Glow and Grow

The Business Future of Electronic AMOLED Displays presented at the 50th Anniversary of the Society for Information Display, 29 Sep 2012

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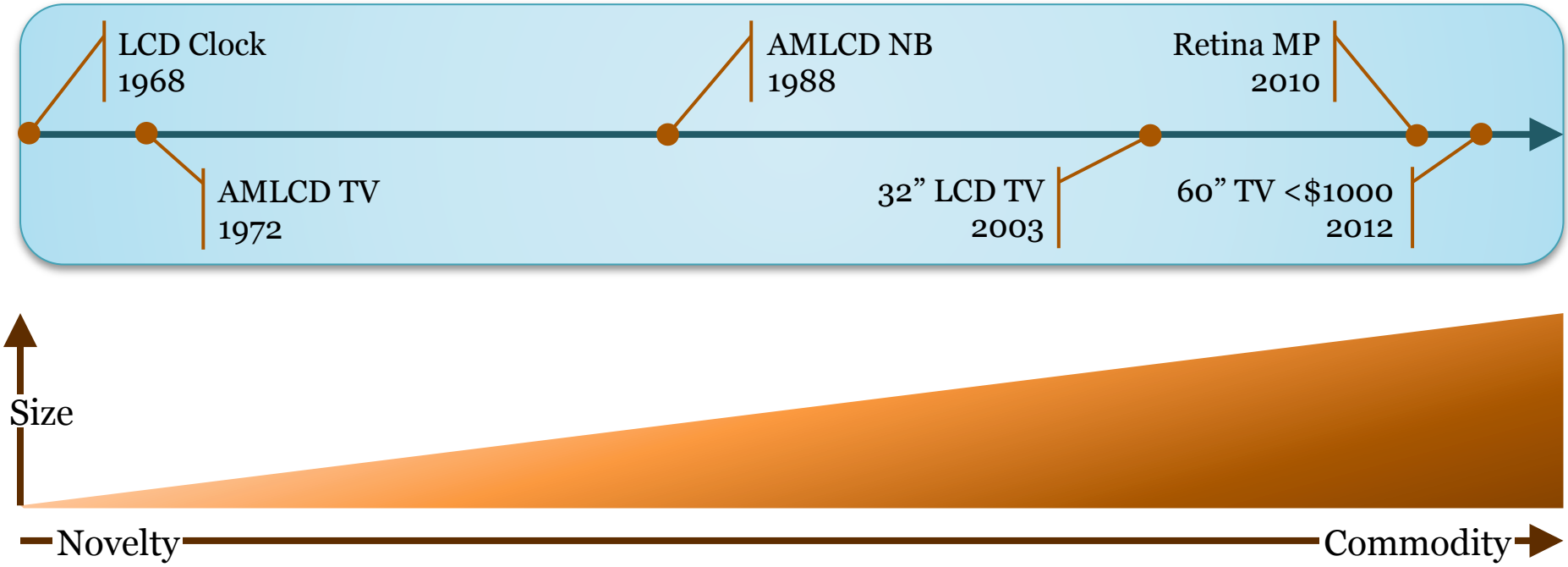
Glow and Grow—
the vision thing

- Emissive displays are more exciting than transmissive or reflective displays.
- AMOLED can re-purpose existing AMLCD assets and create a better cost structure (less material).
- Panel makers that lead the transition to AMOLED will obtain competitive advantages (economic scale and product range).
- AMOLED enables new value propositions, such as formable or flexible displays, that expand the market (for some).

The question is how much of this will be realized, when and by whom?

Technologies take time—
AMOLED remains a novelty



Why now?
Elasticity of demand is favorable for AMLCD

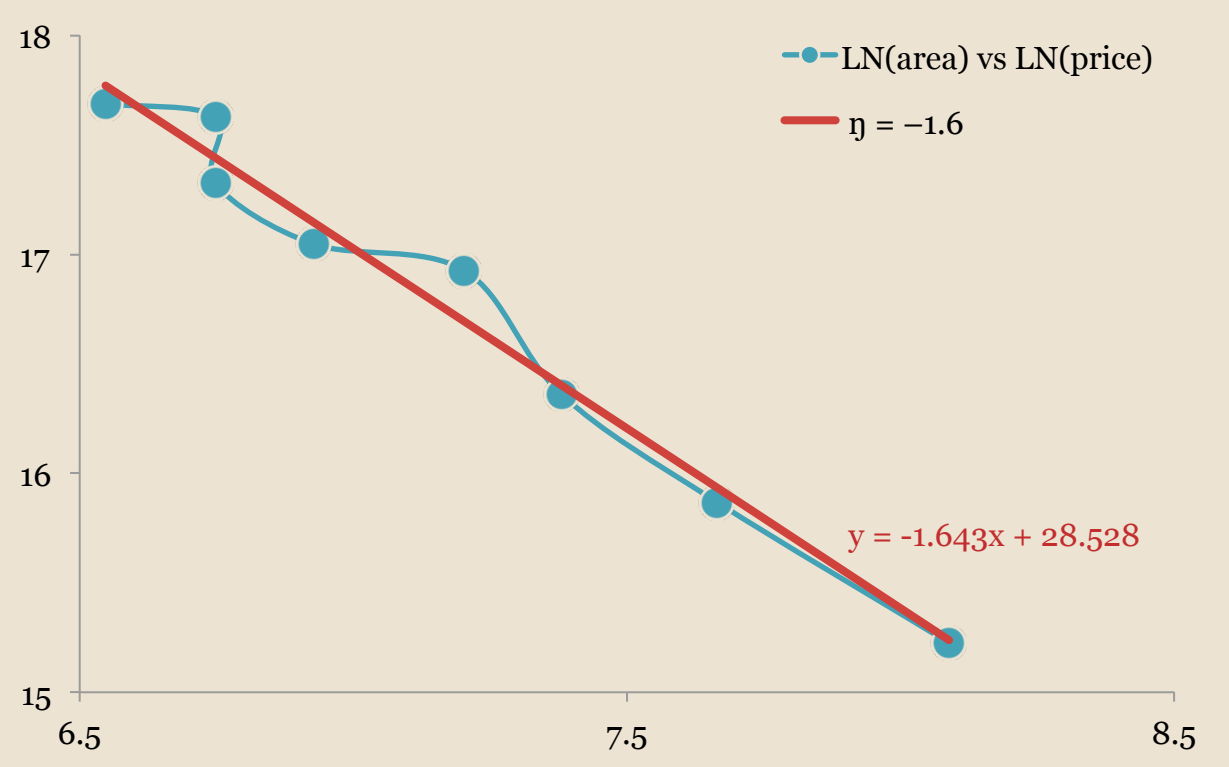
AMLCD area demand has been elastic relative to price for leading producers.

Elasticity of –1.6 implies a 19% increase in area demand for every 10% decrease in area price.

From this perspective, cutting prices seems reasonable… sales revenue increases faster than price decreases.

So why are panel makers losing money and slowing investment?

Demand Elasticity for AUO + LGD, 2004–2011



Source: public disclosures; BizWitz analysis

Why now?
Variable costs are unfavorable for AMLCD

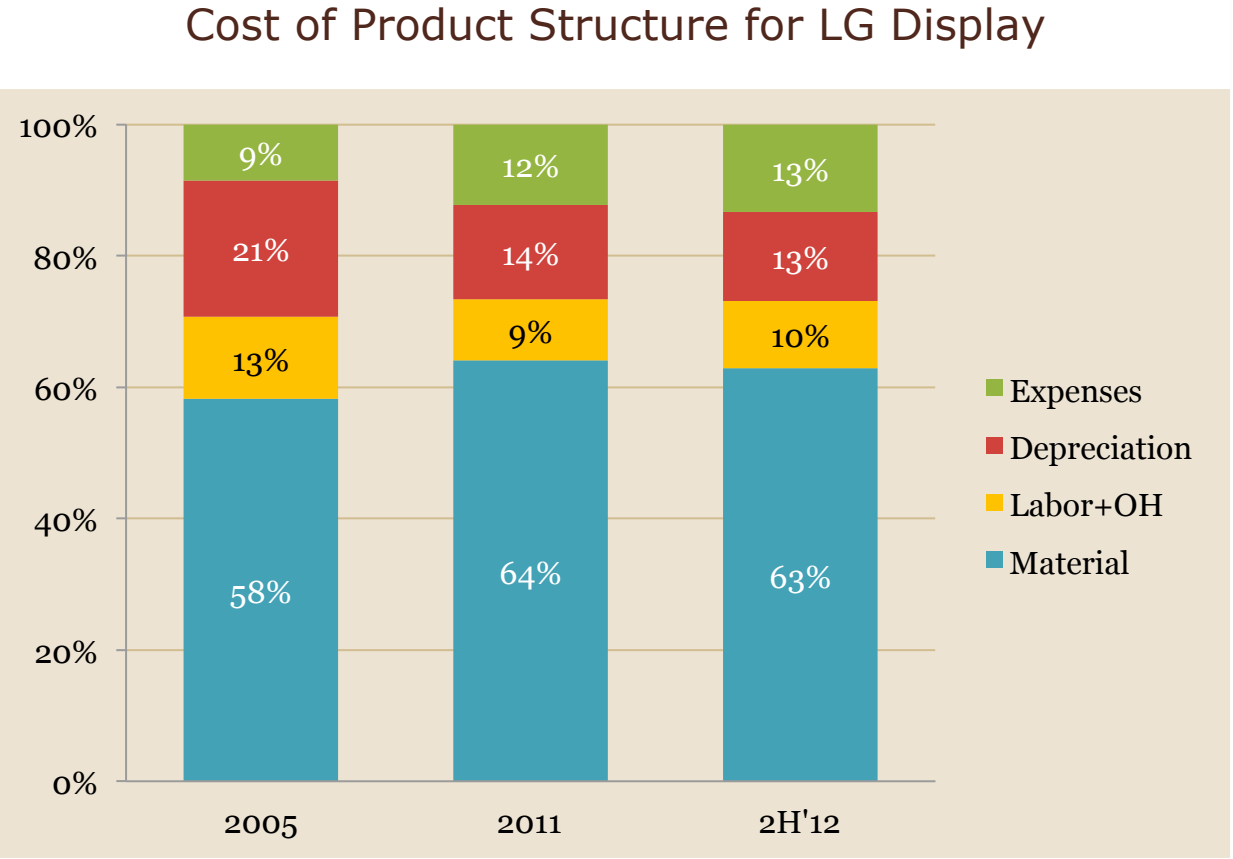
Material remains the primary source of cost, as rising expenses offset falling depreciation charges.

There is no scale benefit.

Operating profit margins cannot cover depreciation charges if producers reinvest in AMLCD capacity.

There is no clear path to sustained profitability even if the cost of capital is near zero (government supported)

... so let the Chinese do it.



Source: public disclosures; BizWitz analysis

Why now?
National industries are under water

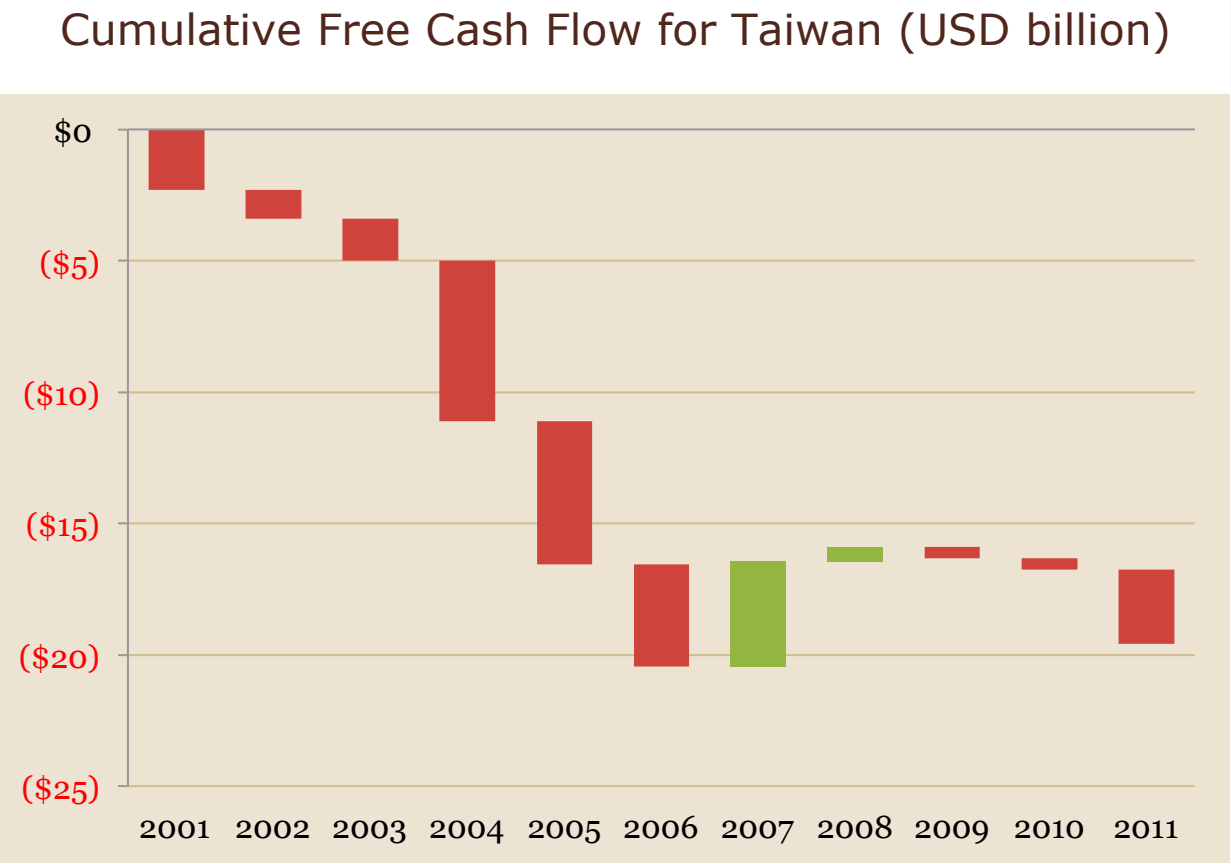
Including all AMLCD makers in Taiwan (except E Ink) we see cumulative free cash flow reaching nearly –$20b by the end of last year.

This year will probably drive it down further.

Taiwan's panel makers put more than $65b into the ground and generated at net loss of 2% on total sales.

The scale of this financial mess calls for government intervention in order to save domestic jobs… and banks.

Hence changes in national policy allowing Chinese direct investment in Taiwan tech.



Source: public disclosures; BizWitz analysis

What now?
Leaders seek advantage through technology

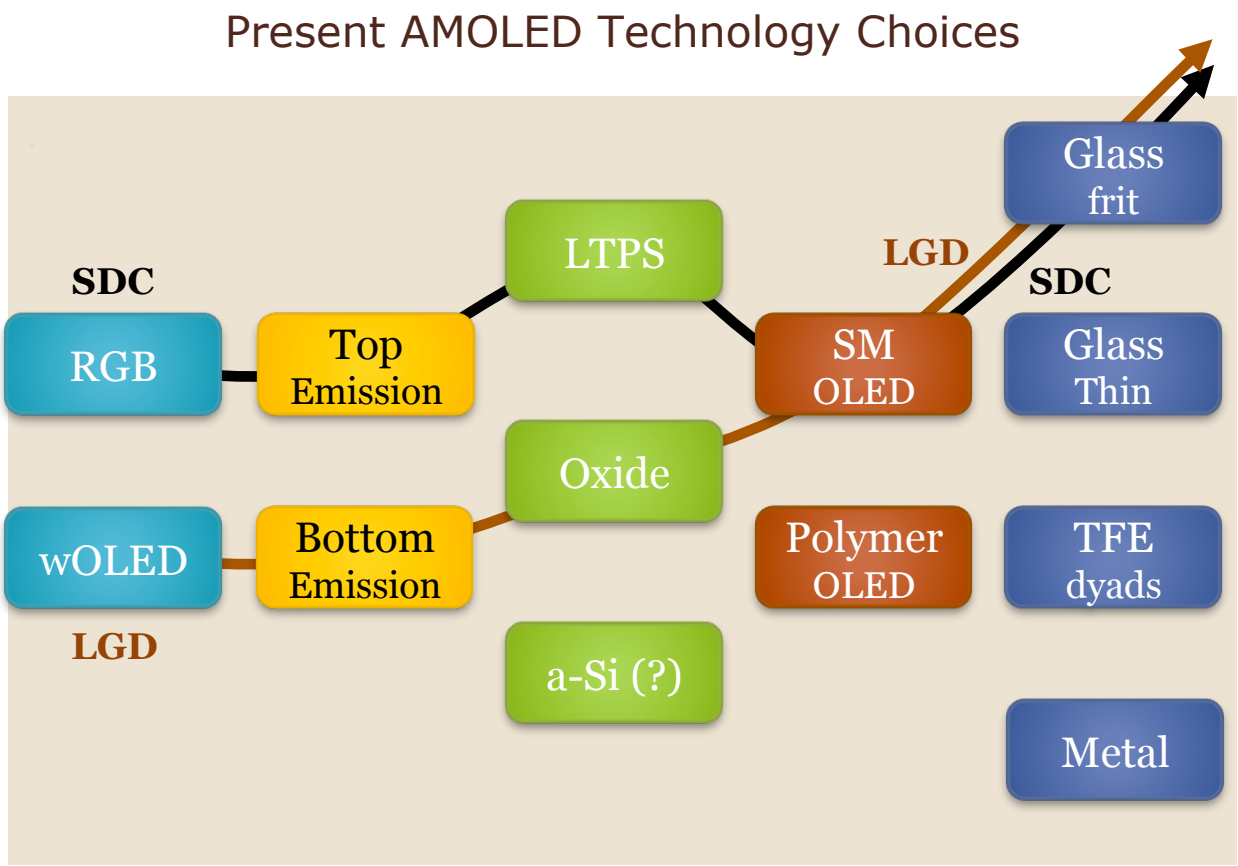
In contrast to development of the AMLCD industry 20 years ago in Japan, leaders in the AMOLED movement seek advantage though distinct technical choices and their own supply chains.

As a result, industry-wide learning is slower this time.

Material and tool suppliers face conflicting priorities rather than a consensual roadmap toward AMOLED.

As a result, economic scale will take longer to develop.

There are more paths to take, so we may see more variation rather than less, mid-term.



Source: BizWitz, conceptual

What now?
It's time for more pixels to constrain AMOLED

The more mature AMLCD infrastructure can supply more pixels at modest extra cost. Apple's supply chain leverages this capability.

In the flat TV market, it's time for new value propositions.

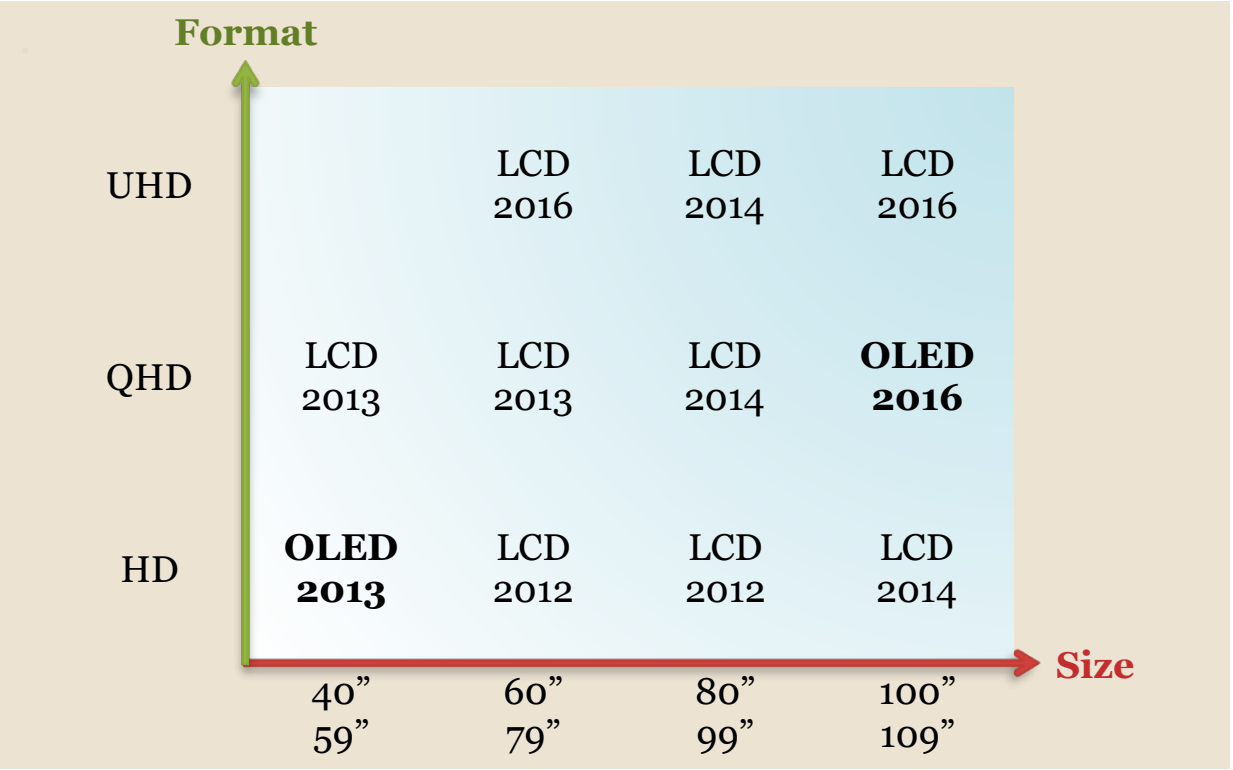
S3D did more for brands than for panel makers, who have always benefitted more from adding pixels to larger panels than from other innovations.

Thus, the ITU spec for UHD (8k4k) comes just time.

It is not clear what market space OLED TV will find uncontested in the near term.

Fight Club?

Potential TV Space for new propositions:
the next three years



Source: BizWitz, conceptual

What now?
Different strokes for different folks

AMOLED will move from novelty towards commodity status later this decade

... but different companies and countries will move at different paces in slightly different directions.

Korean leaders will stay ahead for three more years, at least, but Taiwanese may close the gap in small panels by mid decade. Integrated touch and other functions will become means of differentiation.

Chinese entrants and Taiwanese incumbents may depress AMLCD prices further and constrain OLED growth.

Likely Actions, Strategies and Policies for Incumbents

	Korea	Taiwan	China	Japan
Large Panels	Convert fabs now	Add LCD pixels now	Build big AMLCD	Support the brand
Small Panels	Convert fabs now	Convert fabs now	Link-up regionally	Seek niches
Strategy	Move first	Follow fast	Develop capability	Right-size
Policy	Allow tech transfer	Allow FDI and xfer	Fund capex	Reorg Merge

Source: BizWitz, conceptual

Who now?
New entrants could buy-into the game

A new game attracts new players. We may see other countries throw their hats in the ring this decade.

Brazil wants to lever its global position and cut imports. A JV with Foxconn stalled on the question of AMOLED, so Brazil may try again.

Hyper-democracy in India hampers development but things could change later this decade (positive for OLED TV with really big speakers!).

SE Asia could become a contender by sustaining progress, step by step.

Europe might realize its dreams, eventually.

Likely Actions, Strategies and Policies for Incumbents

	Brazil	India	SE Asia	Europe
Large Panels	Seek JV technology	Assemble for now	Assemble, make parts	Assemble for now
Small Panels	Import for now	Regional design	Assemble, make parts	Invent printing
Strategy	Lever position	Balance power	Build industry	Leap-frog
Policy	Cut imports	Protect local jobs	Reduce risk	Stimulate JD

Source: BizWitz, conceptual

What happens
… if new suppliers act like old suppliers?

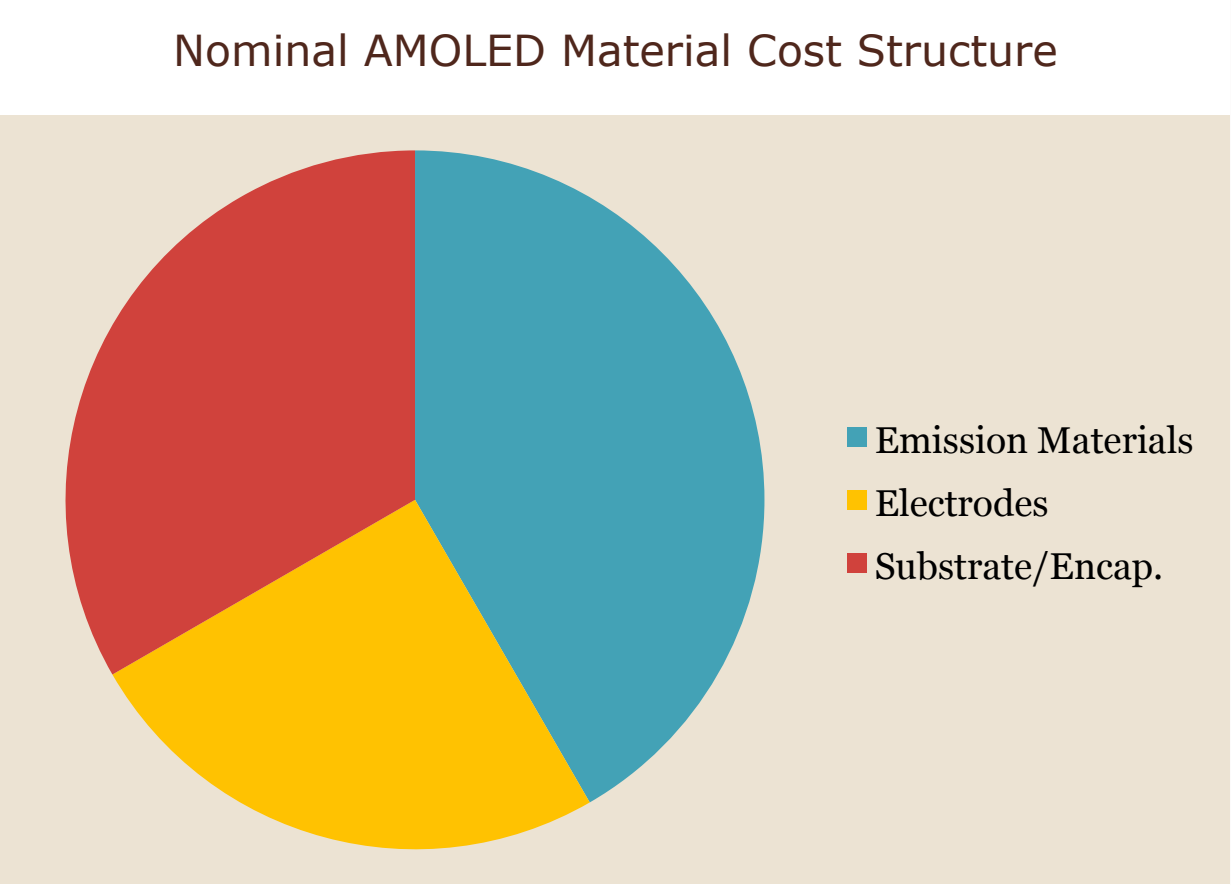
A recent forecast for OLED materials by NanoMarkets showed 5½ X growth in value from 2012 to 2017.

Their model for material cost by component was relatively constant, however:

- 5/12 Emission materials*
- 3/12 Electrodes
- 4/12 Substrates/encaps.

The key question for panel makers is, what portion of total cost will these materials comprise and how much margin can they make by converting these materials?

Will material suppliers still extract AMLCD-like rents?



NanoMarkets, Sep '12; BizWitz analysis
* Emission includes HIL, ETL, et cetera

What happens
… if new entrants play the same old game?

Other players will come to the table if they see the leaders making money (or playing for big stakes, at least).

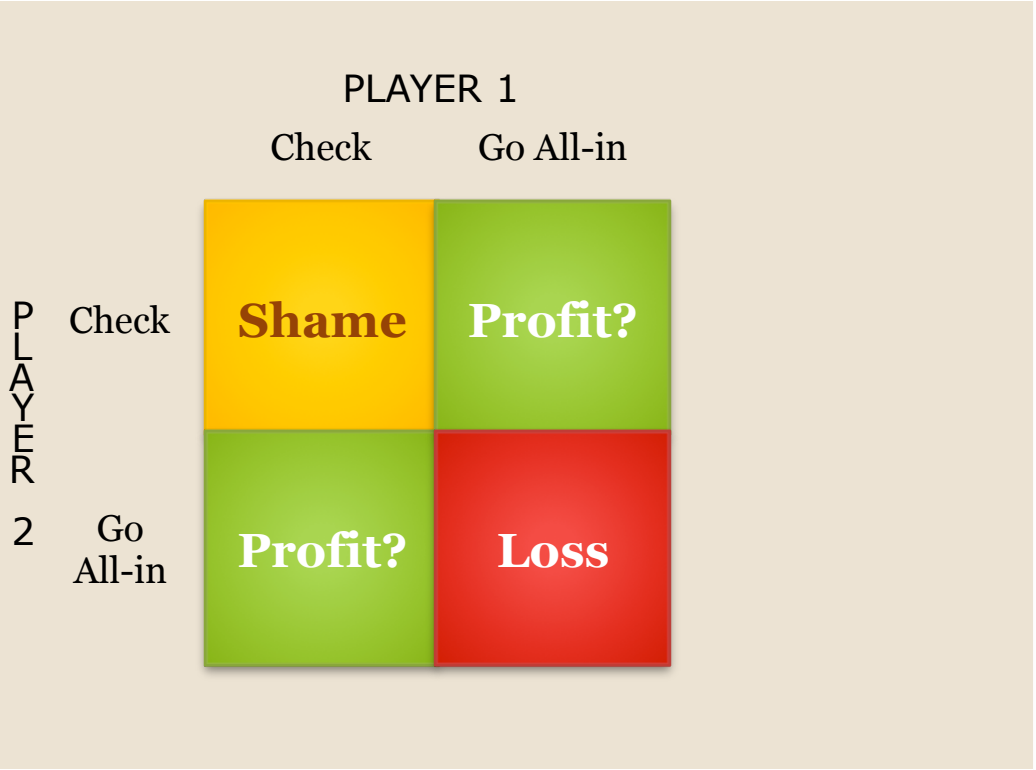
If all players bet big (go all-in like on the Poker shows), then they everyone might lose.

If some players check (delay), then there may be winnings for the others.

One thing is clear: if everyone behaves as they have, then only consumers will win.

The best alternative is starting different games so there can be winners at each table.

Potential Adverse Outcome of a Game



Source: BizWitz, conceptual

What happens?
AMOLED becomes the new commodity

- LCD is vulnerable in the mobile market as PC incumbents give way to new value propositions and alliances
  - Thinner, more flexible design factors open new markets.
  - Shorter product life reduces technical risks and increases chances.
  - Functional integration and brand architectures enable differentiation.
- LCD TV substitution creates a nearly infinite opportunity, at least for a while.
  - CRT TV area share fell from 80% to 20% in 14 quarters.
  - Consumers may not see the LCD–OLED gap to be so big…
  - Nevertheless, substitution could happen fast, later this decade.
- AMOLED becomes the new commodity until holography or some other technology emerges next (next) decade.

FPD is a difficult business…
BizWitz analysts 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