



2019 Solution Process OLED Annual Report

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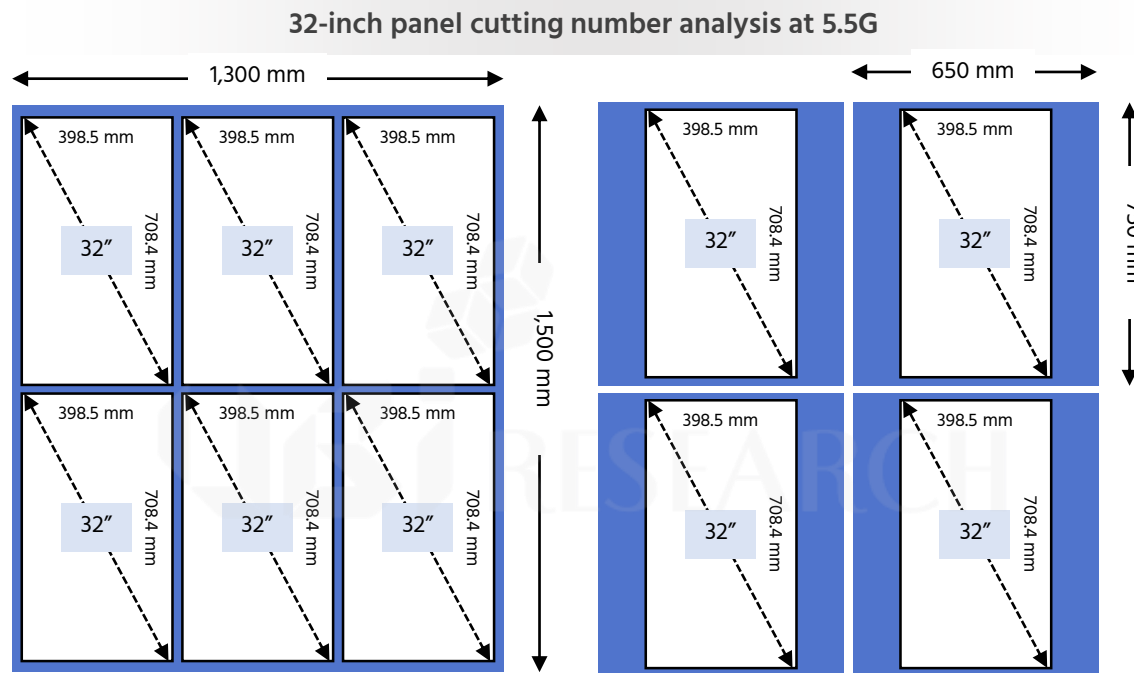
14.1 Equipment Patent Analysis

14.2 Material Patent Analysis

3. Necessity of Solution Process

3.3 Cell Cutting Number Analysis

- Since OLEDs for TVs are manufactured using open masks, OLEDs are manufactured without cutting the substrate. However, the OLED for monitor currently produced uses 5.5G substrate, so the substrate must be divided during evaporation. Since Sol OLED can be used without cutting the substrate, the panel production is higher than that of the FMM method on the 5.5G substrate.



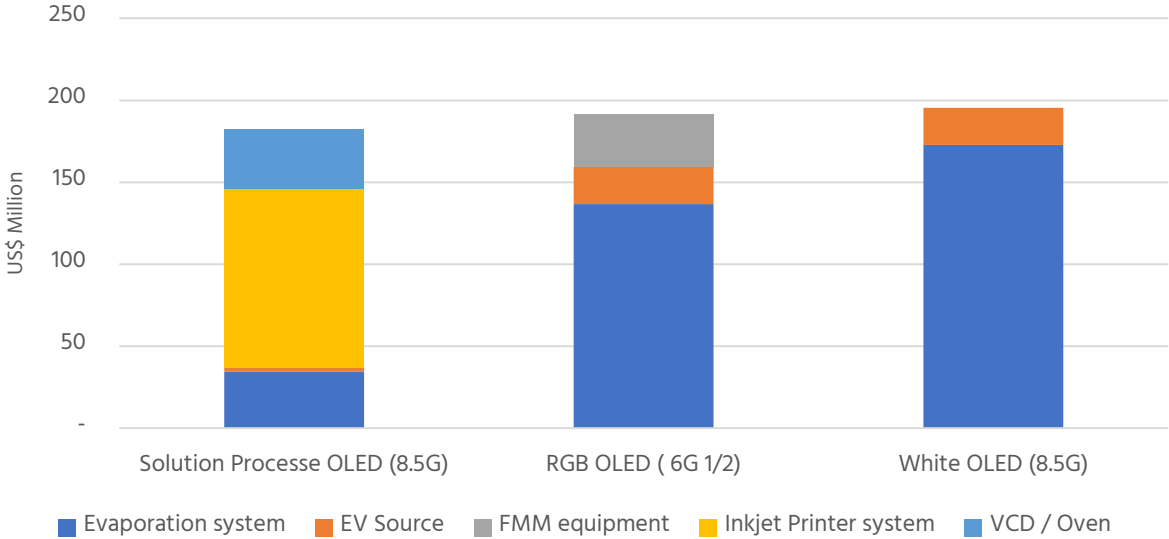
Economical cut per panel					
OLED method	Gen	OLED pixel	Panel size	Economical cut	Glass efficiency
Solution process	5.5	5.5	27"	8	87%
	(1,300 x 1,500mm)	(1,300 x 1,500mm)	32"	6	92%
Evaporation	5.5	5.5 ¼	27"	4	44%
	(1,300 x 1,500mm)	(650 x 750 mm)	32"	4	61%

Source: UBI Research DB

4. Competitive Comparison between Solution Process and Evaporation

4.4 Investment Cost Analysis by OLED Manufacturing Technology

- Sol OLED and White OLED were prepared based on 8.5G 42.5K (45 sec Tact time).
- RGB OLED is written in 6G 1/2 30K standard (58sec Tact time). [6G 1/2 30K = 6G 15K]

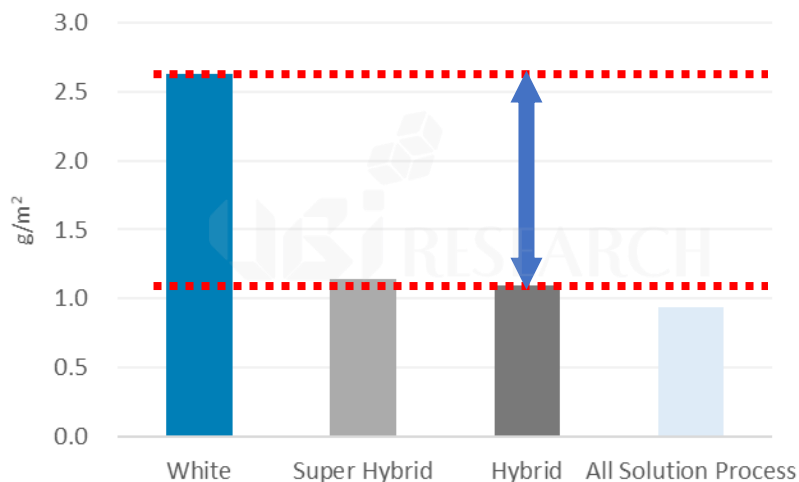


4. Competitive Comparison between Solution Process and Evaporation

4.6 Cost

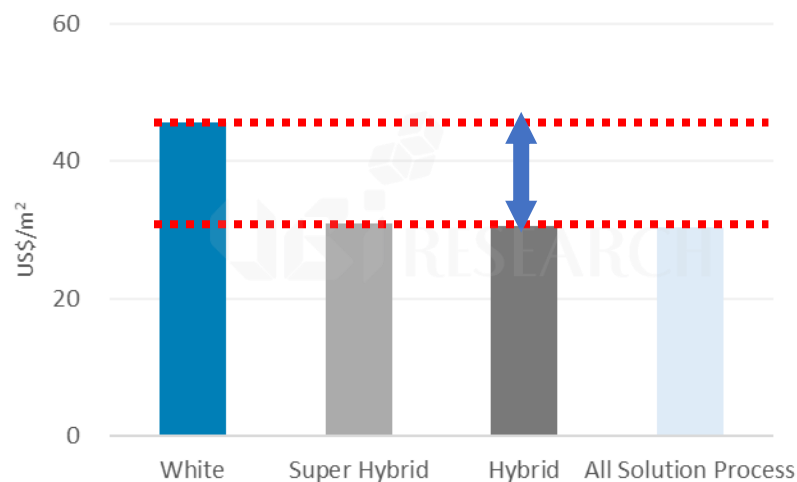
- Compared with white OLED, sol OLED has higher material usage and fewer layers, so it is expected to reduce manufacturing cost by reducing usage of emitting materials.
- However, since the solid light emitting material is manufactured by synthesizing a solid organic material and a solvent, the material price may increase due to the solvent price, synthesis cost, and development cost.
- Assuming that the total price of the soluble light emitting material, including solvent and synthesis cost, is twice that of the deposited light emitting material, the unit price of the hybrid sol OLED is 70% of that of the white OLED.

Comparison of OLED emitting material consumption



Source: UBI Research DB

OLED emitting material unit price comparison

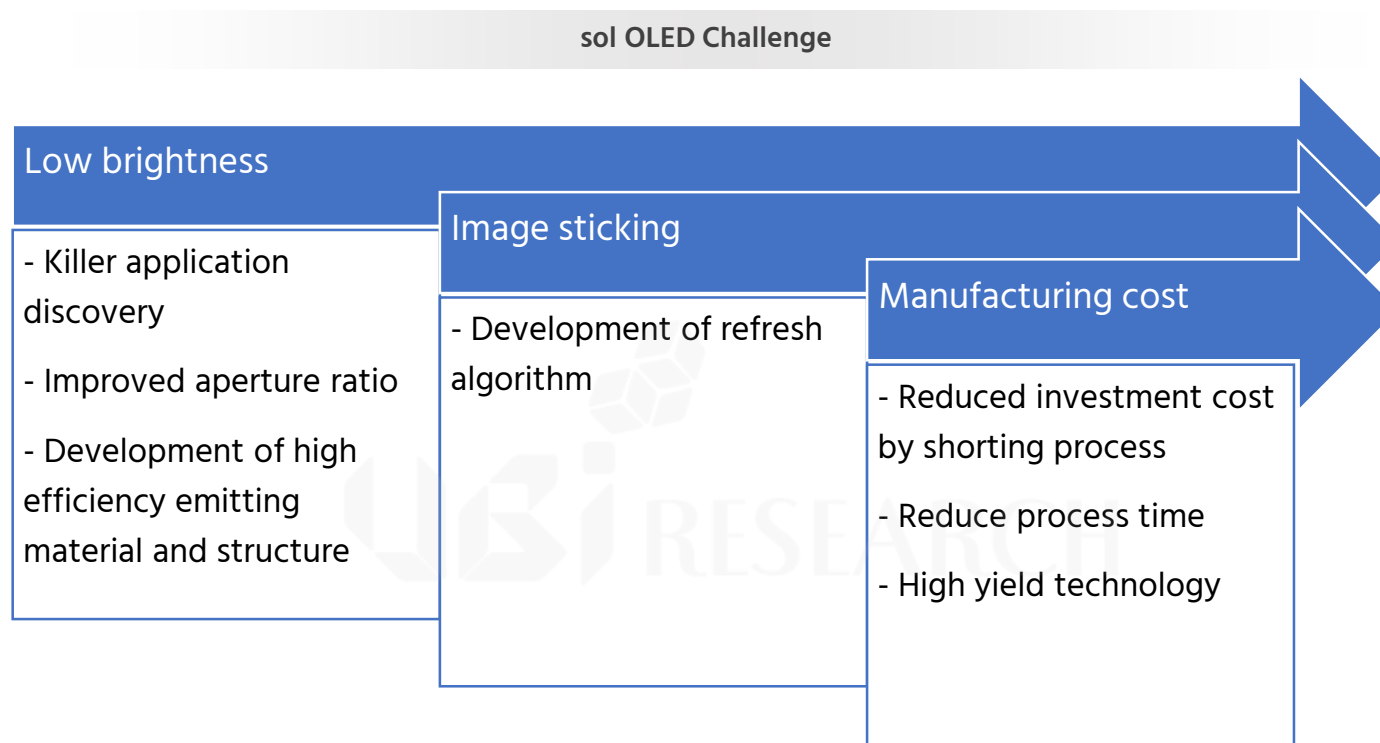


Source: UBI Research DB

5. Solution Process Commercialization Key Issue Analysis

5.6 Solution Process OLED Commercialization Success Factors

- In order to the sol OLED business to be successful, the following three barriers must be resolved.
 1. Low brightness
 2. Image sticking
 3. Manufacturing cost



Source: UBI Research DB

6. Solution Process OLED Monitor Market Entry Scenario

6.1 Solution Process OLED for Monitor

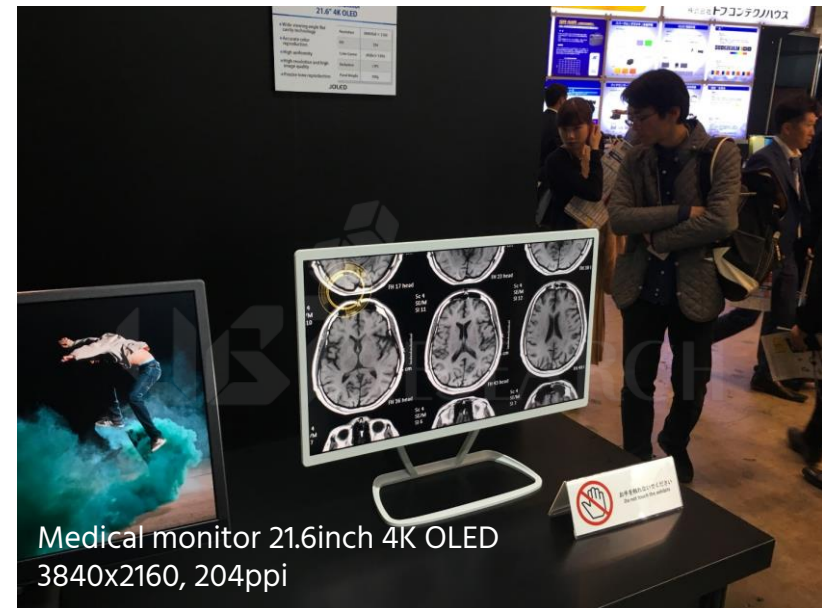
- LCD, RGB OLED, and sol OLED are used for 20-inch and larger premium monitors.
- The main uses of premium monitors are for ultra high resolution, gaming and medical.
- The brightness of premium monitors on the market is the highest at 350nit.
- The brightness of sol OLED for monitor sold by JOLED is 350nit (peak intensity) product.

JOLED's sol OLED monitor



E-sports monitor 21.6inch FHD OLED
1920x1080, 102ppi, 144Hz

Source: UBI Research DB



Medical monitor 21.6inch 4K OLED
3840x2160, 204ppi

Source: UBI Research DB

* Name of the company listed in this report

Category	Company name
Panel	Samsung Display, LG Display, JOLED, BOE, CSOT
Material	Dupont (LG chemical), sumitomo Chemical, Merck
Manufacturing Equipment	LG PRI, Kateeva, SEMES, Tokyo electron, Sti, Unijet, NARAE NANOTECH, Epson