

---

Display industry outlook for 2012:  
Speculative thinking about the future of LCDs and OLEDs

---

March 2012

[Ian.Hendy@hendyconsulting.com](mailto:Ian.Hendy@hendyconsulting.com)

# Introduction to Hendy Consulting

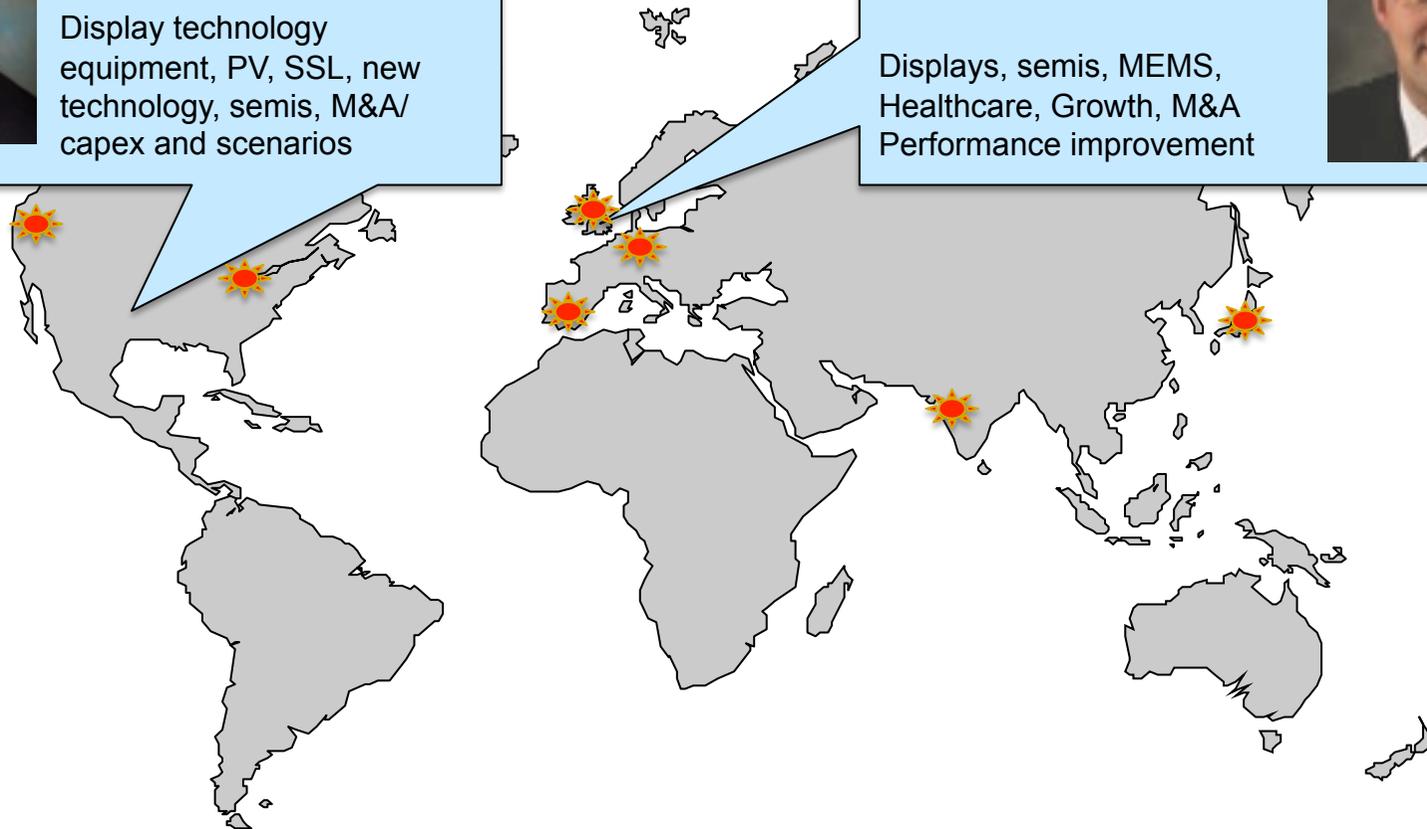


**David Barnes**  
Based in Austin, TX

Display technology  
equipment, PV, SSL, new  
technology, semis, M&A/  
capex and scenarios

**Ian Hendy**  
Based in London UK

Displays, semis, MEMS,  
Healthcare, Growth, M&A  
Performance improvement



Additional collaborators

# Introduction to Hendy Consulting: Service offerings

## Growth strategy

- Market entry strategy
- Business unit strategy
- Growth strategies for new technologies

## Performance improvement

- Product portfolio management
- Pricing strategy
- Cost reduction

## Equipment and Capex

- LCD/OLED factory capex decisions
- Strategies for equipment makers

## Sourcing strategy (Purchasing)

- Sourcing strategies, especially LCD and medical detectors
- Make/buy decisions

## Technology strategy and technology assessment

- Market and commercial strategies for new technology businesses
- Market tracking services for corporates monitoring technology

## Partnering and alliances

- M&A candidates and assessments
- Alliance formation support
- Post merger integration planning

## Professional advisory and business planning

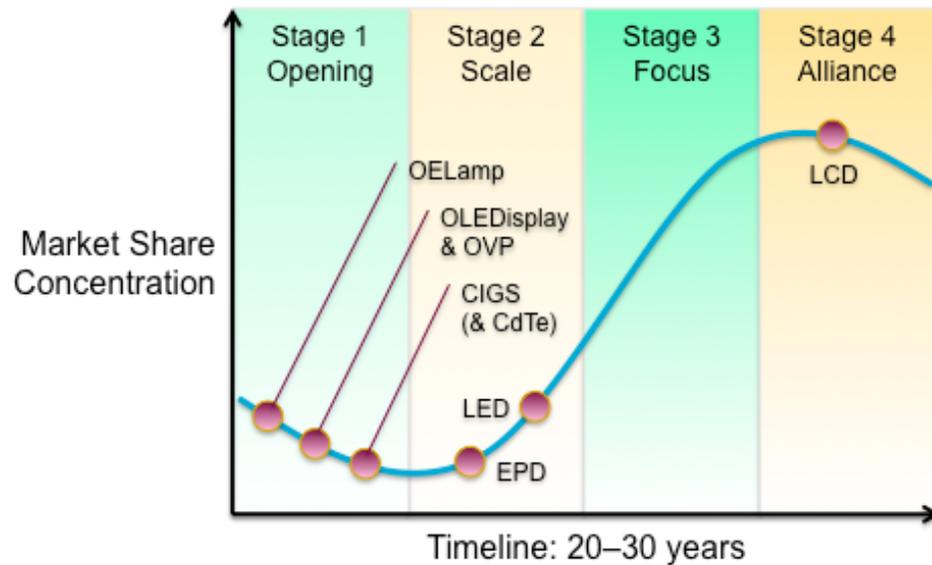
- Specialist insights for bankers, equity investors and other consultancies
- Reviews of business plans and models (Strategic audits)

## Strategies for materials providers

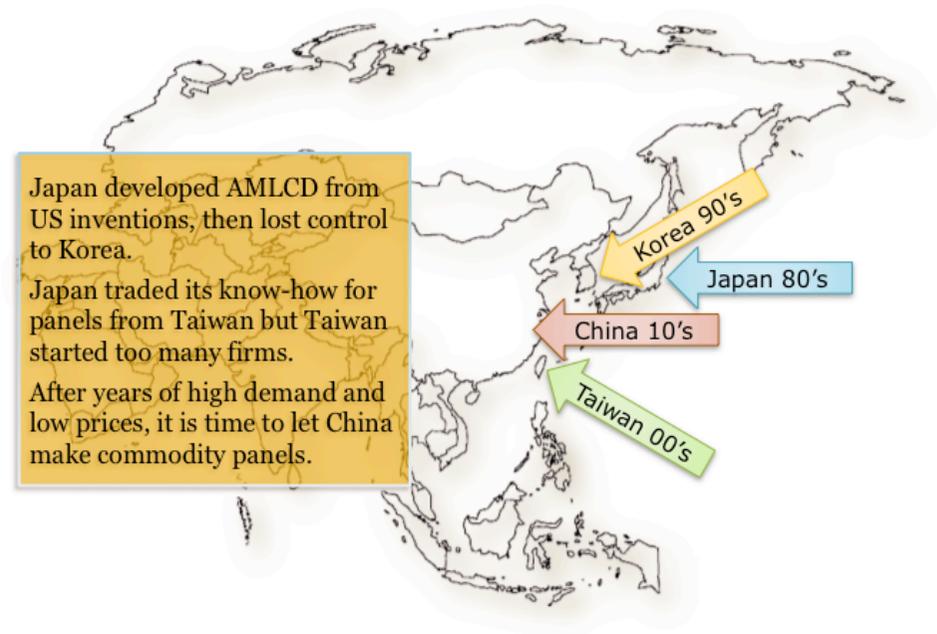
- Strategy support for materials providers in the FPD, SSL, and PV markets
- IP and pricing plans

# LCD industry in the end game and unprofitable

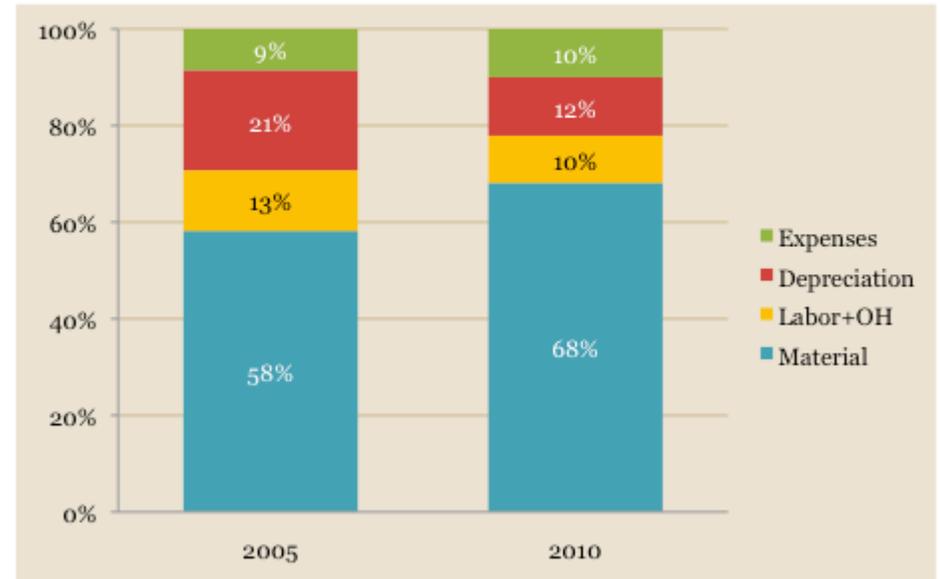
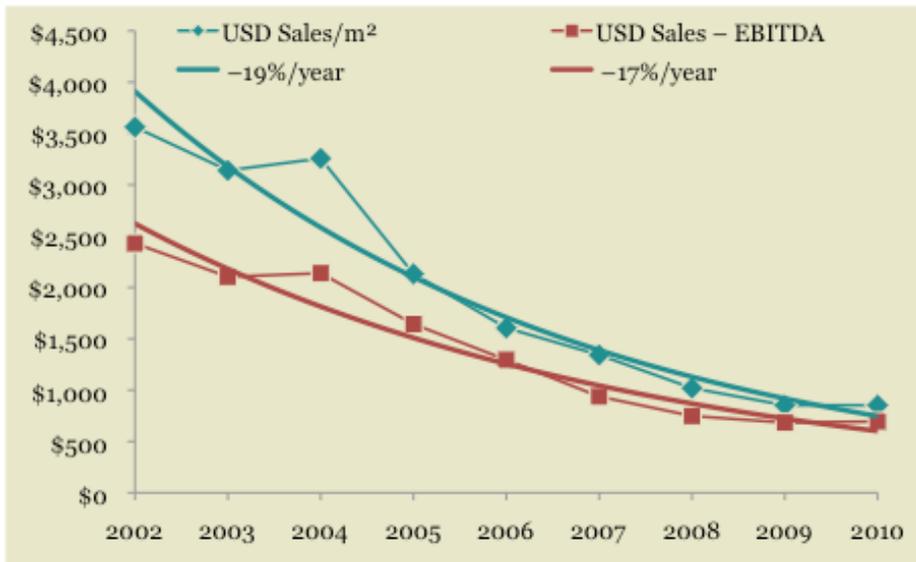
Stages of the Merger Endgame, per AT Kearney  
Impact of "hype curve" felt between stages 1 and 2



Source: A.T. Kearney, 2002 and HCL analysis



# Margins are down and display players have become materials traders



- Financial disclosures from LGD in 2005 and 2010
- Expenses here include: SG&A and R&D
- OH here is manufacturing overhead

- More than 2 decades of > 20% per year price declines
- Cost structure becomes more and more variable and shows less and less impact of technology in the financials

# The reason the display industry does not make money is that large “Fungible Fabs” destroy value in all markets

Leaders learned how to make smallish panels on large glass

Their capacity is fungible: it can serve most large panel markets

Maker	Fab	Small Size	Small Panels	Large Size*
LGD	P5	9.7”	35	27.0”
Samsung	L6	9.7”	36	27.0”
LGD	P6	9.7”	56	30.0”
Samsung	L7-2	17.0”	36	46.0”
LGD	P7	19.0”	35	47.0”
LGD	P8e	20.0”	40	55.0”
Samsung	L8-2	18.5”	50	55.0”

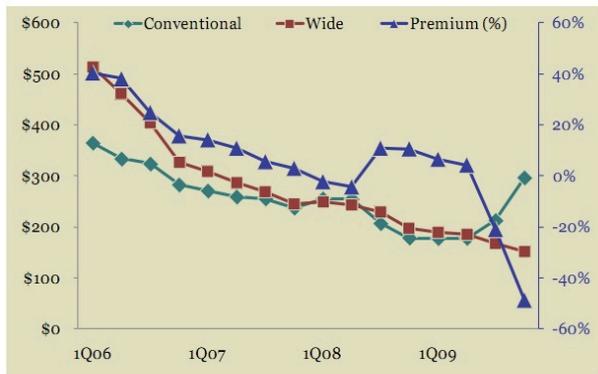
\*6 panels per substrate is the typical target for new fab investments because larger panels command a price premium... making smaller panels makes new fabs undifferentiated...

Source: DisplaySearch US FPD 2011

- Piling more capacity into commodity markets leads to hyper-competition.
- We believe this causes calendar-cyclic behavior in terms of price rivalry. Tit-for-tat reactions drive prices down, even for the leaders
- Similar behavior occurs among retailers who face e-tail competitors
- As a result, consumers see better prices but the supply chain sees worse profits
- Differentiation is one way out of this commodity trap

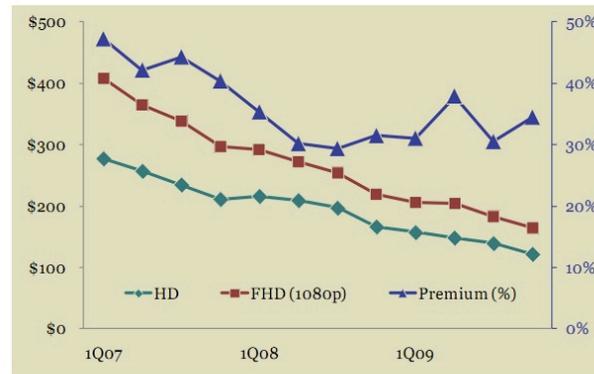
Display players are desperate for “premium product” but the value from most features is arbitrated away. Resolution seems to be ongoing and there may be some small value for higher frame rates

ASP/ft<sup>2</sup> Premium for Wide-format LCD TV Sets



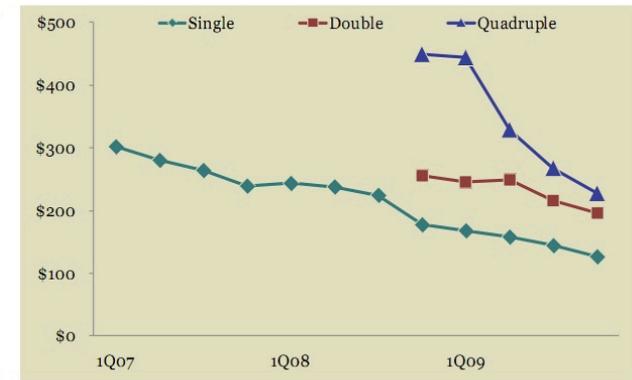
The feature premium declines until it becomes commoditized

ASP/ft<sup>2</sup> Premium for Full-HD (1080p) Sets



The feature premium remains viable if it can remain distinguished

ASP/ft<sup>2</sup> Premium for Faster Frame Rates

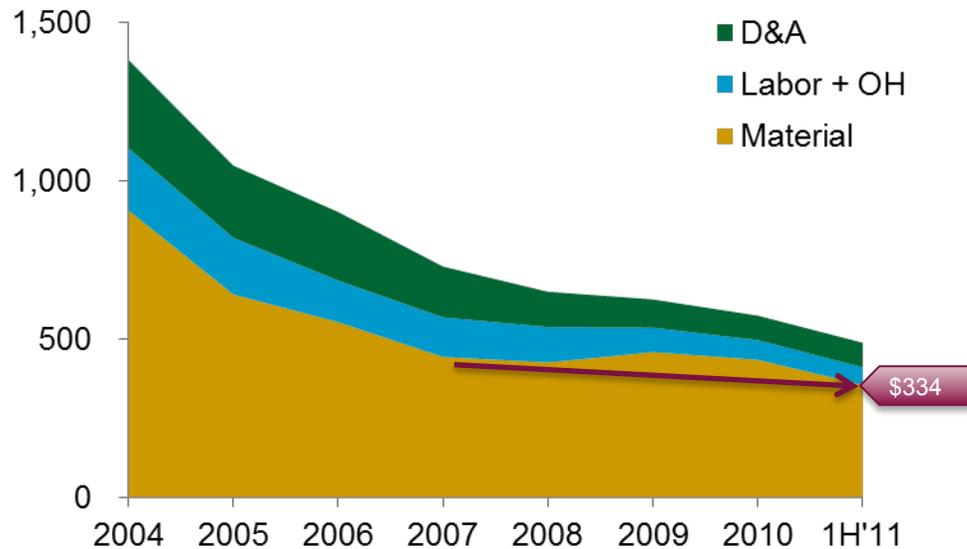


The feature premium declines until it becomes commoditized

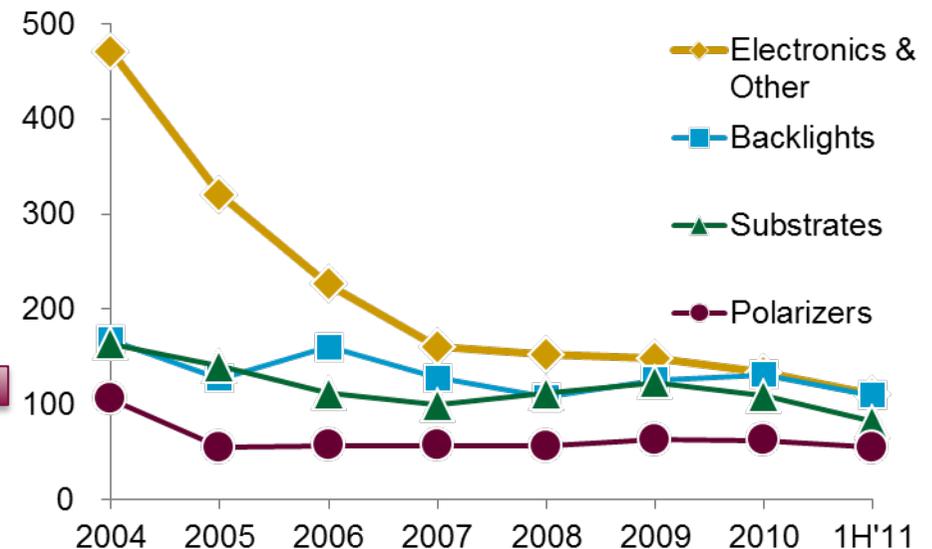
- The industry has been on the hunt for the “elusive premium” for the last 2 decades
- Most feature benefits (see the example of wide format displays) see the value proposition competed away within 2-3 years
- Resolution however, sells sometimes. Full HD LCD TV selling at a 30% premium to 768 line sets
- Initial premia for frame rate but the premium here likely to close

# Cost reduction mostly from electronics. Many materials have surprisingly “sticky” pricing. Is there a floor coming?

Cost of Sales Development for LGD  
000's KRW/m<sup>2</sup>



Cost of Materials Development for LGD  
000's KRW/m<sup>2</sup> by category



- COGS over 7.5 years shows that material cost development has created most of the savings.
- But material costs have been relatively flat since 2007 and remain near \$334 per square meter of output.
- COGS is running near \$458/m<sup>2</sup> and total cost near \$500.
- Current price levels are near \$488/m<sup>2</sup>.

- Electronic parts have delivered most of the cost savings.
- We are fascinated by the stickiness of the cost of polarisers and the fact that there has been more evidence of cost reductions in the oligopolistic glass market.
- Backlight costs moved up in 2010 at the start of serious LED substitution but LED-BLU costs have declined on volume.

Materials businesses more important as profit generators than the displays business. Samsung and LG groups have group level incentives to pump out product:

Profit/m <sup>2</sup> , Q2'11 Estimate	Samsung Elec	LGD	AUO	CMI
Display (\$488)	(\$15)	(\$4)	(\$45)	(\$52)
LED (\$50)	\$10	\$10	\$10	\$10
BLU (\$103)	\$4	\$4	\$4	\$4
Glass (\$76)*	\$17	—	—	—
Polarisers (\$51)	\$5	\$5	\$5	\$5
Chips (\$33*)	\$2	—	—	—
<b>Total</b>	<b>\$23</b>	<b>\$15</b>	<b>(\$26)</b>	<b>(\$33)</b>

- Note: display profit based on Q2'11 results. Sector average profits generally used unless specific company is information available. We assume that the Samsung Semiconductor business more profitable than others. We show 43% of the SCP net income under the Samsung group for glass substrates in line with their shareholding. The operating profit clearly even higher than this
- ODM/Brand value may accrue in addition to panel-level profits for vertically integrated producers.

\* estimate

# The new big game changer is Sharp's upcoming release of TAOS\* processes: Apple's second game changing move to support iPad3

	Apple supply agreement	TAOS shift
SEC	-	↑
LGD	↑	↑
AUO	-	-
CMI	↑	↓
Sharp	↑	↑
TMD	↑	↓

- Apple has redirected the AMLCD industry successfully for the last 3+ years
- The first “supply agreement” looked to secure \$3.9bn of supplies of displays but primarily built out the LTPS capacity at CMI and TMD bringing TMD back from the edge of financial ruin
- The deal with Sharp for TAOS pretty much tips the first one on the head with Apple supporting a move into TAOS that makes LTPS much less competitive
- In both cases Apple has a bet where it ties up capacity
- The only display players that seems to come out well are Sharp and LGD (SEC, or should we say, SDC, to a lesser extent)

\* Transparent Amorphous Oxide Semiconductor; e.g. IGZO



## However it will complicate capital planning and product/technology decisions throughout the industry:

- Of course the most immediate direct threat from TAOS is to those players with LTPS capacity
  - Given relatively low levels of circuit integration with LTPS on mass produced models today, then LTPS does not currently add enough value to justify its higher mask cost, yield challenges and bottlenecks
- The LTPS industry will have to respond by finding product solutions that integrate more direct functionality. This may set up 3 layers of product: a-Si, TAOS and LTPS based
- As a result, current incumbents and new entrants will face a dizzying array of technology and product choices
- For current incumbents, choices may well be on upgrades of existing capacity from a-Si to the higher mask-count, etch-stop process for TAOS
  - In general in the short term we expect to see more greenfield capacity than factory conversions (other than at Sharp) given the opportunity cost of halting current production
- TAOS creates an upgrade opportunity for equipment players but we are concerned that TAOS will not create long-term value for display makers, especially if the technology becomes more widespread. Whilst Apple has been able to value-price, we are concerned that premia will not be high enough overall to recover industry-wide technical or capital investments

Metal oxide and AMOLED, signage, LCD TV replacement rates and whether display players can capture more value through architecture are the key shocks. Apple is important as a shaping hand:

	Future shocks that change the future
<b>Metal oxide processes</b>	Role of IGZO process as higher mobility option for higher frame rate or higher resolution
<b>AMOLED</b>	Degree to which AMOLED is important in TV will depend on pricing behaviours and cost levels for Samsung and LG in particular
<b>LCD TV + Signage</b>	Replacement cycle for LCD TV becomes key metric in determining future LCD TV growth. Signage may be an adder but immature now
<b>Role of architecture to add value to display players</b>	LCD players may try to find new ways to seize back value. We believe that new fabs and functional architectures are key. LTPS needs to respond to the threat from MOTFT
<b>Ongoing role of Apple and Samsung</b>	The Apple vs Samsung battle is defining the display landscape: for mobile devices now and for a growing domain later

## Our view of the FPD industry future: Scenarios

	Base case	Tech race	Race to the bottom	a-Si wins since “Good enough”	Display industry saves itself
Metal oxide	Slow roll out for hi-def TV & mobile devices. Retrofit of a-Si	Metal oxide becomes important but coexists with architecture led LTPS	Metal oxide destroys LTPS value proposition but gains no premium over a-Si	Metal oxide fails to be important in comparison to a-Si	Metal oxide and a-Si coexist, with MO positioned above a-Si
AMOLED	2-3 players develop positions mostly in mobile devices	AMOLED flourishes and hits high-end price points in EU, Japan and US	AMOLED survives in mobile apps as MO TFT becomes cost competitive with a-Si	AMOLED flounders and remains a niche technology	AMOLED has a role for mobile devices and some TV and enables flexible
Market development	Mobile devices still more important. TV replacement faster, but not by much	Market is excited by new offerings. Some TV growth delivered in return	Markets grow but at low price points. Prices fall at 20%+	Markets grow but prices continue down	Price declines slow down as newer technology gains ground
Impact on players	Smaller players in Taiwan and Japan close or convert. New BRIC players	AMOLED or LTPS capable players break from the pack	Faster exits from the industry. Customers gain more power in funding future fabs	Niche technologies fail. Legacy transfer continues faster and more new players	Players begin to specialise in technologies or regional markets
Impact on profits	Profits stabilise but at lower levels. Participation in novel tech or materials key	Increasing profits for technology leaders and for AMOLED “all-in” players	Profits remain poor. Apple, Samsung and HP pay for the fabs they want	Profits remain poor, which leads to more vertical models. Merchants are poorer	Profit improves as display value offsets material cost

## Which is more likely? Our guess

	Base case	Tech race	Race to the bottom	a-Si wins since "Good enough"	Display industry saves itself
Metal oxide	Slow roll out for hi-def TV & mobile devices. Retrofit of a-Si	Metal oxide becomes important but coexists with architecture led LTPS	Metal oxide destroys LTPS value proposition but gains no premium over a-Si	Metal oxide fails to be important in comparison to a-Si	Metal oxide and a-Si coexist, with MO positioned above a-Si
AMOLED	2-3 players develop positions mostly in mobile devices	AMOLED flourishes and hits high-end price points in EU, Japan and US	AMOLED survives in mobile apps as MO TFT becomes cost competitive with a-Si	AMOLED flounders and remains a niche technology	AMOLED has a role for mobile devices and some TV and enables flexible
Market development	Mobile devices still more important. TV replacement faster, but not by much	Market is excited by new offerings. Some TV growth delivered in return	Markets grow but at low price points. Prices fall at 20%+	Markets grow but prices continue down	Price declines slow down as newer technology gains ground
Impact on players	Smaller players in Taiwan and Japan close or convert. New BRIC players	AMOLED or LTPS capable players break from the pack	Faster exits from the industry. Customers gain more power in funding future fabs	Niche technologies fail. Legacy transfer continues faster and more new players	Players begin to specialise in technologies or regional markets
Impact on profits	Profits stabilise but at lower levels. Participation in novel tech or materials key	Increasing profits for technology leaders and for AMOLED "all-in" players	Profits remain poor. Apple, Samsung and HP pay for the fabs they want	Profits remain poor, which leads to more vertical models. Merchants are poorer	Profit improves as display value offsets material cost
	30%	10%	30%	25%	5%

## Summary and implications:

- The display industry is in its end-game in LCD: margins have declined to low levels and display players have become materials traders, with only a little evidence for price premia based on technology
- Bottom of the cycle. Korean majors making group profits based on materials. Taiwanese having challenges with funding
- The industry is now at a cusp with the twin game changers of metal oxide (MO) and LTPS. It is on the verge of the 3<sup>rd</sup> major round of legacy transfers and additional countries beyond China have shown interest in flat panel technologies (such as Brazil). Samsung group considering options to reorganise to increase importance of higher profit OLED and decrease importance of LCD
- We have presented 5 scenarios, all of which are believable to some degree, but fear that old behaviours will be difficult to change
- For systems integration businesses in Europe, and for automotive and other customers in Europe, the likelihood is that technology will be available at cheaper and cheaper prices