

Breaking News

Samsung Electronics will merge Samsung Mobile Display (SMD) and S-LCD into Samsung Display (SDC) on July 1st. Thus, any reference to Samsung concerns SDC as an on-going business including the other 2 ventures. Also Panasonic and Sony have announced an OLED collaboration

Display future scenarios and corporate groupings “*Display Chess*”



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Context

- The flat panel display industry is now a >\$120bn industry in its endgame.
- The role of high performance transistors and of OLED now define new games that will separate display leaders from the second tier.
- We expect continued erosion of margins in the mainstream commodity a-Si markets as new Chinese entrants establish capacity with capabilities up to Gen 10 (as reported for the new CEC-Panda/TPV fab based on Sharp's technology).
- A number of structural differences make the OLED game new and different from LCD.
 - The technology is substantially more complex than LCD and no “standardised” equipment is available yet for future tech platforms, which will likely be based on IGZO TFT and a choice of OLED patterning techniques.
 - The finance community watched display fabrication lead to value destruction. In 1998–2008, money trapped on island in Taiwan and elsewhere funded LCD expansion. We worry that ministries, bankers or investors will not be so eager to fund OLED entrants. We would not be surprised to see BRIC policies foster OLED investment, however.
- This presentation seeks to outline the display industry from 30,000 feet and discuss the main chess pieces on the board, the rules of the game and how the game might evolve.
 - Our general belief is that the display industry is governed by current and past behaviours and relationships. Understanding linkages between major firms can lead to predictions on outcomes.
 - It is too early in the OLED game to see what formations will appear, such as a profitable duopoly or an unprofitable set of perpetual contenders. We fear that if it is the latter formation, efforts by Samsung and others to move towards a “variable cost lite” business structure may expose the industry to even faster price erosion.

Companies & abbreviations

AUO: *AU Optronics*

CMI: *Chi Mei Innolux*

CSOT: *China Star Opto technology*

EIH: *E Ink Holdings*

EPD: *Electrophoretic display*

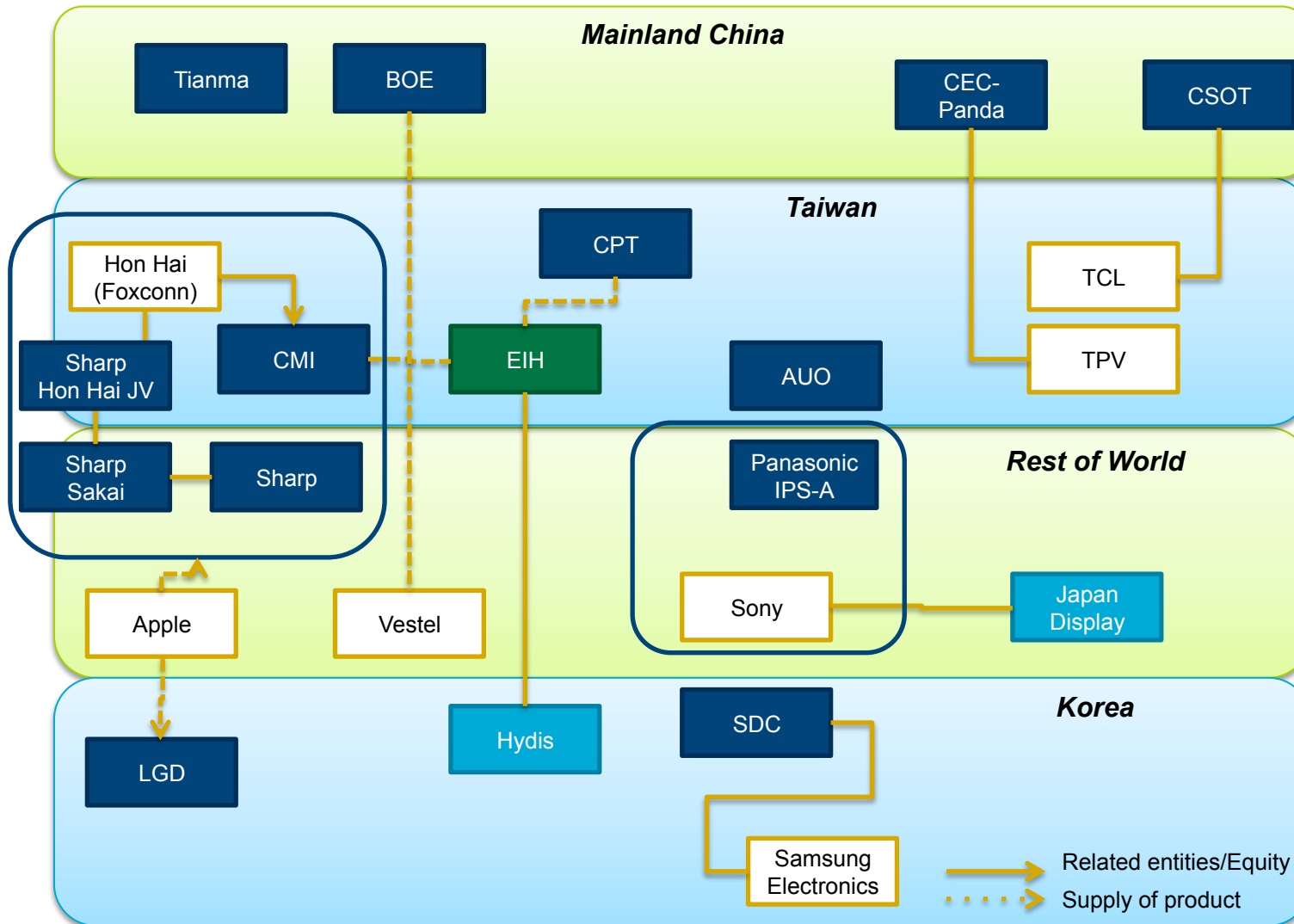
JDI: *Japan Display*

LGD: *LG Display*

SEC: *Samsung Electronics*

SDC: *Samsung Display Company including the former SMD and S-LCD*

The current display industry structure: Selected players

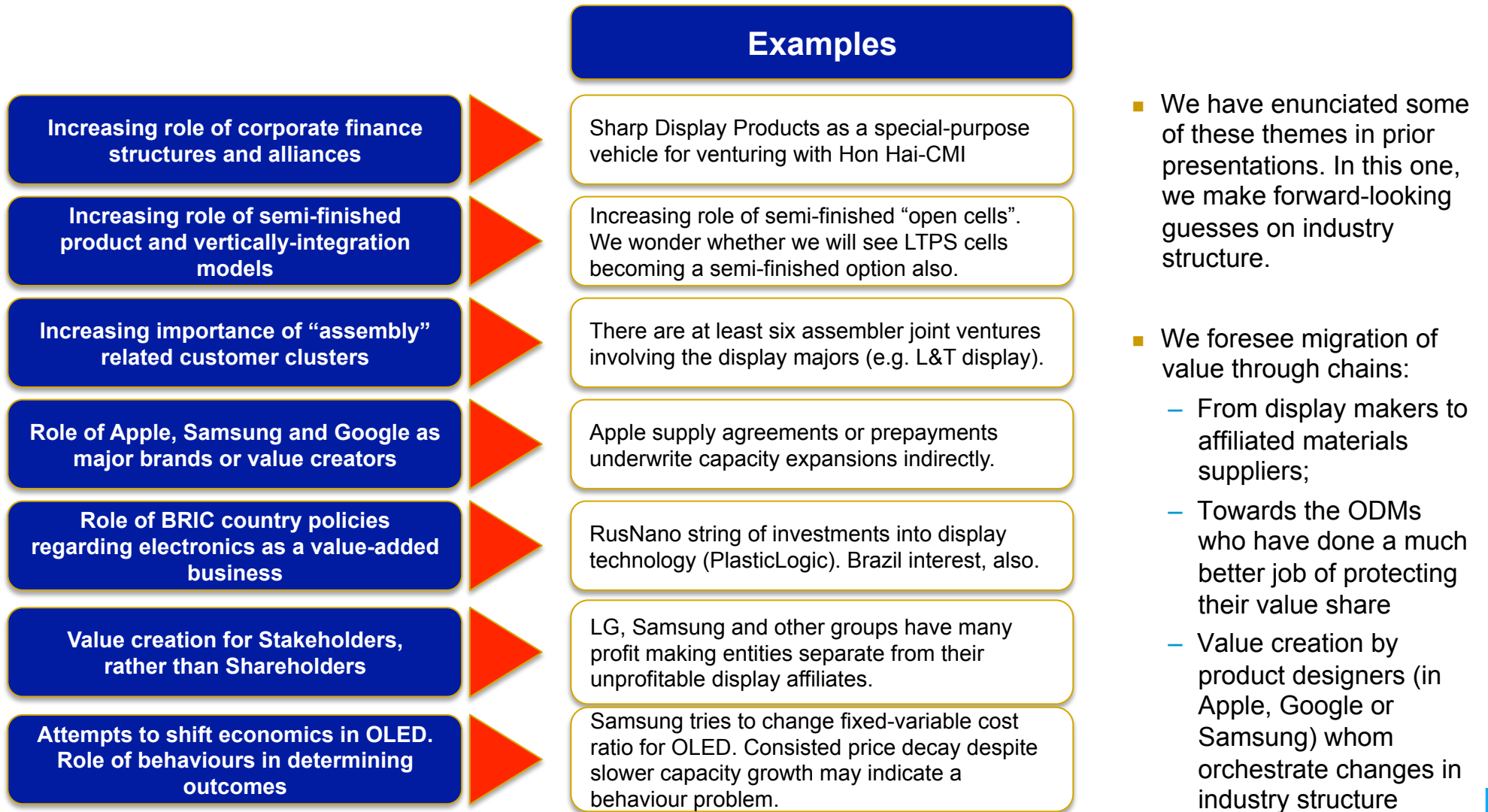


- Samsung Electronics spins-out SDC and then merges in SMD and S-LCD effective July 1, 2012
- Panasonic and Sony have announced an OLED collaboration
- Japan Display merges the small-panel portfolios of Hitachi, Sony (former Sony Toyota venture) and Toshiba (TMD)
- Panasonic reinvests in IPS-Alpha for their future in OLED TV with potential alliances with Sony, AUO
- TPV obtained rights of first refusal on new CEC- Panda Gen 10 panel output

Recent news

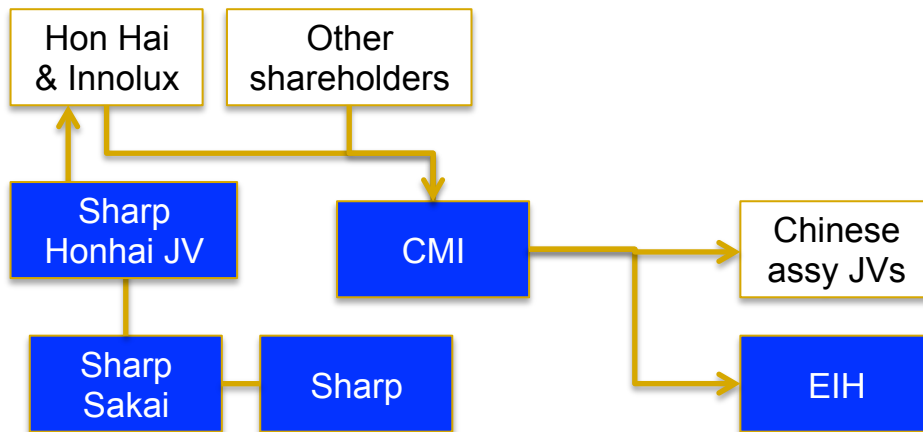
- Sharp consolidated the CF activities of Toppan and DNP for its Gen 10 fab into Sharp Display Products (in Sakai) and then sold 46% of this to the Hon Hai group. Recent conversion of Kamayama 2 to IGZO has become successful after some delay (and missing launch window for the New iPad).
- E-Ink Holdings has reported poor financial results on the back of a collapse in EPD sales to Amazon. Amazon may introduce colour EPD products with a capacitive touch solution and 10" LCD tablets.
- Sony and Panasonic have announced an OLED alliance. Panasonic remains a outlier with potential for LCD-OLED conversion. Panasonic owns previous Gen 6-8 IPS-Alpha fabs. Panasonic, like Sony, has released poor financial results and disappointing forecasts.
- Samsung Electronics spun out Samsung Display (SDC) into a wholly-owned subsidiary and then will merge in SMD and S-LCD on July 1st 2012.
- Japan Display combines the capabilities of TMD (which Toshiba owned), Hitachi and the former Sony-Toyoda venture into one company with heavy focus on mobile displays. Japan Display has formable technology related to small panels and a strong relationship with Apple because of TMD.
- CMI's board composition has changed to eliminate the Chi Mei group representation. This may begin to resolve a two year-long shareholder spat and enable Terry Guo to reorganize his panel-making and product-assembling resources. He faces a heavy debt burden left over from CMO expansion before the merger.

Underlying core themes of the display industry transition:



The Hon Hai story appears to be a deal with Sharp by Terry Guo to sustain his Apple account strategy

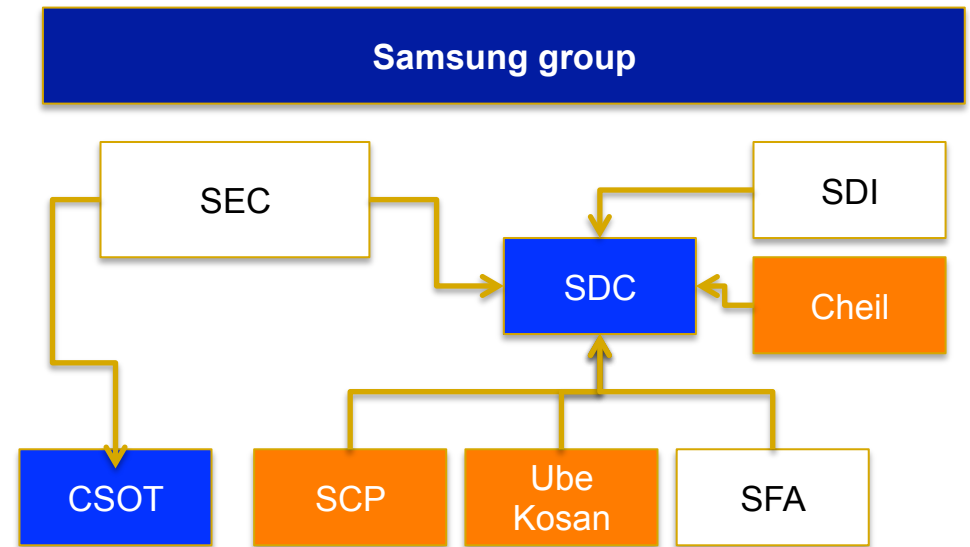
CMI relationships and universe



- Terry Guo (CEO of Hon Hai Precision Industry) seemingly holding all the cards for the power struggle for control of CMI. Chi Mei group representatives just resigned their positions on the board of CMI, perhaps beginning to resolve two years of shareholder spats that have constrained synergy realisation after the CMO-Innolux-TPO merger.
- Terry Guo has also structured a deal with Sharp for high resolution (IGZO) panels to support growth of Apple business
- Sharp has recently done deals with both DNP and Toppan to bring in CF technology from each which allows Sharp to use the Sakai subsidiary as a venturing vehicle (Hon Hai has purchased 46% of the venture)
- We had hoped that a deal between Sharp and Terry Guo would be for the benefit of CMI. However for now it seems like Honhai will build a JV fab with Sharp directly for 30k sheets IGZO and 30k LTPS
 - This may all be part of a master plan for Terry Guo in changing his influence in CMI, or may reflect unresolvable conflicts with the other shareholders for CMI
 - There have been previous discussions about splitting CMI up into a touch panel business, a small panel business and the large panel business. For now, then these plans are likely to be on hold pending some sort of resolution of shareholder differences

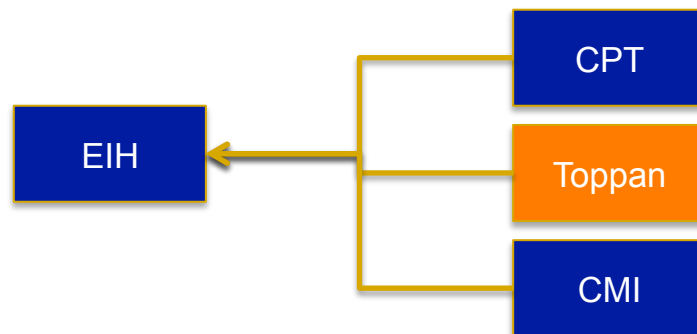
The Samsung group has just announced a merger of all their LCD and OLED display businesses into SDC

- Samsung Electronics recently announced the formation of a separate company for the LCD business: Samsung Display Corporation. It also will then merge in the former SMD business and S-LCD remains into SDC (effective July 1st 2012) which will be jointly held by Samsung Electronics and SDI but with SEC the majority shareholder
- The challenge for the new SDC company will be maintaining a focus on the market and on technology developments at the same time as integrating SMD and S-LCD into the whole
- Other interesting stories of late have been the use of SFA (former Samsung Mechatronics equipment company) as a prime vehicle for OLED equipment, the role of Samsung Corning Precision (SCP) in supplying LITI donor sheets for OLED production (signaling perhaps the increased importance of laser based methods for deposition of high resolution OLED materials) and the recent formation of a Joint Venture with Ube Kosan for polyimide based flexible substrates.



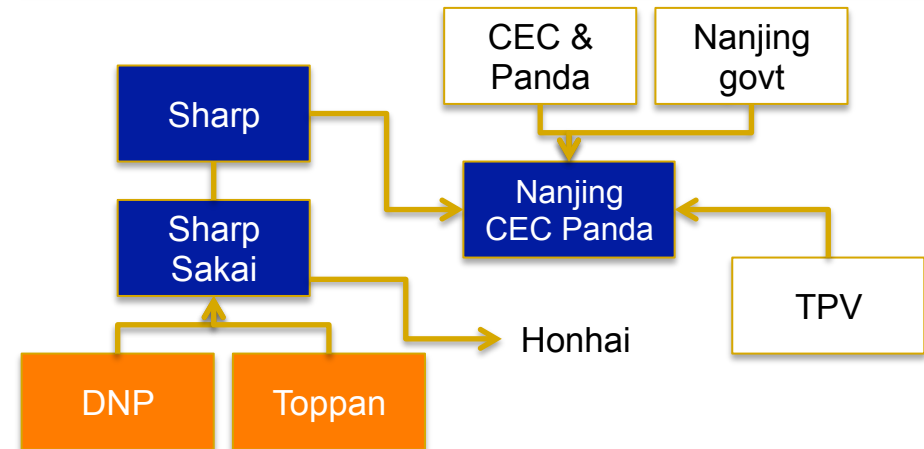
We expect to see E-Ink's business decline and watch Sharp's technology gain a foothold in China by way of the CEC-Panda-TPV play

EIH relationships and universe



- E-Ink Holdings has built up a privileged economic situation by harnessing a-Si array supply from CMI (for electrophoretic displays) and CPT (for FFS LCD). Toppan is one of subcontractors for the EPD film for E-Ink.
- Amazon may soon release colour EPD with a capacitive touch solution but both implementations will lead to reduction in visual performance
- In our view, EIH reached its profit peak in 2011 and value may erode as full colour LCD cannibalises the EPD business. Q1'12 results show a substantial drop in business from Amazon after inventory adjustments for Kindle Fire (LCD).

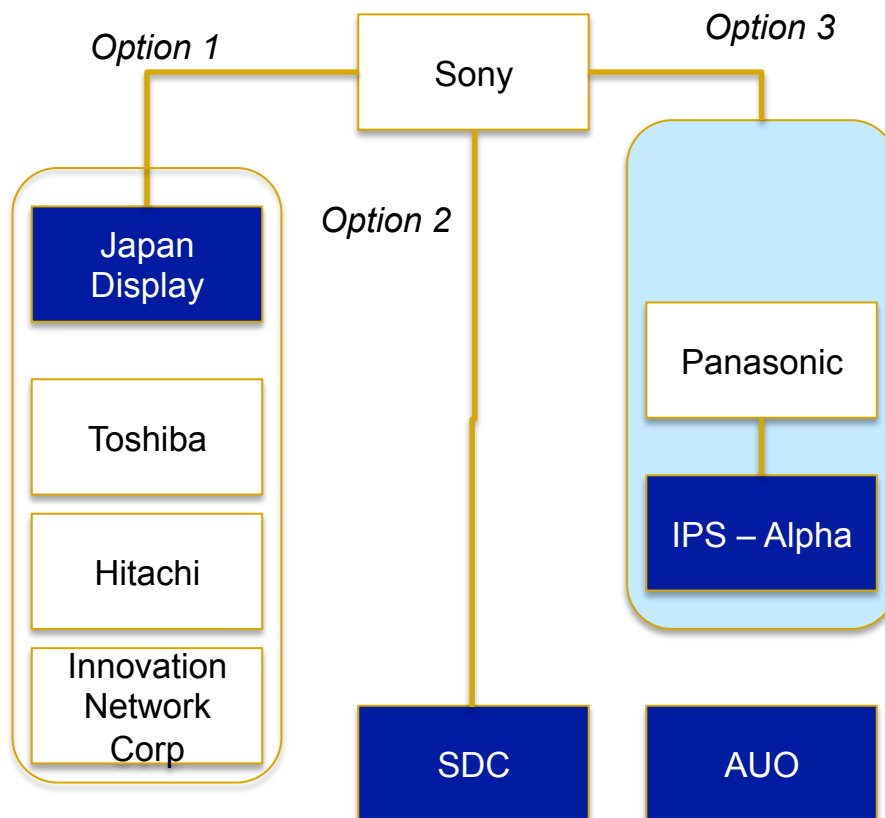
Sharp/CEC-Panda group



- The Nanjing-CEC-Panda investment in Gen 10 capacity is based on technology from Sharp.
- Capital for the new LCD plant (\$5.6 bn) includes a small investment (0.8%) from TPV technologies (the leading monitor and TV ODM) which gives it rights to capacity purchase (right of first refusal).
- Sharp Display in Sakai has acquired colour filter technology from DNP and Toppan, which increases its value add.
- Not clear whether there are different company vehicles for Nanjing CEC Panda for its Gen 6 and Gen 10 fabs

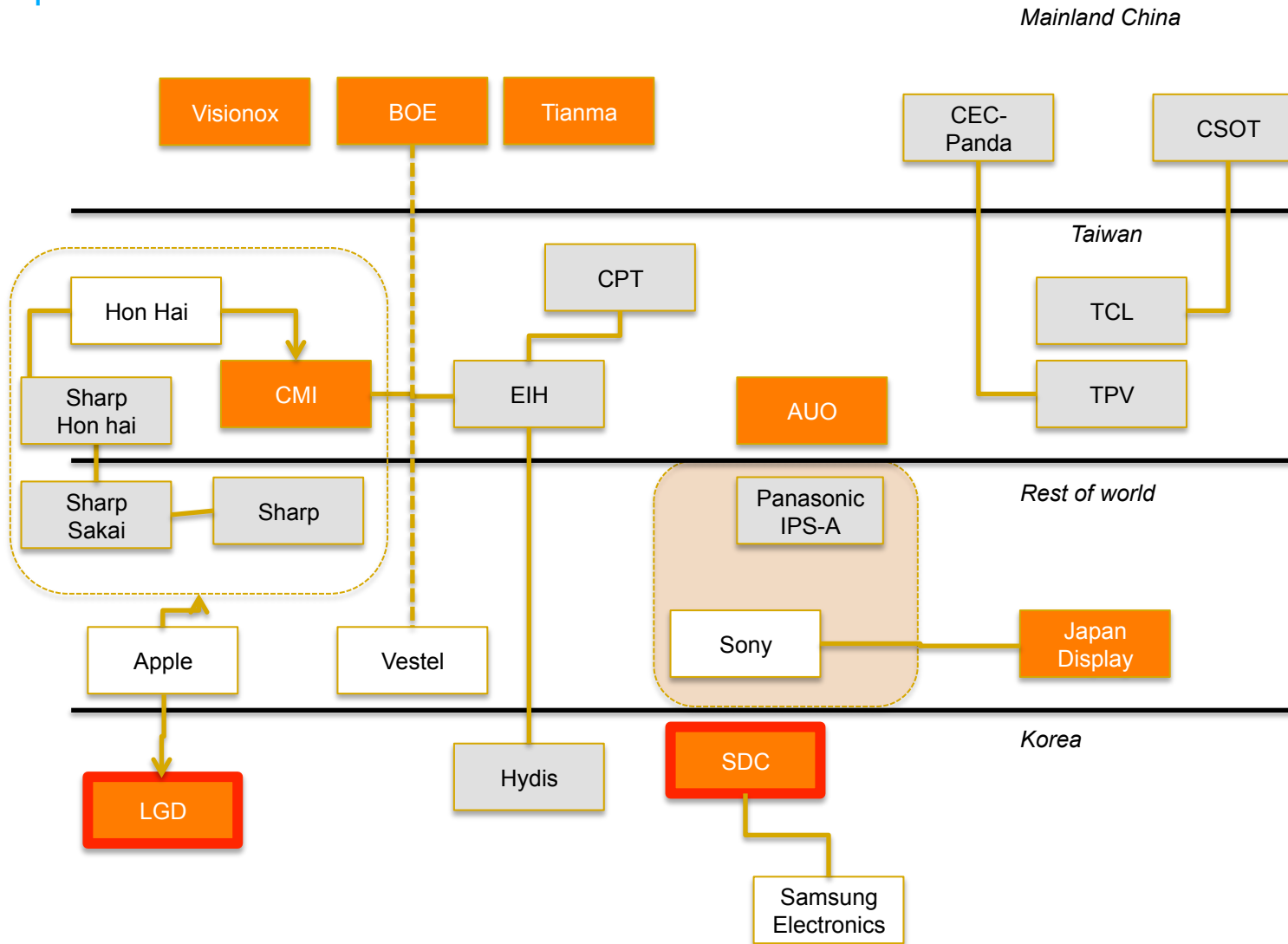
Very recent announcement of Sony-Panasonic OLED plan brings clarity to the choices open to Sony

Sony centric environment



- Panasonic and Sony are under pressure by sceptical equity analysts to restructure TV operations or to abandon the market. AUO admits it will take years to develop large OLED.
- Sony previously contributed their ST-LCD assets into Japan Display, but their corporate labs had the real OLED know how. We think the flexible OLED work remains inside Sony.
- Breaking news: Sony have just announced an OLED collaboration with Panasonic (Option 3 shown here)

Potential OLED alliances and players



- Two Koreans positioning themselves strongly ahead of others in OLED
- AUO has so far committed only to small panel OLED
- We expect CMI to consider a full OLED play
- Sharp has remained on the side lines of OLED, so far
- Japan Display could be a technology provider to others
- We expect the Chinese to try to OLED entry but discover it challenging. Visionox (moving to AMOLED from passives), BOE and Tianma all have OLED plans.
- We would not be surprised to see Russia or Brazil interested in getting into the OLED business, although their paths to technology are not clear
- Recent Sony Panasonic OLED announcement

OLED displays: New game or same game?

Scenario 1 New Game:

SDC and LGD lead the industry and enjoy profits

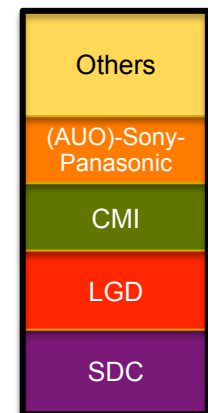
Scenario 2 Same Game:

Players pile on so OLED becomes LCD Part Deux

Scenario descriptions and “What you have to believe”

- In one possible outcome, SDC and LGD use their technology prowess and captive channels to become the leaders of the OLED industry with large market shares.
- SDC and LGD manage to retain the bulk of the profits and pursue models with relatively light variable costs, using fixed costs as a barrier to entry against others.
- *What you would have to believe for this to be true and likely...*
 - IGZO technology remains more difficult than a-Si and/or IGZO fails and LTPS technology is too difficult for new entrants to master.
 - SDC and LGD expand so quickly that others cannot follow quickly.
 - BRIC governments come to the view that investments in OLED are simply too complex.
- Overall, we think that there is still too much government interest in OLED and the Japanese still seem to want to play (Panasonic and Sony) for this to be a two-company race
- We see potential for another pile-on. OLED may develop similarly to the LCD industry.
- *What you might have to believe for this to become true...*
 - Companies like ULVAC offer equipment solutions that provide the core of an OLED system and IGZO becomes standard technology or LTPS cell business models appear.
 - UDC or another player becomes so strong as a source of IP that de facto sets of material become commodities.
 - Several players believe that they can get the funds and technologies needed for entry. Alternatively, partnerships with key “technology owners” develop as they did in LCD.
- SDC aims to reduce variable cost and increase fixed cost, so OLED becomes more like DRAM than like LCD: an industry with one strong, profitable leader.
 - A “winner takes all” market may be good for Samsung and bad for others.
 - The alternative may be bad for everyone. If many OLED players appear, the lower variable cost of OLED would permit deeper price cuts (to the marginal cost level). That could destroy value faster than we have seen in the LCD marketplace.

Resulting industry structure (market shares)



The risk is that OLED is a repeat of LCD but with lower variable costs and deeper price cuts

For now, “OLED technology seekers” outnumber potential donors

OLED Technology donors:

Samsung

Not likely to be a tech donor in the short term but we expect to see them at the table later.

LGD

LGD lacks the DNA to collaborate on technology deals today but they may come to the table if invited or attracted by deals.

Japan Display

We expect to see Japan Display to be a key tech partner here, based on the Sony experience in OLED TV.

CMI

We expect to see CMI at the table here. CMI is well experienced in technology venturing and we think that their current financing position may drive them to deal.

AUO

AUO has a history of work into OLED but has only signed up to a small panel OLED business plan for now.



OLED Technology seekers:

Panasonic

While we imagine that Panasonic will have links to companies like Sumitomo (CDT) and other parts of Japan Inc, we wonder whether this will be sufficient.

OLED lighting

For now many of the OLED lighting start-ups seem to have been going it alone (or taking on licenses from UDC) but we expect this to change.

Russia Inc (>2 firms)

We anticipate a leap-frog jump into OLED by Russian agencies. We have identified two Russian players with interest in OLED so far.

Brazil Inc

Brazil is another country in which we anticipate OLED leap-frog plays. There is less rationale for LCD capacity as that market matures.

China Inc (Many)

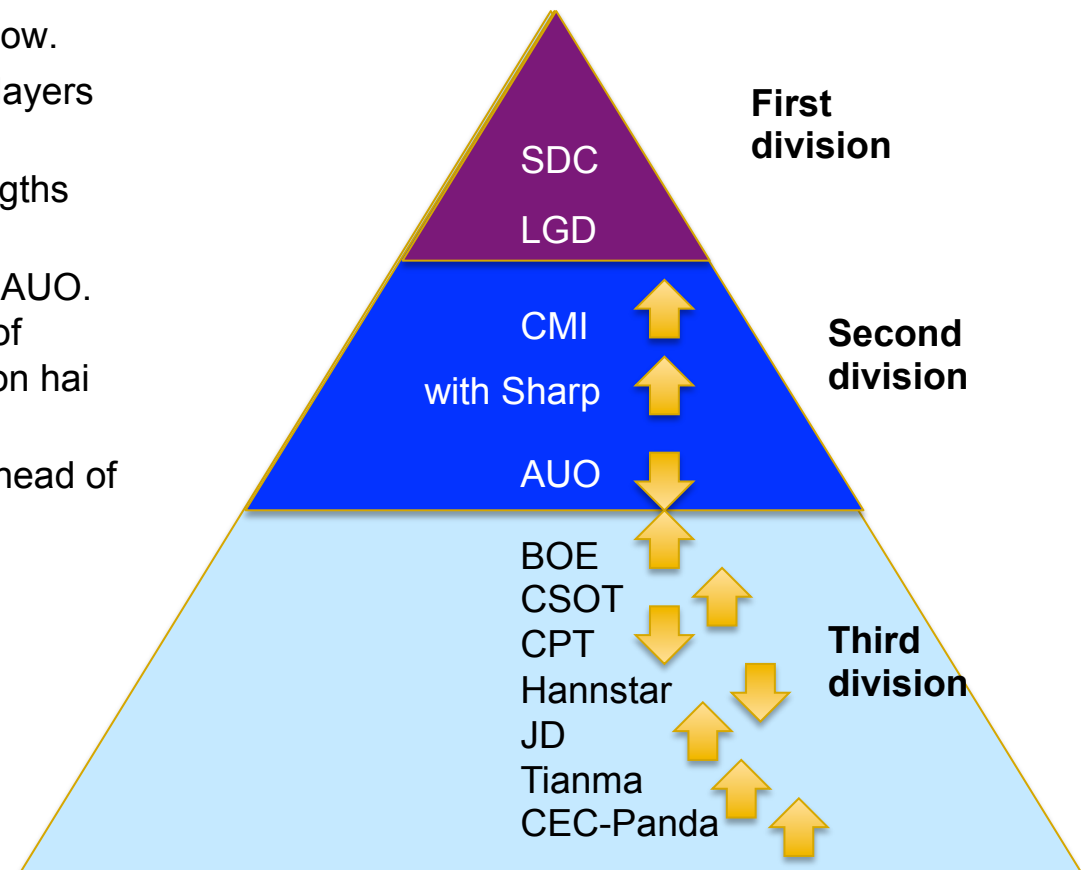
We would expect to see other players in China beyond those who have disclosed interest already. Macroeconomic issues may determine timing.

With three likely technology donors at the table near term (CMI, AUO and Japan Display) and with management turmoil in all companies, we think that the net impact will be a frustration of OLED ambitions. For now, the two Koreans will likely try to keep their technology, but over the medium term it may be financially attractive for them to consider specific alliances. Of course, there are interacting technology choices for front planes and backplanes, so partnering options may become quite complex over time.

Key changes in industry structure and implications

- OLED alliances will change the landscape.
 - SDC and LGD will dominate.
 - AUO (small panels only for now) and CMI will follow.
- Already the display industry is moving into tiers of players based on their technical strengths.
 - LGD and SDC in the top tier based on their strengths
 - The deal with Sharp may allow CMI to retain its position on the leaderboard, potentially ahead of AUO. This is what we would like to see, but the reality of shareholder conflicts for now is a direct Sharp-Hon hai JV in Chengdu
 - The Chinese BOE and CSOT now could move ahead of the second tier Taiwanese with CEC-Panda and Tianma also becoming more relevant.
 - We wonder whether over time HSD and CPT move essentially out of the display industry as primary display players, and support touch panel and/or array supply business models for others
- Both LGD and CMI become important merchants to brands other than Samsung.
- The role of Apple in picking winners remains important.

Company “league structure” in our view



The role of the Chinese players in the display industry:

BOE

- The largest of the Chinese display makers with:
 - Gen 5 in Beijing (105k sheets/month)
 - Gen 4 (730x920mm for small panels) in Chengdu (45k) with planned small capacity for LTPS
 - Gen 6 in Hefei 90k with a small experiment in IGZO planned for this year
 - Gen 8 capacity in Beijing (30k in Q1 2012 ramping to 65k by the end of the year) with plans for a second Gen 8 based on IGZO for 2013
- Local supplied glass by Corning
- Localising supply for other materials
- Rumored collaboration with Mongolia for an AMOLED fab in return for rights to coal in Mongolia. Chengdu site may also be part of AMOLED plans

CSOT

- A 3-way Joint venture between TCL (55% share), Century (30%) and Samsung Electronics (Financial investor, 15%)
- Gen 8 capacity in Shenzhen
- 30k in Q1 2012 ramping to 105k by the end of the year
- CSOT hasn't yet revealed its firm plans for OLED

Tianma

- Acquired the fabs from SVA-NEC for 93k sheets/month.
- Additional capacity:
 - 30k Gen 4 for small panels in Chengdu
 - 30k Gen 4 for small panels in Shanghai
 - 30k Gen 4 in Wuhan
 - 2k LTPS pilot line 730x920 (for OLED pilot)
- New capacity that has been discussed is 30k of Gen 5.5 in Xiamen of LTPS (Basis for future OLED play one assumes)
- More focused on small medium panels than other Chinese players
- Publically listed in Shenzhen

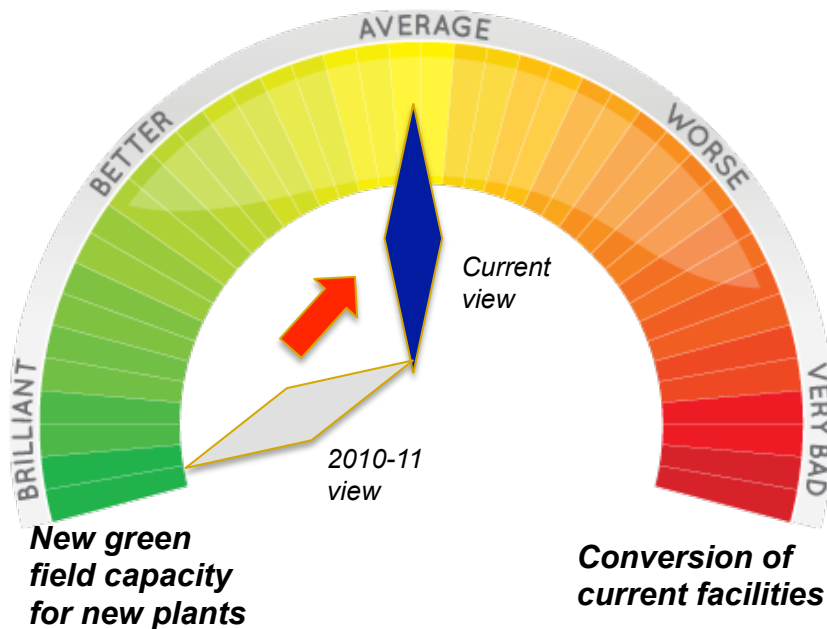
CEC-Panda

- Currently have a 75k Gen 6 facility ramping to 83k by the end of the year
- Have recently announced a \$5.7bn investment into a Gen 10 fab. We believe the technology for this would have to come from Sharp who previously sold Gen 6 kit from Kameyama to form the first CEC-Panda facility and also built an R&D centre in Nanjing
- CEC is a major Chinese state owned company

Irico and Visionox have expressed an interest in OLED. IVO established smaller LCD play

Growth profile of the industry moving towards a mixed model for asset expansion:

Impact on capacity planning outlook on equipment industry

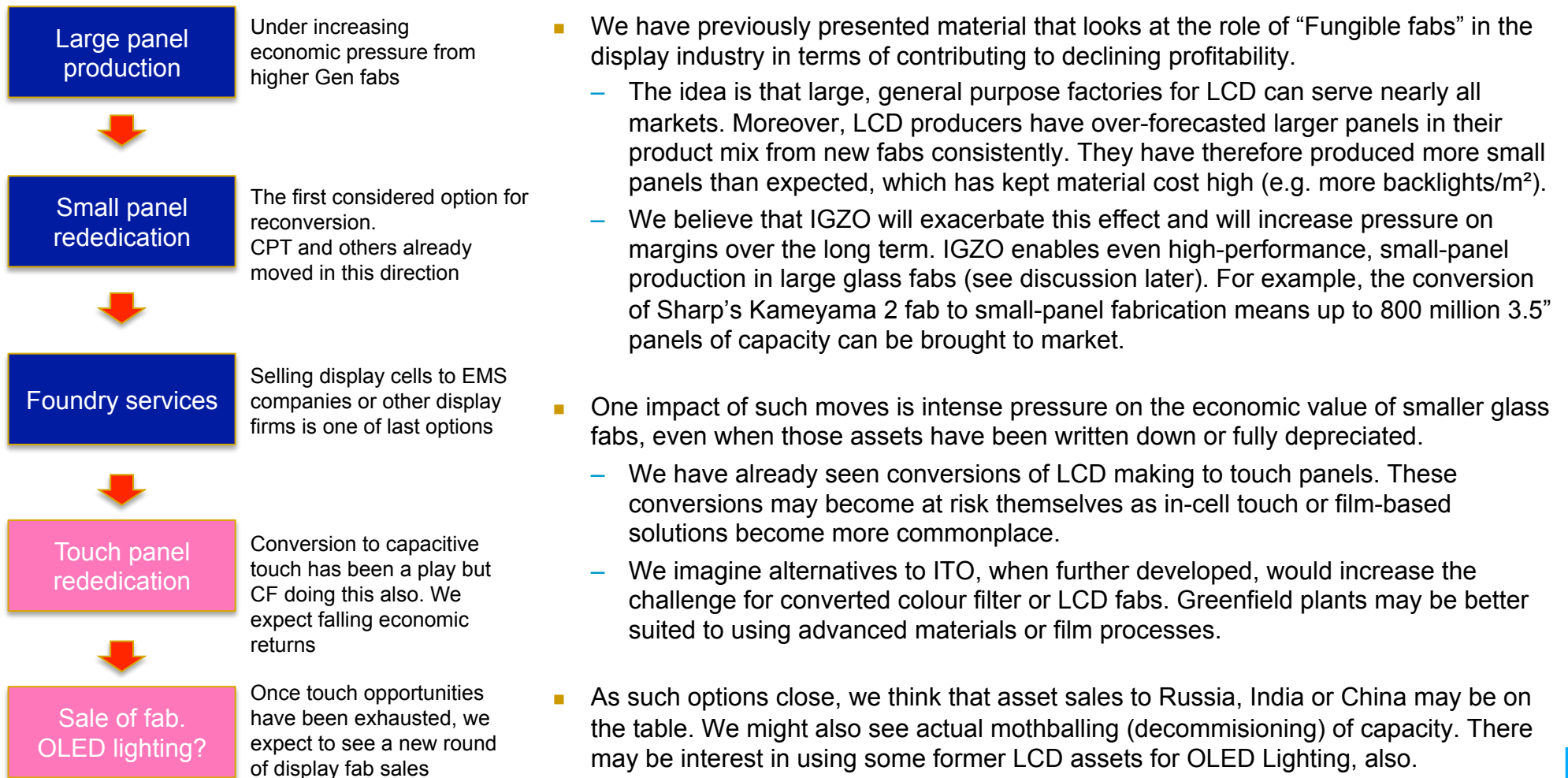


- The ongoing commentary in LG Display's IR conference calls about the future of capacity investments is important for understanding how the industry will restructure itself to serve OLED
- Q4 2011 call from LGD discussed the notion that the cost of greenfield capacity for OLED is the *same* as the sum of a factory conversion plus the lost margin on current LCD sales on those assets
- Current outlook seems to be that LGD considering a mix of factory conversions and some new capex (for example move the lower Generation kit out of ballroom fabs in Korea and then retrofitting the cleanrooms with OLED equipment)

- The implications of these oscillations in planning by the display majors has fundamental implications for the equipment industry. Clearly, the best outcome from an equipment industry perspective would be a reinvestment in green field facilities. Given we are at the tail end of the trough in display pricing for this crystal cycle, we are not surprised to see a more conservative view on capacity expansion. As prices lift now over the next 12 months, we may see a move back to the left (More greenfield capacity) especially since the players that will actually succeed with AMOLED will be the ones for whom the opportunity cost of lost LCD cash margin will be greater.

The other strategic issue that will begin to challenge the display industry soon is the role of Gen 3-5 fabs:

Strategy options for fabs by descending level of attractiveness



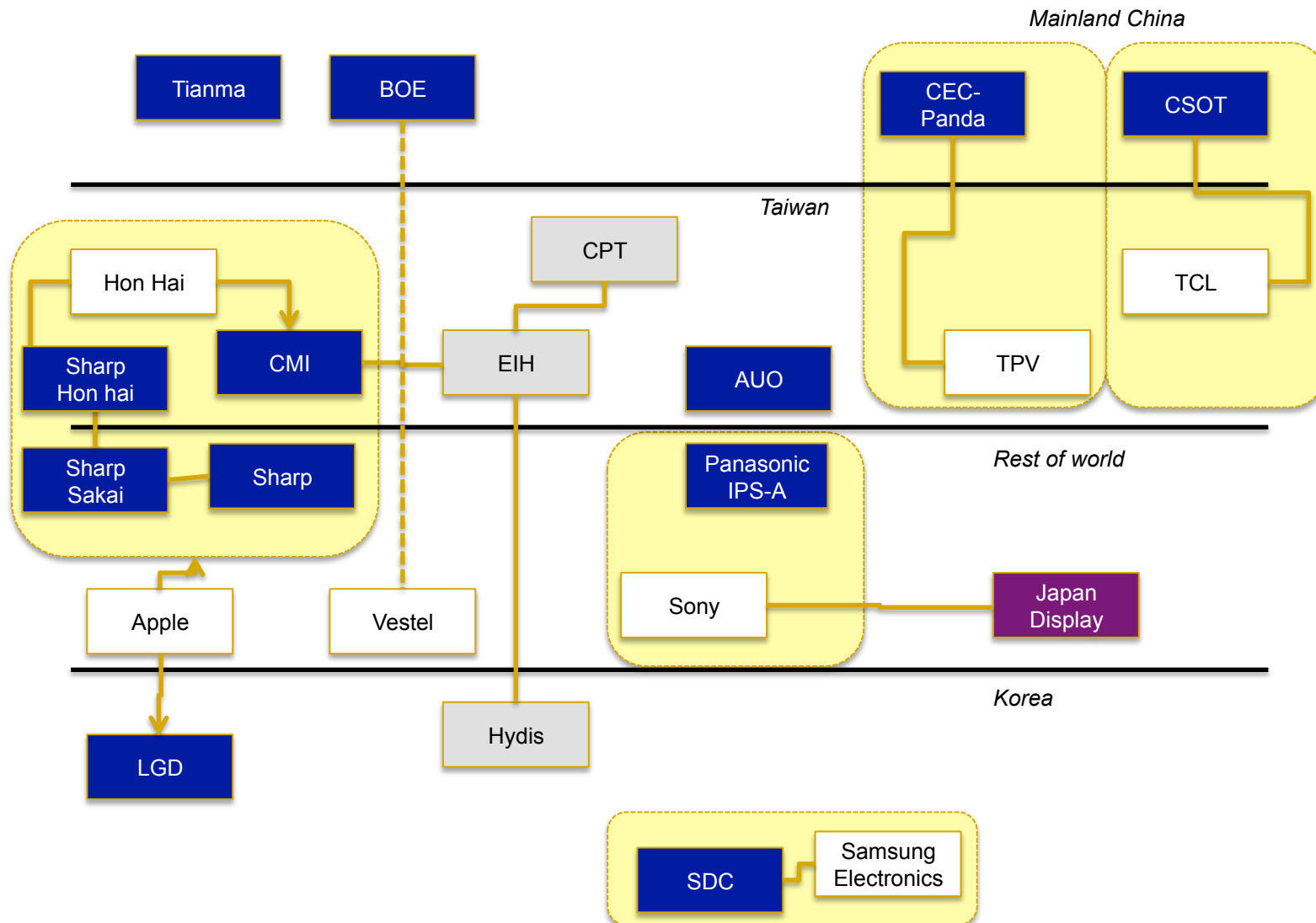
Drivers for how the industry will realign itself for the future:

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- Japan Display appears to be a way for Japan's senior technologists to ride off into the sunset. In addition, it may supply technology or know how for advanced displays, perhaps for OLED to others, in a few years.
- Panasonic may become important in OLED but only if it is prepared to play big bets and partner with others.
- Sharp will continue to bump along the bottom, and will need to form many new customer partnerships to serve a huge increase in small panel output based on IGZO. We see Sharp as a key "playing piece" in terms of technology going forward. Further collaboration with CMI through Terry Guo seems possible if the shareholder spat can be resolved. Alternatively we see the further breakup of Sharp capacity and technology packages to new Chinese or other players.
- As display making margins have structurally moved towards losses in LCD, then the economics of the key integrators have actually moved ahead: we see more influence of top integrators such as TPV, TCL and Vestel. These will make incremental returns through innovations in the material space and their own privileged sources of supply.
- China, Russia and Brazil will all show interest in leap-frogging LCD and moving into OLED but access to the right core technology will constrain outcomes. We assume that IP related to IGZO will prove to be a barrier to entry influenced or controlled by IP owners such as Sharp, LGD, Samsung, HP, SEL and JIST.
- The position of E Ink will decline (move further down the rankings) based on declining importance of EPD products and proliferation of FFS-LCD suppliers for tablet products. Low-power has always lost to high-performance.
- HSD and CPT effectively exit the LCD industry through conversion to touch screen manufacture.
- LGD becomes a second major technology provider to others and gains some interest in licensing technology for OLED.
- Samsung group also uses OLED technology as a way to further corporate partnering agenda. Potential deal for OLED with Sony and perhaps with Russia or China, but on terms favourable to Samsung.
- Gen 10 fabs flounder and the main opportunity for equipment suppliers remains in the Gen 5.5 to Gen 8 regime.
- LTPS continues to be a special-purpose technology suitable for high-performance products in niche markets.

Potential future display clusters

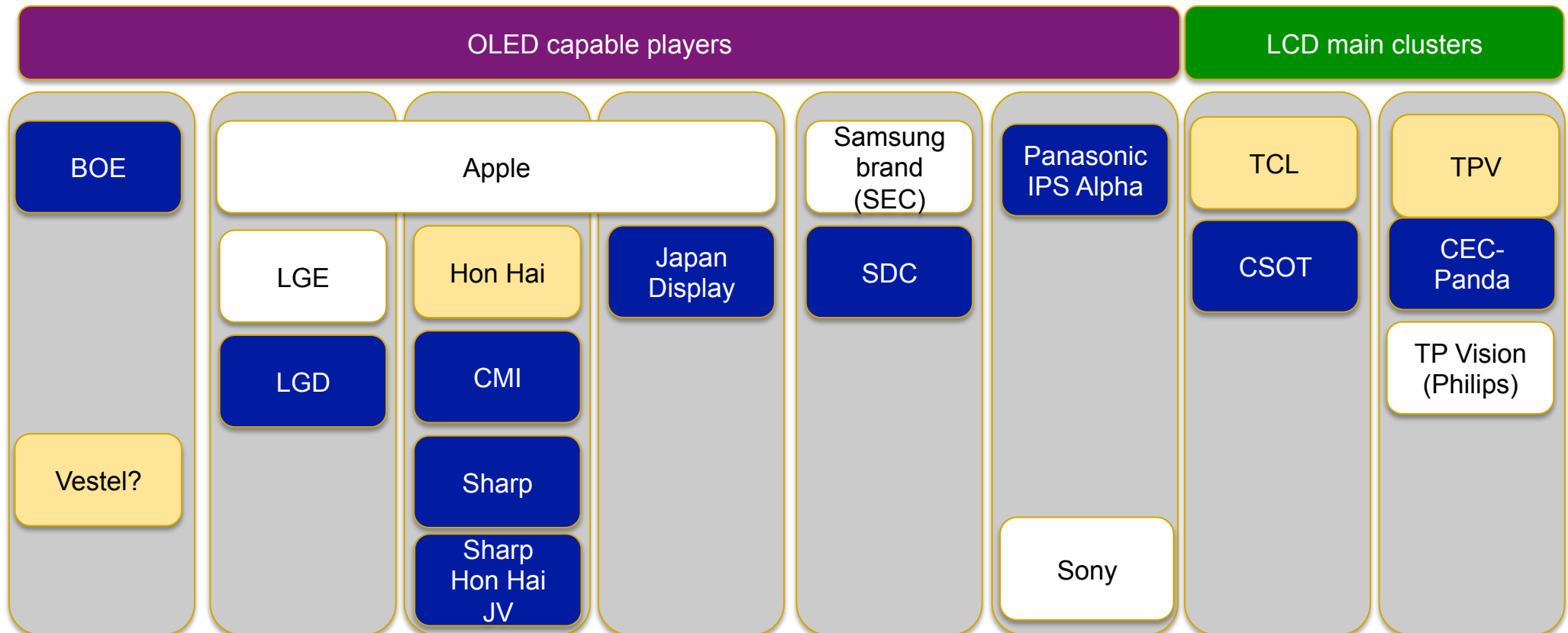
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- We might expect to see further tightening of the CMI-Hon Hai-Sharp relationship if shareholder issues can be resolved. An ongoing stand off may see more invested into Sharp-Hon hai vehicle
- Sony clearly has a range of choices open to it. Here we show the option that has most recently been in the press
- Apple may seek to retain strong relationships with a number of the clusters from CMI-Hon Hai-Sharp to LGD and Japan Display
- Might expect to see other moves by Chinese brands and ODMs to secure panel capacity with more than just assembly JVs

Potential speculative groupings: Selected players and relationships

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- Potential development of eight clusters, six with potential or actual OLED capabilities and two based on LCD capabilities
- Not clear yet whether Japan Display will come to the table with plans for OLED
- For now, Apple has strong relationships with LGD, CMI-Hon Hai-Sharp and Japan Display (through prior business with TMD)
- Perhaps not so clear out of this: how Google and its allies (Android platform) will manage their display sourcing
- What AUO will now do is not clear. Recent Sony-Panasonic announcement does not include them for now, despite rumours



Display
maker



EMS/ODM



Corporate

Market restructuring: Summary

- LCD business is deep into the end-game.
- A transition to AMOLED transition has begun but compared with the start-up of LCD, there fewer “technology donors”, less coordination of material-tool roadmaps and tighter financial markets.
 - There are more players who want to enter OLED than those with the requisite competencies.
- EPD companies and products may have reached or passed their peak value. This may be a cautionary tale for electrowetting or other low-power display technologies: color video always takes the high ground.
- The unfortunate effects of fungible fab assets may be exacerbated if IGZO is adopted widely: any IGZO fab could serve any market and spoil gains there.
 - A corollary to this is that Gen 2–5 fabs will soon have few economic options, even including conversion to touch panels. We wonder whether some fab equipment will move to new countries or find its way into OLED lighting operations.
- Some of the weaker, second-tier Taiwanese players will exit the flat panel display industry, effectively.
- We see Japan Display as a vehicle for cashing out on Japanese experience in the display sector as senior executives retire (the best story is the relationship of former TMD with Apple) and we see Sharp as the most valuable pivot point for remaining technology competencies.
- The language being used by LGD in particular with respect to OLED conversions is critically important: and for now the model that is being considered is fairly “capital lite”. That being said, conversions and optimisations are opportunities for specific vendors. This may move back towards an emphasis on some more green field capacity but the language from the majors on the economics of doing so is worth monitoring.
- We see moves by SDC as a sign that they want to play a new game in OLED, but long standing behaviours from players are hard to change and we will be looking for the new green shoots of new moves.

Our services:

Growth strategy <ul style="list-style-type: none">• Market entry strategy• Business unit strategy• Growth strategies for new technologies	Performance improvement <ul style="list-style-type: none">• Product portfolio management• Pricing strategy• Cost reduction	Equipment and Capex <ul style="list-style-type: none">• LCD/OLED factory capex decisions• Strategies for equipment makers	Sourcing strategy (Purchasing) <ul style="list-style-type: none">• Sourcing strategies, especially LCD and medical detectors• Make/buy decisions
Technology strategy and technology assessment <ul style="list-style-type: none">• Market and commercial strategies for new technology businesses• Market tracking services for corporates monitoring technology	Partnering and alliances <ul style="list-style-type: none">• M&A candidates and assessments• Alliance formation support• Post merger integration planning	Professional advisory and business planning <ul style="list-style-type: none">• Specialist insights for bankers, equity investors and other consultancies• Reviews of business plans and models (Strategic audits)	Strategies for materials providers <ul style="list-style-type: none">• Strategy support for materials providers in the FPD, SSL, and PV markets• IP and pricing plans