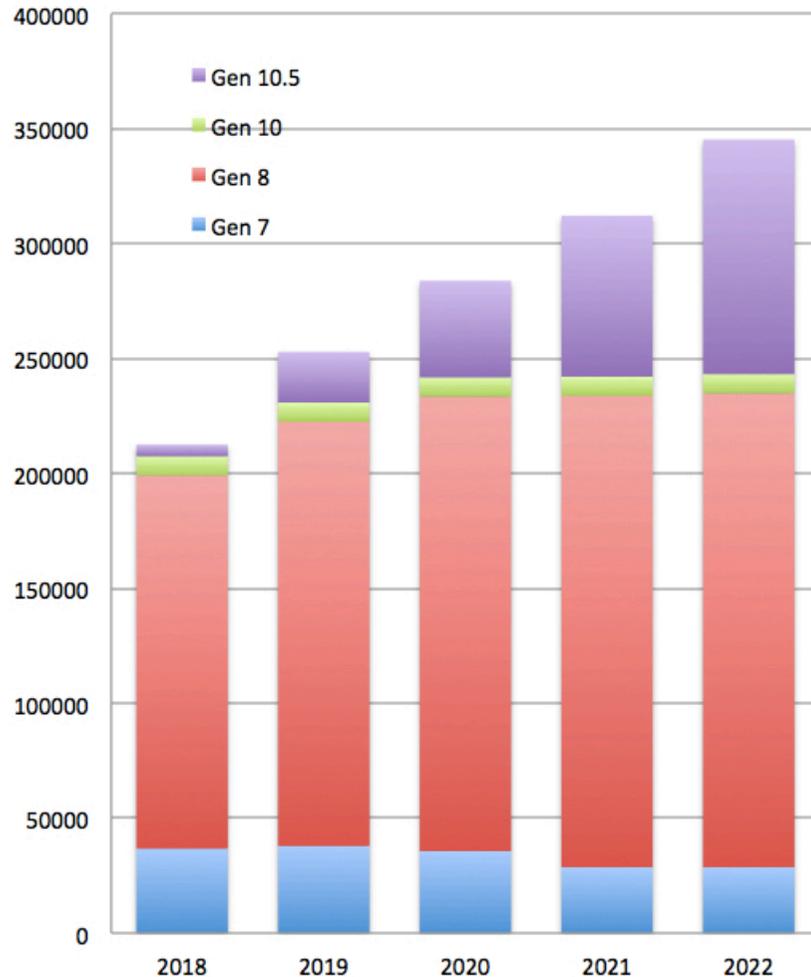

The impact of Gen 10 fabs on the display industry
10 strategic factors to consider in the industry realignment
that will occur

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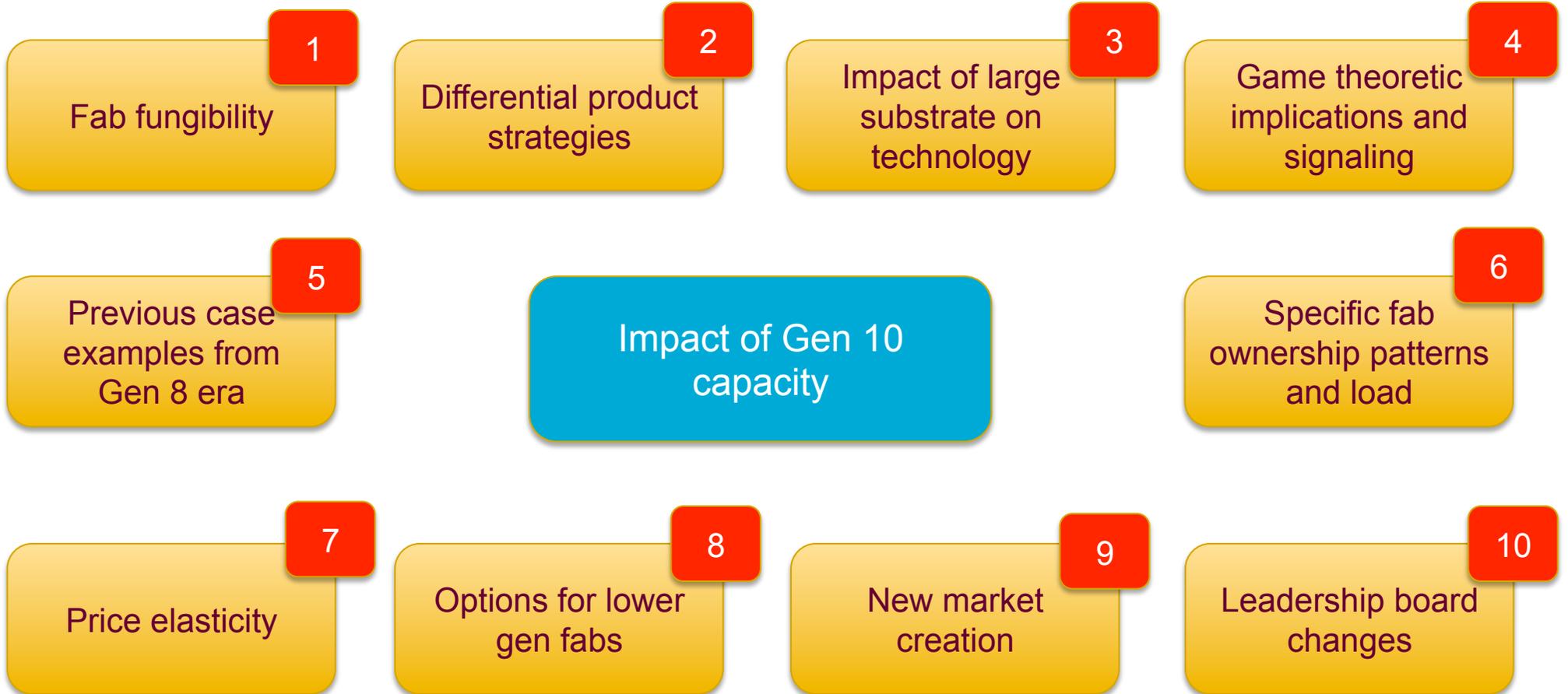
Context: Scale of Gen 10 roll out

Large panel input capacity by Gen size m2 k



- Gen 10 fabs only make sense when considering displays > 65 inch and are particularly strong for this (8 up, 94% efficiency)
- All of the following companies have been thought to be considering large Gen 10.5+ fabs: Samsung, LGD, BOE, Foxconn, HKC, CEC Panda. HKC may have abandoned their plans
- Frankly we find this roll out unprecedented with the large panel business potentially adding an extra 60% to the area of the large panel business over only a small number of years. We are concerned that this “fungible” display capacity (that is can be reallocated to almost any production) could then destroy the economics of the factories that are smaller
 - Note that the Gen 10.5 capacity is more than the Gen 7 capacity that could be withdrawn
 - If this happens then this could produce economic pressure on all Gen 8 facilities also

How can we think about what the impact of this will be: Strategic framework: 10 factor model



1

The first issue we should discuss is fab *fungibility*: larger Gen fabs destroy value in the display market since they can serve all markets

	Gen 4	Gen 5/6	Gen 7	Gen 8	Gen 10
Smart phone	✓	✓	✓	✓	✓
PC iPad	✓	✓	✓	✓	✓
Monitor		✓	✓	✓	✓
TV			✓	✓	✓
Large TV					✓
Others	✓	✓			✓

- Different substrate classes do serve different products to different degrees of glass use efficiency (See next slide) but the big picture is that on the whole the larger gen glass is more versatile. Sharp has even used Gen 8 glass to make smartphone displays despite there being a large number of these per substrate (600 roughly)
- On the whole large gen substrates destroy the economics of multiple markets
- This is a slight exaggeration but for our purposes still important to say

2

Then we should be aware of the product implications of different substrates. On the margin these do make a difference. Gen 10s support 65 and 75 inch particularly well

	Gen 7	Gen 8	Gen 10
32"	12 up 77%	18 up 92%	32 up 91%
40"	8 up 80%	8 up 64%	18 up 80%
42"	8 up 89%	8 up 71%	18 up 88%
55"	3 up 57%	6 up 91%	8 up 67%
65"	2 up 53%	3 up 64%	8 up 94%
75"	2 up 71%	2 up 56%	6 up 94%
5-6" Smartphone	450 up 95%	578 up 97%	1040 up 97%
iPad (9.7 inch)	143 up 95%	176 up 93%	323 up 95%
Monitors (21.5 inch)	32 up 93%	40 up 93%	72 up 93%

3

Impact on technology development: Gen 10s will be major company changing events for each one deployed

- Large Gen 10 glass will have several infrastructure implications
- Firstly we note that Gen 10 facilities will be very coordinated campus projects including local Gen 10 glass supply
- Moreover, once we are talking about very large glass we assume that there will be more interest in sheet level wet processing
 - Role of coating may go up against sputtering
 - Role of sheet level wet processes (e.g. on sheet polariser)
- May be some additional interest in the technologies needed for super premium TV (and perhaps also for low cost TV)
 - QDCFR, oxide and other mid performance semiconductor conversions
- May be some additional interest in the technologies needed for signage and education panels and perhaps video-walls
 - Narrow bezel technologies
- Since prices may fall abruptly these fabs may be streamlined to serve a product class very efficiently

On site glass

Sheet level coatings

Mid perf
semiconductors

Premium technology

Narrow bezel

4

Game theoretic and signaling elements of this problem: Signaling will have some impact but market behaves irrationally

- It is worth noting that the announcement of fab projects can be seen in a game-theoretic manner
 - Players are signalling to each other their commitments to market share positions
- That being said, this market does not behave rationally
 - Often we see 2-3x the amount of capacity the market should require being put into place
- On top of this there is a crystal cycle dimension to this problem (although less pronounced than it used to be)
 - Players try to ramp up new factories into periods of increasing prices
 - Once large chunks of capacity have started ramping this tends to lead to short term price erosion and then later projects are withdrawn due to lower pricing. Over the coming 2-5 years capacity is withdrawn but slowly
- Overall we might not expect to see all of this capacity being put into place that has been announced as later players consider their actions in light of the new pricing environment
 - A fab makes most of its FCF in years 2-5 after launch: so if this is reduced then projects can look unfavourable

Signalling

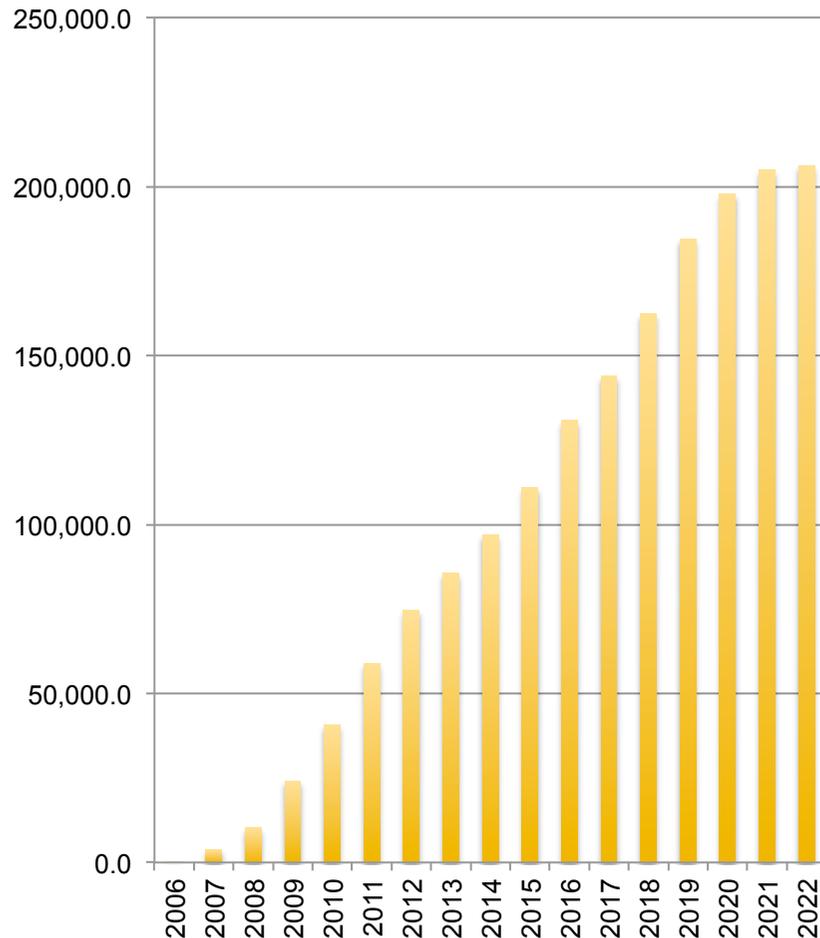
Irrational behaviour

First projects will
alter market pricing
for followers

5

What previous case studies do we have about this sort of level of capacity build up? The Gen 8 pile in is still happening and trickle down to cause fab closures takes years

Input capacity m2 000s



- Let's go back and look at the period of the last major build up of capacity (2008+) for Gen 8
- The implication of this was the following impact
 - Pressure on Gen 2-4 fabs. First Gen 1/2 fabs started being withdrawn from 2008-2009 in serious numbers. Gen 3 fabs start being withdrawn from production from 2010 in serious numbers. Gen 4 start being withdrawn in serious numbers from 2016 onwards in serious numbers. Note that it does take quite a while for the impact to force closures (see later slide 11)
 - Price erosion of 32" and 40-42" panels in particular
- The insight here is an important one: massive waves of new capacity lead to factory closures *2-10 years later*

6

The different players will be impacted differently. Small Gen 7s are the most vulnerable in our view

Capa k/ month	Gen 5	Gen 6	Gen 7	Gen 8
Samsung	190k AMOLED	160k AMOLED	165k LCD	363k LCD
LGD	65k LCD	55k LCD 60k LTPS/ OLED	230k LCD	530k LCD 66k OLED
AUO	255k LCD	270k mostly LCD	175k LCD	139k LCD
Innolux	550k Mostly LCD	360k LCD	140k LCD	115k LCD
BOE	126k LCD (a-si and LTPS)	80k LCD	-	550k LCD
CSOT	-	30k LCD	-	290k LCD
Sharp	-	23k LTPS	-	60k LCD

- The players will be differentially effected based on the factories that they already have
- Overall we see small Gen 7s as being the most vulnerable and small Gen 5 fabs (not yet converted to OLED)
- We expect Samsung to actively pursue options for their Gen 7 capacity (having already shut down some capacity of this sort). We wonder what AUO and Innolux will do with their Gen 7 capacity. Perhaps consider conversions for QDCFR?

7

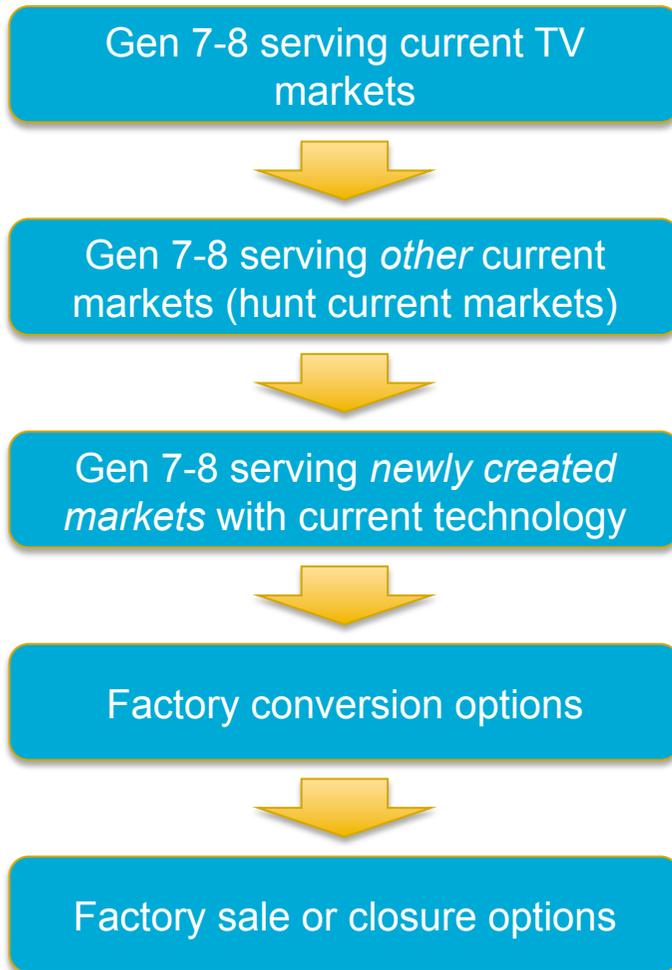
We will need to understand price elasticity: what will tend to happen is rapid drops in pricing on large and smaller panels

- In general periods of massive capacity expansion are accompanied by rapidly declining prices (across all panel types)
- The target panel types that fit the new capacity (Gen 10) start priced as premium product but producers rapidly reduce pricing to fill the total capacity
 - We expect to see heavy price declines for 65 and 75 inch class panels as Gen 10s roll out
 - Players always over estimate the number of high end panels a factory can support: the reality tends to be that they load the fabs with a whole range of smaller panels too
- These dropping prices enable demand growth at higher panel sizes and pricing then needs to be lowered at smaller panel sizes to clear the volume
 - Expect downward pressure also on all other classes of TV panel

8

Gen 7/8 Fab owners will seek new uses of capacity, conversions or sale. Closure of capacity is less likely

Decision hierarchy



- If you are the owner of a current Gen 7-8 fab then what are your strategic options?
- Well if you are the strongest player then you can continue to serve current TV markets with the capacity
- If not then the first thing you consider is serving other current markets, and then the next option is to try to create new markets based on current technology being used on the fab (e.g. 4 mask BCE), Jumbo iPads, new education displays and others
- If these options are not available then you consider factory conversions and then if not asset sales (to others, e.g. in India) or relocations
- Final option would be to consider a factory closure

9

We will see some attempts at new market creation to help offset the problem

Signage

Education panels

Video walls

Retail channel
giveaways to push
demand for large TV

- We have seen this case before: Sharp tried experiments to move more panels from its Sakai Gen 10
 - It tried to help create education markets and large signage markets to help shift volume
- Moreover, we have heard about BOGOF (Buy one get one free) type retail strategies aimed at moving sets in China
- We would expect to see many such efforts as players seek to push the quantities down the channel
 - The other direct implication of course will be the drop of panel pricing across the board (and down to, and sometimes below material cost) to the clearing price

10

Leadership board changes as a result of these very large chunks of capacity

	Impact
BOE	↑
LGD	↑
Samsung	
CSOT	↑
Foxconn (Innolux+Sharp+)	↑
AUO	↓
Innolux	↓

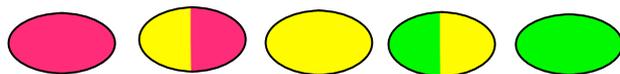
- Each of these Gen 10s represents about **3% of total industry capacity** (60k/month fab)
- LGD, CSOT and BOE are key committed players to early Gen 10s with others considering or moving forward their plans (including Sharp/Foxconn)
 - Net result is a move up the leadership board for the Chinese players. One wonders if this is the last round of player realignment or whether a new country will pick up the baton next

Things that we think likely: a choppy period of difficult market realignment and lower prices overall

- Firstly, not all of this Gen 10 capacity will come line on line. The first Gen 10 players to market are more likely with the later capacity additions less likely
- However, enough new capacity will come on line to cause very real problems to owners of Gen 7 and 8 capacity
 - The weaker fabs and players will feel the pressure first (Mostly AUO and Innolux). Those players small Gen 7 fabs and weakest channel links may feel most pressure
- Based on what we have seen in previous cycles then this will create quite a bit of market chaos for the short *and* long term
 - Tumbling prices for many types of panel short term, and then capacity realignment long term
- We believe the winners here will be the Gen 10 builders with the strongest channels to premium large TV and education panel markets
 - Next will be the Gen 7/8 owners who have the strongest commercial load and those that move first with market strategies to keep load on these fabs or convert to new technologies. This is not a time for inaction. First movers win
- Overall though these moves will still be on the whole value destroying for the display industry and the net beneficiaries are consumers
- This will be a noisy and difficult period of realignment over 5+ years: first movers will win

Implications overall through the value chain

- Gen 10 fabs will represent a great opportunity for the equipment industry and for consumers
 - Massive new capex bubble and much cheaper displays of many types
- For materials players perhaps the outlook will be slightly positive
 - More volumes but potentially at higher rates of downwards price pressure
- For the display players, on the whole we see this move as fairly negative
 - Lots of excess capacity tends to lead to rapidly worsening results
- We expect a choppy future with uncertain changes in profitability and fab loading as this rolls out
- If you would like to understand what the impact of this will be for your organisation, please contact us



Impact	
Equipment	
Materials	
Display players	
Brands	
Consumers	

Our 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