



"Trends in HDTVs, Displays, Markets, & Suppliers..."



**Bruce I. Berkoff, Chairman of the LCD TV Association,**  
(former CMO/EVP Marketing of LG.Philips LCD)

**DisplayForum 2007**  
**Prague, Nov. 14, 2007**

# Trends in Displays:

## • Better Image Quality & Features

### • Better features:

- Viewing angle
- Response time
- True Color

### • “More Green”

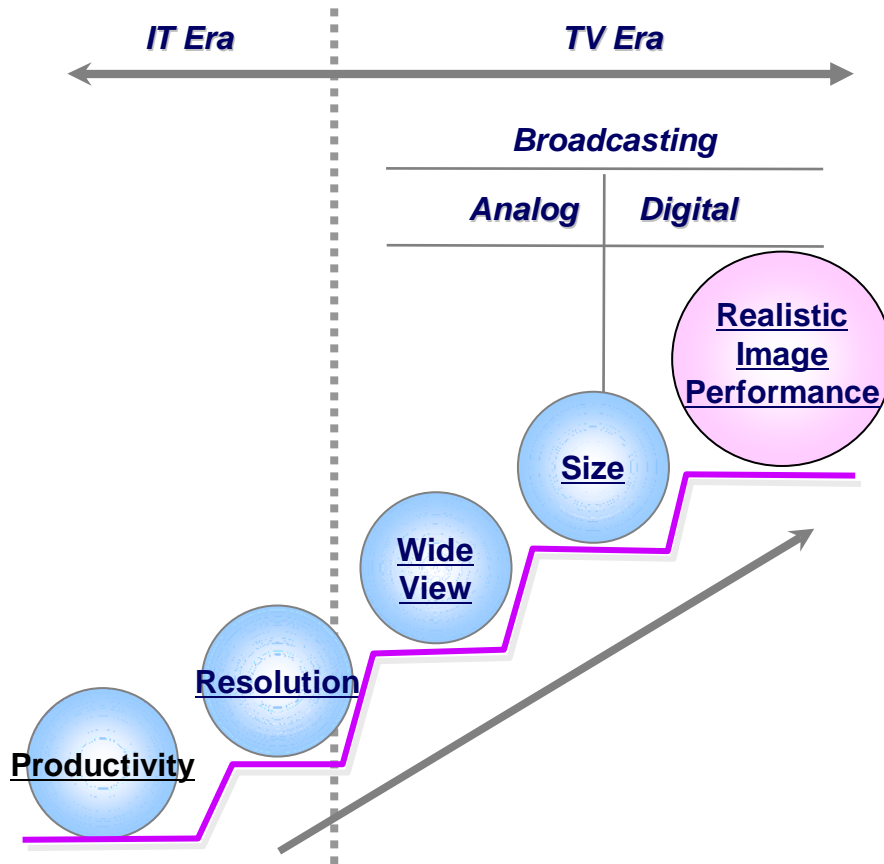
- Low Power Consumption
- Recyclable (RoHS, etc.)

### • Thinner designs and sets...



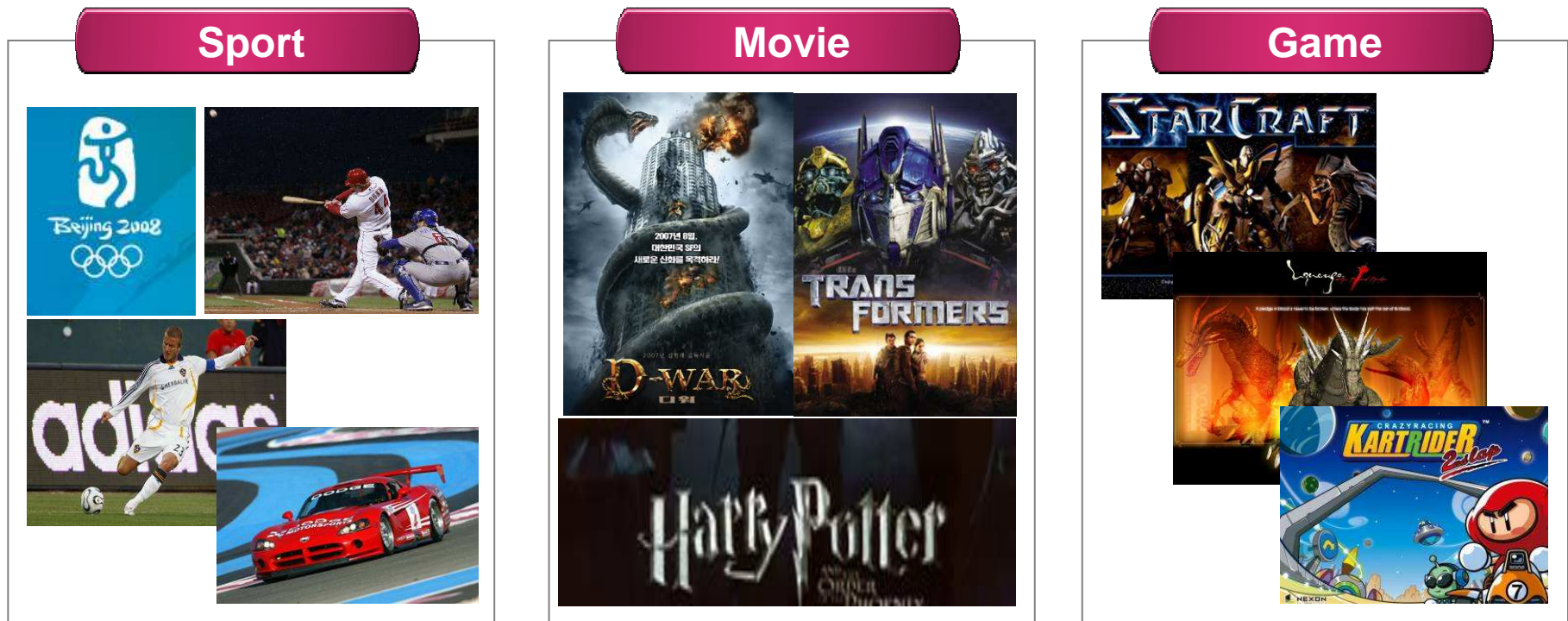
# Image Quality Trends...

- Due to the increase of HD content and digital devices, the ability to produce more “realistic” images is becoming more important



# Display Trends, Motion Picture Quality, faster response time and refresh...

- Less motion blur is more critical for larger size screens and entertainment



Quick response Time ' 120Hz ', film dejudger, ME/MC etc.





# Display Trends, faster response time and refresh...one type!

“IPS is the optimized technology for Motion Blur Reduction ”- recent Japan Mag.

IPS 120Hz Full HD, Be True to Nature  
Clear, Crisp Image with True Color

In Plane Switching

IPS 120Hz Full HD, Be True to Nature

IPS mode is superior to VA mode in MPRT (Motion Picture Response Time)

- VA mode can not surpass 120Hz of IPS mode in MPRT.
- 60Hz of IPS mode is equal level to 120Hz of VA mode in MPRT.

**Faster**

VA 120Hz (MPRT 12ms)

IPS 120Hz (MPRT 8ms)

120Hz Live Scan  
60Hz Live Scan

LG.PHILIPS LCD

# Advantages of a FHD/120Hz, approaching PDP performance...

## LPL's Advantages for FHD/120Hz

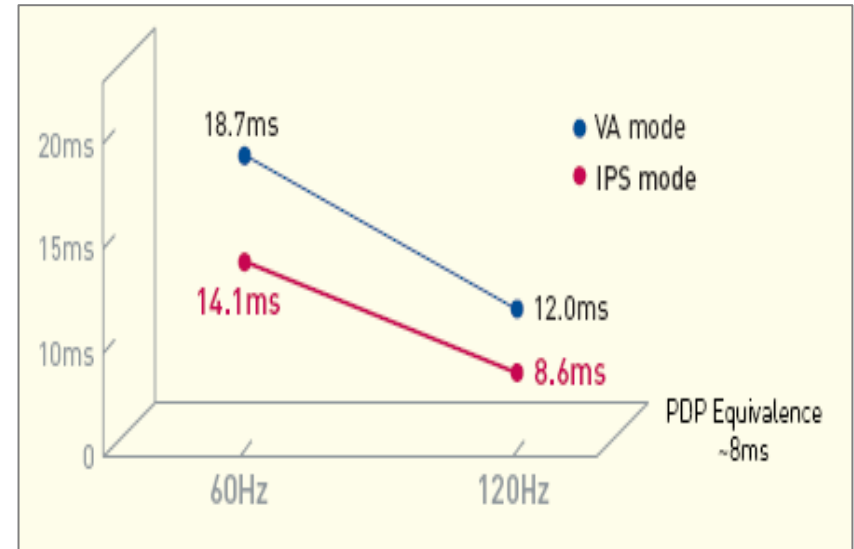
### 1. Simple Pixel Structure

- 1) Fast LC for Less Charging Time
- 2) Fewer Source D-IC

### 2. Cu-bus Line

- 1) No Charging Time Delay
- 2) High Productivity

## MPRT (Motion Picture Response Time)



60Hz  
(MPRT 18.7ms)



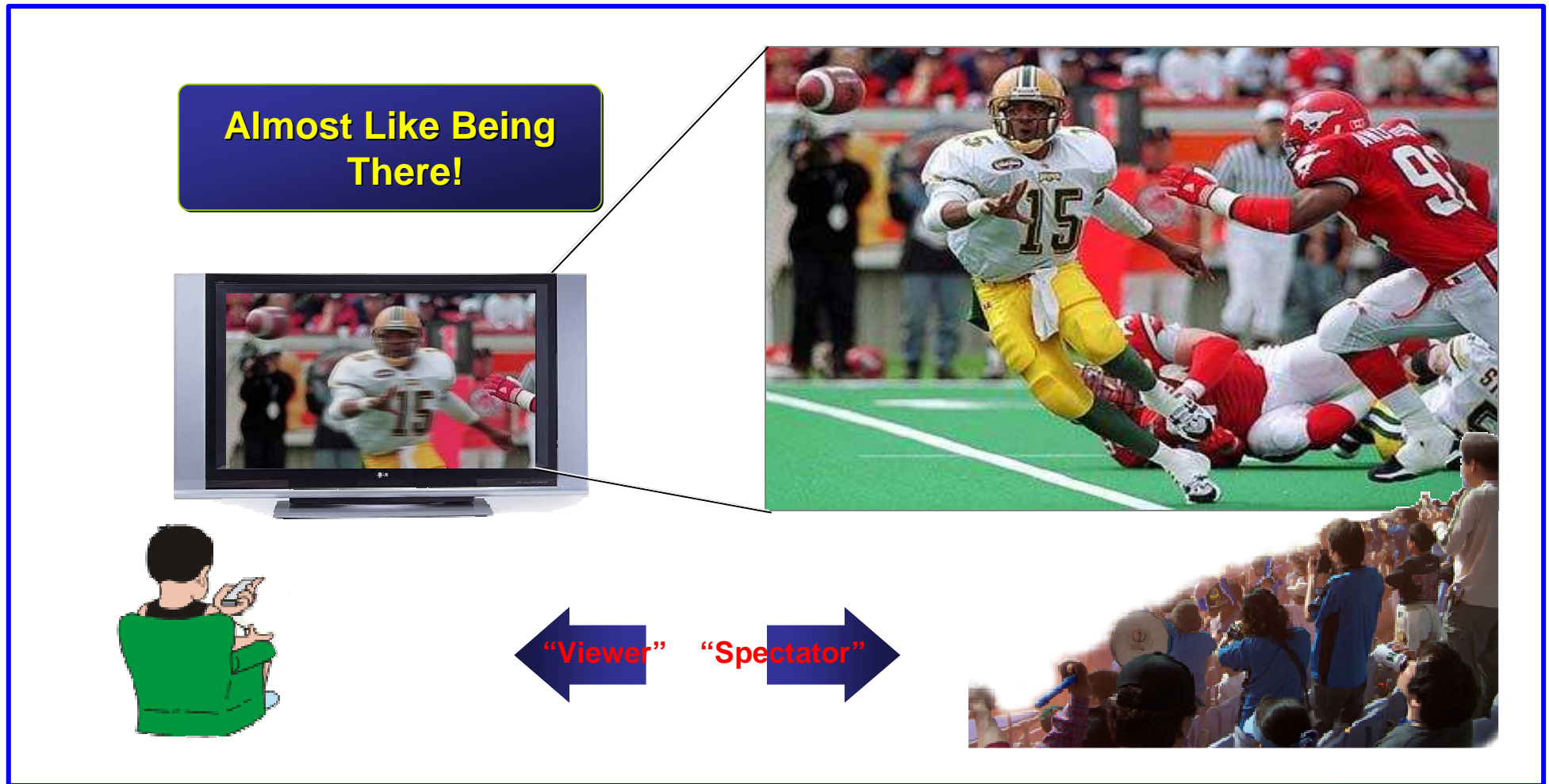
VA 120Hz  
(MPRT 12.0ms)



IPS 120Hz  
(MPRT 8.6ms)

# Display Trends, More natural color, “deep and wide”

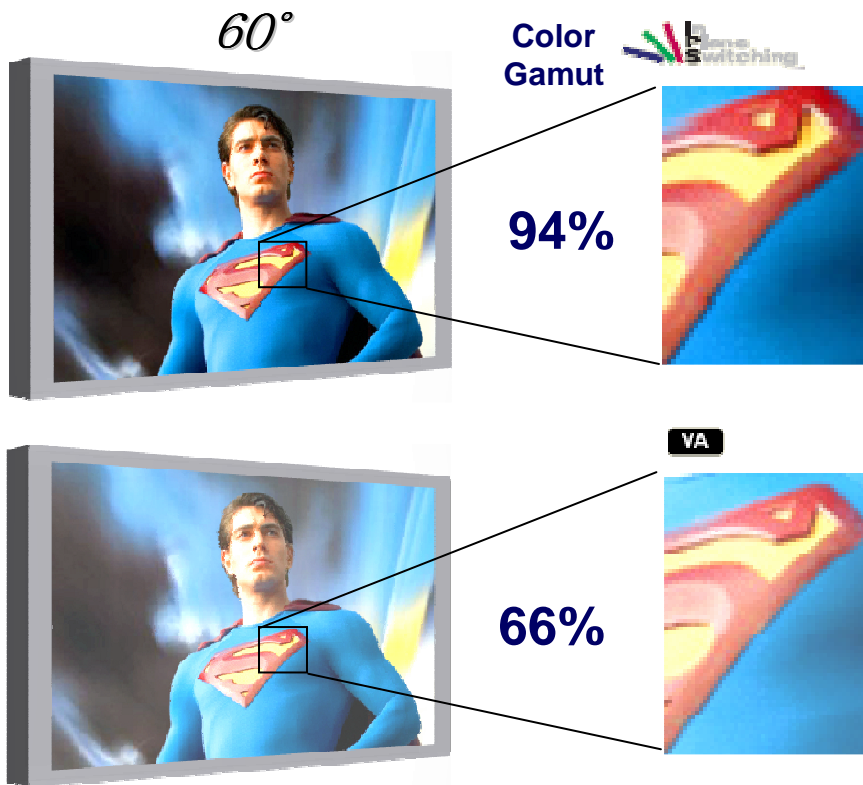
- HDTV requires natural color quality to provide customers with the most exciting experience



# Display Trends, better color, even off angle, and better blacks...

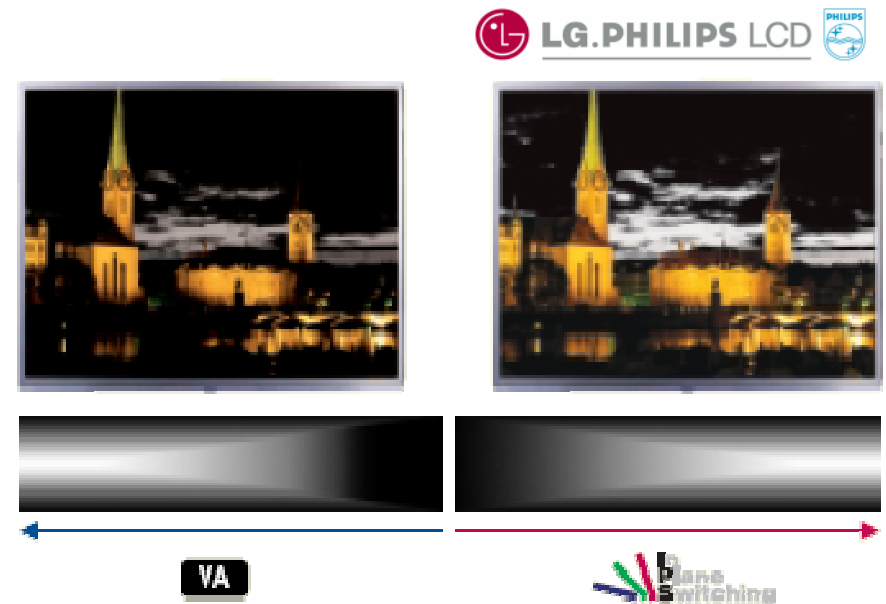
## Best Wide Viewing Angle Performance

- LPL's IPS technology provides wider color gamut at the viewing angle



## High Black Performance in Real Life Contents

- IPS mode provides more detailed image in dark scene with smoother gray gradation



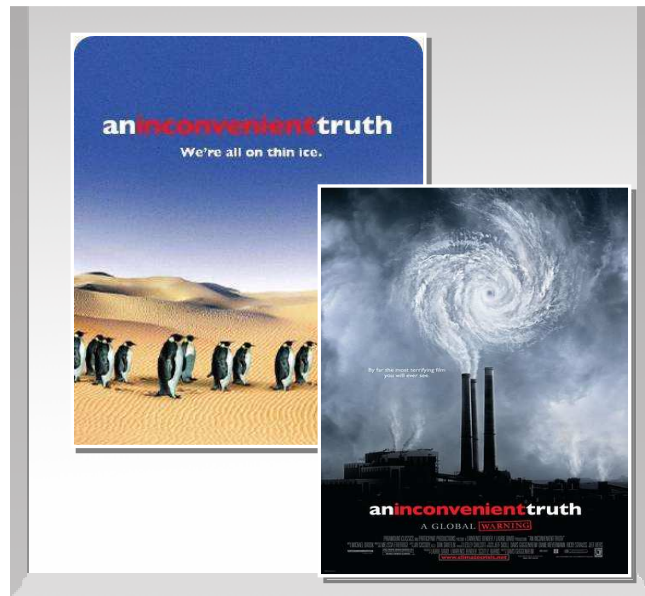


# Display Trends: Better for the “Environment”

- Demand for eco-friendly displays is rising

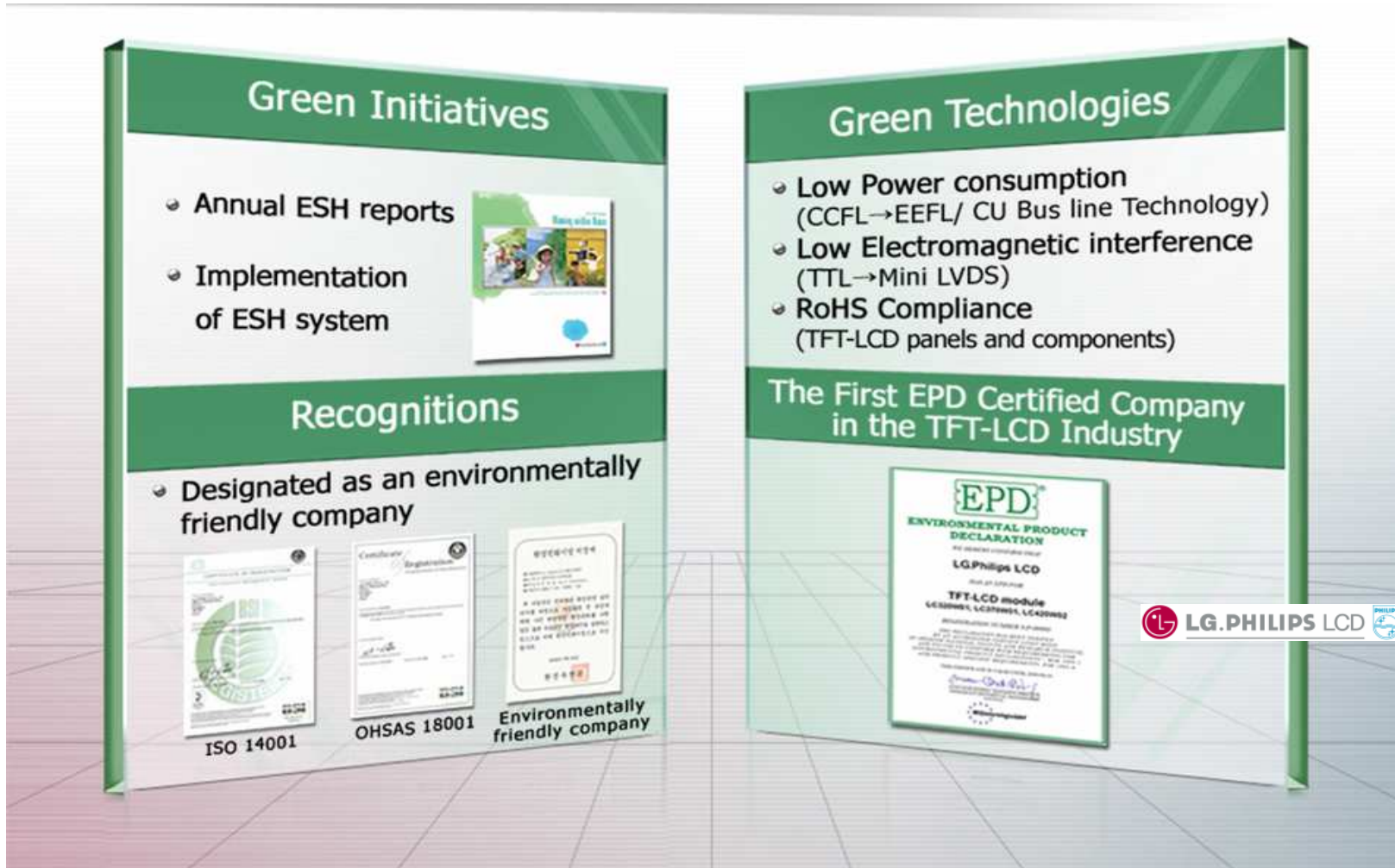


## An Inconvenient Truth...



- More recyclable,
  - cleaner “glass”, **CORNING**
  - safer liquid crystals... **MERCK**
  -
- RoHS Certification
- TCO Certification
- Low Power Consumption
  - Higher aperture panels
  - Better IC's and drive elec.
  - Better BLU's (backlight & controls)

# Display Trends: Example of “Environmental focus”



ESH : Environmental , Safety, Health  
 EEFL: External Electro Florescent Lamp  
 LVDS: Low Voltage Differential Signaling

CCFL: Cold Cathode Florescent Light  
 TTL: Transistor to Transistor Logic  
 RoHS: Restriction of Hazardous Substances

# Display Trends, slimmer panels, and sets....higher WAF!!!

## Slimmer

2- inch TFT-LCD Panel for Mobile Phones



0.79mm(Ultra Slim)

35.5mm



42-inch TFT-LCD  
Panel for TVs

35.5mm(Conventional)  
19.8mm(Ultra Slim)

19.8mm\*



\* MP based



# Trends in the TFT LCD Panel Supplier side... :

•Better , Bigger, Harder to make..

- Better Viewing angles
- Better Brightness
- Better Color
- Better Resolutions
- Better Response time (&MBR)
- Better BackLights (BLU)
  - Higher contrast
  - Regional dimming
  - LED vs CCFL vs EEFL
- Better Blacks
- More integrated electronics...

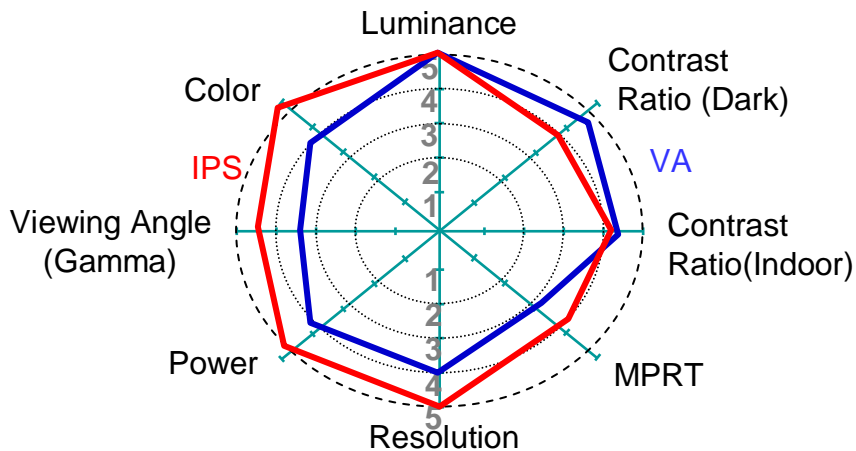
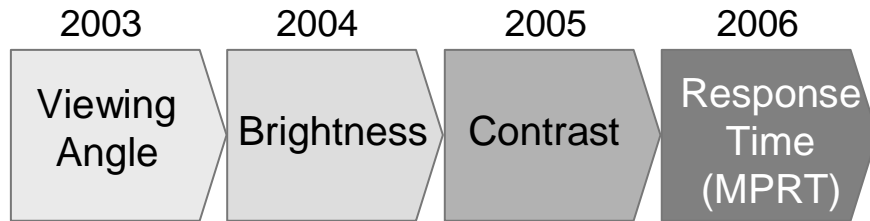




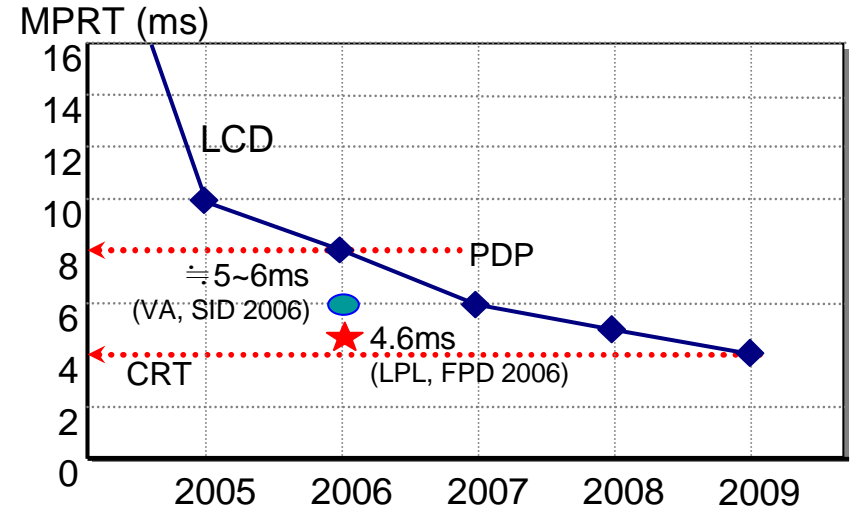
# Panel trends... :

- To improve competitiveness in performance, LCD makers will strengthen technology continuously, to reduce “MPRT” and make better features and specs year over year, and cost reduce as well!

## Technology Focus



## MPRT Spec. Trend



# More Panel trends, better image quality & backlights... :

- Technology advances in dynamic backlight control and new panel design will significantly improve the contrast ratio to the maximum level that human eyes can detect

## Enhanced IPS



1500:1 (7500:1)

- New TFT, Color Filter
- Optical Sheet
- Process Technology
- Active B/L Control

## LED B/L



20,000:1

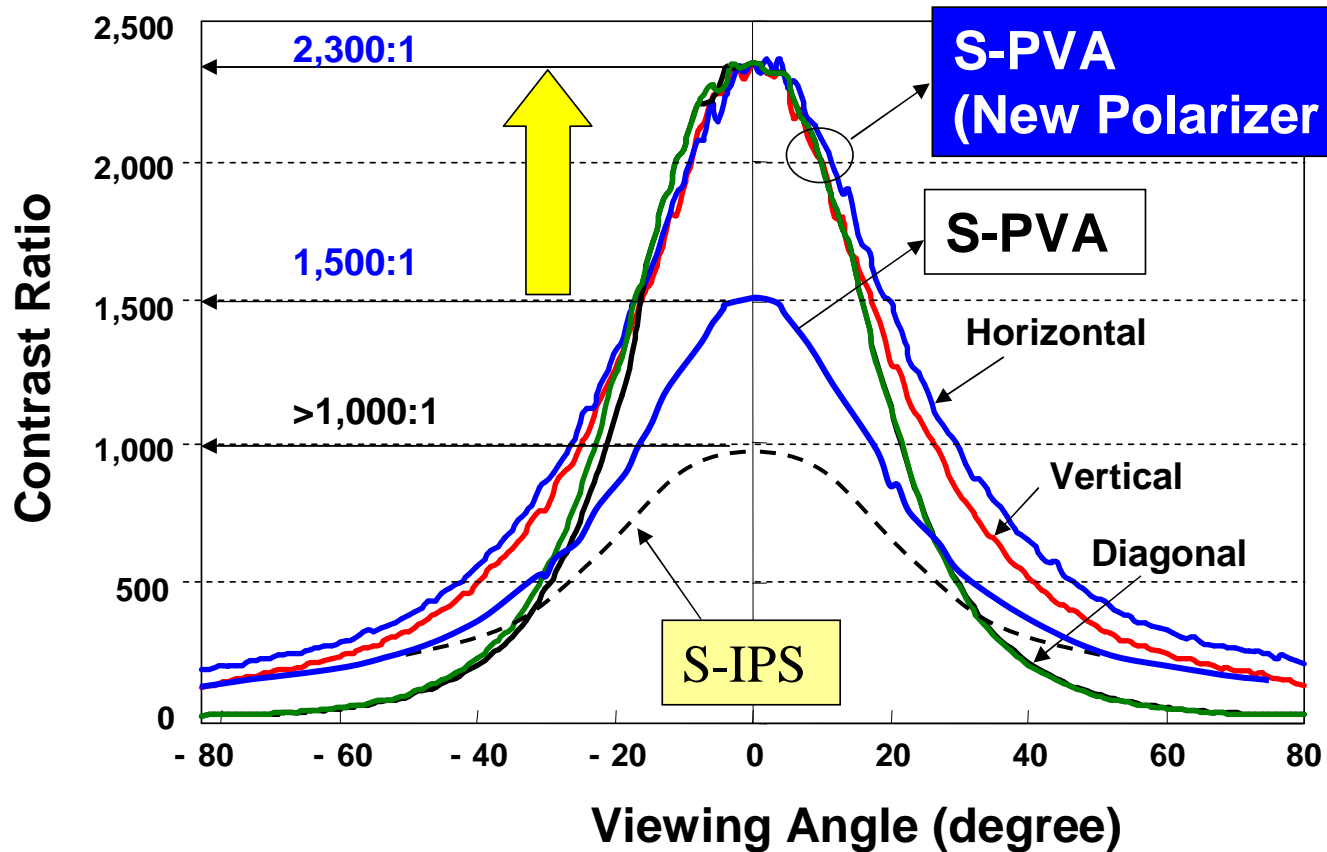
- LED B/L Areal Control



# More panel trends... : Contrast Ratio Improvement



New technologies result in  
0.2 cd/m<sup>2</sup> black luminance & “static” contrast ratio of >2,300:1



# More panel trends... :

*Great images need great “blacks”?*

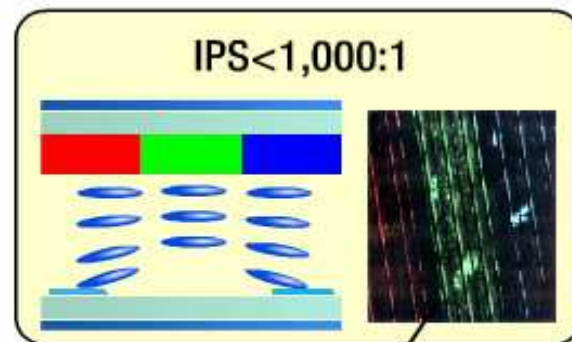
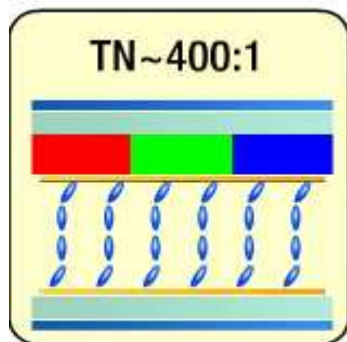


**Q: Which technology can produce the darkest black?**

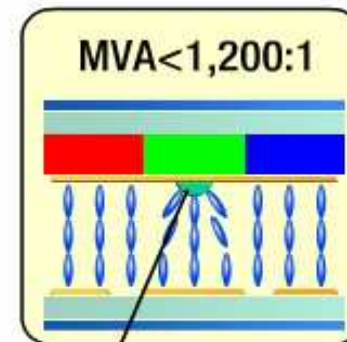
## Flat surface geometry & True Vertical Aligned L/C

- Ultra-thin patterned ITO, No protrusions (vs. MVA)
- Perpendicular orientation at black-state

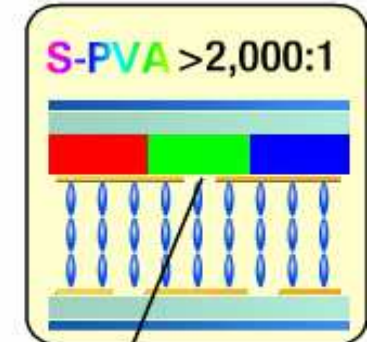
**No Residual Retardation ( $\Delta n \cdot d = 0$ ) at black-state**



light leakage



protrusion



patterned ITO

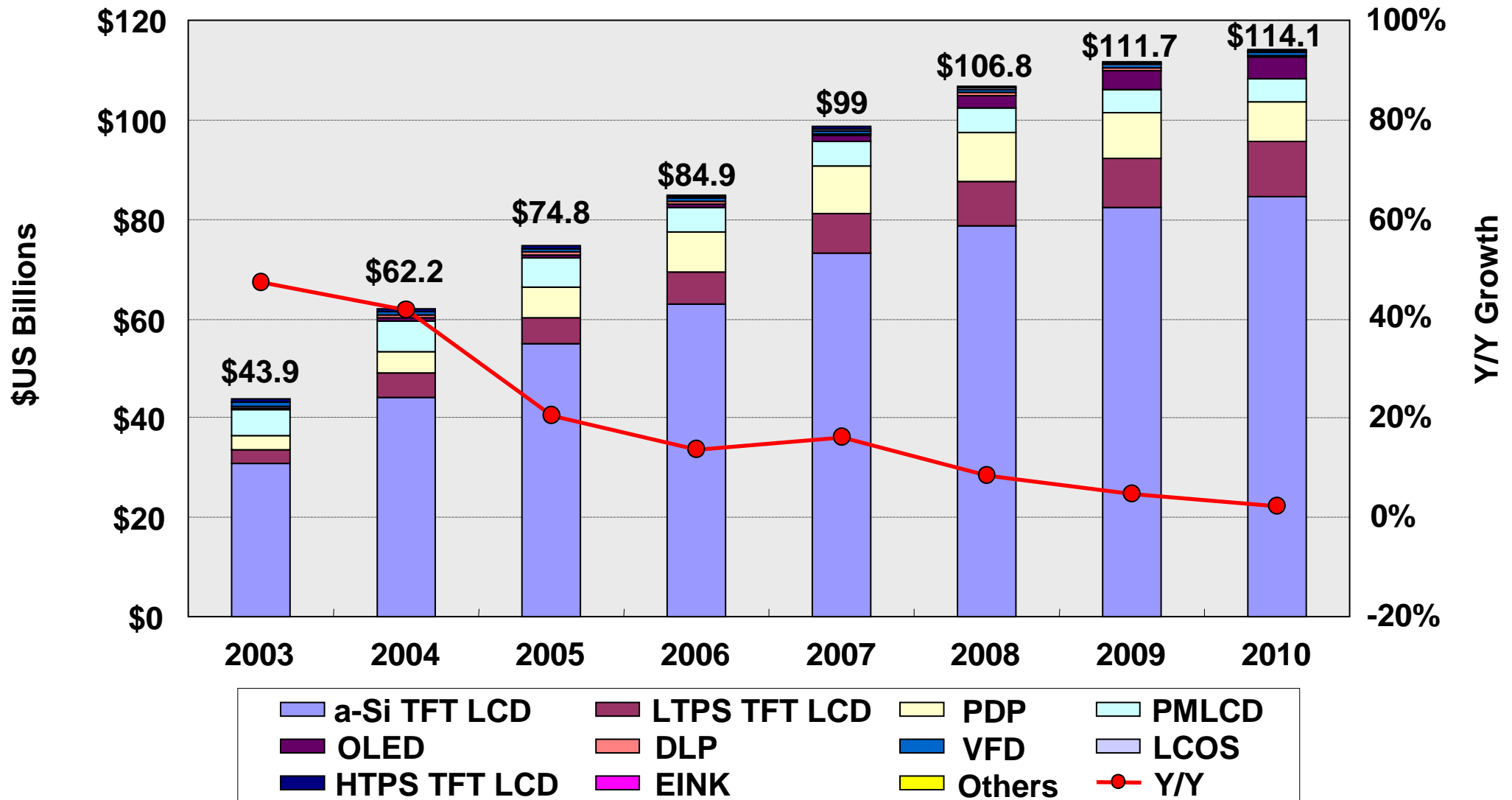


# Trends in the HDTV markets:

- More, Better , Bigger.... Less \$
- More sets and sizes
- Better prices and channels
- Bigger average size
- Higher Resolutions (FHD)
- “More Green” Sets wanted
  - Low Power Consumption
  - Recyclable (RoHS, etc.)
- Wireless Audio 1<sup>st</sup>, video next
  - Cheaper 7.1 Surround sound home theater systems!!



# Global FPD Market is already Close ~ 100 Billion USD in 2007, ..... mostly TFT



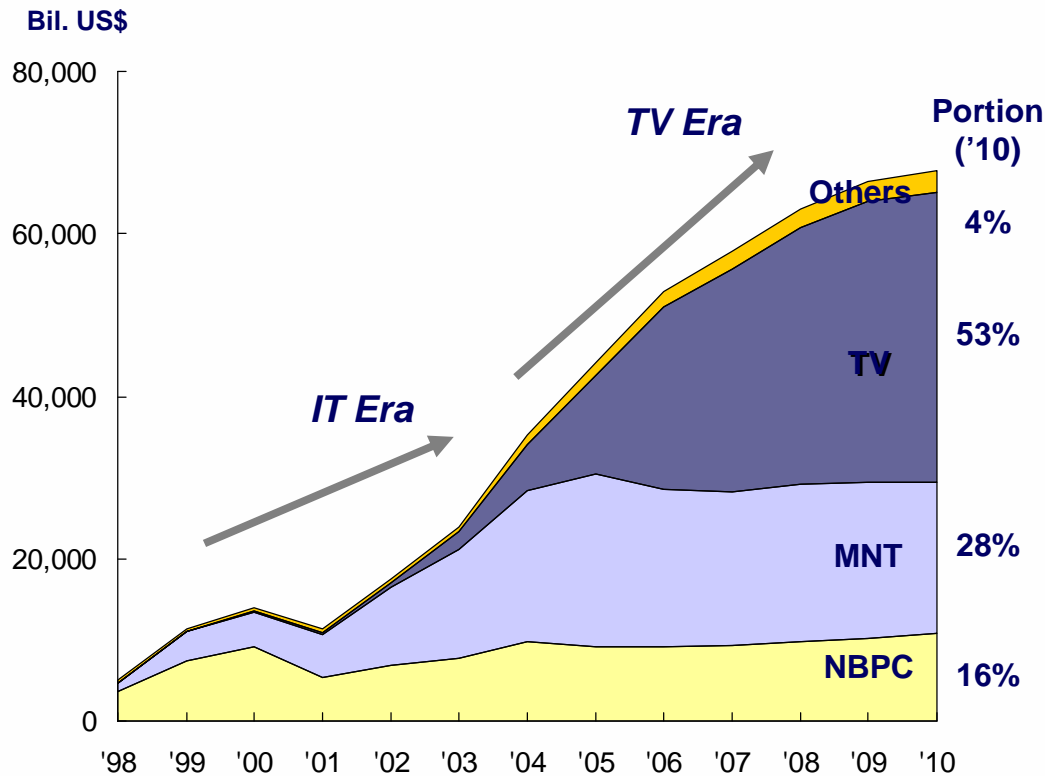
\* Source: DisplaySearch Q2'06 Worldwide FPD Forecast Report

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# Market Trends, Growth and Seasonality:

- TV becomes very important for panel vendors, and
- Seasonal swing is larger in TVs than IT

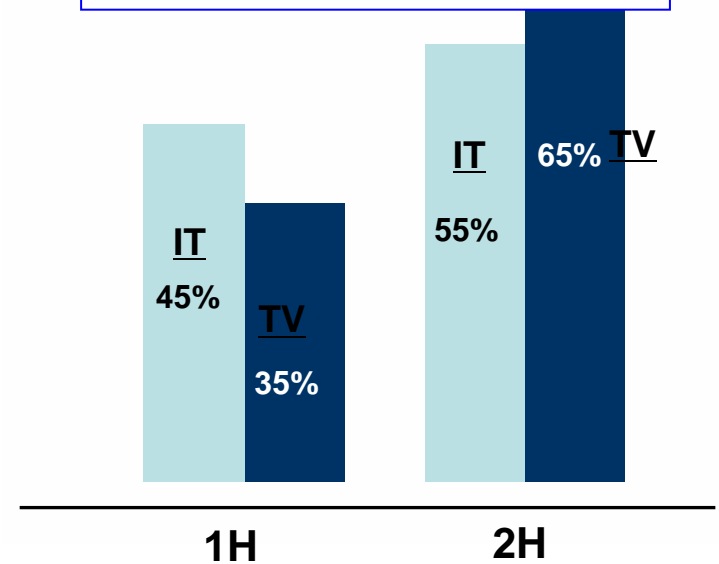
## TFT-LCD Demand Forecast by Revenue



## Seasonality (IT vs TV)

(Set Based)

Seasonal swing  
IT << TV

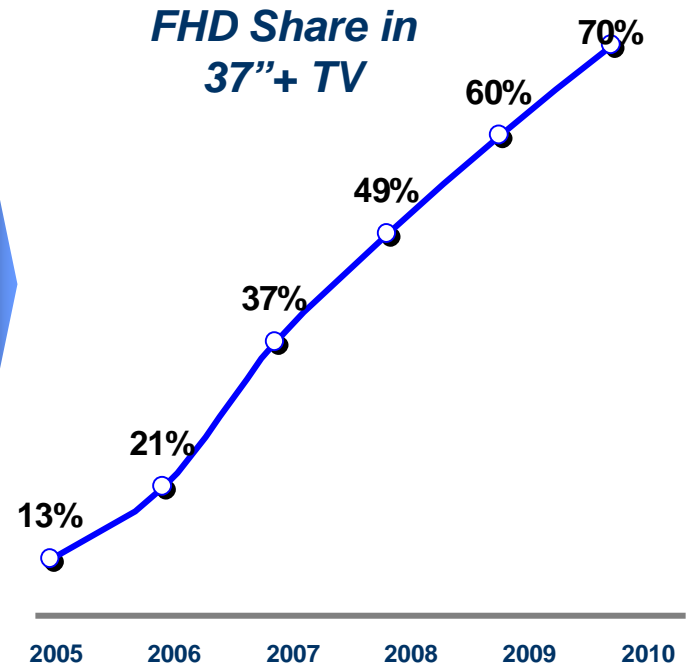
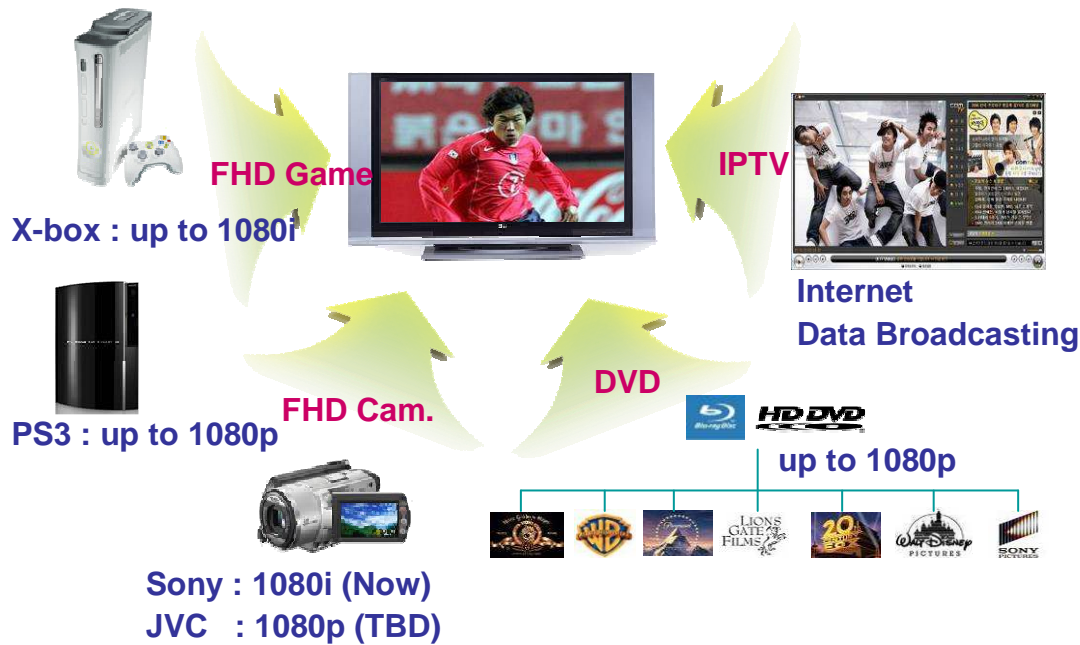


Source : Display Search

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# Market Moves toward more “Full HD”, 1920x1080, 2 megapixels

## Full HD Panel Share in TFT-LCD



Source : Display Search

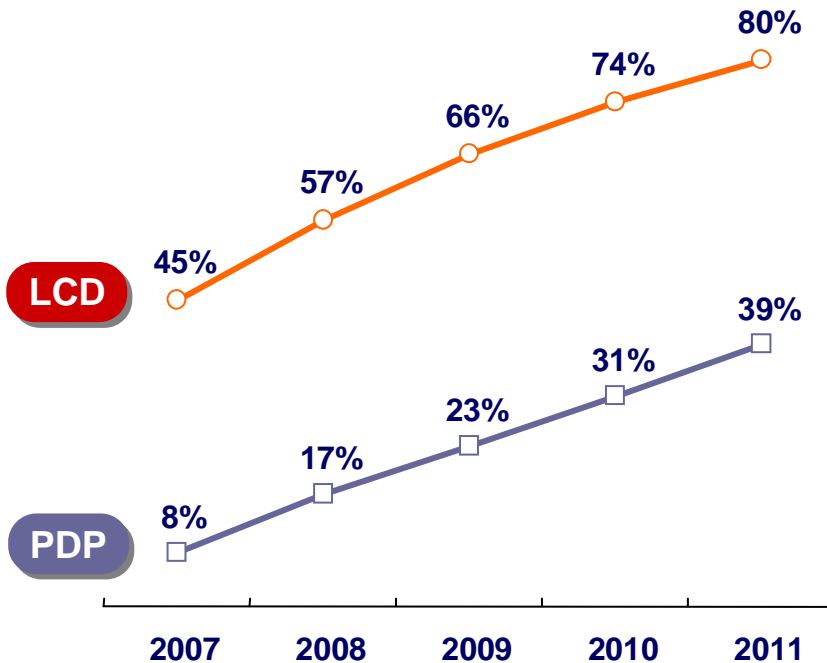


# Market for all FLAT TVs grows, TAM from 200m > 400M! but LCD maintains advantage over PDP for FHD...

- LCD has cost advantages over PDP in Full HD... (PDP yield issues, etc.)

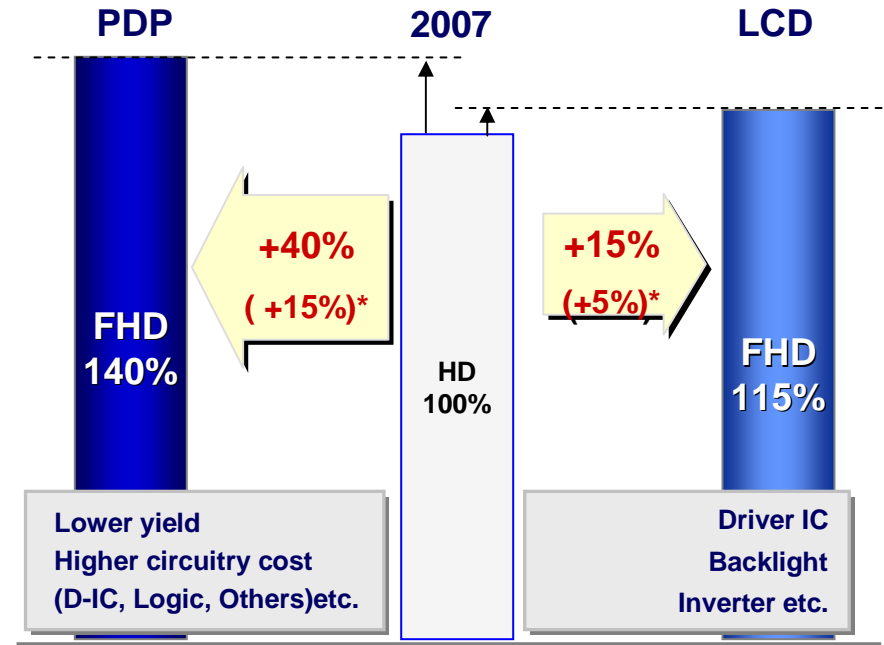
## Full HD Market Forecast

• Full HD adoption rate in  $\geq 40W$



Source : Display Search

## Full HD Cost Up (50")



\* ( ) = 2010 Forecast

Source : Displaybank

## More OVERALL Market Trends:

**“Green” electronics.... LCDs USE less energy to build, use, and dispose of... (and recyclable like Corning’s Eagle XG glass and Merck’s LCs)...  
- this is a 1,3, AND 10 year trend!**

**Wireless has HUGE “WAF”, great acceptance of no cables! Audio easier, and from TV “out”, Video or both via HDMI to TV from “Box” next.... 1-5 years...**

**LEDs and OLEDs will enable better backlights, and edgelights, for better displays.... And thus better products!! Major spurts, over next 1-15 years!**



## More Market Trends:

New fabs enable new and better LCDs...

And better TFT-LCDs Enables New TV Concepts, and realities...  
(S/W sells H/W!!)

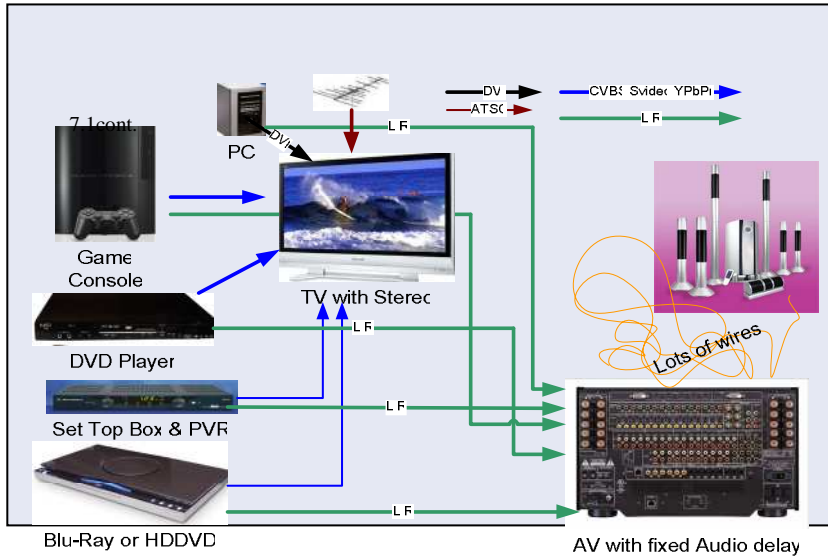
PIP to POP: Picture “out of” picture too



A “mirror” TV



**TV's Before wireless audio (WA), e.g. AudioMojo...  
ugh! , complex, ugly, and costly!... After, High WAF and less \$\$**



	Current 47" Sys.	WA System
DTV	\$2500	\$2500
DTV incremental	n/a	\$25
A/V receiver	\$500	n/a
7.1 speakers	\$800	\$800
Speaker incremental	n/a	\$75
Wiring	\$400	n/a
<b>Total</b>	<b>\$4200</b>	<b>\$3400</b>

- **Consumers spend less, get more, and TV makers make more too!**
- **TAM growth of Audio components**
- **Ease of set up and use!**
- **Better “home Theater” experience for all**

# Overall Emerging Trends: Things to consider....



Displays have already become a large part of our daily lives,  
a trend that will continue to grow



# Confusion for End Users is Endless... Not good for TAM/ \$\$\$

Some terms end users encounter:

- 480i, 480p, 720i, 720p, 1080i, 1080p
- MPEG-2, MPEG-4, H.264
- NTSC, ATSC, ATSC Tuner, HD Tuner, Cable Card, Op enCable, HD Compatible, HD Ready, HD Monitor, Digital Cable Ready, HD Satellite, DVR, HD DVR, HD DVD, Blue Ray
- Component, Composite, S-video, DVI, HDMI, etc.



**Alphabet Soup??**

Our parents will NOT buy if they are **confused**



Many Cables Also Means **Confusion and LOW "WAF"** (flat is high WAF, but...)

Confusion cable "craziness"



**Confusion w/Next Gen DVD "Standards"**

*"The nice thing about standards is that there are so many to choose from."*

- Andrew S. Tannenbaum

Prof. Computer Science, Wrije University, Amsterdam

Some predictions lead to eventual trends (a), or negative results (b), and some to unexpected “flame outs” (c).



(a) 1979



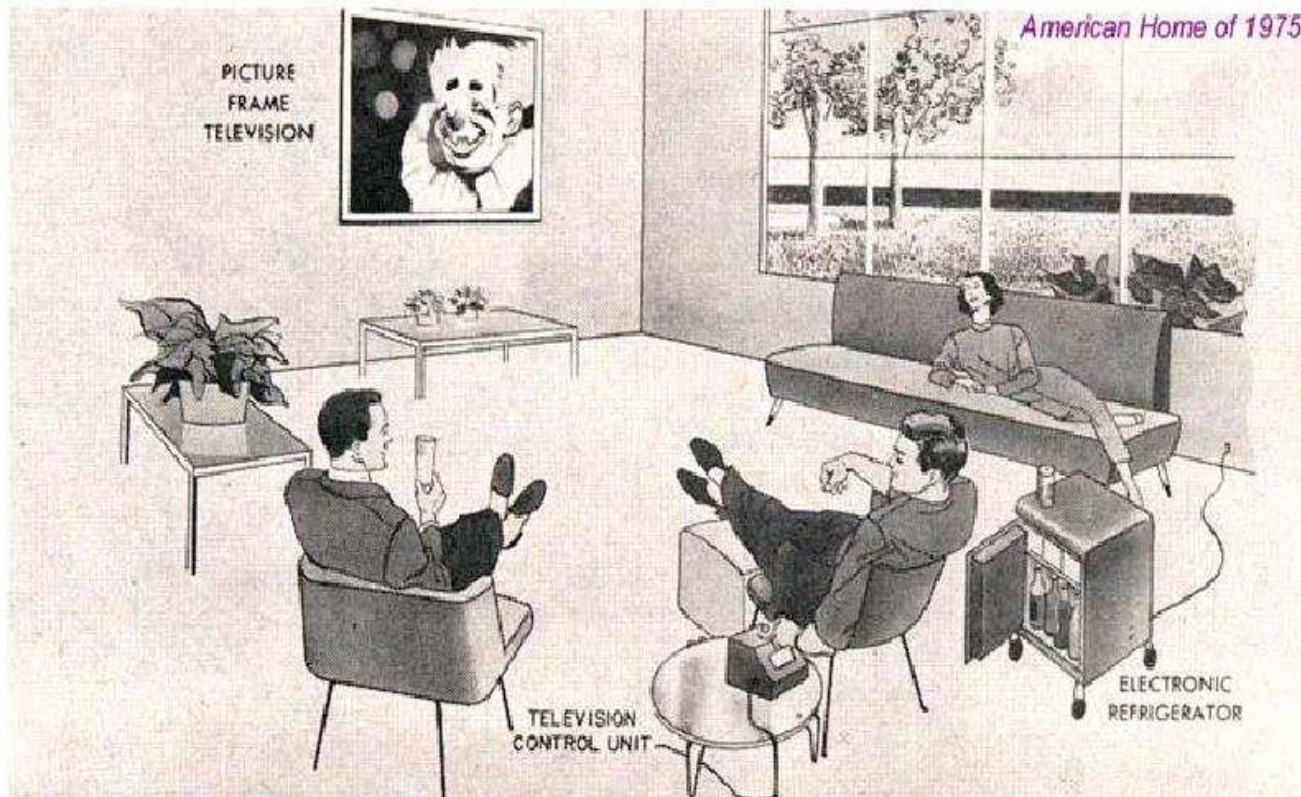
(a) 1999



(a) 2000

Yet, some do come true, like the 50-yr old dream of a “hanging” TV is enabled by LCDs today.... It took a while, but do you notice 2 things “wrong”?...

Picture frame TV, electronic refrigeration and remote electronic controls illustrated in this RCA sketch of the American living room of 1975 are just a few of the amazing devices which will provide conveniences for the consumer, and servicing opportunities for qualified technicians. During the coming years, and even effective in many areas today, the rapidly growing use of communications and electronic control equipment in industry will offer many attractions.



Flat-Screen TV Prediction in 1955

TECHNICIAN • October, 1955



Many Digital Devices Depend on TFT-LCD displays, but flat TVs, which look great OFF, and increasingly ON, are the hottest “area” of area growth.....

So some trends will lead to big growth, how do we “handicap” the future???



# “Berkoff’s rules for Technology”,

**The Display Industry is tough...**, easy to make a small fortune, but most start with a large one and work their way down...

Often companies forget “**Berkoff’s rule**”,  
where “**science always loses to engineering,**  
**engineering always loses to economics, &**  
**economics always loses to politics**”

..... e.g. “face issues”, ( we don’t have to like it but, let’s not forget it....  
ex: Plasma and Projection)



LCD Flat panels are here to stay, and have great “**WAF**”  
, “wife acceptance factor” (SID’98=me),  
(espbut better and less costly  
. off!), solutions are **needed**... &  
maybe coming!.....





# Trends in Display Technology:

- New uses, peripherals, and new tech?

- Touch screens

- Windows and Public Displays

- Multiple views

- Store Ad “net works”

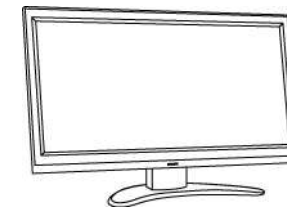
- New Technology...

- OLED

- 3D

- Interactive electronics

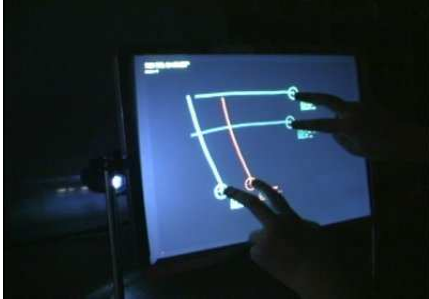
- Flexible displays



???

# LCD Usage and Peripherals might help enable New Market Opportunities.... Especially with large and interactive signage..

- Multi-Touch Sensing



- Window Display



## **PUBLIC Display and Signage Market is GROWING!**

- Multi-Vision

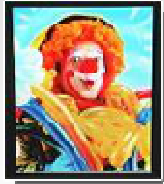


- Triple View Display



# New Technology Trends will enable New Products and perhaps New Markets...

## AMOLED.... Now small, someday?



## More Future Displays

### 3D Display



### Interactive Display



## Flexible Displays (USDC focus...)

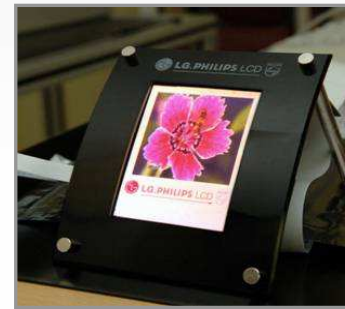
### World's 1st 14.1" Color Flexible Color E-Paper



- 4K Color
- Thickness : 300 $\mu$ m
- `07. May



### World's 1st Full Color Flexible AMOLED using a-Si Tech



- 4" QVGA (320x240)
- Thickness : 150 $\mu$ m
- `07. May



Inform ◦ Promote ◦ Improve ◦ Connect



**A global not-for-profit trade association.... WE CAN HELP....**

**Whose goal is to Inform, Promote, Improve, and Connect.**

We will **Inform** the public on the many benefits of LCD technology vs. CRT, Plasma or PDP, and the various types of rear-projection TVs, or RPTV. The LCD TV Association will **Promote** the industry and technology via speeches, debates, interviews, PR, white papers and research (on various technological specifications) which help to achieve these goals.

We will help **Improve** the product features and functions, by inventing and promoting new specifications and features. For example, we have created a “Green TV” logo for those TVs which can monitor external ambient light and save energy and prevent eyestrain in a dark room by lowering backlight power (this example is. A major goal is to add perceived value for little or no cost, and to help promote them via press reviews and branding. This can only help decrease the relentless downward pressure on margins while making better products available for consumers.

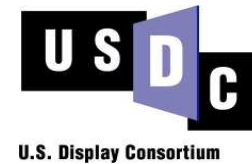


The LCD TV Association serves to **Connect** the industry supply chain, via our web site, publications and research, as well as face-to-face meetings, speeches, white papers, quarterly newsletters, etc. In addition, our “limited” Sustaining Member Advisory Board, has quarterly meetings to set priorities and address issues, as well as to facilitate win/win relationships among our industry partners. We will help many of the latest start-ups with great technology related to LCD TVs (from better backlight controls to wireless audio, etc.), speed their time to market with better features and functions, as this could also help create more value for the TV vendors while even lowering prices for consumers.



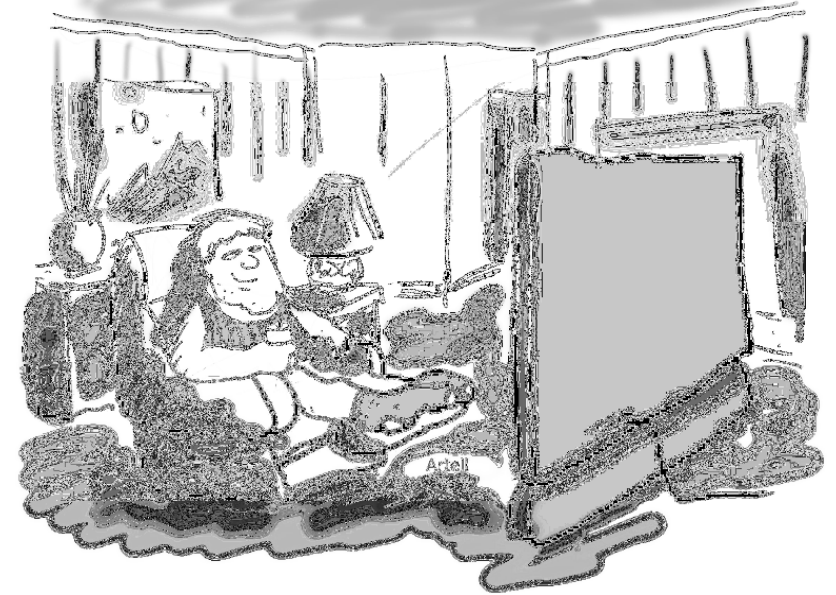
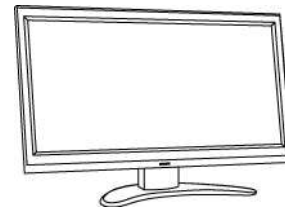
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# Some MORE HDTV trends to be aware of..... What's next???



American, idle.

# LCDTV Association

**Inform ◦ Promote ◦ Improve ◦ Connect**



***A great TV in every room!!!***