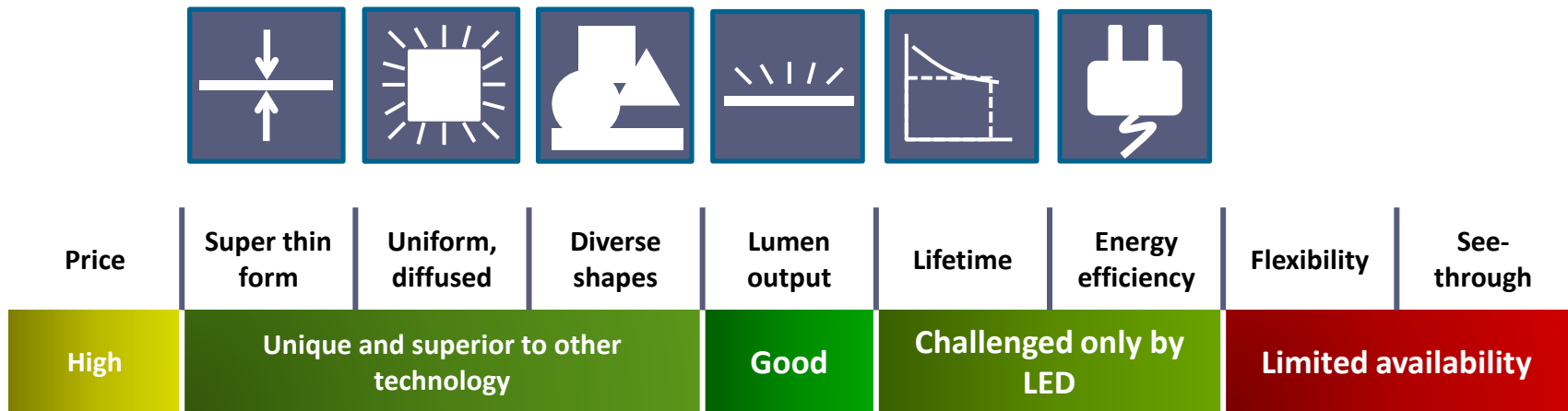
The market is at this point today

# Birot pixelate



# The “Early adopter” phase

Driven by high-end, differentiated look



- Suspended luminaires, desk lamps, free floor standing,
- Exit signage in office, retail, hospitality, and residential
- Pleasant light quality, differentiated look



# Philips Thinair luminaire



# Philips OLED panel FL300 Brite

Parameter	Value
Voltage (V)	20
Power consumption (W)	7.4
Luminous flux (lm)	300
Efficacy (lm/W)	40-50
L70 (hr)	>10,000
Luminance (cd/m <sup>2</sup> )	8,300
CRI	80

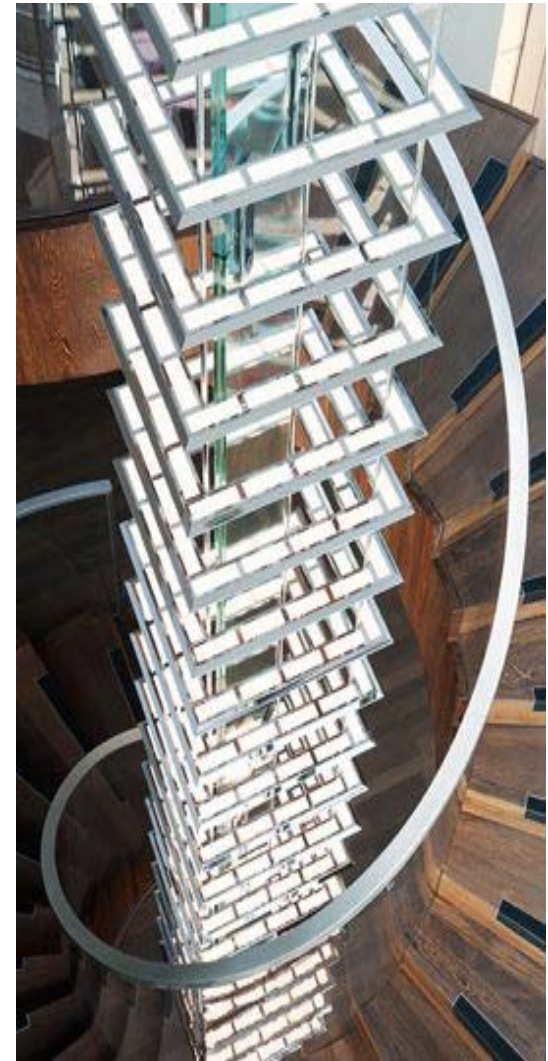


# Audi Forum OLED luminaires












# Outline

- Introduction to OLED technology
- Today's OLED lighting status
- The future of OLED lighting
  - Performance, size, shape, cost
  - Flexibility
  - Transparency
- Conclusions



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# Current and future

								
Price	Super thin form	Uniform, diffused	Diverse shapes	Lumen output	Lifetime	Energy efficiency	Flexibility	See-through
High	Unique and superior to other technology			Good	Acceptable		Limited availability	





# Shape and form: 3D



OLEDs on flexible substrates



OLEDs on curved substrates



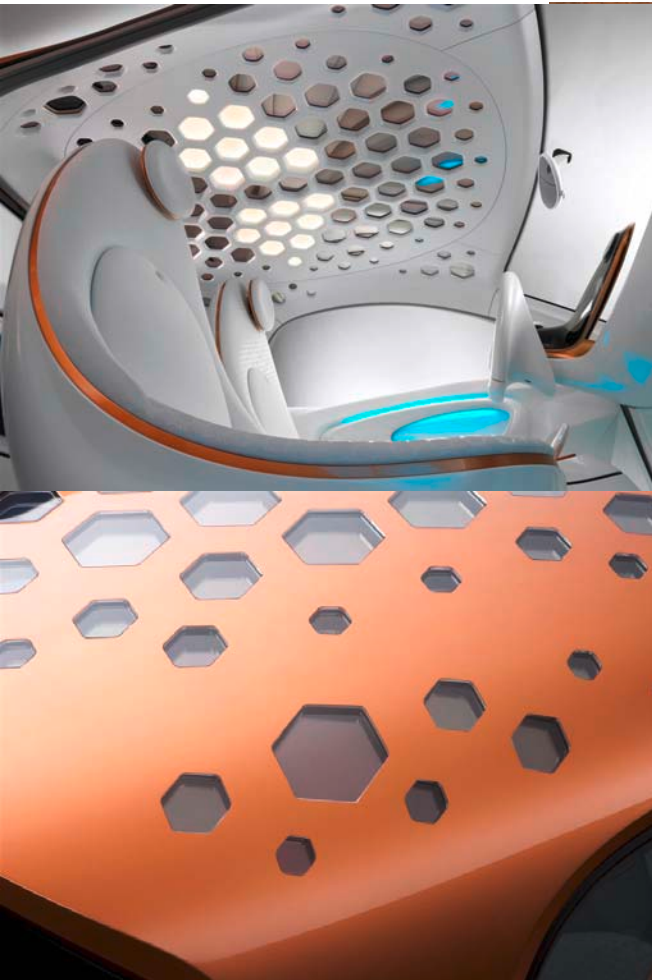


# Transparent OLED



# Transparent OLED

Smart Forvision – Letting the sun thru the roof



# Conclusions

- OLED lighting market is transitioning through a point of inflection and will grow rapidly
- OLED panels are reaching the desired performance levels for functional lighting applications
- OLED panels can be manufactured with high quality, high throughput, and good yield
- Cost will determine eventual market size

