

Crystal clear

[Learn more](#) →

Autumn/Winter 2012

Welcome to ElectronicsIQ, your update from Linde Electronics.

Demand for a more immersive viewing experience delivered by high functionality displays in smartphones, TVs and public displays continues to grow; the Flat Panel Display (FPD) and OLED industry is set to increase steadily over the next five years. In this special issue, we bring to you the latest developments, news and insights that are helping to shape and support the next generation of display technology.

Analyst viewpoint: display market growth continues led by investments in China

The current global display market is worth US\$90 billion in 2012 and is expected to grow by a further 5% in 2013. The main driver for this growth in the Flat Panel Display (FPD) industry is larger screen size trends in almost all applications, from smartphones to TVs and public displays as well as new technology implementations such as OLED, Low Temperature Poly Silicon (LTPS) and Oxide TFT displays. Small/medium applications such as smartphones and tablet PCs are also driving the FPD industry revenue both in terms of volume of shipments and display area growth.

Of the global FPD market, the TFT-LCD segment is currently worth approximately US\$8.5 billion in revenues. Revenues grew 13% year-on-year as of September 2012 and are expected to grow at 5% CAGR in the next five years. This is primarily due to the on-going demand for a more immersive viewing experience delivered by high functionality displays such as Ultra High Definition (UHD) 3D TVs as well as larger screens, particularly in higher resolution smartphones and tablet PCs.

While revenues grew, total TFT-LCD shipment growth was flat over the past 12 months at 240 million units. This was mainly due to weak demand in the consumer market, resulting from the unstable macroeconomic climate globally. Despite weaker demand, the trend towards larger screens means that the total area of displays shipped continues to increase steadily, with a 14% increase this year, and an estimated 11% growth in the total area of displays shipped in 2015.

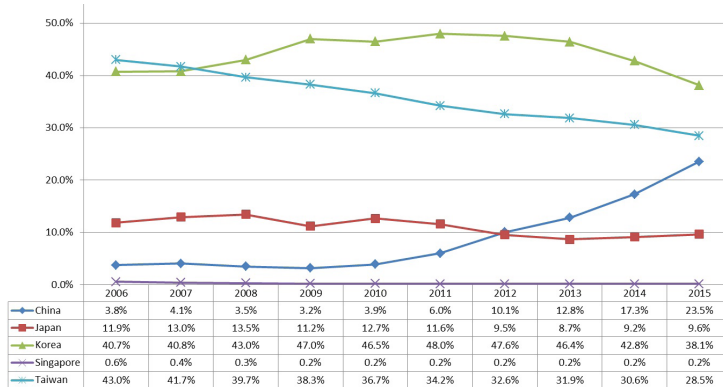
As consumer demand is forecasted to grow in coming quarters with the global economic recovery, analysts expect to see a 3% growth in total TFT-LCD shipments over the next five years. The mobile PC market, particularly tablet PCs, is expected to contribute to this growth, at a healthy pace of 10% in shipments forecasted for the next three years.

Korea is the biggest manufacturer of TFT-LCD displays with Taiwan coming second and Japan third. Korea and Japan are leading the way in the development new display innovations, including Oxide TFT, LTPS, In-Plane Switching (IPS) and Fringe Field Switching (FFS) technologies.

China, however, recorded the highest growth in the TFT-LCD sector in 2012. Almost all panel makers in the country, including BOE and ChinaStar, are investing aggressively in new LCD production capacity. BOE, which over the past 10 years has become one of the largest LCD producers in China, is expected to invest the most in additional capacity over the next three years. In 2012, the company added two Generation 8.5 (Oxide TFT and AMOLED) production facilities and one Generation 5.5 (LTPS and AMOLED) facility, while CEC Panda is expanding capacity with a new Generation 10 facility. China is expected overtake Japan as the world's third largest TFT-LCD manufacturer this year, with over 70% of the global new capacity installed in the country in 2012 and 2013. Following these investments, China is expected to reach over 20% market share by 2015.

Table of Contents

- [Analyst viewpoint: DisplaySearch](#) →
- [Next generation displays](#) →
- [SK Hynix embraces on-site fluorine](#) →
- [KDIA certification](#) →
- [Expansion in China](#) →
- [My Life at Linde](#) →





Nitrous oxide (N₂O) and next generation displays

Improving electron mobility in transistors is crucial in bringing higher resolutions and frame rates to TVs, mobiles and computing devices.

The manufacture of ultra-high definition (UHD) 3D displays is expensive, requiring the use of polysilicon transistors, which cost twice as much as those using amorphous silicon. By replacing polysilicon with metal oxide, it is possible to increase electron mobility by a factor of up to 40 compared with conventional technology, at a comparable cost.

Consequently, more and more display manufacturers are working to implement metal oxide transistors.

This will enable the cost-effective manufacture of UHD 3D displays, and the introduction of next-generation TVs, mobiles and computing devices at an attractive price point.

Table of Contents

- [Analyst viewpoint: DisplaySearch](#) →
- [Next generation displays](#) →
- [SK Hynix embraces on-site fluorine](#) →
- [KDIA certification](#) →
- [Expansion in China](#) →
- [My Life at Linde](#) →



ElectronicsIQ.

Information Quarterly from Linde Electronics.

THE LINDE GROUP

Linde

Metal oxide transistor manufacturing requires high volumes of high-purity nitrous oxide (N_2O), which is used to create functional layers of the microscopic thin-film transistors required to control each of the millions of pixels that make up the visible image.

These transistors will enable the development of large OLED televisions and displays, improved battery lifetime of tablets and smart phones as well as UHD 3D displays, which have resolutions four times higher than traditional HD 3D displays, at 3,840 x 2,160 pixels.

Many leading display manufacturers have recently launched products with metal oxide transistors. Samsung Electronics has unveiled the world's first 55-inch metal oxide-based OLED TV, which features 'Smart Dual View'. This technology enables two users to view different channels with one full HD screen. The product attracted worldwide attention by winning 'Best of Innovation Award' at CES 2012 in Las Vegas in February. LG Display has also unveiled its 55-inch OLED TV featuring one of the world's largest and slimmest OLED screens. Additionally, Sharp recently announced that it has started the commercial production of metal oxide displays in its Kameyama plant.

In summary, the electronics specialty gas N_2O plays a crucial role in enabling the cost-effective development of next-generation UHD 3D TFT-LCD and OLED displays. Linde and LLH are currently running six N_2O plants in Asia with a capacity of more than 3,000 tons per year.



Image courtesy of LG

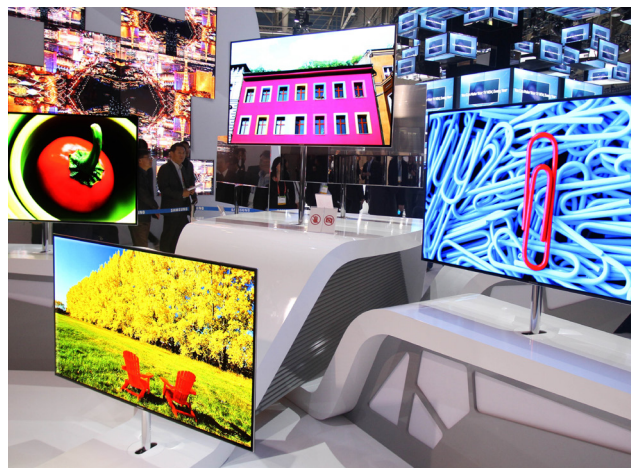


Image courtesy of Samsung

ElectronicsIQ.

Information Quarterly from Linde Electronics.



SK Hynix embraces on-site fluorine (F₂) technology

Table of Contents

- [Analyst viewpoint: DisplaySearch](#) →
- [Next generation displays](#) →
- [SK Hynix embraces on-site fluorine](#) →
- [KDIA certification](#) →
- [Expansion in China](#) →
- [My Life at Linde](#) →

Linde recently announced the signing of a significant long-term supply contract with SK Hynix Inc., a world-leading manufacturer of DRAM and NAND flash memories, to deliver on-site fluorine (F₂) to multiple mass production sites in Korea. The expansion of Linde's patented on-site F₂ technology to these facilities follows successful implementations on all SK Hynix's production sites since 2004. SK Hynix has adopted on-site F₂ as a safer and more cost-effective alternative to cylinder fluorine for cleaning Chemical Vapour Deposition (CVD) chambers in its manufacturing process.

This expansion in F₂ adoption will contribute to Hynix's manufacturing efficiency savings and also help reduce its manufacturing carbon footprint.

SK Hynix has been actively working to expand the range of processes for which they use on-site fluorine and has been investigating switching from NF₃ to fluorine for chamber cleaning on single wafer process tools. NF₃ is a greenhouse gas with a global warming potential (GWP) 17,200 times greater than carbon dioxide (CO₂), whereas F₂ is the highest performance cleaning gas available, with zero GWP. The initial work is completed and was presented at the recent Advanced Semiconductor Manufacturing Conference (ASMC) held in the USA. The results show reductions in total cleaning time of up to 40 percent and in the mass of gas used of 35 percent, which for one type of tool alone could mean the elimination of more than 6.5 tons NF₃ per year if implemented in production.

Linde's on-site F₂ technology is fast becoming the industry standard cleaning method across semiconductor, TFT-LCD and photovoltaics industries, as manufacturers increasingly switch to F₂ for its clear technical, environmental and business advantages. For example, by enabling manufacturers to meet environmental efficiency and safety targets while reducing cost.



ElectronicsIQ.

Information Quarterly from Linde Electronics.



KDIA certifies Linde fluorine technology

Table of Contents

Analyst viewpoint: DisplaySearch	→
Next generation displays	→
SK Hynix embraces on-site fluorine	→
KDIA certification	→
Expansion in China	→
My Life at Linde	→

Linde has received prestigious certification from the Korea Display Industry Association (KDIA) for its patented on-site fluorine technology which has been evaluated as a potential replacement for high global warming potential (GWP) sulphur hexafluoride (SF_6), currently used for dry etching of TFT-LCD panels.

The benefits of using on-site fluorine (F_2) for display chamber cleaning instead of high GWP fluorinated gases such as nitrogen trifluoride (NF_3) have been established for some time. KDIA carried out tests for the first time to establish whether on-site fluorine from Linde could be used as a direct replacement for sulphur hexafluoride in a dry etch application.

Evaluation results on a Gen 4.5 size panel (730 x 920mm) showed significant improvements in etch rate and etch uniformity when using fluorine for both silicon oxide and silicon nitride films whilst maintaining the same feature taper angle.

KDIA has multiple programmes to improve the environmental impact of display manufacturing in Korea with a particular emphasis on reducing use of SF_6 , confirming for the first time that fluorine can be used to replace SF_6 and produce better results. Having demonstrated such positive results, the KDIA now plan to evaluate F_2 as a replacement for SF_6 on larger panel sizes.

Linde's patented on-site fluorine generators are increasingly becoming recognised by manufacturers as a sustainable alternative. The technology offers a dedicated, secure supply that provides a more productive, energy-efficient and environmentally friendly substitute to the use of high global warming potential gases such as NF_3 and SF_6 for etching and cleaning applications in electronics manufacturing.



ElectronicsIQ.

Information Quarterly from Linde Electronics.



Nitrous Oxide (N₂O) Expansion in China

Linde has strengthened its ultra high-purity nitrous oxide (N₂O) gas infrastructure with the acquisition of Zhenjiang Xinhua Industrial Gases Co, an N₂O specialist headquartered in Zhenjiang City in Jiangsu Province, China. This will help accelerate the adoption of metal oxide transistors by display manufacturers. The acquisition follows the expansion of an existing plant in Taiwan and a new plant under construction in Korea. The plants in China and Taiwan are both managed by Linde LienHwa (LLH), The Linde Group's joint venture with LienHwa MiTAC Group of Taiwan.

Table of Contents

Analyst viewpoint: DisplaySearch	→
Next generation displays	→
SK Hynix embraces on-site fluorine	→
KDIA certification	→
Expansion in China	→
My Life at Linde	→



As consumers continue to demand better viewing experiences and high functionality displays, the pressure for manufacturers to use the latest technologies increases. The acquisition strengthens Linde LienHwa's product offering capabilities in the Chinese market and demonstrates Linde's continued commitment to customer satisfaction and commitment to supporting innovation in this market.

Metal oxide is the product of choice, renowned for its cost-benefits and high performance attributes. There are currently about nine major metal oxide projects under development, with new fabs being built or the upgrade of existing facilities underway. These fabs will have a targeted capacity of over 25 million TV sets per year by the end of 2013.

This acquisition and the establishment of two N₂O plants in Korea and Taiwan cement Linde's position as the leading electronics specialty gases supplier and technology partner for the next generation of display technology across Asia.

ElectronicsIQ.

Information Quarterly from Linde Electronics.



My Life at Linde, Andreas, Head of Market Development for Solar and Flat Panel Displays

Table of Contents

Analyst viewpoint: DisplaySearch	→
Next generation displays	→
SK Hynix embraces on-site fluorine	→
KDIA certification	→
Expansion in China	→
My Life at Linde	→

Let's begin by taking a look at your day-to-day activities. What does your job involve?

I am trying to be connected closely with colleagues in Electronics and in the RBUs, customers, OEMs and industry analysts, in order to understand the dynamics, developments, changes and needs of the solar and display markets. Where will our business be in 5 years from now, which products do we need, where do we need to develop our capabilities, and equally important how do we get to this point in perception of our customers. Then I am working to address these questions and initiate projects with the interfaces in Electronics and the RBU's.

Tell us a little about your background?

I have started my professional life as a product manager for Merck Electronic Chemicals. I had a short but enjoyable excursion to Merck's Cosmetics Ingredients business. Then BOC Edwards offered me a job as Sales Specialist for Electronic Materials in 2005. After the merger with Linde, I joined Linde Nippon Sanso and started developing our solar business in Europe. In 2010 I moved to Asia and took over my current position.



What is your career highlight so far?

To achieve our position in the solar market. We started looking at this in 2006 from a follower position. Air Liquide had a head start in solar, and Air Products was number one in global Electronics, both were ahead of us with capabilities to serve the emerging solar industry. We developed a powerful value proposition, built partnerships with OEMs, and engaged with the market with a highly motivated and professional team. We were able to win a series of big projects, to capture the #1 position in the market, and to grow the business to close to a 100 million Euro. Unfortunately the market is not growing as much as we had hoped it would. But it is considerable business for Electronics, and I have learned a lot about development and execution of winning strategies. And how rewarding it is to be better, faster, smarter than our competitors.

ElectronicsIQ.

Information Quarterly from Linde Electronics.



How would you describe your peers in three words?

Open-minded, motivated, professional

What are your top three industry predictions for 2013?

Our business will turn back to high growth, after a more challenging year 2013. The competitive landscape is changing, we will hear even more from new competitors in Asia. Energy efficiency and green production will become even more important than it is today already.

Do you have a personal mantra? If so, what is it?

Think positive & work with passion.

Which actor would you chose to play you in a film about your life?

Tom Hanks

Service

[Visit Linde Electronics website](#)



[Recommend our newsletter](#)



[Unsubscribe from this newsletter](#)



Contact Details:

Linde Electronics
391A Orchard Road,
#23-05 Ngee Ann City Tower A
Singapore 238873

©The Linde Group 2012

Email: electronicsinfo@linde.com

Web: www.linde-gas.com/electronics