Sputtering Equipment G8 Business for IT Market

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Leading the World
In Vacuum Technology

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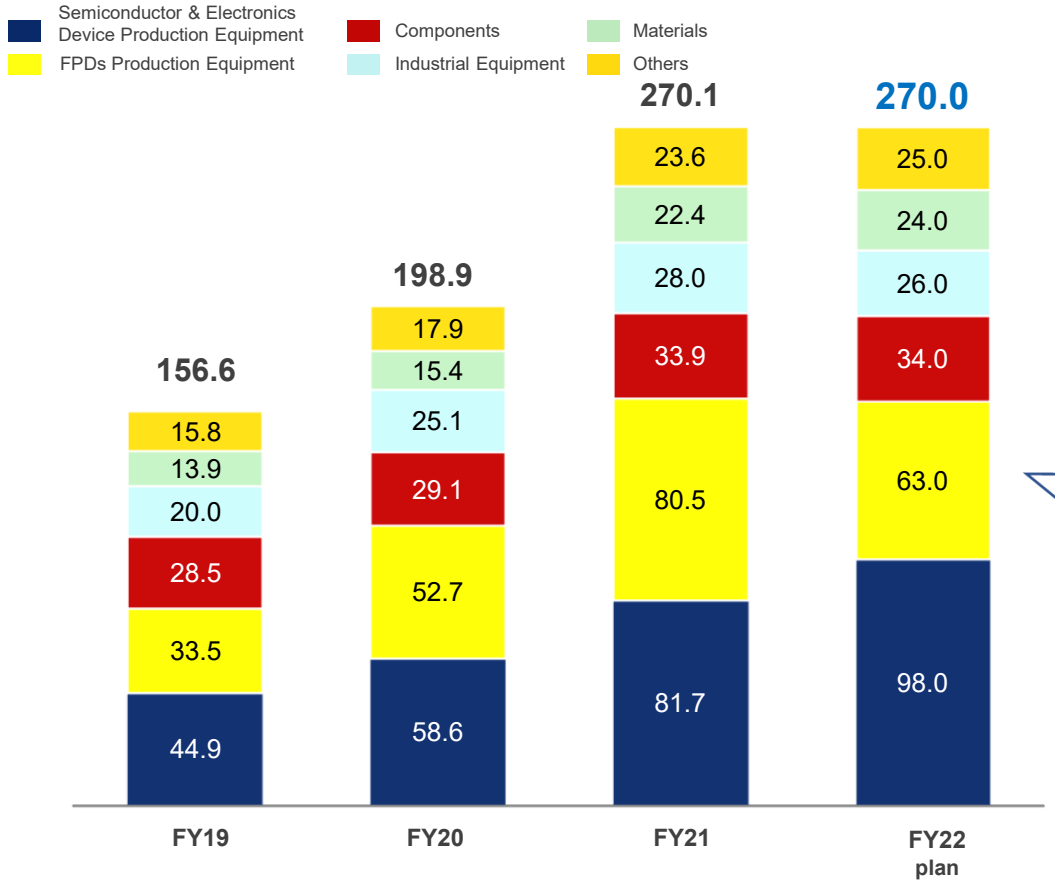
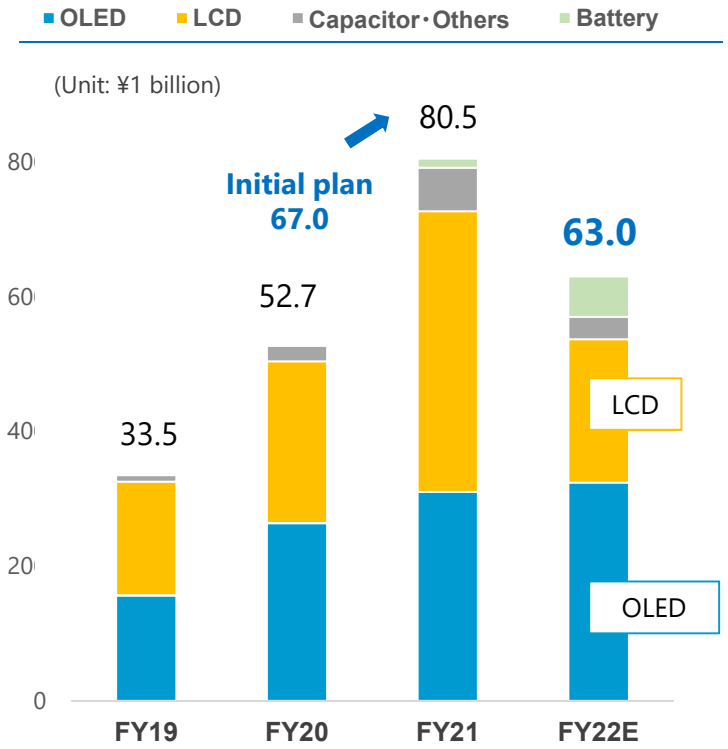
Orders received plan

- **FPD: Decrease in reaction to the strong investment in LCD for IT panels in FY2009 ⇒Expect orders and sales of 70~80 billion yen in OLED investment for IT panels (sputtering equipment) and roll-to-roll equipment for batteries in FY2023 and beyond**
- **Semiconductor Electronics: Growth mainly in power semiconductors, etc. in China**

Orders received (Unit: ¥1 billion)



FPD Order Plan



Summary

- **Why IT OLED?**

  OLEDs for IT panels (IT OLEDs) such as tablets and notebook PCs, which are difficult to mass-produce with existing FPD equipment, are expected to grow significantly as a new category in the future.

  - Investment for IT panels, such as tablets and notebook PCs, is expected to expand and become the main panels for IT usages in the future.
  - OLED (Organic Light Emitting Diode) will become the mainstream for IT panels, and major manufacturers are planing to invest in G8 capex

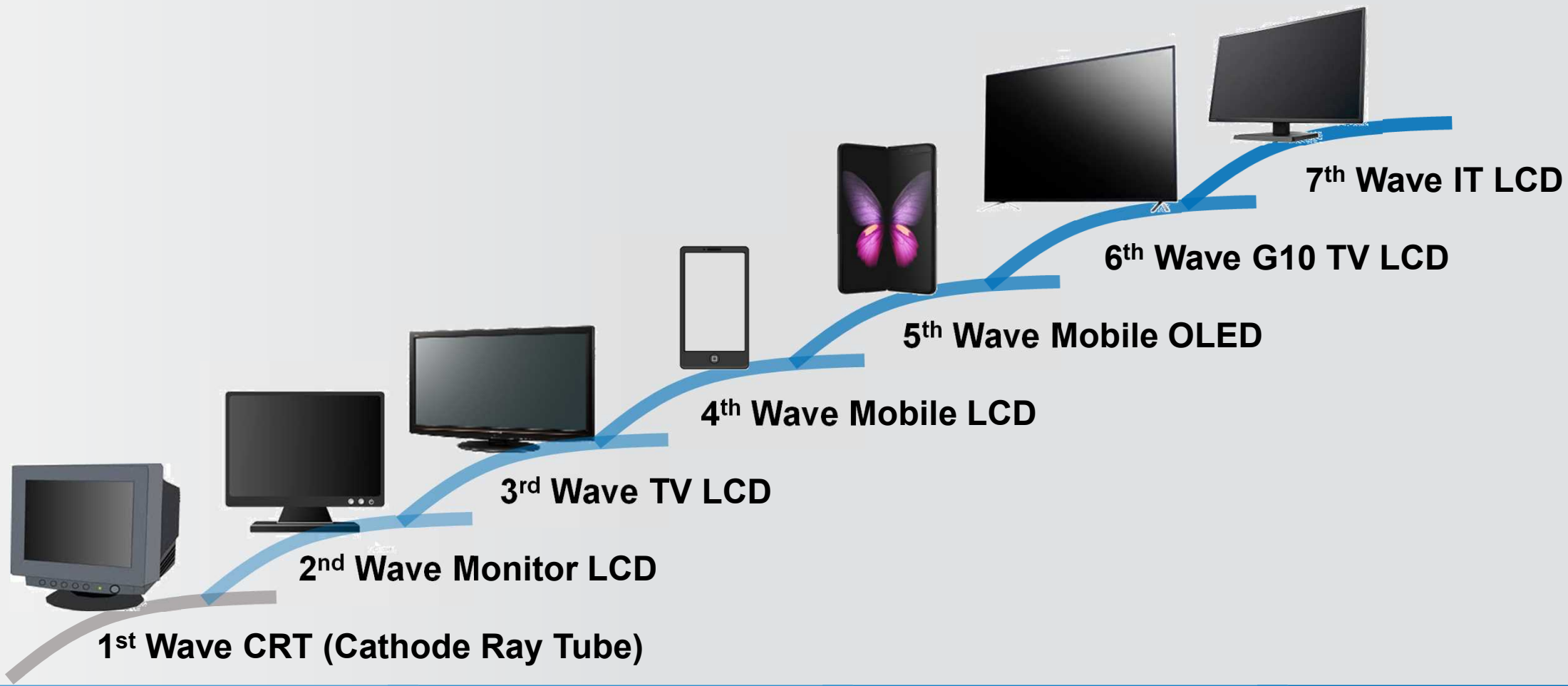
- **Why ULVAC?** :

  ULVAC is a manufacturer that can meet technical challenges through low particle sputter deposition technology and low temperature deposition technology

  - High production efficiency and low cost (8th generation OLED facility)
  - High definition and high purity (low particle sputter deposition technology)
  - Thinner and Lighter (low-temperature deposition technology)

In today's IR seminar, we would like to introduce ULVAC's breakthrough technologies.

Display Market Trends



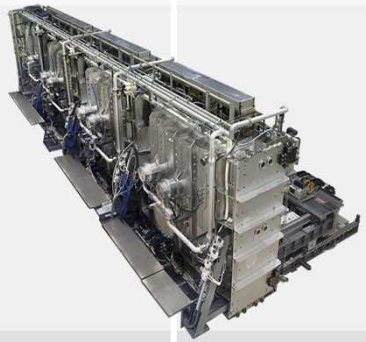
History of Sputtering Equipment for Display Production

1980 | 1990 | 2000 | 2010 | 2020

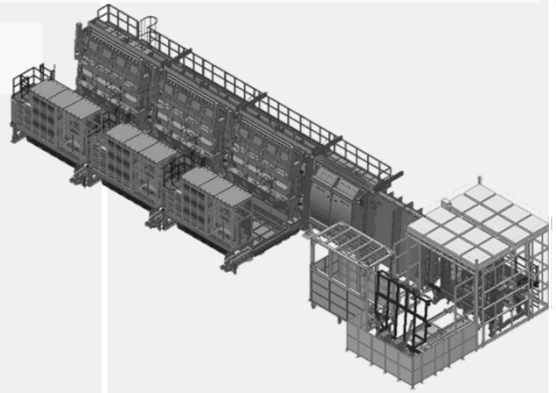
Vertical

For TV

- **2005- SMD-2400 (G8)**



- **2016- SMD-3400(G10)**



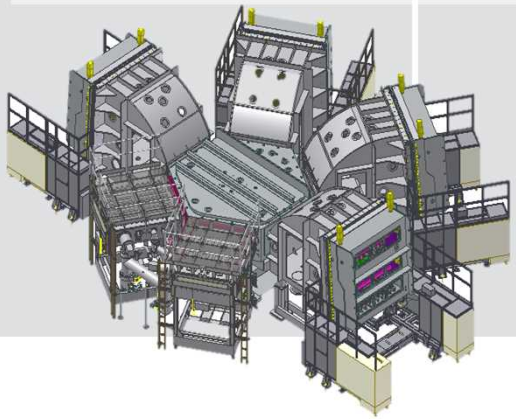
Multi chamber

SMD Series Since 1980's

- **1992- SMD-450 (G2)**

For Mobile

- **2011- SMD-1800 (G6)**



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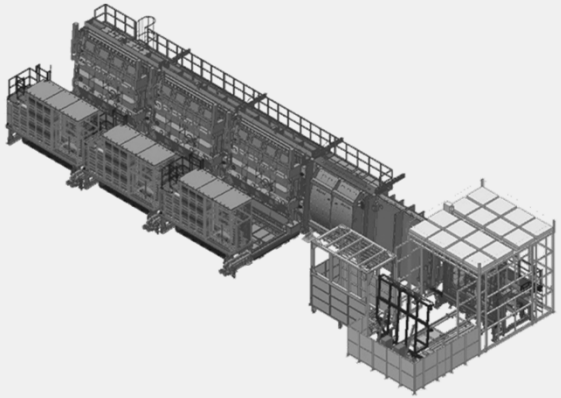
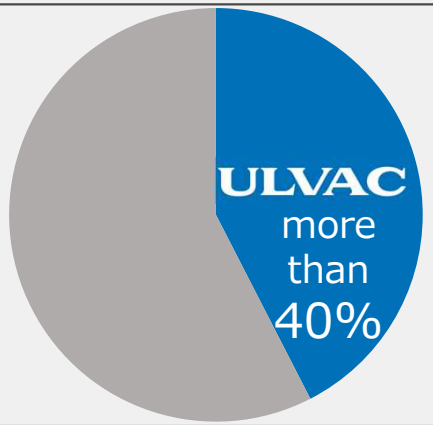
Share of Sputtering Equipment for Display Production

Vertical

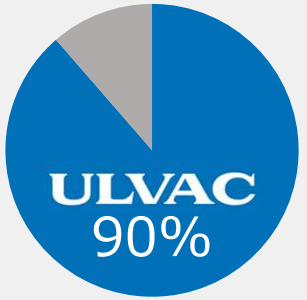
For TV



2019-2022 (TV market)

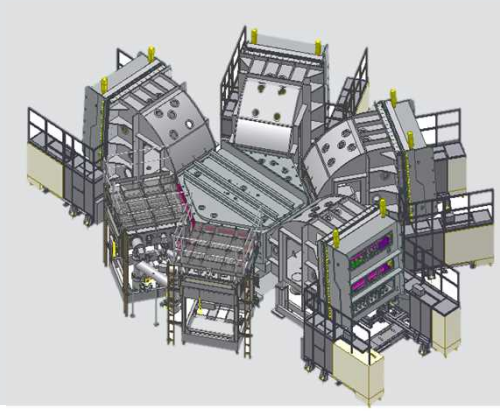


G10 Share

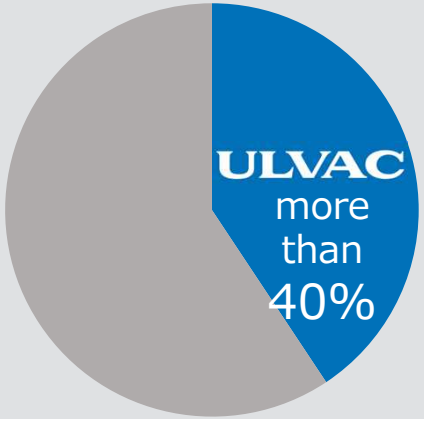


Multi chamber

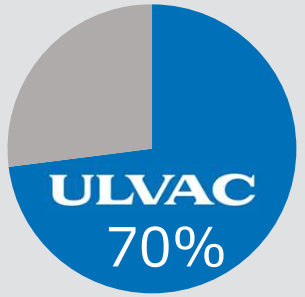
For Mobile



2019-2022 (Mobile market)



G6 OLED Share



Data source: DSCC, arranged by ULVAC

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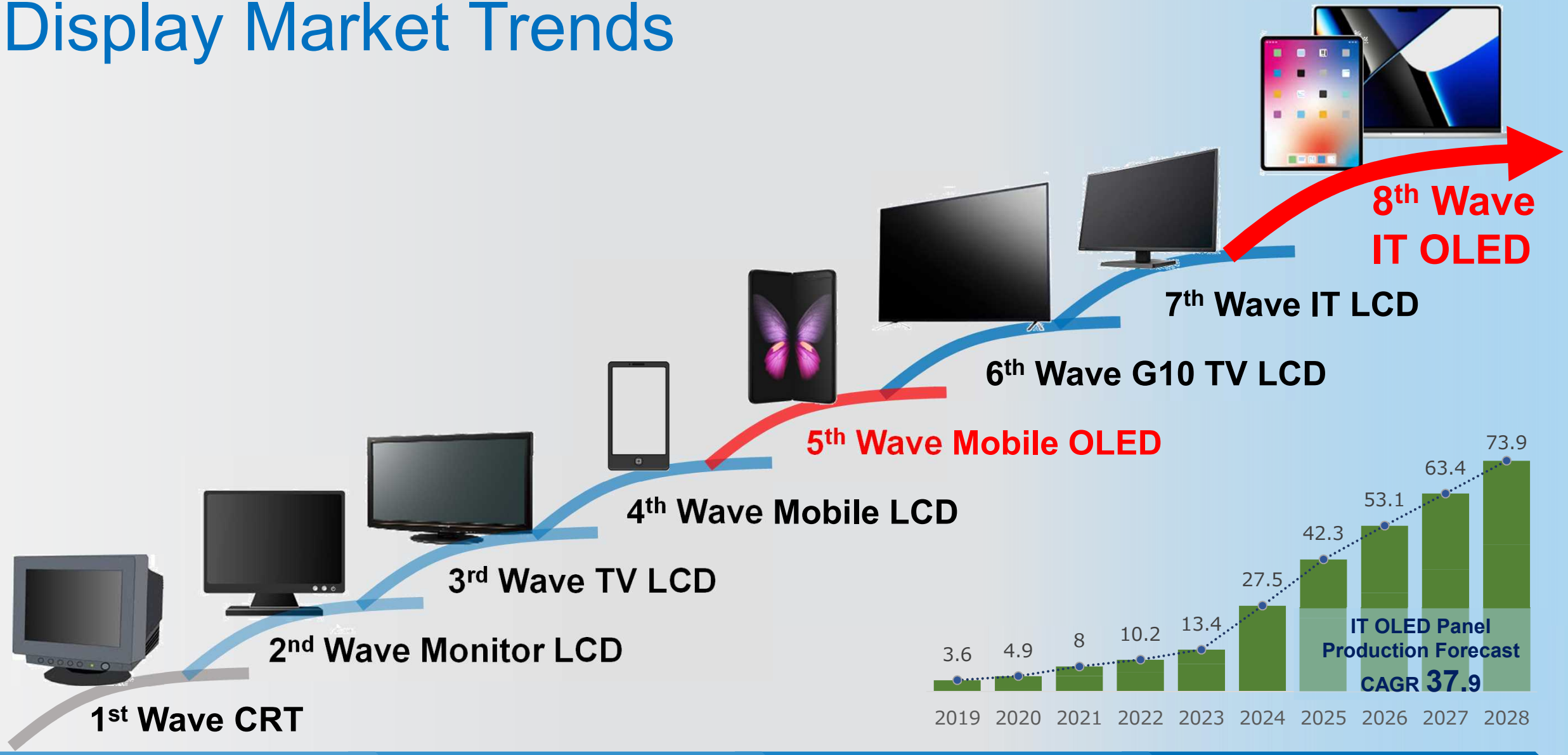
Display Market Trends



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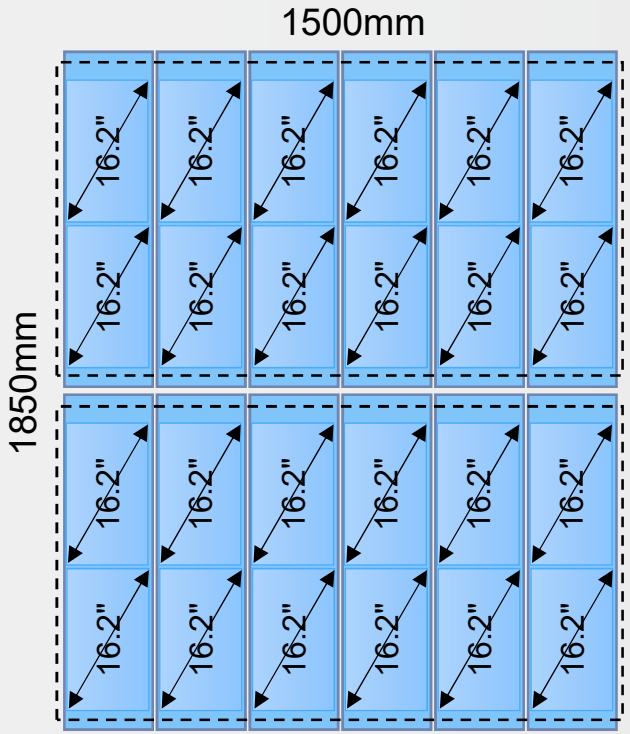
IT OLED G8.6 Requirement

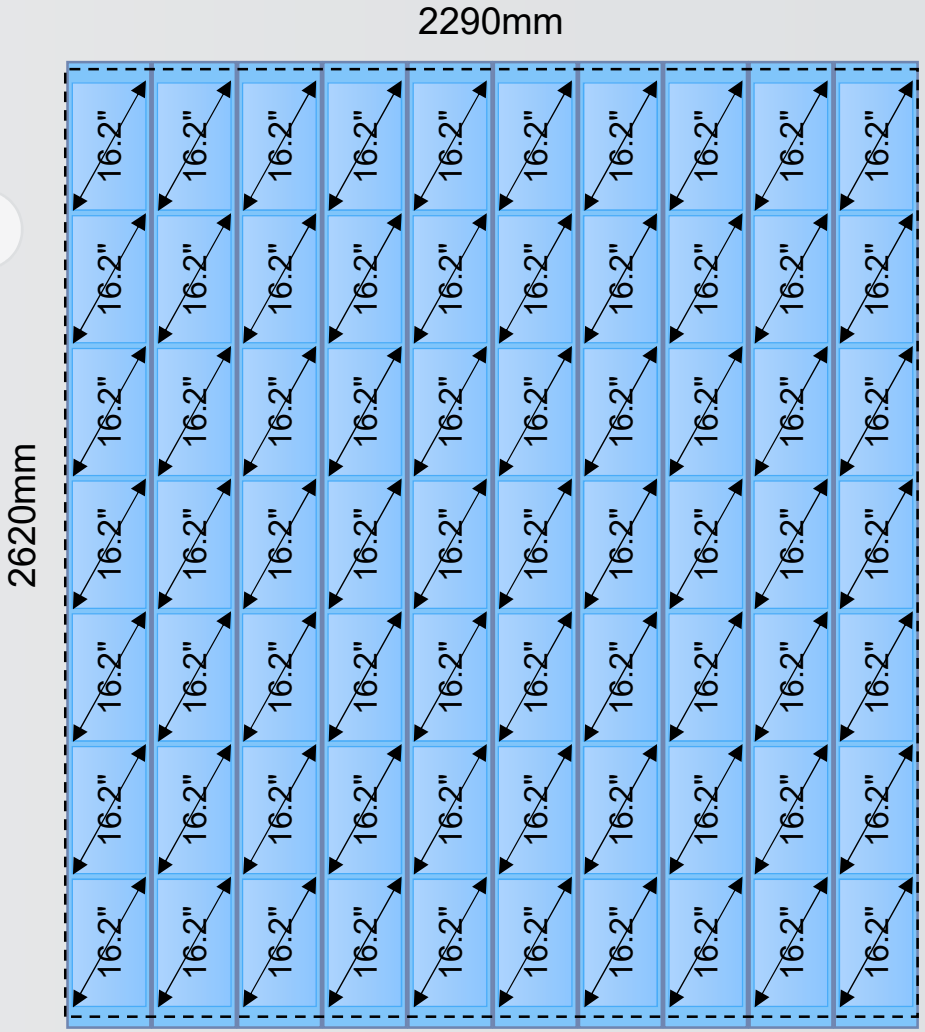
Gen 6 half cut



Total 24 pieces of 16.2" OLED at Gen 6 half cut

Glass cutting ratio: 67%

Gen 8.6 full cut



Total 70 pieces of 16.2" OLED at Gen 8.6 full cut

Glass cutting ratio: 90%

Productivity increased significantly (67% to 90%)

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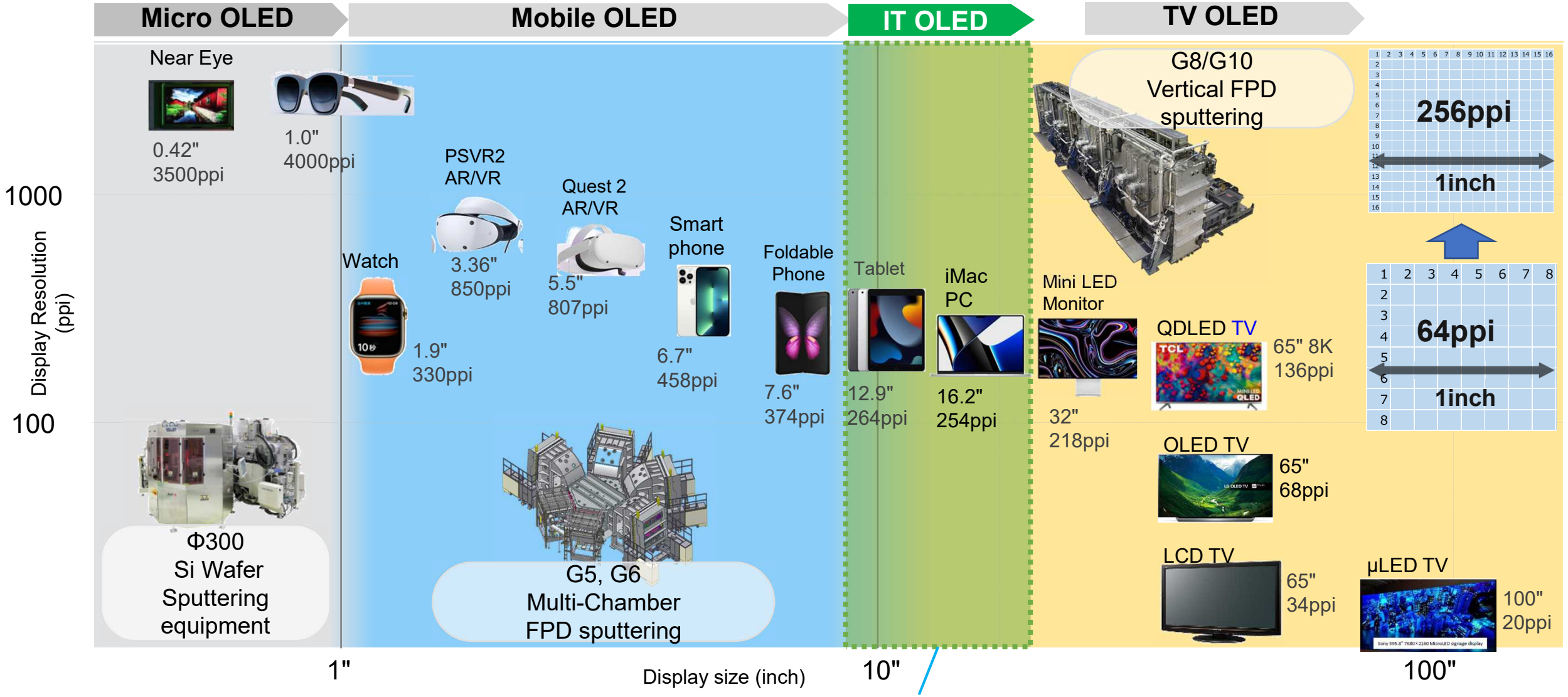
Segmentation of Sputtering Equipment for OLEDs



Currently no G8 sputtering equipment compatible with IT OLEDs

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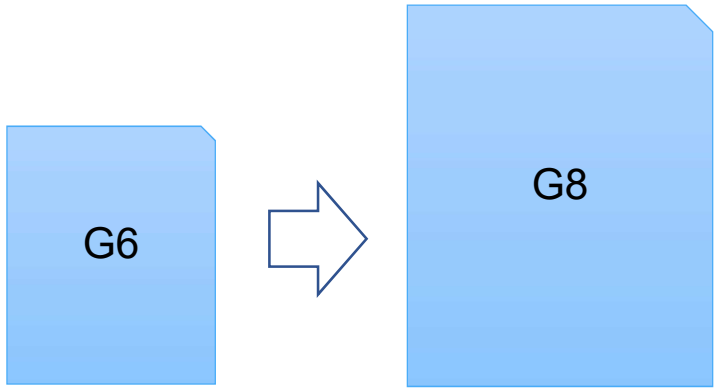
Technical requirements for IT OLEDs sputtering equipment

(1) Low-particle deposition for High definition and large size



(2) Low-temperature deposition for touch sensor

Developing a new concept of sputtering equipment to solve these issues

IT OLED Sputtering Technology Requirement

(1) For high definition and large size

To get the same wiring width as Mobile

Low Particle is required

	Mobile	IT	TV
	 Ref:iPhone13pro	 *1	 *3
Display size	6.7 inch	≒ 11 inch	55 inch
Resolution (e.g. display, dpi)	458ppi	≈ 300ppi	4K(80ppi)
Pixel size	56μm	**85μm**	**317μm**
Electrode width (Source and Drain)	**<2μm**	**<3μm**	<8μm
Film Deposition Equipment	**G6**	**G8** *2	**>G8**

*1 Ref:https://news.lgdisplay.com/global/2022/05/sid2022-zone-03-the-future-of-oled/
*2 ULVAC Estimated value
*3 Ref:LGD Production Catalog

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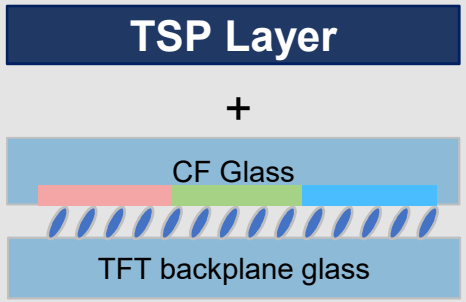
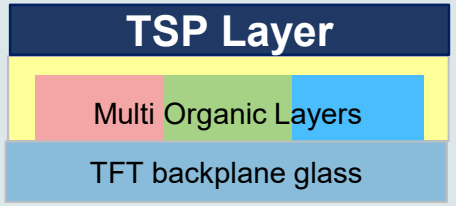
IT OLED Sputtering technology required

(2) for touch sensors

As organic materials are very sensitive to temperature,

Low temperature deposition is required

	LCD	IT OLED
		
Touch sensor method	**Add-On touch**	**On-Cell touch**
Advantages	**Purchased from TSP manufacturer for exterior**	**Thinner plate, lighter weight Highly visible Cost Reduction in TSP**
TSP Layer	**Formed on film**	**Formed on display**
Formation Method	**Adhesion**	**Direct deposition**

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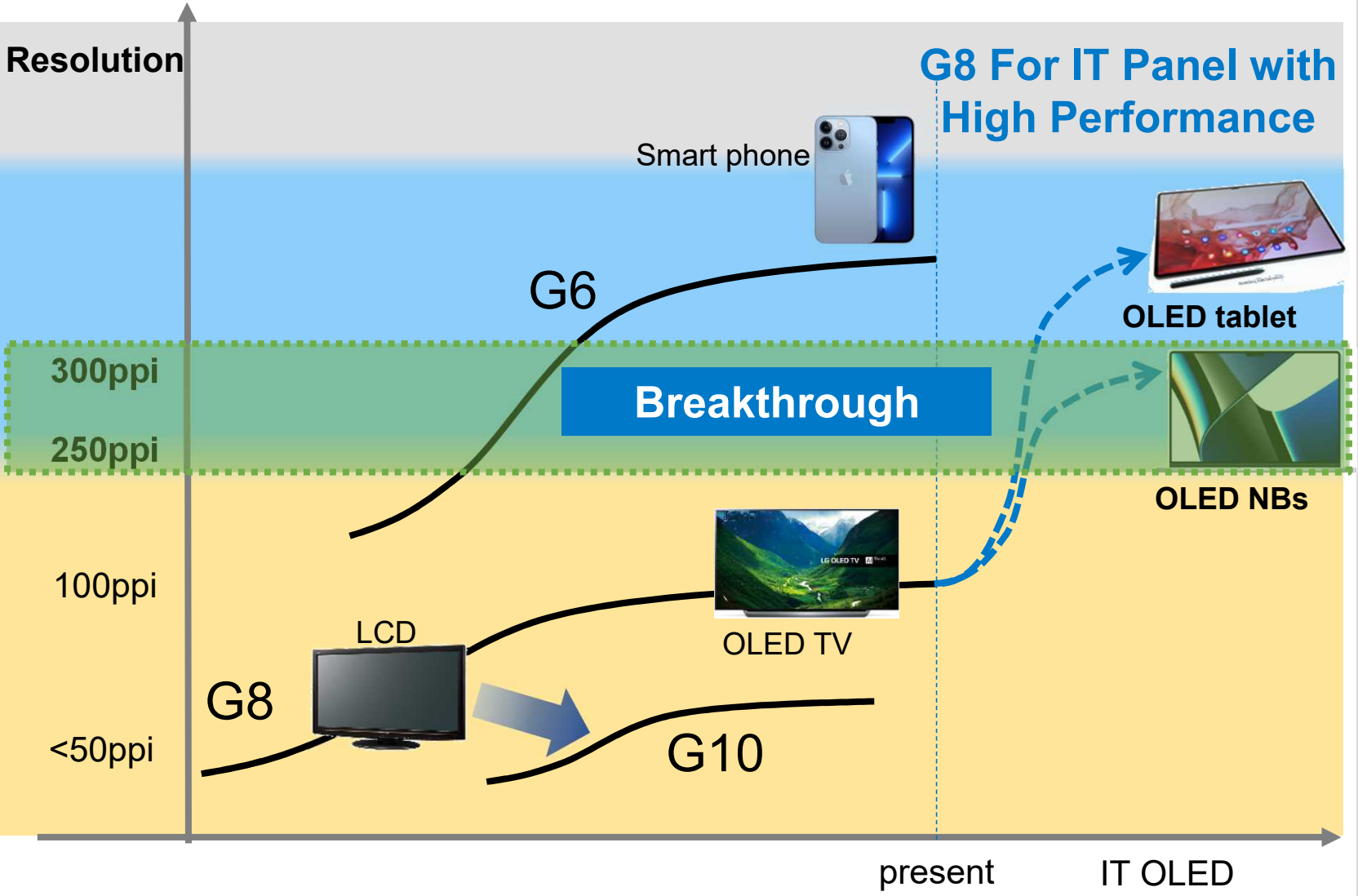
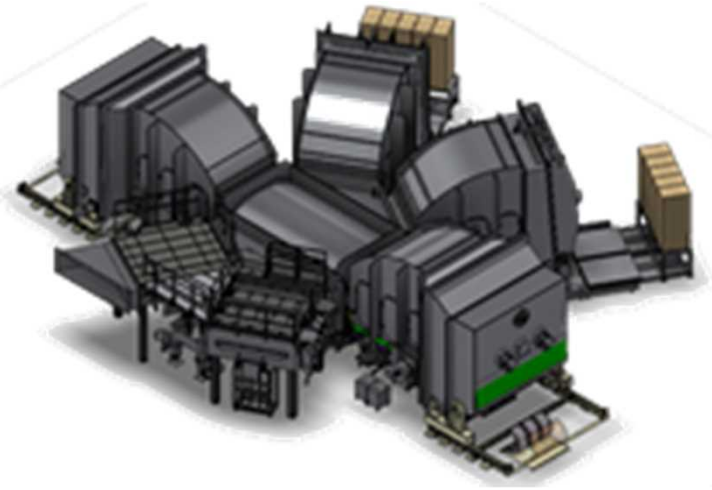
Breakthrough Technology



Breakthrough Technology

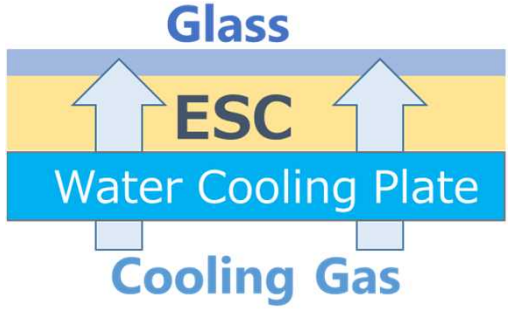
Multi-Chamber G8 new platform

① SMD-2500X



First film deposition system for FPD

②Substrate cooling technology



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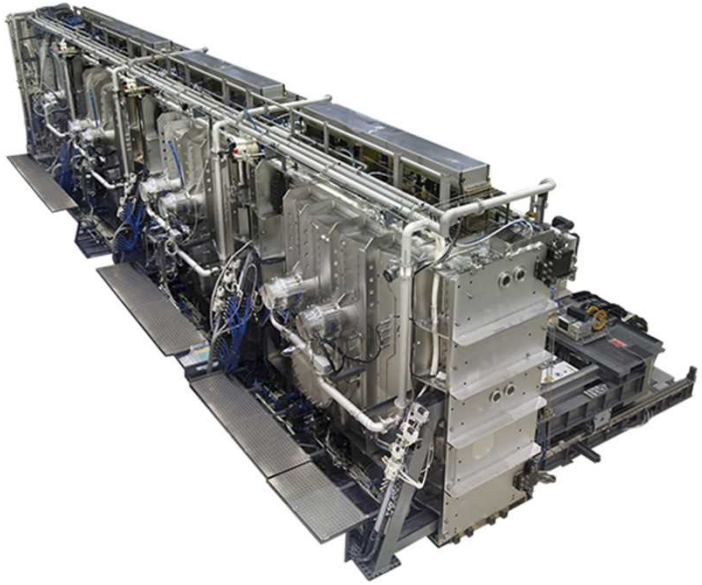
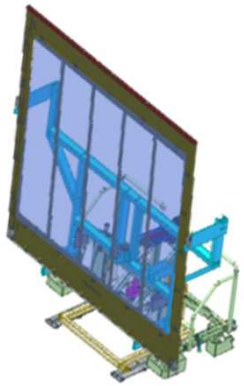
Breakthrough① Platform Vertical/Multi-chamber

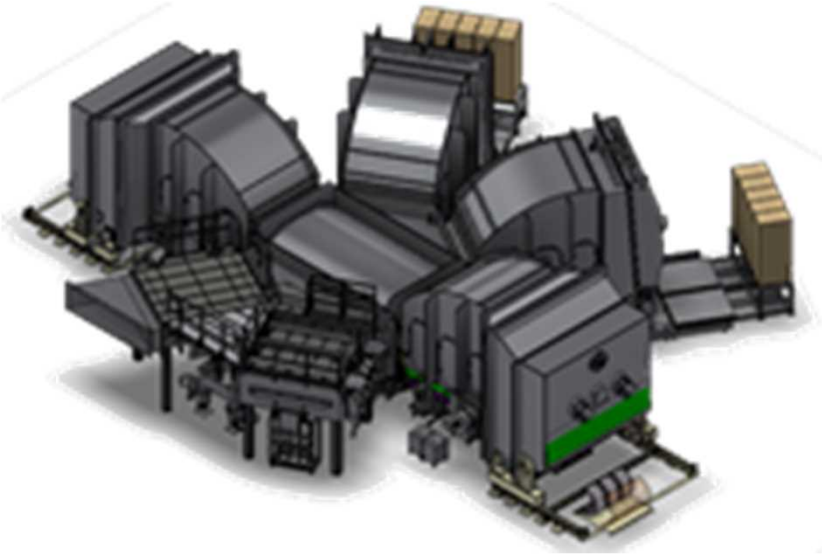
Vertical G8 to G10.5

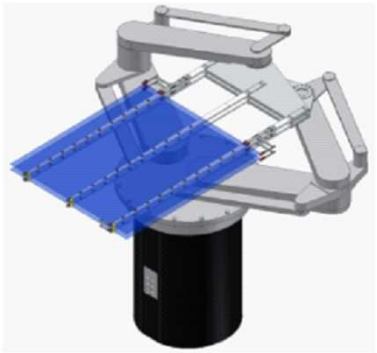




- **Placing the substrate on the tray** and the entire tray would be transported in the chamber
- **Simple structure without** any complicated mechanism in the chamber
- **Space saving, high productivity**
- Tray-derived particles occur

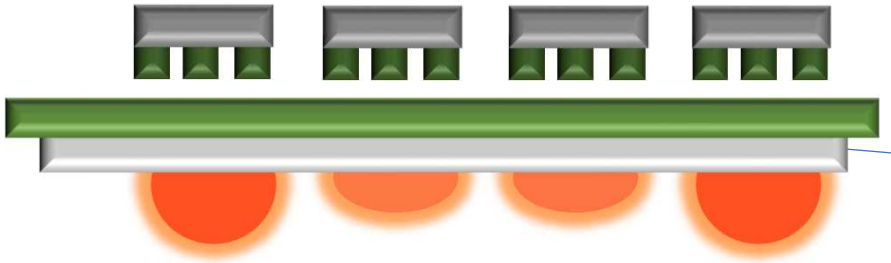
Multi-chamber type G8 **SMD-2500X**



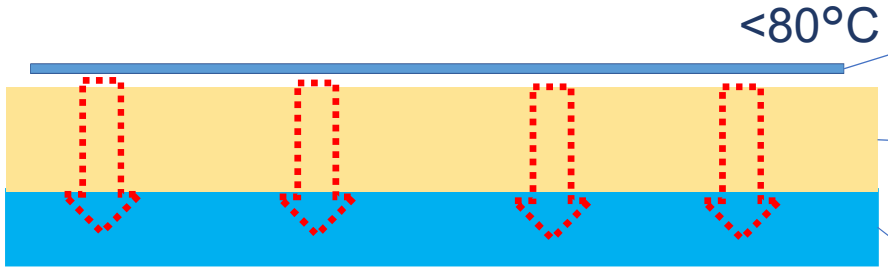


- The substrates are transported by **vacuum robot**
- **No tray-derived particles**
- The substrate is tilted during deposition in vacuum environment
- **Having substrate tilting mechanism** with **cooling function**

Breakthrough ②: Substrate Cooling Technology



Sputtering Target

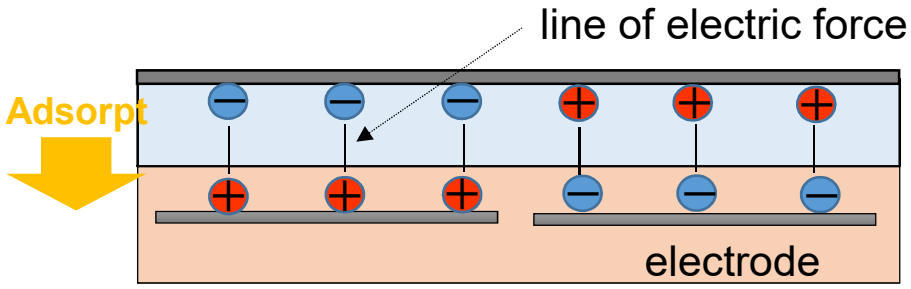


Glass substrate

ESC

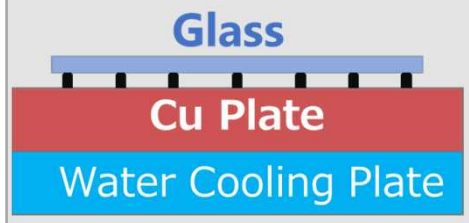
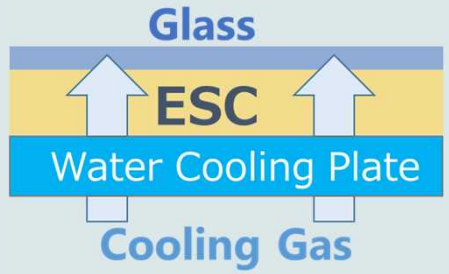
cooling plate

ESC (Electrostatic chuck)



Glass substrate

dielectric layer

	No cooling	Cooling mechanism
		
Thermal conductivity	~4 [W/m2-K].	**20** [W/m²· K]
Deposition speed <80°C	<80nm/min	300nm/min.

- **About 4 times faster compared to conventional deposition speed**

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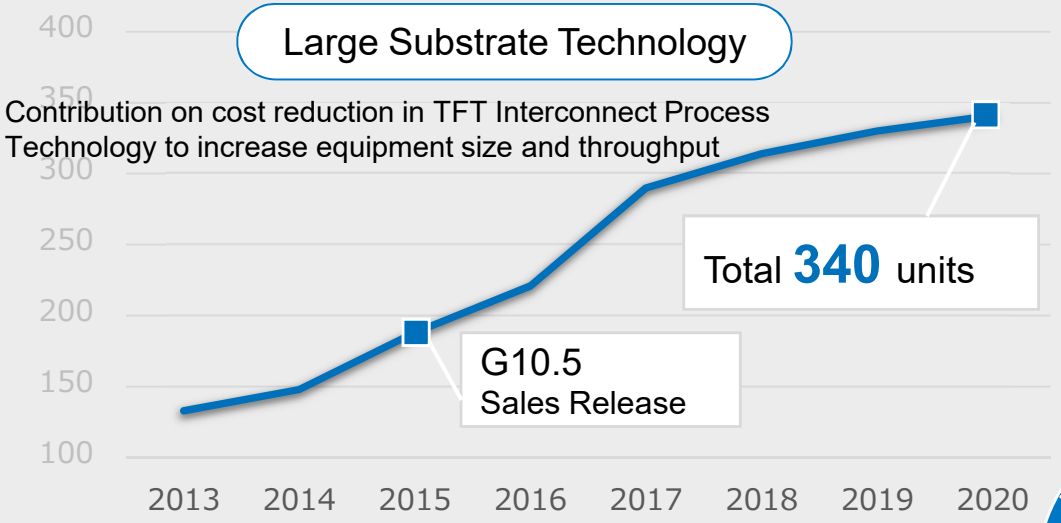
Core Technology

Large Substrate Technology

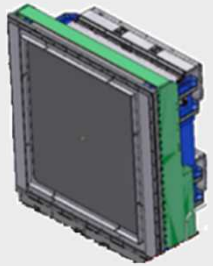
Contribution on cost reduction in TFT Interconnect Process Technology to increase equipment size and throughput



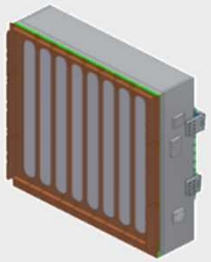
Large-size sputtering for LCD TVs

Sputter Cathode Technology

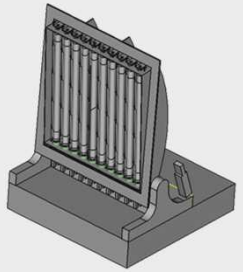
Various Cathode types are available, enabling the most suitable Cathode for the deposition process.



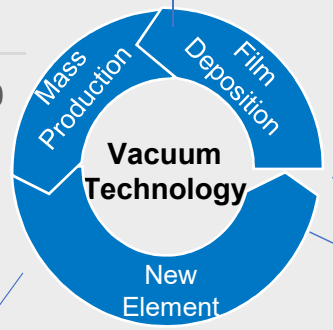
planar



Multi Planar



Multi Rotary



Low-particle Technology

Contribution on product quality and yield improvement Technology to reduce particles at a high-level during manufacturing

Magnetic levitation transfer technology

Semiconductor Technology

ESC Technology

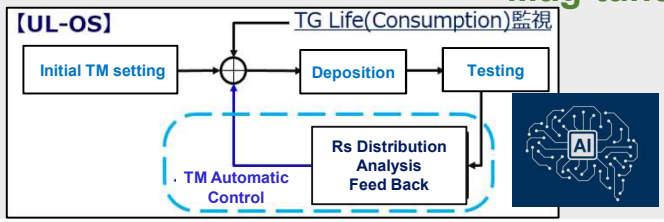
Diverse ESC experience

Substrate Cooling Technology

AI Technology

Automatic adjustment of deposition conditions using AI to achieve uniform film quality.

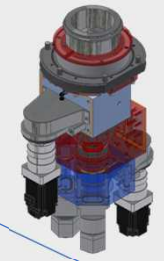
Mag-tune



Mechatronic Technology

The rotary mechanism for Rotary Cathode was developed in-house using the Mechatro technology cultivated in Pump and Robot.

Rotary Cathode



ULVAC Vacuum Technology Contributes to Many Industries and Applications

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