

Research Flash

Investment Ideas

Disruptive displays: Smart, 3D, flexible and transparent

Private Banking

Sharply rising demand for enhanced portable devices

In January 2011 2.3 million tablets were sold. In April more than 5 million were sold, a 220% increase compared to January, driven by strong demand for iPad 2 from Apple and Samsung's Galaxy Tab 10. Further, 1 out of every 3 mobile phones sold in 2011 is projected to have a multi-touch screen and this should rise to 1 out of every 2 mobile phones in 2015, according to Displaybank. This demand pattern illustrates the very strong growth potential of the next generation displays with up to high double-digit growth rates. Demand is mainly driven by rising mobility needs and new application fields such as smart windows for cars and buildings, and advertisement displays, supported by ongoing technological gains.

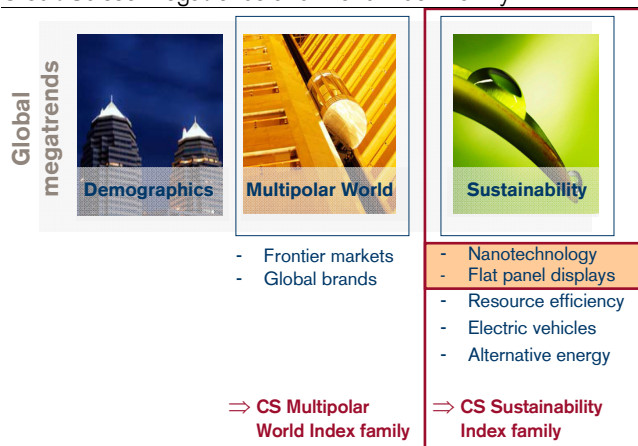
As with many megatrends, novel displays satisfy increasing mobility, rising living standards and ecology-linked needs. As these displays use many nano-based components and save lots of resources and energy, this theme belongs to the Nanotechnology megatrend theme within the Sustainability pillar (see Figure 1).

Key drivers for new displays: Mobility and infotainment

Rising demand for portable instruments with more functionality, such as multimedia applications (wireless, mobile TV,

Figure 1

Credit Suisse Megatrends and Trend Index Family



Source: iStockphoto, Credit Suisse

Highlights

- As with many megatrends, novel display solutions should benefit from increasing mobility, rising living standards and ecology-linked needs.
- Flat display is a disruptive technology as it irreversibly replaces old cathode ray tubes. It enhances mobile device features.
- We also see an emerging trend towards slim, smart, flexible and invisible displays for new applications like smart windows, infotainment and augmented reality.
- We therefore expect a 3-fold rise in sales to USD 110 bn for LED displays and USD 10 bn for organic displays by 2015.
- We recommend investing in firms with technology leadership and development capabilities in slim, smart and flexible displays.

Top investment ideas

BUY Samsung Electronics (005930 KS Equity) – a leading global manufacturer of LED displays and OLED, smartphones, tablets and various electronic devices.

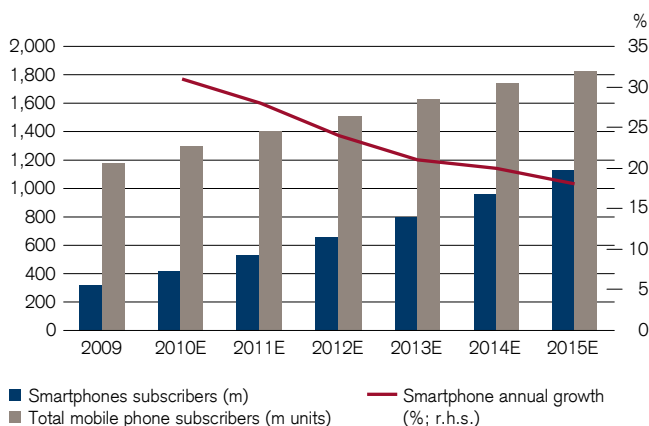
BUY LG Electronics (066570 KS Equity) – a leading producer of LCD displays, TVs, smartphones and many other electronic and consumer goods.

BUY Toshiba (6502 JP Equity) – a leading manufacturer of LED-LCD displays and many electronic devices.

BUY an index tracker on an index, as shown in Table 2.

Figure 2

Up to 28% p.a. increase in smartphone subscribers by 2015E



Source: Gartner, Credit Suisse, various company data

global positioning systems), and with greater data content & processing capabilities (images, video) is supported by solid technological gains and infrastructure availability (e.g. internet-related services) at affordable prices. As most of these applications need a screen to visualize images and other digital data, lightweight and energy- and cost-efficient displays are required. We expect strong demand for new displays owing to:

- Rising mobility leading to growing demand for portable instruments;
- A need to improve the ecological footprint and reduce energy use and waste disposal;
- Improving living standards.

As a result, we also see a rising trend toward the combined use of IT and entertainment tools, leading to a so-called infotainment trend. Samsung's Smart TV illustrates this convergence trend: It is a notebook, a mobile communication tool and a web-connected TV, all in one device.

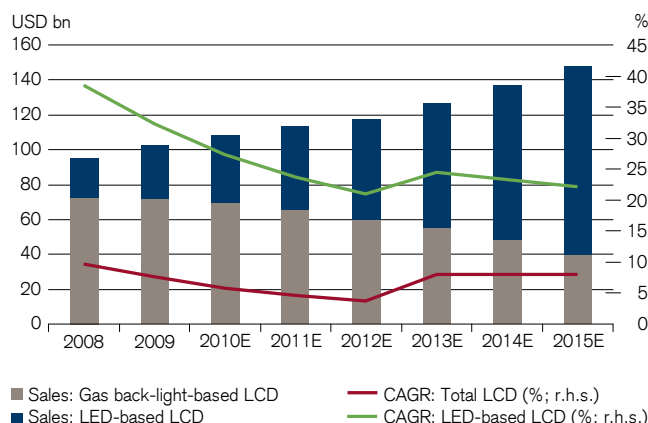
Finally, with growing populations and economic wealth, mobility is on the rise, leading to stronger demand for advanced mobile devices like mobile phones and iPhones, personal digital assistants (PDAs), digital cameras, laptops and other portable consumer electronics accessories.

Projected 10-fold increase in tablet units and 3-fold increase in smartphone units by 2015E

According to Gartner and various industry sources, the number of smartphones, i.e. phones with multiple functions and multi-touch displays, is projected to increase nearly 3-fold to 1.1 billion in 2015 (see Figure 2), and the number of tablets is forecast to increase by more than 10 times to more than 230 million in 2015. This growth is achievable with ongoing innovations and technological advances in various electronic components, notably memories, microprocessors, high-performance batteries and displays, in our view. The latter are likely to offer significant technological advances towards slim, smart, flexible and ultimately transparent displays in the medium term, as will be described in the next sections.

Figure 3

Projected 20% p.a. rise in LED-based LCD displays by 2015



Source: Frost & Sullivan, Displaybank, Display Search, Credit Suisse

The first display generation: LCD – slim, smart and 3D

In the liquid crystal display (LCD) universe, there are basically two LCD panel categories:

- Passive-matrix addressed LCD, in which pixels are addressed one at a time by row or column;
- Active-matrix addressed LCD, in which each pixel is addressed individually.

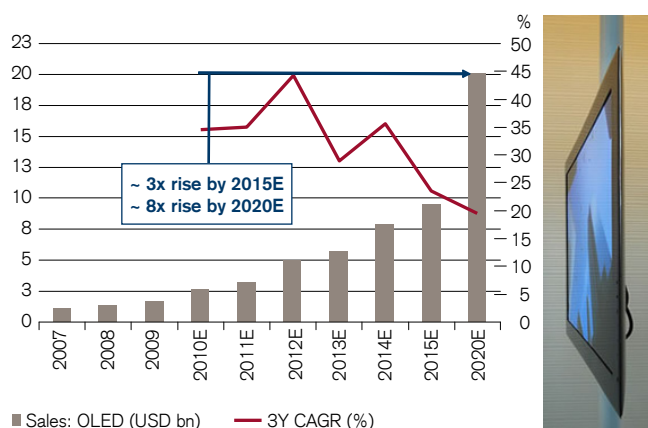
As the display size increases, passive-matrix addressed LCD have a slower response time and poorer contrast, and are therefore used for a limited range of small display size applications (typically a few inches in size). The active-matrix addressed LCDs are used for most other applications, including those with advanced multi-functionality in the mobile electronics, defense, telecom and healthcare sectors.

As the LCD industry is very competitive and fast-evolving, and has a cyclical business nature, only players with a superior cost/benefit structure and innovation potential are expected to be the future winners. Further, thanks to the recent use of light-emitting diodes (LED), LED-based displays are becoming slimmer with higher image brightness and contrast (typically 3–10 times or more) and energy savings (up to 40%) compared to LCD back-lit displays with gas-based (e.g. fluorescent) lamps. In addition, three-dimensional (3D) LED-LCD displays without the use of eyeglasses are likely to come to the market in 1–3 years, driven by ongoing innovations.

Going forward, a strong growth rate for LCD displays will also be supported by a multi-year replacement cycle in the IT sector, such as in the PC and TV product segments (e.g. cathode ray tubes will be replaced by flat screens and gas-light-based displays will be replaced by LED-based displays). As a result, we project a more than 20% annual increase in LED-based LCD sales to more than USD 100 bn by 2015 (see Figure 3). Finally, most of key players in the LED and LCD businesses are expected to be in Taiwan, South Korea and Japan, accounting for more than 90% of the LCD industry's output worldwide.

Figure 4

A 3-fold rise in sales of OLED by 2015E; OLED-TV (right)



Source: Frost & Sullivan, Displaybank, oled-display.net, Credit Suisse

The next generation: OLED – smart, flexible, invisible, 3D

Thanks to the impressive technological progress of display technologies, coupled with affordable production costs, new application fields will emerge in the near future, in our view. These include displays for smart windows in buildings and cars, advertisement windows for shopping malls, head-up displays for the aviation and car sectors, and the augmented reality field. These displays should be slim, smart, transparent and even flexible.

As described above, LCDs could get slimmer and smarter by using compact LED-backlighting. Moreover, by using nano-wired thin-film transistor technology and nano-based optical films, these displays become partially transparent, typically between 5%–10%. Despite these advancements, this transparency isn't sufficient for the new applications mentioned above. Moreover, LCD-based displays are not flexible.

In our view, organic light emitting diode displays (OLED) could enable the additional features (i.e. flexibility and transpar-

ency). Generally speaking, OLEDs consist of nanometer thin organic layers (typ. 20–200 nm thick) sandwiched between two electrodes (anode and cathode). These emissive layers emit light in response to applied electric current. So no back-light is needed compared to LED-LCD. Further, OLED structure consists of a transparent substrate and ultra-thin transparent electrodes like indium tin oxide. As a result, OLED displays offer further benefits versus LED-LCD displays, such as:

- Wider viewing angle;
- Greater range of colors and higher brightness & contrast;
- Faster response (more than 200 times faster vs. LCD), and
- Desired transparency and flexibility: with a 3D option added in the near future.

Presently, OLED may achieve transmittances above 60%–70%, around 6–12 times more compared to LCD. Presently, key weaknesses of OLED are a shorter life time, higher costs and a lower efficiency of blue-color OLED. We expect them to be addressed in the near future due to ongoing technological advances. As a result, we project sales growth rates of between 20%–45% p.a. to nearly USD 10 bn by 2015 and potentially USD 20 bn by 2020, driven by the various applications cited above and general lighting purposes (see Figure 4).

Key risks to these forecasts would be a prolonged economic slowdown leading to lower R&D spending and/or slower technological advances, in our view.

Investment opportunities and conclusion

In the display universe, we recommend selective investments in companies with significant activities or leadership in LCD and/or OLED technologies, such as **Samsung Electronics**, **LG Electronics** and **Toshiba**, supported by superior sales and/or earning prospects in 2012E compared to global markets. At the P/E 2012E ratio level, shares of these companies are trading at a discount of between 5%–35% relative to the world equity markets (see Table 1).

Table 1: Stock selection – LED-LCD and OLED-related businesses

	Bloomberg ticker	Curr.	Price as of 30/05/11	Ann. sales growth 2011E	Ann. sales growth 2012E	Ann. EPS growth 2011E	Ann. EPS growth 2012E	P/E 2011E	P/E 2012E	Dividend yield 2011E	Market cap (bn)	Rec.	Comment
SAMSUNG ELECTR.	005930 KP	KRW	884,000.0	49%	9%	0%	16%	9.1	7.8	0.6%	132,864.0	BUY	LED, LCD, OLED
AU OPTRONICS	2409 TT	TWD	23.0	2%	7%	n.m.	n.m.	n.m.	16.8	1.7%	207.9	SELL	LED-LCD
LG ELECTRONICS	066570 KP	KRW	97,000.0	102%	9%	14%	78%	13.0	7.3	0.2%	14,059.8	BUY	LED-LCD
LG DISPLAY	034220 KP	KRW	36,000.0	3%	7%	-17%	36%	13.0	9.6	2.8%	12,845.6	HOLD	LED-LCD, OLED
SONY CORP	6758 JT	JPY	2,122.0	2%	4%	n.m.	55%	18.2	11.8	1.2%	2,173.0	HOLD	LED, LCD, OLED
TOSHIBA CORP	6502 JP	JPY	421.0	7%	4%	31%	17%	12.6	10.7	1.2%	1,822.2	BUY	LED, LED-LCD
SHARP CORP	6753 JT	JPY	740.0	-7%	5%	-46%	154%	55.7	21.9	2.3%	844.1	N.R.	LED, LED-LCD
PHILIPS ELECTR.	PHIA NA	EUR	19.1	-7%	5%	-11%	18%	11.7	10.0	3.9%	19.6	BUY	LED, LCD, OLED
UNIVERSAL DISPLAY	PANL UQ	USD	46.4	56%	107%	n.m.	n.m.	n.m.	n.m.	0.0%	2.1	N.R.	OLED
Sector average				21%	16%	-4%	47%	17.8	11.6	1.6%			
MSCI World Equity Ind.	MXWO Index	USD	325.7	7%	6%	15%	14%	12.8	11.2	2.9%			

N.R. = not rated. Please note that we do not rate these stocks and make no recommendations on them as investments.

Source: Bloomberg includes consensus estimates, *Datastream (weekly data) includes price index levels adjusted per share; Credit Suisse; n.m.=not meaningful

Table 2: Selection of indices linked to the nanotechnology theme incl. risk/return features vs. the MSCI World Index and the S&P 500 Index (1/1/2004 – 31/05/2011)

	Ann. return	Ann. risk	Sharpe ratio	Total return
MSCI World Equity Index	3.5%	19.3%	0.02	28.9%
S&P 500 Index	2.5%	18.9%	-0.03	20.1%
LUX Nanotech Index	-8.2%	28.6%	-0.39	-47.1%
S&I Global Nanotechnology Index	1.3%	30.7%	-0.06	10.1%
CS Global Nanotechnology Index	6.6%	22.9%	0.15	60.4%
Ave. Libor rates 1Y (USD)	3.0%	12.2%		

Source: Bloomberg (weekly data), Credit Suisse

Finally, as LED, OLED and display-related technologies are parts of the Nanotechnology theme, we also recommend investing in **index tracker** on an index, as shown in [Table 2](#).

For more information on the Nanotechnology megatrend theme within the Sustainability pillar and index fact sheets (see [Figure 1](#)), please see the following publications:

- Trends Index insights: Sustainability – index-based solutions pay off across key asset classes, 25 February 2011
- Nanotechnology insights: Tripling of sales by 2015E, 16 November 2010.

Abbreviations frequently used in reports

Abb.	Description	Abb.	Description	Abb.	Description
CAGR	Compound annual growth rate	EPS	Earnings per share	P/B	Price-to-book value
CFO	Cash from operations	EV	Enterprise value	P/E	Price-earnings ratio
CFROI	Cash flow return on investment	FCF	Free cash flow	PEG	P/E ratio divided by growth in EPS
DCF	Discounted cash flow	FFO	Funds from operations	ROE	Return on equity
EBITDA	Earnings before interest, taxes, depreciation and amortization	IBD	Interest-bearing debt	ROIC	Return on invested capital

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Company	Rating	Date
AU OPTRONICS (2409 TT)	SELL	since 17/05/2011
	HOLD	since 11/01/2011
	BUY	since 29/07/2010
	BUY	since 04/02/2010
LG DISPLAY (034220 KS)	HOLD	since 21/04/2011
	BUY	since 25/10/2010
	BUY	since 23/07/2010
	BUY	since 22/04/2010
LG ELECTRONICS (066570 KS)	BUY	since 04/05/2011
	HOLD	since 28/01/2011
	SELL	since 01/11/2010
	HOLD	since 29/07/2010
	BUY	since 29/04/2010
PHILIPS (PHIA NA)	BUY	since 19/04/2011
	BUY	since 18/04/2011
	BUY	since 25/01/2011
	BUY	since 24/01/2011
	BUY	since 25/10/2010
	BUY	since 18/10/2010
	BUY	since 20/07/2010
	BUY	since 19/07/2010
SAMSUNG ELECTRONICS (005930 KS)	BUY	since 20/04/2010
	BUY	since 04/05/2011
	BUY	since 09/02/2011
	BUY	since 15/10/2010
	BUY	since 08/07/2010

SONY (6758 JP)	BUY	since 03/05/2010
	HOLD	since 10/11/2010
	HOLD	since 18/10/2010
TOSHIBA (6502 JP)	HOLD	since 14/05/2010
	BUY	since 14/02/2011
	BUY	since 17/11/2010
	BUY	since 30/09/2010
	BUY	since 05/08/2010
	BUY	since 11/05/2010

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	Overall	Investment banking interests only
BUY	44.56%	45.85%
HOLD	49.33%	48.27%
SELL	4.62%	4.15%
RESTRICTED	1.49%	1.73%

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