2016 Display component market review and 2017 projection

2016.11.2 for IHS Technology Korea Display Conference

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Polarizer

Two digit decrease in polarizer price

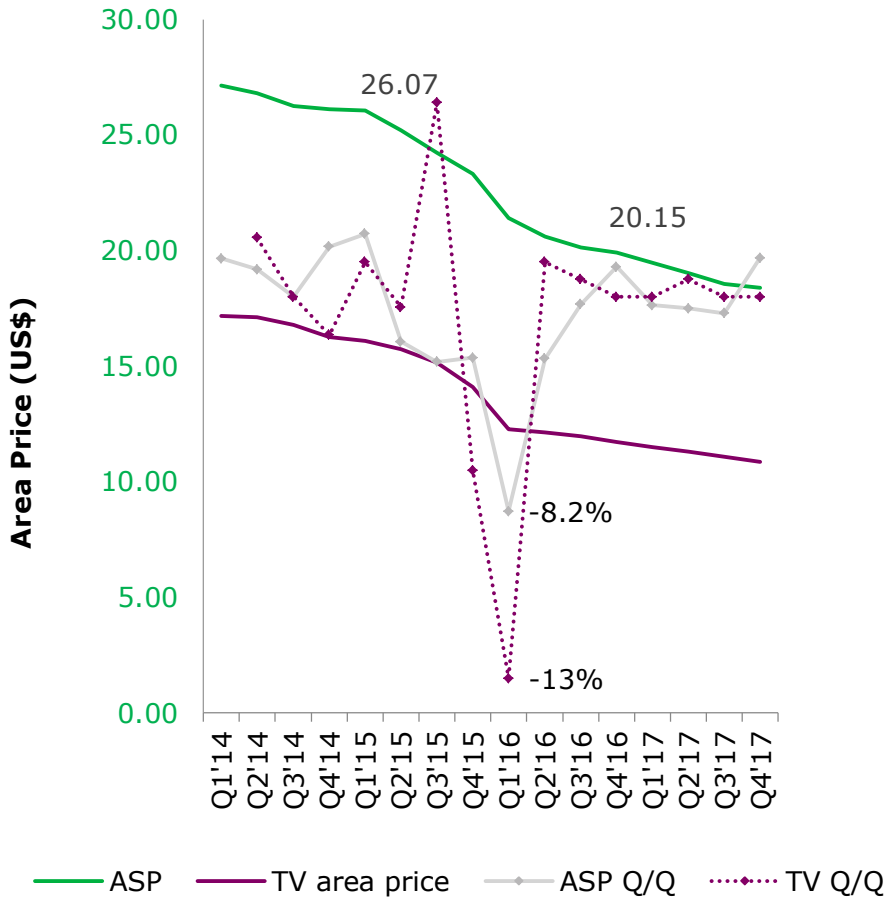
Polarizer makers continue to be in red

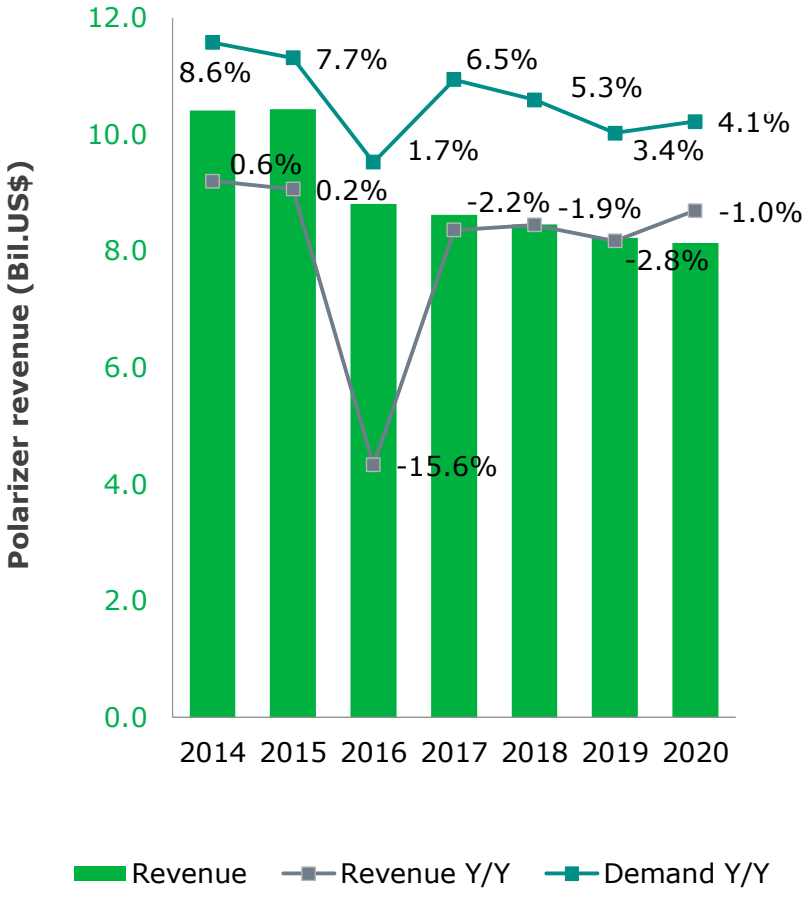
Demand of Non-TAC to be increased due to LCD TV enlargement

Imbalanced Supply/Demand of polarizer and sub-films

Concentration of polarizer manufacturing lines in China

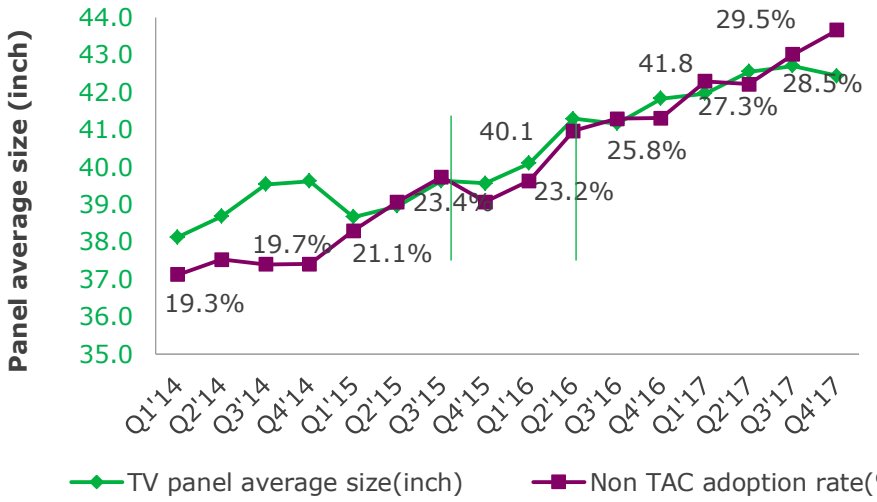
Decrease in TV polarizer price has reached 20%

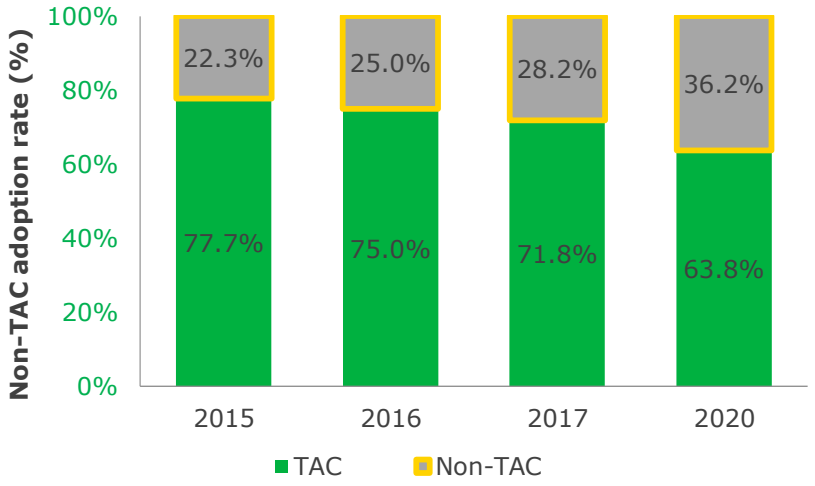




Source : IHS Report 'Display Optical film market tracker'

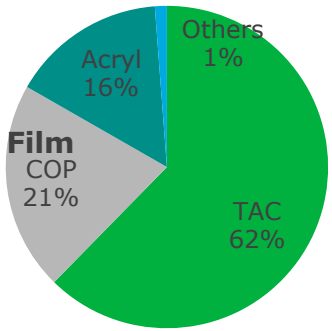
LCD TV enlargement and Non-TAC polarizer



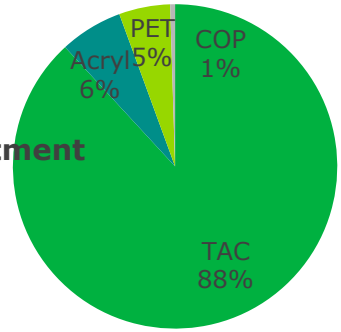


[Market share of PVA protection film usage]

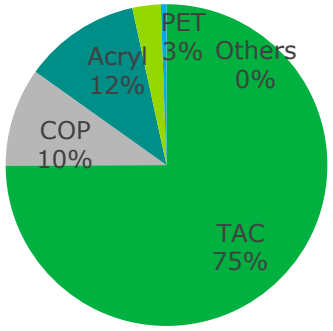
Compensation Film



Surface treatment

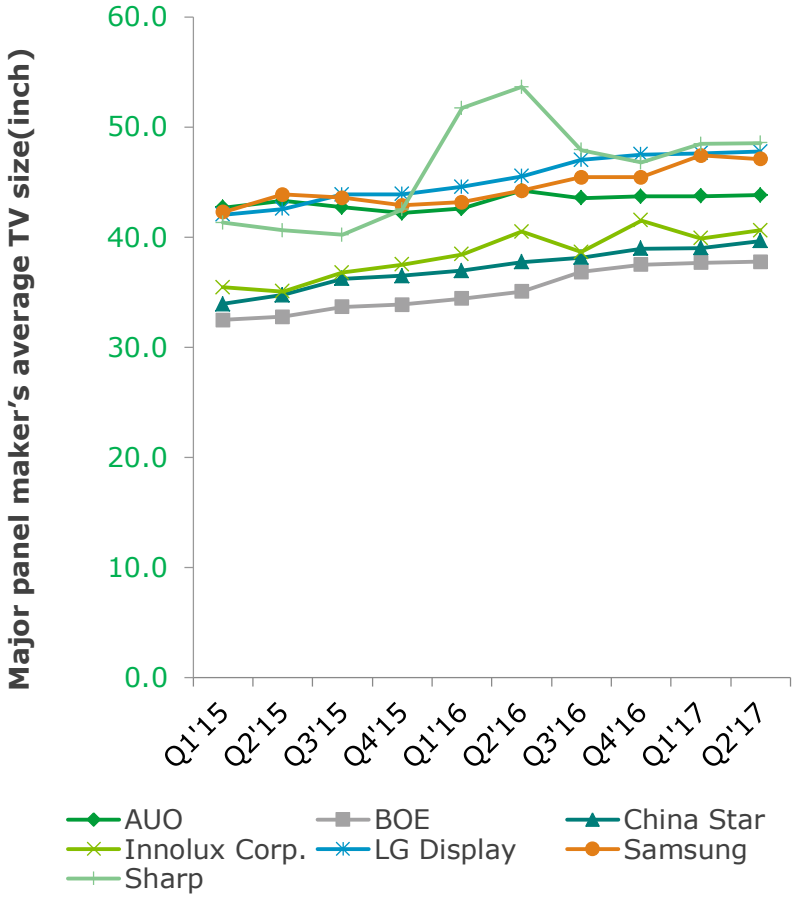


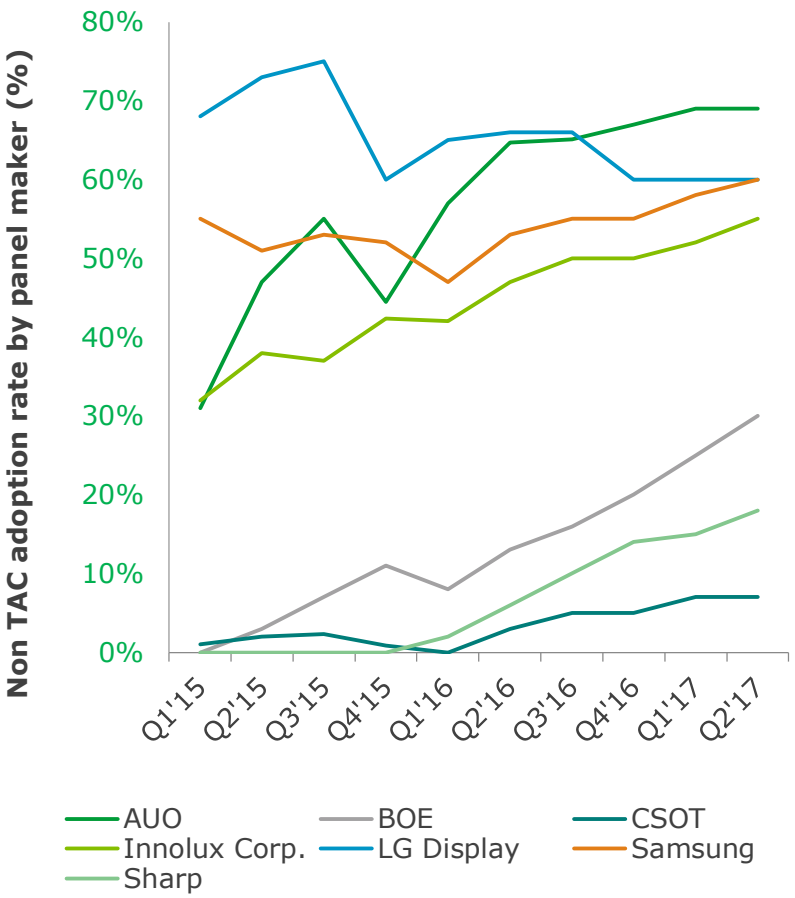
Total



Source : IHS Report 'Display Optical film market tracker'
IHS Report 'Large-area display market tracker'

Correlation between TV size and the adoption of Non-TAC polarizer





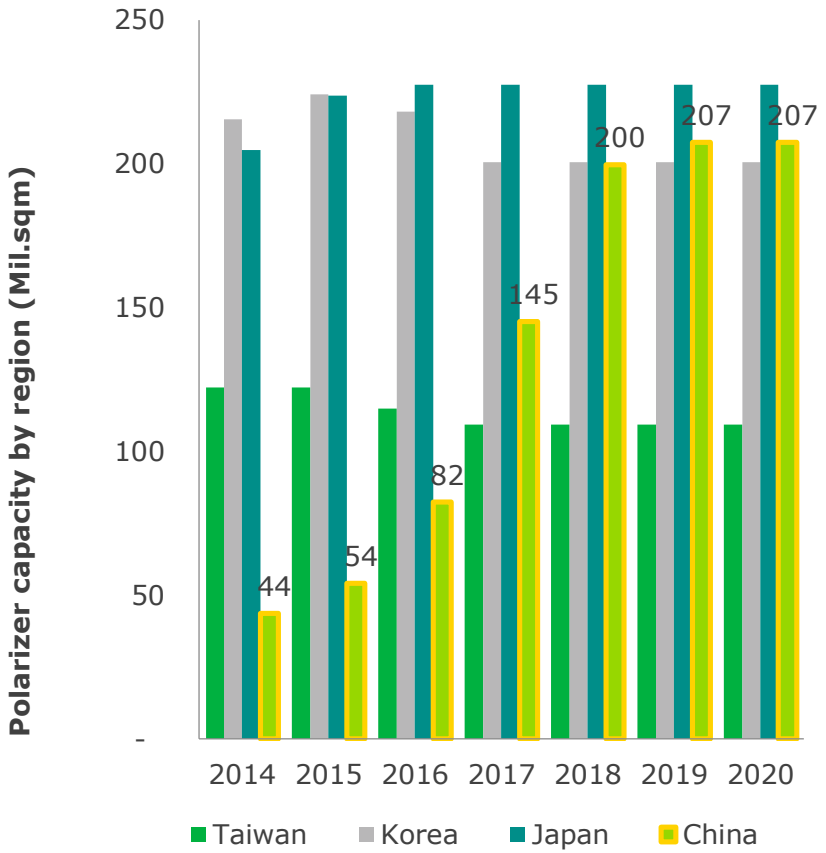
Source : IHS Report 'Display Optical film market tracker'
IHS Report 'Large-area display market tracker'

Concentration of polarizer manufacturing lines in China

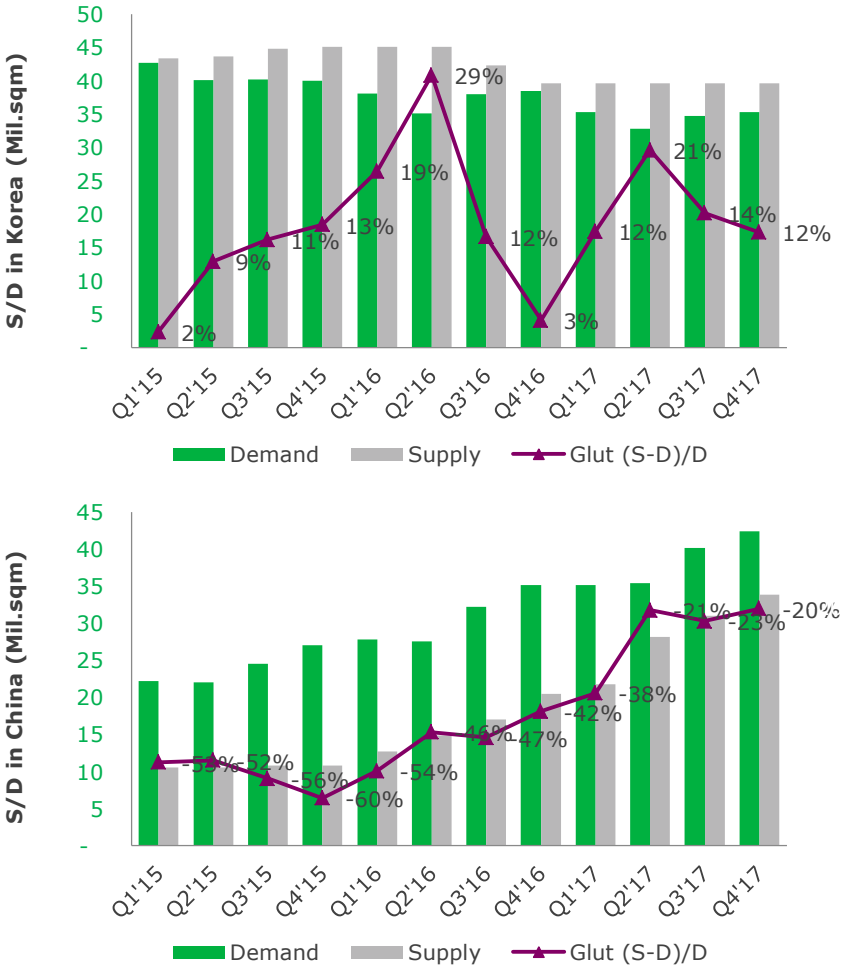
Investment plans of polarizer in China

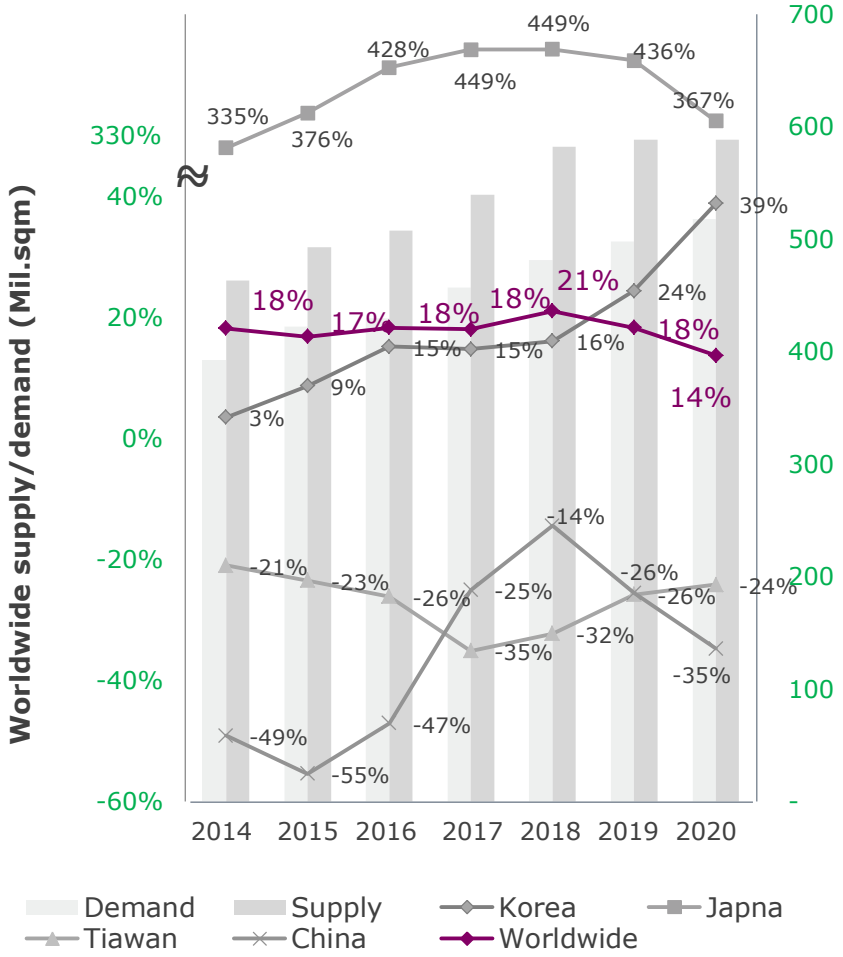
Maker	Location	Film width (mm)	Capacity (Km2/month)	MP
Nitto	Shenzhen	1,490	640	2018
Sumitomo	Wusi	1,490	1,400	Q3'17
SDI	Wusi	2,260	1,700	Q4'16
LGC	Nanjing	2,260	2,700	Q1'16
CMMT	Kunshan	1,490	720	Q2'17
	Kunshan	2,260	1,200	1Q'18
Sunnypol	Shenzhen	1,490	900	Q2'17
	Hefei	2,260	1,000	Q1'18
SAPO	Shenzhen	1,490	700	Q2'17

Source : IHS Report 'Display Optical film market tracker'



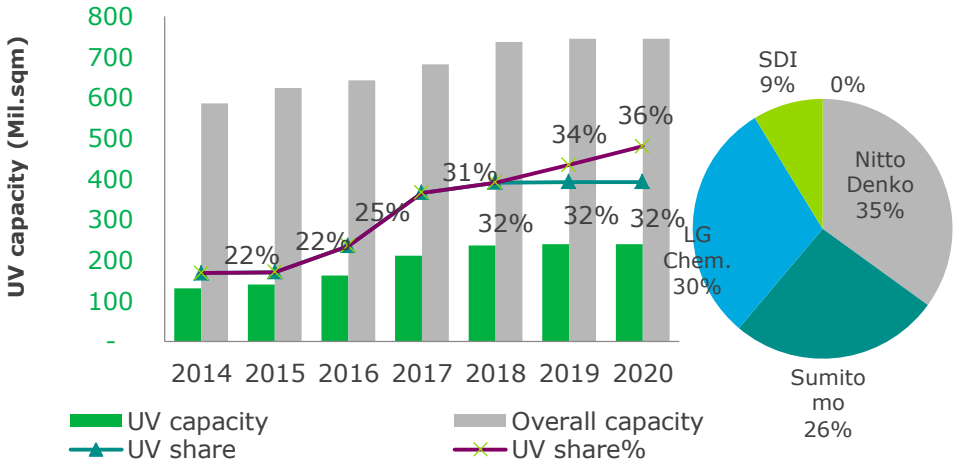
Imbalanced Supply/Demand of polarizer-by region

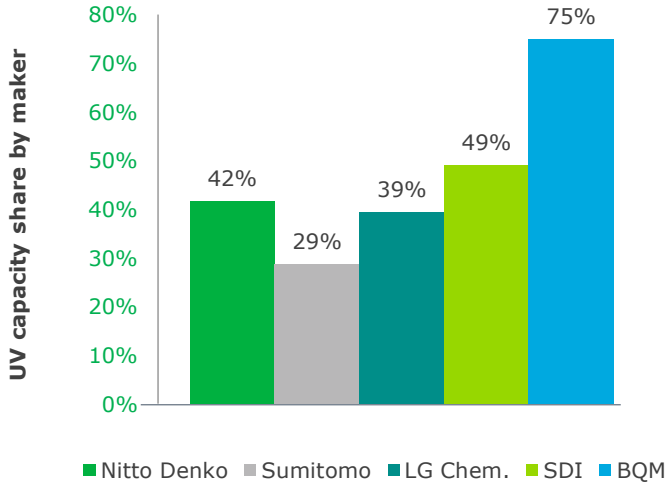


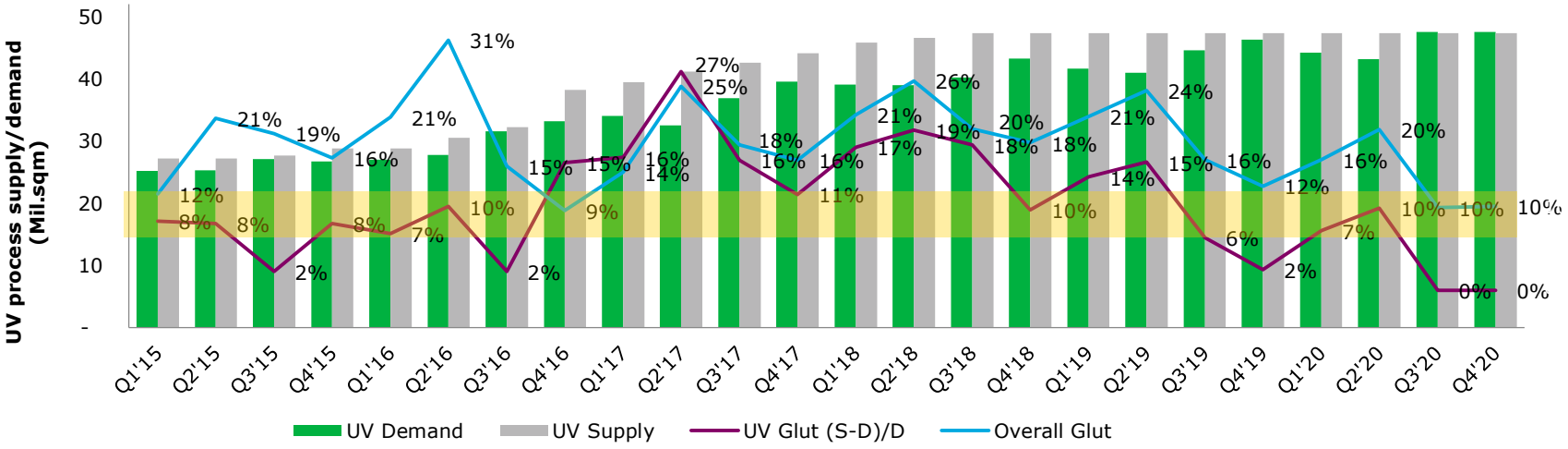


Source : IHS Report 'Display Optical film market tracker'

Imbalanced Supply/Demand of polarizer-by UV lines







Source : IHS Report 'Display Optical film market tracker'

Display Driver IC

Cost reduction - TRD, DRD, GOA

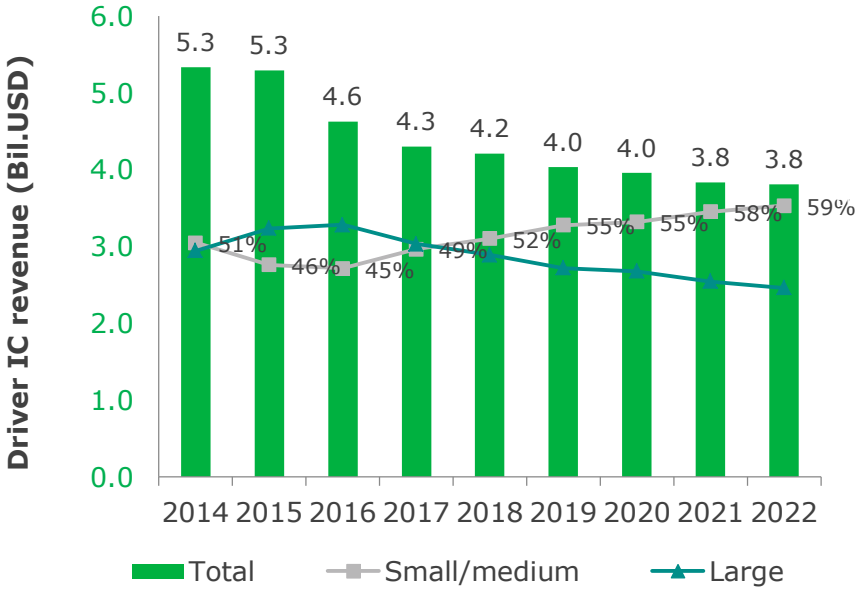
High resolution – Heat problem from DDIC

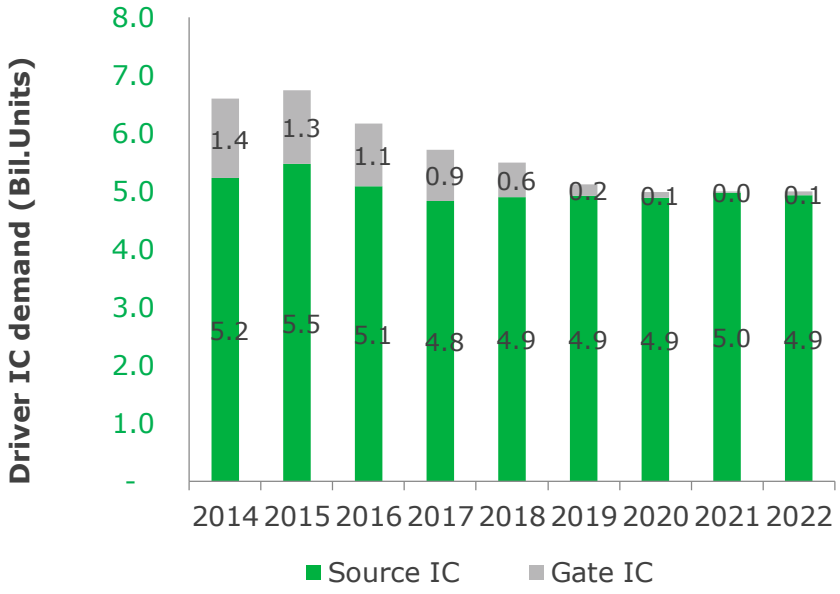
Changes in bonding technology

System on Film

Driver IC market forecast

- DRD and TRD will have a negative impact on the driver IC demand forecast, even though 4K products will grow
- Gate driver IC is expected to fall due to the increase in share of GOA.
- Almost small/medium panels use a single chip for driving.

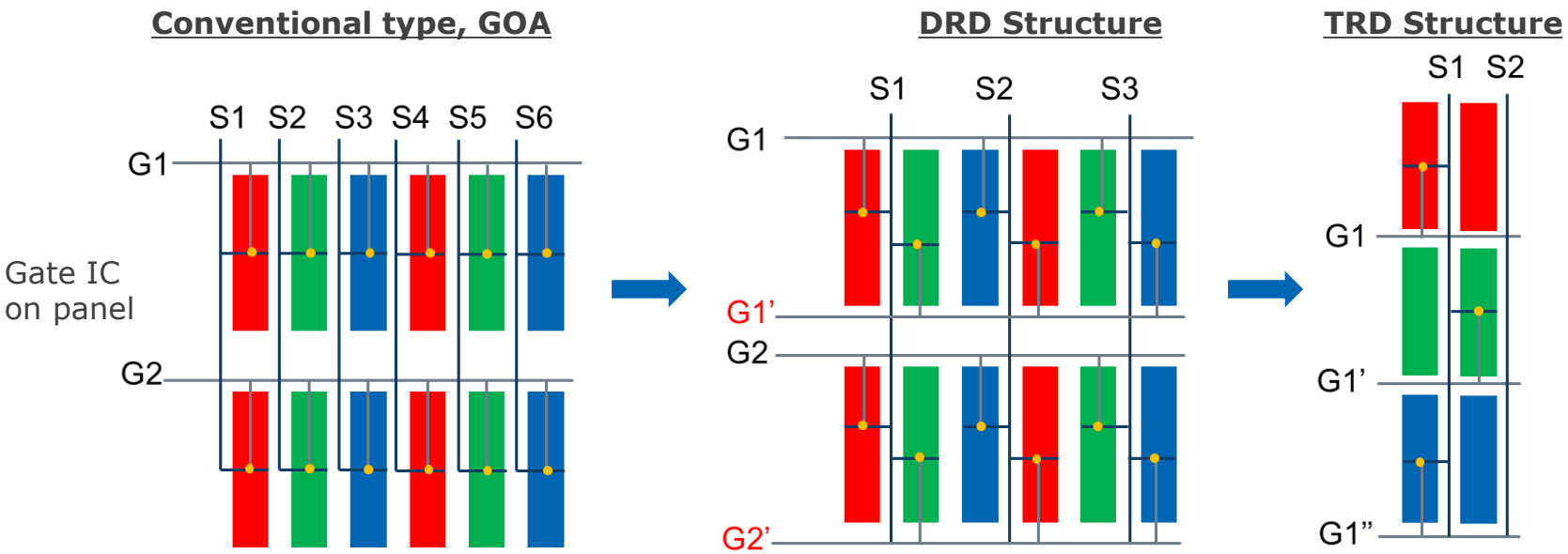




Source : IHS Report 'Display Driver IC market tracker'

GOA double rate/tri rate driving structure

- DRD: One s-channel accepts two signal of g-channel. (S-ICs → 1/2)
- TRD: One s-channel gets to control three sub pixels at the same time. (S-ICs → 1/3)
- GOA is necessary for DRD or TRD due to DRD/TRD asks large number of Gate ICs.



Source : IHS Report 'Display Driver IC market tracker'

Cost reduction of DDIC

- DRD + GOA and TRD + GOA are good ways to reduce costs. Panel makers are aggressively applying DRD + GOA and TRD + GOA for 2016 TV models.
- Chinese VA panel makers have an interest on TRD, so they are focusing on Samsung's TRD products.

Cost reduction of DDIC

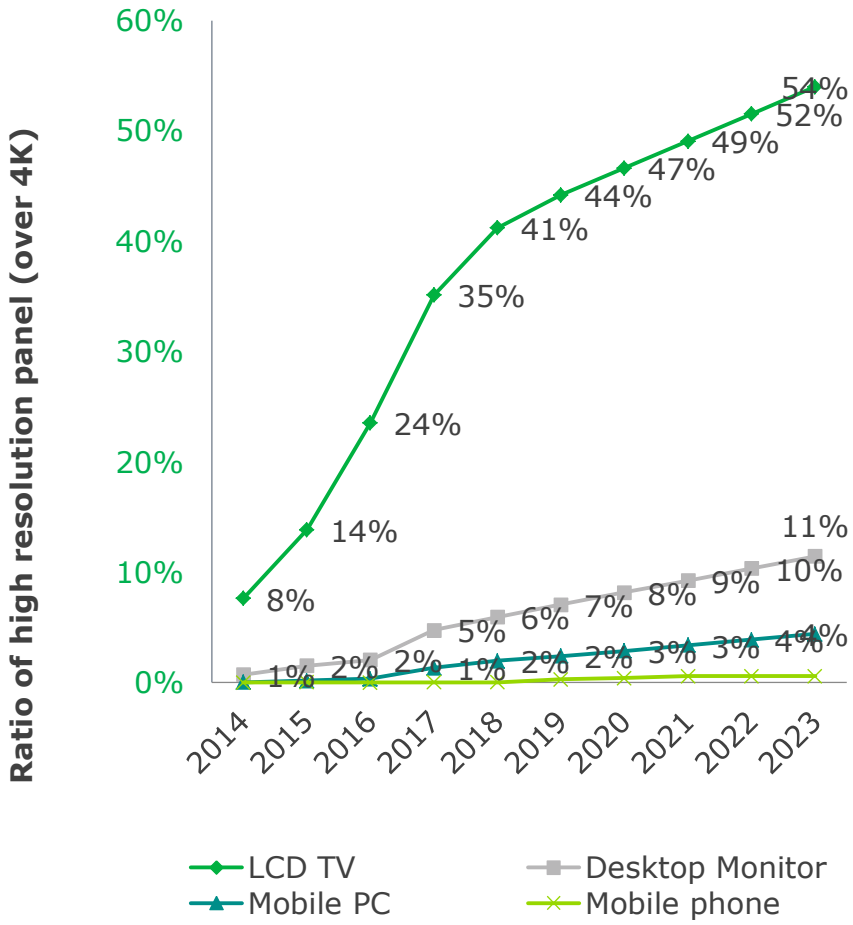
Resolution	Source pin	Conventional	GOA	GOA+DRD	GOA_TRD
HD 1366 x 768	720	6 + 2 = 8	6 + 0 = 6	4 + 0 = 4	2 + 0 = 2
	1440	3 + 2 = 5	3 + 0 = 3	2 + 0 = 2	1 + 0 = 1
FHD 1920 x 1080	960	6 + 2 = 8	6 + 0 = 6	4 + 0 = 4	2 + 0 = 2
4K 3840 X 2160	960	12 + 4 = 16	12 + 0 = 12	8 + 0 = 8	4 + 0 = 4
8K 7680 X 4320	960	24 + 8 = 32	24 + 0 = 24	16 + 0 = 16	8 + 0 = 8

The driver IC interfaces are based on faster standards such as USI-T and EPI.
Source: IHS

Source : IHS Report 'Display Driver IC market tracker'

4K Driver IC trends

- Demand for 4K panels will increase across many applications. Demand for driver ICs will increase accordingly.
- 4K TV demand is growing rapidly and will become a major panel application in 2017.
- Panel makers want to reduce the number of driver ICs necessary for a 4K panel. And it can cause the heat problem from driver IC. Solving the heat problem may be critical success factors.

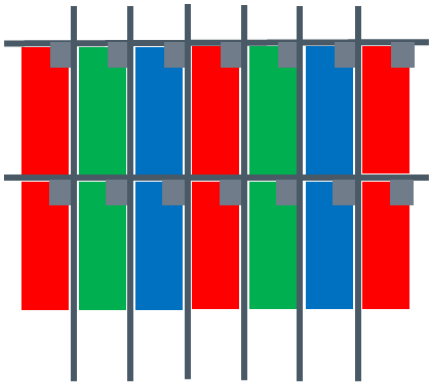


Source : IHS Report 'Display long-term demand forecast tracker'

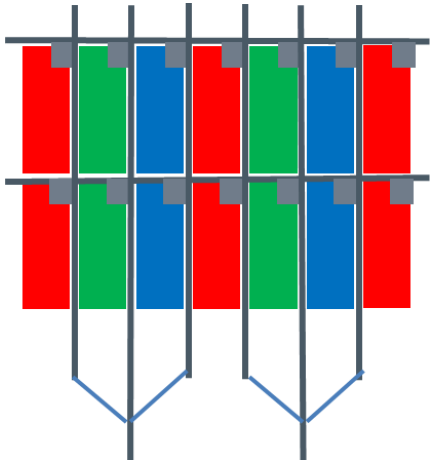
Driver IC for LTPS Notebook PC

- Driver IC for LTPS Notebook PC is as same as Smartphone Driver IC. Usually LTPS Driver IC one source channel supports RGB 3 colors. Some makers are trying 6 split driving for LTPS Driver IC.
- a-Si 4K NotePC panel needs 960channels 12 source Driver IC. 6 split driving of LTPS requires only 2 chips. (12*0.8 = 9.6$ vs. 2*1.8 = 3.6$)

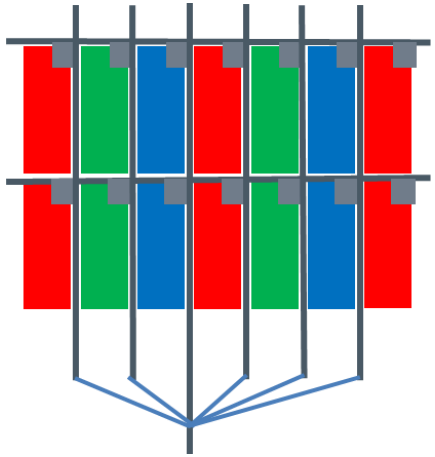
a-Si Structure



Normal LTPS Structure



LTPS 6 Split Structure



Source : IHS Report 'Display Driver IC market tracker'

Issues concerning heat problem from DDIC

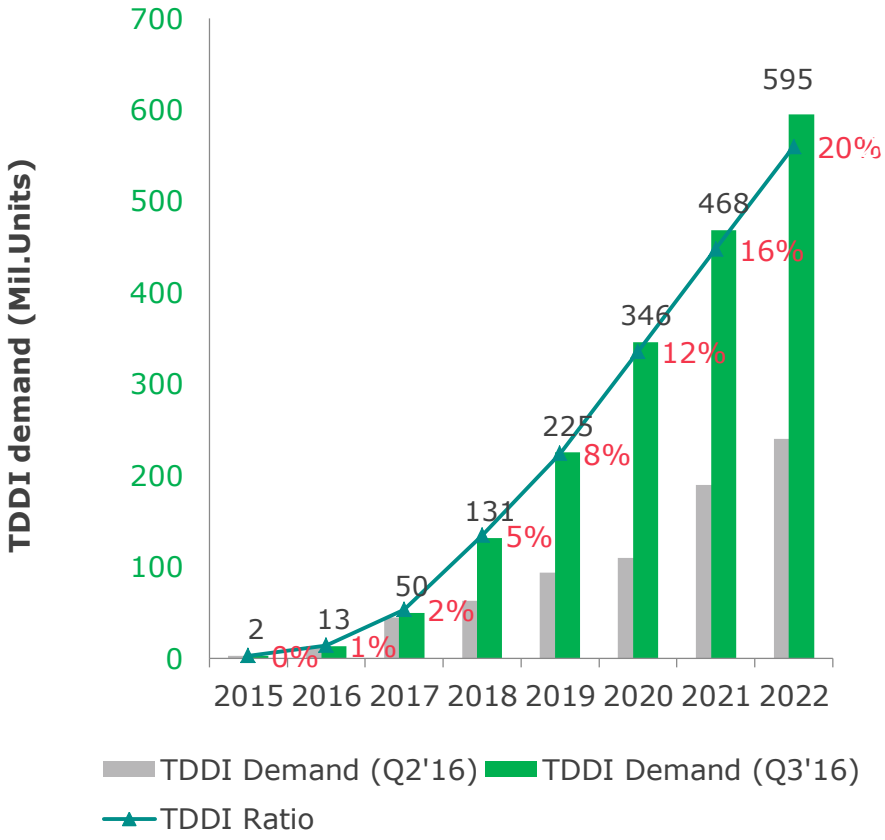
- CPU → Timing controller → Driver IC

Proposed solution		
	Part	Solution
Driver IC package	Special resin	• Special resin to absorb the heat is applied to the part of Driver IC after mounting DDIC on COF
COF	Structural modification	• To raise the thickness of Cu layer of COF can give DDIC package some space to emit the heat from Driver IC. • Adoption of long COF can help to emit the heat from Driver IC through it's long body.
	Ultra low temperature COF	• Add layers like Al and Cu which has the heat sink function onto COF
The heat sink film		• Very simple and effective, but expensive solution, some very large and expensive products for special usage like PID are adopting graphite sheet as role of the heat sink

Source: IHS

Touch embedded driver IC and TDDI

- Synaptics, FocalTech, and Novatek are TDDI chip vendors.
- Synaptics was the only supplier until Q2’16, “One package two chips” has been generally used.
- As of Q3’16, Single chip solution was introduced, and panel makers started to apply it aggressively.
- Accordingly, IHS has increased TDDI forecast as compared to Q2’16.



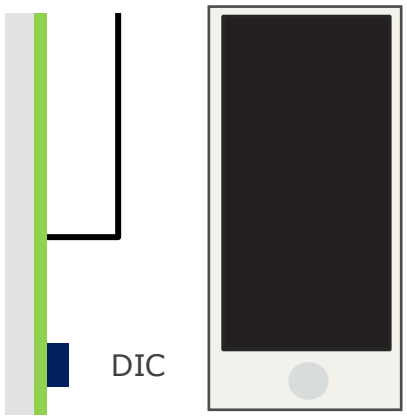
Source : IHS Report ‘Display Driver IC market tracker’

Changes in bonding solution - Mobile phone

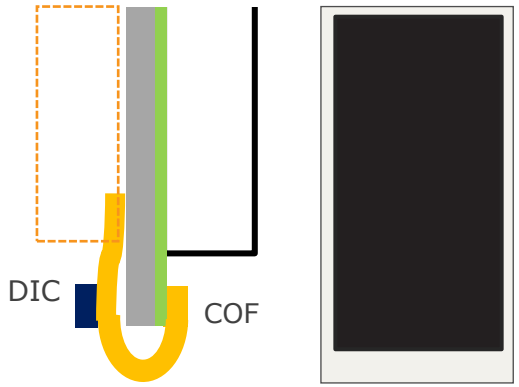
Bonding technology of panel and DDIC		
	COG	COF /COP
Merit	• Able to connect DDIC to the panel glass without extra linking components • Super slim light	• Chips and modules can be miniaturized • Able to folded and bended by the film's flexibility
Demerit	Requires sufficient space to place DDIC	• Increase in cost due to extra film • Limitation on resolution

Source: IHS

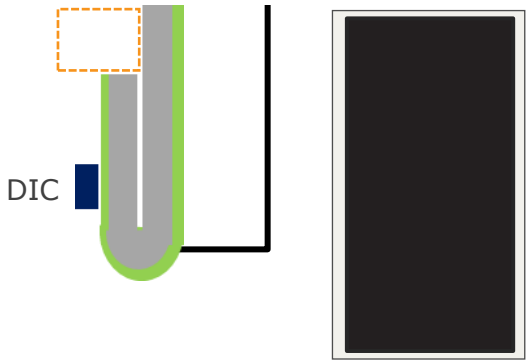
[Side view and bezel type by bonding technology]



Conventional bezel

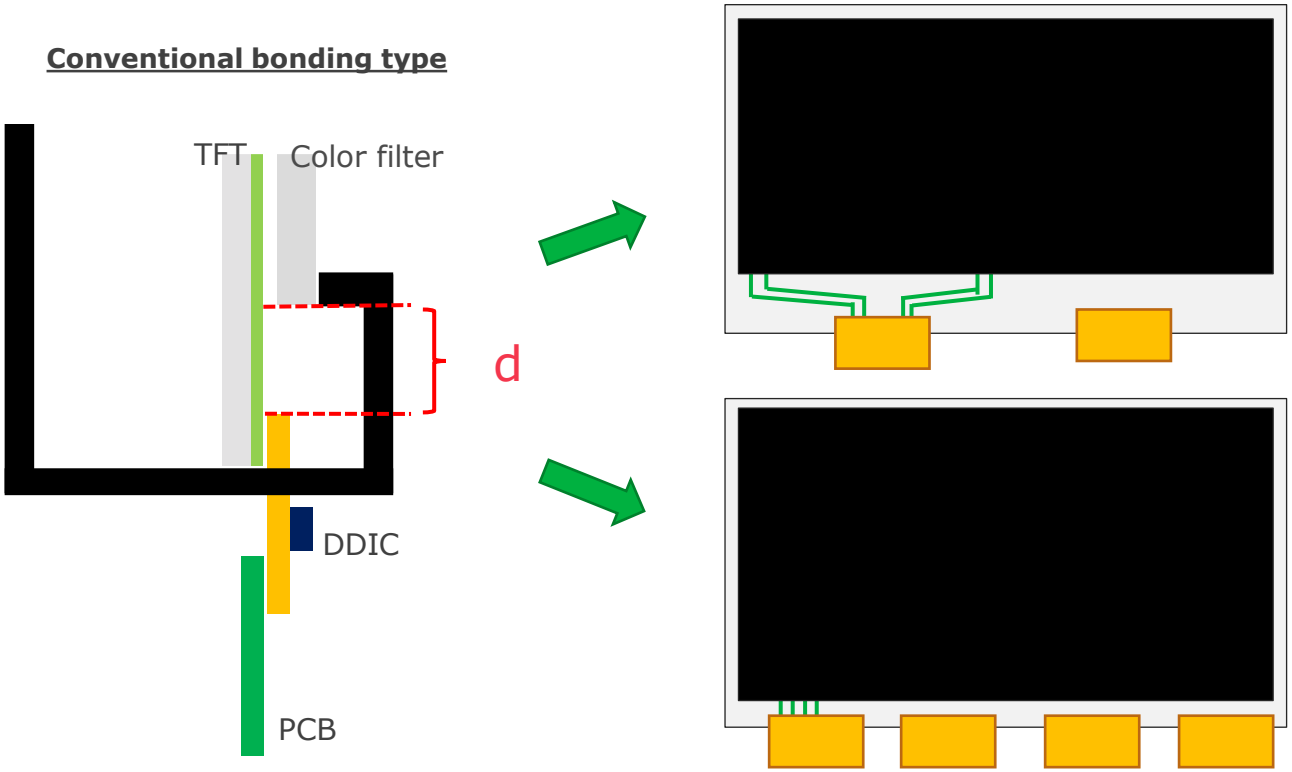


Slim bezel



Like bezel-less

Changes in bonding solution - TV



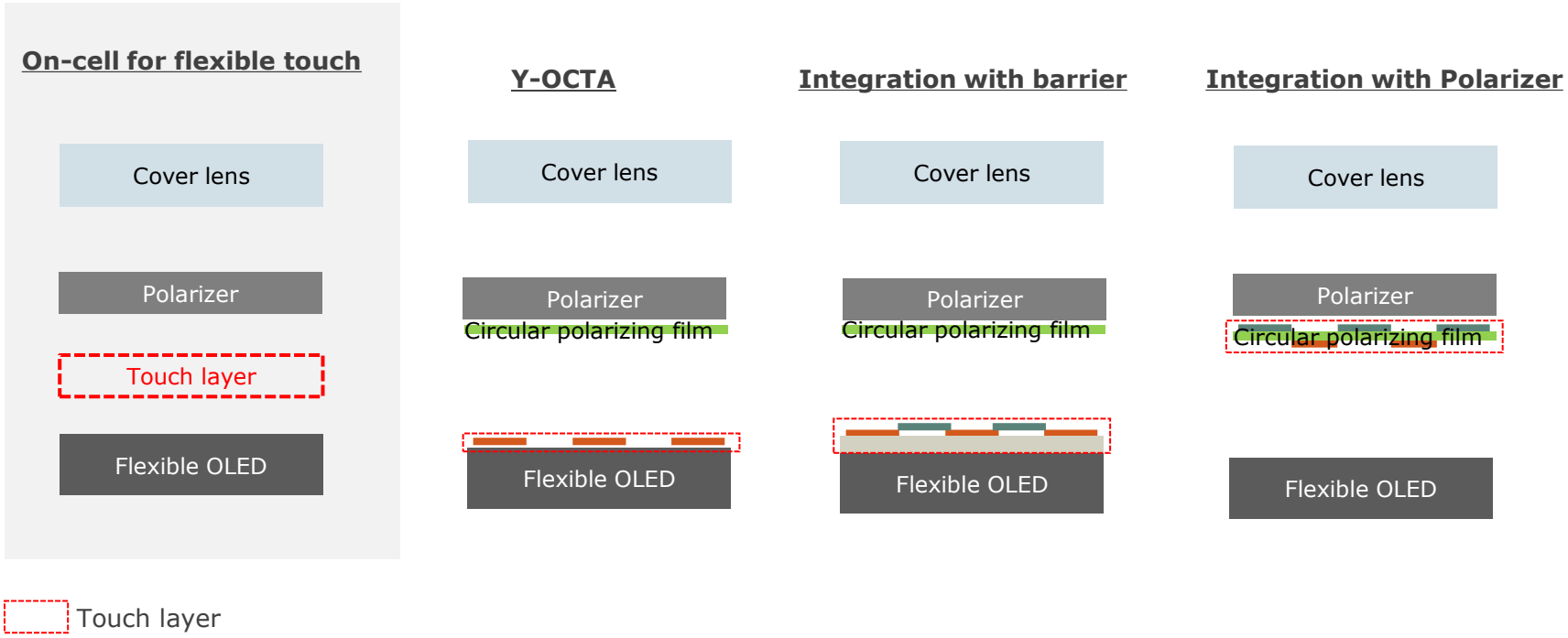
Flexible OLED components trend

Polarizer

Touch sensor

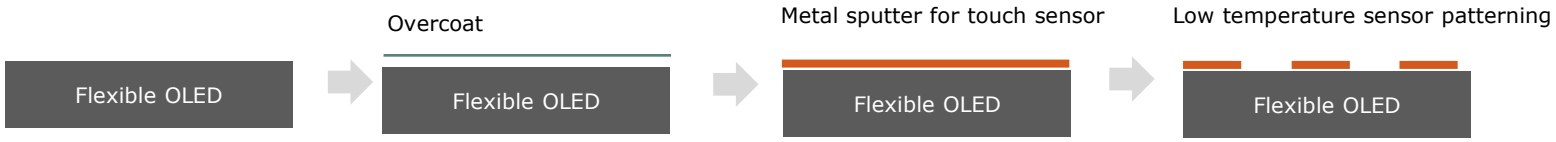
Three types of On-cell for flexible touch

- Current development trends are based on the on-cell for flexible type, but they can be further categorized into three types by manufacturing process

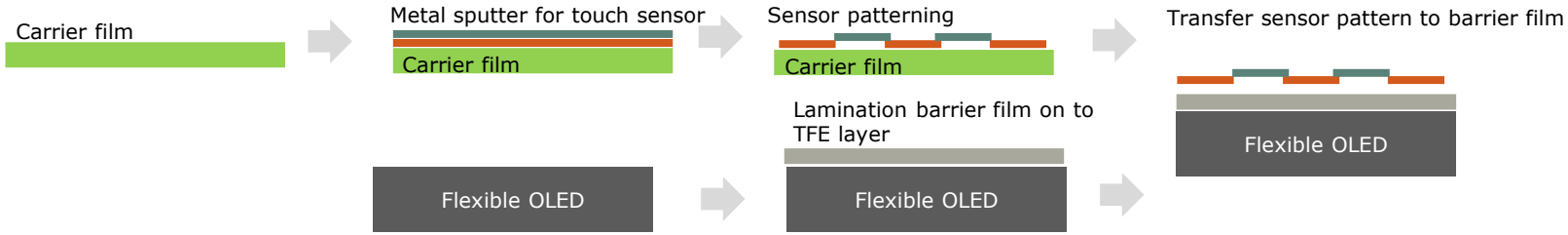


Process comparison between "Y-OCTA" and "Integration with barrier film"

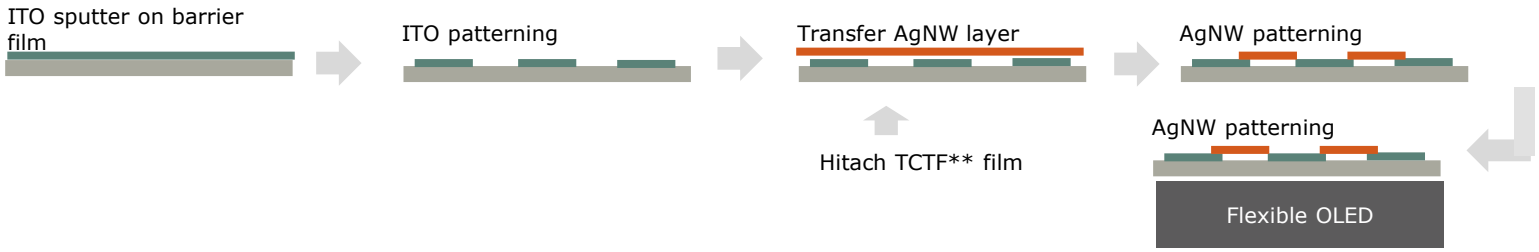
Y-OCTA



Integration with barrier film, Transfer method

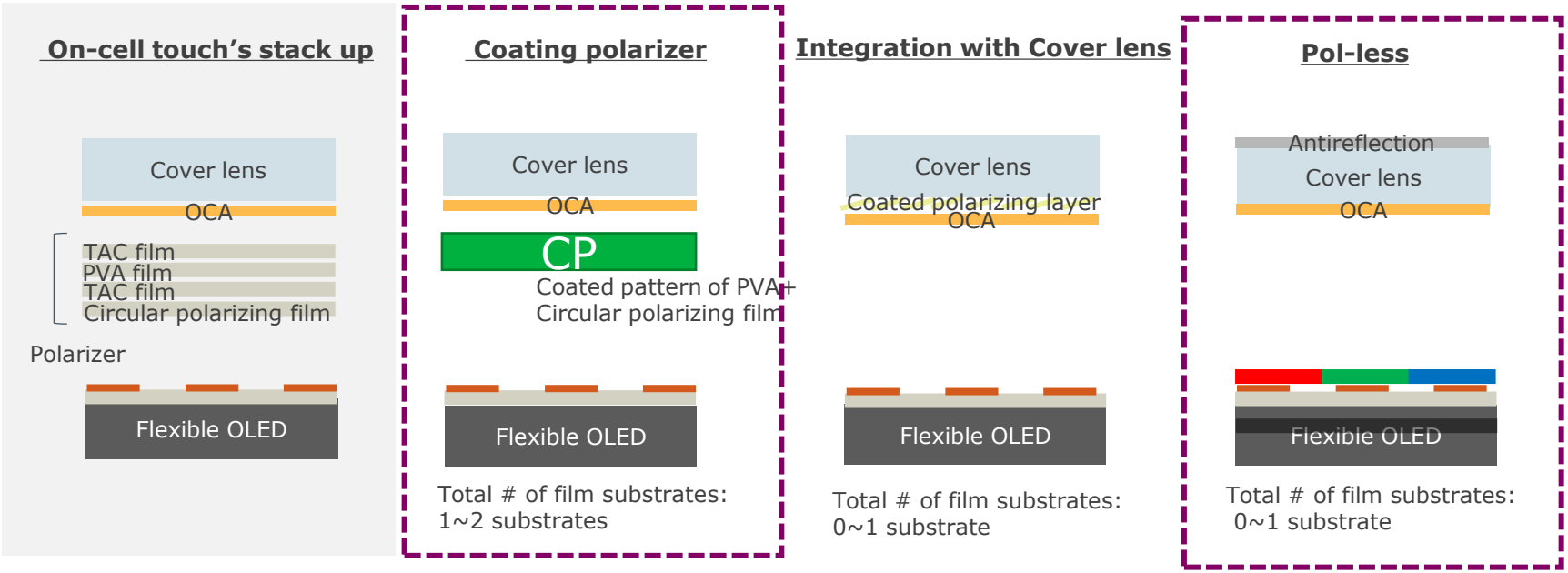


Integration with barrier film, TCTF solution



For ideal flexible OLED solution

- Reducing the number of substrates used in OLED module is one of the most important factor for flexible display



Thank you for your attentions

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