LCD Limbo:
How Low Can You Go?

The SID Business Conference at Display Week 2013

— David Barnes

Yes, we need more LCD: There're ten non-poor BRIIC adults for every non-poor US adult

Demand is still infinite at the right price. "There's plenty of room at the bottom*."

Gross per capita GDP (PPP) is less in BRIIC markets: $7,340 versus $49,800 in US.

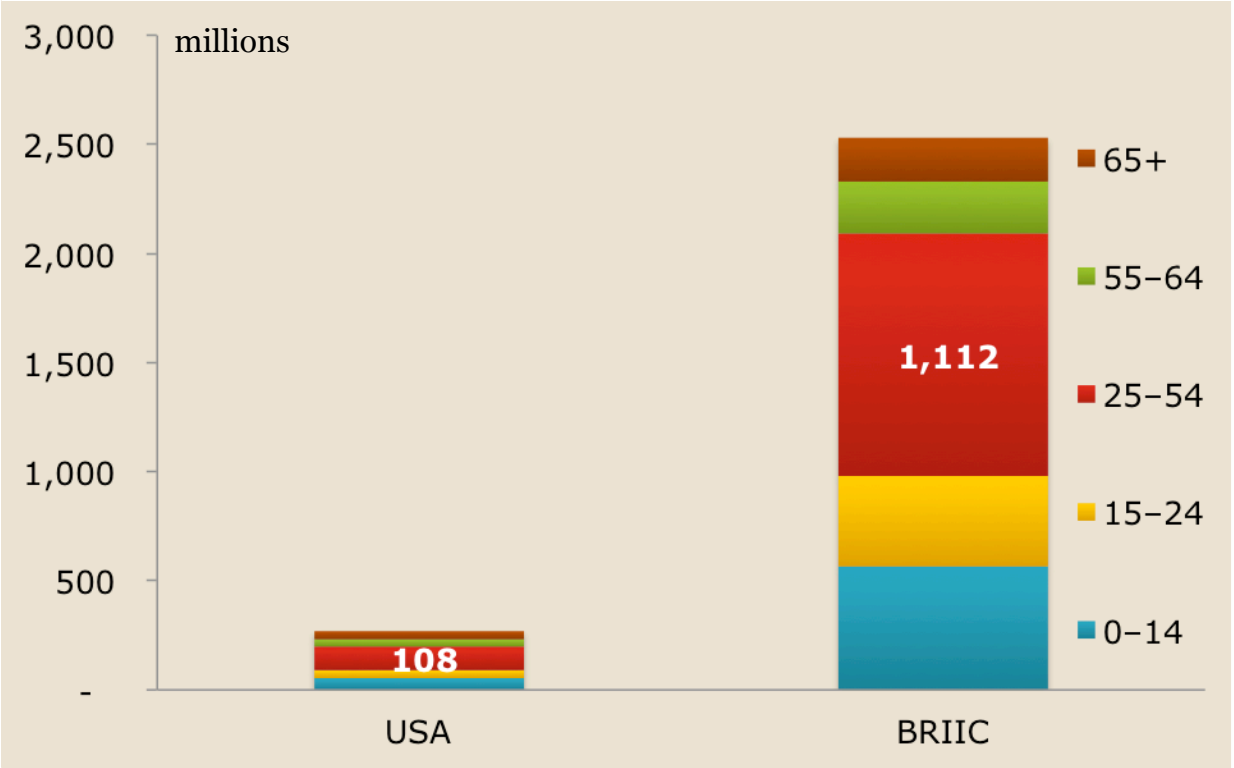
But even one-half of this BRIIC population represents pent-up demand… at a price.

The question becomes, who can serve this population with what capital… at what cost.

The answer for TV displays, which require large area capacity and hence large capital, is most challenging

…but first, we need to know what it will take.

Population Above Poverty Line by Age Cohort



Source: CIA Fact Book; BizWitz analysis

* Richard Feynman, 1959

Doubling the display area sold in 2012 implies a 37% reduction in the average areal price

AUO and LGD comprise more than one-third of the industry and report display area sold.

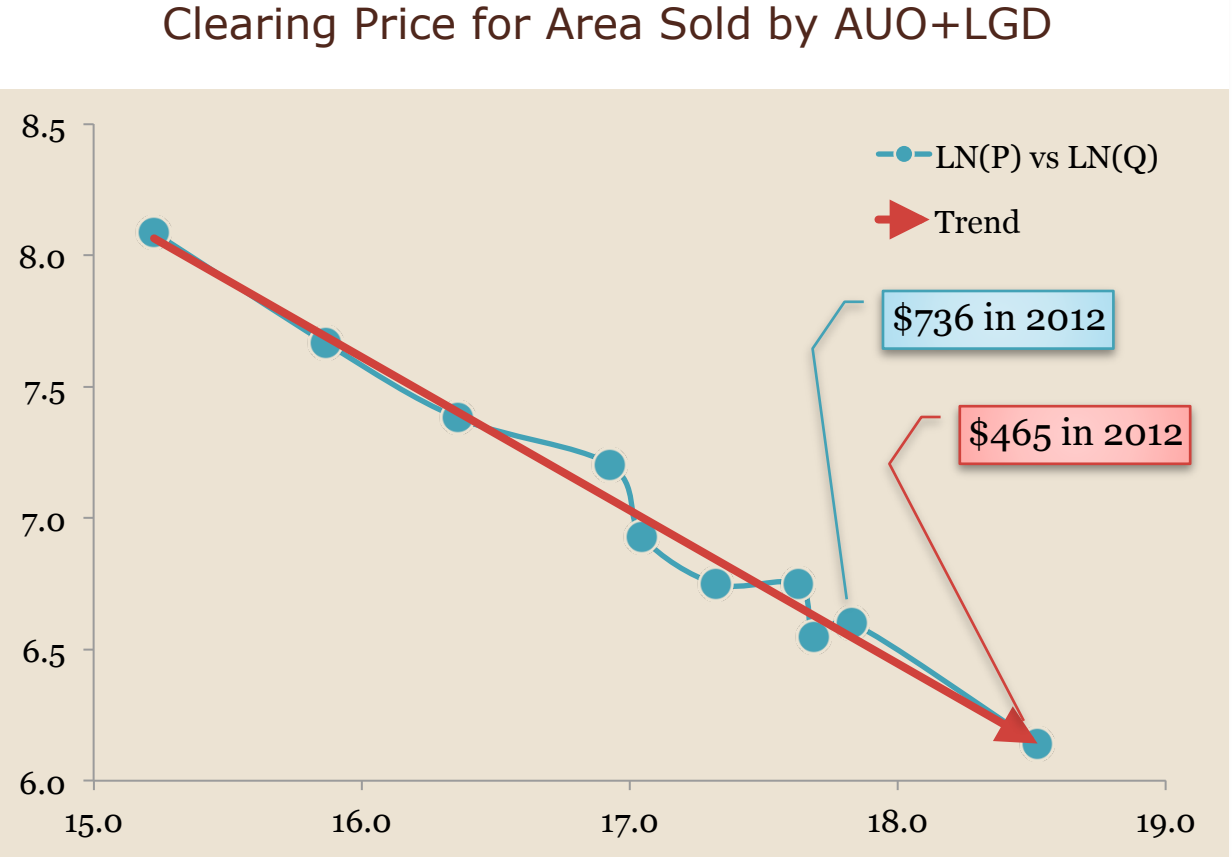
We can plot the relationship between their area price and their area output… and see what it would take to sell twice as much in the future.

Given results in 2012, the LCD producers would have to cut their cash cost of sales 53% to reach zero net profit.

Based on this, they need to cut material cost in half to obtain any net profit margin (NPM).

- 50% reduction for 0% NPM
- 60% reduction for 5% NPM

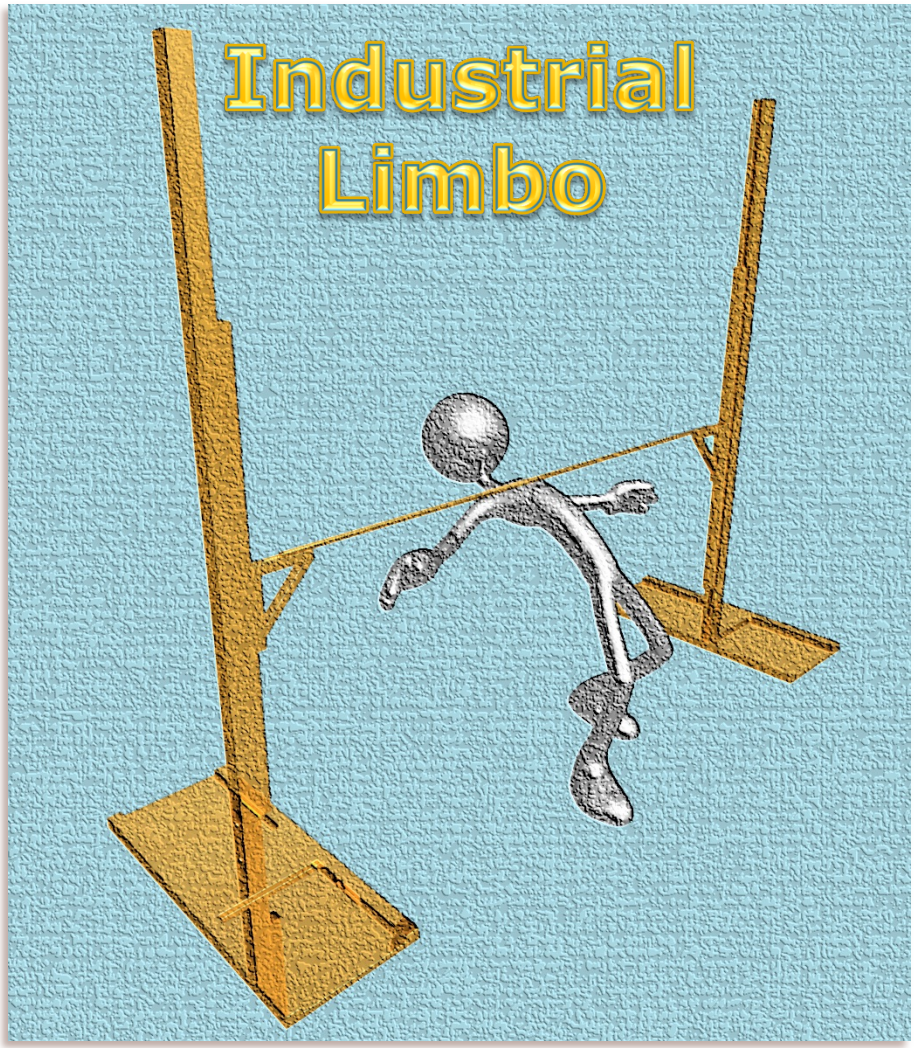
How can they achieve this?



Trend line of areal price versus area (log-log) connotes elasticity

Source: public disclosures; BizWitz analysis

How low can you go?
A new meaning for “flexible displays.”



- Capacity growth is slowing
- OLED TV looks exciting
- But, can big OLED keep trending?
- And what about the spending?
- Operating profits are vanishing
- Organizational expenses are rising
- Material costs are limiting
- How are the Taiwanese doing?
- Is consolidation helping?
- Is product mix helping?

You can go low if you go slow.

Capacity growth is slowing.
Cut ‘em smaller to make them go around.

Ten years ago, capacity was doubling every 22 months.

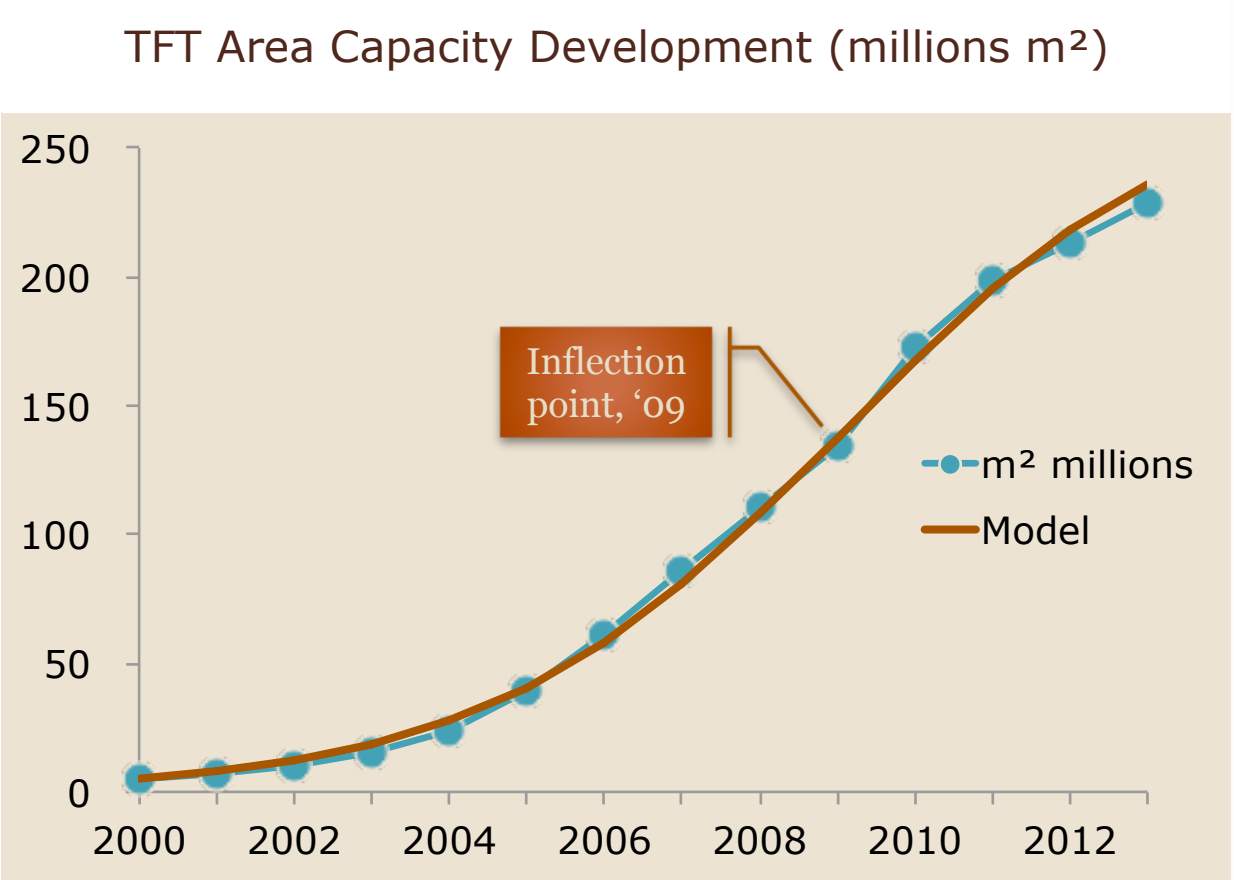
Today, it’s doubling every 117 months, about ten years.

No wonder small panels are popular: it’s the only way to get enough pieces out of the limited amount of new glass.

And it’s not just mobile, the typical TV is not as big as it was, either.

As we shall see, this is both good and bad for panel makers.

The broader question is how technology might save us…



DisplaySearch data and BizWitz analysis

Can big OLED for TV keep trending? Not if it a flash in the pan like LTPS was.

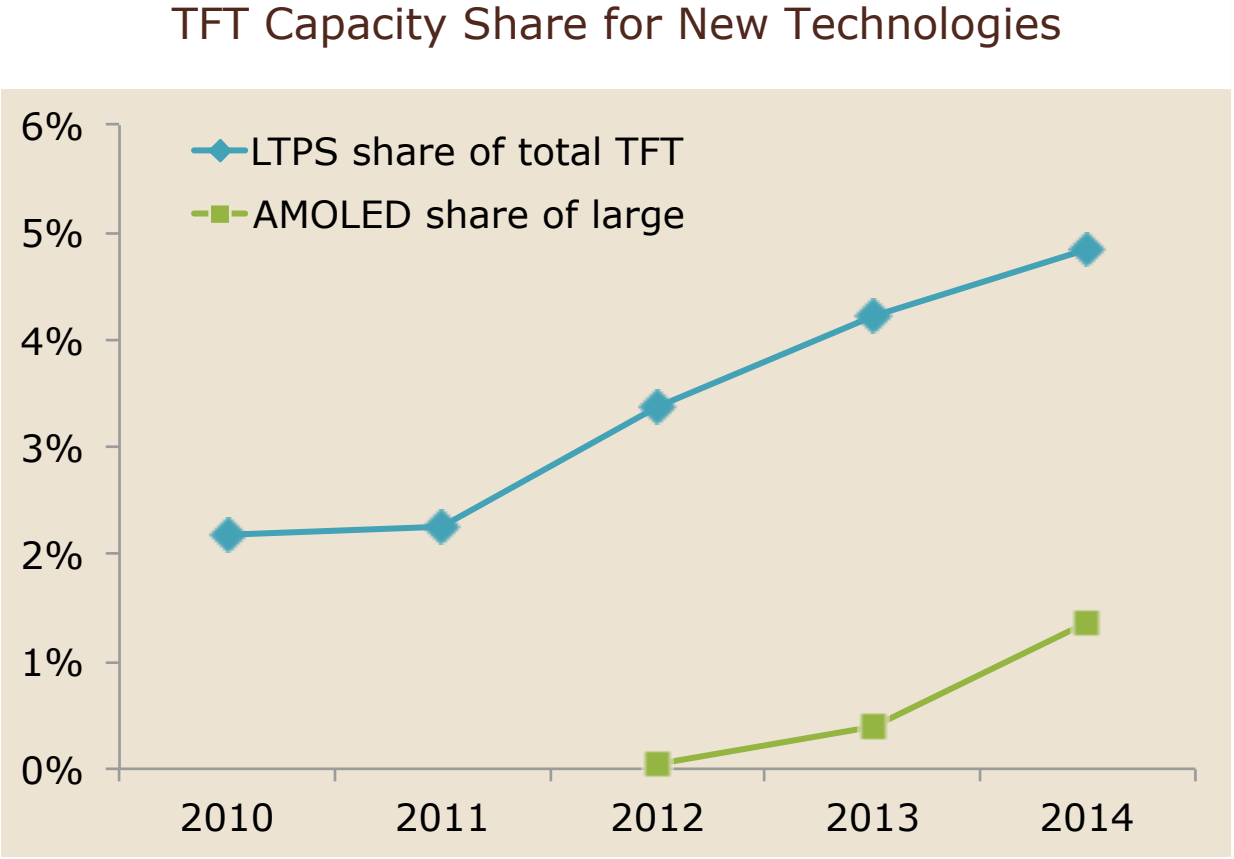
LTPS capacity grew from near nothing in 1998 to 8% of total TFT capacity in 2003.

It declined into 2010 when LTPS found new purpose in AMOLED backplanes.

It's share will increase for a few more years, depending on metal-oxide TFT development

For now, capacity for large OLED TV backplanes seems to be growing slowly, much like the early years of LTPS.

Will large-panel capacity for AMOLED capture significant share this decade?



DisplaySearch data, BizWitz analysis

What about the spending? Double down for only $125 billion more…

If we look at how much AUO and LGD ship using capex spent in prior years, we see…

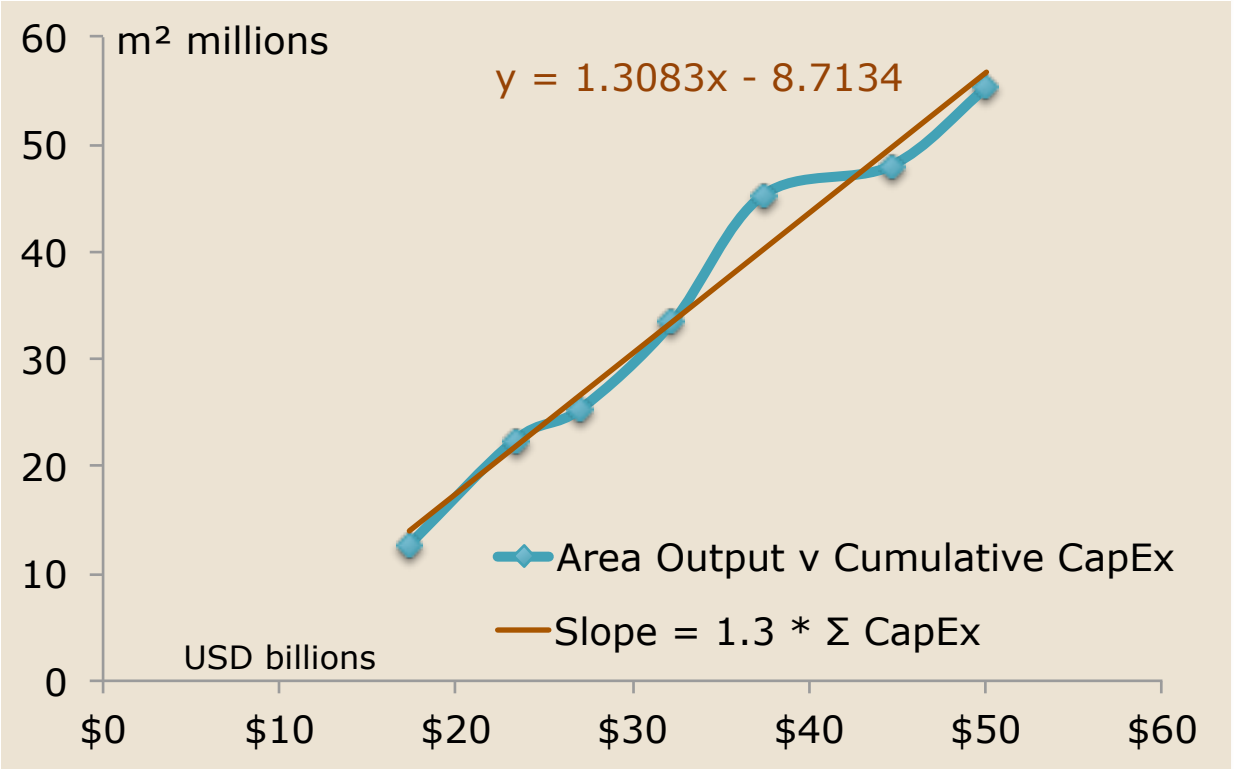
It takes $1 billion of input this year to get 1.3 million more square meters of output next year.

Based on this trend, these producers would need to put $50 billion more into the ground to double their output.

Given the capacity shares of these two leaders, the whole industry may need to put $125 billion more into the ground to double output.

What kind of holes should they dig?

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

And what about the spending—Part II: Should we believe the OLED TV story?

It is tempting to roll recent OLED capex trends forward.

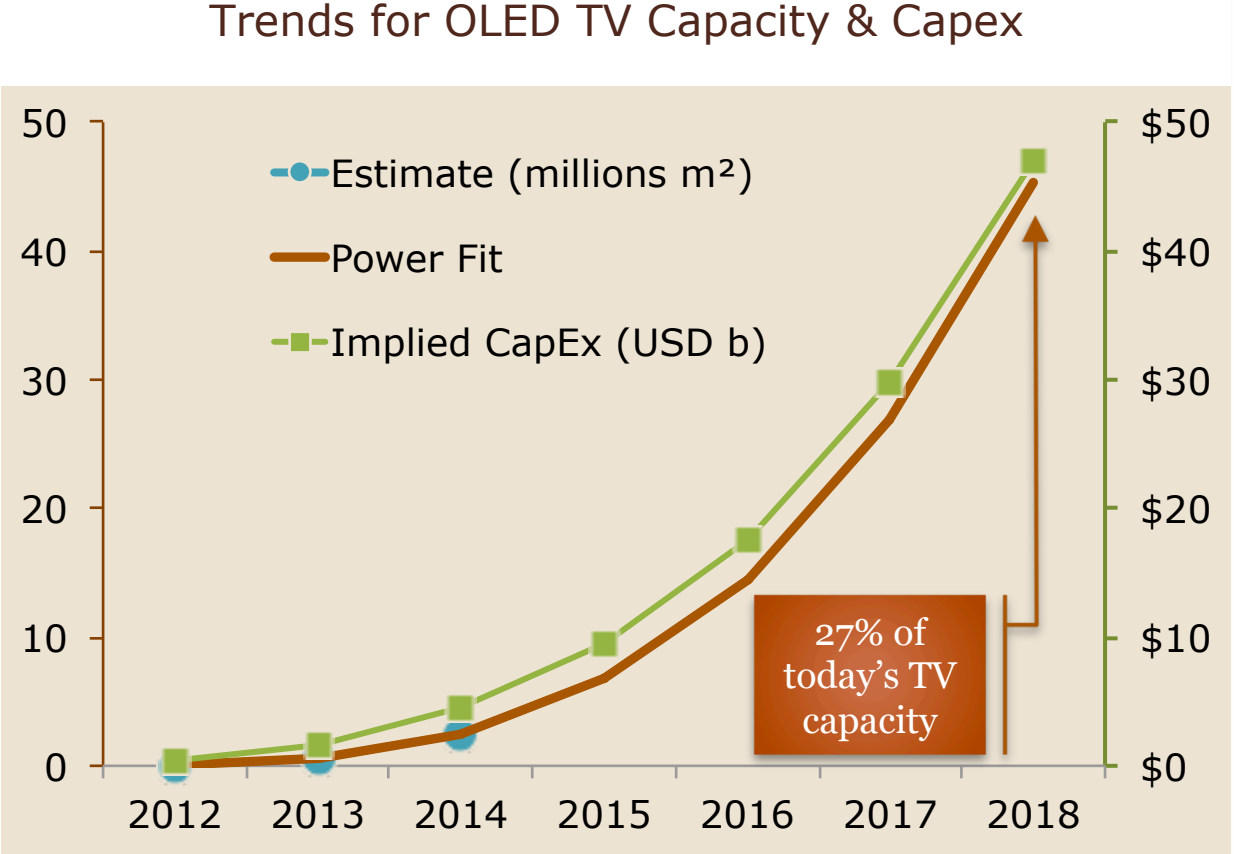
If OLED TV capacity grows at today's rate, it will reach 27% of today's TV panel capacity in 2018 but cost $47 b in capex.

Sure, converting some LCD TV factories into OLED TV factories could reduce that bill

… but is that reasonable?

We've seen AUO stumble on asset conversions and LGD told us that opportunity cost and capex make conversion a push… it's probably better to let existing factories run.

So, who's up for spending $47 billion for a slice of TV?



Power-fits OLED TV capacity 2012–2014 to 2018 and projects implied capex

Source: DisplaySearch data; BizWitz analysis

Operating profits are vanishing. Price falls faster than cost, still.

Nothing new here in 20 years.

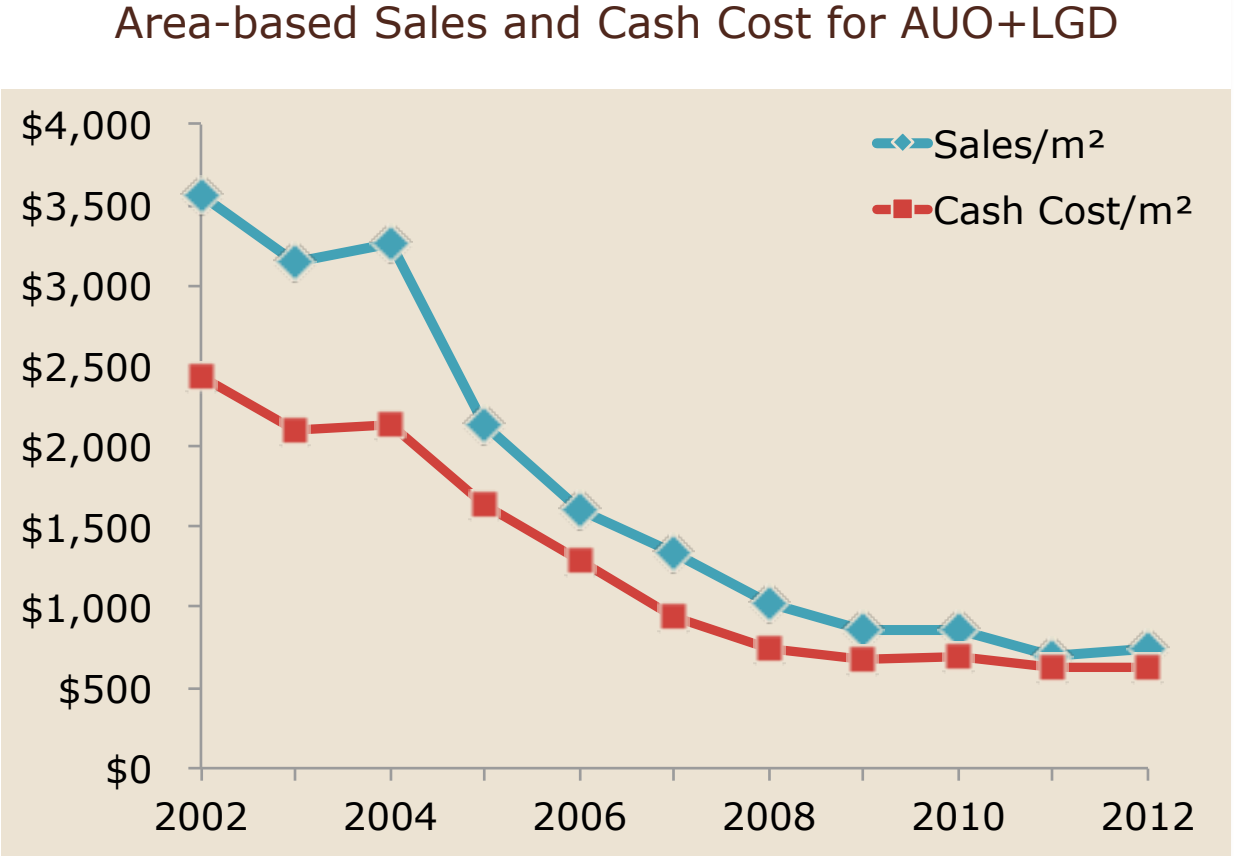
Sales (area price) falls about 17% a year for these leaders.

Cash costs fall about 15% a year: two points slower…

Thus, it was inevitable that price would hit the cash cost line and make it difficult, if not impossible, to cover the depreciation charges on past or present capex.

Conditions for smaller panel makers are worse, already.

From a financial standpoint, there is no rationale for more capex unless cost can come down faster than price.



Divides USD revenues and costs without depreciation by display area sold

Source: public disclosures; BizWitz analysis

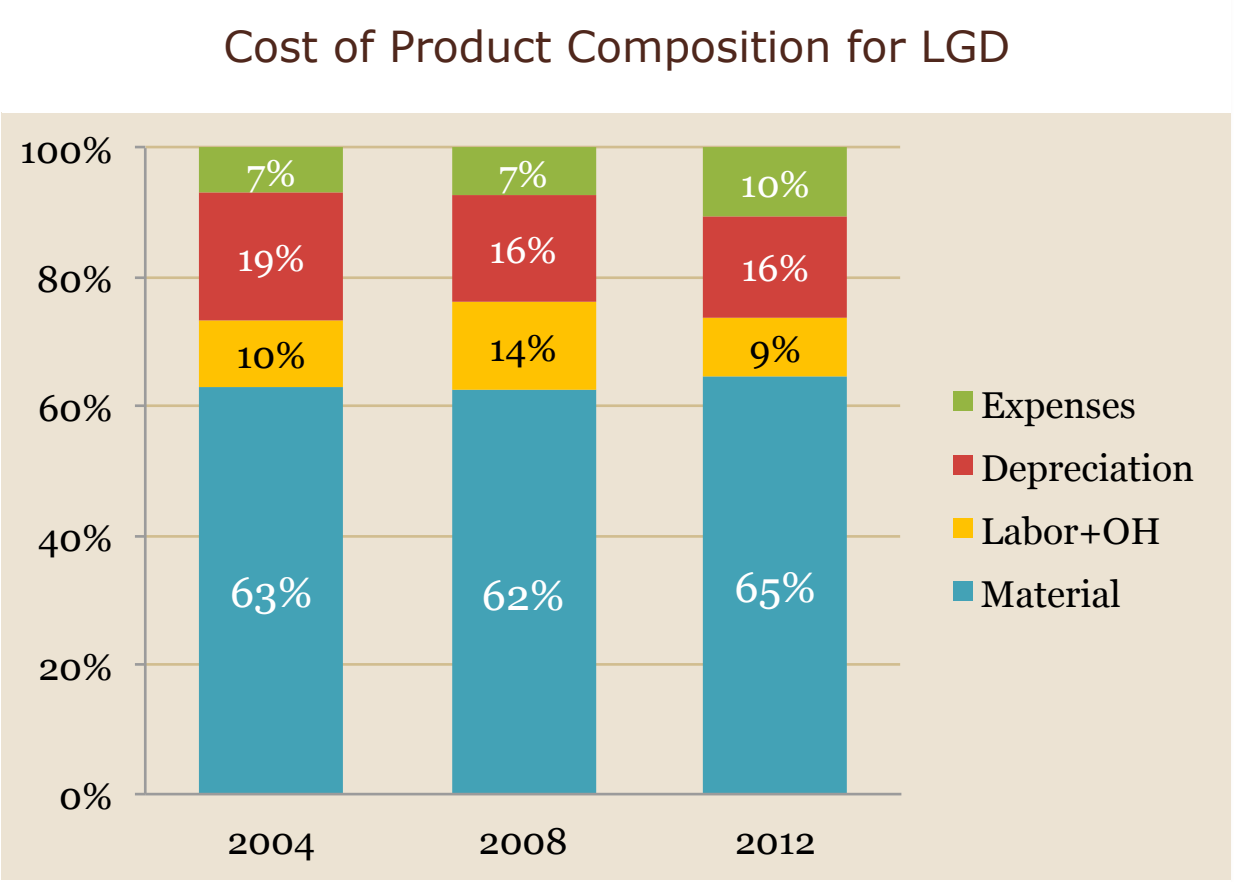
Organizational expenses are rising. Smaller orders and inflation nibble away.

Overall, cost structure has not changed much but we can see material costs and business expenses comprised a larger share of product cost as the product mix tilted toward small panels after 2008.

Organizational expenses such as salaries, commissions and logistics tend to rise…

- Aging workforces
- Inflating dollars

And it takes more work to handle numerous accounts wanting smaller panels… in modest volumes, except for Apple or Samsung.



Compares total cost structure four years apart

Source: public disclosures; BizWitz analysis

But material costs are the limiting factor. What supplier will take 50% less?

Looking at LGD disclosures, Cash Cost of Sales is 74% of their total cost of product.

Take substrates for example.

Alberto Moel of Bernstein Research estimates glass area price falls about 13% a year.

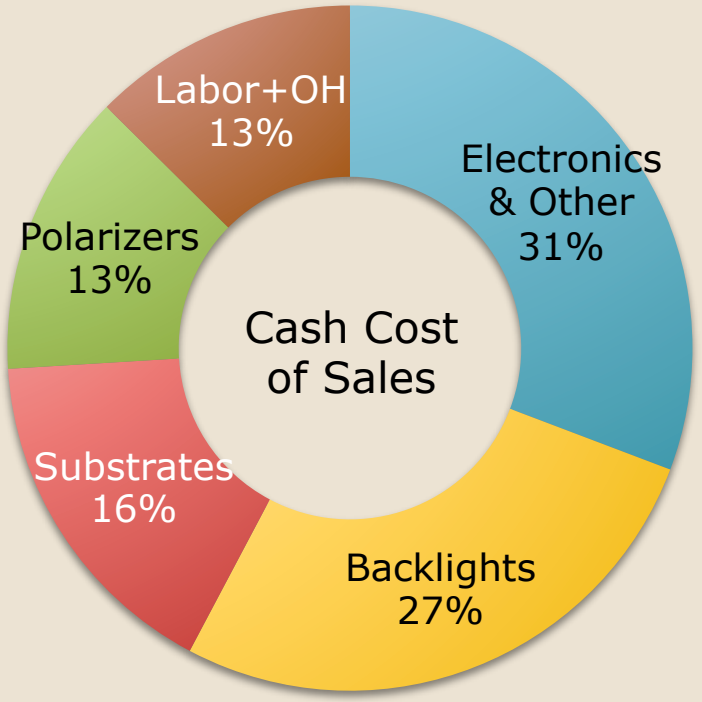
That implies a 50% reduction in five years: 2017 say.

Asahi Glass and Corning may not want to cut prices faster than that… and they will have to double their output, also.

How low can they go?

You can slice the glass thinner but you need more chips… material costs stay high.

LGD's Cash Cost of Sales Composition in 2012



Cash cost of sales is COGS without depreciation charges

Source: public disclosures; BizWitz analysis

How are the Taiwanese doing? Looking at all makers on island since 2001…

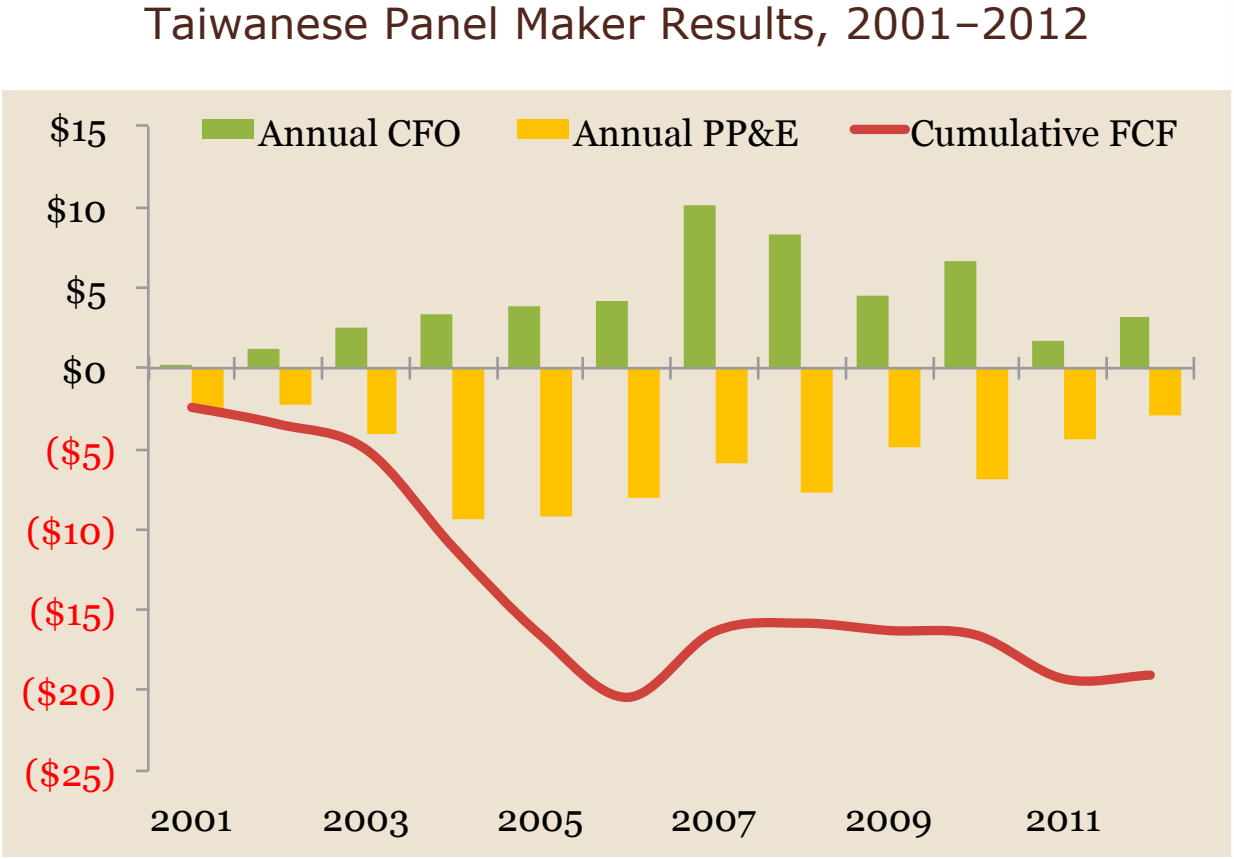
The island's LCD industry rose with the PC and stayed relevant with the TV but what has it got to show for all that?

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 moved $19 billion from stakeholders to suppliers and employees…

Not a bad deal for Taiwan but the LCD business looks like a non-profit social program.



Charts LCD producers' financial results in billions of US dollars

Source: public disclosures; BizWitz analysis

Is consolidation helping?
Cash outflow continues as rivalry decreases.

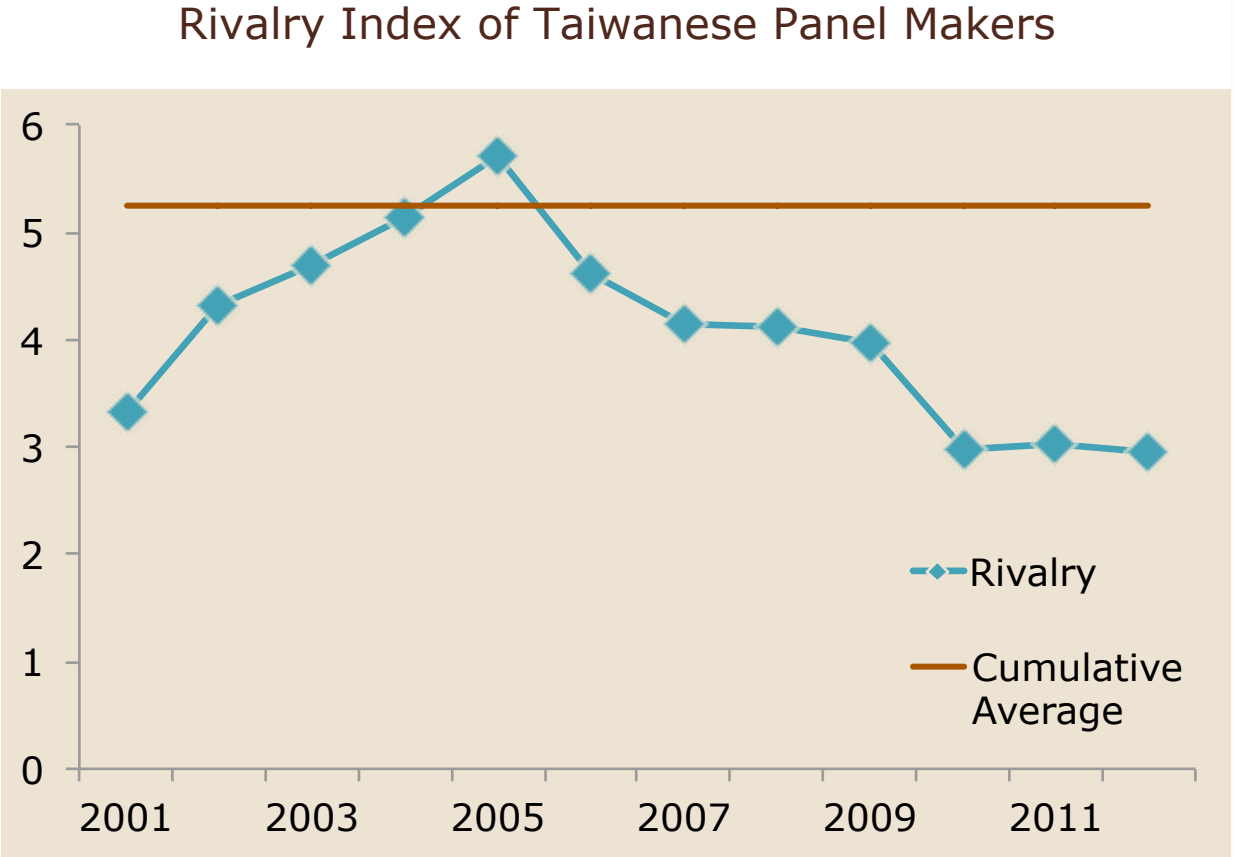
Looking at the rivalry index for Taiwan's LCD makers, we see competition become more intense as players enter and expand in 2001–2005.

Since then, the island's rivalry index has decreased 48% as AUO took QDI and Innolux took CMO and TPO.

That didn't change free-cash flow (FCF) much, however.

After a brief improvement in 2007, FCF continued going down hill… and out the door.

Vertical integration through brands, e.g. LG or Samsung, may help but consolidation alone doesn't seem to help.



Rivalry is the inverse, normalized Herfindahl index of sales revenue

BizWitz analysis

Is product mix helping?
Remember "Wide"? Digital Picture Frames!

There has always been a new story. I remember when it was 10.1" notebooks… today it's UHD and phablets.

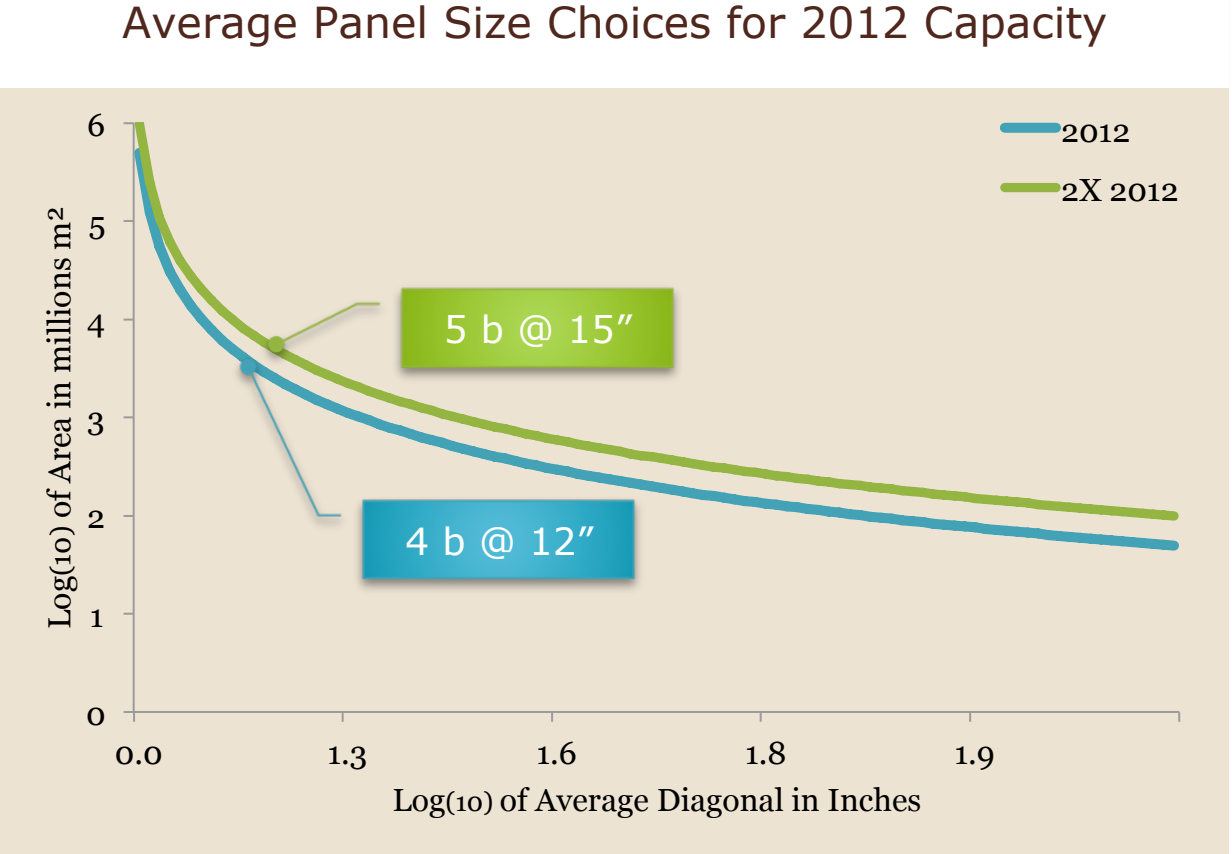
Producers can adjust their shipments to absorb capacity by changing the average size.

They could double capacity and raise shipments only 23% if they increased size by 3":

- 4,084 m 12" HD panels
- 5,042 m 15" HD panels at 2X area output

Pick any point on the curve but mean reversion rules!

You can cut the pizza as thin as you like but the cost per pie doesn't change much.

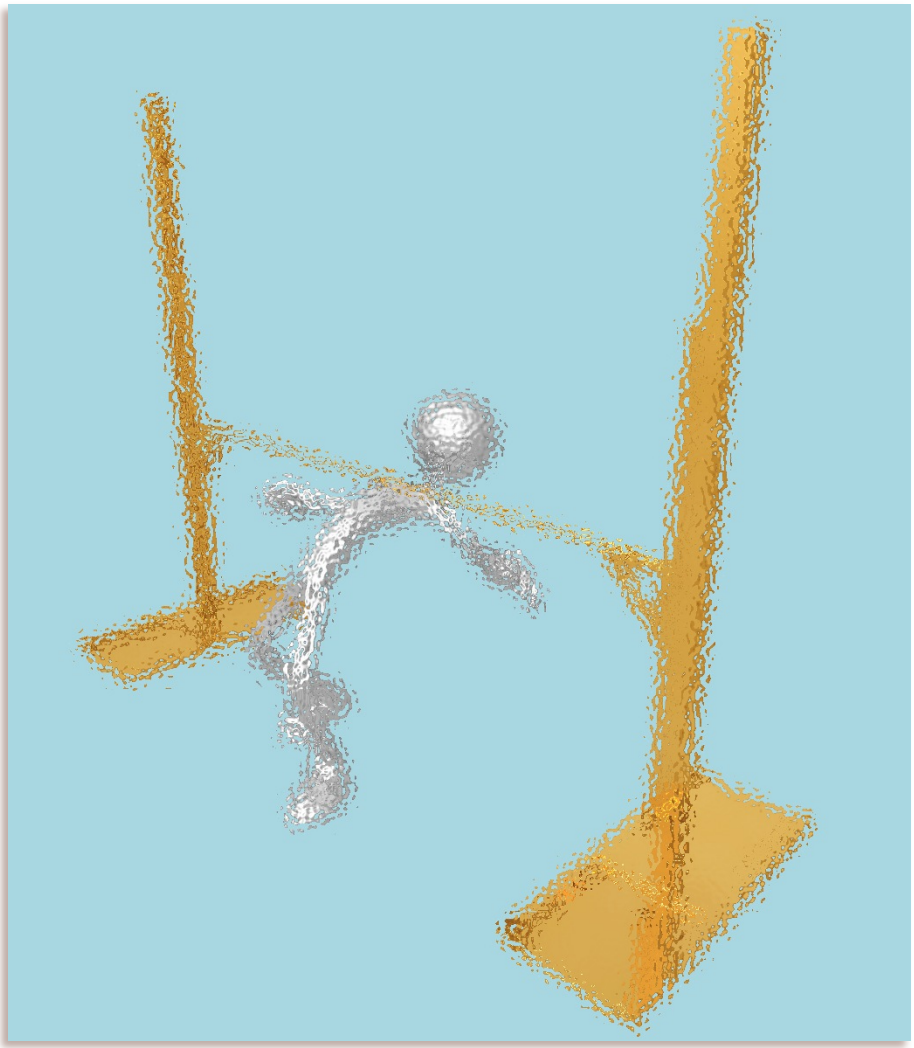


Charts number of panels possible for a given average panel size based on capacity

Source: Al G. Brah; BizWitz Analysis

How low can you go?
The future looks fuzzy…

- A few brand owners may put more money into the ground for OLED.
- Some suppliers may change with technology or may accept less.
- Overall, however, it is unclear who will fund $100 billion or more of capex for an industry that may never generate positive free-cash flow.
- More, better or different panels have made little difference.
- Larger, consolidated players have made little difference.
- Time may make a difference… you can go low if you go slow.
- Meanwhile, slice the pizzas thinner.



FPD is a difficult business…
We are here to help

Growth	Performance	CapEx	Sourcing
▪ Market entry ▪ Business structure ▪ Phase gates, R&D	▪ Price position ▪ Cost reduction ▪ Portfolio balance	▪ Factory plans ▪ Tool selections ▪ Plant conversions	▪ Make/buy ▪ Value chains ▪ Supplier selection

Technologies	Alliances	Plans	Materials
▪ Market sensing ▪ Market & IP value ▪ Consortia synergy	▪ M&A candidates ▪ Partnerships, JVs ▪ Integration plans	▪ Strategic audits ▪ Investor insights ▪ Business valuation	▪ Pricing policies ▪ Market strategies ▪ Licenses, royalties