Continued growth
China's impact on the semiconductor industry 2011 update

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Welcome

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Driven both by robust domestic demand and a seemingly insatiable global demand for mobile devices, China's semiconductor industry continues to set new records. China's consumption growth has been greater than the rest of the world for nine of the last ten years, growing at a 24.8% compound annual growth rate (CAGR). But the year was not without its challenges. While companies in the communications sector—particularly mobile phones—achieved rapid growth in revenue and size, those in the IC card sector experienced relative declines.

While no longer growing at unsustainably high rates, we see many indications of a maturing and healthy market able to maintain long-term industry growth. For example, China accounted for 70% of total semiconductor IPOs during 2010 and is now a significant source of new semiconductor companies and of financial funding for start-ups. Further, an increasing number of semiconductor IPOs are occurring on the Chinese exchange, rather than in the US. Finally, original patents, a strong indication of local IP development, continue to grow.

The following report is our sixth update to the original 2004 study. It uses a variety of industry statistics, augmented by a number of deep conversations with industry executives, to deliver an in-depth analysis of the current state of the semiconductor industry in China. You will find a discussion of both geographical and product category demand as well as commentary on changes in the semiconductor value chain. We revisit the growth scenarios developed for our original report, summarizing the probability of those realities in light of the global recession and current conditions.

Since semiconductors play a key role in every sector of the technology industry, I'm sure you will find this report of interest and, I hope, useful as you adjust your business plans in response to ever-changing market conditions.

If you would like to discuss any of the findings in our report and how they might impact your business, please reach out to me or any member of our global technology team listed in the back of this document. To learn more about PwC's involvement in the technology industry, visit pwc.com/technology.

Sincerely,

About this report

The 2011 Update assesses the current status of the semiconductor industry in China and how it has changed since our previous update. As with our previous reports on this issue, we conducted a second-order analysis for the 2011 Update. To accomplish this, first we reconciled data from different, incomplete and often contradictory reports from various sources. These sources included industry associations and third-party research firms located in and outside of Asia. Then we analyzed the reconciled data with an eye towards filling in gaps and revealing information that was not apparent in the original source material. We also interviewed industry executives to obtain current views from various parts of the value chain.

China's impact on the semiconductor industry primarily occurs in two separate and distinct areas: China's semiconductor market (consumption) and China's semiconductor industry (production). China's semiconductor market is the value of all semiconductor devices consumed in China by electronics manufacturing services (EMS) companies, original design manufacturers (ODMs), and original equipment manufacturers (OEMs). China's semiconductor industry is the sum of the reported revenue of all semiconductor manufacturers in China, including: IC design (fabless); IC manufacturing (integrated device manufacturers [IDMs] & wafer foundries); IC packaging and testing (IDM & semiconductor assembly and test services (SATS); and O-S-D (optoelectronics-sensors/actuators-discrete) companies.

This year we found reasonable consistency between various sources about the direction and relative magnitude of the changes in China's semiconductor market and industry. However, there was still a noticeable variation between sources about absolute size of the market. Between the various sources, the reported size of China's 2010 semiconductor market varied by as much as 31%, with China Center for Information Industry Development (CCID) Consulting reporting the largest value when converted into dollars and IC Insights the smallest value in dollars.

For our top level reporting of China's semiconductor consumption market and production industry, we have continued to utilize the values reported by CCID. They provide the most comprehensive detail about China's market and industry available and their reports are the principal source of information for Chinese policymakers.

For some of our detail analysis we have utilized alternate sources that provide information not available elsewhere and have, wherever possible, tried to base each such analysis on a homogeneous data source. For example, for our analysis of China compared with the worldwide semiconductor market by application and by device as well as the analysis of semiconductor consumption versus purchases. For China versus worldwide by region we have continued to utilize the values reported by Gartner Dataquest (GDQ) as they provide database information for each of those markets that is reconciled on a worldwide basis. As a consequence, the value of some metrics may vary slightly between different figures and tables. We acknowledge these differences and trust that they will not divert our readers' attention from the value and significance of the findings of the report.

Our intent with this method remains to construct a more comprehensive, meaningful and yet quantitatively based picture of the industry than is otherwise available. Using this method, we surfaced additional findings and considered the ramifications of those findings for multinational semiconductor industry companies. Then finally, based on this newly developed information, we formulated a current set of recommendations for industry companies.

The growth of China's semiconductor market—which consists primarily of electronics manufacturing services (EMS) companies, original design manufacturers (ODMs) and original equipment manufacturers (OEMs) that consume chips in China—continues to be a major catalyst for changes in the industry. For this reason, we assessed the status of the market in depth and considered its effects on semiconductor production; wafer fabs; packaging, assembly and test facilities; and integrated design manufacturers (IDMs) of the industry. We also reviewed the status of the fabless and design companies in China.

Our report also examines the composition of the semiconductor value chain in China and compares it with the worldwide value chain. As part of that analysis, the report reviews both the demand for semiconductor equipment in the country and the primary equipment suppliers to the market. We then reviewed three production forecast scenarios against actual production and consumption growth realized during the period.

A couple of further points must be noted on the data sources. The metrics we use or developed had to be sufficiently comprehensive and consistent to be useful for the type of report we wanted to publish. For that reason, we elected to use the World Semiconductor Trade Statistics (WSTS) values for the worldwide semiconductor market wherever possible even though several other market research firms have reported greater values. The WSTS values are the only official values recognized by the various industry associations, including the China Semiconductor Industry Association (CSIA), that are members of the World Semiconductor Council. We also elected to convert the Renembi (RMB) currency values from various Chinese data sources to US dollar values at the average foreign exchange rate for the year reported on rather than at the year-end rate. Most of the semiconductor transactions in China are originally priced in dollars or other foreign currencies and converted to RMB on a contemporaneous basis for local reporting purposes.

Finally, our original 2004 report explored in detail the overall dynamics of the global semiconductor industry and various issues that make China's part of that industry different or even unique. The fundamental analysis of the 2004 report remains valid and readers who would like to gain a better understanding of these fundamentals should refer to the original report available at www.pwc.com/chinasemicon in the archive section.

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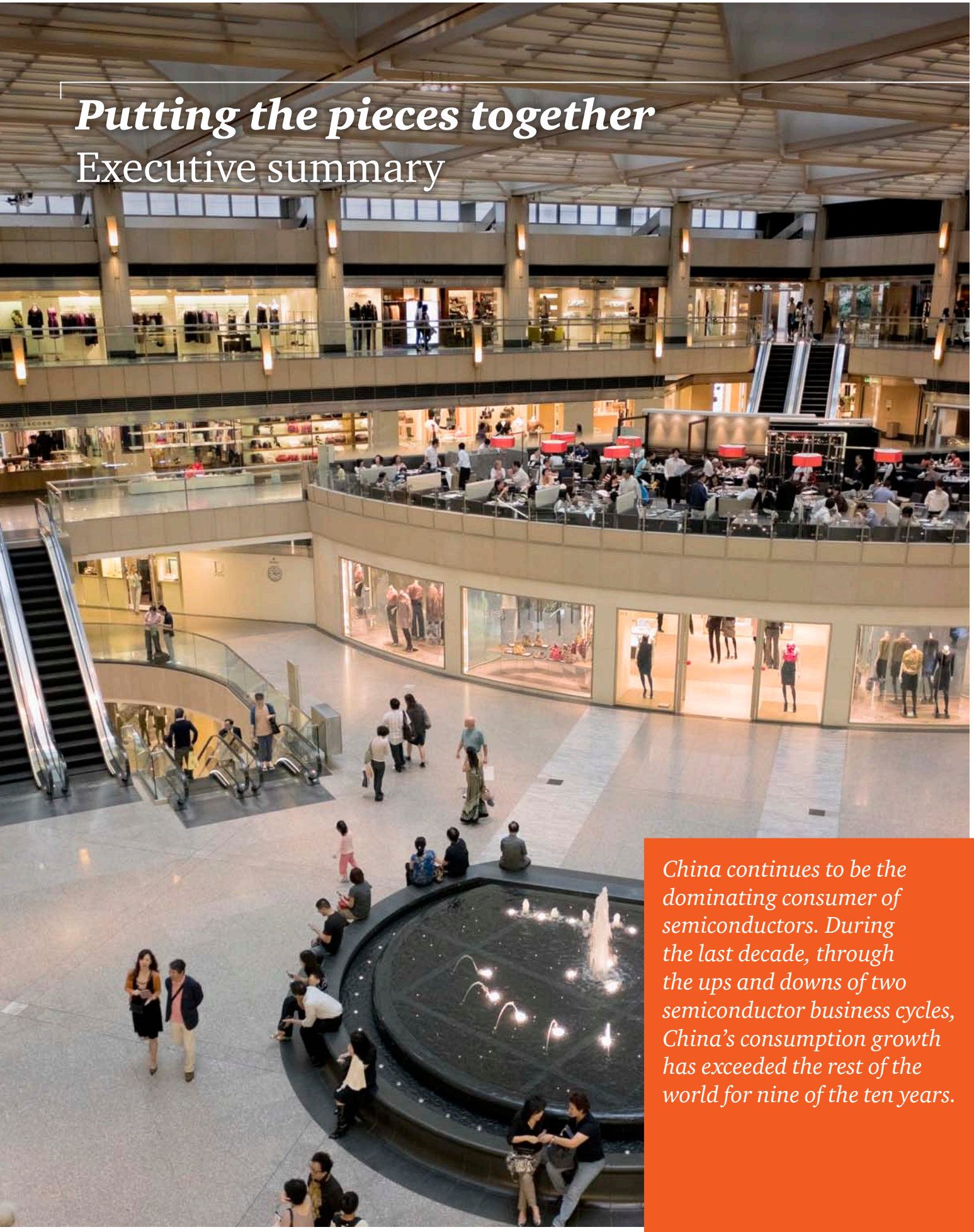
Putting the pieces together
Executive summary



China continues to be the dominating consumer of semiconductors. During the last decade, through the ups and downs of two semiconductor business cycles, China's consumption growth has exceeded the rest of the world for nine of the ten years.

PwC began the study series, *China's Impact on the Semiconductor Industry*, in 2004 in response to our clients' interest in the rapid growth of the semiconductor industry in China. Specifically, clients wanted to find out whether China's production volumes would contribute to worldwide overcapacity and a subsequent downturn. Since then, it has become clear that market growth in China is far more significant to the worldwide semiconductor industry than production volumes.

The worldwide technology trend towards mobility has contributed to China's increasing share of worldwide electronic systems production. Even during the global recession in 2008 and 2009 China's electronic equipment production value grew, while worldwide production decreased.

China continues to be the dominating consumer of semiconductors. During the last decade, through the ups and downs of two semiconductor business cycles, China's consumption growth has exceeded the rest of the world for nine of the ten years. Since 2000, the peak of the prior semiconductor business cycle, China's semiconductor consumption has grown at a 24.8% compounded annual growth rate (CAGR) while total worldwide consumption has grown at a comparatively anemic 3.9% CAGR.

This exponential growth is a result of two driving factors: the continuing transfer of worldwide electronic equipment production to China and the above-average semiconductor content of that equipment. The worldwide technology trend towards mobility has contributed to China's increasing share of worldwide electronic systems production. Even during the global recession in 2008 and 2009 China's electronic equipment production value grew, while worldwide production decreased. During the past six years, from 2004 to 2010, China's share of electronic equipment production has increased from 17% in 2004 to 31% in 2010, while the semiconductor content of that production averaged 25.4% compared to the worldwide average of slightly less than 20%.

In 2010, China's semiconductor consumption market kept pace with the worldwide semiconductor market recovery. Both the Chinese and the worldwide semiconductor markets reached record levels in 2010. China's semiconductor market grew by 30.4% in 2010 to reach a new record of US$132B. Although China's consumption market share declined slightly in 2010, its overall performance during the business cycle was notably stronger than that of the global market. By the fourth quarter of 2010, China's consumption had recovered and grown to a level of 164% of 2007 average quarter consumption while the global market had only recovered to about 120%.

The major global semiconductor companies continue to dominate the Chinese market. The largest suppliers to the Chinese market continue to be

the same multinational semiconductor companies. In the eight years we have been preparing this report, there have been only thirteen different companies among the top ten suppliers to China. Eight of these companies have been among the top ten suppliers every year from 2003 through 2010. These companies include Intel, Samsung, Hynix, Toshiba, TI, ST, NXP/Philips and Freescale.

While the export market consumption of semiconductors, i.e., used in components of finished products assembled in China and exported for sale in other countries, has been the major contributor to the growth of China's semiconductor consumption market, China's domestic market is growing in significance to the global semiconductor industry. China's domestic market—the value of semiconductors consumed in China that are used in components of finished products assembled and sold in China—has risen from US$10B in 2003 to more than US$46B in 2010. By itself, China's domestic consumption market has made up more than 27% of total worldwide semiconductor market growth since 2003. Largely driven by China's economic stimulus package, with its focus on increased consumption of electronic consumer products, China's domestic market grew to represent more than 15% of the worldwide semiconductor market for the past two years. That growth is often credited with initiating or leading the industry's recovery from the depths of its decline in the first quarter of 2009.

Integrated circuit (IC) design is the one segment of China's semiconductor industry that achieved positive year-over-year growth for every year of the past decade.

China's semiconductor industry in 2010 also kept pace with the worldwide semiconductor market recovery. Both grew to record levels in 2010, with China's semiconductor industry growing by 30.4%, just slightly below the overall industry growth of 31.8%. A lot of that growth continues to be led by multinational IDMs (integrated device manufacturers) who make up four of the five largest semiconductor manufacturing enterprises in China. The top two completed evolutionary extensions becoming truly vertically integrated IC manufacturers within China during 2010. China's semiconductor production accounted for at least 7.9% and possibly 11% of the worldwide semiconductor industry in 2010, up from just 2% in 2000.

Integrated circuit (IC) design is the one segment of China's semiconductor industry that achieved positive year-over-year growth for every year of the past decade. It was also the fastest growing segment of China's semiconductor industry for this decade. Thanks to booming domestic demand, China's IC design industry even grew during the 2008/2009 downturn. Mobile devices became the major products for China's IC design industry during 2010. Companies in the communications sector, particularly mobile phones, achieved rapid growth in revenue and size, while those in the IC card sector experienced relative decline. The result is a significant change in the makeup of China's top 10 IC design companies.

China's LED (light emitting diode) production revenue growth in 2010 exceeded that of the overall O-S-D (optoelectronics-sensor-discrete) industry growth by more than 33%. Moreover, during the two-year span from 2008 to 2010, China's LED production revenue grew by almost 58%, exceeding the overall O-S-D growth by almost one third. LED production revenues grew to more than US$4B in 2010, representing more than 26% of China's O-S-D sector. China's LED industry has been growing with specific government policy support. China established 14 National LED Industry Bases as part of the "National Semiconductor Lighting Project" sponsored by China's Ministry of Science and Technology (MOST). An increasing number of foreign companies are establishing LED fabs in China. Forty-six percent of the new LED fabs es-

tablished in China during the last two years were sponsored by foreign companies. Most new LED fabs receive financial support or subsidies from local governments. As of July 2011, there were 69 LED wafer fabrication companies in China of which 49 were in full production, eight were equipping and ramping into production and twelve were under construction.

As noted in our 2010 Update, China has emerged as a significant source of new companies and more recently of financial funding for semiconductor start-ups. That momentum continued through 2010, with 30 Chinese companies comprising more than 70% of the 42 semiconductor initial public offerings (IPOs) completed in 2010. Twenty-six of these took place in China's financial markets, accounting for 72% of total funding. During 2010, China overshadowed the US and the rest of the world with the most technology IPOs—67 Chinese companies completed their IPOs in 2010 as compared to 19 US companies. China's Shenzhen exchange displaced NASDAQ as the leading exchange for technology IPOs, accounting for 49% (53) of total deals and 40% (US$7.2B) of total funds raised. China's strong showing was largely a result of its focus on technology manufacturing and the semiconductor and alternative energy subsectors.

Finally, China promulgated its 12th Five Year Plan (FYP) which runs from 2011 through 2015. The Five Year Plans for China are a series of initiatives proposed and driven by the Communist Party of China to shape China's economic and social developments for every span of five years beginning in the early 1950s (1953). China's 12th FYP is less of a roadmap for a new development path for China and much more of a message to the Party ranks and government hierarchies to set parameters for "acceptable" behaviors. Still, it will result in new implementation policies affecting the semiconductor industry. The effects of the relevant policies of China's 12th FYP are projected to move China's IC manufacturing industry in two key directions: increasing and accelerating concentration within the sector and increasing the number of firms funded from security market listings.

What's new
Findings

China's semiconductor consumption market and IC design industry recovery from the impact of the global recession has been much stronger than that of the worldwide semiconductor market or China's overall semiconductor industry. By the fourth quarter of 2010, China's consumption had recovered and grown to a level of 164% of the 2007 average quarter consumption, while the global market had only recovered to about 120%. China's IC design industry had grown to a level of 277% of 2007 average quarter revenue, while China's semiconductor industry only recovered to about 155%.

China's semiconductor consumption in 2010 represents more than 40% of worldwide semiconductor consumption. However, the percentage-based consumption performance of the individual companies among the top ten suppliers to the China market varies considerably. Three companies had less than 40% of their total sales consumed in China: Samsung, TI and Renesas. Three companies achieved sales between 40% and 50%: Intel, Toshiba and ST. Total sales consumed in China at two more companies ranged between 50% and 70% (Hynix and AMD), while two more companies registered sales of more than 70% (NXP and Freescale).

IC design is the one segment of China's semiconductor industry that achieved positive year-over-year growth for every year of the past decade. It was also the fastest growing segment of China's semiconductor industry for this decade. IC design revenues grew from US$178M in 2001 to US$5.4B in 2010—experiencing a CAGR of just over 46%.

Mobile devices became the major products for China's IC design industry during 2010. Companies in the communications sector, particularly mobile phones, achieved rapid growth in revenue and size, while those in the IC card sector experienced relative decline. The result is a significant change in the makeup of China's top 10 IC design companies.

The 2010 list of Chinese semiconductor companies with largest revenues has increased to 43 from 38 on the 2009 list. This group recorded superior performance for 2010. Overall, these 43 companies reported an average 41% increase in dollar revenues. Four of these Chinese companies saw revenues more than double in 2010: Shenzhen Netcom Electronic, Spreadtrum Communications, Tianjin ZhougHuan Semiconductor and Leadcore Technology.

Both Haier (Beijing) IC Design and Availink, which had emerged as two of China's new leading semiconductor companies with greater than 550% revenue increases in 2009, reported 70% or more declines in 2010 revenues and missed the qualifying threshold for the 2010 list of Chinese semiconductor companies with largest revenues.

During the past year China resumed increasing wafer fab capacity faster than the worldwide average. China increased the net number of fabs in production by 21, or 17%, and increased its net capacity by 19% while the industry only increased the net number of fabs in production worldwide by 20, or 2%, for an 11% increase in net capacity.

Over the past two years, China's share of wafer fab capacity allocated to the O-S-D sector has been increasing. O-S-D capacity now represents 25% of China's current wafer fab capabilities versus 15% of worldwide. China currently accounts for 17% of worldwide O-S-D capacity and that could increase to 19% by 2015 if all of the committed wafer fabs under construction are completed and ramped to full production. Currently there are fourteen foreign companies with some form of investment in O-S-D wafer fabrication capacity in China.

Most of China's O-S-D capacity increase has been in LED fab capacity. Eighteen of the 21 fabs that went into production last year and 19 of the 22 fabs that are currently committed and under construction are all LED wafer fabs and most are 2" (50mm) wafer fabs. This reflects China's recent concentration on the establishment of new LED wafer fabs.

During 2010, two of the top ten worldwide MNC (multinational corporations) semiconductor companies (also two of the top five semiconductor suppliers to China) established wafer fabrication capabilities in China: Intel by starting production of its new Fab 68 in Dalian and Texas Instruments by its acquisition of Cesion Semiconductor Manufacturing Company in Chengdu from SMIC. They became the second and third top five semiconductor suppliers to China to establish a significant wafer fabrication capability in China after Hynix. These three MNC fabs represent 22% of China's current wafer fab capacity and almost all of its advance process technology.

In 2010, China's semiconductor packaging, assembly and test (SPA&T) revenues grew by 27.5% to US$9.3B. This is a new record, more than 4% higher than 2008's previous record of US$8.9B. As of the end of 2010, China had 106 SPA&T facilities, representing:

- 20% of the total number of worldwide SPA&T facilities;
- Almost 20% of worldwide SPA&T manufacturing floor space; and
- 23% of reported worldwide SPA&T employees (up from 20% of employees in 2009).

China's SPA&T facilities continued to rank first in share of worldwide SPA&T manufacturing floor space for the second year, just ahead of Taiwan (at slightly less than 20%) and Japan (18%).

The Greater China semiconductor industry enjoyed a good 2010. Taiwan's semiconductor companies are well-positioned to take advantage of growth in the still-buoyant China market. Indeed, Taiwan's growing economic relationship with China and the progressive easing of cross-Strait investment restrictions will have a significant influence on the direction of the Greater China semiconductor industry. Taiwan's IC industry revenues, as a whole (including design, manufacturing, assembly and testing), jumped 37.3% to a record NT$1,716B (US$54.4B) in 2010. For the time being, Taiwan's domination of the global chip foundry and semiconductor assembly and testing sectors' revenues is assured. However, Taiwanese IC designers face increasing competition in the China market, while local DRAM manufacturers are on the ropes again.

One of the consequences of the semiconductor recovery in 2010 was the resumed growth of China's IC consumption/production gap. This gap is the difference between IC consumption and IC industry revenues. Both China's IC market consumption and China's IC industry production increased to new record levels in 2010. As a result, the China IC consumption/production gap also increased to a new record level in 2010, increasing by more than US$20B to reach US$87.3B. By comparison, Taiwan's annual production/consumption surplus, which had decreased to US$30B in 2009 increased dramatically by 48% to reach a new record US$44.7B in 2010. So on the net, Greater China had an IC consumption/production gap of US$48B in 2010. While it is still significantly less than that of China (PRC) alone, this gap is now more than 16% of the total worldwide semiconductor market.

Things you should consider
Recommendations

The following recommendations are intended to provide general guidance based upon our current findings. Issues addressed by this series include investment, intellectual property protection, risk assessment and contingency planning. Several recommendations are unchanged from prior reports while others are new or updated.

Understand and leverage China's 12th Five Year Plan. Companies that effectively develop and convey a value proposition that tangibly supports and speaks to one or more of the eight priorities implicit in China's 12th FYP could gain a favorably opportunity set and/or allay regulatory pressure.

Identify and engage in all opportunities to team with Chinese government agencies in strategically addressing how to plan, develop and provide the advanced technology needed to support China's development program that covers railroad and air transportation, telecom networks, rural improvements and healthcare reforms. These programs will need huge investments in advanced technology and should promote the use of semiconductor-enhanced products.

Reassess company presence. China's semiconductor consumption market has weathered the global recession better than any other regional market. It did so at the expense of semiconductor consumption in other countries. This favorable preferential difference is expected to continue through the next semiconductor business cycle driven in part by China's rapid urbanization, increasing consumer consumption and green energy initiatives. In addition, many new opportunities for serving the worldwide market are emerging from inside China. Consequently, companies whose benchmarking reveals their China presence is less than that of their peers need to ramp up their business development efforts.

Design for the marketplace. China has become the largest site of low-cost consumer electronic system production, including a significant white label market and, therefore, the largest user of low-ASP analog and standard logic devices. Companies should design products that meet the specific requirements of this market.

Adapt to China's unique standards. China continues to propose alternate and unique standards which, if successful, may provide more desirable and effective solutions for specific developing-country environments that have large potential markets. Consequently, companies should monitor evolving Chinese standards keeping an eye out for emerging opportunities.

Explore acquisition or partnering opportunities. The majority of domestic design companies are small. The global recession put a severe strain on many of them. Moreover, many are focused on domestic opportunities that foreign companies tend to overlook. Multinational design companies can bring considerable local market intelligence and relationships to bear on Chinese market initiatives. In general, multinational companies should consider acquisition or partnership opportunities with Chinese design companies as a strategy to address the local market.

Take advantage of China's emergence as a source of financial funding for semiconductor start-ups. During the past two years, China's financial markets have accounted for more than 70% of total semiconductor IPO funds raised. Over the longer term, it is expected that the 12th FYP policies aimed at promoting different levels of market stock transfer mechanisms will help business to expand financial channels in phases as their operations grow in scale which in turn will provide greater incentives for semiconductor companies to list themselves on the Chinese exchanges.

Take advantage of China's National Major Science and Technology Project 02 to work with and evaluate Chinese equipment manufacturers and develop new process capabilities. This may be most applicable for their semiconductor packaging and testing operations.

Move mature products to China. Companies should consider transferring mature product lines to China. This can extend the competitiveness of those lines as well as free up scarce capacity and resources. First movers are using this strategy successfully.

Re-brand for mature markets. Companies may find they can expand a product line by re-branding products for the Chinese and other markets. A local enterprise can even be used to manage the development effort. First movers are also using this strategy successfully.

Keep an eye on local competition. Continuously monitor the efforts of local EMS and ODM enterprises to gain control over their BOM (bill-of-material) sourcing. Their success could lead to the OEM qualification of local competitors and displacement of multinational suppliers.

Preempt O-S-D competition. Chinese companies continue to compete most effectively in the discrete and LED areas. As such, they could be gaining the scale, qualifications and recognition necessary to grow into potential worldwide competitors or to extend into the commodity IC area. So, leading O-S-D companies should consider preempting these market share losses by participating actively in the Chinese market.

Adapt to China's "dislocated" buying structure. More than 25% of the semiconductors consumed in China in 2010 continued to be purchased outside of China. Suppliers need a team effort with design-in, qualification and purchasing focus at the OEM location outside China coordinated with application and supply chain focus at the manufacturing locations in China to ensure success.

Use Chinese foundries to gain pricing leverage while assuring future capacity. It is likely that the next semiconductor cycle will bring a foundry capacity shortage as a result of expected reductions in capital spending and accelerating IDM shift to the fab-lite business model. With their preponderance of 150mm and 200mm wafer fabrication facilities, local foundries may provide an immediate lower-cost alternative and assured future supply source for some product categories.

Adapt to the Corporate Income Tax and other business laws. Companies with operations in China should carefully examine and monitor their business strategy, model and structure in light of China's Corporate Income Tax and other business laws and related incentive programs. Recent entrants, for example, have seen a reduction in expected incentives while many existing companies have been able to qualify for incentives that seemed to favor R&D, design and foundry operations.

Invest in effective human relations. When establishing an enterprise in China, apply the effort and resources from the start to develop an HR program that is both effective and sensitive to local demographics and environment. The impact on employee retention and operating costs can be quite significant.

Promote participation in global and local industry forums. Encourage the China Semiconductor Industry Association (CSIA) and its member companies to participate in the World Semiconductor Trade Statistics (WSTS) and Semiconductor International Capacity Statistics (SICAS) programs. Encourage local subsidiaries of all

multinational semiconductor companies to participate in CSIA and CCID statistics programs. Their participation in these industry-wide statistic programs would contribute to a better and more accurate understanding of China's semiconductor market and industry and their capabilities and contributions to the worldwide industry totals which would benefit the entire industry as well as themselves.

Keep an eye on Greater China. Taiwan has started to further loosen its restrictions on semiconductor investments in China and Chinese investments in Taiwan. Taiwan-based companies have already increased their presence in China, and the supply chain has started to follow suit. So companies should monitor the status of Taiwan and the Taiwan/China relationship with an eye toward new market opportunities and risks in Greater China.

Diversify—globally. Companies should at all times keep tabs on global production and consumption trends. For example, there is always a need to diversify manufacturing by location to reduce risk. Trends to watch: greater China had 55% of all new fabs but only 25% of all fab capacity under construction in 2010.


EXCHANGE

Maintaining a dominant share
The semiconductor market in China

During the last decade, through the ups and downs of two semiconductor business cycles, China's consumption growth has exceeded the rest of the world for nine of the ten years.

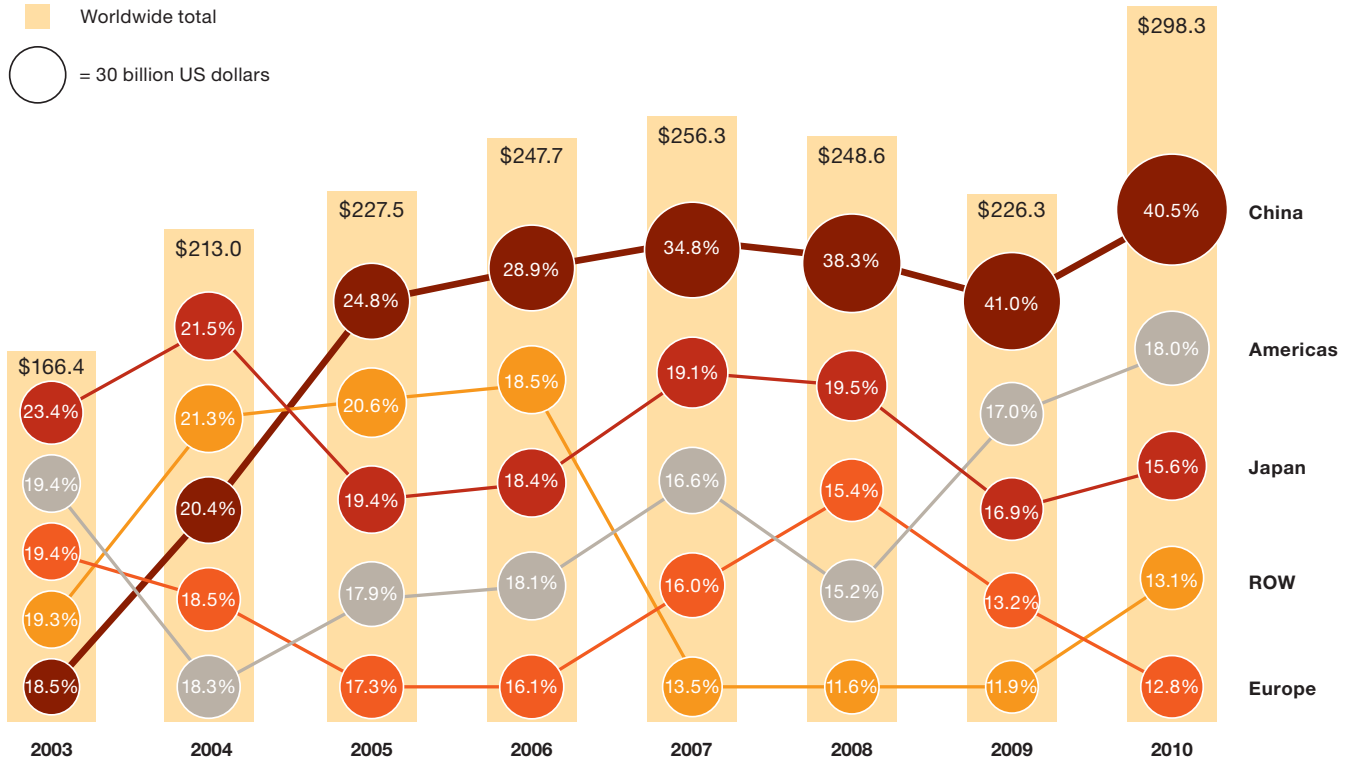
Overall consumption

China's semiconductor consumption market in 2010 kept pace with the worldwide semiconductor market recovery. Both the China and the worldwide semiconductor markets reached record levels in 2010. China's semiconductor market grew by 30.4% in 2010 to reach a new record of US$132B. Though this pace is slightly below that of the global market, which grew at 31.8%, China's growth had significantly outpaced that of the global market in 2009. In spite of these two years of consecutive growth, China's share of the total 2010 worldwide semiconductor consumption market decreased fractionally to 40.5%—a figure which is still two percentage points higher than its share of the 2008 worldwide market.

Measured in US dollars, China's semiconductor market growth in 2010 trailed that of the total worldwide semiconductor industry by 1.4 percentage points. However, over a percentage point of China's market growth was due to China's further revaluation of its currency. Reported in local currency, China's semiconductor market grew by 29.2%, with its integrated circuit (IC) market growing slightly more than its optoelectronics-sensor-discrete (O-S-D) market.

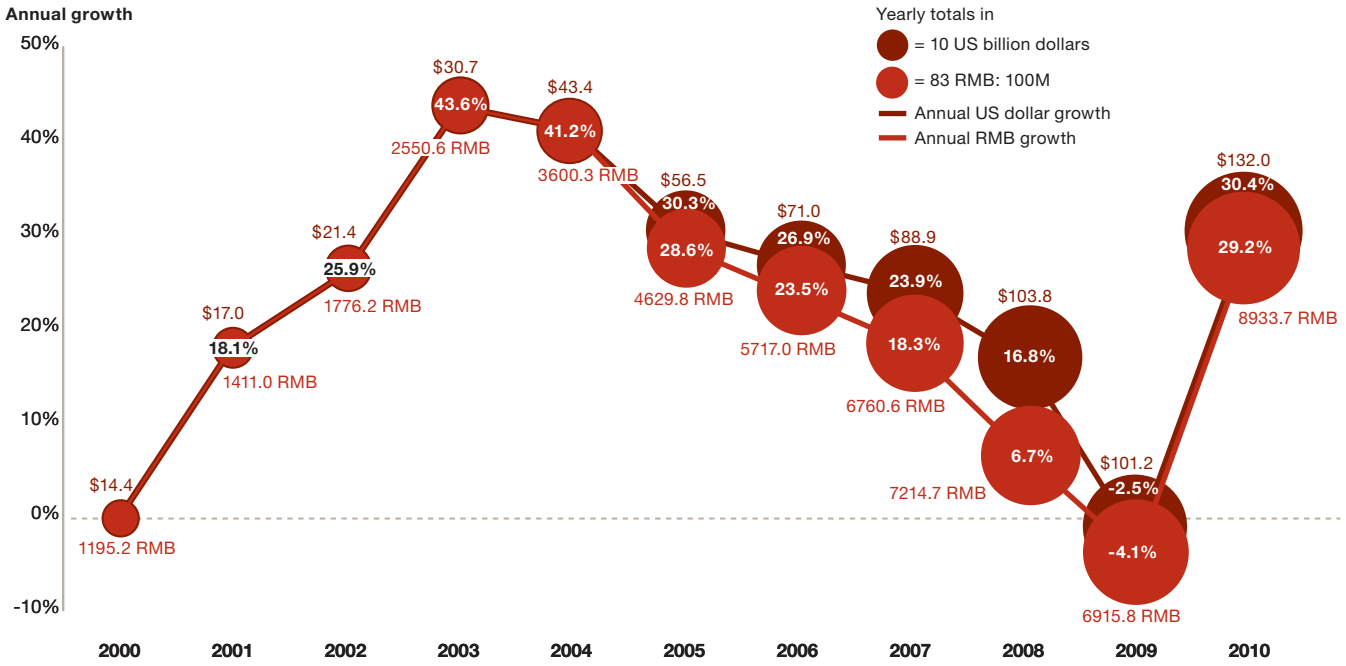
Figure 2 shows China's market size and growth rate from 2000 through 2010 in both US dollars and RMB with the circles representing the mar-

Figure 1: Worldwide semiconductor market by region, 2003–2010
(Total worldwide in billions of US dollars)



Source: SIA, CCID

Figure 2: China's semiconductor market growth, 2000–2010



Source: CCID, CSIA

ket being of equal size at the old fixed exchange rate of US$ 1=RMB 8.3. The circles are concentric from 2000 through 2004 and then diverge after 2005 as China began changing its FX rate to show the relative impact of the FX changes.

During the last decade, through the ups and downs of two semiconductor business cycles, China's consumption growth has exceeded the rest of the world for nine of the ten years. Since 2000, the peak of the prior semiconductor business cycle, China's semiconductor consumption has grown at a 24.8% compounded annual growth rate (CAGR), while total worldwide consumption has grown at a comparatively anemic 3.9% CAGR. China's market growth has been at the expense of all other regions. Since 2000, China has accounted for more than 100% of the overall worldwide semiconductor market growth. China's semiconductor consumption market grew by US$118B (from US$14B in 2000 to US$132B in 2010), while the worldwide market grew only US$94B (from US$204B to US$298B).

Since 2000, China has accounted for more than 100% of the overall worldwide semiconductor market growth.

China's semiconductor consumption market has grown many times faster than the worldwide market as a result of two driving factors: the continuing transfer of worldwide electronic equipment production to China and the above-average semiconductor content of that equipment. Even during the global recession in 2008 and 2009, China's electronic equipment

Table 1: China's production and worldwide share of main electronic products 2008–2010

	Production in 1000s			% Growth	Worldwide market share %		
	2008	2009	2010		2008	2009	2010
Main products							
Mobile phone	559,640	619,520	998,000	61.1%	44.7%	49.9%	71.3%
Computer/PC	136,666	182,150	246,000	35.1%	47.0%	60.9%	73.4%
Color TV	90,331	98,990	118,000	19.2%	43.9%	48.3%	47.8%
Digital camera	81,883	80,260	90,000	12.1%		62.3%	64.9%

Source: CSIA, MIIT, Digitimes Research 2010–2011

production value grew, while worldwide production decreased by 3% in 2008 and 11% in 2009. As a result, China's share of worldwide electronic equipment production increased to 28.7% in 2008 and to 32.8% in 2009. Worldwide electronic equipment production recovered in 2010 to near 2007 levels by increasing almost 16%. Meanwhile, China's electronic equipment production increased just 10.6%, reaching new record levels but decreasing its overall share to 31.4%. Table 1 shows China's production and worldwide share of main electronic products for 2010.

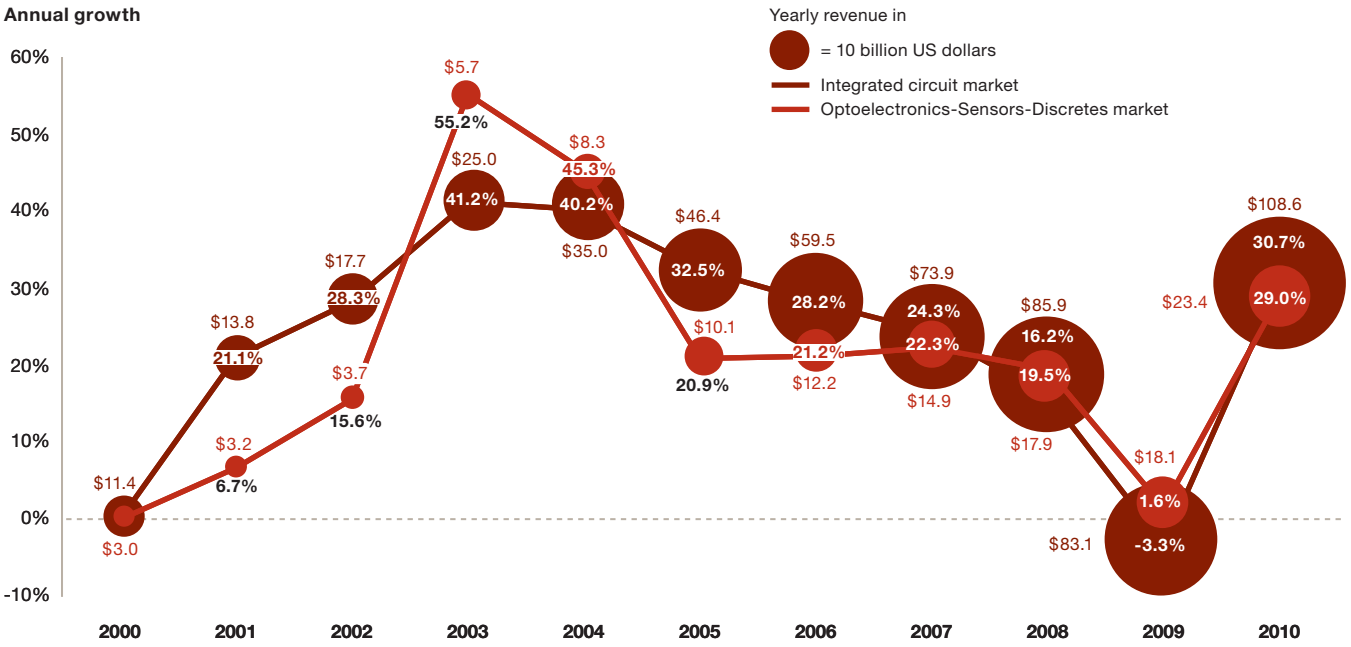
At the same time, the semiconductor content of the electronic equipment produced in China rose in 2010. It had decreased from 25% in 2008 to 23% in 2009. The figure rose to 27% in 2010 and is still significantly higher than the worldwide average of 19%. During the past six years from 2004 to 2010, China's share of electronic equipment production has increased from 17% in 2004 to 31% in 2010, while the semiconductor content of that production averaged 25.4% compared to the worldwide average of slightly less than 20%.

Prior to the recovery of 2010 the growth rate of China's semiconductor consumption market had been decelerating for six years. Measured in US dollars that growth rate has decreased from a peak of 43.6% in 2003 to 41.2%, 30.3%, 26.9%, and 23.9% during the next four years respectively. It remained a still-noteworthy 16.8% in 2008 before diving into its first negative year in 2009.

China's revisions to its currency exchange rate, beginning in 2004, are contributing to this deceleration. When measured in local Chinese currency (RMB) the decline in growth rate is more severe, decreasing from a peak of 43.6% in 2003 to 6.7% in 2008 before declining by 4.1% in 2009. As the Chinese record it, 2008 was the first year their semiconductor consumption market declined to single-digit growth since the early 1990s and 2009 was the first year of negative growth ever. The immediate cause of that decline was attributed to the worldwide economic crisis and the decline in transfer of electronic equipment production to China. In the longer term, China's semiconductor market has passed through its high-speed development period. As demonstrated in 2010, its future growth is likely to be closer to the worldwide growth rate as it represents an increasingly larger share of the worldwide market.

Both the global and Chinese semiconductor markets reached the bottom of the last business cycle in Q1/09 and then gradually improved in the following quarters. That improving trend continued through 2010,

Figure 3: China's IC and O-S-D market growth, 2000–2010



Source: CCID, CSIA

with the global and China markets experiencing somewhat different growth profiles. The global market grew for the first three quarters and then declined in the fourth quarter, while the China market was almost flat in the first quarter and then grew in each of the following three quarters. Both the global and Chinese semiconductor markets achieved record highs in 2010.

Although China's consumption market share declined slightly in 2010, its overall performance during the business cycle was notably stronger than that of the global market. By the fourth quarter of 2010, China's consumption had recovered and grown to a level of 164% of 2007 average quarter consumption, while the global market had only recovered to about 120%. Whether the Chinese semiconductor market will be able to continue to gain global share will be primarily determined by the future transfer of electronic equipment production.

Most industry analysts are predicting that the trend of transferring electronic equipment production to China will continue through 2015.

The market for ICs and O-S-D devices

The IC consumption market in China grew 30.7% to US$108.6B in 2010. Though slightly below the worldwide increase of 31.1%, China's IC consumption continued to represent almost 44% of worldwide consumption. Measured in local currency, the increase in IC consumption in 2010 was 29.5%. Measured in US dollars, China's IC consumption increased by about US$26B, while the worldwide IC market increased by almost US$59B. By inference, IC consumption in the rest of the world other than China increased by more than US$33B or 31.5% compared to China's 30.7% increase. This is the first time in four years that the rest

of world's IC market grew faster than China's IC market and that China's IC consumption did not grow at the expense of displacing IC markets in other regions. This may represent a noticeable change in the dynamics of China's impact on the industry.

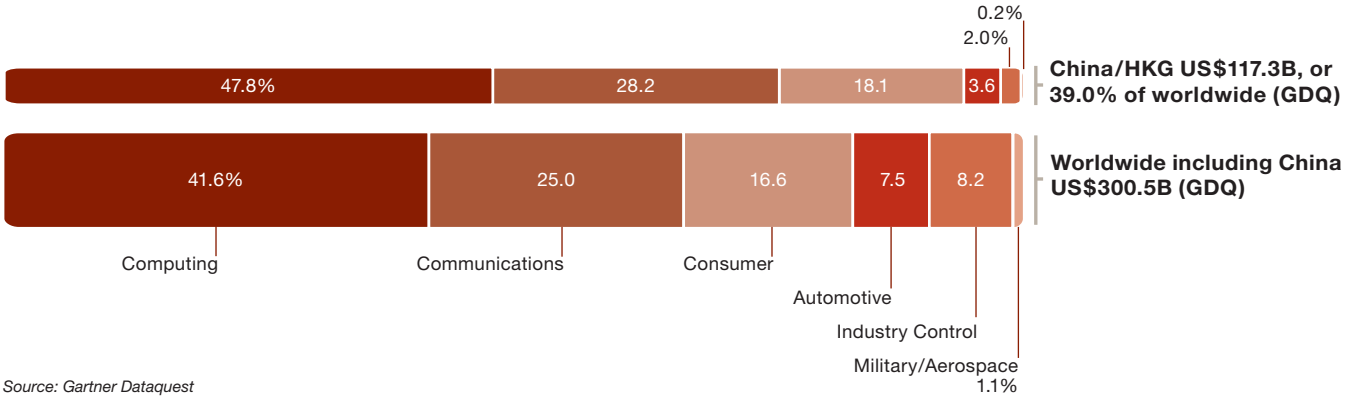
During 2010 China's O-S-D market, measured in dollars, grew 29% to reach a new peak of US$23.4B. This increase was less than the worldwide O-S-D market increase of 35%, leaving China's share of the market to recede two percentage points to slightly less than 47%. Sensors were the smallest segment of China's O-S-D market at US$2.0B, but at 35% growth was also the fastest growing. Discrete remained the largest segment of this market at US$12.2B, while growing at 28%. Optoelectronic grew 27% to US$8.5B in 2010. Measured in local currency, China's O-S-D market grew by 27.8%. This represents 17.7% of China's total semiconductor consumption market in 2010, which is about one percentage point higher than the worldwide average of 16.8%. Similar to the IC market, this is the first time in four years that China's O-S-D consumption did not grow at the expense of displacing O-S-D markets in other regions.

Market by application

When compared with the worldwide semiconductor market, the distribution of China's 2010 semiconductor consumption continued to be somewhat more concentrated in the computing and communications application sectors. Meanwhile, it became only slightly more concentrated in the consumer sector, relatively less concentrated in the automotive and notably less concentrated in the industrial and mil/aero sectors.

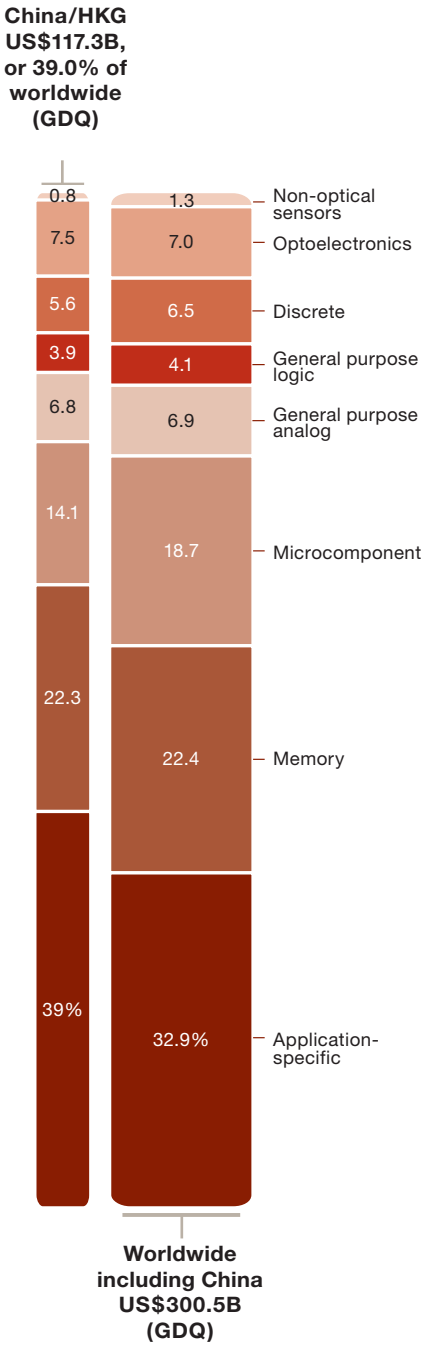
Worldwide semiconductor consumption in 2010 became slightly more concentrated in the computing and automotive sectors. The share of China's semiconductor market consumed by the computing sector in 2010 increased by almost 4%, while the shares consumed by the communications and consumer sectors decreased by about 3% and 2% each. Since 2003, China's consumption of semiconductors for computing applications has grown at a 24% CAGR, while consumption for communications and consumer applications has grown at 22% and 17%. China's consumption of semiconductors for industrial/military applications is smaller, but has grown at the fastest rate of 31%. This is followed by automotive applications, which grew at a 27% CAGR.

Figure 4: China compared with worldwide semiconductor market by application, 2010



Source: Gartner Dataquest

Figure 5: China compared with worldwide semiconductor market by device, 2009



Source: CCIC, Gartner Dataquest 2011

Market by device type

China's semiconductor consumption market in 2010 remained noticeably more concentrated in the application-specific integrated circuit sector and less concentrated in the non-optical sensors and microcomponent sectors than the worldwide market. At the same time, it also remained slightly less concentrated in the discrete sector. During 2010, worldwide semiconductor consumption became more concentrated in the memory sector and less concentrated in the application-specific integrated circuit sector.

As a result, the share of China's semiconductor market filled by application-specific devices in 2010 decreased by almost 5% and the general purpose logic share by slightly more than 1%. The share filled by memory increased by 4% and the microcomponent share grew by more than 1% with minor fractional share decreases in the analog and discrete sectors.

Since 2003, non-optical sensors, the smallest device sector of China's semiconductor market, was the fastest growing, increasing at a 57% CAGR. Memory was the next fastest growing sector at 27%, followed by optoelectronic at 24% CAGR. The general purpose logic and discrete sectors had the slowest growth at about 11% and 18% CAGR, respectively, while all the remaining sectors grew at about 22%.

Suppliers to the Chinese market

The major global semiconductor companies continue to dominate the Chinese market. The largest suppliers to the Chinese market continue to be the same multinational semiconductor companies. Table 2 lists the top ten suppliers that have the largest sales revenue from the Chinese market. In the eight years we have been preparing this report, there have been only thirteen different companies among these top ten suppliers. Eight companies have been among the top ten semiconductor suppliers to China every year from 2003 through 2010 including Intel, Samsung, Hynix, Toshiba, TI, ST, NXP/Philips and Freescale. AMD has been among the top suppliers for the last seven years since 2004. Infineon and its spinoff, Qimonda, were among the top ten suppliers for the first four years, from 2003 to 2006, until exiting the DRAM business. Media Tek ranked in the top ten for the three years from 2007 to 2009 until losing market share to Chinese IC design competitors. Renesas, which made the top ten list in 2003, returns in 2010 as a result of its merger with NEC Electronics.

China's consumption of semiconductor products from these ten largest suppliers in 2010 increased by 32.1%. This is almost two percentage points higher than the growth of the overall semiconductor market in China and marginally better than the growth of the overall worldwide semiconductor market. However, the increase in China's total consumption of semiconductor products from these ten largest suppliers was notably less, 10 percentage points, than the increase in worldwide consumption of their products. This is primarily due to the large growth in worldwide consumption of DRAMs from Samsung and Hynix.

As a result, the Chinese semiconductor market in 2010 reversed a prior trend to become less concentrated than the worldwide market. The top ten suppliers to the Chinese semiconductor market had a 47% share of that market, while the top ten suppliers to the worldwide market had a more than 49% share in 2010. This reverses what had been a very gradually declining share, ranging from 50% in 2004 to 47% in 2007 and 46% in 2009. Together, these 10 largest suppliers have maintained their

Table 2: Semiconductor suppliers to the Chinese market 2009–2010

Company	Rank 2009	Rank 2010	Revenue in millions of US dollars 2009 IC	2010 IC	% Change	2009 Semi	2010 Semi	% Change	Market share
Intel	1	1	15,570	19,659	26.3%	15,570	19,659	26.3%	14.9%
Samsung	2	2	5,548	8,018	44.5%	5,681	8,175	43.9%	6.2%
Hynix	4	3	3,644	5,564	52.7%	3,644	5,564	52.7%	4.2%
Toshiba	3	4	3,231	4,138	28.1%	3,904	4,970	27.3%	3.8%
TI	7	5	3,127	4,248	35.8%	3,292	4,479	36.1%	3.4%
ST	5	6	2,704	3,305	22.2%	3,601	4,449	23.5%	3.4%
AMD	6	7	3,415	4,174	22.2%	3,415	4,174	22.2%	3.2%
NXP	8	8	2,281	2,965	30.0%	2,891	3,751	29.7%	2.8%
Renesas*	12	9	1,272	2,634	31.0%	1,716	3,484	32.6%	2.6%
NEC*	18		739			911			
Freescale	10	10	2,057	2,788	35.5%	2,436	3,233	32.7%	2.4%
Media Tek (MTK)	9	12	2,442	2,453	0.5%	2,442	2,453	0.5%	1.9%
Total Top 10			**44,019**	**57,493**	**30.6%**	**46,876**	**61,938**	**32.1%**	**46.9%**

Total Top 10 share of						
Chinese integrated circuit market	53.0%	52.9%				
Chinese semiconductor market				46.3%	46.9%	

Note: Semi equals IC + Discrete (including LED) market.
** Renesas for 2010 is compared with Renesas + NEC for 2009 due to their merger.*

Source: CCID IC Market China 2010 & 2011 Conferences—Feb. 2010 & 2011

share of the Chinese IC market at about 53% in 2009 and 2010, up from the slightly more than 51% share they had maintained for the three preceding years.

Although Gartner Dataquest (GDQ) stopped reporting company market share data by country in 2008, it now appears that there is still no Chinese company within the top 45 suppliers to the Chinese semiconductor market. Even if the largest Chinese semiconductor company sold all of their output within China, no Chinese semiconductor company would be among the top 40 suppliers to the Chinese semiconductor market in 2010. It may be notable that Media Tek, the one Taiwanese company that had been within the top ten suppliers to the Chinese semiconductor market from 2007 through 2009, dropped to the twelfth position in 2010 as a result of losing market share to Chinese IC design competitors.

Since China represents more than a third of the worldwide semiconductor market, it should not be surprising that many of the same companies are the largest suppliers to both the Chinese and worldwide markets. Seven of ten companies were the largest suppliers to both markets in 2010. This is the same number as in 2009, but is more than in 2008 (six) and less than 2007 (eight). And while AMD, NXP and Freescale Semiconductor are among the top 10 suppliers to the Chinese market, they are not among the 10 largest suppliers to

the worldwide market. Conversely, though Micron Technology, Qualcomm and Broadcom are among the top 10 suppliers to the worldwide market, they do not make the list of the 10 largest suppliers to the Chinese market in 2010.

While all of the top ten suppliers to the Chinese semiconductor market were also the largest IC suppliers, only four were among the largest O-S-D suppliers: ST, Renesas Electronics, Toshiba and NXP. The other top ten suppliers to the Chinese O-S-D market in 2010 include Fairchild Semiconductor, ON Semiconductor, Infineon, Rohm, KEC and International Rectifier. China's IC market is slightly more concentrated than China's combined semiconductor market, while the O-S-D market is less concentrated. The top ten IC companies accounted for 53% of that market, while the top 10 O-S-D companies accounted for only 37% of their market in 2010.

China's semiconductor consumption in 2010 represents more than 40% of worldwide semiconductor consumption. However, the percentage-based consumption performance of the individual companies among the top ten suppliers to the Chinese market varies considerably. Three companies had less than 40% of their total sales consumed in China: Samsung, TI and Renesas. Three companies achieved sales between 40% and 50%: Intel, Toshiba and ST. Total sales consumed in China at two more companies ranged between 50% and 70% (Hynix and AMD), while two more companies registered sales of more than 70% (NXP and Freescale).

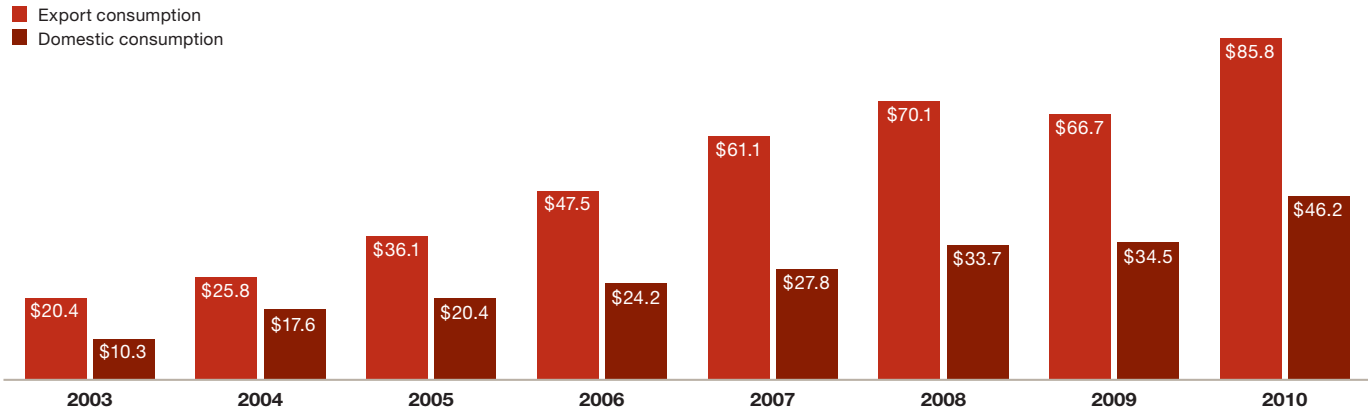
Based upon a comparison of CCID's report of China consumption by supplier and GDQ's report of worldwide market share, the variations are even more notable among the top 20 suppliers to the Chinese market. Nine of the top twenty suppliers to the Chinese consumption market weighed-in at less than 40%, the national average, of their total sales consumed in China. Five of these top 20 suppliers had between 40 and 50% of their total sales consumed in China; three between 50% and 70%. Three more companies, meanwhile, NXP, Freescale and Media Tek, saw 70% or more of their total sales consumed in China.

Table 3: Chinese semiconductor exports by segment, 2008–2010
(in billions of US dollars)

	Total sales			Export sales (% of total)					
Market segment	**2008**	**2009**	**2010**	**2008**		**2009**		**2010**	
Data processing	36.9	39.9	56.1	23.5	(64%)	24.1	(61%)	34.1	(61%)
Communications	29.2	27.8	33.1	20.4	(70%)	19.9	(71%)	22.9	(69%)
Consumer	20.9	18.0	21.2	16.7	(80%)	14.1	(78%)	16.2	(77%)
Automotive	3.3	3.1	4.3	0.9	(28%)	0.9	(30%)	1.2	(28%)
Industrial	1.8	1.5	2.4	0.7	(36%)	0.6	(39%)	0.9	(37%)
Mil/aero	0.2	0.2	0.2	0	(15%)	0	(18%)	0	(18%)
Totals	**92.3**	**90.5**	**117.3**	**62.3**	**(67.5%)**	**59.7**	**(66%)**	**75.3**	**(64%)**

Source: Gartner Dataquest, PricewaterhouseCoopers 2009-2011

Figure 6: China's export and domestic semiconductor consumption markets
(in billions of US dollars)



Source: Gartner Dataquest, PricewaterhouseCoopers 2009-2011

The Chinese export market and domestic consumption

Almost two thirds of all the semiconductors consumed in China were used in components of finished products assembled in China and exported for sale in other countries. We describe this as the export market.

Table 3 shows the relative distribution of this export market by major market segments. Although this export market has been somewhat more volatile than its complementary counterpart, the domestic market, it has been the major contributor to the growth of China's semiconductor market for the last decade. Since 2003, the consumption of semiconductors for export products has increased by US$65B, constituting 65% of the overall growth of China's semiconductor market. Its share of total semiconductors consumed in China had risen for three years, from 64% in 2005, to 66% in 2006 and 69% in 2007—then declining to 68% in 2008, to 66% in 2009 and to 64% in 2010. During 2009, semiconductor exports decreased by more than US$3B, even as the consumption of semiconductors for domestic products increased by just under US$1B. Driven by the global recession, this decline in export market consumption became the overwhelming contributor to the decline of China's semiconductor market in 2009. Then, in 2010, the export market became the major contributor to the growth of China's semiconductor market, increasing by just over US$19B, while the consumption of semiconductors for domestic products increased by just under US$12B.

China's domestic market is growing in significance to the global semiconductor industry. Since 2003, China's domestic market—the value of semiconductors consumed in China that are used in components of finished products assembled and sold in China—has grown at a 23% CAGR. This market has risen from US$10B in 2003 to more than US$46B in 2010. By itself, China's domestic consumption market has made up more than 27% of total worldwide semiconductor market growth since 2003. Largely driven by China's economic stimulus package with its focus on increased consumption of electronic consumer products, China's domestic market grew to represent more than 15% of the worldwide semiconductor

market for the past two years. This is up from 13.5% in 2008 and 11% in 2007—and such growth is often credited with initiating or leading the industry's recovery from the depths of its decline in the first quarter of 2009.

Dislocated purchasing

A significant portion of the semiconductor devices consumed in China continue to be purchased outside of China. This is because some customers—due to supply chain considerations such as control of key inventory items, intellectual property protection and/or toll processing business models—will buy semiconductor devices outside of China and transship them to China for use and consumption. This means that a significant portion of buying decisions for customer-specified devices consumed in China continue to be made outside of China. During the past four years, the largest share of this dislocated purchasing of semiconductors for consumption in China took place in Taiwan, Korea and Japan, which corresponds to the ongoing transfer of electronic equipment production from these regions to China. Other regions with a smaller share of this dislocated purchasing include Europe and Singapore.

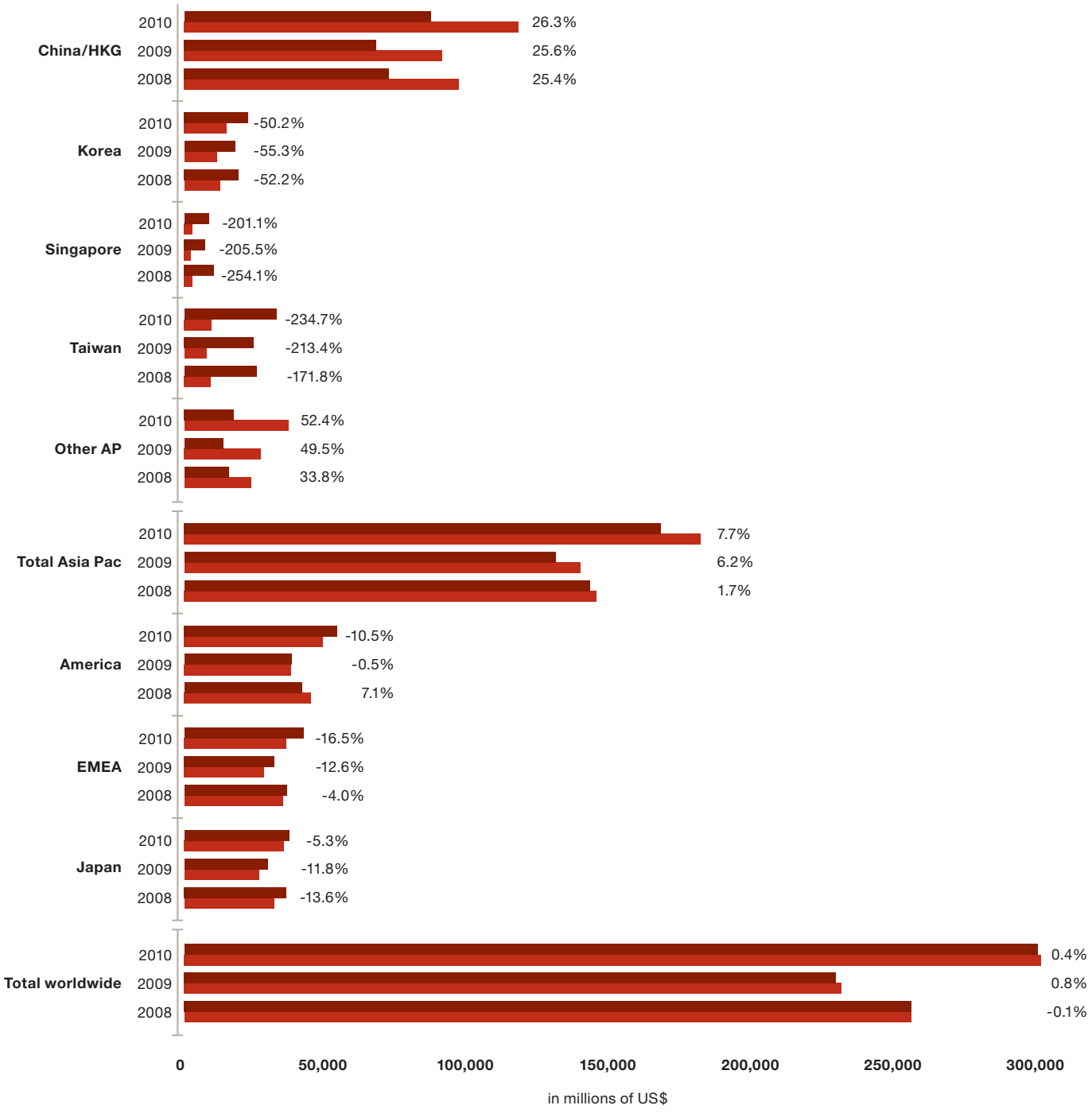
We originally identified this "dislocated" purchasing of semiconductors for the Chinese consumption market by a comparison of consumption to vendor direct sales or purchase market or billing total available market (TAM) to China. Based upon those comparisons, dislocated purchases for China had increased noticeably from about a third in 2004 to more than 45% in 2007 before decreasing to 42% in 2008 and to 38% in 2009. Since 2009, industry analysts have started reporting electronic equipment manufacturer's purchases in China (purchasing TAM) in place of vendor sales to China (purchase market or billing TAM) in order to eliminate the distortion created by distributors who purchase devices in one country to sell to manufacturers in another country. An example of this could be a semiconductor vendor selling devices in Taiwan to a Taiwanese distributor who in turn sells the same devices to an electronics equipment manufacturer in China.

As a result, we are now identifying this dislocated purchasing of semiconductors for the Chinese consumption market by a comparison of consumption to purchasing TAM.

China became the largest market in the world for cell phones, digital TVs and automobiles in 2010 and is expected to also become the largest market for PCs in 2011. As a consequence, the following ten applications each accounted for over US$1B of domestic semiconductor consumption in 2010:

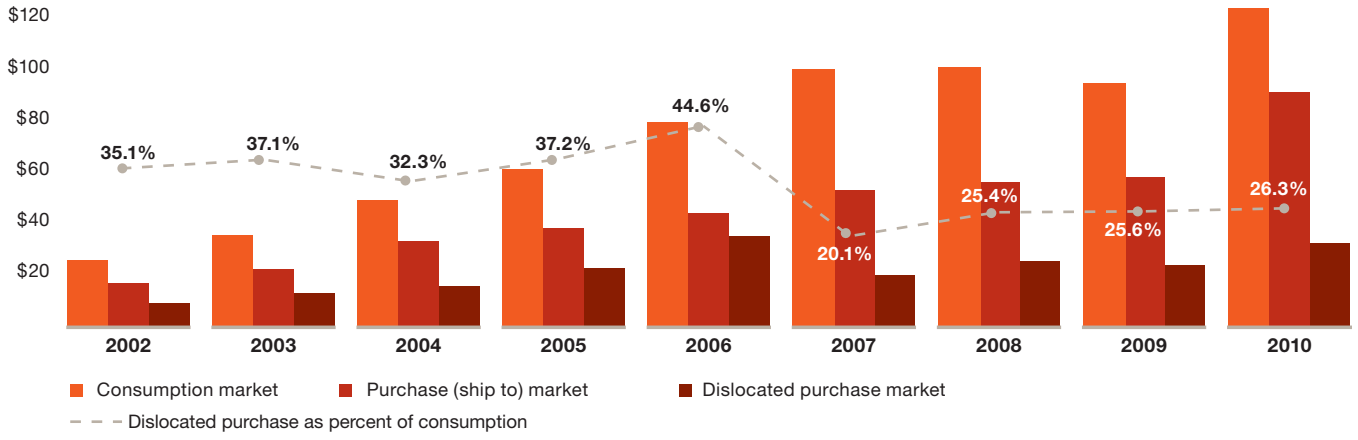
	(US$B)
PC Desktop – Professional	*4.1*
PC Mobile – Home	*3.3*
Digital Cellular Enhanced	*3.3*
PC Mobile – Professional	*3.3*
PC Desktop – Home	*3.0*
Digital Cellular Smart Phone	*2.6*
RS3 Flash Cards	*1.3*
TV LCD	*1.3*
Monitor Flat Panel	*1.2*
Digital Cellular Basic	*1.2*

Figure 7: Analysis of 2008–2010 semiconductor consumption versus purchasing TAM; China vs. worldwide by regions



Source: Consumption Market is based upon Gartner Dataquest Semiconductor Forecast Database. Purchase TAM is based upon Gartner Dataquest Market Share OEM, IDM, and EMS Semiconductor Demand Worldwide, 2010: Database

Figure 8: Analysis of China/Hong Kong consumption versus purchase (sales to) semiconductor market history
(in billions of US dollars)



Source: Consumption market is based upon Gartner Dataquest Semiconductor Forecast Database. Purchase (ship to) market is based upon Gartner Dataquest Market Share Database through 2006. From 2007 Purchase TAM is based upon Gartner Dataquest Market Share OEM, IDM, and EMS Semiconductor Demand Worldwide, 2010: Database

Revising prior calculations (back to 2007), we now find that dislocated purchases for China have increased from 20% in 2007 to 26% in 2010. Although lower than the prior findings, it still represents a significant portion of buying decisions—and therefore selling opportunities—for customer-specified devices consumed in China but made outside of China.

We expect that this dislocated purchasing share of the total China consumption market will begin to decrease gradually over a number of years as:

- China's domestic market consumption increases its share of China's total semiconductor market;
- ODM and EMS plants in China achieve greater control over their bills of materials (BOM);
- Multinational electronic equipment OEM (original equipment maker) and semiconductor companies offshore more design and purchasing activities to China;
- Chinese fabless semiconductor companies gain market share in the China market; and
- Leading multinational and regional distribution firms establish self-reliant purchasing and warehouse/logistic centers in China.

Chinese semiconductor companies

Chinese semiconductor companies with the largest revenues in 2010 are listed in Table 4. By definition, those on the list are the largest indigenous Chinese companies that design, manufacture (or "have manufactured", the legal term for outsourcing), market and sell semiconductor devices. Therefore, neither foundries nor packaging and testing companies are included on the list. These latter forms of companies, along with foreign semiconductor companies manufacturing in China, are included in Table 6.

Since 2007, the threshold for inclusion in this list has been maintained at US$30M. The number of companies qualifying in 2010 increased to 43 from 38 on the 2009 list. Thirty-four of the same companies qualified, although many changed their relative ranking in 2010. Three companies were dropped from the list due to declining revenues: Haier (Beijing) IC Design Co., Ltd., Availink and Huaya Microelectronics Company. Each reported a greater than 50% reduction in revenue during 2010.

One company, Ning KiangQuiang Electronics Co. Ltd., was determined to be a semiconductor materials rather than device company and also dropped from the 2010 list. Six new IC design, one integrated device manufacturer (IDM) and two discrete companies were added to the list: GalaxyCore Inc., Leadcore Technology Co., Ltd., Fuzhou Rockchip Electronics Co.,Ltd., Shenzhen Netcom Electronic Co.,Ltd., Hangzhou Silan Azure co., Ltd., Xi'an Microelectronics Technology Institute, Beijing Sigma Jinghua Microelectronics, Jinan Jingheng Co., Ltd. and Ingenic Semiconductor Co. Ltd.

Four of nine new companies are IC design companies that had been qualified for listing in 2009 but were overlooked: GalaxyCore, Leadcore, Rockchip and Ingenic. Only two of the five largest companies, HiSilicon Technologies and Wuxi China Resources Huajian Microelectronics, retained their number 1 and 5 rankings, while 10 companies improved their rankings, five others retained their rank and 17 fell in ranking. Together, these top 43 companies constitute 55% of China's IC design sector, 9% of China's IC chip manufacturing sector and 7% of China's discrete sector.

This group recorded superior performance for 2010. Overall, these 43 companies reported an average 41% increase in dollar revenues, which is better than the 37% increase reported for China's overall semiconductor industry—and notably better than the 32% increase reported for the worldwide semiconductor industry for 2010. Four of these Chinese companies saw revenues more than double in 2010: Shenzhen Netcom Electronic, Spreadtrum Communications, Tianjin ZhougHuan Semiconductor and Leadcore Technology. Revenues at an additional eight companies grew by less than 100% but more than 50% during 2010. This means that 28% of these 43 companies grew by more than 50% in 2010, compared to just 16% of the 280 worldwide semiconductor companies in the Gartner Dataquest worldwide semiconductor market share database.

Although still representing only a very modest portion of worldwide semiconductor revenues, these top Chinese semiconductor companies as a group have consistently increased their presence and significance in the industry over the past five years.

The largest absolute dollar revenue increases for 2010 were achieved by Spreadtrum Communications, Tianjin Zhonghuan Semiconductor, HiSilicon Technologies and RDA Microelectronics, with increases ranging from US$70M to US$260M. Three of the four companies with the greatest relative or absolute growth in 2010 revenue were IC design or fabless companies.

Table 4: Major Chinese semiconductor companies by revenue, 2010

Name of company	Rank		Sales revenue (RMB:100M)			Sales revenue (US$M)			
	2009	2010	2009	2010	Change	Sector	2009	2010	Change
HiSilicon Technologies Co., Ltd.	1	1	39.11	44.16	12.9%	DF	572	652	14.0%
Spreadtrum Communications Inc.	7	2	7.18	25.00	248.3%	DF	105	369	251.5%
TianjIn ZhongHuan Semiconductor Co., Ltd.	10	3	5.89	15.02	155.0%	DC	86	222	157.4%
RDA Microelectronics, Inc.	6	4	8.09	12.81	58.4%	DF	118	189	59.9%
Wuxi China Resouces Huajian Microelectronics Co., Ltd.	5	5	8.30	11.39	37.2%	I DC	121	168	38.5%
Jilin Sino Microelectronics Co., Ltd.	2	6	10.88	11.00	1.1%	DC	159	163	2.1%
Hangzhou Silan Microelectronics Co., Ltd.	11	7	5.88	10.03	70.5%	DF	86	123	42.9%
Shenzhen ZTE Microelectronics Technology Co., Ltd.	3	8	9.88	10.00	1.2%	DF	145	148	2.2%
GalaxyCore Inc.		9	4.25	8.40	97.6%	DF	62	124	99.4%
Suzhou Good-Ark Electronics Co., Ltd.	13	10	5.55	8.33	50.0%	DC	81	123	51.4%
No. 50 Research Institute of China Electronics Technology Group Corporation	4	11	8.34	8.11	-2.7%	I	122	120	-1.8%
BCD Semiconductor Manufacturing Ltd.	8	12	6.81	8.04	17.9%	I	100	119	19.0%
Leadcore Technology Co., Ltd.		13	3.89	7.90	103.1%	DF	57	117	105.0%
Nationz Technologies Inc.	17	14	4.66	7.02	50.7%	DF	68	104	52.1%
ShenZhen Si Semiconductor Co., Ltd.*	16	15	4.90	7.00	42.9%	DC	72	103	44.2%
Shanghai Huahong IC Co., Ltd.	23	16	6.52	6.87	5.3%	DF	95	101	6.2%
Beijing Vimicro Co., Ltd.	14	17	5.20	6.69	28.7%	DF	76	99	29.8%
Wuxi China Resources Semico Co., Ltd.	12	18	5.75	6.17	7.4%	DF		91	8.4%
Datang Microelectronics Technology Co., Ltd.	9	19	6.47	6.14	-5.2%	DF	95	91	-4.3%
Changzhou Galaxy Electrical Co., Ltd.*	20	20	4.26	6.09	43.0%	DC	62	90	44.3%
Shanghai Belling	15	21	5.13	5.86	14.4%	I F	75	87	15.5%
Fuzhou Rockchip Electronics Co., Ltd.		22	5.19	5.55	6.9%	DF	76	82	7.9%
Shanghai Fudan Microelectronics Co., Ltd.	27	23	3.22	5.11	58.7%	DF	47	75	60.1%
NingBo Hualong Electronics Co., Ltd.	25	24	3.23	5.03	55.9%	DC	47	74	57.3%
CEC Huada Electronics Design Co., Ltd. (HED)	18	25	4.63	5.01	8.2%	DF	68	74	9.2%
Shantou Huashan Electronic Device Co., Ltd.	24	26	3.28	4.83	47.3%	DC	48	71	48.7%
Shenzhen Netcom Electronic Co., Ltd.		27	0.96	4.66	386.2%	DF	14	69	390.7%

PT Packaging & Testing D IC Design DF IC Design (Fabless) F Foundry DC Discrete I IDM

Name of company	Rank 2009	Rank 2010	Sales revenue (RMB:100M) 2009	Sales revenue (RMB:100M) 2010	Change	Sector	Sales revenue (US$M) 2009	Sales revenue (US$M) 2010	Change
Fosham Blue Rocket Electronics Co., Ltd.	29	28	3.05	4.51	47.7%	Dc	45	67	49.1%
Shenzhen State Microelectronics Co. Ltd. ((SSMEC)	28	29	3.14	4.13	31.5%	DF	46	61	32.7%
Hangzhou Silan Azure Co., Ltd.		30	1.98	3.93	98.4%	Dc	29	58	100.2%
Xi'an Microelectronics Technology Institute		31		3.86		I		57	
Beijing Huadazhibao Electronic Systems Co., Ltd.*	30	32	2.76	3.72	34.9%	DF	40	55	36.2%
Tongfang Microelectronics Company	19	33	4.50	3.44	-23.5%	DF	66	51	-22.8%
Chendu Sino Microelectronics Systems Co., Ltd.	31	34	2.60	3.32	27.8%	DF	38	49	28.9%
Forward Semiconductor Company*	34	35	2.32	3.31	42.7%	Dc	34	49	44.0%
Yangzhou JingLai Semiconductor (Group) Co., Ltd.*	36	36	2.26	3.23	42.9%	Dc	33	48	44.2%
China Electronics Technology Group Corporation No. 58 Institute	37	37	2.22	2.92	31.4%	Dc	32	43	32.6%
Hangzhou Youwang Electronics Co., Ltd.	35	38	2.28	2.85	24.8%	DF	33	42	26.0%
Beijing Huahong IC Design Co.,	38	39	2.05	2.64	28.8%	DF	30	39	30.0%
Actions Semiconductor Co., Ltd	32	40	2.52	2.45	-2.8%	DF	37	36	-1.9%
Beijing Sigma Jinghua Microelectronics		41	1.84	2.44	32.1%	DF	27	36	33.3%
Jinan Jingheng Co., Ltd.		42	1.72	2.34	36.0%	I Dc	25	35	37.3%
Ingenic Semiconductor Co., Ltd.		43	2.20	2.25	2.4%	DF	32	33	3.4%

** Note: 5 companies estimated based upon sectors' average 2010 growth including 3 previously estimated based upon 2009 growth*
Source: CCID, CSIA, GDQ, GSA, PwC 2009-2011

Tianjin ZhougHuan Semiconductor was the only integrated device manufacturer (IDM) among the four. It is even more distinct in that it is a long established O-S-D IDM rather than an IC IDM. It commenced business in 1969 and claims to be the largest discrete manufacturer in the world. Its main products are high voltage diodes, rectifier diodes and bridge rectifiers. The company sells its products in more than 22 countries mainly in Asia, Europe and America. It also claims to be the largest manufacturer of high voltage diodes in the world with a greater than 50% market share in China and 43% abroad. After suffering a 34% decrease in revenues in 2009 due to the economic recession, the company recovered with more than a 150% increase in 2010. The company typifies China's growing presence and dominance in the commodity discrete semiconductor industry sector—a dynamic that has yet to be widely recognized.

The combined revenue of the 43 companies on the list increased by more than 40% in 2010 to US$4.6B, representing 12% of China's semiconductor industry. These top 43 companies together constitute 55% of China's IC design sector, 9% of China's IDM/

foundry sector and 7% of China's discrete sector. Although still representing only a very modest portion of worldwide semiconductor revenues, these top Chinese semiconductor companies as a group have consistently increased their presence and significance in the industry over the past five years. In our 2006 Update report, the list of top Chinese semiconductor companies consisted of 29 companies with 2005 revenues of US$20M or more—and only 14 with revenues of US$30M or more. These 29 companies had an average 2005 revenue of US$47M and together accounted for only 0.6% of worldwide semiconductor industry revenues.

During the last five years, the period of China's 11th 5 Year Plan, the number of Chinese semiconductor companies with revenues of US$30M or greater tripled from 14 to 43.

Over the next five years, 20 more Chinese companies achieved revenues of US$30M or more and were added to the list, while seven companies were dropped from the list. Haier (Beijing) IC Design and Availink became disqualified after 2010 revenues decreased around 75% (following 2009 sales growth of nearly 600%).

The 43 companies on this year's list have average 2010 revenues of US$108M and together account for 1.6% of worldwide semiconductor revenues. During the last five years, the period of China's 11th 5 Year Plan, the number of Chinese semiconductor companies with revenues of US$30M or greater tripled from 14 to 43. Their average revenue, meanwhile, more than doubled from US$47M to US$108M—and the revenue of the largest company on the list increased by more than 320% from US$155M to US$650M.

Industry awareness of Chinese semiconductor companies is on the rise. By definition, all 43 of these largest Chinese semiconductor companies should be included in the semiconductor market share reports compiled by industry analysts. However, only 19 of these companies were included in the third-party research firm Gartner Dataquest's database entitled "Top Companies (ALL) Revenue from Shipments of Total Semiconductors—Worldwide (Millions of US$)". This database ranks 280 companies by their 2010 revenues. Six of the top 10 were included, with HiSilicon Technologies, China's highest revenue semiconductor company, ranked 82nd worldwide.

According to Gartner Dataquest, HiSilicon's ranking among worldwide semiconductor companies had improved from 156 in 2007 to 108 in 2008 and to 81 in 2009 before dropping back one position to 82 in 2010. About half of the largest Chinese semiconductor companies missing from the Gartner Dataquest database continue to be discrete companies—an indication of the industry's general lack of awareness of the significance of China's discrete semiconductor industry sector. The Gartner Dataquest database did include one additional Chinese semiconductor company with 2010 revenues less than US$30M, for a total of 20 Chinese companies. This is one more than was included in their 2009, 2008 and 2007 databases. Their 2005 version, meanwhile, included only 15 Chinese companies.

Four of the new companies to the list for 2010 were added as a result of exceptional results. Two, GalaxyCore and Leadcore, emerged from product development to a degree of market presence that was not fully recognized in 2009. All four, including Shenzhen Netcom and Hangzhou Silan Azure, grew by 100% or more in 2010. They include:

GalaxyCore, Inc., an IC design company, focuses on developing and marketing CMOS image sensor applications in China and internationally. The company offers VGA, SXGA, SVGA and UXGA resolution levels chips. It also provides a single-chip camera and image processor in a footprint package, including de-noise, auto-gain, auto-exposure and frame control that is programmed through a single two-wire serial interface. GalaxyCore was founded in September 2003 by Silicon Valley experts with a good understanding of technologies and market potential. Its operations are strategically located in Pudong, Shanghai close to China's huge domestic market and supply chain partners (foundries, packaging & testing houses). GalaxyCore has paid attention to building its own IP technologies, already has several CMOS image sensor patents granted in the USA and has established long-term cooperative, close relationships with advanced semiconductor foundries in China. GalaxyCore cites as a core competence its ability to provide high quality, cost-effective and fast-time-to-market CMOS image sensor solutions worldwide.

Leadcore Technology Co.,Ltd (Leadcore Tech) is an IC design company that was registered in March 2008 as one of the core members of Datang Telecom Technology and Industry Group. As a TD-SCDMA fundamental technology provider, Leadcore Tech has been dedicated to providing terminal manufacturers and design houses leading TD-SCDMA mobile phone terminal solutions and chipsets. Leadcore Technology Co., Ltd. has licensed a suite of ARM IP, including the ARM® Cortex™-A9 MPCore Processor, the ARM Mali™-400 MP Graphics Processing Unit (GPU) and the ARM Cortex-A9 Performance Optimization Pack™ for the TSMC 40LP process technology. Leadcore integrates the ARM CPU- and GPU-based applications processor with its own baseband chip to target high-end smartphones based on China's 3G standard, TD-SCDMA. Their terminal solutions have been adopted by key terminal developers. China Mobile received China's first license for the TD-SCDMA standard in January 2009 and reportedly two-thirds of the TD-SCDMA phones specified in the China Mobile order were based on a baseband processor designed by Leadcore.

Shenzhen Netcom Electronics Co., Ltd. (Netcom) is an IC design company founded in 1998 with a Hong Kong subsidiary set up in 1999. Netcom has been dedicated to the design and manufacture of high-quality, cost-effective mobile data storage products, concentrating on flash memory devices, their components and related applications. The company offers flash controller software, flash card package substrate, flash value-added applications and also systemic flash connected products. Netcom is also active in multimedia products. The company provides a mini-player, an SD/HD player, an internet player and a portable media player—all widely used in home and automotive electronics. Netcom is also a strong performer in the intelligent card and mobile payment application arenas. The company began providing intelligent cards and consulting services for mobile payment to China Union Pay in 2008. The company says its key goals include the integration of client needs and ideas into developing IC designs, wafer processing technologies and package testing.

Hangzhou Silan Azure Co., Ltd. is an affiliate company of Hangzhou Silan Microelectronics group. It is an optoelectronics semiconductor device company engaged in the design and manufacturer of high brightness LEDs. Founded in December 2004, it has grown to become one the largest LED manufacturers in China. The company concentrates on the research and development of the metal organic chemical vapor deposition (MOCVD) process and is committed to developing new products with its own intellectual property. Its products have been widely used in LED displays and traffic lights and the company claims to enjoy a leading market share.

Domestic OEM buying power

Since 2005, the top 10 Chinese OEMs have achieved an average CAGR of 16% per year.

Since 2005, the top 10 Chinese OEMs have achieved an average CAGR of 16% per year. These top companies, taken from China's Ministry of Industry and Information Technology (MIIT) report, Top 100 Chinese Electronic Information Enterprises in 2010, are listed in Table 5. Each had 2010 revenues of US$7B or more. These 10 largest Chinese OEMs saw a 31% increase in their combined revenues during 2010, following a 16% increase in 2009, to reach a record total of US$134B. Their combined revenue increase was somewhat better than that of China's electronic and information industry, which rose 25% measured in US dollars (or 24% reported in RMB) during 2010. Assuming the semiconductor content of their products was 26.8% (the average for all of China's electronic systems production in 2010), these 10 Chinese OEMs could have been responsible for semiconductor consumption of US$36B—or 27% of China's total semiconductor market.

Two other Chinese OEMs with 2010 revenues greater than US$7B, Midea and Gree, had been included in PwC's prior listings. But these are no longer included in the MIIT report because they are now classified as appliance enterprises with only modest semiconductor consumption in 2010.

Semiconductor consumption of these top OEMs is usually referred to as "Brand TAM" (total available market). This means the total semiconductor devices consumed in all the products branded with any of the OEM's brands or names even though some of those products were designed and/or manufactured by other electronic manufacturing services (EMS) or original design manufacturers (ODM). For example the motherboards of Lenovo PCs are usually made by ODM's such as Quanta, rather than by Lenovo itself. Since 2009 this report has estimated the semiconductor consumption by OEMs based upon design (semiconductor selection by OEM engineers) which is identified as "Design TAM". We feel this provides a more meaningful insight relative to the market influence of the various Chinese OEMs.

Design TAM semiconductor consumption of these top 10 OEMs was reported to be US$14.2B—an increase of almost 49% from 2009. But this is only 11% of China's total semiconductor market, up from slightly more than 9% in 2009. The calculated Design TAM semiconductor content of the combined revenues of these top 10 OEMs increased from 9.3% in 2009 to 10.6% in 2010. Some of this growth is believed to be a reflection of the increase in worldwide IC ASPs (average selling prices) realized during 2010, especially the significant increase in memory device ASPs.

Another means of measuring the influence of these OEMs on semiconductor consumption is based upon their direct purchases, or "Purchasing TAM". Purchasing TAM semiconductor consumption among these 10 firms was reported to be US$12.9B, a 47% increase from their 2009 reported Purchasing TAM. These values are less than their Design TAM because some of

the OEMs (for example Lenovo) will design a product specifying specific key components and then consign manufacturing and purchasing to an EMS company.

Eighteen Greater China OEM/ODM companies rank within the top 100 semiconductor-consuming companies based upon their 2010 Design TAM. Their aggregate consumption represented more than 13% of total worldwide semiconductor consumption in 2010. They include five Chinese companies: Lenovo (ranked 10th), Huawei (16th), ZTE (32nd), TCL (51st) and Heir (97th). Two Hong Kong companies also made the list, TPV and Wingtech, along with eleven Taiwanese companies, Acer, Hon Hai, ASUSTek, Compal, Pegatron, Quanta, HTC, BenQ, Wistron, Inventec and Gigabyte.

As a result of this analysis, we continue to believe that Chinese OEMs influence and/or purchase a significant and increasing number of semiconductor devices. They could be important customers for many of the international semiconductor companies intending to participate in China's economic stimulus projects and the continuing growth of the Chinese semiconductor market. As a result, the strategies of these OEMs could soon have a more pronounced effect on the design and sales operations of major international semiconductor companies.

Table 5: Chinese top OEMs by revenue and semiconductor consumption 2009–2010 ($B)

	Rank		Revenue			Semiconductor consumption (Design TAM)			Purchase TAM		
Name of company	**2009**	**2010**	**2009**	**2010**	**Change %**	**2009**	**2010**	**Change %**	**2009**	**2010**	**Change %**
Huawei	1	1	21.8	27.5	26.0%	2.3	3.4	49.0%	2.3	3.4	48.7%
Lenovo	3	2	16.6	21.6	30.1%	3.7	6.1	64.0%	2.8	4.6	67.4%
Haier	2	3	18.2	20.2	10.8%	0.3	0.4	41.2%	0.3	0.4	37.3%
Great Wall Technology	9	4	5.4	15.6	187.4%	0.1	0.2	25.6%	0.1	0.1	42.0%
ZTE	4	5	8.8	10.4	18.4%	1.5	2.1	41.0%	1.5	2.1	41.1%
Hisense	5	6	8.2	8.3	1.6%	0.3	0.3	-0.4%	0.3	0.3	-4.3%
Changhong	10	7	4.6	8.1	76.9%	0.2	0.2	9.3%	0.2	0.3	43.5%
Founder	7	8	6.4	7.8	22.3%	0.4	0.4	-6.1%	0.3	0.3	-9.7%
TCL	6	9	6.5	7.7	19.0%	0.6	0.8	52.3%	0.8	1.1	44.6%
BYD	8	10	5.8	6.9	20.1%	0.3	0.4	41.0%	0.3	0.3	3.0%
Total			**102.4**	**134.3**	**31.2%**	**9.5**	**14.2**	**48.7%**	**8.7**	**12.9**	**47.0%**
% Semi penetration						**9.3%**	**10.6%**				
Midea			6.9	11.1	60.7%						
Gree			6.2	9.0	45.8%						
Skyworth			2.9	3.1	6.2%	0.3	0.2			0.3	
Konka Group			1.9	2.5	31.1%	0.2	0.2			0.2	

Source: MIIT, Thomson Reuters, Gartner Dataquest 2009–2011

Keeping pace by growing to record levels

The semiconductor industry in China

An increasing number of foreign companies are establishing LED fabs in China. Forty-six percent of the new LED fabs established in China during the last two years were sponsored by foreign companies. Most new LED fabs receive financial support or subsidies from local governments.

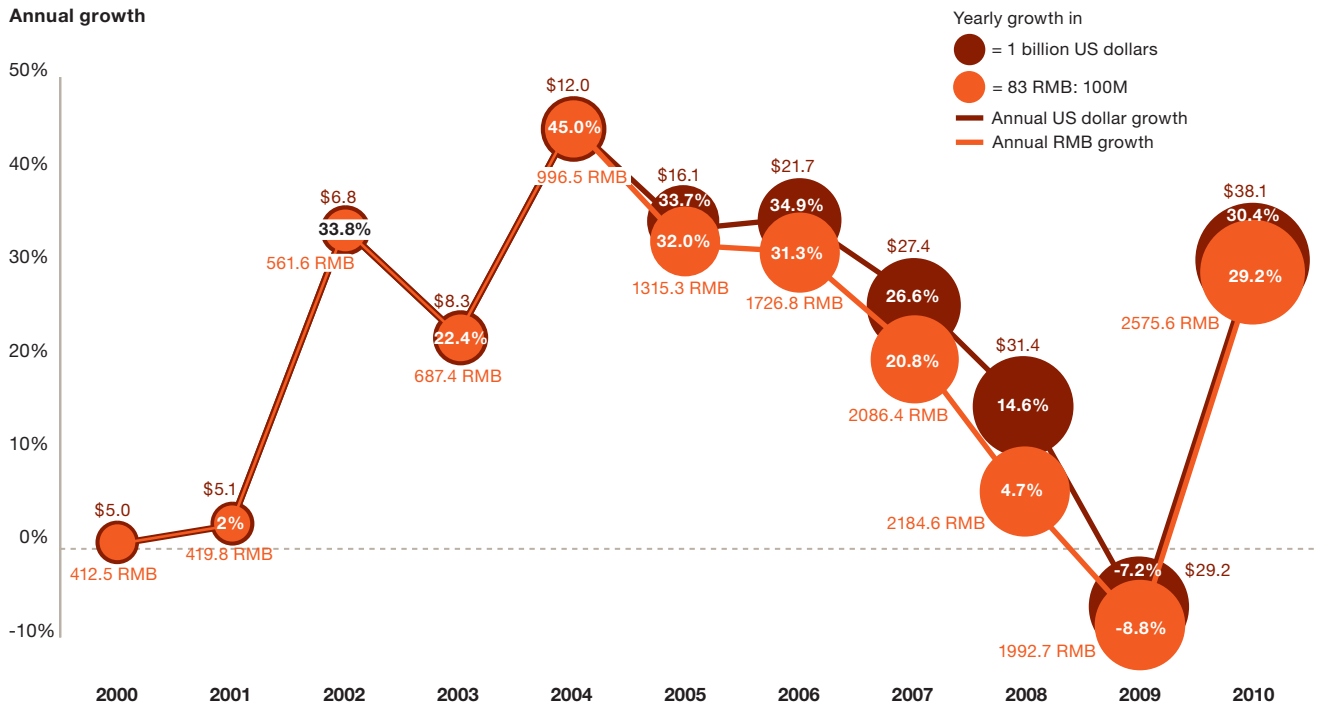
Production growth

China's semiconductor industry in 2010 also kept pace with the worldwide semiconductor market recovery. Both grew to record levels in 2010, with China's semiconductor industry growing by 30.4%, just slightly below overall industry growth of 31.8%. However, measured over a two-year period, from 2008 to 2010, China's semiconductor industry achieved an overall growth of 21.1% (reported in US dollars) which exceeds the worldwide market growth of 20.0%. But this performance is driven by currency exchange rate changes as when measured in RMB, the increase for China is only 17.9%, compared to the worldwide market growth of 20.0%.

The CSIA reports that the fixed-asset investments in China's semiconductor industry increased by 44% in 2010 to US$9.1B. According to CSIA reports, total fixed-asset investments in China's semiconductor industry for the last five years from 2006 through 2010 were US$35.5B, with about US$30B for the IC industry sectors and the remainder, about US$6B, for the discrete sector.

As noted in our 2010 Update, China's semiconductor industry, formerly relatively uncoupled, is now being affected by global industry cycles. China's industry growth peaked in 2004 with a growth rate of 45%. Its growth rate then began slowing, with 2008 becoming the first year of single-digit growth and 2009 being

Figure 9: China's semiconductor industry revenues and growth, 2000–2010



Source: CCID, CSIA

It is clear that China's still-growing share of the worldwide semiconductor industry is now both noticeable and significant.

the first year with negative growth. With the recovery in 2010, however, China's semiconductor industry has achieved a nine-year CAGR of 25.1% measured in US dollars or 22.3% measured in local RMB currency.

Owing to potential overstatement or double counting, a comparison between China's reported semiconductor industry revenue and the sum of worldwide semiconductor device sales, plus foundry and semiconductor assembly and test services (SATS) revenue, may provide a more representative measurement of China's impact on the semiconductor industry. On this basis, China's semiconductor industry accounted for 10.8% of the worldwide semiconductor industry in 2010, slightly down from 11.0% in 2009, but up from 10.7% in 2008. This compares to a mere 2% in 2000.

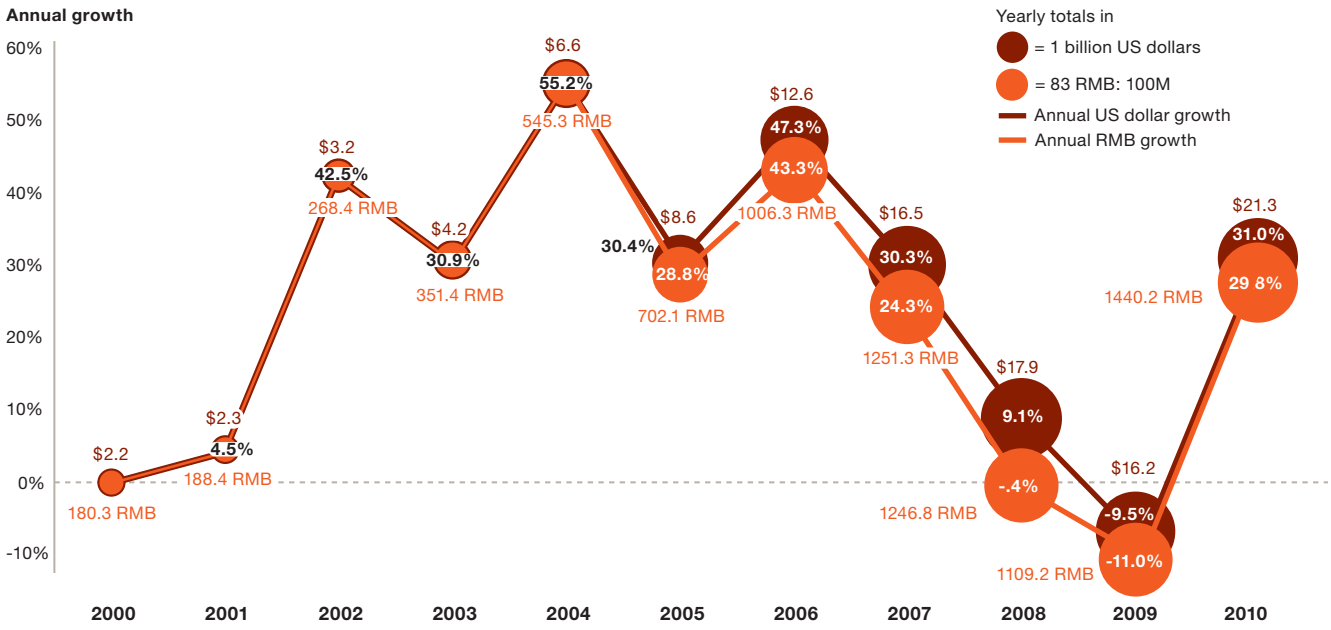
Though useful, this measurement is probably overstated. A more conservative comparison uses the sum of: device sales revenue, the value of all wafer fabrication and packaging and the assembly and test production. This measure indicates that China's semiconductor industry accounted for at least 7.9% of the worldwide semiconductor industry in 2010. Regardless of the metric employed, it is clear that China's still-growing share of the worldwide semiconductor industry is now both noticeable and significant.

The performance of China's IC industry in 2010, measured by the sum of IC design, IC wafer manufacturing and IC packaging and testing, generally corresponded to the recovery of the worldwide industry. China's IC industry revenues measured in dollars increased by 31.0% to slightly more than US$21B in 2010. These same industry revenues reported in local RMB currency increased by 29.8% to 1440 RMB:100M in 2010. This follows a decrease of 11.1% (to 1109 RMB:100M) in 2009 and a 0.4% decrease in 2008.

The three sectors of China's IC industry have been affected quite differently by the global recession. Thanks to a booming domestic demand driven by China's economic stimulus policies, the IC design sector grew against all odds in 2009, increasing by almost 17% to reach a record US$4B. Benefiting from the worldwide market recovery, China's IC design sector grew by a further 36% in 2010 when measured in US dollars (34.8% in local RMB currency) to a new record of US$5B.

IC manufacturing and IC packaging and testing, meanwhile, are both more export dependent and more closely involved with multinational corporations. As such, their performance had been much more adversely affected in 2009. IC manufacturing, which includes China's wafer foundries, was affected earlier in the cycle with reduced orders. This led to lower capacity utilization and year-over-year revenue declines for four consecutive quarters in 2008 and 2009. The result was an overall sector revenue decrease of nearly 12% in 2009. This was followed by

Figure 10: China's IC industry and growth, 2000–2010



Source: CCID, CSIA

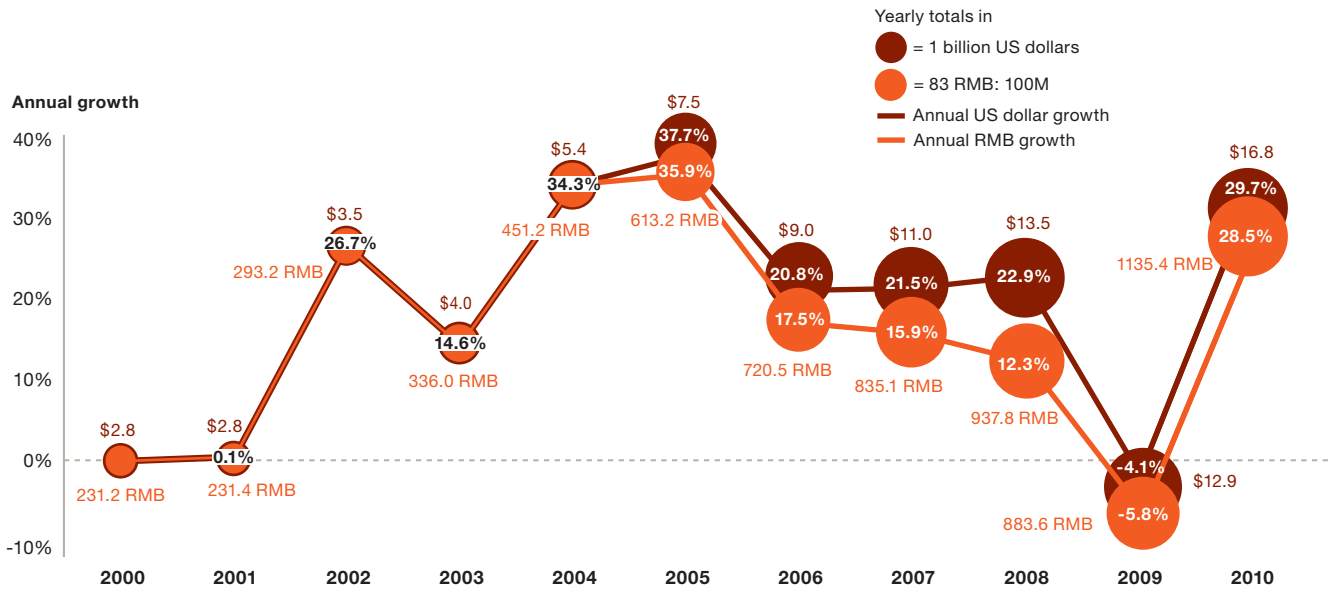
strong year-over-year growth for the first three quarters of 2010 and a flat fourth quarter, resulting in an overall sector increase of 32% in 2010.

IC packaging and testing, which includes both multinational semiconductor assembly and test services (SATS) and captive facilities, was affected later in the cycle but much more severely. With reduced or cancelled orders causing capacity underloads, the result was an 18% decline measured in US dollars (or almost 20% measured in RMB). This was followed by strong year-over-year recovery growth in the first two quarters of 2010, a decline in the third quarter and then moderate year-over-year growth in the fourth quarter. Overall, IC packaging and test revenues grew by 27.5% in 2010.

According to the China Semiconductor Industry Association (CSIA), China's IC industry unit production increased by 57% in 2010, while unit ASP decreased by 18%. Since China's IC industry unit output is heavily determined by IC packaging and testing output, this likely reflects changes in relative unit mix rather than individual unit prices. Based upon revenue values, China's IC industry achieved an overall self-sufficiency ratio (ratio of production versus consumption value) of around 20% in 2010. Based upon CSIA's reported unit volumes, however, China's IC industry unit self-sufficiency ratio for 2010 could be much greater.

China's O-S-D sector recovery performance in 2010 was a bit less than the worldwide recovery performance. China's O-S-D sector revenues increased slightly less than 30% measured in US dollars (or about 29% reported in RMB) in 2010, while the worldwide O-S-D industry grew by 37%. This moderately lower 2010 performance is the result of China's somewhat better than worldwide O-S-D performance in 2009. Over the

Figure 11: China's O-S-D industry revenue and growth, 2000–2010



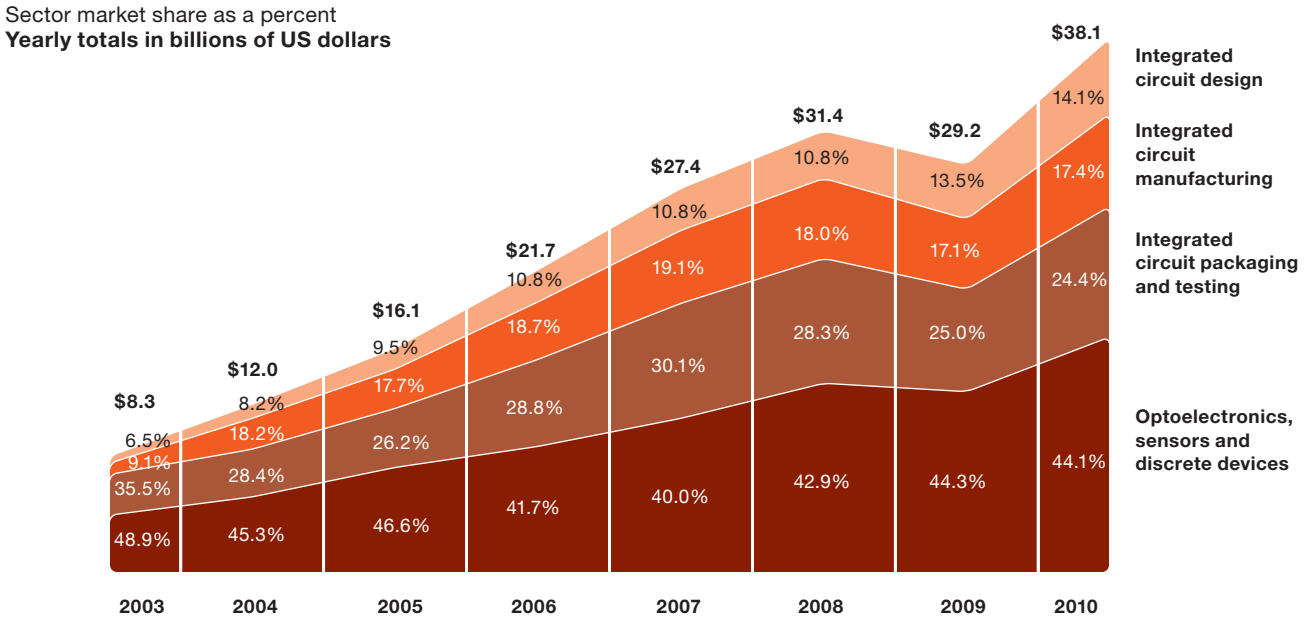
Source: CCID, CSIA

two-year span from 2008 to 2010, a period featuring both global recession and recovery, China's O-S-D industry achieved an overall growth of 24.3% reported in US dollars, slightly exceeding worldwide market growth of 23.0%. China's O-S-D production unit output increased by about 29% in 2010, while unit ASP remained relatively constant compared to 2009.

China's LED production revenue growth in 2010 exceeded that of the overall O-S-D industry growth by more than 33%. Moreover, during the two-year span from 2008 to 2010, China's LED production revenue grew by almost 58%, exceeding the overall O-S-D growth by almost one third. LED production revenues grew to more than US$4B in 2010, representing more than 26% of China's O-S-D sector. This growth rate is up from 25% in 2009 and up again relative to an average of about 21% during the prior four years. China's LED industry had been experiencing double-digit growth for several years prior to 2008, since the implementation of China's national semiconductor lighting project. That growth rate, reported in RMB, dropped to 9% in 2008 as a result of the global recession's impact on export production. Recovery followed in 2009, with growth reaching just over 16% in 2009 and 32% in 2010, largely with the help of government policies. During 2010, more than 83% of China's LED industry revenues came from packaging and testing and almost 17% from IDM and chip manufacturing.

China's LED industry has been growing with specific government policy support. China established 14 National LED Industry Bases as part of the "National Semiconductor Lighting Project" sponsored by China's Ministry of Science and Technology (MOST). These include Dalian, Hangzhou, Nanchang, Shanghai, Shenzhen, Tianjin, Wuhuan, Xiamen, Yangzhou and Shijiazhuan, where most of China's LED manufacturers are concentrated.

Figure 12: China's semiconductor industry by sector, 2003–2010



Source: CCID, CSIA, PwC 2004-2010

An increasing number of foreign companies are establishing LED fabs in China. Forty-six percent of the new LED fabs established in China during the last two years were sponsored by foreign companies. Most new LED fabs receive financial support or subsidies from local governments. As of July 2011, there were 69 LED wafer fabrication companies in China of which 49 were in full production, eight were equipping and ramping into production and twelve were under construction. Most of these have focused on GAN-based epitaxial wafer fabrication, though MOCVD equipment installations in China are accelerating. SEMI reports that more than 170 new MOCVD tools were installed in China in 2010 and that China will overtake Korea in the number of MOCVD installations in 2011. China is expected to represent 40% of the MOCVD tool market in 2011 and have over 1000 sets of MOCVD tools installed by the end of 2012.

Industry by sector

The distribution of China's semiconductor industry continued to change incrementally in 2010. This is driven by above-average growth of the IC design (fabless) and IC manufacturing sectors. (See Figure 12.) The IC design sector has been the fastest growing sector over the past nine years, with a dollar revenue CAGR of 46%. It has grown from less than US$200M in 2001 to more than US$5B in 2010. It had represented almost 11% of China's semiconductor industry for each of the three years from 2006 to 2008 before reaching 13.5% in 2009 and 14.1% in 2010. The sector's growth slowed from 54% in 2006 to 27% in 2007 and 14% in 2008 before increasing to almost 17% in 2009 and 36% in 2010.

IC manufacturing, which includes the IC wafer foundries, has been the second fastest growing and most variable sector over the past nine years. During

Although it continues to be the least celebrated or promoted and has been one of the slowest growing sectors of China's semiconductor industry, the O-S-D sector has remained the largest sector since at least 2001.

this time, this sector has experienced annual dollar revenue growth ranging from a 2004 peak of 190% down to an almost 12% decrease in 2009 before recovering with a more than 32% increase in 2010. The IC manufacturing sector dollar revenue has grown from less than US$400M in 2001 to US$6.6B in 2010, for a nine-year CAGR of almost 38%. This represents 17.4% of China's 2010 semiconductor industry revenue, up fractionally from 17.1% in 2009 and down from 18% in 2008 and 19% in 2007.

IC packaging and testing, which includes multinational and Chinese SATS as well as multinational captive facilities, remains the second largest sector of China's semiconductor industry. Over the past nine years its dollar revenue has grown at a 20.6% CAGR, from less than US$2B in 2001 to more than US$9B in 2010 . However those past nine years include the single largest annual decrease of any sector, a more than 18% drop in 2009. As a result, IC packaging and testing's share of China's semiconductor industry revenue declined to 24.4% in 2010, down from 25% in 2009, 28% in 2008 and 30% in 2007.

Although it continues to be the least celebrated or promoted and has been one of the slowest growing sectors of China's semiconductor industry, the O-S-D sector has remained the largest sector since at least 2001. During this nine-year period, the O-S-D sector grew from US$2.8B in 2001 to almost US$17B in 2010 for a CAGR of just over 22%. Measured in dollars, the O-S-D sector achieved a relatively strong—but still less than China's overall industry average—29.7% growth rate in 2010. As a result, the O-S-D sector lost a fractional percentage of industry share in 2010, but at more than 44%, still remains the largest sector of China's semiconductor industry.

The top Chinese semiconductor manufacturers

The 50 largest semiconductor manufacturers in China—those reporting 2010 revenues of US$89M or more—are detailed in Table 6. This revenue threshold is up from the US$57M and the US$72M thresholds used in our 2008 and 2009 reports, respectively. It is the highest revenue threshold to-date and reflects the growing number and size of Chinese semiconductor manufacturers.

This table includes seven groups that each own one or more companies in the various sectors of China's semiconductor industry. These groups are included in place of listing their several individual companies in order to better reflect their increasing significance in the growth and concentration of China's semiconductor industry. This approach also corresponds to the CSIA's current reporting practice, which reports group totals (by industry sector) in response to requests by the groups.

In addition to these seven groups, Table 6 also lists a single entry for each of several multinational semiconductor companies that have more than one manufacturing facility in China—even though each facility may be legally organized as a separate company in China. These companies include ASE, Diodes, Freescale, GEM Electronics, Hynex, Intel, Renesas, RFMD and ST Microelectronics. Each listing reflects the combined revenues of all the companies' manufacturing facilities in China.

The combined 2010 revenues reported for these top 50 enterprises is US$20.8B, representing 55% of China's total 2010 semiconductor industry revenue of US$38B. China's

industry remains significantly less concentrated than the worldwide industry in which the top 50 companies represent 82% and the top 13 companies 55% of the total market. The combined reported RMB revenues of these top 50 manufacturers increased more than 37% in 2010, while their dollar revenues increased by more than 39%. This, in both cases, was significantly more (8-9%) than the increase reported by China's total semiconductor industry.

There are three companies that were new and one company that returned to the top 50 Chinese semiconductor manufacturers list for 2010. Listed by 2010 rankings, these include:

- **[33] Shenzhen National Holdings Co., Ltd** is a new group consisting of two design companies. This includes Shenzhen State Microelectronics (SSMEC) which had been added to the 2009 update

Seven groups with their most significant semiconductor companies

	Revenue (US$M)			
	2007	2008	2009	2010
China Resources Microelectronics (Holdings) Ltd.	613	654	540	669
Wuxi China Resources Microelectronics Co., Ltd. (CR Micro) (former CSMC)—Foundry	143	154	144	179
Wuxi China Resources Huajing Microelectronics Co., Ltd.—Discrete	110	134	121	168
Wuxi China Resources Semico Microelectronics Co., Ltd.—IC Design	112	90	84	91
XINCHAO Group	497	574	618	944
JECT (Jinangsu Changjiang Electronics Technology Co., Ltd.)—Pkg & Test	304	342	347	531
Natong Huada Microelectronics Group Co., ltd.		383	398	618
Natong Fujitsu Microelectronics—Pkg & Test	181	254		
Shanghai Huahong (Group) Co., Ltd.	461	431	411	555
HHNEC (Shanghai Huahong NEC Electronics Co., Ltd.)—Foundry	319	279	240	367
Shanghai Huahong IC Co., Ltd.—IC Design	90	88	95	96
China Huada Integrated Circuits Design (Group) Co., Ltd. (CIDC Group)	192	208	211	215
CEC Huada Electronics Design Co., Ltd.—IC Design	74	84	68	74
Beijing Huada Zhaibao Electronic Systems Co., Ltd.—IC Design	23	32	40	
Nationz Technologies Inc.	20	31	68	104
Shenzhen National Holdings Co., Ltd.			163	
Shenzhen State Microelectronics—IC Design	27	27	46	61
Shenzhen Sunmoon Microelectronics—IC design				
Shenzhen State Micro Technology—OEM				
Hangzhou Silan Microelectronics Co., Ltd.	128	134	140	148
Hangzhou Silan Microelectronics Co., Ltd.—Design	108	76	86	96
Hangzhou Silan Integrated Circuit Co., Ltd.—IDM / Foundry	43	56	59	96
Hangzhou Silan Azure Co., Ltd—LED	26	29	58	

Table 6: Major Chinese semiconductor manufacturers (including groups) in 2010

Name of company	Rank 2009	Rank 2010	Sales revenue (RMB: 100M) 2009	2010	Change	Sector	Sales revenue (US$M) 2009	2010	Change
Intel Products (Shanghai & Chengdu) Co., Ltd.	1	1	122.96	186.13	51.4%	PT	1,800	2,750	52.8%
Hynix—Numonyx Semiconductor	2	2	106.39	137.86	29.6%	I	1,557	2,037	30.8%
SMIC (Semiconductor Manufacturing International Corp.)	3	3	73.09	104.60	43.1%	F	1,070	1,545	44.4%
Freescale Semiconductor (China) & (Suzhou) Co., Ltd.	4	4	65.98	85.29	29.3%	PT D	966	1,260	30.5%
RFMD (RF Micro Devices) (Beijing) Co., Ltd.	5	5	52.85	64.37	21.8%	PT	774	951	22.9%
XINCHAO Group	6	6	42.24	63.89	51.2%	PT	618	944	52.6%
China Resources Microelectronics (Holdings) Ltd.	8	7	36.86	45.30	22.9%	I Dc D	540	669	24.0%
HiSilicon Technologies Co., Ltd.	7	8	39.11	44.16	12.9%	DF	572	652	14.0%
Natong Huada Microelectronics Group Co., Ltd.	13	9	27.20	41.81	53.7%	PT	398	618	55.1%
Renesas Semiconductor (Beijing & Suzhou) Co., Ltd.	9	10	32.89	39.83	21.1%	PT D	482	588	22.2%
Shanghai Panasonic Semiconductor Co., Ltd.	10	11	29.53	39.43	33.5%	PT	432	583	34.8%
Shanghai Huahong (Group) Company Ltd.	11	12	28.06	37.56	33.9%	D F	411	555	35.1%
ST Microelectronics	12	13	27.91	32.15	15.2%	PT	409	475	16.2%
ASE Assembly & Test (Shanghai) Ltd.	16	14	19.92	29.70	49.1%	PT	292	439	50.5%
Spreadtrum Communications Inc.	34	15	7.18	25.00	248.3%	DF	105	369	251.5%
Leshan Radio Co., Ltd. (incl ON Semiconductor JV)	14	16	21.63	24.19	11.8%	Dc	317	357	12.9%
Infineon Technologies (Wuxi) Co., Ltd.	17	17	18.58	22.20	19.5%	PT	272	328	20.6%
Samsung Electronics (Suzhou) Semiconductor Co., Ltd.	15	18	20.80	21.86	5.1%	PT	305	323	6.1%
Diodes Shanghai Co., Ltd.	40	19	15.71	20.98	33.5%	PT	230	310	34.8%
STATS ChipPAC	18	20	16.84	20.63	22.5%	PT	246	305	23.7%
TSMC (Shanghai) Co., Ltd.	29	21	8.69	17.80	104.8%	F	127	263	106.7%
Chipmore Technology Corporation Ltd.	20	22	12.67	16.02	26.4%	PT	185	237	27.6%
Shanghai Grace Semiconductor Manufacturing Co., Ltd	23	23	10.98	15.46	40.8%	F	161	228	42.1%
Hangzhou Silan Microelectronics Co., Ltd.	26	24	9.58	15.16	58.3%	D D F	140	224	59.7%
HeJian Technology (Suzhou) Co., Ltd.	22	25	12.20	15.06	23.4%	F	179	223	24.6%

PT Packaging & Testing D IC Design DF IC Design (Fabless) F Foundry Dc Discrete I IDM

Name of company	Rank 2009	Rank 2010	Sales revenue (RMB: 100M) 2009	2010	Change	Sector	Sales revenue (US$M) 2009	2010	Change
Tianjin ZhongHuan Semiconductor Co., Ltd.	41	26	5.89	15.02	155.0%	D C	86	222	157.3%
Amkor Technology China Ltd.	28	27	9.54	14.84	55.6%	P T	140	219	57.0%
SanDisk Semiconductor (Shanghai) Co., Ltd.	21	28	12.47	14.82	18.8%	P T	183	219	19.9%
Tianshui Huatian Microelectronics Co., Ltd.	27	29	9.60	14.60	52.1%	P T	140	216	53.5%
China Huada Integrated Circuits Design (Group) Co., Ltd.	19	30	14.41	14.58	1.2%	D F	211	215	2.1%
RDA Microelectronics, Inc.	32	31	8.09	12.81	58.4%	D F	118	189	59.9%
Shougang NEC Electronics	33	32	7.34	12.10	64.8%	F	108	179	66.3%
Jilin Sino Microelectronics Co., Ltd.	24	33	10.88	11.00	1.1%	D C	159	163	2.1%
Shenzhen National Holdings Co., Ltd.		34		11.00		D		163	
Shenzhen ZTE Microelectronics Technology Co., Ltd.	25	35	9.88	10.00	1.2%	D F	145	148	2.2%
ASMC (Advanced Semiconductor Manufacturing Co., Ltd.)	39	36	6.42	9.56	48.9%	F	94	141	50.3%
UTAC Dongguan Ltd.	30	37	8.54	9.21	7.8%	P T	125	136	8.8%
Fairchild Semiconductor (Suzhou) Co., Ltd.	35	38	7.12	8.88	24.7%	P T	104	131	25.8%
Siliconware Technology (Suzhou) Co., Ltd.	36	39	6.87	8.70	26.6%	P T	101	129	27.8%
GalaxyCore Inc.		40	4.25	8.40	97.6%	D	62	124	99.5%
Suzhou Good-Ark Electronics Co., Ltd.	58	41	NA	8.33		D C		123	
No. 50 Research Institute of China Electronics Technology Group Corporation	31	42	8.34	8.11	-2.7%	I	122	120	-1.8%
BCD Semiconductor Manufacturing Ltd.	37	43	6.81	8.04	18.0%	I	100	119	19.1%
EEMS (Suzhou) Co., Ltd	55	44		7.95		P T		117	
Leadcore Technology Co., Ltd.		45	3.89	7.90	103.1%	D	57	117	105.0%
GEM Electronics (Shanghai) Co., Ltd.	45	46	4.44	7.65	72.3%	P T	65	113	73.9%
Nationz Technologies Inc.	43	47	4.66	7.02	50.7%	D F	68	104	52.1%
Beijing Vimicro Co., Ltd.	42	48	5.20	6.69	28.7%	D F	76	99	29.8%
Datang Microelectronics Technology Co., Ltd.	38	49	6.47	6.14	-5.2%	D F	95	91	-4.3%
China Wafer Level CSP Ltd. (Suzhou)	46	50	4.30	6.05	40.7%	P T	63	89	42.0%

Source: CCID, CSIA, GDQ, PwC 2009–2011

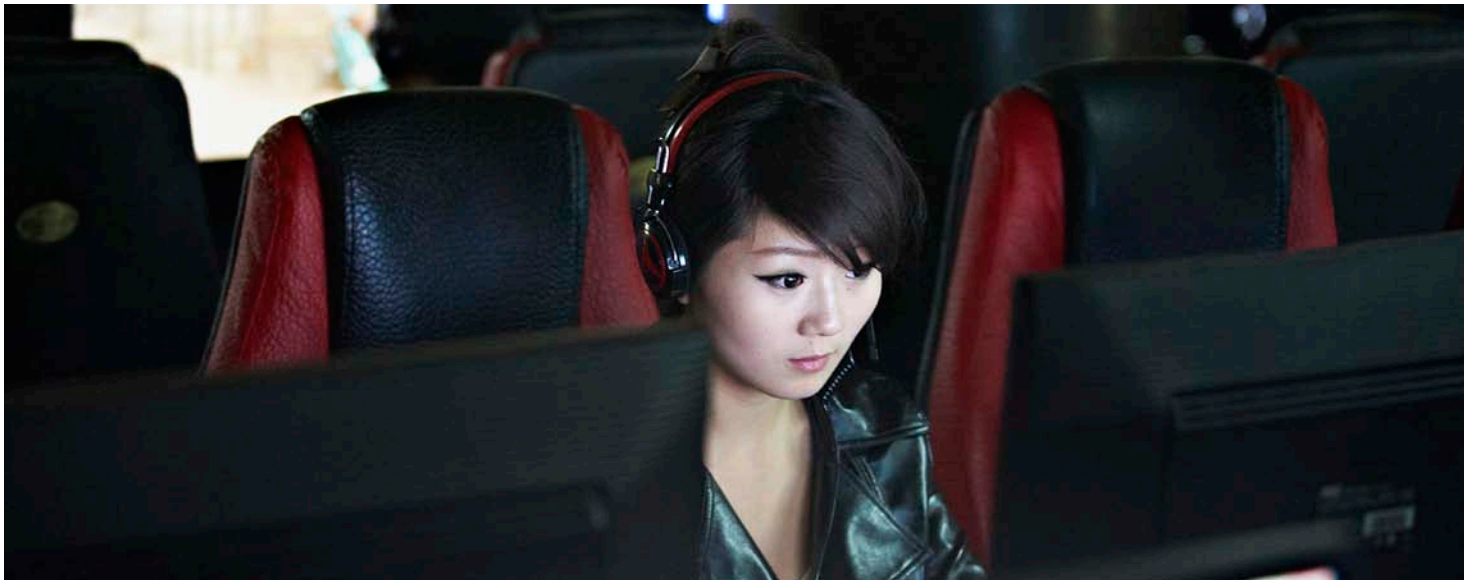
Six of China's top 50 semiconductor manufacturers each reported revenue growth of more than US$250M in 2010.

listing of top Chinese semiconductor companies as a result of their noteworthy 67% revenue increase in 2009. SSMEC, which is engaged in the development of digital audio and video IC, embedded CPU and DSP chips and ASSP devices for government electronics, further increased its revenues by 33% in 2010.

- **[40] Galxycore Inc.** is an exclusively foreign-funded enterprise founded at the end of 2003 by several engineers returning to China from Silicon Valley. This group is mainly involved in the design, development and sale of CMOS image sensors and reported a 100% increase in dollar revenues for 2010 to qualify.
- **[41] Suzhou Good-Ark Electronics** is a discrete device manufacturer which had been dropped from the 2008 listing due to a less-than-qualifying increase in revenues. It has since reported a 72% two-year increase in dollar revenues to re-qualify.
- **[45] Leadcore Technology** is one of the core members of the Datang Telecom Technology and Industry Group that has been dedicated to providing TD-SCDMA mobile phone terminal solutions and chipsets to terminal manufacturers and design houses. Leadcore Tech emerged as one of China's a new leading semiconductor companies, with a 105% increase in 2010 dollar revenues to qualify.

Correspondingly, four companies fell from the rankings. Listed by 2009 rankings, they include:

- **[44] Tongfang Microelectronics Co. (TMC)** is an IC design enterprise that focuses on chips used in smartcards and other systems. They are one of the main providers of the Chinese second generation national ID card chip. However, the company reported a 23% decline in dollar revenues for 2010 and thus failed to meet the qualifying threshold.
- **[47] Changzhou Galaxy Electrical Co.** is a discrete device enterprise which, although reporting a 40% increase in 2010 revenues, just missed the qualifying threshold for the 2010 list.
- **[48] Haier (Beijing) IC Design** had emerged as one of China's new leading semiconductor companies



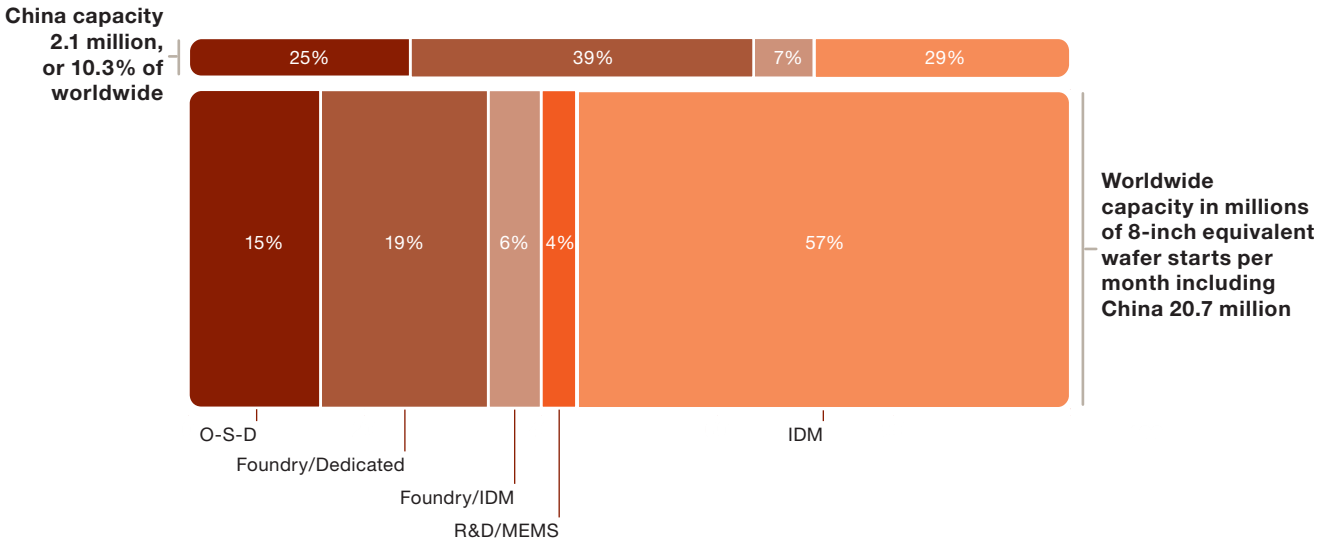
with a 587% increase in dollar revenues in 2009. However, reporting a 70% decline in 2010 revenues, the group failed to meet the qualifying threshold.

- **[49] Availink** had also emerged as another of China's new leading semiconductor companies with a 580% increase in dollar revenues in 2009. But the group missed the threshold after reporting a 74% decline in 2010 revenues.

Measured in dollars, China's semiconductor industry reported revenues increasing by 30.4% or US$8.9B during 2010. China's top 50 manufacturers accounted for almost two thirds of that increase. Six of China's top 50 semiconductor manufacturers each reported revenue growth of more than US$250M in 2010. These include Intel, Hynix, SMIC, Freescale, Xinchao Group and Spreadtrum. Another 10 manufacturers reported 2010 revenue increases of between US$100 and US$250M and a further 13 manufacturers between US$50 and US$100M. Similarly, four of China's top 50 semiconductor manufacturers each reported revenue growth of more than 100% in 2010: Spreadtrum, TianJin ZhougHuan, TSMC and Leadcore. An additional 11 manufacturers reported 2010 revenue growth of between 50% and 100%, with eight more landing between the industry average of 30.4% and 50%. In total, 23 of China's top 50 semiconductor manufacturers reported 2010 revenue growth above industry average—with only two reporting revenue decreases.

Both of the top two Chinese semiconductor manufacturers completed evolutionary extensions to become truly vertically integrated IC manufacturers within China during 2010. Intel, which established its first packaging and testing facility in China in 1996, has since grown steadily to, by 2009, become China's largest semiconductor manufacturer (based on die-included packaging and testing revenue). Prior to 2010, all of the chipset and microprocessor wafers used by Intel's packaging and assembly operations in China were imported from Intel facilities in other countries. That changed in October 2010 once Intel began IC chipset wafer production at its new 300mm Fab 68 in Dalian, China.

Figure 13: Current wafer fab capacity comparison, China and worldwide
(wfw probability ≥ 1.0)



Source: SEMI Wafer Fab Watch May 2011

Hynix established its first 200mm Hynix-Numonyx wafer fabrication facility in China in 2005. It since grew rapidly to become China's largest semiconductor manufacturer (as of 2008) and now operates China's largest and most advanced 300mm wafer fabrication facility. Although many of Hynix's finished IC devices are consumed in China, all of its wafer output had been exported from China to be packaged and tested at Hynix facilities in Korea. That changed in 2010 when Hynix completed a joint venture IC packaging and testing facility, Hitech Semiconductor, in Wuxi, China and began production in July 2010.

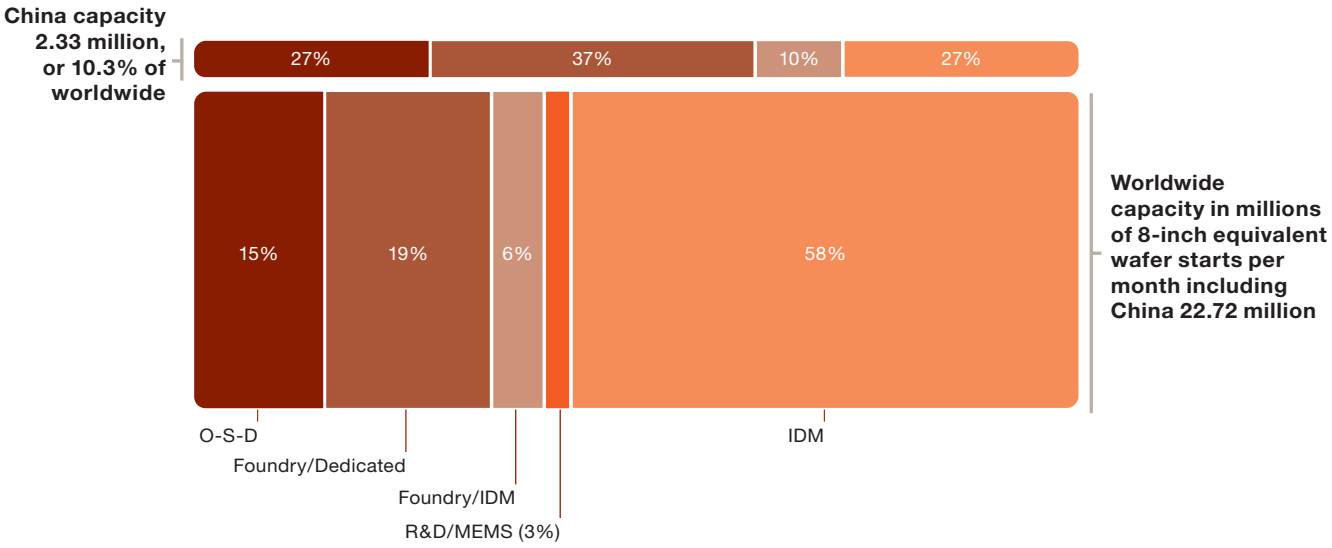
Completion of these extension programs has provided China with two large vertically integrated advanced technology IC IDM operations. Since Intel and Hynix are among the top five suppliers to China's semiconductor consumption market, a noticeable portion thereof will soon be able to be satisfied by IC devices manufactured completely within China. Although not indigenous Chinese companies, the success of these two vertically integrated IC IDM operations in China has the potential to impact the semiconductor industry owing to size, revenue, prominence, technology and manufacturing prowess.

During 2010 a third top five supplier to China's semiconductor market established an IC wafer fabrication capability in China when Texas Instruments acquired Cension Semiconductor Manufacturing Company, from SMIC in October. Located in Chengdu, China, this is a large and relatively new 200mm facility with significant expansion capabilities for larger wafer size, advanced technologies and vertical integration.

Wafer fab capacity

During the past year, China resumed increasing wafer fab capacity faster than the worldwide average. Prior to 2009, China had been increasing wafer fab capacity faster than other

Figure 14: China compared with worldwide current and committed wafer capacity
(wfw probability ≥ 0.8)



Source: SEMI Wafer Fab Watch May 2011

regions every year during the decade. That trend was, however, upended in 2009, when China added only a single net new fab—and failed to add to its net capacity—whereas worldwide capacity increased by 3.3%. During the past year, China increased the net number of fabs in production by 21, or 17%, while increasing its net capacity by 19%. By comparison, the industry increased the net number of fabs in production worldwide by 20, or 2%, for an 11% increase in net capacity.

Moreover, based upon their current capabilities (rather than intentions, i.e., World Fab Watch, WFW, Probability ≥1.0), China will now be able to increase its share of total worldwide semiconductor wafer production. China can now move from the ≤ 2% realized in 2003 to ≥ 10.3% by 2013—simply by fully equipping and ramping to full capacity at mature yields all of their existing wafer fabrication modules. This would more than quintuple the nation's share of worldwide wafer production compared to 2003. It further represents an increase in China's relative capacity during the past year from 9.6% to 10.3% of worldwide capacity.

For the third consecutive year, a number of pre-existing wafer fabs were added to the WFW database. Ten more were added in 2010, joining the 26 added in 2009 and 13 more in 2008. Once again the vast majority, 9 out of 10, were discrete wafer fabs. These continuing additions represent a growing recognition of the significance and impact of China's local O-S-D sector. As a result of the 2010 additions, China's 2009 current wafer fab capacity was revised to 1,783.8K Wafer Starts per Month (a 2% correction), now representing 9.6% of worldwide capacity.

Currently China has 22 additional wafer fabs that are committed and under construction. That is a bit over 40% of the total of 51 committed fabs under construction worldwide, but represents slightly less than 10% of capacity. China is deriving less

capacity per new wafer fab plant because of a greater proportion of 4" (100mm) or smaller O-S-D fabs than other regions and a lower proportion of 12" (300mm) plants . Eighteen of the 21 fabs that went into production last year and 19 of the 22 fabs that are committed and under construction are all LED wafer fabs with most focusing on 2" (50mm) wafer fabs.

During the past five years, the number of wafer fabrication modules committed and under construction in China has varied widely. It decreased from 20 in 2006 to 8 in 2008 before reaching 12 in 2009 and 22 in 2010. The 22 modules currently under construction have the potential to increase China's wafer fabrication capacity by just 9.5%, somewhat less than the 9.9% increase in potential worldwide capacity from the total of 51 modules under construction worldwide . If and when these China-based wafer fabs are complete, the nation will have resumed increasing wafer fab capacity faster than other regions.

China's current wafer fabrication capabilities continue to lag the worldwide industry's more leading-edge capabilities.

Based upon their current plus committed capabilities, i.e., plants in production plus plants under construction (i.e., WFW Probability ≥ 0.8), China could increase and maintain their share of total worldwide semiconductor wafer production from the ≤ 2% realized in 2003 to ≥ 10.3% through 2014. Completing these 22 wafer fabrication plants, then fully equipping and ramping to full capacity at mature yields not only these new plants but also all of the existing wafer fabrication modules, would require significant financing. However, should this come to pass, it would increase China's share of worldwide wafer production by slightly more than five times, exacting a moderate impact on the semiconductor industry.

Capacity by process node and wafer size

From a geometry/technology node distribution standpoint, China's current wafer fabrication capabilities continue to lag the worldwide industry's more leading-edge capabilities. When fully equipped and ramped, China will have only 23% of its capacity at the leading edge <0.06µm node—compared to a worldwide industry distribution of 39%. China will meanwhile run 22% of its capacity at the less advanced <0.12 to ≥ 0.06µm nodes versus 17% worldwide. As for mid-range, China runs at 24% (<0.4 to ≥ 0.12µm nodes) versus 22% worldwide. Possibly owing to its heavier focus on discrete production, China will also run 31% of its capacity at the mature >0.4µm nodes versus 20% worldwide.

In terms of wafer size, China's current capabilities continue to be more concentrated in the smaller ranges. To illustrate, China has:

- 37% of its capacity in 6-inch or smaller wafers versus the worldwide mix of 22%;
- 29% of its capacity in 8-inch wafers equal to the worldwide mix of 29%; and
- 33% of its capacity in 12-inch wafers compared to the worldwide mix of 48%.

The past year's start-up of Intel's Fab 68 in Dalian and SMIC's Mega Fab 5 in Beijing represents somewhat of an improvement in China's 12-inch (300mm) fab capability. Of the 94 12-inch (300mm) wafer fabrication plants currently in production

Table 7: Comparison of current wafer fab capacity, 2010

	China		China's % of Worldwide	Worldwide	
	Capacity	%		Capacity	%
Geometry					
≥ 0.7µm	544.1	26%	21%	2,614.7	13%
< 0.7 to ≥ 0.4µm	119.7	6%	9%	1,398.8	7%
< 0.4 to ≥ 0.2µm	202.4	10%	9%	2,204.9	11%
< 0.2 to ≥ 0.12µm	315.0	15%	14%	2,238.7	11%
< 0.12 to ≥ 0.08µm	245.0	12%	14%	1,722.6	8%
< 0.08 to ≥ 0.06µm	218.3	10%	12%	1,837.7	9%
< 0.06 µm	483.7	23%	6%	8,107.3	39%
N/A			0%	541.1	3%
Total	**2,128.2**	**100%**	**10%**	**20,665.8**	**100%**
Wafer size					
≥ 4″	260.1	12%	28%	928.3	4%
5″	153.7	7%	22%	701.9	3%
6″	392.4	18%	13%	3,027.7	15%
8″	620.0	29%	10%	6,051.1	29%
12″	702.0	33%	7%	9,956.8	48%
Total	**2,128.2**	**100%**	**10%**	**20,665.8**	**100%**

Capacity = 1000's 8" Equivalent Wafer Starts per Month (KWSpM)
Current Capacity = World Fab Watch Probability ≥ 1.0

Source: SEMI World Fab Watch, May 2011

worldwide, seven are now in China, constituting 7.1% of worldwide 300mm capacity. However, China has only one additional 12-inch (300mm) wafer plant committed and under construction, compared to 12 committed worldwide. When completed and if fully equipped and ramped to full capacity—which could be three years from now—this could increase China's 300mm capabilities to constitute 34% of its total wafer fab capacity. But that would not sustain China's share of worldwide 300mm capacity, which would still decrease to 6.7% when all 12 of the committed worldwide 12-inch fabs are brought into production. As a result, for at least the next three years, wafer fab plants in other locations will retain their low mix/high volume advanced technology (e.g., DRAM NAND Flash) wafer manufacturing cost leadership.

Offsetting this relative lack of 12-inch (300mm) wafer fab capacity, China continues to maintain a greater than worldwide average concentration of 6-inch and smaller fab capacity. China currently has 122 6-inch or smaller wafer fabs in production, constituting 37% of total capacity compared to a worldwide average of 22%. To a considerable extent, this mix is a result of China's concentration in the O-S-D sector and recent growth of its LED capabilities. Fifty of these smaller fabs are LED wafer fabs and another 40 are discrete fabs.

Table 8: Comparison of committed future wafer fab capacity, 2010

	China			China's % of Worldwide	Worldwide		
	# Fabs	Capacity	%		# Fabs	Capacity	%
Geometry							
≥ 0.7µm	20	103.4	51%	48.3%	28	214.2	10%
< 0.7 to ≥ 0.4µm	0				3	3.6	0%
< 0.4 to ≥ 0.2µm	0				3	7.3	0%
< 0. to ≥ 0.12µm	1	20.0	10%	100.0%	1	20.0	1%
< 0.12 to ≥ 0.08µm	1	78.7	39%	50.8%	4	154.9	8%
< 0.08 to ≥ 0.06µm	0				0	0.0	0%
< 0.06µm	0				12	1,651.6	81%
N/A	0				0		
Total	**22**	**202.1**	**100%**	**9.9%**	**51**	**2,051.6**	**100%**
Wafer size							
≥ 4″	20	103.4	51%	83.3%	26	124.2	6%
5″	0				0		0%
6″	0	N/A			8	100.8	5%
8″	1	20.0	10%	21.0%	4	95.2	5%
12″	1	78.7	39%	4.6%	12	1,711.1	83%
18″	0				1	20.3	1%
Total	**22**	**202.1**	**100%**	**9.9%**	**51**	**2,051.6**	**100%**

Capacity = 1000's 8" Equivalent Wafer Starts per Month (KWSpM)
Committed Future Capacity = Wafer Fab Watch WFW Probability ≥ 0.8 to <1.0

Source: SEMI World Fab Watch, May 2011

Overall, it appears China runs newer wafer fabrication plants but with older technology. The majority of China's current wafer fab capacity came into production within the last five years. Seventy of China's current 146 wafer fab plants began production after 2005, representing 51% of China's current capacity. By contrast, worldwide wafer fab plants starting production after 2005 represent only 30% of total current capacity. At the same time, China lags the worldwide average in technology node and wafer size. Previously, this apparent anomaly had been the result of many of China's wafer fab plants being established with used equipment and technology. Currently, it also reflects China's recent concentration in the establishment of new LED wafer fabs.

From a business model standpoint, China's wafer fabrication capabilities remain noticeably different from worldwide capabilities. Foundry capacity continues to dominate both China's current and committed capabilities. For example, when fully equipped and ramped to full volume, foundry production will occupy 46% of China's current capacity compared

to just under 25% worldwide. In the future, if all the committed wafer fab plants under construction are fully equipped and ramped to full volume worldwide, foundry production will continue to account for 46% of China's capacity versus 24% worldwide.

China's wafer foundry revenues increased by more than 45% in 2010, accounting for about 11% of worldwide total. The most significant revenue increases in 2010 were recorded by SMIC, TSMC (Shanghai) and Hua Hong NEC (HHNEC). This is a reversal of the trend of the prior two years, when China's share of worldwide foundry revenues decreased from a peak of 12.5% in 2007 to 11.5% in 2008 and 10.5% in 2009. Although China's wafer foundry revenue growth exceeded the worldwide average foundry growth of 39% in 2010, it had not equaled the cumulative worldwide average foundry revenue growth since 2007. Based upon its current capabilities, China should be able to increase its share of worldwide foundry production to slightly more than 21% by 2013. This could be accomplished by fully equipping and ramping to full capacity at mature yields all of their existing wafer fabrication modules—which could have a significant impact on the semiconductor industry.

China's relative revenue growth could lag significantly if its foundries continue to compete on price rather than leading-edge technology.

However, China's relative revenue growth could lag significantly if its foundries continue to compete on price rather than leading-edge technology. Based upon SMIC's relative peer performance, China's foundries have only been earning 76.5% of worldwide average revenue per wafer start over the past five years. Further, if all of the worldwide committed wafer fabs under construction are completed and ramped to full production, China's potential share of foundry production would be reduced to slightly less than 20% by 2014. Given their continuing below-worldwide-average revenue per wafer start, this would equate to China reaching a 15% potential share of worldwide foundry revenues by 2014.

During the past year, China's share of current wafer fab capacity allocated to IC IDMs increased to 29%, but remains notably less than the worldwide average of 57%. Three additional IC IDM fabs accounted for that increase: the new Intel 12-inch (300mm) Fab 68 in Dalian (which started production in October 2010), the TI acquisition of the Cension 8-inch (200mm) former foundry fab in Chengdu and the addition of an existing Beijing Yandong Microelectronics fab to the WFW database. Together, these three increased China's IC IDM capacity by almost 35%. However, since there are no IC IDM fabs among the 22 wafer fabs that are committed and under construction, it is expected that China's share of wafer fab capacity allocated to IC IDMs will decrease to 27%, while the worldwide average increases to 58%. In either case, China represents only about 5% of worldwide IC IDM capacity. This divergence is probably the result of multiple factors: the timing of China's opening of the semiconductor sector to foreign investments, a decision to mimic the Taiwan foundry model and the very weak market position of China's state-owned semiconductor companies. The trend continues through China's

Over the past two years, China's share of wafer fab capacity allocated to the O-S-D sector has been increasing.

focus on developing the IC design (fabless) and O-S-D (LED) sectors. Currently there are only five foreign IDMs with some form of invested IC wafer fabrication capacity in China: Hynix, Intel, NEC (Hua Hong & SG JVs), NXP (JaLin JVs) and TI.

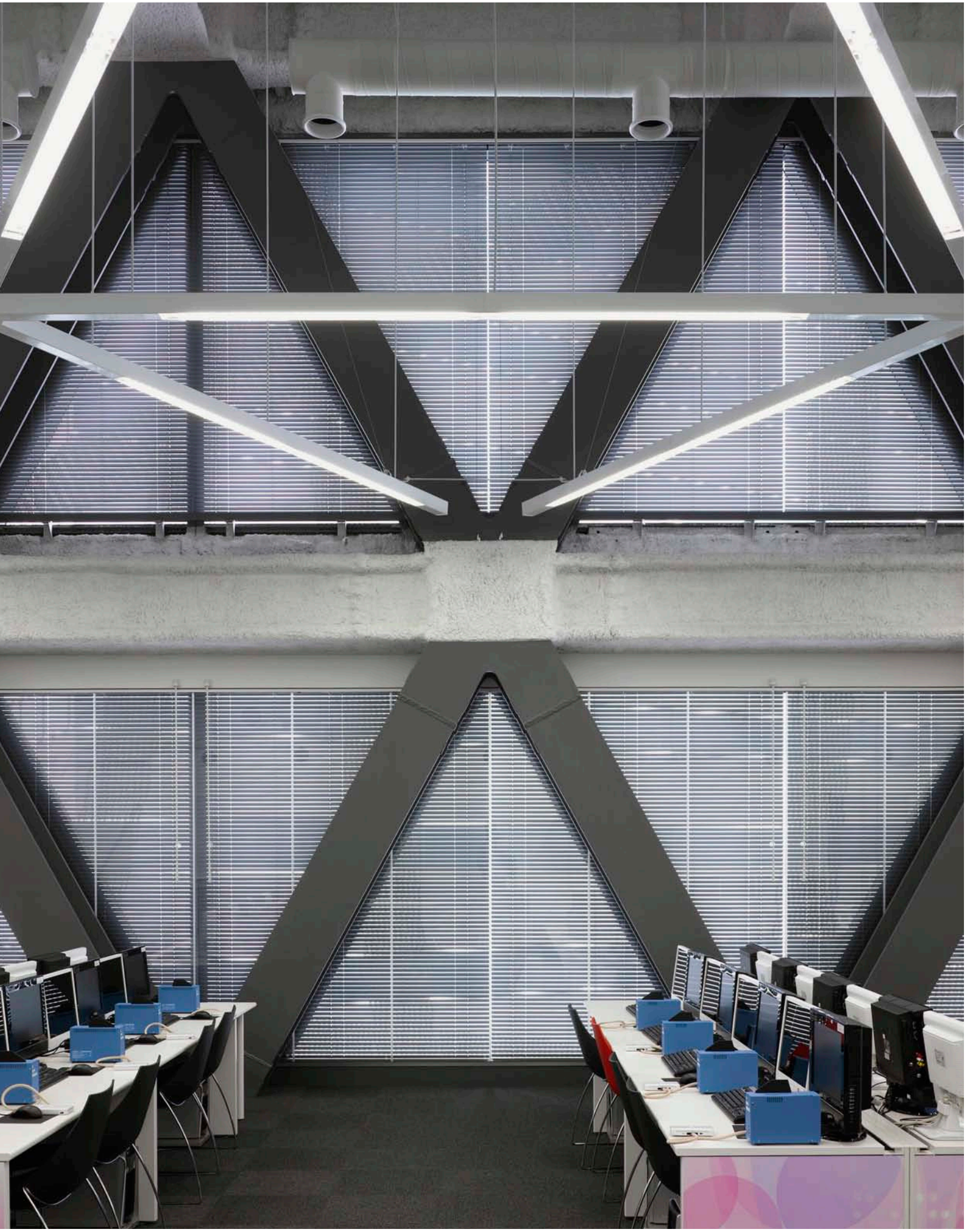
Ninety of China's 146 current wafer fabs are dedicated to the O-S-D sector. Over the past two years, China's share of wafer fab capacity allocated to the O-S-D sector has been increasing. O-S-D capacity now represents 25% of China's current wafer fab capabilities versus 15% of worldwide. It could increase to 27% for China versus 14.5% worldwide by 2015 if all of the committed wafer fabs under construction are completed and ramped to full production. China currently accounts for 17% of worldwide O-S-D capacity and that could increase to 19% by 2015 if all of the committed wafer fabs under construction are completed and ramped to full production. Currently there are fourteen foreign companies with some form of investment in O-S-D wafer fabrication capacity in China.

They include:

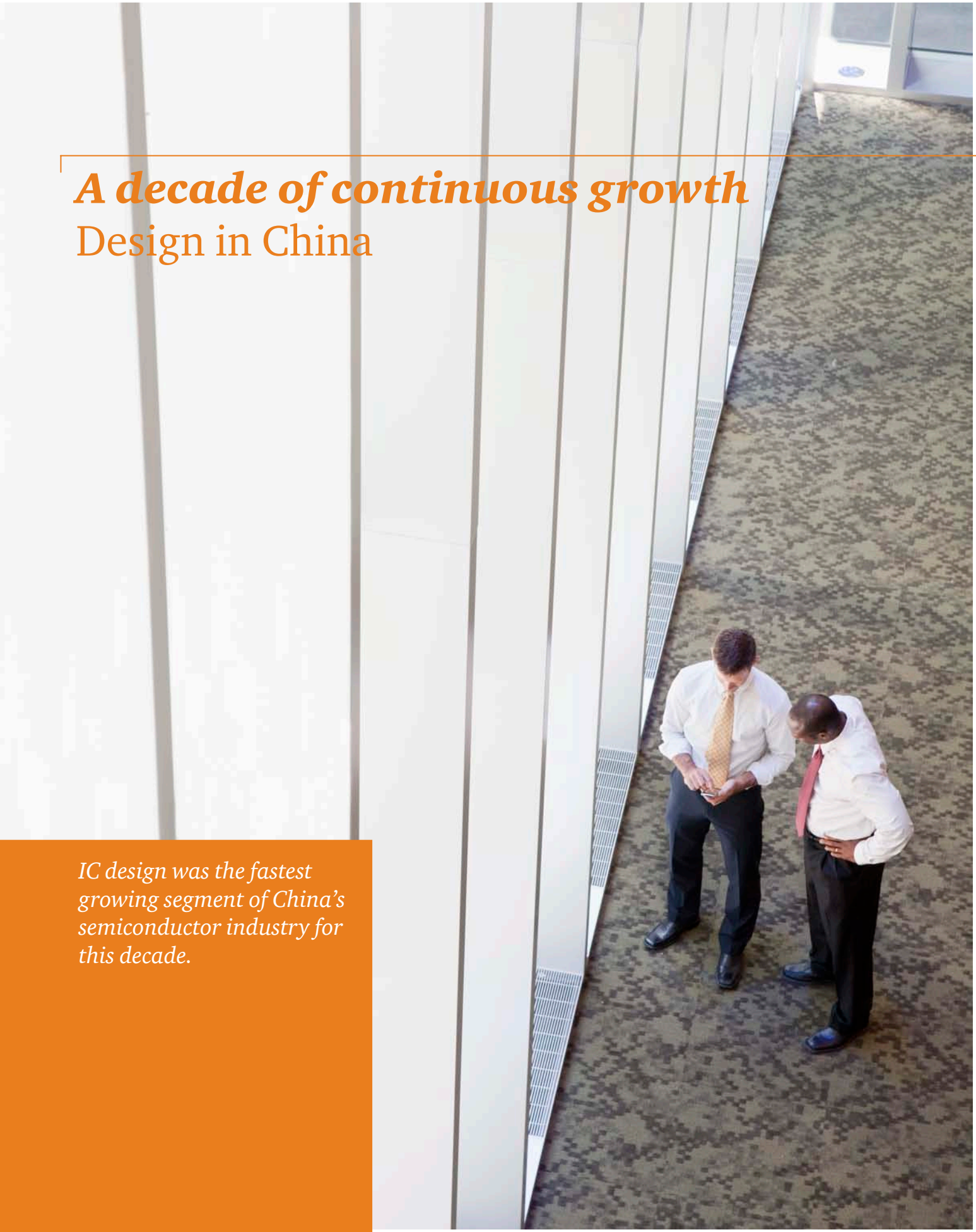
- Arima Optoelectronics, Epistar, FOREPI, Lextar SemiLEDs, United LED and Walsin Lihwa (from Taiwan)
- Cree, Inven Lux and Littlefuse (U.S.)
- AUK and KEC (Korea)
- NXP (Netherlands)
- Toppan (Japan)

As of the May 2011 WFW, fourteen additional new wafer fabs announced and/or planned (i.e., WFW probability of $\geq 0.45 < 0.80$) for China had not been committed by the start of construction. This is four more than a year ago and represents 34% of the 41 new fabs announced and/or planned worldwide, but only 13% of their equivalent capacity. The number of such announced and/or planned but not committed new fabs worldwide decreased noticeably from 54 in 2008 to 32 in 2010 before recovering somewhat to 41 this year. If all of these additional new fabs were completed and ramped into full production at mature yields, China's share of total worldwide semiconductor wafer production would increase from the approximately 2% realized in 2003 to 10.6% by 2016. This is similar to the plans prior to the economic downturn and could have moderate impact on the semiconductor industry.

While it remains unlikely that all of these announced and/or planned wafer fab plants will be realized, this does provide a measure of the evolving prospects for China's semiconductors. Three of the fourteen are planned to be 12-inch (300mm) fabs, which would account for 67% of the potential additional capacity . Four are 8-inch (200mm) fabs and account for 26% of the potential additional capacity. The other seven include six 2-inch (50mm) and one 4-inch (100mm) specialty LED fabs. Four of the seven, other than LED fabs, are planned for foundry, two for IC IDM and one for discrete power production. Chinese companies are responsible for almost 75% of these possible additional wafer fabs. Taiwan-based UMC (He Jian Technology), Chi Mei Lighting Technology and Epistar are involved with three and US-based TI with one of these fourteen possible additional wafer fabs.



A decade of continuous growth
Design in China



IC design was the fastest growing segment of China's semiconductor industry for this decade.

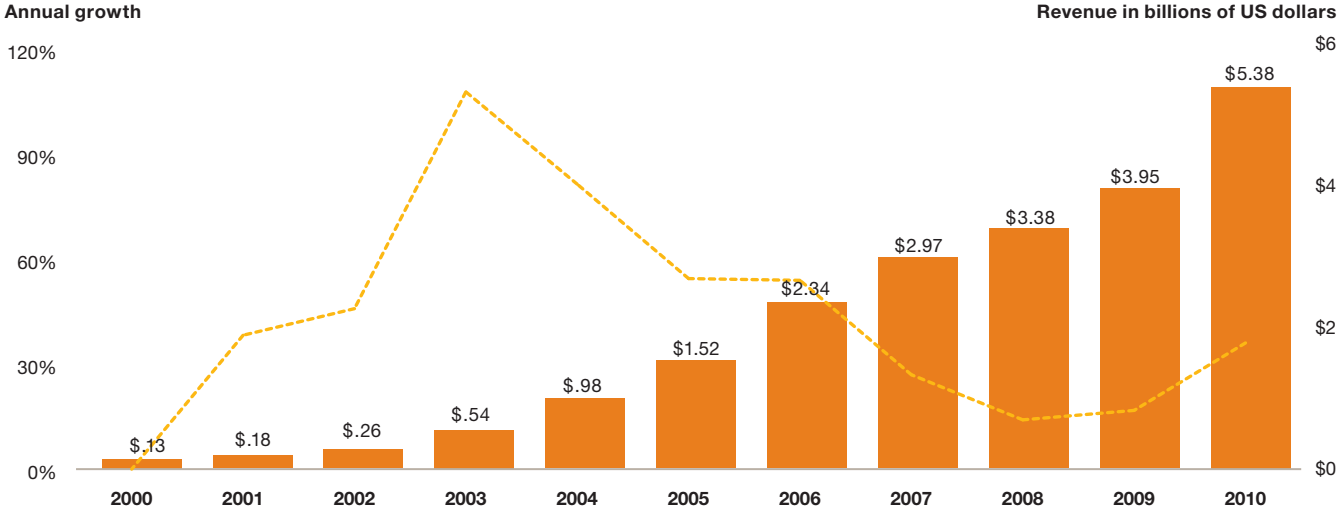
Integrated circuit design

IC design is the one segment of China's semiconductor industry that achieved positive year-over-year growth for every year of the past decade. It was also the fastest growing segment of China's semiconductor industry for this decade. Thanks to booming domestic demand, China's IC design industry grew during the 2008/2009 downturn against all the odds. During 2009, a series of domestic demand stimulus policies introduced by the government were implemented, driving up demand. These policies included subsidies for home appliance sales in rural areas, old-for-new home appliance replacement subsidies, 3G network building and infrastructure construction.

IC design revenues grew from US$178M in 2001 to US$5.4B in 2010—experiencing a CAGR of just over 46%. As this sector has grown larger, its year-on-year growth rate has decreased from a peak of 108% in 2003 to a plateau of about 55% in 2005 and 2006. This was followed by decreases to 27% and 14% in 2007 and 2008, before improving to 17% in 2009 and 36% in 2010. Notably, China's IC design sector dollar revenues did grow by 14.1% and 16.8% in 2008 and 2009, despite a 2.8% and 9.0% decline in the worldwide semiconductor market for those years. The market then grew by 36% in 2010, again exceeding the worldwide market growth rate of 32%.

China's IC design revenue growth in 2010 exceeded that of China's IC manufacturing, IC packaging and testing and also the much larger O-S-D sectors. Consequently, the IC design sector's share of China's semiconductor industry increased to 14.1% in 2010, up from 13.5% in 2009, after having remained flat at 10.8% for the three prior consecutive years. Most of the revenue in this sector can be attributed to China's fabless semiconductor companies, which in 2010 constituted more than 7% of the US$74B worldwide fabless IC industry—up from a 1% share in 2001 and a 4% share in 2004.

Figure 15: China's integrated circuit design industry revenue and growth, 2000–2010



Source: CCID, CSIA

Design enterprises

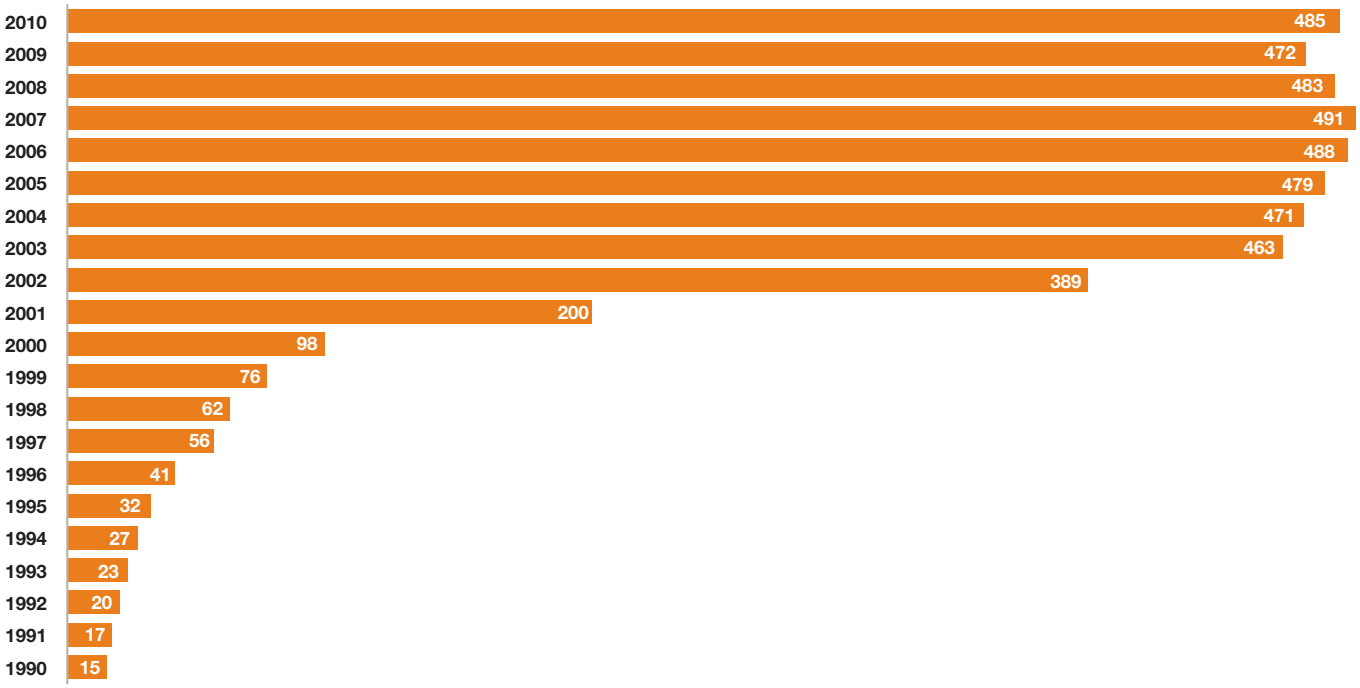
China had 485 IC design enterprises at the close of 2010, according to CCID. This is up from the 472 reported at the close of 2009, with the increase believed to be a result of China's stimulus package.

The 2008-2009 global recession impacted China's IC design industry, but the government's quick action on stimulus funding kept demand from collapsing. China's IC design companies responded to stimulus-generated demand in the second half of 2009 and then posted significant gains in 2010.

Mobile devices became the major products for China's IC design industry during 2010. Companies in the communications sector, particularly mobile phones, achieved rapid growth in revenue and size, while those in the IC card sector experienced relative decline. The result is a significant change in the makeup of China's top 10 IC design companies. Companies involved in mobile device design, such as Spreadtrum, RDA, GalaxyCore, Leadcore and Nationz, made the top 10 list. Meanwhile, IC chip companies, including CEC Huada, Datang Microelectronics, Wuxi China Resources Semico and Beijing Tongfang Microelectronics, dropped off the list.

While the 2008/2009 financial crises had less effect in China than elsewhere, it still hindered many Chinese companies, including a number of IC design companies. With a significant slowdown in the Chinese and worldwide semiconductor markets in 2008, competition between Chinese IC design enterprises intensified. Many of these enterprises' products were concentrated on low-end consumer

Figure 16: Number of IC design enterprises in China, 1990–2010



Source: CCID

applications. Differentiation between enterprises and products became blurred as the applications became more commoditized. Price wars resulted, and slow growth in new markets restricted the operations of IC design enterprises. These conditions placed a severe strain on many of China's IC design enterprises and several face difficulty surviving. Some IC design enterprises went bankrupt in 2008 and more did so in 2009. Last year many of the survivors became stronger. However, it is still estimated that no more than 100 local indigenous IC design enterprises remain truly viable.

Of the 472 IC design enterprises reported at the end of 2009, approximately 100 were the design units or activities of foreign-invested or subsidiary multinational companies. Of this group, PwC analysis has identified over 90 participants. This group remains concentrated among the largest of the more than 275 multinational semiconductor companies and the 100 largest semiconductor-consuming OEMs identified in the Gartner Dataquest market share databases. It includes the Chinese design activities of 18 of the top 25 multinational semiconductor companies and 24 of the top 100 semiconductor-consuming OEMs. The drivers behind these multinational companies' design activities being based in China include:

- Protecting their long-term local market by demonstrated participation in the country's technology growth initiatives;
- Servicing large Chinese OEMs that are addressing the worldwide market;
- Developing products for the unique and specific standards and requirements of the Chinese market;
- Developing and utilizing China's large pool of lower cost talent;
- Participation in the government's economic stimulus and other long-term infrastructure development initiatives; and
- Qualifying for NHTE (New and High Tech Enterprise) status tax incentives.

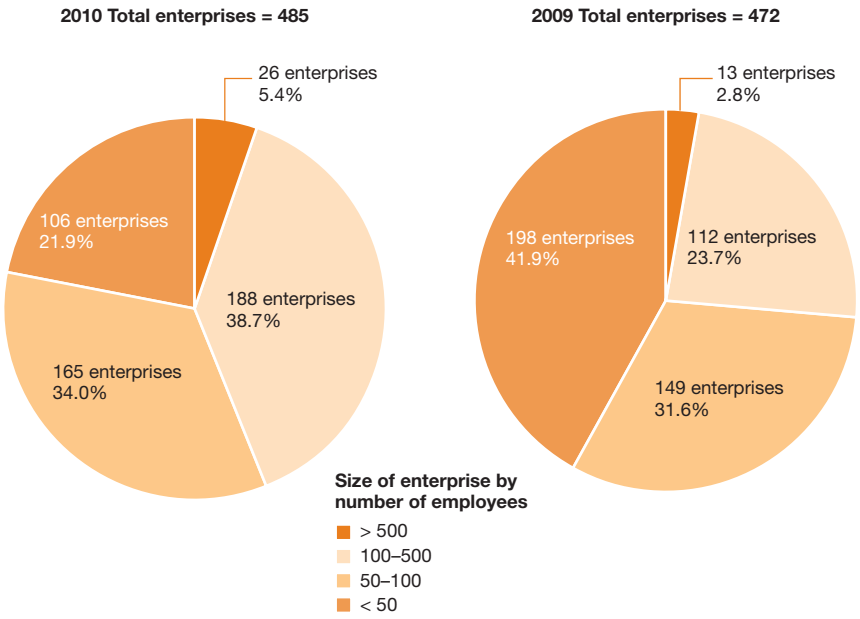
Many MNC semiconductor companies are investing heavily in their design activities in China which will inevitably provide designs and services in the local market and will compete directly with the local indigenous IC design companies for market and resources. These companies are viewed by some authorities as posing a challenge to proprietary IC IPR (intellectual property rights) in the country.

Design employees

During the past year, the number of reported IC design enterprises in China increased by nearly 3%, to 485, whereas the total number of employees in the IC Design sector increased by more than 50%. There has been a continuing increase in the employee density among the IC design enterprises, with the number of IC design enterprises with more than 500 employees doubling to 26. During 2010, the number of enterprises with more than 100 employees increased by 77% (89 enterprises), while the number with less than 50 employees decreased by 46% (92 enterprises). Similarly, by the end of 2010, less than 22% of China's IC design enterprises had less than 50 employees, which is a reduction from the more than 40% reported at the end of 2009.

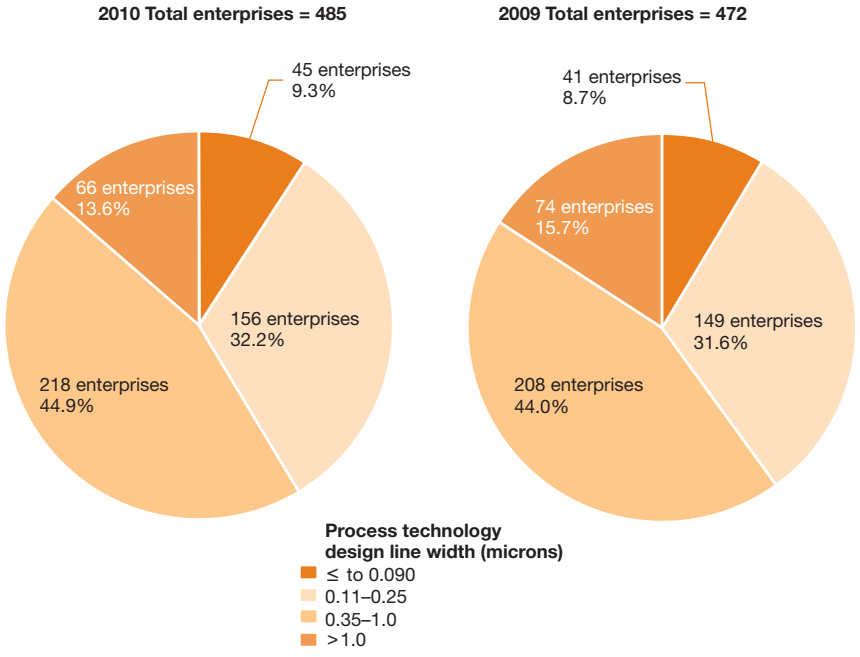
This increase in employee density is resulting in reduced sales per employee productivity for China's IC design sector. During 2010, the average sales per employee productivity for China's IC design sector decreased by almost 17% from US$206,000 in 2009 to US$172,000. By comparison, the

Figure 17: China's IC design enterprises by employee count, 2010 & 2009



Source: CCID

Figure 18: China's IC design industry by process technology, 2009 & 2010



Source: CCID

average sales per employee productivity of the 149 worldwide public fabless semiconductor companies, as reported in the Global Semiconductor Alliance (GSA) Global Financials Report, increased by 14% in 2010 to US$541,000.

Of the seven Chinese IC design companies mentioned in the GSA's Global Financials Report, only one, RDA Microelectronics, exceeded the worldwide average. With 199 employees, the company achieved sales per employee of US$961,000. One other, Spreadtrum Communications, significantly improved their sales per employee productivity to US$508,000 in 2010 (682 employees), up from US$156,000 in 2009 and US$141,000 in 2008.

The other five all experienced declines in revenue per employee. These include:

- Hangzhou Silan Microelectronics (US$331,000 / 696 employees)
- Zhuhai Orbita (US$266,00 / 103 employees)
- Shanghai Fudan Microelectronics (US$142,000 / 513 employees)
- Vimicro (US$125,000 / 724 employees)
- Actions Semiconductor (US$60,000 / 624 employees)

Design focus

China's IC design industry continued to achieve notable qualitative improvements during 2010. For example, there was a moderate migration of design capabilities to finer design line widths. According to CCID the number of design enterprises with design capabilities of equal to or less than 0.25 micron increased to more than 41% of all enterprises. In particular, 45 of these enterprises achieved design capabilities equal to or less than 90 nanometers—four more than in 2009. At the same time,

the number of IC design enterprises with less advanced technologies has decreased.

Another change is that Chinese IC design companies have begun licensing intellectual property cores along with software developed by foreign IP providers. It is believed that the Chinese stimulus package has helped Chinese IC design companies compete globally at more advanced process nodes using available IP . For example, *EE Times* reports that ARM has reached licensing deals with 30 Chinese companies for its Cortex processor and Mali graphics processor cores. Cerva, meanwhile, now has more than 25 licensing agreements in China. Also, Chinese IC design companies now have access to finer process technology nodes at foundries outside of China such as TSMC.

Design industry outlook

This year could represent a turning point in the development of the Chinese semiconductor industry and of its IC design industry in particular. The 36% growth achieved by the IC design industry in 2010 was more than twice that forecast by CCID at the start of the year. Among the drivers of this transition are:

- The economic stimulus packages funded by state and provincial governments in response to the global financial crises;
- China's push for the adoption of a TD-LTE wireless specification plus other domestic standards; and
- TSMC's provision of advanced semiconductor processes previously unavailable to companies headquartered in China.

In addition, China's IC design companies are now leveraging a range of intellectual property cores from foreign suppliers. The flood of Android-based products sweeping the global mobile and consumer markets, for example, is encouraging Chinese system and IC design companies to aggressively capture that market. Furthermore, the wealth effect created by listing on the GEM (Global Enterprise Board) or other local financial markets is attracting more and more start-up funds—and even talent—into China's IC design industry. By the end of 2010, 25 Chinese semiconductor companies had become publicly-listed companies for a combined IPO funding of more than US$3.6B—including 10 IC design companies for a combined IPO funding of US$1.1B.

At the end of 2010 there were almost 500 IC design enterprises in China. The grouping exhibits great diversity, comprised of state-owned, OEM-owned subsidiaries and spin-offs; IC design teams affiliated with university research departments; start-ups founded by returning Chinese engineers and local entrepreneurs; and the Chinese-staffed development centers of multinational companies. International and local venture capital and private equity are injecting funding through IPOs and M&A deals.

The new State Council Document No. 4, issued in January 2011, has made it clear that encouragement will be given in financing activities including investment from within the central government budget, industrial investment funds, bank loans and enterprise self-raised funds. With such encouragement, authorities believe, China will experience another wave of start-up IC design companies in the next couple of years along with a rapid increase in the total number of IC design enterprises. On this basis, CCID's current forecast is that China's IC design sector industry will grow by an almost 27% CAGR over the next three years to reach US$11B by 2013. If this forecast is realized, China's IC design sector would represent almost 14% of worldwide fabless semiconductor revenues and about 3.5% of the worldwide IC market.

Recovering from hard times
China and the semiconductor value chain

The impact of the semiconductor market recovery in 2010 was greater on the aggregate semiconductor value chain than on the industry itself.

Value chain revenue

The impact of the semiconductor market recovery in 2010 was greater on the aggregate semiconductor value chain than on the industry itself. Aggregate semiconductor value chain revenues increased 37.4% in 2010 compared to the industry's 31.8% growth. Most of this relative difference was the result of the 148% increase in semiconductor equipment revenues in 2010. All of the other sectors of the value chain reported double-digit increases in revenue. The foundry and semiconductor assembly and test services (SATS) sectors also reported greater than industry average increases of 39% and 37%. However, the electronic design automation (EDA) and semiconductor intellectual property (SIP) sectors posted moderate, below-average increases of 11% and 15%, respectively. Overall, the integrated device manufacturer (IDM) sector reported the largest growth in absolute value, with an increase of US$55B or 32%.

Table 9 lists worldwide semiconductor value chain revenues for 2000-2010 compared with forecasts for 2010. For comparison purposes, the 2010 forecast and the CAGR for the ten-year period remain unchanged from our original 2004 report—although the actual CAGR is also shown.

The global recession has significantly changed industry performance from earlier expectations. The overall semiconductor value chain revenues realized a CAGR of only 3.7% for the decade as opposed to the 5% forecasted in 2004. Only the materials and fabless sectors revenues grew faster than forecast. Materials growth was driven by a shift to advanced and more complex materials for advanced wafer fab technology nodes and the increasing use of advanced substrate based packages. Fabless growth came from the transition of several large IDMs to the fabless business model. The combined impact of the 2000/01

Table 9: Worldwide semiconductor value chain revenue and forecast, 2000–2010
(in billions of US dollars)

	Actual				Original report		Actual
	2000	2008	2009	2010	2010	CAGR 2000–2010	CAGR 2000–2010
Electronic Design Automation	3.8	4.2	3.8	4.2	7.8	7	1.1
Semiconductor Intellectual Property	0.7	1.5	1.3	1.5	2.3	13	7.9
Equipment	52.5	29.5	15.9	39.5	43.3	-2	-2.9
Materials	26.6	42.5	34.6	43.6	35.7	3	5.1
IDMs	184.0	193.2	169.7	224.7	291.7	5	2.0
Fabless	20.4	55.4	56.6	73.6	44.6	9	13.7
Foundries	7.4	24.4	21.7	30.2	49.6	21	15.1
SATS	10.9	20.1	17.2	23.6	26	9	8.0
Totals	**306.3**	**370.8**	**320.8**	**440.9**	**501**	**5**	**3.7**

Source: EDAC, Gartner Dataquest, GSA. SEMI, SIA, PwC 2001–2011

Table 10: China's contribution to worldwide semiconductor value chain revenue, 2010
(in billions of US dollars)

	Worldwide	China		
	Revenue	Sales	Consumption	China's role
Electronic Design Automation	4.2	N/A	0.31	Software user, not EDA producer
Semiconductor Intellectual Property	1.5	N/A	0.12	Licensees by IC design & foundries; not licensor
Equipment	39.5	0.10*	3.63	First-tier & wafer-fab buyer; used equipment favored; solar & second or third-tier producer
Materials	43.6	0.43*	4.15	First-tier buyer, solar and second or third tier producer
IDMs	224.7	18.9	99.6	Plant location for MNC IDMs' SPA&T & 3 fabs; local source of OSD and smaller IC IDMs
Fabless	73.6	5.4	32.4	Small but continually growing local capabilities
Foundries	30.2	3.2	13.4	Substantial; 21% worldwide foundry capacity by 2013
SATS	23.6	9.1	10.4	Substantial: about 25% worldwide SATS capacity
Totals	**440.9**	**36.6**	**164.01**	

**Chinese domestic equipment and materials companies only, without local subsidiaries of foreign companies.*
Source: CSIA, EDAC, Gartner Dataquest, GSA, SEMI, PwC

and 2008/09 semiconductor industry downturns made it a challenging decade for the semiconductor industry and value chain.

Table 10 presents our current analysis of China's estimated contributions to worldwide semiconductor value chain revenues for 2010. China's role within each value chain segment is characterized on the basis of its relative revenue for production and consumption (where data is available).

China's role on the production side continues to be most significant in discrete device manufacturing, IC IDM assembly and test operations and foundry operations. Its role in SATS operations is less pronounced. In 2010, China contributed almost 32% of worldwide discrete device revenues, more than 15% of worldwide IC packaging and testing revenues and almost 11% of worldwide wafer foundry revenues. China has grown to become the dominant supplier of several lines of low-cost commodity discrete devices. This includes small signal diodes and transistors for major IDMs who either have their discrete manufacturing operations in China or have entered into rebranding programs with indigenous Chinese suppliers. China's now significant presence in the SATS and foundry segments has increased market competitiveness, placing downward pressure on prices and providing alternative sources of capacity for small and start-up fabless companies.

China's IC Design (fabless) sector remains its fastest growing, expanding by 36% in 2010. As a result, China's fabless revenues have increased by more than 250% since 2005 to now represent more than 7.5% of worldwide fabless revenues. At the same time, China's IDM sector, including O-S-D, recovered from the negative 2009 impact of the recession and achieved a revenue increase of 37% in

2010. As a result, China's IDM sector, including O-S-D revenues, has now increased by almost 140% since 2005, reaching about 8.5% of worldwide IDM revenues. In aggregate, China's 2010 semiconductor value chain production revenues increased 37%—fractionally less than worldwide value chain revenues—to reach more than 8% of those revenues.

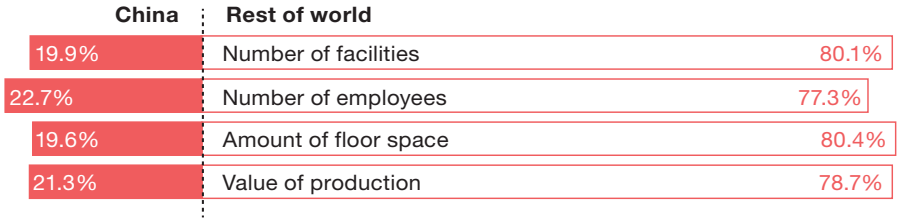
China is a net consumer of semiconductor devices. It is expected this role will continue well into the next decade. While less than 65% of the semiconductors devices China consumed in 2010 were used in the manufacture of electronic products for export from China, more than one third were used in electronic products for domestic consumption within China. The portion of semiconductors used for electronic products for domestic consumption within China increased by more than US$11B during 2010. This share is expected to increase further as a continuing result of China's economic stimulus package and other government initiatives.

With the recovery, China will continue to be a growing buyer of materials, a cyclical user of equipment and a modest licensor of semiconductor property and electronic design automation tools. Due to China's relatively large share of semiconductor packaging, assembly and test production, its materials use continues to be somewhat more concentrated in back-end materials rather than in wafer fab materials . And given that China's semiconductor value chain aggregate consumption had decreased less severely than worldwide in 2009, it grew at a slightly slower pace, 33.1%, upon recovery in 2010. Since 2005, it has increased by more than 142%, representing more than 37% of the worldwide semiconductor value chain in 2010 compared to 21% in 2005.

Packaging, assembly and test production

In 2010, China's semiconductor packaging, assembly and test (SPA&T) revenues grew by 27.5% to US$9.3B. This is a new record, more than 4% higher than 2008's previous record of US$8.9B . Measured in RMB, China's SPA&T revenue grew by 26.3%, to 62.9B RMB, which was only slightly higher than 2007's previous record of 62.8B RMB. The difference between the two record accomplishments reflects the impact of China's continuing strengthening of the RMB exchange rate. China achieved these record revenues with a decreasing share of worldwide SPA&T facilities and manufacturing floor space. As a continuing consequence of the global recession, 2010 was another year of

Figure 19: Comparison of China and all remaining countries' SPA&T resources, 2010



Source: Gartner Dataquest 2010

reduction in overall SPA&T facilities. In 2010, 17 existing worldwide SPA&T facilities were closed. Nonetheless, five new facilities started production and overall manufacturing floor space increased by more than 2%. As part of these changes, China reported the closure of five old and the opening of one new facility, along with the expansion of several others. As of the end of 2010, China had 106 SPA&T facilities, representing:

- 20% of the total number of worldwide SPA&T facilities;
- Almost 20% of worldwide SPA&T manufacturing floor space; and
- 23% of reported worldwide SPA&T employees (up from 20% of employees in 2009).

China began production at one new large SPA&T facility in 2010, the Hitech Semiconductor (Wuxi) Co. Ltd plant. The nation also expanded several existing facilities. China's SPA&T manufacturing floor space, a proxy for potential manufacturing capacity, increased to represent slightly more than 20% of worldwide SPA&T manufacturing floor space. As a result, China's SPA&T facilities continued to rank first in share of worldwide SPA&T manufacturing floor space for the second year, just ahead of Taiwan (at slightly less than 20%) and Japan (18%). China's SPA&T facilities also ranked first in the number of reported employees, with 23% of worldwide SPA&T employees at the end of 2010, ahead of Malaysia (16%) and Taiwan (15%).

China continues to have the largest share of planned future SPA&T facilities. Of the 12 SPA&T facilities planned worldwide at the end of 2010, five were located in China, compared to one each in seven other countries. These five represent 42% of the planned facilities and more than 98% of the announced planned manufacturing space.

In terms of the ownership of China's SPA&T facilities, very little has changed since 2008. Of the total 106 existing SPA&T facilities, about one third belong to Chinese companies and 14% belong to companies from Taiwan (12%) and Hong Kong (2%). The largest foreign ownership comes from the US, with almost 19% of China's SPA&T facilities.

China continued to gain share of worldwide SPA&T production value during 2010. The composite weighted average of China's 2010 SPA&T production is estimated to be slightly more than 21% of worldwide, up from 20% in 2009. The value of China's IC SPA&T production increased by 24.4% to reach more than 18% of the value of worldwide production value in 2010—approximately the same share as in 2009. However, the value of China's O-S-D SPA&T production increased by 29.7% in 2010 to represent more than 35% of the value of worldwide production, which is an increase from the 32% it had represented from 2008 through 2009. As a result, the composite of China's SPA&T production value

As a continuing consequence of the global recession, 2010 was another year of reduction in overall SPA&T facilities. In 2010, 17 existing worldwide SPA&T facilities were closed. Nonetheless, five new facilities started production and overall manufacturing floor space increased by more than 2%.

increased by a weighted average of almost 29% in 2010, representing slightly more than 21% of the worldwide production value.

China's increased share of worldwide SPA&T value during 2010 was the result of its increased share of worldwide production volume offsetting decreases in IC ASPs. China's SPA&T production continues to be more heavily utilized for higher-volume and lower-cost packages. Meanwhile, their ICs account for 34% of worldwide unit volume and their OSDs for 62%, compared to 28% of ICs and 68% of OSDs in 2009.

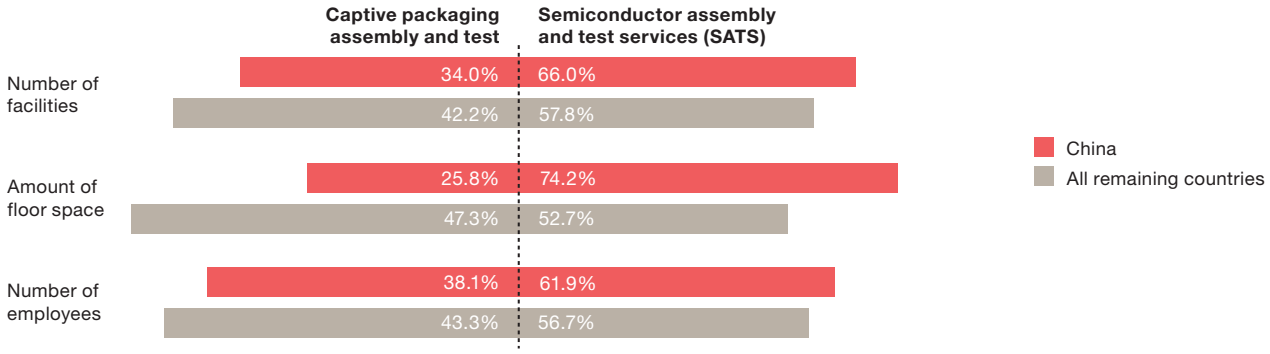
Semiconductor assembly and test services (SATS)

Figure 20 shows China's share of its SPA&T capacity that is dedicated to SATS suppliers compared with all other regions. China's share remains somewhat more concentrated than that of other regions. SATS resources represent 74% of China's SPA&T manufacturing floor space and 66% of China's SPA&T facilities versus 58% and 53% for all other countries.

At the end of 2010, 70 SATS facilities were in production in China. Of these, 35 were owned by Chinese companies and 35 by foreign companies. Each of the five largest and eight of the ten largest multinational SATS companies had one or more facilities in China. By comparison, 34 of the 36 IDM SPA&T facilities in production in China by the end of 2010 were owned by foreign companies and only two, Jilin Sino Microelectronics and Wuxi China Resources Huajing Microelectronics, were owned by Chinese companies.

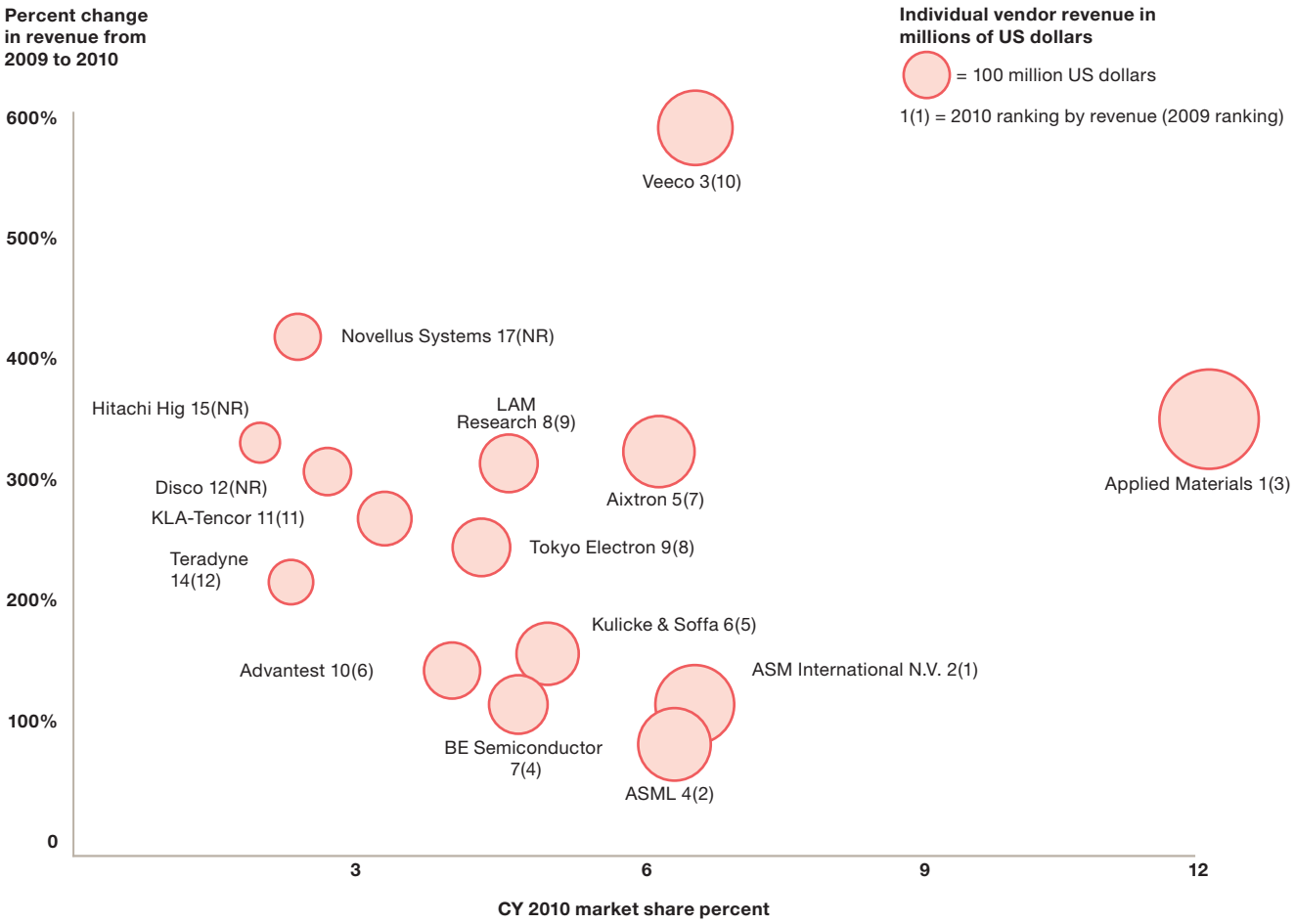
Two of the Chinese SATS companies continue to be ranked among the 20 largest SATS suppliers in the world. The first is Xinchao Group (including JCET and JCAP), which was ranked 9th in 2010, with a worldwide market share of 2.3%. The second is Natong Fujitsu (NFME), ranked 18th, with a 1.1% market share . Both have grown to reach a sizeable scale in the leadframe segment of the SATS sector while moving into the substrate and more advanced package sectors, resulting in their ability to influence pricing.

Figure 20: Comparison of China and all remaining countries' SATS share of SPA&T capacity, 2010



Source: Gartner Dataquest 2011

Figure 21: Equipment sales to China by vendor revenue, 2010



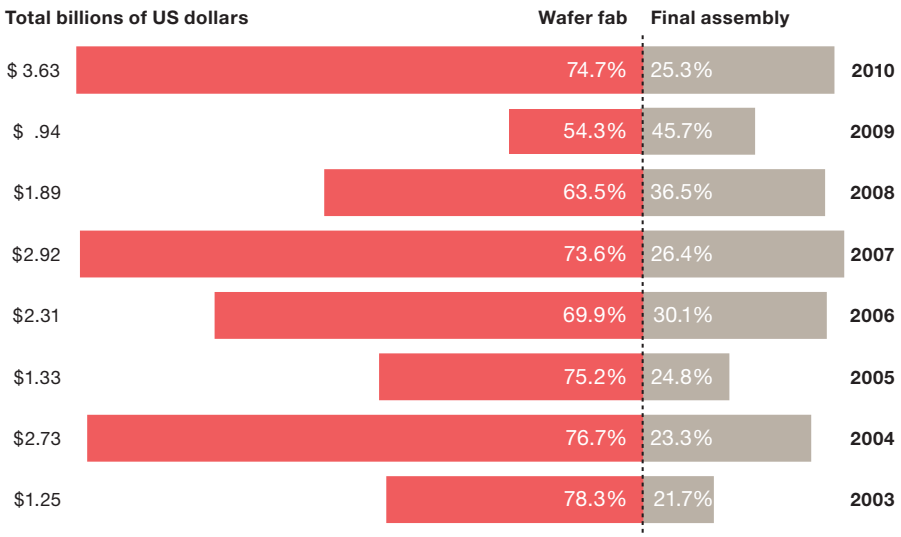
Note: NR—Not ranked in top 15 in 2009
Source: Gartner Dataquest 2011

Both have received support from China's National Major Science and Technology Project 02 (Project 02) enabling JCET to successfully move into advanced QFN (quad flat no-lead) package technology and BGA (ball grid array) package technology. Similarly, Project 02 support enabled NFME to successfully move into BGA, QFN and copper wire bonding package technologies. Both companies are expected to develop even more advanced, smaller-volume package technologies including FC (flip-chip), SIP (system in package) and TSV (through silicon via).

Equipment sales and market share

The global semiconductor market recovery had a very dramatic impact on equipment sales in 2010. Semiconductor equipment sales to China increased by 286% to a record US$3.6B. This compares with worldwide semiconductor equipment sales which increased by a meager 148% in 2010 (to US$39.5B). China's 286% sales increase in 2010 was the largest relative increase of all the seven regions tracked by SEMI (Semiconductor Materials and Equipment International).

Figure 22: China's semiconductor equipment market and growth



Source: SEMI, Solid State Technology 2006–2010

China's semiconductor equipment market remains a relatively small share of the worldwide market, increasing from 5.7% of worldwide equipment sales in 2003 to 7.0% in 2007, declining to 6.4% in 2008 and 5.9% in 2009 before resurging to a record 9.2% in 2010. It is now expected to remain at about 9% of a moderately larger worldwide market through 2012. More than anything else, these upswings in semiconductor equipment sales in China reflect the equipping and ramping to full production of a number of very large 300mm wafer fab installations: the Hynix-Numonyx and SMIC Wuhan fabs in 2007 and 2008; the Intel Dalian fab in 2009 and 2010; and the HuaLi (GSMC/HHNEC JV) and SMIC Beijing Fab 5 fabs in 2011.

At the end of 2010, China had 22 wafer fab plants that were committed and under construction. This represented 43% of the 51 new plants under construction worldwide, but only slightly less than 10% of worldwide capacity. China continues to add less capacity and spend less on equipment per new wafer fab plant. This is because they are adding a greater proportion of 4" (100mm) or smaller O-S-D fabs than other regions along with a lower proportion of 12" (300mm) plants. Nineteen of the 22 fabs committed and under construction are LED and most are 2" (50mm) wafer fabs.

According to Gartner Dataquest, sales of the 15 largest semiconductor equipment suppliers to China increased 221% in 2009 to US$2.8B, representing 75% of the market. This is slightly more concentrated than the worldwide market, where the top 15 suppliers represented about 73% of the total.

The concentration and ranking of the top 15 suppliers with the largest market share in China (shown in Figure 21) changed somewhat in 2010, with Nikon, FOI and Verigy being displaced by Disco, Novellus and Hitachi High Tech. Benefiting from China's subsidized expansion of MOCVD LED

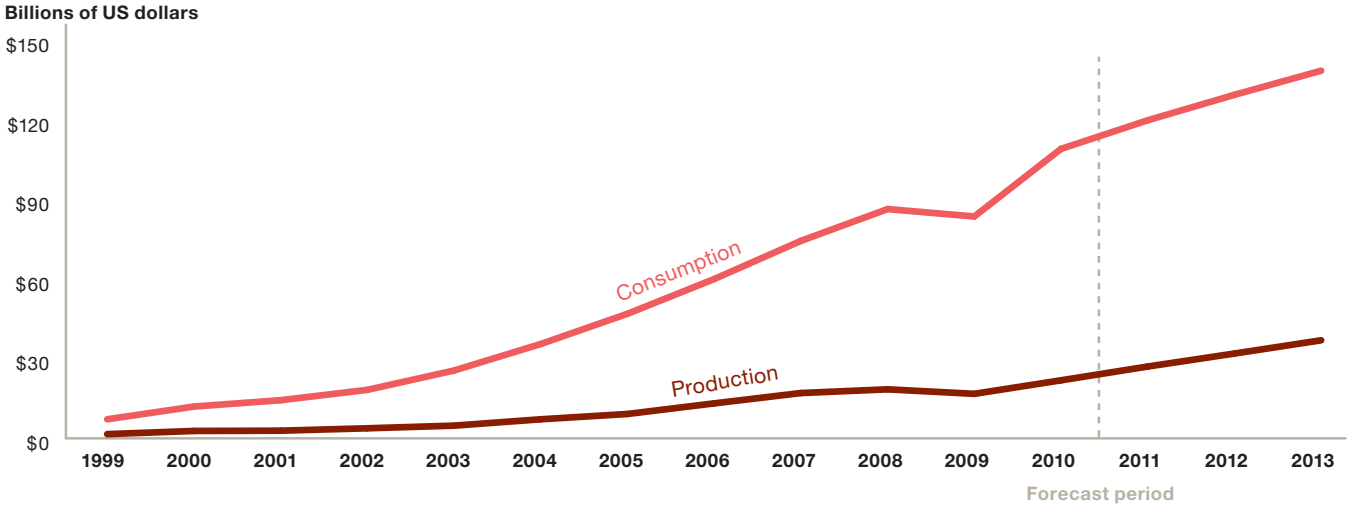
wafer fab capacity, Vecco achieved an almost 600% sales growth in 2010 to improve its relative ranking from 10th in 2009 to 3rd in 2010. Ten of these 2010 top 15 supply wafer fab equipment, three focus on packaging and assembly equipment and two provide testing equipment.

In addition to the recognized international suppliers to the China semiconductor equipment market, there are a large and growing number of other suppliers. This includes many regional, along with some 80 indigenous Chinese suppliers, that are trying to establish a viable presence in the market. These 'other' suppliers as a group also benefited from the semiconductor industry recovery as their sales in China increased by 156% during the past year. The China Electronics Production Equipment Industry Association (CEPEIA) reports that among this group, the indigenous Chinese semiconductor equipment industry sales in RMB increased by 73% in 2010. However, most of that increase was in sales of solar energy equipment, which increased 82% to represent 85% of the industry's sales in 2010. Sales of semiconductor equipment increased only 36% in 2010 to about $98M, representing less than 3% of the overall $3.63B Chinese semiconductor equipment market.

Integrated circuit consumption/ production gap

One of the consequences of the semiconductor recovery in 2010 was the resumed growth of China's IC consumption/production gap. This gap is the difference between IC consumption and IC industry revenues. Both China's IC market consumption and China IC industry production increased to new record levels in 2010. As a result, the China IC consumption/production gap also increased to a new record level in 2010, increasing by more than US$20B to reach

Figure 23: Comparison of China's integrated circuit consumption and production: 1999–2013



Actual annual average FX rates used for 1999–2010, & 2010 average FX rate used for forecast 2011–2013
Source: CCID, CISA, PwC 2004–2011

US$87.3B. Because this annual gap had decreased slightly in 2009 as a unique consequence of the global recession (to US$66.9B), the subsequent increase to US$87.3B in 2010 was the largest ever recorded. Reported in RMB, China's IC industry revenue (production) increased 29.8% in 2009 for an increase of 331RMB:100M while China's IC market increased by 29.5% for an increase of 1,671 RMB:100M.

Measured in dollars, China's annual IC consumption increased 30.7% (US$25.5B), while IC production increased 31.0% (an increase of only US$5.1B). Consequently, China's IC consumption/production gap increased by US$20.4B to reach US$87.3B for 2010. Prior to 2009, this annual gap had grown from US$5.7B in 1999 to a record US$68B in 2008. And despite all Chinese government plans and efforts to contain matters, the Chinese authorities had expected that it would continue to increase through at least 2012.

Following new record highs, Chinese authorities now expect this gap will continue to grow through at least the next five years. According to the China Semiconductor Association (CSIA) 2011 report, China's IC market is forecasted to grow to US$151B by 2013, with IC industry revenues expected to reach US$36B. Implicit in this forecast is a further widening of China's IC consumption/production gap to US$115B. It is our belief that this gap continues to contribute to the Chinese government's ongoing initiatives to increase indigenous production.

At the same time, the ratio of China's IC production revenue to IC consumption value has shown some modest improvement. This had grown with some yearly variability from 16% in 2001 to a peak of 22% in 2007 before declining slightly to 20% for both 2009 and 2010. According to CSIA, this ratio is expected to increase to 24% by 2013.

We would describe this ratio as more of a measure of parity than one of IC self-sufficiency since China's reported IC industry revenue includes significant production activities, such as foundry wafer fabrication or packaging and testing, for IC devices that are only partially completed in China. As will be noted later in this update, one of the stated MIIT objectives of China's 12th Five Year Plan is to improve this ratio.

The economic tie that bind Greater China

Taiwan's growing economic relationship with China and the progressive easing of cross-Strait investment restrictions will have a significant influence on the direction of the Greater China semiconductor industry.

Closer cross-Strait ties benefiting Greater China semiconductor industry

The Greater China semiconductor industry enjoyed a good 2010. But gathering clouds surrounding the strength of the global recovery signal stormy weather ahead. Despite this uncertainty, Taiwan's semiconductor companies are well-positioned to take advantage of growth in the still-buoyant China market. This market has in fact become an increasingly important production and sales location for Taiwanese EMS and ODM companies and their supply chains. Indeed, Taiwan's growing economic relationship with China and the progressive easing of cross-Strait investment restrictions will have a significant influence on the direction of the semiconductor industry in the Greater China region.

The initially positive outlook for Taiwan's semiconductor industry in 2011 has dimmed on mounting concerns over slower global growth.

Shifting industry outlook on global uncertainty

Taiwan's IC industry revenues as a whole (including design, manufacturing, assembly and testing) jumped 37.3% to a record NT$1,716B (US$54.4B) in 2010, according to Taiwan Semiconductor Industry Association (TSIA) statistics. The industry is benefiting from a global economic resurgence along with China's ever-growing consumption of semiconductors. However, the initially positive outlook for Taiwan's semiconductor industry in 2011 has dimmed on mounting concerns over slower global growth. More recent TSIA forecasts, made in August 2011, project an 8.3% decrease in IC industry revenues for the year, in stark contrast to the 8.7% increase predicted seven months earlier.

For the time being, Taiwan's domination of the global chip foundry and semiconductor assembly and testing sectors is assured. Taiwan Semiconductor Manufacturing Co. (TSMC) and United Microelectronics Corp. (UMC) together account for about two-thirds of the total worldwide pure-play IC foundry market, while Advanced Semiconductor Engineering Inc. (ASE) is the world's largest provider of contract semiconductor assembly and testing services. However, IC design start-up companies in China are increasingly challenging Taiwan's chip design industry, which is the second largest in the world behind the United States. In addition, Taiwan's DRAM manufacturing industry, which once accounted for about a fifth of the world's production of PC memory chips, is progressively shrinking as it struggles to keep up with larger global rivals.

Mixed China fortunes for Taiwan's contract foundries

TSMC and UMC, the world's two largest contract chipmakers, started to report weaker demand from the second quarter of 2011, as clients cut orders to reduce inventory on concerns about the global economic outlook. In response, TSMC cut its 2011

Taiwan continues to dominate the IC foundry and assembly and testing sectors, but its IC designers face growing competition in China, and its DRAM makers are on the ropes again.

capital spending target from US$7.8B to US$7.3B, while UMC maintained its expenditure program for the year at US$1.8B. Both companies' capex plans remain aggressive to handle increased outsourcing from IDMs of their chip production, as well as to fend off new competition from GlobalFoundries Inc. At the same time, the companies are seeing continued strong demand for lower-priced chips from China.

TSMC stepped up its presence in China in 2010, after the Taiwan government relaxed restrictions on China-bound high-tech investments. In June 2010, TSMC received approval to take an 8% stake in Shanghai-based Semiconductor Manufacturing International Corp.—an ownership percentage it was awarded as part of a legal settlement over a trade secrets dispute. In September 2010, TSMC received the go-ahead to upgrade the process technology at its 8-inch wafer fab in Shanghai to 0.13 micron from 0.18 micron. TSMC also reportedly plans to expand production capacity at its Shanghai plant.

As for UMC, it terminated its proposed full merger with Suzhou-based chipmaker Hejian Technology (Suzhou) Co. Ltd. in November 2010 after the deal was rejected by Taiwan's financial regulator. This was due partly to the way UMC intended to finance the transaction, which ran afoul of the investment and securities rules. A few months later, the company resubmitted an investment application to instead acquire a 35.7% stake in Hejian, including the 15.3% ownership interest held in trust for UMC, plus the cash purchase of an additional 20.4% stake. In late October 2011, UMC received approval for its China investment from Taiwan's Investment Commission. After the acquisition is completed, UMC plans to use its majority shareholding in Hejian as a springboard to expand its business in China.

Copper wire-bonding boost for IC assemblers

Despite rising caution among global chipmakers, Taiwan's leading providers of IC assembly and testing services have maintained their capital expenditure plans for 2011. ASE will spend most of its US$750M budget on boosting copper wire-bonding, high-end flip-chip and discrete-device packaging capacities at its factories in Taiwan and China. IC assembly sales generated from copper wire-bonding increased substantially in 2011, as more clients have accelerated the migration process from gold bonding to keep up with thriving demand from tablet-PC, smartphone and smart-TV makers. ASE has also vigorously boosted its production capacities in China as part of its plan to relocate low-end production to the mainland while retaining high-end production in Taiwan.

Taiwan's IC designers face increasing competition in China

MediaTek Inc. and other Taiwanese IC design houses continue to see robust demand for their various chipset solutions. However, they face growing competition from their Chinese counterparts, most notably Shanghai-based Spreadtrum Communications (in the low-end mobile-phone market). The threat to Taiwan's IC design companies will grow stronger as the Beijing government has adopted policies in its 12th five-year economic development plan (2011-2015) to accelerate the expansion of China's IC design industry in favor of home-grown companies. Still, Taiwanese IC designers can expect to benefit from China's push for triple network convergence—the Internet, telecom and TV broadcasting networks—given their strength in customized solutions.

MediaTek, the biggest supplier of chips in China, has seen its earnings decline since the second quarter of 2010. This owes to intensifying competition in the firm's core feature-phone chip market and its slow progress in designing chips for high-end smartphones. In response, the company has stepped up efforts to diversify its product portfolio, primarily through acquisitions that aim to build up MediaTek's technology capabilities in communications and digital home entertainment. A good example of this strategy is the US$598M deal (March 2011) for smaller Taiwan-based rival Ralink Technology.

Taiwan's DRAM chipmakers on the ropes again

The DRAM recovery in 2010 proved short-lived for Taiwan's chipmakers, as slowing demand, bloated inventory levels and falling prices again threaten the sector. With only one year of respite since the last slump, most local manufacturers' financial status and cash positions have not recovered. Even worse is that deep-pocketed Samsung Electronics, the biggest DRAM maker in the world, is investing heavily to increase its market share, which in turn has pushed DRAM prices down further on a renewed supply glut. The sharp fall in prices has had the greatest impact on Taiwan's DRAM manufacturers, which are among the least profitable companies in the business owing to their small scale and lagging production technology. A major industry shake-up is coming.

Several chipmakers have already taken action to reduce their over-dependence on PC DRAM, a highly commoditized product that is the best-selling type of DRAM chip. Winbond Electronics Corp., Powerchip Semiconductor Corp. and ProMOS Technologies Inc. have all largely left the PC DRAM market to become either contract manufacturers for Japan's Elpida Memory Inc. or manufacturers of other, niche DRAM products. Taiwan's two other DRAM companies, Nanya Technology Corp. and Inotera Memories Inc. (a joint venture between Nanya and America's Micron Technology Inc.), also plan to diversify their volatile business by selling chips for mobile devices and servers—products which require greater sophistication and customization but that fetch higher prices.

Elpida and Micron Technology have formed key partnerships with Taiwan's DRAM companies with the aim of taking stakes in them and boosting market share. In February 2011, Elpida, the world's third-largest memory chipmaker, cross-listed on Taiwan's stock market through a Taiwan Depositary Receipts issue, which it hopes will help deepen its alliances with local DRAM makers. Elpida CEO Yukio Sakamoto said at the time that while Taiwan's chipmakers do not favor integration, they could still work together on different product lines. Elpida remains interested in buying a stake in ProMOS, which, facing imminent default again, filed a radical restructuring plan in July 2011 that it hopes will solicit support from its creditors and a future strategic partner.

As they ride out the latest crisis, Taiwan's DRAM manufacturers will have only themselves to count on—the government having ruled out throwing them a life raft as it did two years ago. "The government will not inject any capital [into any company]," Minister of Economic Affairs Yen-Hsiang Shih said after ProMOS announced its restructuring plan. This was a u-turn by the government after its previous efforts to consolidate Taiwan's memory chipmakers came to nothing. Its original plan to revamp the industry

by building a stronger DRAM entity—Taiwan Memory Co.—was scrapped in March 2010 following repeated opposition from lawmakers.

Taiwan pushing new industry initiatives

Meanwhile, the Taiwan government is developing initiatives in conjunction with the cabinet-level National Science Council (NSC) to boost growth in the semiconductor industry. In January 2011, the NSC kicked off a five-year National Program for Intelligent Electronics which will see the government inject over US$400M into the domestic IC design sector. The program aims to develop integration technologies and applications for Taiwan's strategic priority targets, including medical services, green energy equipment, vehicle telematics, information communication technology and consumer electronics. The NSC estimates the program will help grow the output of Taiwan's IC design sector from about US$15B in 2010 to around US$22B in 2015.

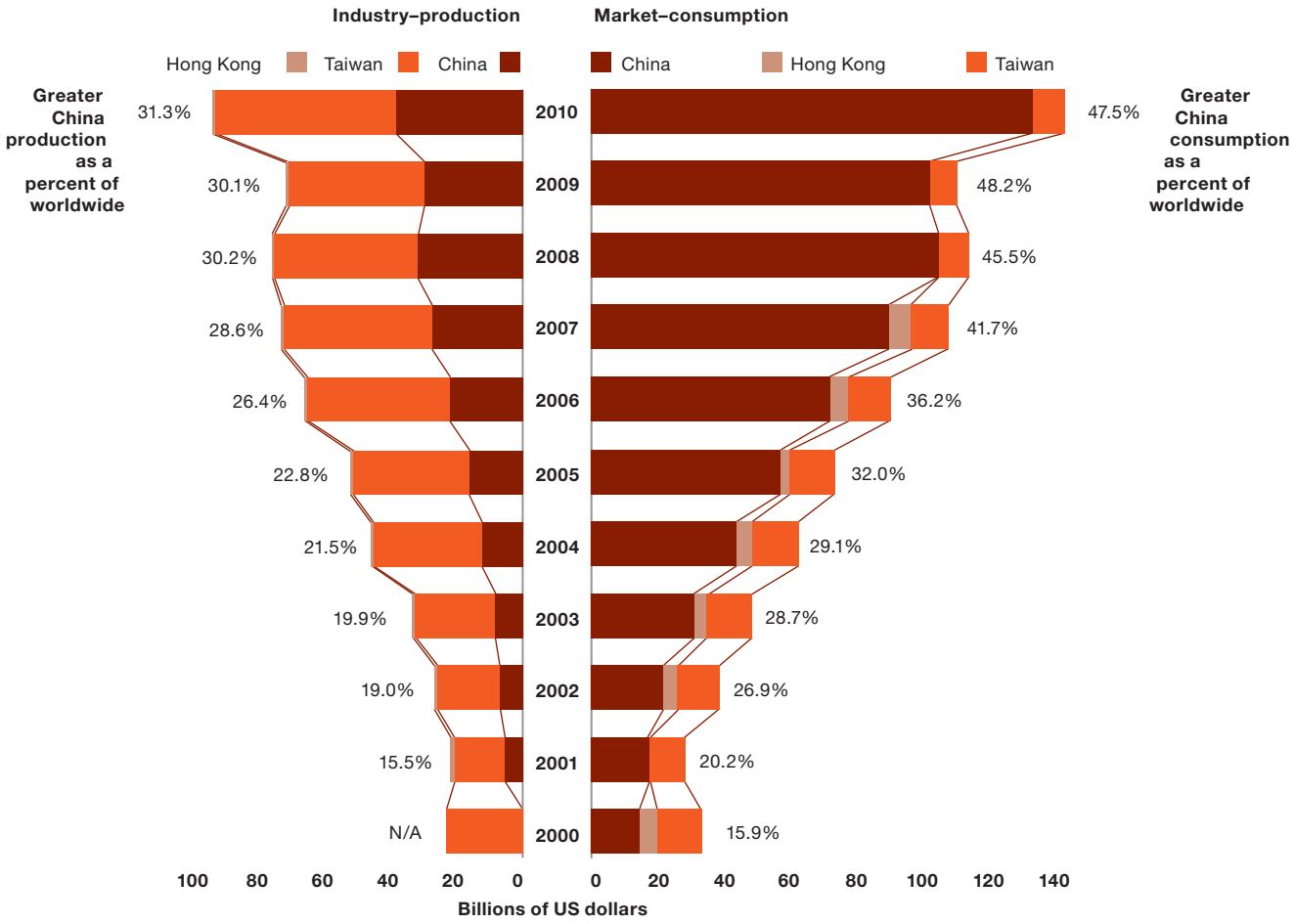
Also, in March 2011, Taiwan's National Chip Implementation Center, which promotes IC and system design technology, announced a new method of fabricating multi-chip systems that can cut development time by two-thirds and costs by half. The new technology stacks chip modules with different functions on top of each other, thereby enabling a higher density of electronic components on a circuit board, which could lead—among other things—to smaller mobile devices. TSMC Chairman Morris Chang calls the new technology, dubbed "MorPACK", a paradigm shift.

More positive cross-Strait developments

The Greater China semiconductor industry received a fillip in March 2011 when the Taiwan government opened the door for the first time to investment from China in sensitive high-tech industries. The new rules allow Chinese investors to take investment stakes of up to 10% in Taiwan's technology companies, including semiconductor and flat-panel manufacturers, and up to 50% in new technology-sector joint ventures. The new rules give Chinese investors access to some of Taiwan's most globally competitive companies, including semiconductor manufacturer TSMC. For Taiwanese companies, the new rules will make it easier to forge strategic alliances with their customers or suppliers in China, which is already by far Taiwan's biggest export market. The move is also a sign of greater comfort in Taiwan with establishing closer economic ties with China.

Another recent positive development was the Beijing government's announcement in February 2011, as part of its 12th five-year plan, setting out six measures to stimulate the development of China's software and semiconductor industries. In essence, the new policy will shift the emphasis for development away from pursuing capacity and output growth and towards improving R&D capabilities. Semiconductor firms meeting certain conditions will be eligible to receive state funding support, and the government will also introduce new tax breaks and incentives to encourage independent innovation. Taiwan's semiconductor companies welcome the new policy and may decide to expand their investments in China to take advantage of the tax breaks on offer.

Figure 24: Greater China share of the worldwide semiconductor industry, 2000–2010



Source: CCID, Gartner Dataquest, ICI, TSIA, WSTS, PwC 2004–2011

Greater China's impact on the semiconductor industry

Greater China was a major participant and benefited from the semiconductor industry recovery in 2010. Driven by the China market, Greater China's consumption market recovered to a record level in 2010, growing by 30% to reach US$142B. This growth, however, was almost two percentage points less than worldwide market growth. As a result, Greater China's share of the worldwide semiconductor consumption market dropped slightly to 47.5% in 2010. Since China's market was growing from a base of notably better 2009 performance than the worldwide market, its 2010 growth of 30.4% was slightly below worldwide market growth of 31.8%—while the much smaller Taiwan market only grew 24%.

During this last business cycle, Greater China has fared much better than the total industry. Over the past three years, Greater China's consumption market has increased 33% while the worldwide market increased by only 17%. This is because China's

We gauge semiconductor market share by region including Greater China to be:

	2007	2008	2009	2010	Change (10-07)
Greater China	42%	45%	48%	47%	+05%
Japan	19%	19%	17%	16%	-03%
Americas	16%	15%	17%	18%	+02%
Europe	16%	15%	13%	13%	-03%
Rest of world	07%	06%	05%	06%	-01%

consumption market has increased 48% while Taiwan's has decreased 13%. The difference between the two markets reflects the continued and sustained transfer (or off-shoring) of worldwide electronics equipment production to China from other locations, including Taiwan. As a result, China's consumption of semiconductors in 2010 has grown to be almost fourteen times that of Taiwan. A conspicuous portion of that market consumption in China continues to be created by Taiwanese EMS and ODM companies.

Taiwan's semiconductor industry continues to be larger and uses more advanced technology. It also features a number of more renowned companies and, as a result, obtained greater benefit from the 2010 recovery than did China's. Measured in US dollars,Taiwan's IC industry revenues increased 43% (but only 37% in local currency) in 2010 to a record US$54.4B. By comparison, China's IC industry grew only 31%.

During the past three years, both the China and Taiwan IC industry revenues have increased: China by 39% and Taiwan by 22%. Greater China's semiconductor industry has, in fact, performed better than the worldwide industry, growing 28% versus only 16%. During this three year period, however, the Taiwan industry's performance was much more volatile than that of China's. Much of this volatility came from Taiwan's IDM/IC sector, reflecting both the crash of the worldwide DRAM market in 2008 and 2009 and its dramatic recovery in 2010. After a two-year run of declines (-27% in 2008 and -19% in 2009), the sector abruptly grew by 86% in 2010. Taiwan's foundry and packaging plus testing sectors also contributed to the volatility, declining 2% in 2008 and again falling 9% in 2009 before growing by 36% in 2010. Taiwan's IC design sector had a more stabilizing performance, declining 6% in 2008, but growing 3% in 2009 and 18% in 2010. As a result, Taiwan's IC industry relative revenue performance improved to be slightly more than two and a half times as large as China's in 2010.

China's annual IC consumption/production gap (value of consumption less production) had been growing steadily since 2000, with only a slight decrease in 2009. However, the gap grew by 29% in 2010 to reach a new record US$86.5B. By comparison, Taiwan's annual production/consumption surplus reached over US$33B for two consecutive years in 2007 and 2008. It then decreased to US$30B in 2009 before increasing dramatically by 48% to reach a new record US$44.7B in 2010. So, on the net, Greater China had an IC consumption/production gap of US$48B in 2010. This is a continuing pattern of increases from US$41B in 2009, US$38B in 2008 and US$34B in 2007. While it is still significantly less than that of China alone, this gap is now more than 16% of the total worldwide semiconductor market.

Almost all of the wafer fab projects that were suspended or altered and then resumed after the 2008/09 semiconductor downturn—along with several additional projects—have been completed. Since the end of 2009, 29 new wafer fabs have started production in Greater China,

representing 63% of all the new fabs starting production worldwide and 45% of their capacity.

Of these, 23 were discrete/LED fabs, giving Greater China a significant 80% share of new discrete/LED fabs starting production since 2009. In addition, as of May 2011, there were 28 additional wafer fab facilities under construction in Greater China, representing 55% of all fabs under construction worldwide and 25% of their capacity. Twenty-two of these fabs under construction in Greater China are discrete/LED fabs, representing 82% of all discrete/LED fabs under construction. If and when all these fabs are completed, put into production, fully-equipped and ramped to full capacity, Greater China will have 29% of total worldwide wafer fab capacity. This includes:

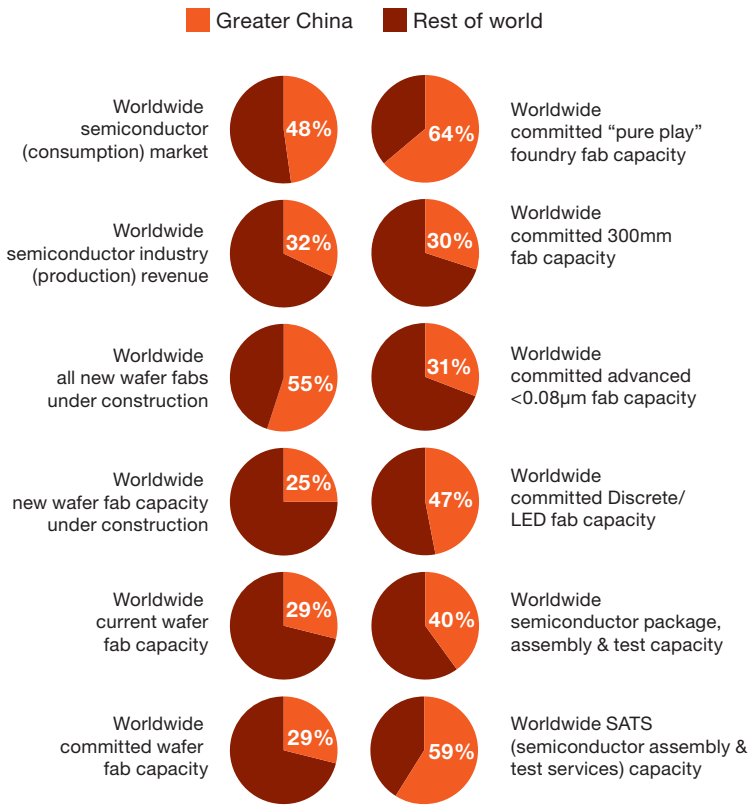
- 68% of pure-play foundry capacity;
- 47% of Discrete/LED capacity;
- 30% of 300mm capacity; and
- 31% of advanced ≤ 80µm capacity.

Four of the six new semiconductor package, assembly and test facilities that were added worldwide since 2009 were located in Greater China. As a result, Greater China continues to account for 40% of total worldwide semiconductor package, assembly and test capacity.

In summary, in 2010 Greater China represents:

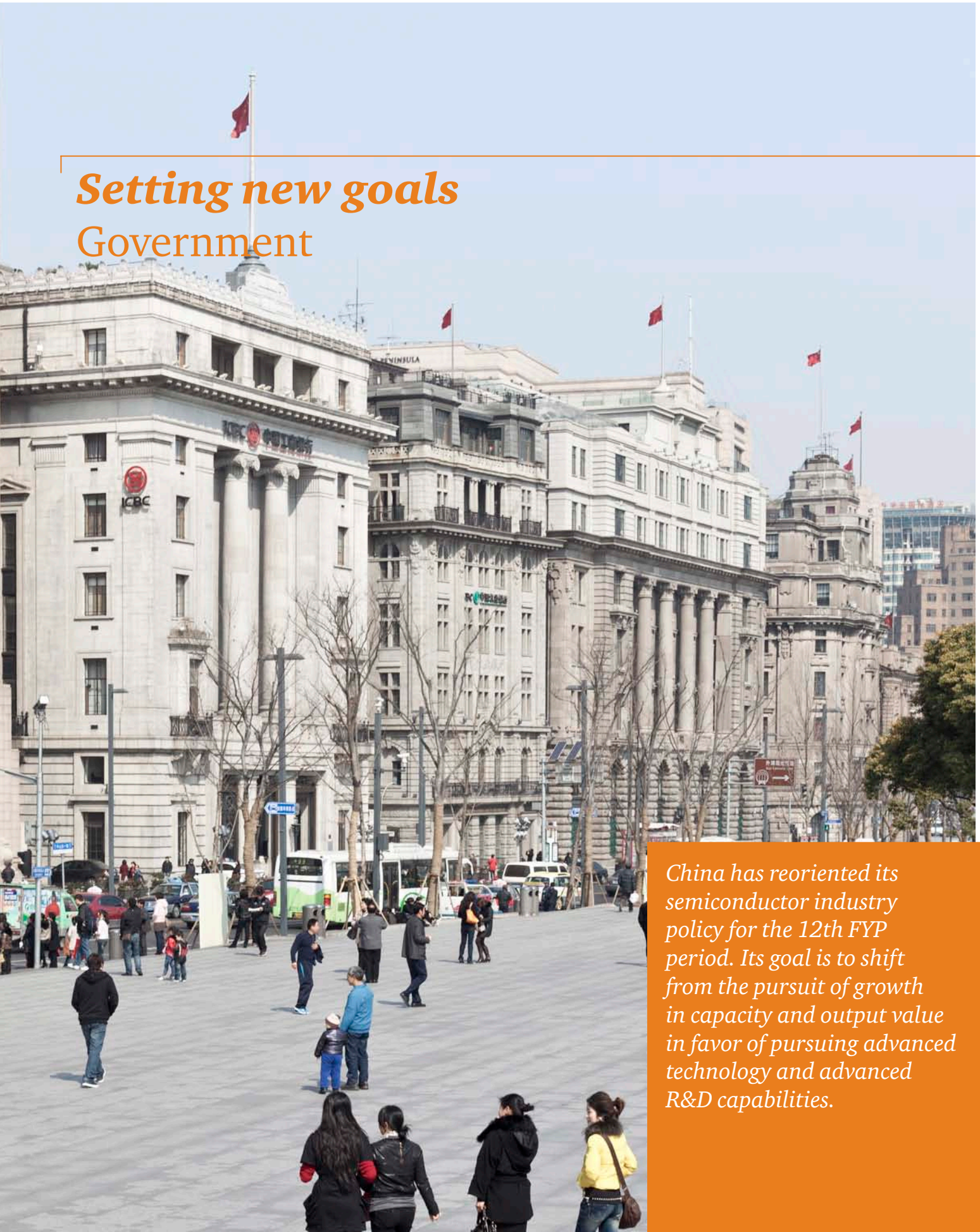
- 48% of the worldwide semiconductor (consumption) market;
- 32% of the worldwide semiconductor industry (production) revenue;
- 55% of all new wafer fabs and 25% of all fab capacity under construction;
- 29% of current worldwide wafer fab capacity;
- 29% of committed worldwide wafer capacity;
- 68% of committed worldwide pure-play foundry capacity;
- 30% of worldwide 300mm fab capacity;
- 31% of worldwide advanced, ≤ 80µm fab capacity;
- 47% of worldwide committed Discrete/LED fab capacity;
- 40% of worldwide semiconductor package, assembly & test capacity; and
- 59% of worldwide SATA (semiconductor assembly & test services, or contract) capacity.

Figure 25: Greater China represents, by 2010



Source: CCID, Gartner Dataquest, ICI, SEMI World Fab Watch, TSIA, WSTS, PwC 2009

Setting new goals
Government



China has reoriented its semiconductor industry policy for the 12th FYP period. Its goal is to shift from the pursuit of growth in capacity and output value in favor of pursuing advanced technology and advanced R&D capabilities.

China's 12th Five Year Plan

China's 12th Five Year Plan runs from 2011 through 2015. The Five Year Plans (FYPs) for China are a series of initiatives proposed and driven by the Communist Party of China to shape China's economic and social developments for every span of five years beginning in the early 1950s (1953). China's 12th FYP is less of a roadmap for a new development path for China and much more of a message to the Party ranks and government hierarchies to set parameters for "acceptable" behaviors. Still, it will result in new implementation policies affecting the semiconductor industry.

The 1st to 5th FYPs (1953–1980) were aimed a dealing with shortages of goods and materials within China and therefore concentrated on increasing production of materials essential for everyday life and industrial production such as iron, steel, coal and cotton.

The 6th to 8th FYPs (1981–1995) focused on expanding basic infrastructure throughout the country, including railways, power generation facilities and networks, highways, ports, airports and telephone and communications networks. These plans also opened up 1,100 towns and cities in the Yangtze River Basin to foreign trade. One of the most important was Pudong in Shanghai. This move accelerated the development of foreign trade and could be considered the first phase of China's transition towards a modern society.

The 9th FYP (1996–2000) explicitly listed the machinery, petrochemicals, vehicles, construction and semiconductor industries as key industries for China's medium-term development. The goal of this was to adjust the industrial structure to increase the share of GDP accounted for by industry and the science and technology sectors so that they could become the key drivers of long-term national development. The provisions for the semiconductor industry established goals for the construction of 6-inch and 8-inch wafer fabs for 0.5µm and for investment in R&D for 0.3µm processes.

The 10th and 11th FYPs (2001–2010) continued to pursue stable economic growth, adding the objective of doubling GDP between 2001 and 2010. Key goals included increasing the capacity for independent innovation, enabling firms to obtain key technologies by investing in R&D and raising their level of competitiveness with major international players. These FYPs shared a focus on opening markets and adjusting the industrial structure to achieve sustained economic growth. The 10th FYP including phased targets to increase individual disposable income and the 11th FYP concentrated on building a market-led, private business-centered economy. This policy direction also became the main motivation for promoting the growth of China's semiconductor industry. The semiconductor industry was, in fact, listed as one of the key industries for state support and was therefore the beneficiary of a series of tax incentive policies and measures. China notably exceeded the economic targets set during the 10th and 11th FYP periods. China's GDP grew from 11 trillion RMB in 2001 to 39.8 trillion RMB in 2010, while the disposable income of both the urban population and the average net income of the rural population doubled several times over. Likewise China's semiconductor industry revenues grew more than seven times, from US$5B (42B RMB) in 2001 to US$38B (26 billion RMB) in 2010.

The 12th FYP makes it clear that China, which became the world's number two economy in 2010, has now turned its attention from the pursuit of national strength to increasing its people's prosperity. The 12th FYP marks a shift away from output growth to R&D and overall industry competitiveness. It places far greater emphasis on internal markets and domestic demand than prior FYPs and includes industrial structures that emphasize added value.

The Conference Board China Center has identified eight imperatives implicit in China's 12th FYP and deemed to be of the highest priority that offers MNCs important alignment opportunities:

1. Maintaining export competitiveness
2. Solving the energy import challenge
3. Solving the food import challenge
4. Slowing the growth rate of resource mal-distribution
5. Maintaining a respectable rate of improvement in standards of living and quality of life
6. Institutionalizing more stable balances and controls in administrative and regulatory activities at every non-central level to curtail corruption, abuse of power and misalignment with national government priorities
7. Creating a sustainable role for China in regional economic, political and security relationships
8. Repairing and enhancing global perceptions of China's interests, roles and impacts on the major issues facing the globe physically, economically and politically

A value proposition that speaks compellingly to one or several of these imperatives should serve to avail opportunities and/or allay regulatory pressure as precedent shows that MNCs tend to be permitted to expand and build their business, both formally and informally (i.e., with no objections from regulators), commensurate with their perceived contribution to China and to their specific Chinese stakeholders.

China has reoriented its semiconductor industry policy for the 12th FYP period. Its goal is to shift from the pursuit of growth in capacity and output value in favor of pursuing advanced technology and advanced R&D capabilities. China's stated policy objectives are to transform the industry into one of the world's major development and manufacturing bases. The plan calls for sufficient capacity to cater to the majority of China's domestic demand while achieving a certain level of exports. Moreover, its goal is to reduce the manufacturing process technology gap between China and more advanced nations. One way this will be achieved is by fostering a group of globally competitive semiconductor firms that will develop into global leaders in terms of both technological standards and market share.

The 12th FYP continues to support the industry by means such as expanding domestic demand, promoting the seven new major strategic industries, providing funding and subsidies for major scientific and

The 12th FYP makes it clear that China, which became the world's number two economy in 2010, has now turned its attention from the pursuit of national strength to increasing its people's prosperity.

technological projects and intensifying reform of the financial markets.

State Council Rule 32 (2010), published October 10, 2010, defines policies that are incorporated into the 12th FYP. It designates seven major sectors as strategic new industries:

- Energy saving and environmental protection;
- Biotechnology;
- Advanced equipment manufacturing;
- Next-generation IT;
- New energy sources;
- New materials, and
- New energy-source-powered vehicles.

The semiconductor industry is included as one link in the infrastructure for next generation IT and, therefore, relevant semiconductor businesses will be able to receive government support providing they meet the proper conditions. Rule 32 also sets policy goals for these seven new strategic industries to reach 8% of China's GDP by 2015, increasing to 15% by 2020. To achieve these targets, Rule 32 also calls for three government-supported measures:

- Tax incentives;
- Expansion of government purchases of relevant businesses; and
- Establishment of specialized funds for the development of strategic new industries.

Rule 32 also specifies four measures aimed at private funds. These include:

- Encouraging financial organizations to expand credit support for businesses;
- Pushing the development of venture capital and equity investment funds;
- Pushing the development of capital markets such as securities and bonds; and
- Diversifying financing channels for businesses.

Support for the semiconductor industry under Rule 32 and in the 12th FYP is markedly more indirect than in previous FYPs. The most direct source of support for the semiconductor industry, in fact, comes only from funding and subsidies for major scientific and technological projects. The semiconductor industry had been the recipient of long-term support as one of China's strategic industries since the 9th FYP.

Under this latest FYP, the industry is now a subset within seven new strategic industries—specifically residing as one part of the infrastructure for the next-generation IT industry. This could be a sign that the industry's importance to China's development and economic growth could be declining.

However, at the Executive Meeting of the State Council on January 12, 2011, it was noted that the software and semiconductor industries were in fact new national strategic industries. As such, they are vital foundations for the creation of an information-based society in China. This helped to confirm that these industries retain an important strategic role in China's national and economic development outside the framework of the seven new industries. The State Council has therefore set out six policies to further the development of the software and semiconductor industries:

- Strengthen investment and financing;
- Expand support for research and development;
- Implement tax incentives;
- Improve measures to retain and attract talent;

- Provide strict enforcement of protections for IP rights; and
- Regulate markets to maintain order.

State Council Rule 4 (2011), issued January 28, 2011, is the most important core government policy for the development of China's semiconductor industry during the 12th FYP period. While Rule 32 (2010) and the six measures for the software and semiconductor industries set out direction for policy and development activities for the semiconductor industry, Rule 4 (2011) sets out specific encouragement and incentive measures for China-based semiconductor firms. This could be regarded as the successor to the policies of State Council Rule 18 (2000)—which applied during the 10th and 11th FYP periods.

Henceforth, semiconductor firms will receive the support of national tax incentives as long as they are capable of making a profit. Those unable to generate profits will face a commensurate lack of government support, making it more difficult to invest in advanced processes, R&D or capacity expansion.

Of all the policies set out in Rule 4 (2011), those relating to tax incentives will be the most critical to the development of China's semiconductor industry and most likely to affect associated investment. Rule 4 rescinds VAT incentives for semiconductor firms in favor of business tax breaks. It also expands corporate income tax incentives and extends these to include semiconductor package, testing specialist materials and equipment firms.

More importantly, instituting tax incentives through corporate income tax means that only profit-making businesses are eligible to benefit from them. The shift in tax incentives seen in Rule 4 reflects the 12th FYP policy objectives of improving R&D and technology to create companies with strong technical capabilities and large output. This is a change in direction relative to the 10th and 11th FYPs, which had focused on expanding capacity and output. At that time, companies were subsidized through tax incentives regardless of whether they were profitable or not.

Henceforth, semiconductor firms will receive the support of national tax incentives as long as they are capable of making a profit. Those unable to generate profits will face a commensurate lack of government support, making it more difficult to invest in advanced processes, R&D or capacity expansion. This change in tax incentive policy may increase the degree of concentration in China's semiconductor industry and indirectly work to accelerate mergers between companies in the industry.

Alongside tax incentives, Rule 4 (2011) also includes several investment fundraising-related measures that will become another focal point for the development of the semiconductor industry. There are three government investment and policy measures that provide government subsidies for semiconductor firms on a selective basis. Only those firms that have advanced technology and R&D capabilities should expect to receive such subsidies. Meanwhile, there are five fundraising measures that provide for diversifying financing channels. This will enable the government to reduce its share of investment in companies by increasing the propor-

tion of funds coming from private financing. These measures are largely an extension of the goals stated in the 11th FYP: "create a semiconductor industry centered on private companies and possessing independently developed advanced technologies".

The effects of the relevant policies of China's 12th FYP are projected to move China's IC manufacturing industry in two key directions: increasing and accelerating concentration within the sector and increasing the number of firms funded from security market listings. The following results are likely:

- Increased number of Chinese IC design firms;
- Increased concentration of China's IC design industry;
- Increased IC design share of China's semiconductor industry revenue;
- Mobile communications to become more central to China's semiconductor industry technology and development;
- Advanced packaging to become a key technology for next generation IT (within the 12 FYP seven new strategic industries);
- Increased concentration of China's IC wafer foundry industry;
- Increased Chinese government stake in IC wafer foundry firms; and
- Decreased IC wafer foundry share of China's semiconductor industry revenue.

Although the MIIT official FYP for the 2011-2015 period has yet to be published, there have been several semi-official press releases and statements that provide an insight into their designs for the semiconductor industry. One states that "the goal

is for China-made IC sales to exceed 330 billion yuan (or RMB, about US$49B) and meet 27.5 percent of domestic demand in 2015."

Another source, Xinhua, quoting MIIT Vice Minister Yang Xueshan (EE Times Asia 4/25/2011), says that the MIIT expects China's IC market to top US$180B in 2015. If attained, this goal would require China's IC industry to achieve an average 18% CAGR over the next five years, while projecting that China's IC market would grow at a 10.6% CAGR.

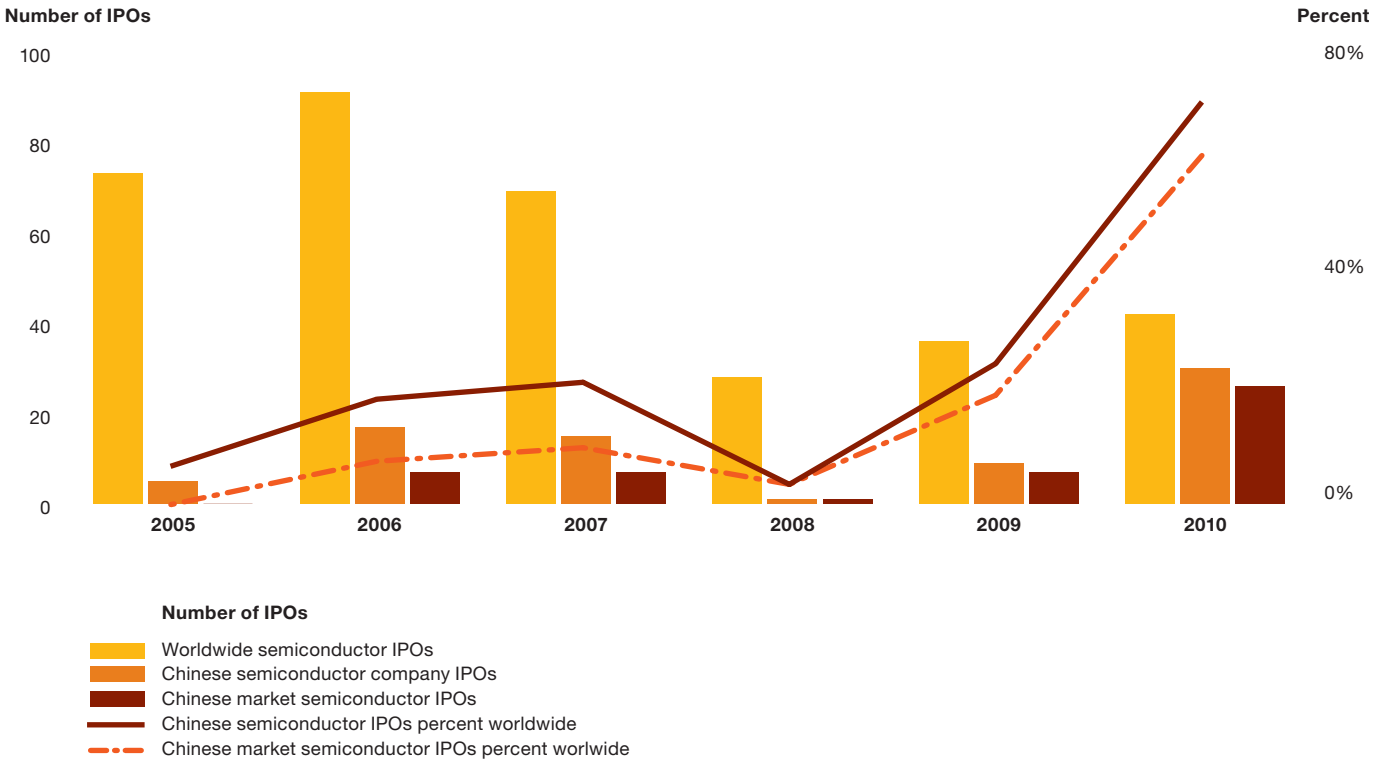
Finally, in the EE Times Confidential Special Report: China Fabless Profile (Summer 2011), this quote appears: "In China's 12th FYP, which took effect this year, the central government

has called for the country's total IC design revenues to double from about US$7.7B in 2010 to roughly US$16B in 2015." Attainment of this goal would require China's IC design sector to achieve an average 16% CAGR over the next five years.

Financial markets and IPO funding

As noted in last year's update report, China has emerged as a significant source of new companies and, more recently, of financial funding for semiconductor start-ups. According to Thomson Reuters, Chinese domiciled companies represented the second largest group of semiconductor IPOs (initial public offerings) completed between 2005 and 2010. During that period, there were a total of 339 semiconductor IPOs completed worldwide, including 52 by South Korean, 77 by Chinese and 100 by Taiwanese companies. The 77 Chinese IPOs represented 23% of the number of IPOs and 43% of the proceeds realized. However, prior to 2009, less than half of Chinese IPOs were completed in China's financial markets. That trend changed very significantly in 2009 with the opening of the Shenzhen Stock Exchange Small and Medium Enterprise (SME) Board and the ChiNext Board to facilitate fund-raising of small- and medium-sized enterprises and growing venture enterprises. ChiNext was launched in 2009 and offered a new capital platform for Chinese enterprises engaged in innovation and other growing industries.

Figure 26: China versus worldwide semiconductor IPOs, 2005–2010



Source: Thomson Reuters 2010

There was also a significant rebound of IPO activities in the Greater China capital markets in the second half of 2009, even though other worldwide capital markets were still suffering from the global recession and contracting economies. As result, nine Chinese companies represented 25% of the 36 semiconductor IPOs completed in 2009 and 77% of the funds raised by completed IPOs in 2009. Seven of those nine IPOs were completed in China's financial markets, accounting for 75% of all worldwide semiconductor IPO funding in 2009.

That momentum continued through 2010, with 30 Chinese companies completing more than 70% of the 42 semiconductor IPOs completed in 2010. Twenty-six of these took place in China's financial markets, accounting for 65% of total funding. During 2010, China overshadowed the US and the rest of the world with the most technology IPOs—67 Chinese companies completed their IPOs in 2010 as compared to 19 US companies. China's Shenzhen exchange displaced NASDAQ as the leading exchange for technology IPOs, accounting for 49% (53) of total deals and 40% (US$7.2B) of total funds raised. China's strong showing was largely a result of its focus on technology manufacturing and the semiconductor and alternative energy subsectors.

While China's predominance in technology IPOs has continued through the first two quarters of 2011, the number of semiconductor IPOs has decreased significantly. There were three times as many internet software & services IPOs as semiconductor IPOs. Chinese companies accounted for 60% of the 53 technology IPOs that were completed during the first two quarters of 2011. However, there were only six semiconductor IPOs

Table 11: China versus worldwide semiconductor IPOs 2005–2010

	2005	2006	2007	2008	2009	2010	1Q/11	2Q/11	Total 6 yrs 2005–10
Worldwide semiconductor IPOs									
Number of IPOs	73	91	69	28	36	42	3	3	339
Proceeds (US$ millions)	3,006.0	3,663.8	3,727.1	678.2	1,693.6	6,202.6	278.5	995.0	18971.3
Chinese semiconductor company IPOs									
Number of IPOs	5	17	15	1	9	30	1	1	77
% of worldwide	6.8%	18.7%	21.7%	3.6%	25.0%	71.4%	33.3%	33.3%	22.7%
Proceeds (US$ millions)	407.9	743.6	1,109.5	37.4	1,308.9	4,493.5	63.0	135.0	8100.9
% of worldwide	13.6%	20.3%	29.8%	5.5%	77.3%	72.4%	22.6%	13.6%	42.7%
Chinese market semiconductor IPOs									
Number of IPOs	0	7	7	1	7	26	0	1	48
% of worldwide	0.0%	7.7%	10.1%	3.6%	19.4%	61.9%	0.0%	33.3%	14.2%
Proceeds (US$ millions)	0.0	285.5	351.6	37.4	1,270.7	4,062.5	0.0	135.0	6007.7
% of worldwide	0.0%	7.8%	9.4%	5.5%	75.0%	65.5%	0.0%	13.6%	31.7%

Chinese semiconductor company = domiciled in China

Source: Thomson Reuters 2010–2011

completed during this period and just two were for Chinese companies. Although second quarter IPO activity was robust, growing market uncertainty about slowing economic growth, combined with volatility in global capital markets, may slow the enthusiasm for IPOs in the coming quarters.

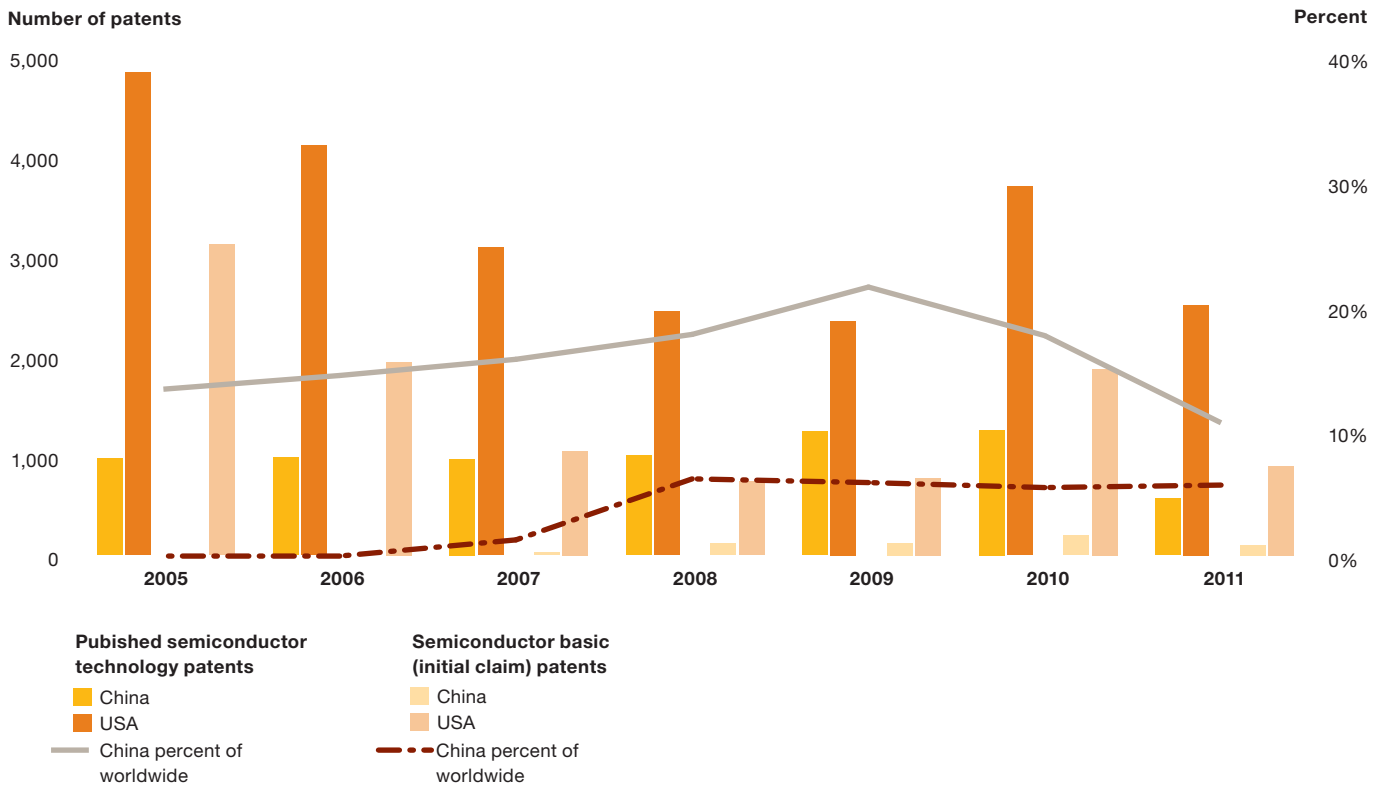
Over the longer term, it is expected that the 12th FYP's policies aimed at promoting different levels of market stock transfer mechanisms will help businesses to expand financial channels in phases as their operations grow in scale. This will likely provide greater incentive for Chinese semiconductor companies to list themselves on these domestic exchanges.

Semiconductor patents

One of the policy objectives of the 12th FYP for the semiconductor industry is to foster a group of semiconductor firms that will develop into global leaders in terms of both technology standards and market share. Rule 4 (2011) aims to create globally competitive Chinese semiconductor firms assisted by seven policy areas, including an IP protection policy.

Generally, Rule 4 (2011) reinforces the focus of the Chinese government to promote and support the software and IC industries. This includes the continuation of existing tax incentives, for example, the reduced corporate income tax (CIT) rate of 15% for new/high technology enterprises (NHTEs).

Figure 27: China versus worldwide semiconductor patents 2005–2010



One of the criteria for qualification for NHTE status is the number and quality of core proprietary intellectual property (IP) rights. According to data from the Derwent worldwide patent database, China's share of worldwide semiconductor technology focused patents published by year had increased from 13.4% in 2005 to a peak of 21.6% in 2009 before declining to 17.7% in 2010. China's share declined further during the first half of 2011 and is forecast to decline to about 11% for 2011.

Perhaps more important is the gradual growth of China's share in the first instance of a semiconductor patents publication, referred to as the patent basic statistic.

Perhaps more important is the gradual growth of China's share in the first instance of a semiconductor patents publication, referred to as the patent basic statistic. China had no semiconductor patents basic issued in 2005 or 2006. Then, in 2007, the figure grew to 1.3% and then in 2008 to 6.2%. Following a decline to 5.5% in 2010, China is now expected to account for about 6% of semiconductor patents basic issued during 2011. This means that for the past four years, 5% to 6% of patents on semiconductor inventions are being first issued in China. Further research with the Innography patent data base reveals that these Chinese semiconductor patents are being issued to companies registered outside of China (this might include SMIC which is incorporated in the Cayman Islands), but that the majority of the listed inventors are identified as of Chinese nationality.

Evaluating outcomes
Production growth scenarios

China's IC consumption exceeded our aggressive growth scenarios for every year since 2003. However, China's IC production, which exceeded the original conservative scenario for every year since 2003, fell short of the moderate scenario in 2009 and 2010.

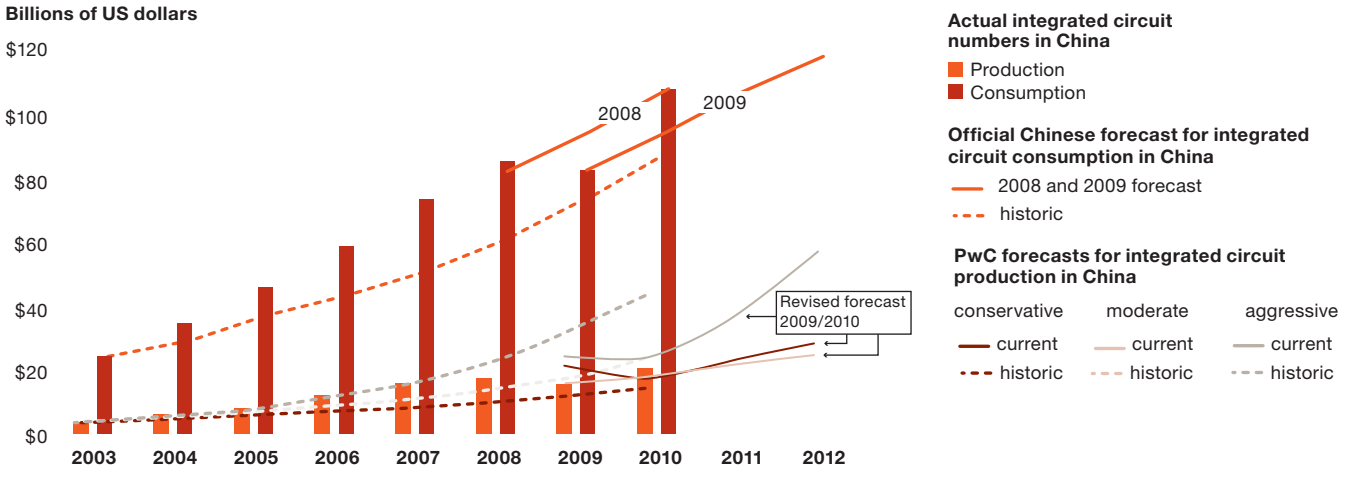
Overview

PwC's original 2004 report examined the effects that different levels of growth in the Chinese IC semiconductor industry would have on the greater industry. We used scenarios that spanned the time period of 2003 through 2010. We also analyzed the developments, investments and milestones that would need to occur for China to achieve each level of growth during the forecast period. Finally, we predicted the likelihood that China would achieve each level of growth—conservative, moderate or aggressive—based upon then current market conditions.

In subsequent updates, we reexamined these original production growth scenarios and revised our analysis. Before the global recession, we had not identified any fundamental changes that would cause the basic concepts of our original production growth scenarios to be changed. However, we did add revisions to each scenario for the 2008 Update, reflecting the application of then current market conditions to those concepts.

The global recession significantly altered the relative likelihood of those revised scenarios. While it remains very likely that our original market projection and conservative production scenario would be met or exceeded, the 2008 revised scenarios become very unlikely. Further, the global recession made revisions based upon our conservative production concepts less likely than those based upon our moderate concepts. An examination of those scenarios and recent history may provide a better understanding of China's recent and potential impact on the semiconductor industry. Those revisions along with our original forecasts are shown in Figure 28 where we have also added actual consumption and production through 2010 for comparison.

Figure 28: China's integrated circuit production and consumption forecasts compared with actual



Source: CSIA, CCID, World Fab Watch, PricewaterhouseCoopers

Conservative growth scenario

Our conservative growth scenario was based upon the assumption that China would only be able to equip and ramp to full capacity at mature yields all current and committed wafer fabrication plants that existed as of mid 2004. Under those original assumptions, China's IC industry revenues were forecast to reach US$16B by 2010. In the 2008 Update, we refined our scenario model to incorporate a trend of continuing decreasing average wafer values to US$800 per 8-inch equivalent wafer with an average of 90% capacity utilization. We also assumed that the plants then under construction would realize only 50% of their nominal capacity by 2010.

As a result of the global recession, CSIA in March 2010 had forecast IC production revenue to increase to 128 billion Yuan (US$18.7B at 2009 FX rates) by 2010 and to 172 billion Yuan (US$25.2B) by 2012.

To better reflect the realities of the global recession, in the 2009 Update we further refined this scenario model to consider a three-year recovery cycle through 2011, a further decrease in average wafer price to US$700 and a 40% increase in equipment required to reach full capacity. That revised scenario could have resulted in an increase in 2012 IC production revenue to US$30B, requiring an additional investment of at least US$19B for capital equipment and facilities. Although SEMI and others reported that the Chinese government was likely to invest a total of over US$20B in semiconductors over the next five years, we concluded that attainment of this scenario projection no longer appeared probable. It seemed unlikely, regardless of availability, that anyone would make such large investments in additional semiconductor capacity—especially in less-than-advanced technology—at least until a recovery from the world economic crises was clearly underway.

Moderate growth scenario

Our moderate growth scenario was based upon China achieving the specific objectives articulated by the Chinese Semiconductor Industry Association (CSIA) in 2002, with IC production revenues forecasted to reach US$24.1B by 2010. These objectives called for meeting 50% of domestic demand by 2010 with IC production of 20 billion pieces and revenue of 60 to 80 Yuan (US$7.2B to US$9.6B) by 2005. It then called for 50 billion pieces and revenue of 200 billion Yuan (US$24.1B at then current FX rates) by 2010. This forecast represented a CAGR of 25% from 2004 to 2010.

As a result of the global recession, CSIA in March 2010 had forecast IC production revenue to increase to 128 billion Yuan (US$18.7B at 2009 FX rates) by 2010 and to 172 billion Yuan (US$25.2B) by 2012. That forecast represented a CAGR of 15.8% from 2009 to 2012, but fell short of the CSIA's original revenue objective—and well short of their 50% of domestic demand objective (practically reaching no more than 20% of China's consumption demand by 2010). However, in order to realize this revised moderate growth scenario, China would require further capital investment of less than US$8B. The investment requirements for that revised moderate scenario became less than half that of the revised conservative scenario. As a result, achievement of the revised moderate scenario appeared to be more probable than achievement of the revised conservative scenario.

The global recession made the scenario revisions based upon our conservative production concepts less likely than those based upon our moderate concepts. The basic premises underpinning our conservative scenario concepts were: a) that future achievements are more determined by capabilities than by intentions and that b) if you build it they will come, or, in other words, investments made in physical plants would ultimately be completed and utilized. The resulting concepts were effective for the earlier years. But with the recession, it appears not all wafer fabs that have started construction will be completed nor that all of those starting production will soon be fully equipped and ramped to full production. This is because: investment requirements for large, leading-edge plants have increased significantly; investment sources have dried up; physical plants can be initially built as lower-cost shells with individual modules completed on an as-needed or as-financed basis only; equipment investment requirements are three to four times as much as plant investment requirements; investments are being focused on advancing technology capabilities rather than increasing capacity; and, with one notable IDM exception, China continues to lag in wafer fabrication technology by more than two years.

Aggressive growth scenario

Our aggressive growth scenario was based upon the assumption that the Chinese semiconductor market would grow from its 2003 level at 20% CAGR, twice the worldwide rate. It also called for China achieving its goal of having its IC industry revenues equal to at least half of its market demand by 2010, amounting to US$44.8B in that year. Under those original assumptions, China's IC market was forecast to reach US$89.5B by 2010. The Chinese authorities have postponed their goal of growing their IC industry revenues to equal half of their IC consumption market from 2010 to some indefinite time in the future. However, our aggressive growth scenario remained based upon that concept for comparative purposes through 2010. Under the 2009 revision to that aggressive growth scenario, China's IC industry would have had to reach revenues of US$47.5B by 2010 (which was impossible) or to US$59.6B by 2012 (which represented a 54% CAGR from 2009 to 2012—also very unlikely).

Furthermore, under the most likely business model, that scenario would have required China to increase its wafer fab capacity to almost 4,500,000 8-inch equivalent WSpM (wafer starts per month) by 2012. This would require an additional investment of about US$50B beyond that required for the conservative growth scenario—another unlikely scenario. We believe that the size of the required investment and the uncertainties of being able to undertake such a plan probably explain why the goal of growing the IC industry to equal half of the IC market has been indefinitely postponed.

This scenario is most sensitive to China's IC industry business model and reporting practices. Assume that China would be able to radically expand its design (fabless) sector to achieve a business model where all its wafer fabrication and packaging and testing production could be used to support that design. Assume also that the nation would continue its current reporting practices, with its inherent double counting. Under these circumstances, the aggressive scenario could have been achieved simply by completing and fully utilizing four additional new plus all the current and committed wafer fabrication plants.

This would reduce the required additional capital investment to about US$5B, for a total investment of US$25B by 2012. However, all this would still require China's design (fabless) sector to grow more than nine times during the three years from 2010-2012. While we consider that to be an impractical scenario, we believe it provides valuable insight into the impact of that business model and China's motivation to continue incentivizing the development of their IC design sector.

China's performance compared with the scenarios

Figure 28 includes China's actual performance for 2003 through 2010. Comparing actual performance to our original scenarios shows that China's IC consumption exceeded our aggressive growth scenarios for every year since 2003. However, China's IC production, which exceeded the original conservative scenario for every year since 2003, fell short of the moderate scenario in 2009 and 2010. It also totally missed the aggressive scenario in 2009 and 2010 after falling short of this yardstick for the first time in 2008.

In fact, both the revised conservative and moderate scenarios were achieved in 2010. According to the CSIA 2011 annual report, China's IC unit production increased 57.5% to 65.2 billion pieces, while IC production revenue increased 29.8% to 144 billion Yuan (US$21.3B) in 2010.

Several factors have contributed to this outcome. China's IC consumption market has grown more than two and a half times the worldwide rate and much faster than forecast. China's IC market has grown at a 23.3% CAGR from 2003 to 2010, while the worldwide IC market has grown at a 8.5% CAGR. The negative impact of the global recession on China's IC consumption, measured against a 2007 average quarter baseline, occurred later and was less severe than on the worldwide market. As a result, China accounted for more than three quarters of the total net increase in the worldwide IC market between 2003 and 2010. During those seven years, China's IC consumption market grew from US$25B to US$109B, an increase of US$84B, while the worldwide consumption market grew from US$140B to US$248B, an increase of US$108B.

China's IC market growth is now expected to moderate, approaching the worldwide rate. The CSIA now forecasts that China's IC market growth in local currency (RMB) will average almost 11.6% CAGR for the next three years through 2013. This is approximately 3% greater than is currently forecast for the worldwide market growth rate.

China's IC production was more severely affected by the global recession in 2009 than the worldwide industry. As a result, while China's IC production has increased by an average 26% CAGR during the past seven years, that rate was down from 40% for the first four years, was less than our moderate scenario and significantly less than our aggressive scenario. The very high rate of growth achieved through 2007 was the result of:

- An extraordinary 190% increase in the IC manufacturing (primarily foundry) sector in 2004;
- Three years of greater than 50% per year growth in the IC design (fabless) sector between 2004 and 2006; and
- A greater than 40% increase in the IC packaging & test sector in 2006.

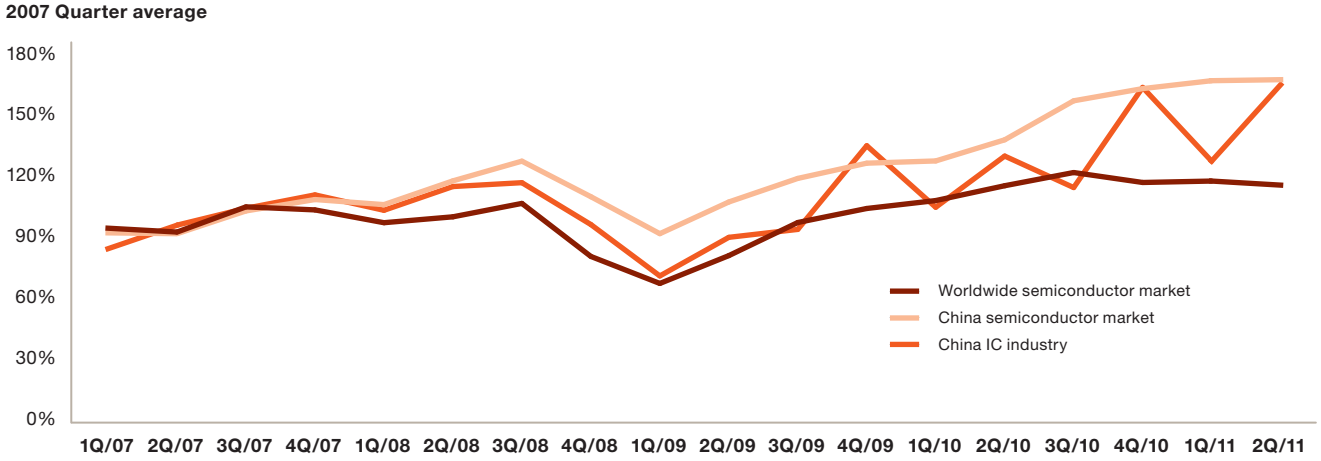
China has fewer, but much larger, IC wafer fabs than was expected in 2004. By the end of 2010, China had more (51) IC wafer fabs in production than committed (46) at the start of 2004, with significantly more capacity, (1,701K versus 939K 8-inch equivalent Wafer Starts per Month). Also, China has more than doubled the amount of IC packaging and testing done with imported wafers since 2005. China's IC production declined by 10% in 2009 as a result of the global recession, and recovered slightly more slowly, 31% versus 32%, than the worldwide industry in 2010. China's expectations for IC industry growth have improved significantly from a year ago. The CSIA forecasts that China's IC production in local currency (RMB) will average almost a 20% CAGR for the next three years through 2013, significantly higher than China's IC market growth and about four percentage points higher than forecast a year ago. The CSIA forecast for China's IC industry revenue is 23% greater than their forecast of a year ago.

Recession, recovery and new scenarios

Figure 29 illustrates the relative impact of the global recession and recovery on China's IC consumption and production during the period from first quarter 2007 through second quarter 2011. It uses an index comparing China's IC consumption and production revenues for each quarter as a percent of 2007 average quarter consumption and production revenue against a similar measure of the worldwide IC market. For example, it shows that in Q1/2009, China's IC consumption had fallen to 92.9% of 2007 quarter average, IC production to 72.1% and worldwide IC market to 68.4%. The year 2007 was selected as the index base as it was the most recent complete year not affected by the global recession.

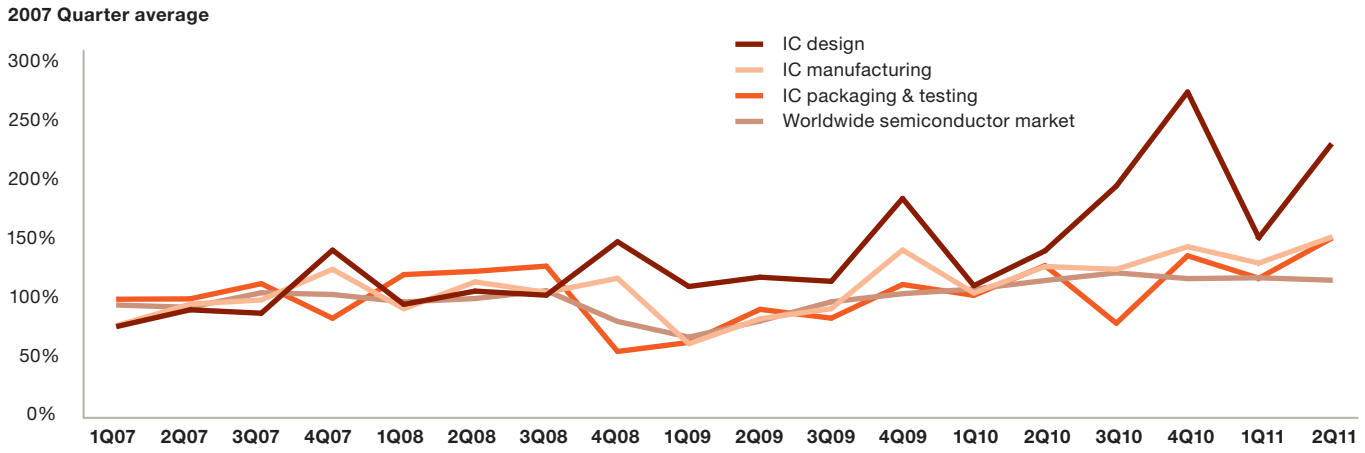
This comparison demonstrates that the impact of the global recession was later and less severe on China's IC consumption than on the worldwide IC market. China's IC consumption

Figure 29: Comparison of China vs. worldwide semiconductor growth by quarter, 2007–2010



Note: Comparison of China semiconductor market and China IC industry growth versus worldwide semiconductor market by quarter 2007–2010 indexed against 2007 average quarter.
Source: SIA, CCID, CSIA Quarterly Reports

Figure 30: Comparison of China's IC industry sector growth by quarters 2007–2010



Note: Comparison of China IC industry sectors versus worldwide semiconductor market growth by quarter 2007–2010 indexed against 2007 average quarter.

Source: CSIA, SIA Quarterly Reports

index dropped below 100% for only one quarter, Q1/2009. By comparison, the worldwide IC market index dropped below 100% for four quarters, starting in Q4/2008. China's IC market recovery was earlier and stronger than the worldwide IC market recovery. Since Q1/2008, China's IC market has outperformed the worldwide IC market every quarter.

This comparison also demonstrates that the impact of the global recession on China's IC production industry was somewhat less severe than on the worldwide IC market during the first three quarters of the recession (Q4/2008–Q2/2009), but became more severe during Q3/2009. It also shows that China's IC industry recovery since Q3/2009 was more volatile than that of the worldwide IC market, with the index dropping below that of the worldwide IC market for two quarters, Q1/2010 and Q3/2010.

China's IC industry recovery has been more volatile but stronger than that of the worldwide market. Since Q1/2008, China's IC industry has outperformed the worldwide IC market for eleven out of fourteen quarters. Further, it can be seen from this comparison that although China's IC consumption and production revenues increased slightly less than the worldwide IC market in 2010, their relative performance was better than that of the worldwide IC market because they were growing from a stronger 2009 base.

Figure 30 illustrates the relative impact of the global recession and recovery on the three segments of China's IC industry: IC design, IC manufacturing and IC packaging and testing, during the period Q1/2007 through Q2/2011. It compares revenues for each quarter as a percent of 2007 annual quarter revenues against a similar measure of the worldwide IC market. For example, it shows that in Q1/2009, China's IC design sector revenue was 111.4% of its 2007 quarter average. Meanwhile, IC manufacturing sector revenues dropped to 62.8% and IC packaging and testing sector revenues fell to 63.9%.

This comparison illustrates the relative strength and success of China's IC design (fabless) sector during both the recession and the subsequent

recovery. All quarters had an index value greater than 100% and, with the exception of Q3/2008, all quarters had index values larger than the worldwide IC market. China's IC design (fabless) sector continues to be strongly driven by China's semiconductor consumption market and especially China's domestic consumption. Successful companies in this sector continue to grow by a number of means. This includes: exploiting opportunities for China's white label handsets and other consumer electronic products; reducing costs for alternative products for volume-based electronic systems manufacturers; addressing unique Chinese standards and requirements for products such as smart cards and developing designs for China's major OEMs. There has also been some sector consolidation as well as continued government incentive support for new entrants and successful survivors. Therefore, we expect this sector to continue to grow faster than the other sectors of China's semiconductor industry and faster than China's consumption market.

China's IC manufacturing sector, which includes both foundries and IDM wafer fabrication facilities, was impacted by the global recession one quarter later than the worldwide IC market and not quite as severely. There were three quarters in 2009 with index values of less than 100%, two of which were a bit lower than the worldwide IC market. However, the sector had a much stronger recovery in Q4/2009 to finish with somewhat better relative annual performance for 2009. It also had one relatively lower quarter in Q1/2010, followed by three better quarters, to again finish with better relative annual performance for 2010.

Over the long term, the growth of China's IC manufacturing sector will be determined by the availability and relative cost of investment capital. Almost all of the sector revenue is produced by foundry and IDM wafer fabrication facilities. Increasing wafer fabrication capacity is very capital intensive. The Chinese government has provided some very innovative investment funding (through separate provincial agencies) for China's largest foundries, but those foundries have yet to earn an attractive return to support further expansion via internal growth or outside funding. They seem to be handicapped by high depreciation expenses and low, technology-limited, selling prices. They have also been two or more years behind their leading competitors in implementing the most advanced technologies.

China's IC manufacturing sector, which includes both foundries and IDM wafer fabrication facilities, was impacted by the global recession one quarter later than the worldwide IC market and not quite as severely.

Whether they can make the investments required to fully equip and ramp their facilities to further increase their capacity is most likely to be dependent upon continuing Chinese government assistance. The multinational IDMs have the appropriate technology and three have made significant investments in China's IC manufacturing sector. However, there is a finite and decreasing number of such IDMs and there is intense competition between different locations to attract their next wafer fab capacity investment. Whether another IDM is attracted to invest in a major wafer

fabrication plant in China will be determined by the success of the first three IDMs and the availability of attractive investment incentives. While that is a reasonable possibility, it may be several years before it has an impact on China's IC manufacturing sector. Therefore, we expect that over the next five years China's IC manufacturing sector will grow along the lines of our moderate scenario, which forecasts increases of almost 70%.

China's IC packaging and testing sector was the most severely impacted by the global recession and has had a weaker and more volatile recovery. It was the first sector to be impacted by the recession, with its index dropping more sharply than the worldwide IC market in Q4/2008. It had four successive quarters with an index of less than 100%, with three of those quarters below the worldwide IC market index. Its recovery since Q1/2010 has been variable, with its relative index performance in three of the six quarters through Q2/2011 weighing in at less than the worldwide IC market. This includes Q3/2010, when the index was below 100%.

As a result, China's IC packaging and testing sector's relative performance for all of 2009 and 2010 has been below that of the worldwide IC market. China's IC packaging and testing sector has been more affected by the worldwide semiconductor market than the local market. Most

of the sector's capacity is owned and controlled by multinational semiconductor or SATS companies with similar facilities in several regions. During business cycles, these companies will allocate capacity between their different facilities based upon cost, capability, qualification, logistic and other considerations.

During previous cycles this sector has grown faster than the worldwide market primarily because companies added capacity in China to meet their growth in worldwide demand in preference to other regions because of favorable cost considerations. But China's cost advantage for IC packaging and testing may be waning as other countries, e.g., Vietnam, Philippines, et. al., offer very competitive wage rates and incentives. On the other hand, China has developed strong infrastructure support for IC packaging. There could also be supply chain and logistical advantages for locating IC packaging and testing in China to meet the needs of China's consumption market provided customs and VAT issues are effectively resolved. As noted in our 2010 Update, if the Chinese government continues to provide competitive incentives, there is a logical reason to expect China's IC packaging and testing industry to grow faster than China's IC consumption market and to increase by at least 60% over the next five years.

If the semiconductor recovery is sustained despite current global economic uncertainties, it is expected that China's electronic systems production will continue to grow at a greater rate than worldwide production. The transfer of electronic systems production to China is forecast to continue through the next business cycle, although probably at a slower rate. Forces at work include further worldwide industry cost and market-driven restructuring, China's competitive support infrastructure, China's longer term economic stimulus programs and China's growing domestic market demand. As a result, China's semiconductor consumption market will continue to grow somewhat faster than the worldwide market and should gain at least a couple of percentage points of market share over the next five years.

However, an increasing share of this market will come from domestic consumption. If the relative share of domestic versus export consumption increases at the expected GDP growth rates of China versus the world, the share of China's semiconductor consumption market used in the production of electronic products for domestic use will increase by seven percentage points to almost 40% in five years' time. This should further increase the importance of semiconductor companies developing products that meet the unique requirements of China's domestic market, ranging from white-label handsets to transportation and medical infrastructure servers. It should also increase the government's focus and efforts to encourage the development of China's IC design (fabless) industry sector and to reduce the use of foreign-owned intellectual property.

Over the long term, the growth of China's IC manufacturing sector will be determined by the availability and relative cost of investment capital. Almost all of the sector revenue is produced by foundry and IDM wafer fabrication facilities.

Such a scenario would result in China's IC industry growing at a slightly greater than 9% pace for the next five years to reach revenue of US$33B by 2015.

New scenarios for the 12th FYP

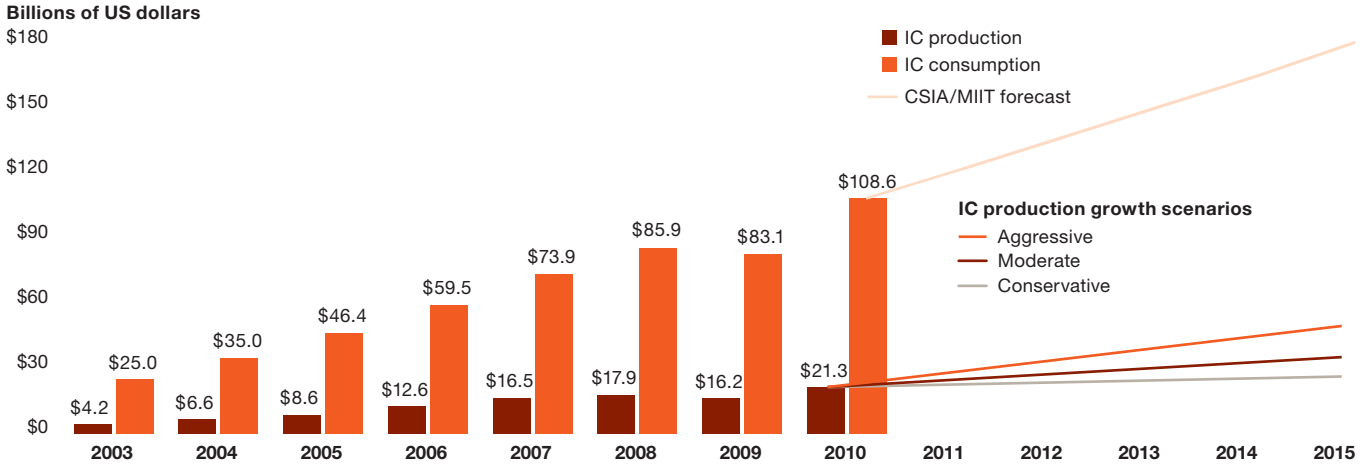
Since our original 2004 report, China has progressed through the last of its 10th and all of its 11th Five Year Plan periods and the semiconductor industry has progressed through more than one complete business cycle. Therefore, based upon those experiences, it seems appropriate to revise the basic assumptions and business models used for our further scenario analysis of China's IC industry. The following is a concise summary of our analysis of new conservative, moderate and aggressive growth scenarios for China's IC industry over the period from 2010 through 2015. The analysis covers the assumptions, business models, developments, investments and milestones for each scenario over that five year period.

The moderate scenario is based upon an assumption that China completes and fully equips all current plus its two committed IC wafer fab facilities that are currently under construction. It will further ramp all into full production and operate at a utilization and effectiveness that averages 90% of their WFW nominal capacity. Output, it is assumed, will earn an average of $600 per 8-inch equivalent wafer. This scenario further assumes that all of the resulting wafer fab output is packaged and tested in China—this being in addition to the 2010 volume of imported wafer devices packaged and tested in China. It also supposes that China's IC design sector grows at the same CAGR as the IC manufacturing sector.

Such a scenario would result in China's IC industry growing at a slightly greater than 9% pace for the next five years to reach revenue of US$33B by 2015. It would require an additional investment of about US$13B. Under this scenario, if the IC design sector were to grow at the CCID forecast of 26.7% CAGR, China's IC industry revenue would increase at more than a 14% rate to reach US$41B by 2015 for about the same capital investment. We believe this to be the most likely scenario, with about a 65% probability.

The conservative scenario is based upon an assumption that China completes and equips all current

Figure 31: China's integrated circuit production and consumption 12th FYP scenarios compared with actual



Source: CSIA CCID, World Fab Watch, PricewaterhouseCoopers

and the two committed IC wafer fab facilities currently under construction to 70% of their nominal capacity, ramps them into full production and operates them at a utilization and effectiveness that averages 90% of their 70% WFW nominal capacity. We estimate that 70% of nominal capacity is slightly more than the highest level equipped in China to date. That level was achieved in 2009, but then declined to about 61% in 2010. This scenario further assumes that all of the resulting wafer fab output is packaged and tested in China in addition to the 2010 volume of imported wafer devices packaged and tested in China, and that China's IC design sector grows at a 10% CAGR, slightly higher than China's forecast GDP growth.

This scenario would result in China's IC industry growing at a CAGR of slightly less than 5% to reach revenue of US$27B by 2015. It would require an additional investment of about US$4B. The results of this scenario are almost the same as what would result if China's IC manufacturing sector grew at the same rate as the worldwide GDP, while China's IC design grew at the same rate as China's GDP. We believe this to be a less likely scenario, with about a 20% probability.

The aggressive scenario assumes that China's IC industry and IC design sector achieves the goals established by MIIT as part of China's 12th FYP. Those goals are for China's IC industry to achieve revenue of 330 billion RMB and China's IC design sector to reach 70 billion RMB by 2015. Working from the assumptions used for the moderate scenario, these goals would require a remarkable set of circumstances, including the addition of more than 10 large wafer fab facilities (each as large as the Intel Fab 68 in Dalian), along with an additional investment of US$21B (beyond the US$13B required for the moderate scenario), bringing total investment to almost US$34B. Achievement of the MIIT 12th FYP goals will, meanwhile, require China's IC industry to achieve an 18% CAGR for the five year period through 2015. We believe this to be the least likely scenario, with a 15% probability.

Appendix
Interpreting Chinese semiconductor statistics

Despite increasing international interest and press coverage, market reports and statistics on the Chinese semiconductor industry remain difficult to obtain and are often subject to misinterpretation or skepticism. Nonetheless, this report is based, in part, on data derived from Chinese sources. We use this data for two reasons. First, Western sources on the subject are incomplete and somewhat divergent and second, this is the same data used by the Chinese policymakers.

The two principal indigenous sources for most Chinese semiconductor industry and market reports, data and statistics are the China Center for Information Industry Development (CCID) Consulting and the China Semiconductor Industry Association (CSIA). Both are associated with the Ministry of Industry and Information Technology (MIIT) and share common data sources and industry analysts. Below we delineate how these Chinese sources differ from conventional semiconductor industry statistics.

Definitional differences

CCID and CSIA measure and report on the China semiconductor market only. Their data is based upon a consumption model. They obtain data on the output of China's electronic systems production, calculate the consumption of semiconductors in every electronic product, value at current local average selling prices and then add all the consumption to get the total of China's semiconductor market size. CCID collects output data on electronic system production from MIIT, National Bureau of Statistics of China, General Administration of Customs of PRC, CCID's Electronic Products Research Database and other industry associations and organization. This is different from World Semiconductor Trade Statistics (WSTS) and most international market research firms which measure and report on the worldwide semiconductor market based upon a sales model. The WSTS and others compile their reports of semiconductor market size based upon sales revenue data collected from semiconductor companies. As a consequence, there can be significant differences and discrepancies resulting from the use of these two different models and from major inventory changes, dislocated purchasing, WSTS' lack of Chinese company participants and the difference between worldwide and Chinese local average selling prices.

In addition, CCID has had to make some noticeable adjustments to their historical Product Structure of China Semiconductor Market database to bring it into complete and inclusive alignment with the international definitions of the O-S-D market segments. It appears that prior to 2008 CCID included LEDs in their discrete market segment and only reported photo electrics rather than all optoelectronic devices. CCID's semiconductor monthly monitoring reports still only include the IC and discrete markets and not the optoelectronics and sensors markets.

Because both CCID and CSIA compile their data and write their reports in Chinese, their English-language translations of the reports contain a number of anomalies. For example, while traditional industry reports use three orders of magnitude such as thousands (kilo), millions (mega),

and billions (giga), China's reports use two orders of magnitude such as ten-thousands and hundred-millions. So analysis requires a translation to a common standard.

Further, both the CCID and CSIA compile and analyze their industry or production data based upon a structure that is somewhat different from that employed by Western analysts. This industry structure is not clearly defined in their English-language reports, but may be best described by the following statement contained in CSIA's seminal report, An Investigation Report of China's Semiconductor Industry 2002:

"The term 'the semiconductor industry' in this report covers IC [integrated circuit] design, IC manufacture, packaging and test, semiconductor discrete device and semiconductor supporting sector, etc. In view that the investigation on supporting sector is not comprehensive, the term 'China semiconductor industry' in 'General Introduction' and in its relevant statistic data excludes this sector."

Therefore, according to CCID, CSIA and MIIT usage, their reports on the Chinese semiconductor industry are based upon an industry structure organized into the following sectors:

IC design This sector includes IC design companies, institutes and laboratories, as well as all fabless IC semiconductor companies in China regardless of ownership structure. Most of the revenue and all of the unit production reported for this sector come from product sales by fabless semiconductor companies.

IC manufacture Sometimes identified as the chip manufacturing industry, this sector includes wafer foundries, wafer fabrication plants of foreign IC semiconductor companies and Chinese IC integrated device manufacturers (IDMs). As a result, the revenue and unit production reported for this sector is a heterogeneous mix of wafer and finished product unit sales.

IC packaging and testing This sector, which is sometimes identified as the encapsulation and testing industry, includes the IC semiconductor packaging, assembly and test (SPA&T) plants of foreign semiconductor companies, as well as all IC semiconductor assembly and test services (SATS) plants and companies in China.

This sector does not include the discrete SPA&T plants of foreign semiconductor companies or the IC SPA&T activities of Chinese IDMs. Nor does it include LED plants since the CSIA continues to include LEDs within the discrete industry. Because some SPA&T plants of foreign semiconductor companies use a wafer/die sale/buy-back or imported processing business model and others use a consigned wafer/die or another toll-processing business model, the revenue reported for this sector is not homogeneous and is potentially misleading. However, reported unit production is relatively homogeneous.

Discrete device This sector includes all Chinese discrete IDMs and several Chinese SPA&T plants, as well as all discrete wafer fabrication and SPA&T plants of foreign semiconductor companies in China. It also includes LEDs, which CSIA continues to include within the discrete industry sector. Because many of the SPA&T plants of foreign semiconductor companies use a consigned wafer/die business model rather than the fully-costed IDM business model, the revenue reported for this sector is not homogeneous and can be misleading. However, reported unit production is relatively consistent and reliable.

Data compilation methods

Both the CCID and CSIA compile their industry data from reports or survey responses filed by the various entities in each industry sector. These entities usually report their activities as separate stand-alone companies, and the CCID and CSIA consolidate the reports from each company in an industry sector without any eliminations or offsets. The results are often industry-sector totals that are aggregates of different inputs and therefore misleading. For example, the data might include foundry wafer revenues and wafer shipments combined with IDM finished-unit product sales revenues and unit shipments.

Because at least three of the largest SPA&T plants of foreign semiconductor companies use a wafer/die sale/buy-back business model, their reported revenues are approximately two and a quarter times as large as they would be if reported using the conventional consigned wafer/die (cost less die) basis. This reporting difference is significant and could account for an overstatement of 15% in the 2010 revenues for the IC packaging and testing sector, 7% in the 2010 revenues of the Chinese IC industry and 4% in the 2010 revenues of the overall Chinese semiconductor industry.

Probable double-counting: A hypothetical example

Because of the way the CCID and CSIA compile their data without any eliminations or offsets, it is very probable that there will be instances of double-counting between sectors. The following example—a hypothetical manufacturing flow for a Chinese fabless semiconductor company using both a Chinese wafer foundry and SATS company to manufacture its products—illustrates the impact of this approach.

In our example, Average Semiconductor is a fabless semiconductor company in the IC design sector; XMIC is a wafer foundry in the IC manufacturing sector; XSE is a SATS company in the packaging and testing sector and Solectron is an electronics manufacturing services (EMS) customer.

Further assume:

- Average buys 1,000 wafers (200mm) from XMIC for US$650 per wafer, for a total of US$650,000
- Average consigns the 1,000 wafers to XSE for assembly and testing in plastic QFN or PLCC packages with 1,250 net die per wafer and a die-free package cost of $0.17 per package, for a total of 1,250,000 finished units and value of US$212,500
- Average sells the 1,250,000 finished units to Solectron for an average selling price of US$1.00 per device, for a total of US$1,250,000

Using CCID and CSIA reporting practices, these transactions would be classified and recorded as shown in Table 12.

Under CCID and CSIA reporting practices, the revenue at each stage is included in the total—a divergence from traditional industry standards. Consequently, in this example, the total Chinese semiconductor industry revenue is overstated by 70% and the unit shipments by 100% relative to conventional industry standards.

Implications of statistical disparities

Compared with the more conventional practices and standards of the World Semiconductor Trade Statistics (WSTS) and related industry associations and analysts, these differences in CCID and CSIA reporting practices and standards could lead to notice-

Table 12: Revenue comparison
(All revenues are in US$)

	Pieces	Revenue	Revenue using industry standards
Main products			
IC manufacturing sector	1,000	$650,000	Not reported
Packaging and testing sector	1,250,000	$212,500	Not reported
IC design sector	1,250,000	$1,250,000	$1,250,000
Total	2,501,000	$2,122,500	$1,250,000

Source: CSIA, MIIT, Digitimes Research 2010–2011

able variability in reported Chinese semiconductor industry results. This variance would be greater or lower depending upon the mix of business models employed.

Furthermore, these differences could have a significant impact on China's ability to gauge the need for or to even manage the output of nationwide IC production (for example, to meet a greater share of its domestic consumption).

Consider the accounting impact as it relates to an IC device that is wafer fabricated, packaged, assembled and tested in China. Using the current CCID/CSIA reporting practices, the average reported semiconductor industry revenue could range from 62-162 RMB, depending on the scenario:

- **62 RMB** The device is manufactured by a wafer foundry and SATS supplier for a foreign fabless semiconductor company.
- **100 RMB** The device is manufactured and sold by a Chinese IDM.
- **162 RMB** The device is manufactured by a Chinese wafer foundry and SATS supplier for a Chinese fabless semiconductor company and sold by that fabless company.

This variance is significant, creating an operational and planning challenge for both China and the global semiconductor industry.

For the future, increasing international interest and visibility may encourage the CCID and CSIA to replace their current Chinese semiconductor industry reporting practices and standards with more common international standards and practices. For example, the CSIA is a member of the World Semiconductor Council (WSC). They should be encouraged to participate in the World Semiconductor Trade Statistics (WSTS) and Semiconductor International Capacity Statistics (SICAS) programs. If China elects to change to more conventional semiconductor industry reporting practices and standards, the country may find it desirable to revise the CSIA objectives accordingly.

Statistics used in our report

Despite the evident disparities, we use the aggregate statistics as reported, while carefully noting that they represent China's semiconductor industry as reported in China—that is, the sales revenue of all semiconductor companies in China as reported to the Chinese authorities. We do so because we have no way to determine which business model is being used by every company, and because Chi-

nese policymakers themselves rely upon these result. Although the tendency is for these sources to overstate the size of the industry, understatement is far less likely, we want to be careful not to understate the impact of China on the industry as a whole. Still, in cases where the Chinese have identified individual company revenues, we have been able to augment that data with information from other sources.

Identifying Chinese semiconductor companies

For a variety of translation and structural reasons, the English names of many of the Chinese semiconductor companies are often a source of confusion. Many companies have English names that are different from the literal translation of their Chinese names and often inconsistently incorporate location prefixes. As a result, the same company may be identified by a number of different English names in various reports and articles.

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Industry perspectives

During the preparation of this report, we benefited from interviews with the following executives:

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Of further interest

Below you will find a few examples of reports and papers on related topics. If you would like to view any of these, please go to the publication website at www.pwc.com/chinasemicon and click on the links. Additionally, if you would like to read more about doing business in China, please visit our Chinese website at www.pwc.com/cn.

The US-China cleantech connection: Shaping a new commercial diplomacy

What is the right cleantech China strategy for your company? As the U.S. and China deploy ambitious cleantech build-outs, opportunities for alliances and cross-border collaboration are emerging in cleantech sector "sweet spots." This 12-page report outlines where those opportunities lie.

Greater China IPO Watch 2010

This Greater China IPO Watch provides an overview of the initial public offerings (IPOs) and listing activities on Greater China's principal stock markets, including Hong Kong, Shanghai, Shenzhen and Taiwan. The analysis covers companies which were listed on these markets from 1 January to 31 December 2010. For comparability purposes, all figures in this report have been translated into United States Dollars at the applicable closing exchange rate at the end of each year.

Transfer pricing hot topics for tech companies with operations in China

This article discusses industry-specific transfer pricing challenges that technology multinational corporations in China face under the current environment. Topics include restructuring, location savings, royalty payments, characterization of entities, inter-company service charges, tax incentives, business tax exemptions and establishing appropriate mark-up rates.

The China Greentech Report 2011

The China Greentech Report 2011 analyses recent developments in the greentech sector in China and examines existing and emerging opportunities in six key sectors: cleaner conventional energy, renewable energy, electric power infrastructure, green building, cleaner transportation and clean water.

Outlook remains bright for the BRIC countries

An economic review of both the challenges and the opportunities these fast-growth countries are facing.

PwC can help

If your company is facing challenges doing business in China, or you just want to have a deeper discussion about what's happening in the market and how we can help, please reach out to one of the technology industry leaders listed below.

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