

LCD or OLED: Who Wins?



The SID Symposium at Display Week 2013

— David Barnes, BizWitz LLC db@bizwitz.com

Introduction to non-managerial accounting:

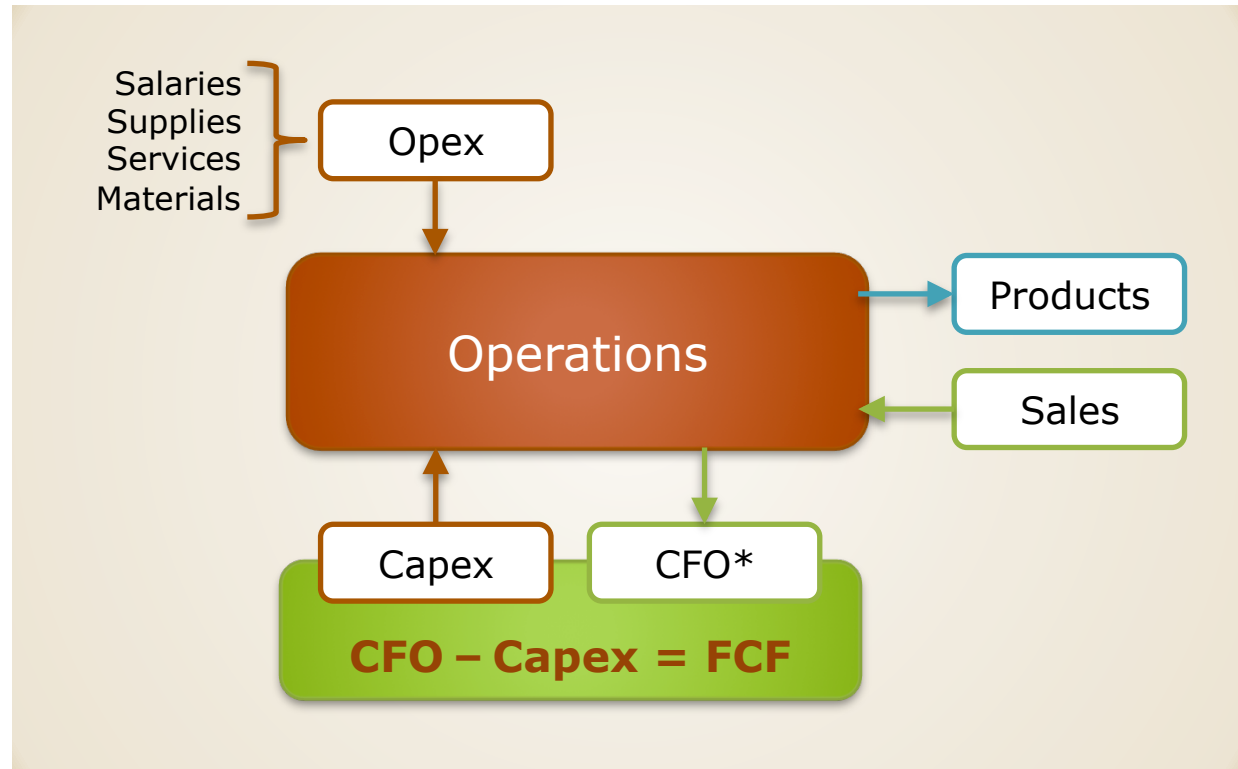
Free cash flow is what security holders get.

From a financial point of view, what matters is the free cash flow (FCF) a business generates for its stakeholders.

If cash flow from operations is less than capital expenditures, stakeholders see money flowing out of their pockets, which is the wrong way to make stakeholders happy.

Employees, suppliers and societies may benefit, despite negative FCF, which is why governments might support unprofitable businesses for a while... In the meantime, consumers often benefit the most from good prices for great products.

Cash Flow Model of Business Operations



*CFO is cash flow from operations, which is Sales minus Opex, basically.
Note that depreciation is not on this chart because it is not an expense, really.

From that point of view, the sum of Taiwanese LCD makers has disappointed stakeholders.

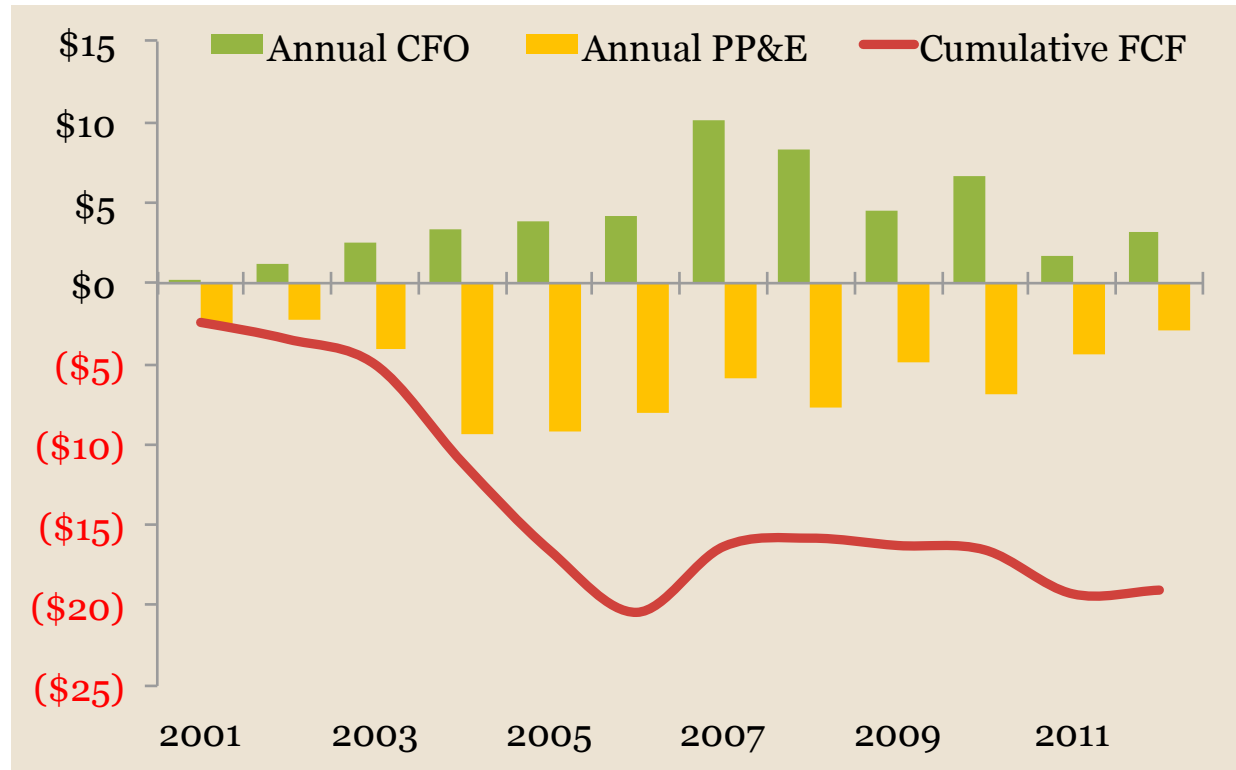
We can add all the results from Unipac to Innolux, from 2001 through 2012, to see these cumulative results:

Sales	\$307.5 b
Net Loss	(\$7.3 b)
Capex	(\$68.4 b)
Op Cash Flow	\$49.4 b
Free Cash Flow	(\$19.1 b)

Yes, from 2001 through 2012, Taiwan's LCD makers shifted \$19 billion from stakeholders to suppliers and employees...

Not a bad deal for Taiwanese society and global consumers but the LCD business was not supposed to be a charity.

Taiwanese Panel Maker Results, 2001–2012



Charts ten LCD producers' financial results in billions of US dollars

Source: public disclosures; BizWitz analysis

The problem is not all in Taiwan of course... all display area prices fall faster than costs.

We can combine results for two leaders in US dollars based on display area sold.

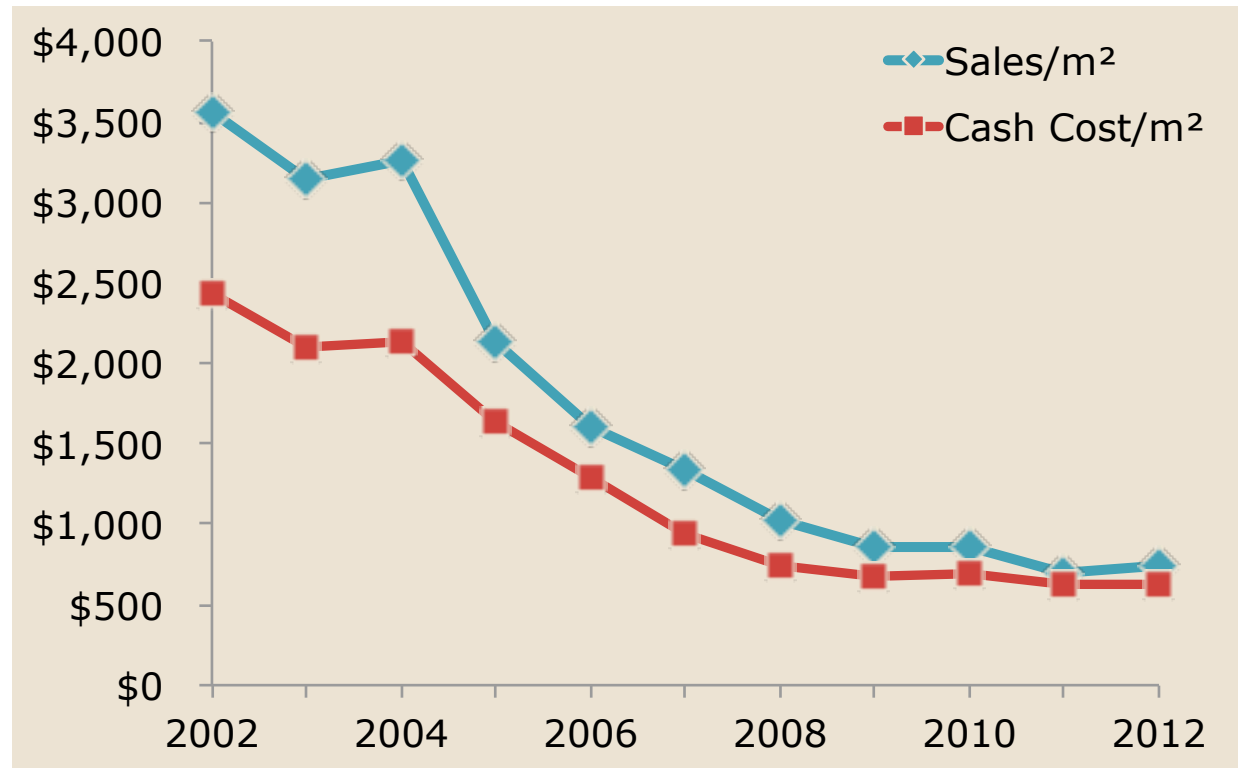
Their areal price falls about 17% a year while their area opex falls about 15% a year.

I have seen the same 2-point spread for all makers since the 1990's. It was only a matter of time before cash profits fell below the capex level...

Bringing the era of rapid capacity expansion to a close.

It may take many years of near-zero capex for AMLCD makers to accumulate positive free cash flow (FCF).

Area-based Sales and Cash Cost for AUO+LGD



Divides USD revenues and costs without depreciation by display area sold

Source: public disclosures; BizWitz analysis

The typical response has been “Technology!” ... but what has been the financial effect?

Financial results for various producers in different nations look similar.

They put similar materials into similar equipment to make similar products sold to similar customers who serve similar applications.

Most of what we talk about at SID makes little difference.

Well, sure it does... consumers get better displays!

For stakeholders, however, nothing seems to improve.

That’s because there is no real technology differentiation in AMLCD... and little product distinction, either.

Financial Effects of so-called Technologies

“Technology”	Strong Effect	Weak Effect
TFT structures	◆	
LC optics	◆	
Color filters	◆	
Photolithography	◆	
IPS vs. MVA		◆
Small vs. Large		◆
OLED structures	◆	

Source: BizWitz analysis and experience

If technology and scale mattered, the output/input function would not be linear.

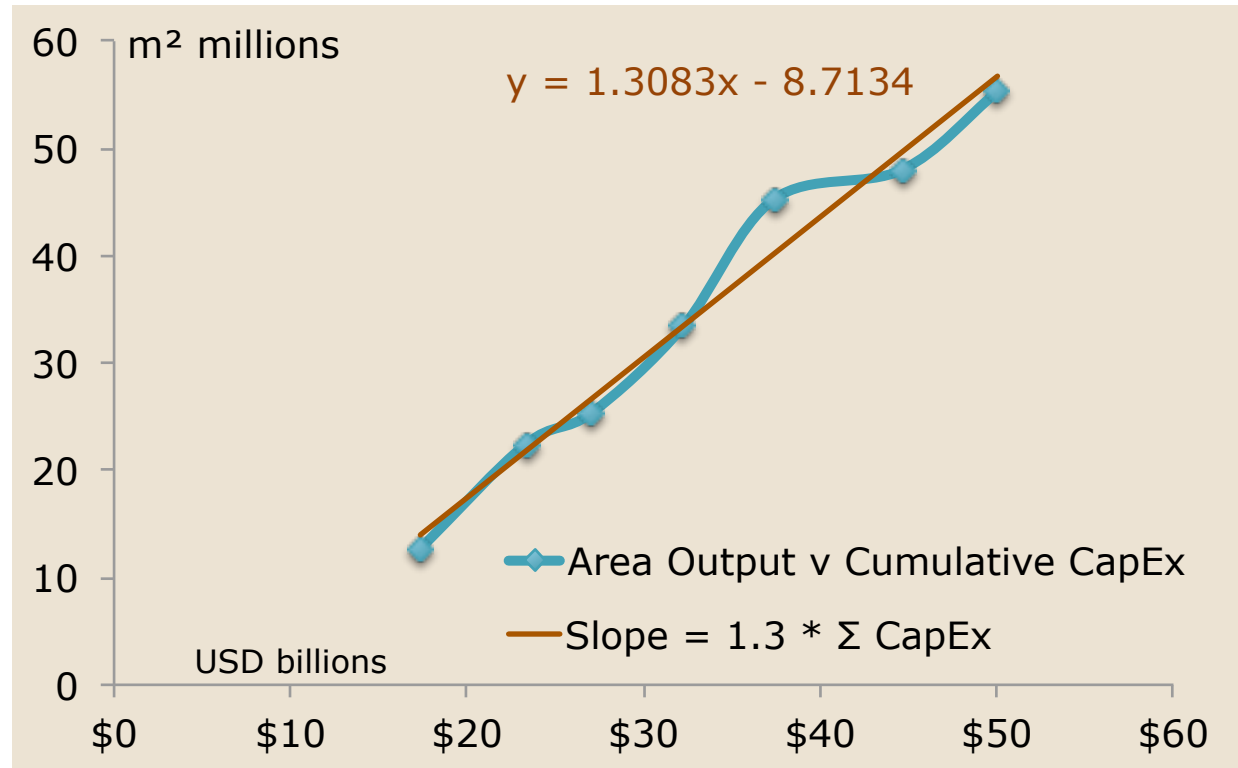
If we look at how much display area AUO and LGD ship using capex spent in prior years, we see a line.

It takes \$1 billion of input this year to get 1.3 million more square meters of output next year.

Economies of scale would bend this curve up so that producers got more from smaller amounts of capex.

There are no economies of scale, except for negotiating power over suppliers that might reduce material costs.

Display Area Output per Capex Input for AUO+LGD



Millions of m² sold versus millions of USD in cumulative capex (lagged 1 year)

Source: BizWitz analysis

Technology has changed little, so material cost still dominates the full cost of product.

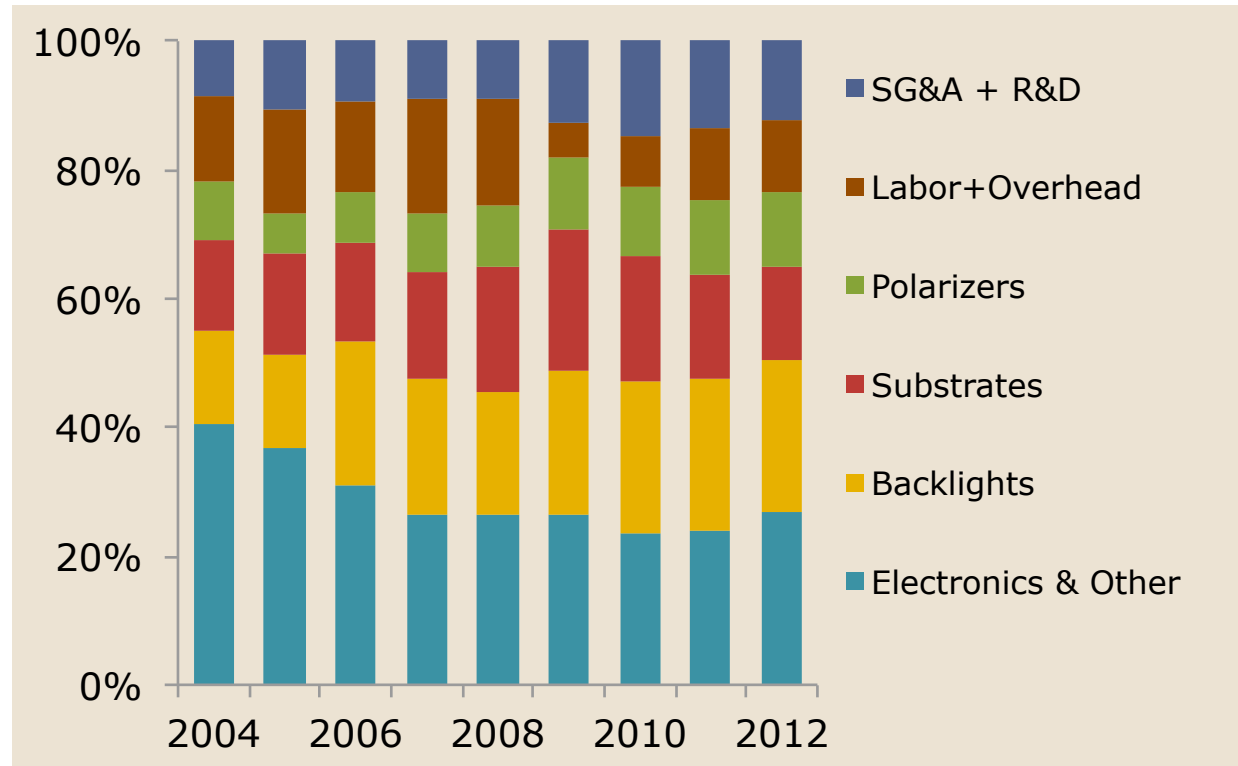
LG Display discloses their material purchases, so we can see the composition of their cash cost is dominated by materials, which comprise 77% of total cash cost.

Electronics and other parts have become a smaller portion of cost since 2007 but the cost of better backlights has gone up with display performance.

More important, we can see organizational expenses (R&D and SG&A) become more important when LGD shifted more capacity to mobile apps after 2008.

This implies that small panels won't solve the problem.

Cash Cost of Product Composition for LGD



Tracks the composition of cash costs for LGD, 2004–2012

Source: public disclosures; BizWitz analysis

The domination of material costs reduces the benefit of operational learning curves.

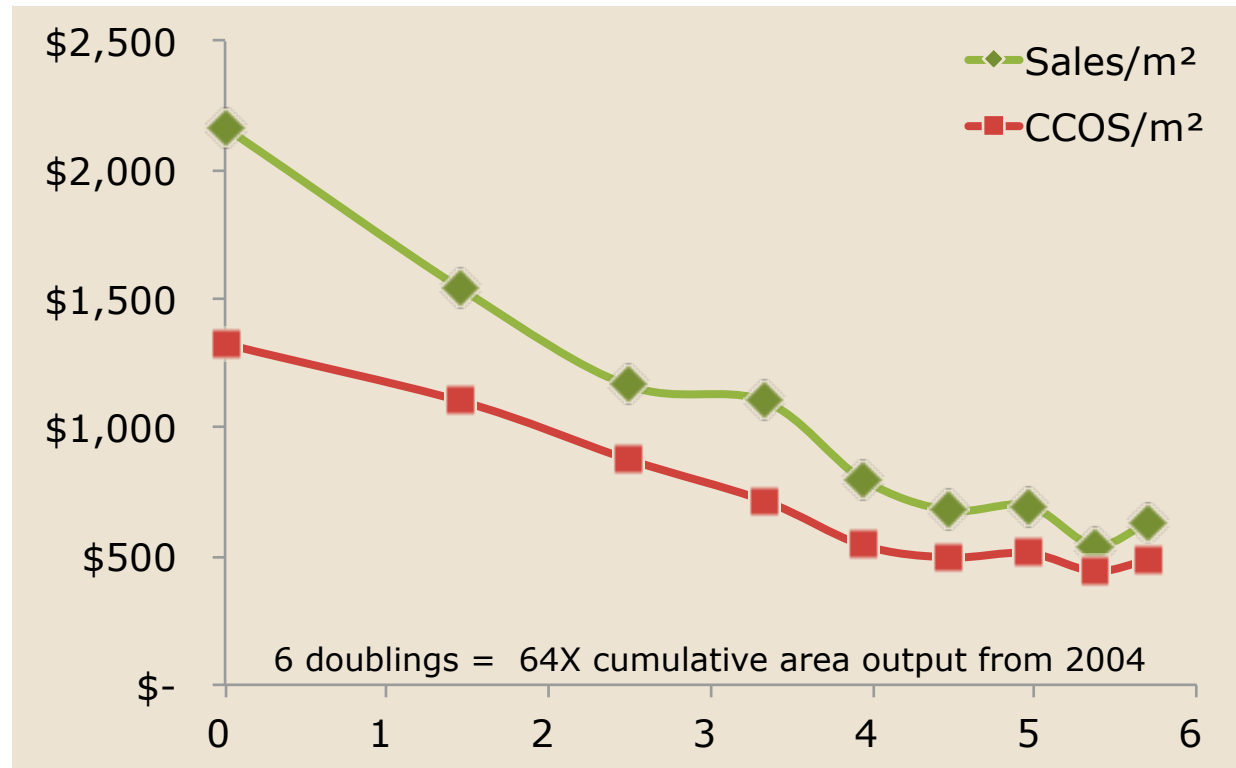
We can see the effect of no real change in technologies and the continued dominance of materials in the cash cost of sales, which reflects factory running (variable) costs.

In earlier years, each dot is a year's worth of data here, we see a linear decrease in price and cost as the output doubled... a typical learning curve dynamic.

After 2008, the learning slowed down. It did not keep pace with experience...

AMLCD makers are giving suppliers and employees all they can and making more does not help investors.

Area Price and Cash Cost of Sales Development for Each Doubling of AUO+LGD Area Output



CCOS is COGS less depreciation charges (ignores organizational expenses).

Source: public disclosures; BizWitz analysis

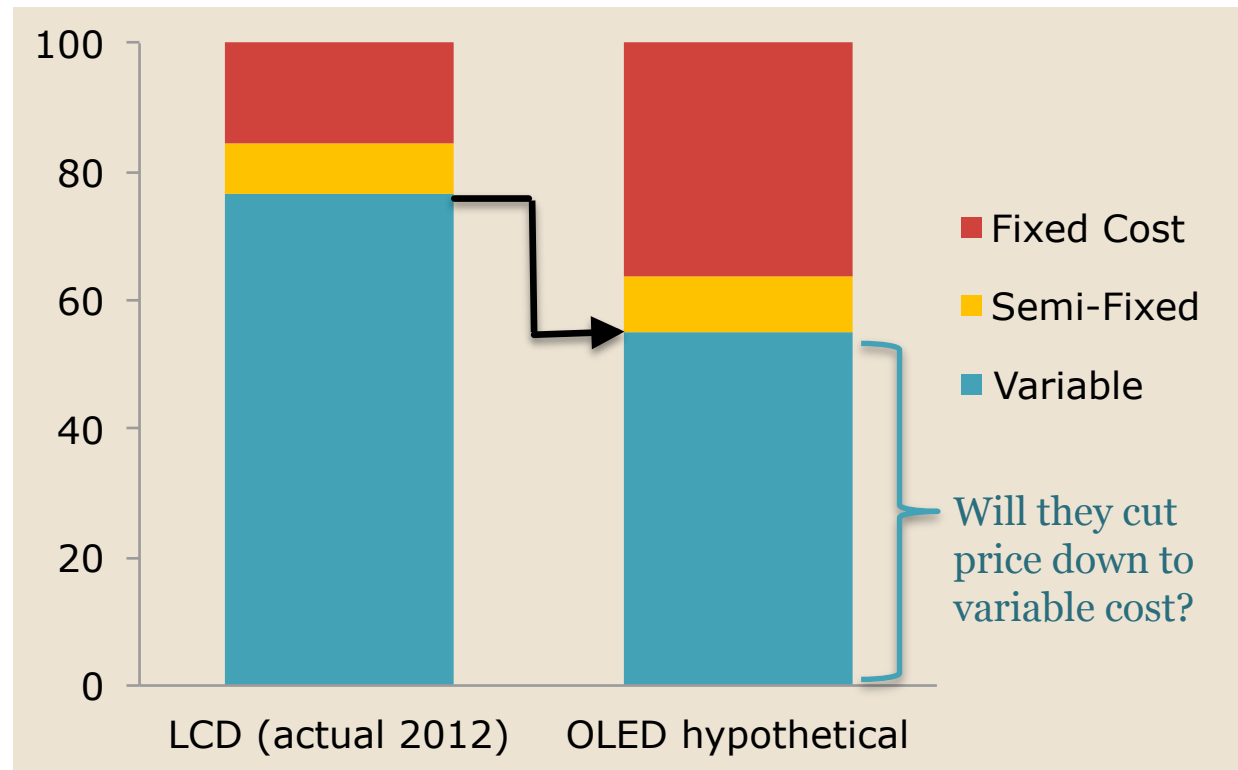
Let's bring depreciation back into the picture... will making OLED help?

Splitting LGD's actual cost of product in 2012 into fixed and variable categories, we see that semi-fixed costs such as sales and logistics are only 8% and that depreciation or fixed costs are 16%. The rest is variable cost that doesn't get much better with scale.

If gearing-up for AMOLED multiplies depreciation by 2.5 but reduces the variable cost contribution by 25% to 30%, then AMOLED makers may be able to keep more of their sales revenues and to enjoy more profits...

But can they, will they, keep prices at premium levels?

What If OLED Had 2.5X Fixed Cost Over LCD?



Plots a hypothetical 100 units of product cost contribution for AMLCD in 2012 and a hypothetical case of AMOLED with 2.5 times more fixed cost.

The question is then whether OLED makers trade-away their fixed costs for market share.

In the past, we have seen LCD makers trade-away their fixed costs and price down to their variable cost, or less... hoping to keep or raise their share.

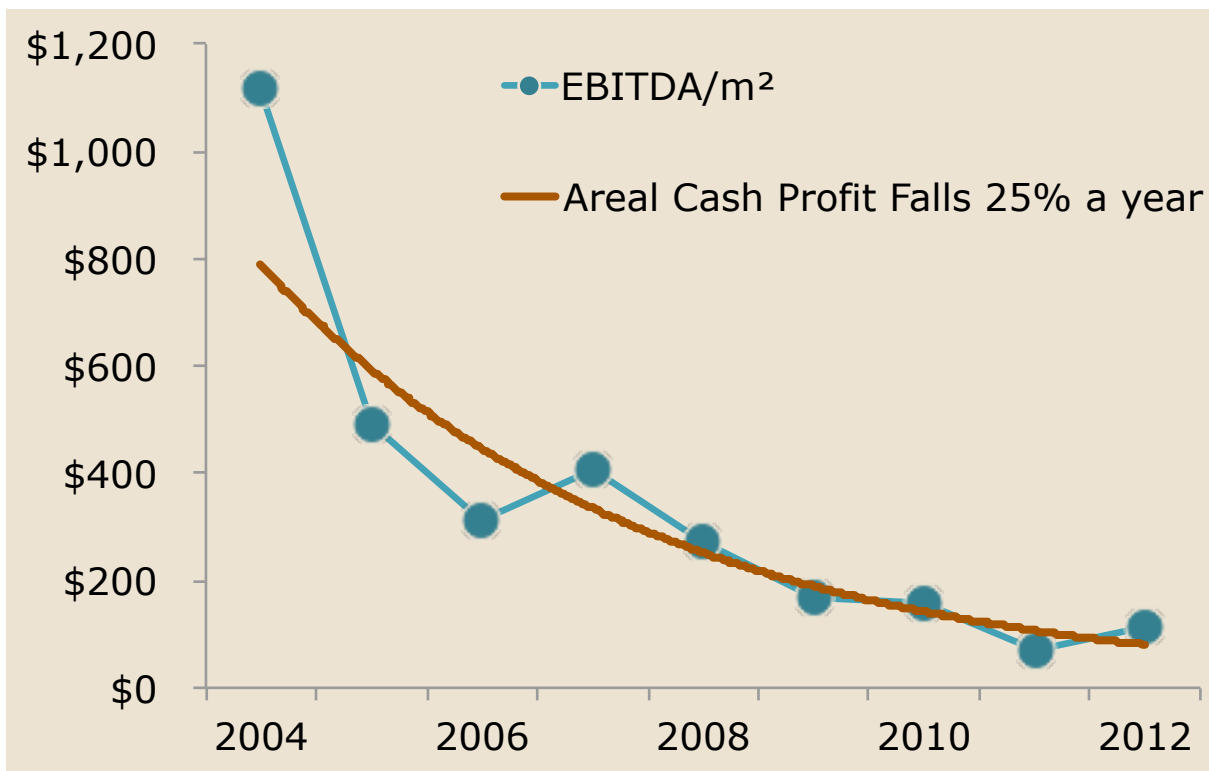
We have seen cash operating profits (EBITDA) fall 25%/year through good times and bad...

Why should we expect the market behavior to change for OLED technology?

If OLED makers trade-away their fixed costs, they will face even greater losses!

OLED growth makes things better... if there are only one or two producers who keep the prices and profits high.

EBITDA/m² for AUO+LGD Is Falling 25% a Year



EBITDA is earnings before income tax, depreciation and amortization... a proxy for operational cash flow. Source: public disclosures and BizWitz analysis.

Control over market price levels depends on the producer concentration and competitor rivalry.

Lanchester theorems provide a way to predict how a market behaves based on the number of producers.

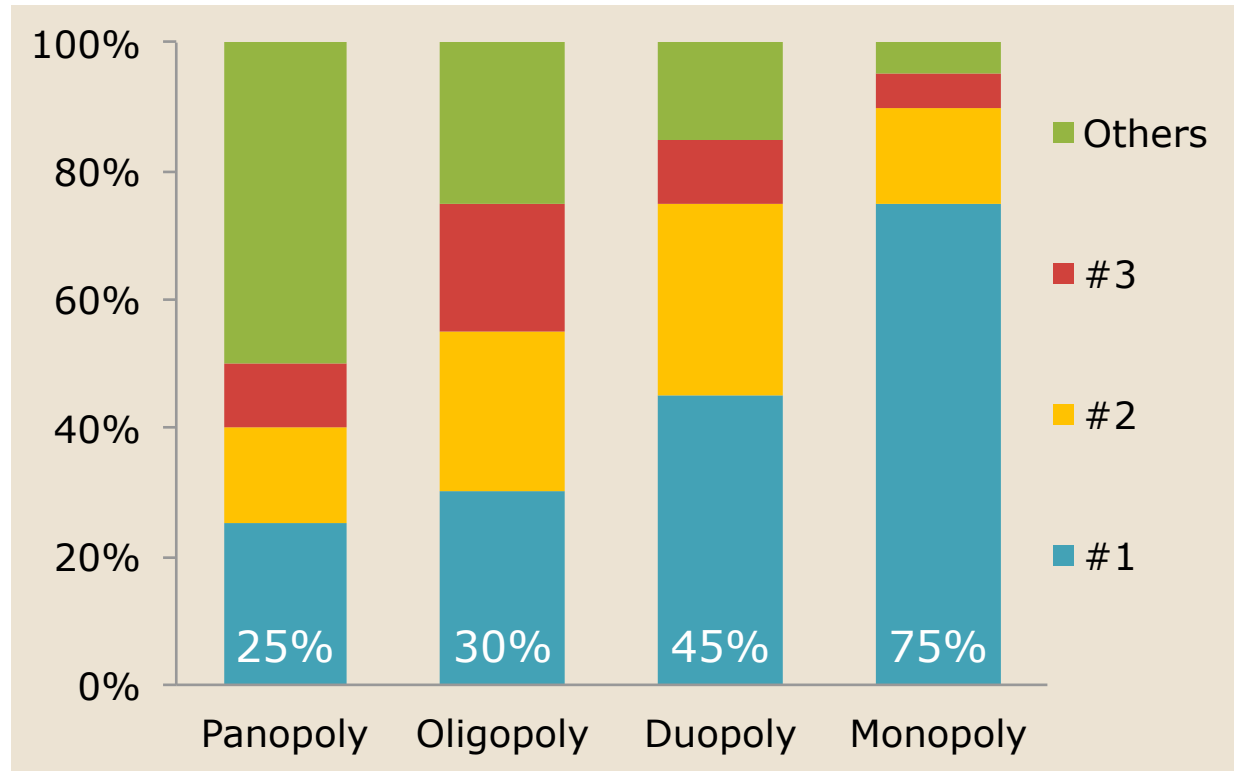
Most markets evolve stable structures based on a few distributions of capacity shares...

Industrial capacity can be considered to be the “fighting strength” of competitors.

Pricing control is strongest in a monopoly and weakest in a panopoly... like LCD today.

Efforts to create a unique, proprietary OLED capability make sense... price premiums allow only 1 or 2 producers.

The Leader's Market Share in Various Markets



Source: Lanchester Theory; BizWitz analysis

So far, consumers have paid less to buy more... can multiple OLED producers survive?

We can see how price depends on demand for LCD... it is a power function as economic theory would expect.

The more producers make, the more they have to cut their price. Consumers seem to behave rationally, overall.

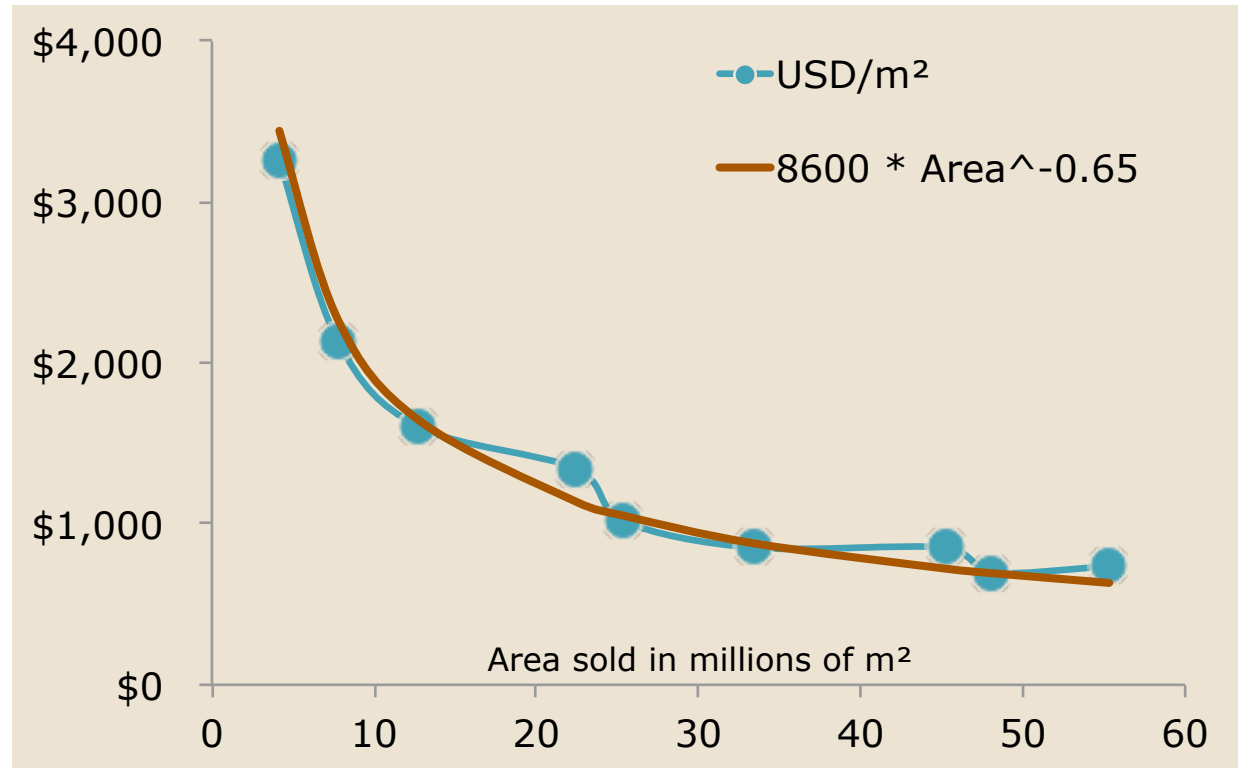
Why are they going to pay more for AMOLED?

They may, but for how long?

Unless the market changes, AMOLED prices will have to follow this power function.

The more producers compete, the faster prices and cash flows approach the trend line.

Demand Function for AUO+LGD, 2004–2012



Areal price falls as a power function of area sold.

Source: public disclosures; BizWitz analysis

In summary then, consumers win, regardless of whether OLED wins or loses...

- LCD producers have not benefitted from scale.
 - Material cost structure is the biggest problem.
 - Rivalry without technology differentiation is a related problem.
- They must invest more to produce more, but they get less.
- LCD production is a non-profit business, overall.
 - Suppliers and societies may benefit from expansion.
 - Stakeholders see money flow out of their pockets... of course, if they are also customers or suppliers as in vertically integrated groups...
- LCD producers are reaching their credit limits
... so the stronger ones seek new opportunities in OLED.
- If OLED wins, prices will fall and consumers will win.
- If LCD wins, consumers still win.

FPD is a difficult business...

BizWitz analysts are here to help



Growth

- Market entry
- Business structure
- Phase gates, R&D

Performance

- Price position
- Cost reduction
- Portfolio balance

CapEx

- Factory plans
- Tool selections
- Plant conversions

Sourcing

- Make/buy
- Value chains
- Supplier selection

Technologies

- Market sensing
- Market & IP value
- Consortia synergy

Alliances

- M&A candidates
- Partnerships, JVs
- Integration plans

Plans

- Strategic audits
- Investor insights
- Business valuation

Materials

- Pricing policies
- Market strategies
- Licenses, royalties