

Key Thoughtz:

- Chinese OEM and consumer demand for LCD TV panels is underserved by domestic AMLCD fabricators.
- Taiwanese fabricators have fallen behind Korean producers.
- China seeks technology transfer; Korea has the best production technology.
- Transference of existing technology will sustain present trends and raise barriers to entry for alternative display technologies.

Will Korea Approve?

The potential lifting of restrictions on Korean or Taiwanese panel makers

The announcement that LG Display signed a memorandum of understanding (MOU) with authorities in Guangzhou regarding an 8th generation AMLCD fabrication plant looked like a warning shot fired at competing panel makers in Taiwan. The next day, we read Sharp's press release about an 8th generation fab in Nanjing. In Beijing that same day, BOE Technology announced construction of an 8th generation fab, also. The announcement by LG Display now looks like an attempt to capture attention ahead of those releases but it remains a threat to the two leading panel makers in Taiwan, AU Optronics and Chi Mei Optoelectronics, nevertheless.

Ability to fabricate panels for 47" and larger LCD TV sets in China would change the balance of power at several points in the value chain. We believe that material suppliers will face more shocks, possibly as significant as the sudden decrease in demand felt in 2008. Chinese domestic operations will seek local sources. We assume that the pace of capex will continue declining outside China, which may allow domestic ODM or TV brands to improve their global position. As a result, TV retailers may increase their bargaining power as new or in-house brands seek shelf space. On the other hand, we believe that the pace of panel price reduction will be sustained. That suggests commoditization and diminishing returns to scale for suppliers but value consumption for consumers.

Legacy Transfer

Legacy transfer is one of our BizWitz Themes for scenario planning. The geo-commercial center of AMLCD fabrication has moved west since the 1970's but the basic production technology has changed little since the 1980's. This sustains a certain cost structure and a consistent secular rate of price reduction as succeeding waves of nations and corporations expand capacities in contests for dominance. As a result, established AMLCD producers reach points of diminishing returns to scale and emerging display technologies such as OLED face barriers to entry. The transfer of legacy AMLCD manufacturing technology to another country reinforces such barriers.

The specific effect of 8th generation AMLCD technology moving to China would be local concentration of component, intermediate and finished product manufacture for TV and other consumer goods. There is no precise definition of 8th generation technology other than the processing of 2.2 meter by 2.5 meter glass substrates (>59 square feet). Glass of that size supports efficient fabrication of 27", 32", 47", 55", 65" and 95" HDTV panels. At present, Chinese OEM/ODM and brands depend on Korean and Taiwanese AMLCD suppliers for most of such panels, even though many of the display modules may be assembled in subsidiaries based in China. A future ability to influence or control supply from domestic sources would change things.

China's policy of stimulating consumer spending and reducing the savings rate has accelerated growth of demand for LCD TV sets there. Domestic demand for other display-related goods such as netbooks or smart phones is growing faster in China than elsewhere, as well. Plans for AMLCD fabs in Italy and India have failed, leaving China as the nation most able to serve domestic and export consumption of digital goods for the foreseeable future.

The following sections describe national and commercial competition in the AMLCD industry and how a geo-commercial shift to China may disrupt current relationships while preserving long-term dynamics.

National Competition

The AMLCD industry has been moving West since the technology was invented in the USA. Companies such as RCA foresaw a long period of investment before LCD TV could become a commercial product. Companies in Japan took up the challenge and spread their risks through industrial cooperation and ministerial coordination. After experiencing several booms and busts, Japanese firms wanted to slow their pace of investment until their pace of production improvement caught up. Korean companies used this hiatus to enter the market. They leveraged their experience in DRAM to design much larger, more flexible AMLCD (TFT) fabs. This weakened the influence of coordinating organizations in Japan and reinforced the reluctance to invest aggressively.

By the late 1990's, some computer companies in Japan worried about their ability to obtain adequate supply of AMLCD. In addition, Japan's electronics conglomerates were changing strategies after the mainframe computer market, one they had struggled to lead, went into decline. Such factors led to the exchange of technology for allocation with Taiwanese firms. That nation's technology agencies realized that they lacked the TFT manufacturing know-how required to replicate their success in fostering DRAM ventures in Taiwan. The exchange made sense for both nations but Japanese firms lacked knowledge of Korean innovations and some mistakes were made. Legacy technology transfer kept Taiwanese panel makers a step behind their Korean competitors.

Taiwan was eager to support its domestic supply chain for PC manufacture and the government stimulated waves of investment. Deals with Japanese producers created five AMLCD producers in Taiwan in addition to the two indigenous ones. In hindsight, that was too many for a small country. Today, Taiwan still has seven producers, despite some re-combinations.

In contrast, there are only two substantial producers in Korea. The LCD business of Korea's third chaebol (zaibatsu in Japanese), Hyundai, suffered greatly during the currency

crisis of 1997–1998. Hyundai benefitted from government mandated restructure, however. It obtained the DRAM unit of LG Electronics and it sold the LCD business to Beijing Oriental Electronics (BOE Technology). That company was spun-out after a few years and acquired by Prime View International of Taiwan, the only pre-Japanese wave producer remaining there. In essence, then, Korea has two producers, each large enough to support its own supplier network.

China began obtaining AMLCD technology in 1999 when the IBM-Toshiba JV in Japan transferred an old line to Jilin Electronics. Subsequent transfers of uncompetitive technology by NEC and others in Japan gave Chinese companies the ability to make commodity PC monitor panels but not 32" or larger panels for TV sets. Market researchers estimate that Chinese consumers will buy about one in five LCD TV sets sold in 2009 but all of these sets will use panels fabricated in Japan, Korea or Taiwan. Chinese officials are eager to create high-tech infrastructure and source more of their domestic demand. For these reasons, they have been seeking state of the art technology from leaders like Sharp, LG Display, Samsung or AU Optronics.

Looking forward to conditions in 2010, we expect China will import even more AMLCD cells, though a greater portion of modules will be assembled there. The chart in figure 1 on page 3 shows how national capacities stack up for 2010. China will have only 4% of total industry capacity and all of that will be in fabs suitable for making mobile phone, portable DVD or PC monitor panels. Taiwanese firms own most of the capacity suitable for those market segments. Korean firms dominate the industry in terms of capacity for large TV.

As mentioned above, not all 8th generation fabs are the same. We believe LG Display and Samsung have the most productive fabs. Sharp has been an LCD technology leader for many years but it operates in black-box mode. It uses unique approaches that are difficult to evaluate. AU Optronics has just started its 8th generation line but we expect it will succeed. Any of these producers could transfer know-how sufficient for creating a fab for TV panels.

National technology policy will be a key factor in which company will transfer technology, where and when. Japan has moved beyond PC and TV hardware manufacture to concern itself with software and services. It therefore permits the transfer of AMLCD technology. We believe this is the reason Sharp has made the most definitive announcement. Korea still prizes its IC and AMLCD prowess. It remains more dependent on high-tech exports than Japan is and its consumers remain less rich than those in Japan. Nevertheless, it appears Korea realizes it is time to move up the value added scale. In addition, its chaebol tend to get their way. For this reason, Korea may permit LG Display to form a fabrication joint venture. Taiwan may accept the inevitability of opening its high-tech industry to Chinese investment or to Chinese joint venture but it may prefer to use this as a bargaining point with the mainland. If Korea lets LG Display or Samsung loose, Taiwan may feel compelled to loose its companies in time to commence 8th generation operations in 2012–2013.

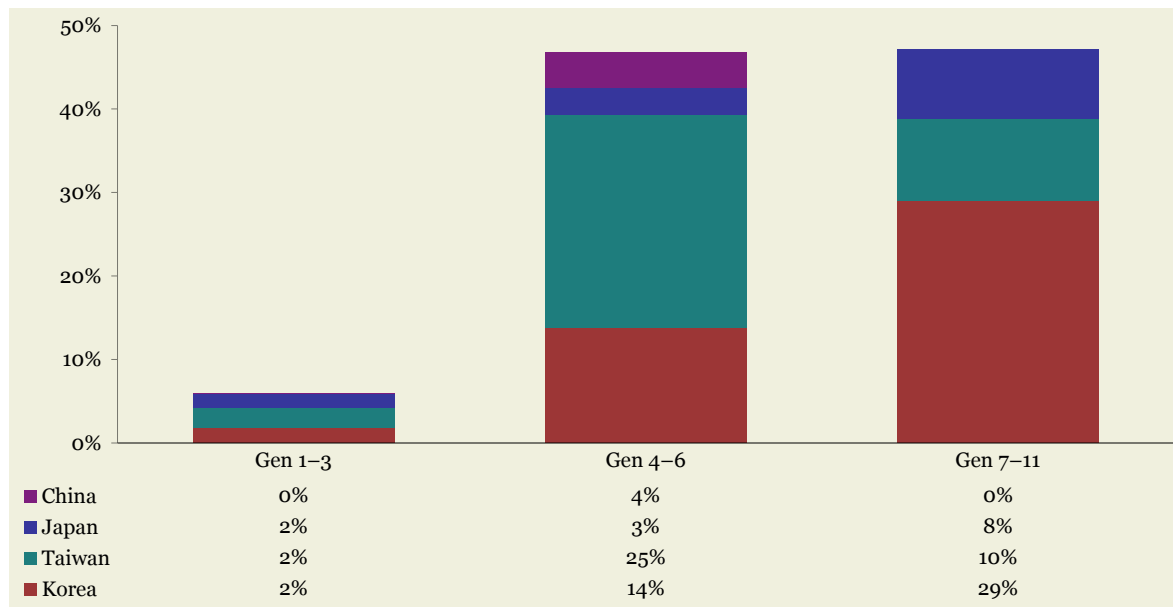
Commercial Competition

Intra-country rivalry has been nearly as intense as national rivalry has been. AMLCD producers sense the importance of scale and signal capacity expansion frequently. Some signals are more credible than others, as will be described in subsequent paragraphs, but a press release by one producer often leads to a cascade of announcements.

Another feature of AMLCD rivalry can be seen in claims and counter claims about the superiority of one technology over another. In most cases, the technology in dispute relates to optical performance (e.g. contrast over a range of viewing angles) rather than to core technologies used in production. Such claims tend to mask the reality that AMLCD are commodities. Producers use the same gear to run similar processes to make products for the same applications that they sell to the same customers.

This makes scale one of the few competitive advantages a producer can obtain. Larger scale leads to purchasing power and materials account for about two-thirds of product cost. Larger scale tends to confer more product design and qualification capabilities, which help capture and keep leading clients.

FIGURE 1: NATIONAL TFT FAB CAPACITY SHARE BY GENERATION IN 2010



Source: DisplaySearch, BizWitz

For this reason, AMLCD producers strive to intimidate competitors by adding capacity as fast as possible. They may also cut prices to

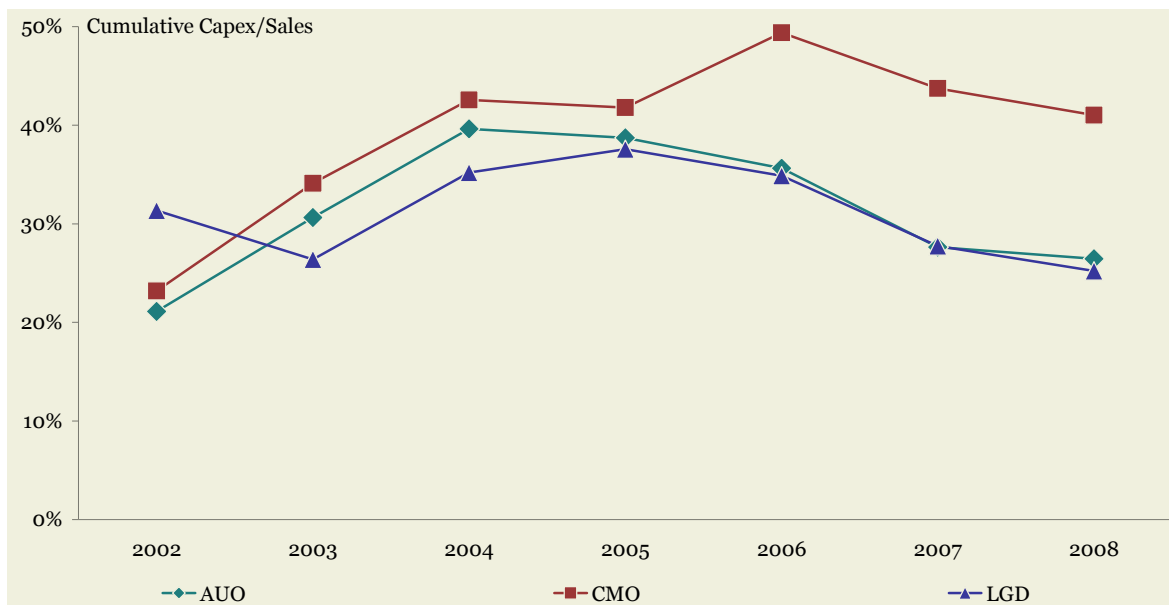
reduce potential profits; hoping competitors will defer or cancel capacity investments. Unfortunately, all competitors know scale is a key success factor so they stay in the game by adding capacity as fast as they can. The result is wave after wave of plunging prices and operating losses. Competitors stop investing only when they become unable to do so or their parent firm alters its portfolio.

Clan governance is another factor that keeps competitors from exiting or combining for more scale. In many cases, executives of AMLCD companies are members of family networks. This tends to prevent mergers as seen in recent failures to combine DRAM companies in Taiwan. The one Taiwanese AMLCD maker that expanded by merger did so by acquiring companies without family members at the top. Unipac was a venture of United Microelectronics (UMC) staffed by professional managers. Acer Display Technology could take control and replace them. Later, as AU Optronics, the company was able to replace the professional managers running Quanta Display because key people remained safe in Quanta itself.

Merchant Rivalry

Rivalry among the three leading merchant producers of AMLCD has become more acute as their shares of capacity have converged. Considering capacity in 6th generation and larger fabs, the share for LG Display is 24%, the share for AU Optronics is 16% and the share for Chi Mei Optoelectronics is 15%. The shares of these first two have not changed as much as the share of Chi Mei Optoelectronics has in recent years. That company invested aggressively in response to acquisitions by AU Optronics and to market opportunities for LCD TV sets. As illustrated in figure 2, capex by the other two companies (AUO and LGD) peaked in 2004–2005, early in the build-up for LCD TV demand. CMO increased capex faster than revenues at that time and stayed on that course longer. As a result, CMO spent 42% of its sales revenue on capex over the five years of 2004–2008 while AUO spent 26% and LGD spent 25%. The higher rate put CMO in a worse position for the recession. The company had to halt its 8th generation project. Delivered equipment remains unused. As a result, CMO is a prime candidate for restructure or joint venture in China. On the other hand, it lacks experience running an 8th generation line that Samsung, Sharp and the two leading merchants have.

FIGURE 2: CUMULATIVE RATIO OF CAPEX TO SALES



Source: BizWitz analysis of public disclosures

[continued]

Provincial Rivalry

The Cultural Revolution destroyed clan-based organizations in China. Provincial political interests replaced them and act as organizing boundaries for business combinations. Many regions vie for foreign direct investment in high-tech industries such as AMLCD under the aegis of state-owned enterprises.

Early this decade, Beijing Oriental Electronics and SVA Group (Shanghai) typified such rivalry. BOE acquired AMLCD technology by buying the former Hyundai LCD business (later called Hydis). SVA acquired AMLCD from NEC through a joint venture. Both companies experienced losses while engaged in a war of words over future expansions. The Chinese entrants found it difficult to compete with larger Korean and Taiwanese producers who had more scale and were able to re-purpose larger substrate fabs to serve the same markets the entrants served. [Refer to Commentz 20090731 for discussion of the increasing number of panels per substrate.]

SVA has put its 5th generation fab up for sale. The recession in 2008 led SVA NEC to take in assembly work from TPV Technology, a PC and TV OEM. In August this year, SVA Group selected Tianma Microelectronics (Shanghai) as a bidder for the business. It rejected BOE as a bidder, of course.

BOE began restructuring its AMLCD holdings in 2006 and shed its interest in the Korean company last year. It issued new shares in private placements this year and started construction of a 6th generation fab that may commence production in 2010. Despite a loss of \$111 million in 1H'09, BOE also announced plans to build an 8th generation fab.

Meanwhile, companies in Jiangsu province north of Shanghai were busy establishing AMLCD plants with the help of Japanese engineers left over from impairments and liquidations. The 5th generation fab adjacent to Infovion Optoelectronics (Kunshan) (IVO) is a notorious example. Some of its technology came from Taiwanese engineers who were surplus when Chi Mei Optoelectronics closed a plant it bought from Display Technology (originally, an IBM-

Toshiba joint venture and the largest AMLCD producer of its time). The transfer was cloaked by transmission through Japan.

By early 2007, it was apparent that Chinese producers lacked sufficient scale or expertise to compete with Korean or Taiwanese firms in general and in TV markets in particular. The former Ministry of Electronics Industry, reorganized as China Electronics Corporation (CEC) in 1989, attempted to consolidate the AMLCD businesses of BOE, IVO and SVA. The attempt failed but financial and organizational restructurings accelerated in each business group.

Since then, Sharp restructured its AMLCD operations and decided that its 6th generation assets were unnecessary. The substrate size was too large for practical use in its related businesses such as personal electronics and office equipment. The substrate was too small to remain competitive for its TV brand. A bidding war for the fab broke out between northern and southern provinces in China.

The north won. CEC announced that one of its affiliates, Panda Electronics (Nanjing) would form a company (Nanjing CEC-PANDA LCD Technology) to take the 6th generation line from Sharp. Construction of the plant may begin as early as November and production may begin in Q1'11.

Apparently, the real goal of CEC was to obtain 8th generation technology. The deal with Sharp included transfer of technology through establishment of a Sharp-sponsored LCD R&D Center in Nanjing next year. The goal is an 8th generation fab that could start production in 2012 or 2013.

Authorities in the south took consolation in a deal with LG Display for an 8th generation fab in Guangzhou. The Korean producer has a module assembly plant in Guangzhou and it formed a joint venture company for making TV sets with Skyworth Digital Holdings there. LG Display's first assembly plant in China was built in Nanjing close to an industrial complex operated by LG Electronics. LG Display operates two module lines in Nanjing built in 2002–2004 but the company has looked southward since then.

Implications

Diminishing returns to scale is forcing panel makers to consider expansion using other peoples' money. China, like Japan, Korea and Taiwan before it, is eager for AMLCD plants to further its national goals. This makes China a prime target for expansion. The enormous domestic market for products made with LCD and government mandated lending makes China the obvious choice.

Recent press announcements differ in their credibility but, as a whole, they indicate a transfer of AMLCD fabrication technology to China is immanent. A combination of rivalry between provinces and between producers seems likely to perpetuate industry dynamics we have noted for more than ten years. These result in large panel prices falling 19% to 20% a year on an display area basis and small panel prices falling faster as producers re-purpose depreciated assets for portable electronics applications.

We believe new producers in China will compete for dominance through capacity expansion as established producers have. This implies need for local supply of tools and materials. We expect suppliers in Japan, Korea or Taiwan will create subsidiaries in China and that such activities will foster local competitors, as we saw in Korea and Taiwan earlier this decade. A number of suppliers have been weakened by the recession and the fab utilization reductions that resulted. A shift of demand to China may cause more disruption in existing supply chains.

Links to Chinese product assembly may become stronger as regional networks form around new AMLCD campuses. Chinese brands have expanded overseas already with assembly sites in Mexico, for example. Domestic demand would drive them toward tighter relationships with regional fabs. These trends may combine to make Chinese brands stronger competitors outside China.

US retailers seek more brands to compete with and reduce the power of global brands such as Samsung or Sony, so new brands from China may be welcomed in developed markets. Existing brands may find that tariff

barriers are not high enough to deter Chinese set assemblers from exporting sets. The cost and complexity of operating assembly lines for knock-down kits may be prohibitive for some Chinese companies. Direct export may remain a less risky alternative and greater scale derived from Chinese domestic demand may confer cost advantages.

In short, the transfer of legacy technology to China may disrupt supply relationships but perpetuate industry dynamics. Alternative technologies, however exciting, may find it difficult to surmount the price barrier to entry created by such transfer. We expect the price of LCD-enabled goods will decline at historical rates until such time as the goods are subsidized by the sale of services or advertisements.

—by David Barnes for BizWitz LLC, a consultancy specializing in electronic display and imaging business decisions throughout the supply chain from raw materials through retail, worldwide

