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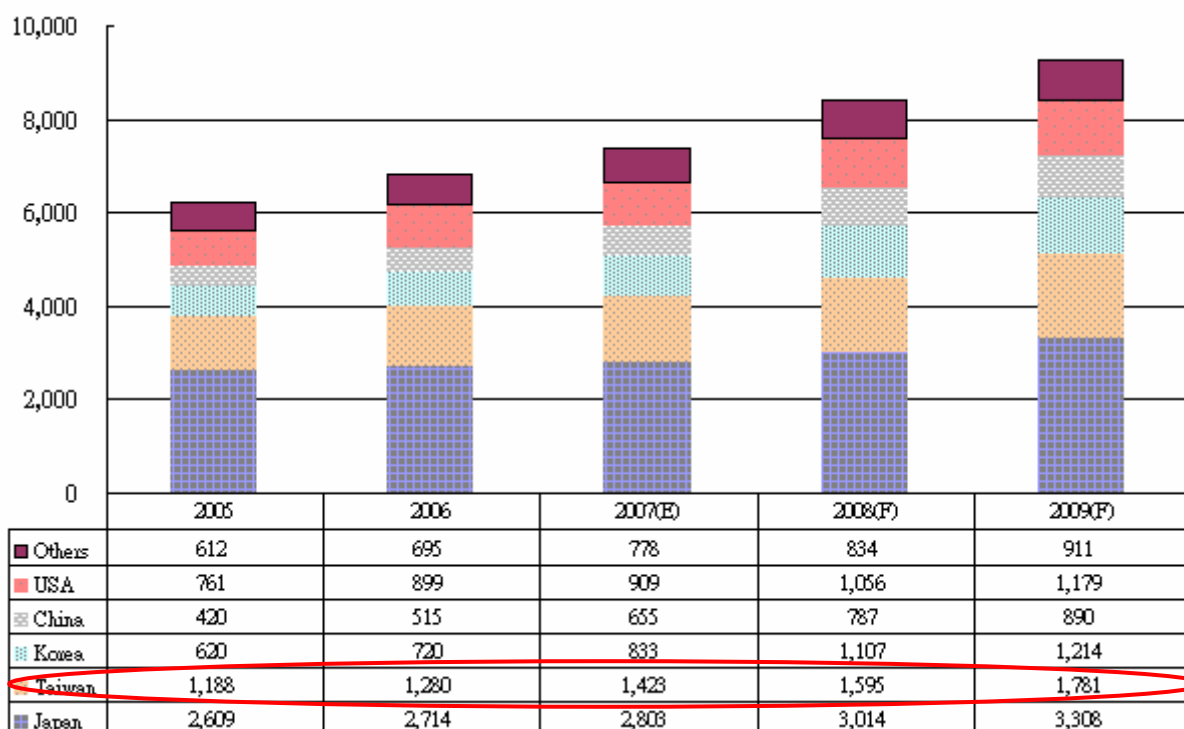
## The Status of LED Industry Development in Taiwan

### (I) Supply & Demand

Taiwan is the second largest LED manufacturing country in the world in terms of output quantity, just after Japan. The output value of LEDs in Taiwan for the year 2007 was US\$1.423 billion, which was a 21.6% share of the global output. It is estimated that this figure will rise to US\$1.595 billion in 2008, representing an annual growth of 12.1%. At present, LED manufacturers in Taiwan are focusing on the production and sales of AlGaInP and blue LEDs. As the investment cost and technology threshold for LED chips and packaging is relatively low, many downstream LED manufacturers have been established since 1996.

Development of LED Output Value in Taiwan (2005-2009)

Unit: USD Million



Source: Compiled for the present study, 2007/12

## **(II) An Analysis of Existing Gaps in the Industry Supply Chain, Investment Niches, and Prospective Foreign Investors**

The LED industry chain in Taiwan comprises epiwafer manufacturers upstream, chips manufacturers midstream and packaging manufacturers downstream. The comprehensive industry chain is currently composed of approximately 200 enterprises. In terms of terminal applications, enterprises such as China Electric, Tatung, Forward Electronics, Lite-On, Alliance Optotek, Epistar, I-Chiun, Lustrous, and Wei Min have already stepped foot in the LED lighting industry, and are making strides into automobile electronics and monitor applications. The entire LED industry supply and demand chain is therefore complete.

### **1. The Manufacturing of Epiwafers and Chips**

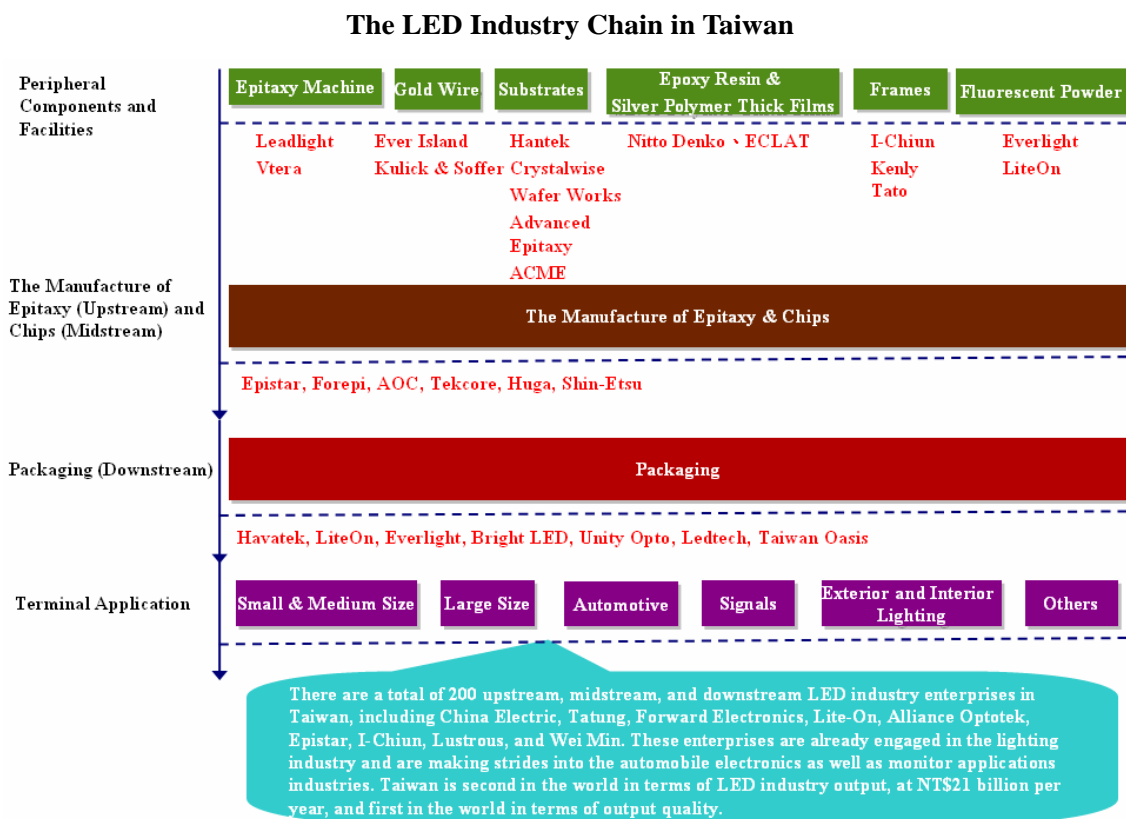
At present, LED epiwafers and chips manufacturers in Taiwan include Epistar, Forepi, Arima, Tekcore, Huga, ShinEtsu, etc. Distinguished among them is Epistar, which, following its merger with Epitech, Highlinktech, and United Epitaxy, has become the world's largest red LED manufacturer as well as the world's fourth largest blue LED manufacturer. All this has contributed to an even more comprehensive product line, client base, and patent coverage, making Taiwan a world-class LED manufacturing center.

### **2. LED Packaging**

In the area of LED packaging, Taiwanese firms include Harvatek, Lite-On, Unity Opto, Everlight, etc. Cooperation has also been established with Osram, the leading international manufacturer.

### 3. Others—Peripheral Components and Facilities

In addition to epiwafers, chips, and packaging, much effort has been devoted to LED peripheral materials and facilities. Traces of Taiwanese manufacturers can be found everywhere from conductor rails, gold wires, fluorescent powder, and substrates, to MOCVD facilities. These manufacturers include I-Chiun, Kenly, Ever Island, Leadlight, Hantek, Crystalwise, etc.



Source: Compiled for the present study, 2007

Because Taiwan was a late-comer in terms of LED industry development, patents for key LED components and materials are controlled by leading Japanese and American firms. The main gaps in the LED supply chain are in upstream source materials, equipment supply, LED patents, and industry integration. Although Taiwan is the largest exporting country of blue LED, the industry is limited by foreign-owned patents. The release of LED

industry patents by leading foreign manufacturers will therefore have great impact on the market.

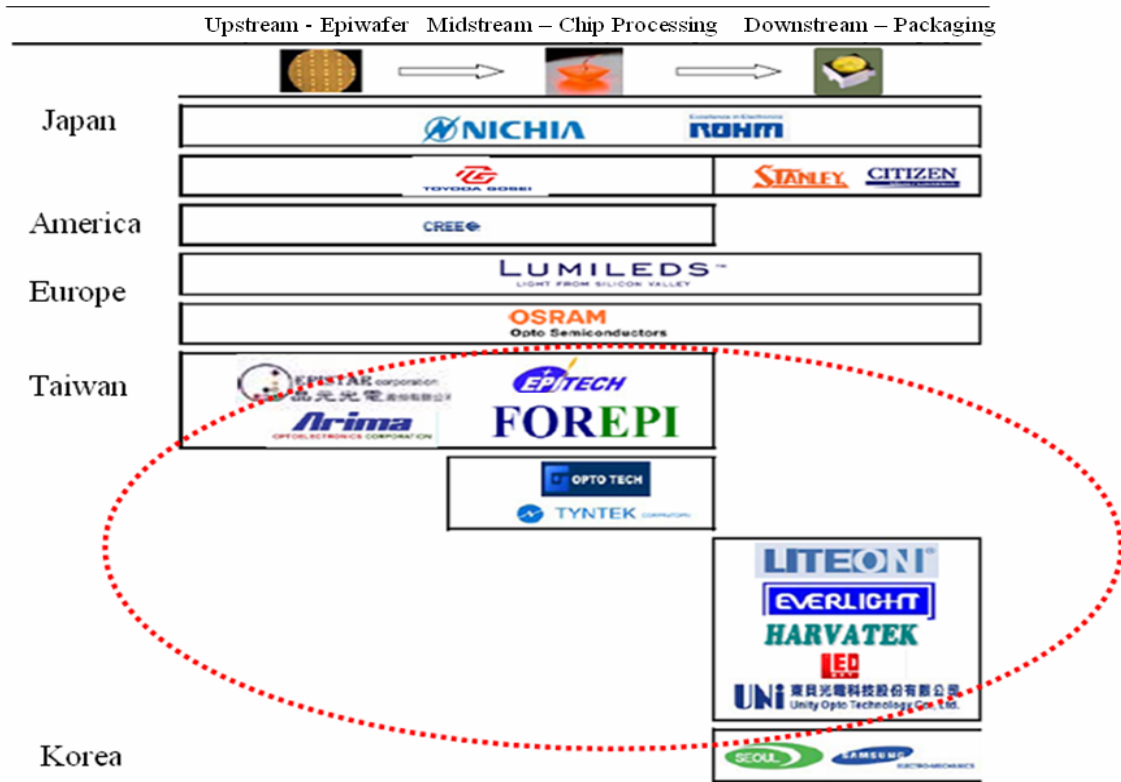
Major potential foreign manufacturers of high-brightness LEDs include Nichia, Lumileds, OSRAM, Cree, and Toyoda Gosei. But LED industry patents are mainly in the hands of major manufacturers such as Osram, Nichia, Lumileds, and Intermatix. Although Everlight and Lite-On are already licensed by Osram for white LED OEM, production quantities are insufficient. For Taiwanese LED manufacturers, the key to development is more patent licensing deals with international manufacturers such as Osram.

### **(III) Major Suppliers in Taiwan**

#### **1. Complete and Specialized Vertical Disintegration**

Just as it does in the IT industry, Taiwan plays an important role in the LED industry. This is mainly attributed to the complete and specialized system of vertical disintegration on the island. Taiwanese manufacturers have delved deeply into different areas of manufacturing ranging from upstream epiwafers, midstream chips, to downstream packaging. As opposed to highly integrated industrial production systems in other countries, the Taiwanese LED industry is more flexible and capable of providing quality services to fulfill the needs of different customers.

## LED Industry Vertical Disintegration in Taiwan



Source: Compiled for the present study, 2007/12

## 2. Conglomerate-Style Operation

In recent years, the LED industry in Taiwan has been moving towards a conglomerate-style business mode. After the scope of applications for LED technology was expanded from mobile phone back lights to large-size TV backlights, Taiwan's two panel giants—AUO and Chi Mei—began to invest in the LED industry in 2006. This shows that panel manufacturers are optimistic about the prospect of LED TVs and are prepared for a gradual cross-sector integration that would ensure a steady supply.

Aside from panel manufacturers, other manufacturers such as Foxconn, Lite-On, Delta, and Powerchip have also planned to join the LED industry. Through mergers, acquisitions, and strategic alliances, an LED conglomerate comprising upstream to downstream manufacturers has emerged to accelerate industrial development, which is also a major feature of, and investment

niche for Taiwan's LED industry. Foxconn is revisiting its former 1C-to-4C development strategy and starting in the field of modules, Foxsemicon is working on the development of LED road lights, and Innolux has assumed responsibility for panel development.

In the area of LED chips, Foxconn is in cooperation with Epistar and HPO; for LED packaging, it has transferred investments to AOT; and for LED cooling and LED driving IC, it relies on the support of its subsidiaries, Foxconn Technology and Fitipower. At present, the company has plans to expand its manufacturing plant in Guanggu, Wuhan (China). In future, backlights, road lights, and lighting systems will become the business focus of the company.

**Organization of LED industry Conglomerates in Taiwan**

	AUO	Chi Mei	UMC	Powerchip	Foxconn	Lite-On
LED Chips	Epistar, AOC	Forepi, Chi Mei Lighting	Epistar, High Power Lighting	Epilux	Epistar, High Power Opto	Epistar
LED Packaging	Wellypower, Everlight, LightHouse	Everlight, Unity Opto, Chi Mei Lighting	Harvatek, High Power Lighting	--	AOT	Lite-On
LED Cooling / Driving IC	Acquired	Acquired	ITE (Driving IC)	---	Foxconn (Cooling), Fitipower (Driving IC)	Lite-On
Module Supplier	AUO (Panel)	Chi Mei (Panel), Chi Hsin	Edison	---	Foxsemiconn (LED Road Lights), Innolux (Panel)	Lite-On
Current Product Planning	Large-size backlights	Small, medium and large-size backlights	Large-size backlight, lighting	Large-size backlight	Backlights, road lights, lighting systems	Small and medium-size backlights, LED notebook computers, traffic signals, solar energy (Avago)

Source: Compiled for the present study, 2007

### 3. Governmental Support

Government support is essential to every emerging industry or application that wishes to grow popular and successful. The Taiwanese

government offers much in the way of support and niche policies for the local LED industry.

In December 2007, the government announced the “Energy Saving Promotion Project for Lighting” with objectives to replace all incandescent light bulbs with energy-saving light bulbs within a short period of time and, in the long run, to replace traditional lighting with LED lights for better energy-saving performance. The first phase of this project is to replace incandescent light bulbs with their energy-saving counterparts. The government is to take the lead by ensuring compliance in all central and local government offices by the end of 2008. Also, starting in 2008, the government is providing guidance to hotels, hostels, homes, farms, and markets for carrying out voluntary light bulb replacements. In phase two, the more energy-efficient LED lights will become the ultimate lighting solution. Once LED lights are popularized, it is estimated that lighting-related electricity consumption in Taiwan will decrease substantially by 40%, or approximately 10.7 billion kw. Total savings in electricity expenditures by the government and the general public is estimated at NT\$26.75 billion.

In 2008, specific regions in Taiwan will be selected for the implementation of the “LED Road Lights Demonstration Project.” Moreover, the Ministry of the Interior has revised the Fire Safety Act to encourage the use of LED products for exit and escape lights in residential areas and office buildings. A “Minimum Energy Efficiency Standards for Light Source” has also been established in compliance with the Energy Management Act. After 2012, the production and sales of low-efficiency light sources such as incandescent lights will be prohibited. Targeted at specific users such as department stores and hotels, mandatory measures will be taken to prohibit the use of low-efficiency light sources like incandescent lights.

#### **4. Establishing Related Alliances**

In addition to government policy support, manufacturers have formed a number of LED-related alliances to share their industry experiences and carve out future niches together. At the moment, there are the “LED Lighting Standards and Quality Development Alliance,” and “Advanced Automobile Lighting Alliance.” The former was established by seven manufacturers including TA YIH, China Electric, Epistar, I-Chiun, Alliance Optotek, Lite-On, Wei Min, and Lustrous, and the latter by eight manufacturers including Hua-Chuang, Bright Led, Everlight, Forepi, Tyntek, Forcecon, and Unice.