OLED Light

LED EVENT **2017**

Design en engineering trends voor LED-applicaties

BE **WOENSDAG 29 NOVEMBER 2017**
TECHNOPOLIS, MECHELEN

NL **DONDERDAG 30 NOVEMBER 2017**
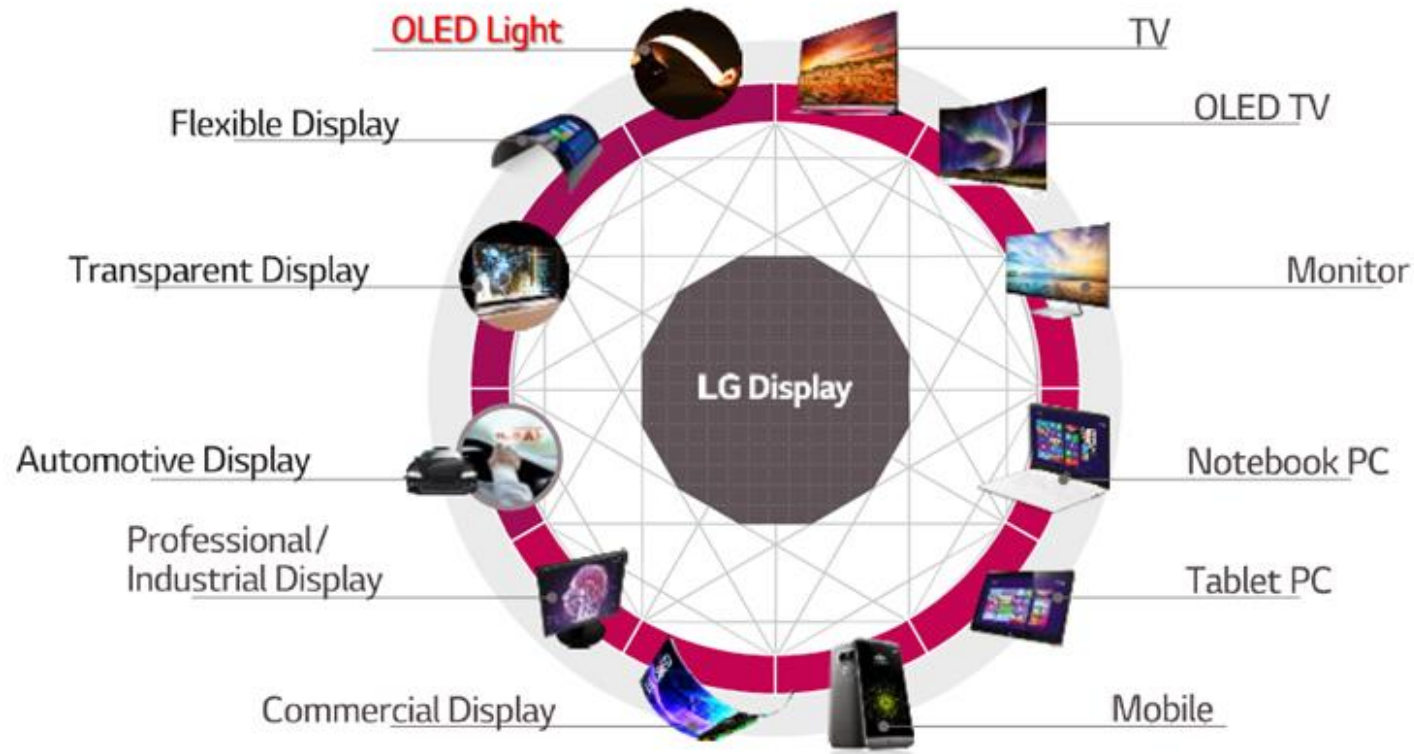CONGRESCENTRUM 1931
BRABANTHALLEN, DEN BOSCH

LG Display OLED Light

1. Corporate Overview

LG Display offers a variety of the world's top display products. To capitalize on LG Display's leadership in OLED display technology, LG Chem's OLED Light business was transferred to LG Display in 2015

1. Corporate Overview

LG Display is the world`s leading OLED company in both display and lighting

About OLED Light Business

■ **Technology Leadership**

   – Over 15 years of R&D before launching the business

   – The first to release 90lm/W & 40,000hrs OLED Light panels

■ **Manufacturing Leadership**

   – The first to adopt an in-line production system (since 2008)

   – The first to adopt a Gen 5 mass production line (from 2017)

■ **Sustainable Leadership**

   – Synergies between the lighting and display business

   – Strong foundation in OLED technology and infrastructure

1. Corporate Overview

The new 'Gen. 5' OLED Light panel production facility will begin mass production as of September 2017

Gen. 2 vs. Gen. 5

	Gen. 2	Gen. 5
Substrate Size (mm)	370x470	1,100x1,250
Production Capacity (substrates)	4,000/month	15,000/month
Availability	2011 ~	2017. 09
Factory (city)	Ochang	Gumi

Benefits

- **Increase in Production Capacity**
  - Monthly Input Capacity (Glass Substrates): 15K (Initial) → 90K

- **Price Competitiveness**
  - Production volume increase will result in significant reduction in manufacturing costs
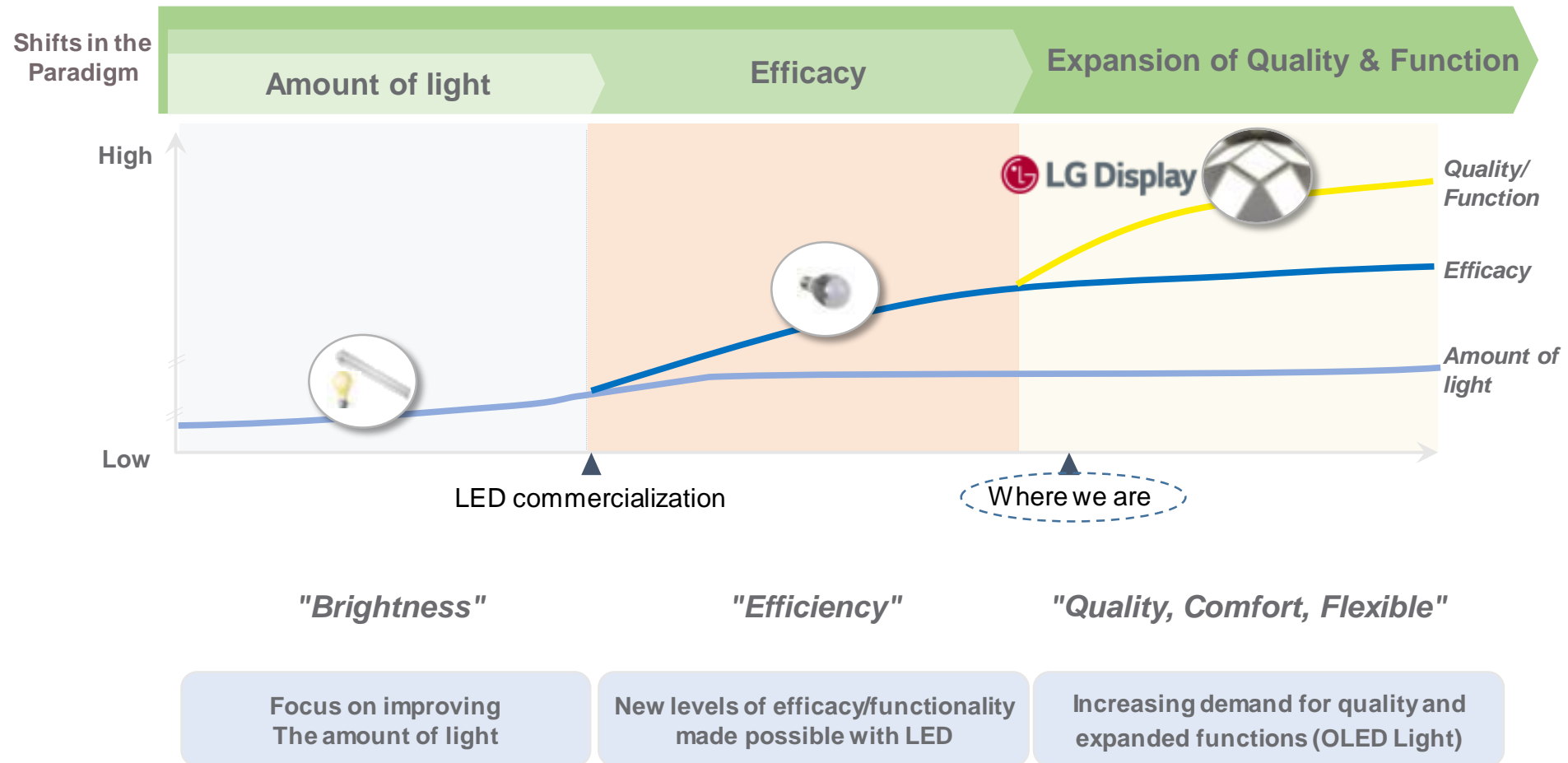
- **Performance Improvement**
  - 75 ~ 90 lm/W for Rigid Panels
  - 50 ~ 55 lm/W for Flexible Panels

- **Quality Enhancement**
  - New state of the art facility and high quality control system will improve product quality levels

2. Market Trend

OLED Light is expected to contribute to the new industry trends additionally emphasizing light quality

Shifts in the Paradigm		
Amount of light	**Efficacy**	**Expansion of Quality & Function**

High

Low

LG Display — Quality/ Function

Efficacy

Amount of light

LED commercialization

Where we are

"Brightness" *"Efficiency"* *"Quality, Comfort, Flexible"*

| Focus on improving The amount of light | New levels of efficacy/functionality made possible with LED | Increasing demand for quality and expanded functions (OLED Light) |

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2. Market Trend

OLED Light panel market is expected to grow up to USD $1 Billion in 2020

OLED panel Market

(Unit :USD$Mil)

UBI Research

1,630
659
427
297

Boston Consulting Group

510
323
191
-

'17   '18   '19   '20
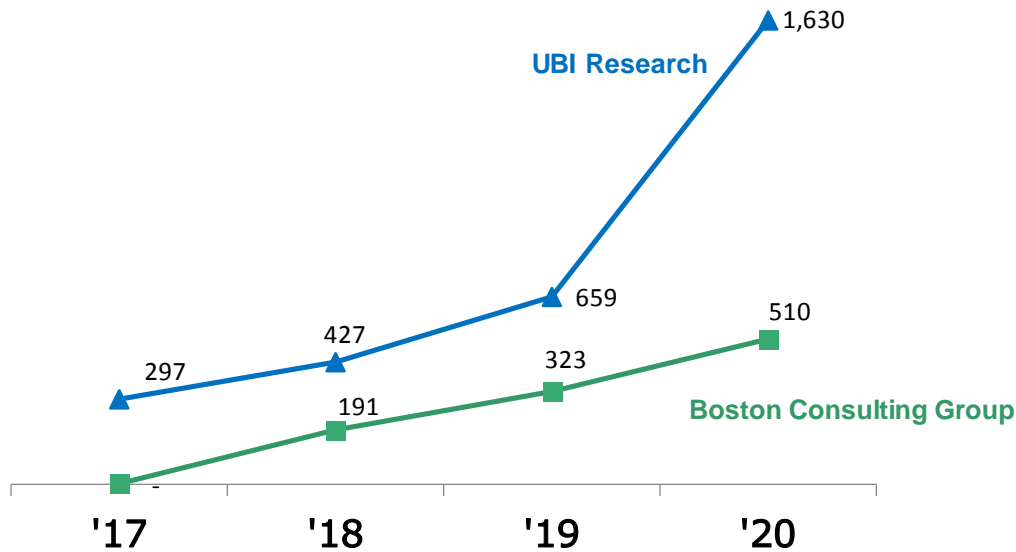
1)Integrated fixture: Lighting fixtures integrated with light sources e.g.) LED Troffers
2)Lighting quality: CRI(Color Rendering Index) & Color control

Market Status

- **Lighting fixture market expected to grow**

  - **Increase total usage of lighting products**
    - Overall GDP growth
    - Improve efficacy of lighting products

  - **Expand total market size**
    - Lighting product varieties
    - Smart lighting controls

- **Light source market driven by LED/OLED**

  - % of LED/OLED : 44% ('17) → 75% ('22)
  - Conventional retrofit market will be replaced by LED/OLED
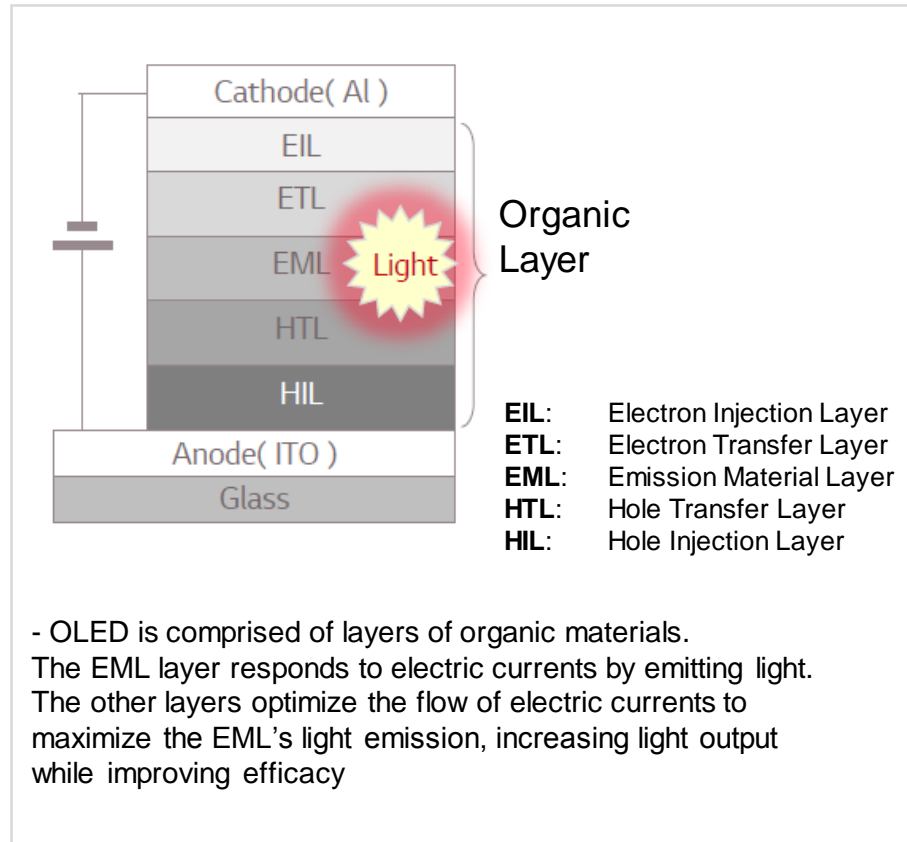   - LED/OLED integrated fixtures[1] will occupy the market

- **Trends focusing on light quality, design differentiation**

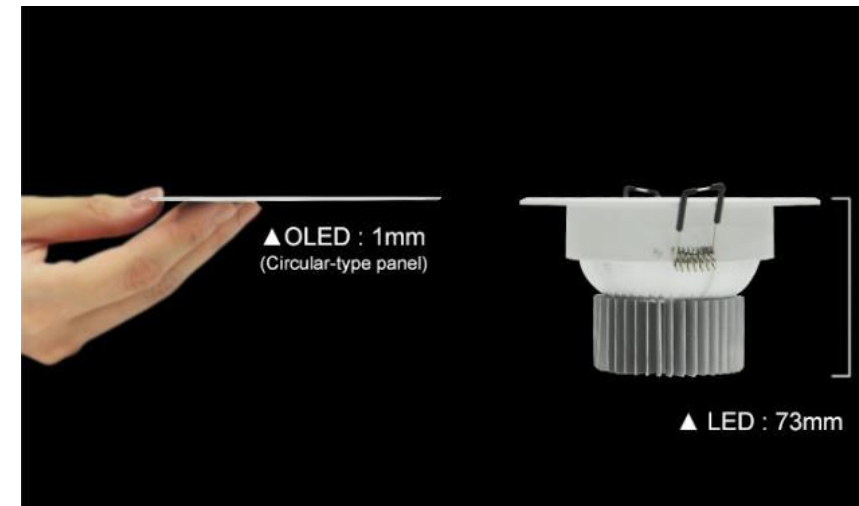 - Luminous flux/efficacy → Light quality[2] /Design oriented

3. New Product

OLED is an ultra thin area light source that produces a very comfortable and evenly diffused light

Structure

EIL: Electron Injection Layer
ETL: Electron Transfer Layer
EML: Emission Material Layer
HTL: Hole Transfer Layer
HIL: Hole Injection Layer

- OLED is comprised of layers of organic materials.
The EML layer responds to electric currents by emitting light.
The other layers optimize the flow of electric currents to
maximize the EML's light emission, increasing light output
while improving efficacy

Ultra Slim and Lightweight

- OLED is a diffused light source with no heat issues, eliminating
the need for diffusers and heat sinks

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3. New Product

Nine different models are available in two different color temperatures

Type	Size		CCT	Models
Flexible	Rectangular	200 x 50	3000K	
		400 x 50		
	Square	300 x 300		
Rigid	Square	100 x 100	4000K	
		300 x 300		
	Rectangular	300 x 100		
		200 x 50		
		400 x 50		
	Circular	100Φ		

3. New Product

2017		2018					
Q4		Q1			Q2		
Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
P200x50, 3000K	P200x50, 3000K	P200x50, 3000K	P200x50, 3000K	P200x50, 3000K	P200x50, 3000K	P200x50, 3000K	P200x50, 3000K
P400x50, 3000K	P400x50, 3000K	P400x50, 3000K	P400x50, 3000K	P400x50, 3000K	P400x50, 3000K	P400x50, 3000K	P400x50, 3000K
	P300x300, 3000K	P300x300, 3000K	P300x300, 3000K	P300x300, 3000K	P300x300, 3000K	P300x300, 3000K	P300x300, 3000K
		100x100, 3000K	100x100, 3000K	100x100, 3000K	100x100, 3000K	100x100, 3000K	100x100, 3000K
		200x50, 4000K	200x50, 4000K	200x50, 4000K	200x50, 4000K	200x50, 4000K	200x50, 4000K
		400x50, 4000K	400x50, 4000K	400x50, 4000K	400x50, 4000K	400x50, 4000K	400x50, 4000K
			300x100, 4000K	300x100, 4000K	300x100, 4000K	300x100, 4000K	300x100, 4000K
				100x100, 4000K	100x100, 4000K	100x100, 4000K	100x100, 4000K
				100Φ, 4000K	100Φ, 4000K	100Φ, 4000K	100Φ, 4000K
					200x50, 3000K	200x50, 3000K	200x50, 3000K
					400x50, 3000K	400x50, 3000K	400x50, 3000K
					P200x50, 4000K	P200x50, 4000K	P200x50, 4000K
					P300X300, 4000K	P300X300, 4000K	P300X300, 4000K
Flexible					P400x50, 4000K	P400x50, 4000K	P400x50, 4000K
						300x100, 3000K	300x100, 3000K
Rigid							100Φ, 3000K

The start of mass production – commercial availability in volume
Samples will be available 1 month prior to MP start

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3. New Product

Model	CCT (K)	Outline Dimension (mm)	Active area (mm)	Power Consum. (W)	Luminous Flux (lm)	Efficacy (lm/W)	Voltage (V)	DC Current (mA)	CRI (Ra) (Tpy)	Uniform. (%)	Thickness (mm)	Weight (g)	Life Time (hrs)
200x50 Flexible	3000K	200x50	189x39	1.38	75	55	8.6	160	93	85	0.41	<5	30,000
	4000K	200x50	189x39	1.51	75	50	6.1	250	93	85	0.41	<5	20,000
400x50 Flexible	3000K	400x50	389x39	2.85	150	52	8.9	320	93	85	0.41	<15	30,000
	4000K	400x50	389x39	3.18	150	47	6.4	500	93	85	0.41	<15	20,000
300x300 Flexible	3000K	300x300	286x286	14.24	750	52	8.9	1600	93	80	0.41	<76	30,000
	4000K	300x300	286x286	15.88	750	47	6.4	2500	93	80	0.41	<76	20,000
100x100 Rigid	3000K	100x100	89x89	0.83	75	90	8.5	98	93	85	0.88	<20	40,000
	4000K	100x100	89x89	1	75	75	6	166	93	85	0.88	<20	40,000
200x50 Rigid	3000K	200x50	189x39	0.83	75	90	8.5	98	93	85	0.88	<20	40,000
	4000K	200x50	189x39	1	75	75	6	166	93	85	0.88	<20	40,000
400x50 Rigid	3000K	400x50	389x39	1.72	150	87	8.8	196	93	85	0.88	<45	40,000
	4000K	400x50	389x39	2.09	150	72	6.3	332	93	85	0.88	<45	40,000
300x100 Rigid	3000K	300x100	286x86	2.64	230	87	8.8	300	93	85	0.88	<70	40,000
	4000K	300x100	286x86	3.21	230	72	6.3	510	93	85	0.88	<70	40,000
100Φ Rigid	3000K	100Φ	89Φ	0.66	60	90	8.5	78	93	85	0.88	<20	40,000
	4000K	100Φ	89Φ	0.8	60	75	6	133	93	85	0.88	<20	40,000

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3. New Product

Constant improvements in performance are planned, with efficacies reaching 120lm/W in 2019

		'17	'18	'19
Rigid Panels	Efficacy	90 lm/W		120 lm/W
	Lifetime	40Khr@3000nit		40Khr@5000nit
Flexible Panels	Efficacy	55 lm/W		110lm/W
	Lifetime	40Khr@3000nit		40Khr @5000nit
	Bezel	5.5mm		2.5mm
	Flexibility		20R(mm)	5R(mm)

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3. Advantages of OLED light

- LG Display's OLED Light panels come with CRI above 90 even in it's natural state

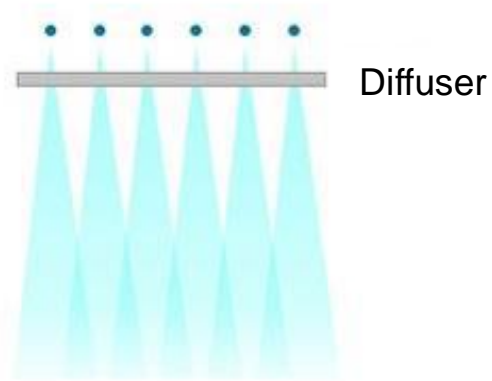Conventional Light: CRI 80   VS.   LG Display OLED Light: CRI 90

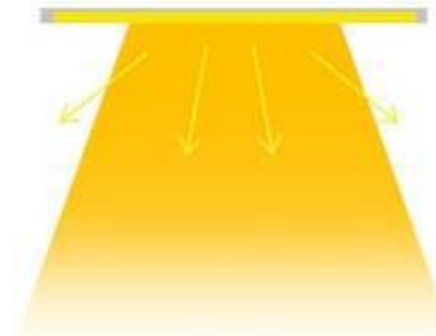*True color is a key element that influence to product presentation, moods, and buying decision.*

- OLED provides higher TM-30 color fidelity levels even at similar CRI levels

3. Advantages of OLED light

▪ OLED Light improves visual comfort by reducing shadows

Diffuser

Multiplee Shadows

Smooth Shadows

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3. Advantages of OLED light

- The flexibility of the light source offers unprecedented design freedom for designers and architects

  - Current bending radius: 20 mm
  - Will become available in formats of 400x50mm, 200x50mm and 300x300mm

5. Application Areas

Hospitality

4-5 star luxury hotels that invest 2 ~ 3 times more[1] in lighting than second tier hotels

Retail

Designer's boutiques, luxury specialty shops, fine jewelry shops spend 3 ~ 4 times more[2] in store lighting than other types of retail stores

Architectural

Indoor architectural provides one of the most viable applications for OLED which enables unique and creative designs

Office

High-rise office buildings spend up to twice as much[3] in lighting than low-rise office buildings

Residential

Luxury houses invest up to 1.5 times more[4] in lighting than average houses in developed countries

Automotive

OLED adoption has already begun in premium sports cars, soon to be extended to luxury automotive brands' F/E/D segments

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5. Application Areas

OLED Cafe Lighting

OLED Desk Lamp Lighting

OLED Wardrobe Lighting

OLED Meeting Room Lighting

OLED Mirror Lighting

OLED Shelf Lighting for Retail

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6. Price Indication

LGD's long term OLED panels price strategy:

1. The future price level reduction is expected to be deeper than the forecast

2. Flexible panels will become a major part of the future products portfolio

Life will be beter with OLED light