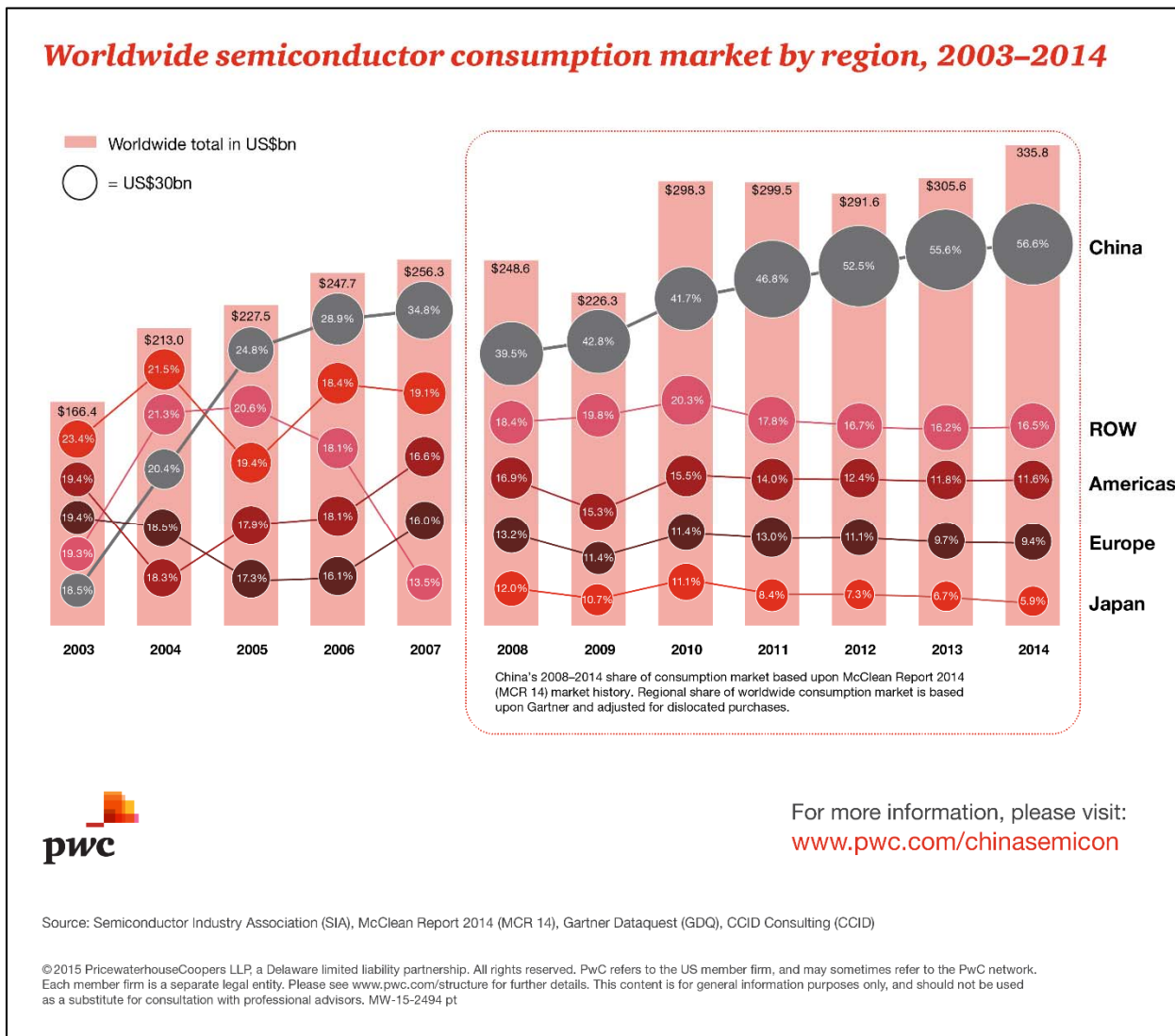


*China's impact  
on the  
semiconductor  
industry:  
2015 update*

*Technology Institute  
Groups 1-4  
January 2016*

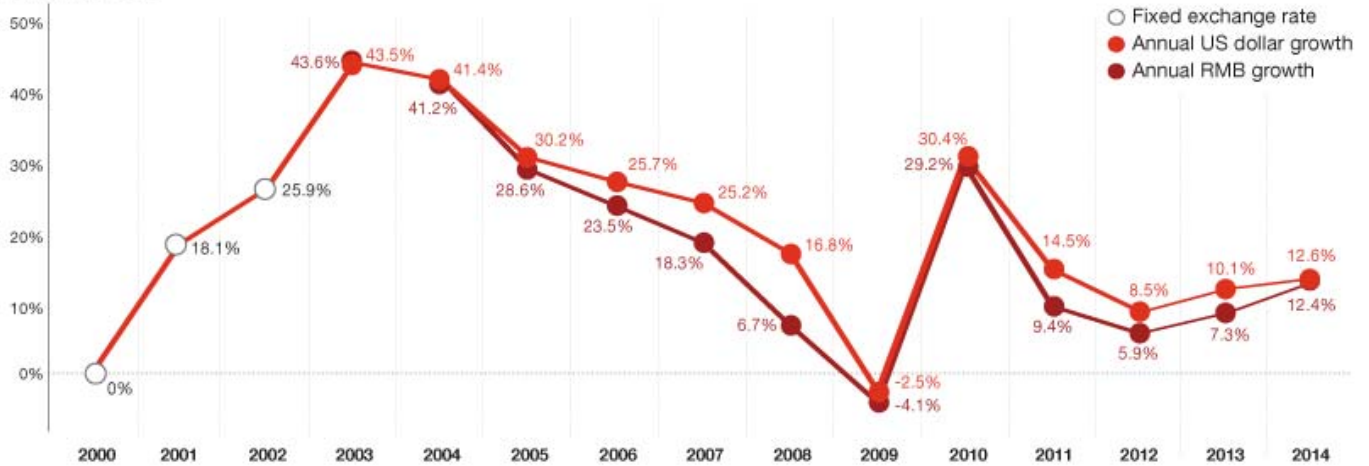
## Group 1: China's semiconductor market



For the fourth consecutive year China's semiconductor consumption growth continued to far exceed worldwide semiconductor market growth in 2014. While the worldwide semiconductor market increased 9.8% in 2014, China's semiconductor consumption market grew by 12.6% in 2014 to reach a new record of 56.6% of the global market. During the past eleven years, China's semiconductor consumption has grown at an 18.8% compounded annual growth rate (CAGR), while total worldwide consumption has only grown at a 6.6% CAGR. The worldwide semiconductor market as reported by World Semiconductor Trade Statistics (WSTS) has grown by US\$169bn from 2003 to 2014 while China's semiconductor consumption as reported by the China Semiconductor Industry Association (CSIA) has grown by US\$173bn.

## China's semiconductor market growth, 2000–2014

### Annual growth



### Market value

US\$b	14.4	17.0	21.4	30.7	43.4	56.5	71.0	88.9	103.8	101.2	132.0	151.2	164.1	180.8	203.5
RMB\$b	119.5	141.1	177.6	255.1	360.0	463.0	571.7	676.1	721.5	691.6	893.4	977.5	1,035.6	1,111.7	1,249.9

**Note:** Market reporting has changed since 2003 with sensors and optical semiconductors included as part of the optoelectronics-sensors-discrete (O-S-D) segment which along with integrated circuits make up the total semiconductor market.



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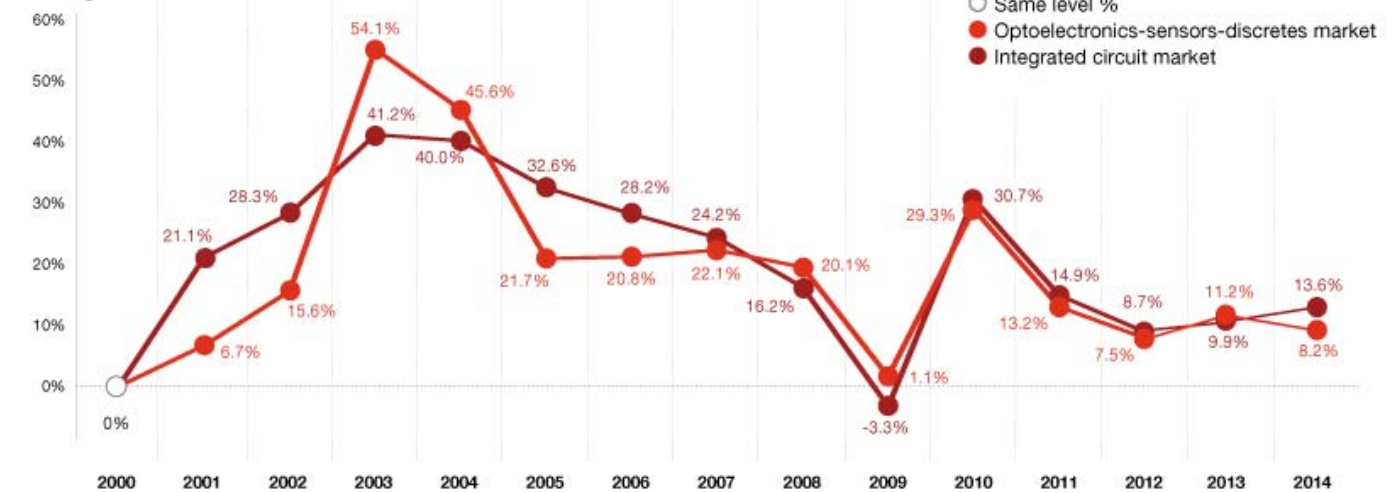
Source: CCID Consulting (CCID), Semiconductor Industry Association (SIA)

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China's semiconductor consumption market continues to grow 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. Most industry analysts predict that the trend of an increasing share of electronic equipment production in China will moderate but continue over the next several years. According to Gartner, China's share of electronic equipment production is forecast to increase to more than 38% by 2017; the semiconductor content of that production to gradually increase to over 35% while the worldwide average content increases to 25%; and China's share of worldwide semiconductor consumption to increase by a further 4%.

## China's IC and O-S-D market growth, 2000-2014

### Annual growth



### Market value

US\$bn	3.0	3.2	3.7	5.7	8.3	10.1	12.2	14.9	17.9	18.1	23.4	26.5	28.5	31.7	34.3
US\$bn	11.4	13.8	17.7	25.0	35.0	46.4	59.5	73.9	85.9	83.1	108.6	124.8	135.6	149.0	169.2

**Note:** Market reporting has changed since 2003 and the definition of O-S-D (optoelectronics-sensors-discretes) now includes sensors and optical semiconductors.



Source: CCID Consulting (CCID), Semiconductor Industry Association (SIA)

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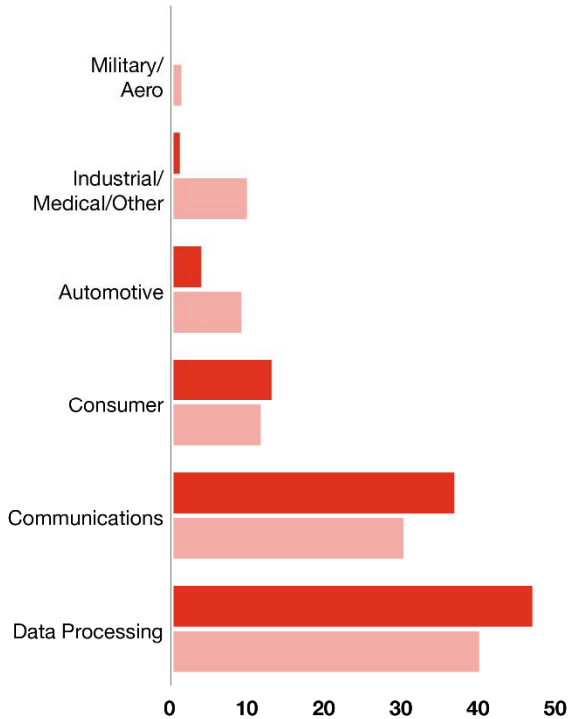
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The integrated circuit (IC) consumption market in China grew 13.6% to US\$169bn in 2014 while the worldwide IC market saw only a 10.1% increase. As a result, China's IC consumption represented almost 57% of worldwide consumption in 2014. During 2014 China's IC consumption increased by more than US\$20bn while the worldwide market increased by US\$26bn. However during the past ten years China's IC consumption has grown by more than US\$134bn while the worldwide market increased by only US\$99bn. China's IC consumption has grown at the expense of IC markets in other regions although China's rate of IC consumption market growth is gradually moving closer to the worldwide rate.

In 2014 China's O-S-D (optoelectronics-sensor-discrete) consumption market grew 8.1% to reach a new peak of US\$34.3bn. For the first time in four years this increase was slightly less than the worldwide O-S-D market increase. As a result, China's share of that market remained relatively flat at 56% in 2014.

## China compared with worldwide semiconductor market by application, 2014

Percentage by application



2014 China revenue values estimated based from 2013 actuals factored by Asia Pac's relative overall semi growth in 2014.

China  
Worldwide



Source: Gartner Dataquest

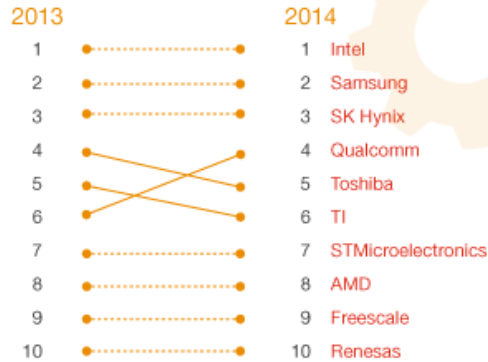
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During 2014 China's semiconductor consumption continued to be more concentrated in the data processing (computing) and communications applications sectors and became slightly more concentrated in the consumer sector than the worldwide market while remaining less concentrated in the automotive and noticeably less concentrated in the industrial/medical/other and military/aerospace sectors. China's share of 2014 worldwide semiconductor consumption was largest for the communications (computing) sector where it increased along with China's share of the 2014 worldwide data processing and consumer sectors. China's share of the worldwide automotive, industrial/medical/other and mil/aero sectors decreased during 2014.

## Semiconductor suppliers to the Chinese market

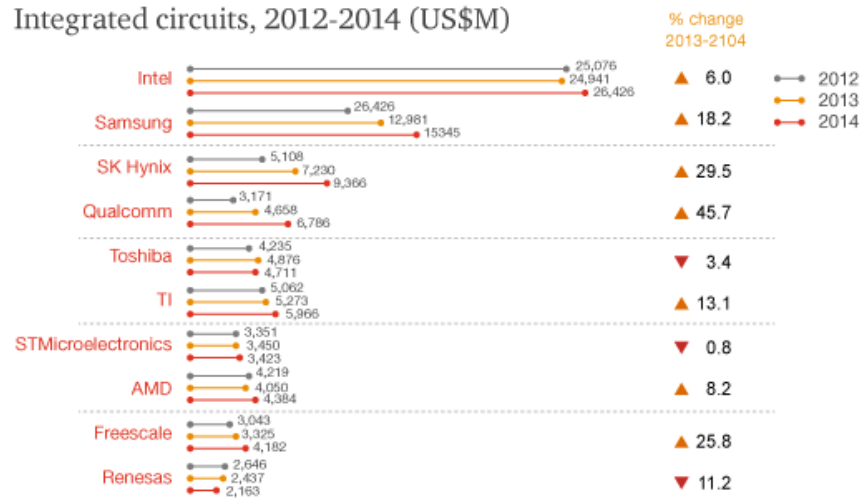
Top 10 ranking, 2013-2014



Source: CCID IC Market China Conferences—March 2014 and 2015

## Semiconductor suppliers to the Chinese market

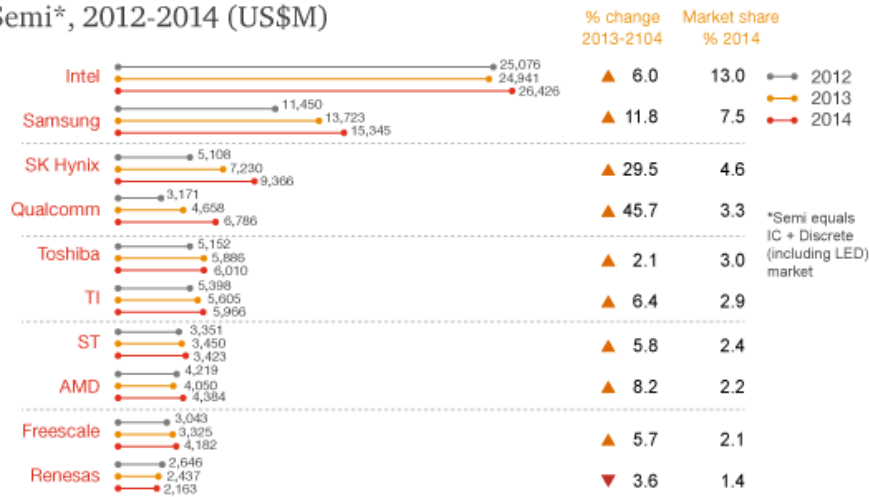
Integrated circuits, 2012-2014 (US\$M)



Source: CCID IC Market China 2012-2015 Conferences—March 2013, 2014 and 2015

## Semiconductor suppliers to the Chinese market

Semi\*, 2012-2014 (US\$M)

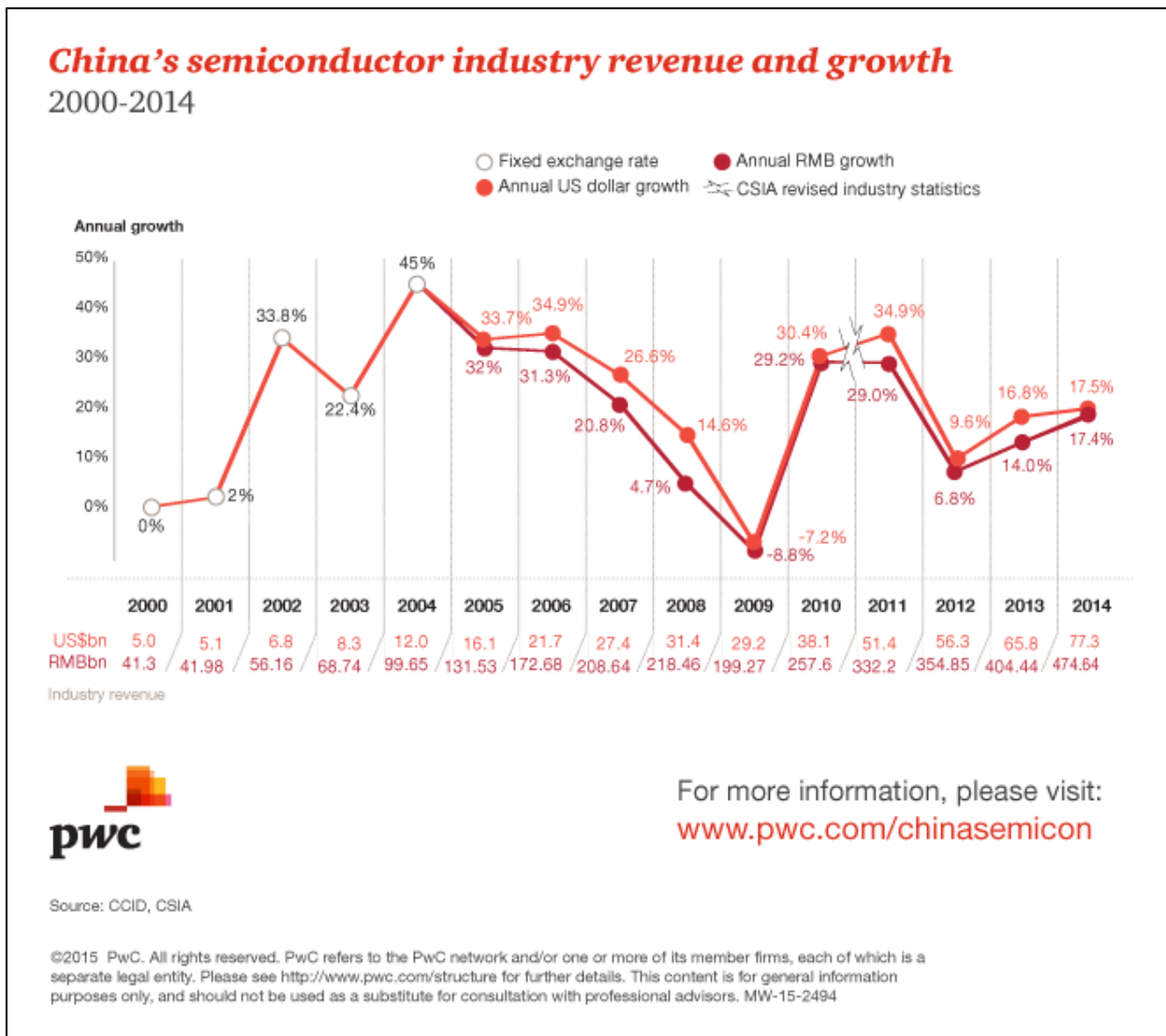


Source: CCID IC Market China 2012-2015 Conferences—March 2013, 2014 and 2015

The major global semiconductor companies continue to dominate the Chinese market. The three graphs above shows the top 10 suppliers with the largest value of semiconductors consumed in China during 2014. There have only been 14 different companies among these top ten suppliers over the past eleven years. Seven companies have been among the top ten suppliers to China every year from 2003 through 2014: Intel, Samsung, TI, Toshiba, SK Hynix, ST and Freescale. AMD joined the list in 2004 and has been among the top ten suppliers to China for the last ten years. Qualcomm, which joined the list in 2012 at number 10, moved up to number 6 in 2013 and to number 4 in 2014. During 2014 China's consumption of semiconductor products from these ten largest suppliers increased by 11%, somewhat less than the growth of the overall semiconductor market in China. The Chinese semiconductor consumption market continued a trend of becoming less concentrated than the worldwide market as the top 10 suppliers' share of China's consumption declined to 42.4% in 2014, down from 43% in 2012 and 45% in 2011.



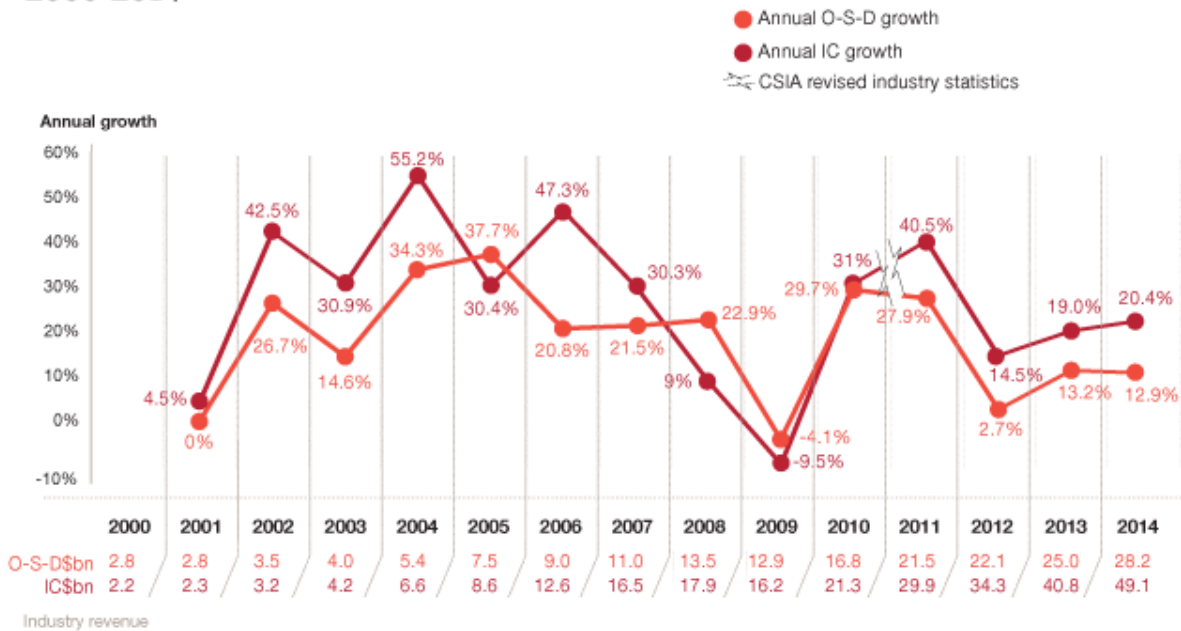
## Group 2: China's Semiconductor Industry



China's reported 2014 semiconductor industry revenue growth continued to exceed both its semiconductor consumption and the worldwide semiconductor market growth. China's semiconductor industry grew by 17.5% in 2014 to a record US\$77.3bn. China's semiconductor industry has grown at an equal or greater rate than its semiconductor market consumption for eight of the past ten years. From 2004 through 2014 China's semiconductor industry grew at a ten-year compound annual growth rate (CAGR) of 20.5% while its semiconductor consumption grew at a 16.7% and the worldwide semiconductor market at a 4.7% CAGR. China's share of the worldwide semiconductor industry is continuing to grow and become significant. Compared to the sum of worldwide semiconductor device sales revenue plus the value of all wafer fabrication and packaging, assembly and test production, China's 2014 semiconductor industry revenues accounted for 13.4% of the worldwide semiconductor industry, up from 12% in 2013 and 11.6% in 2012.



## China's O-S-D and IC industry revenue and growth 2000-2014



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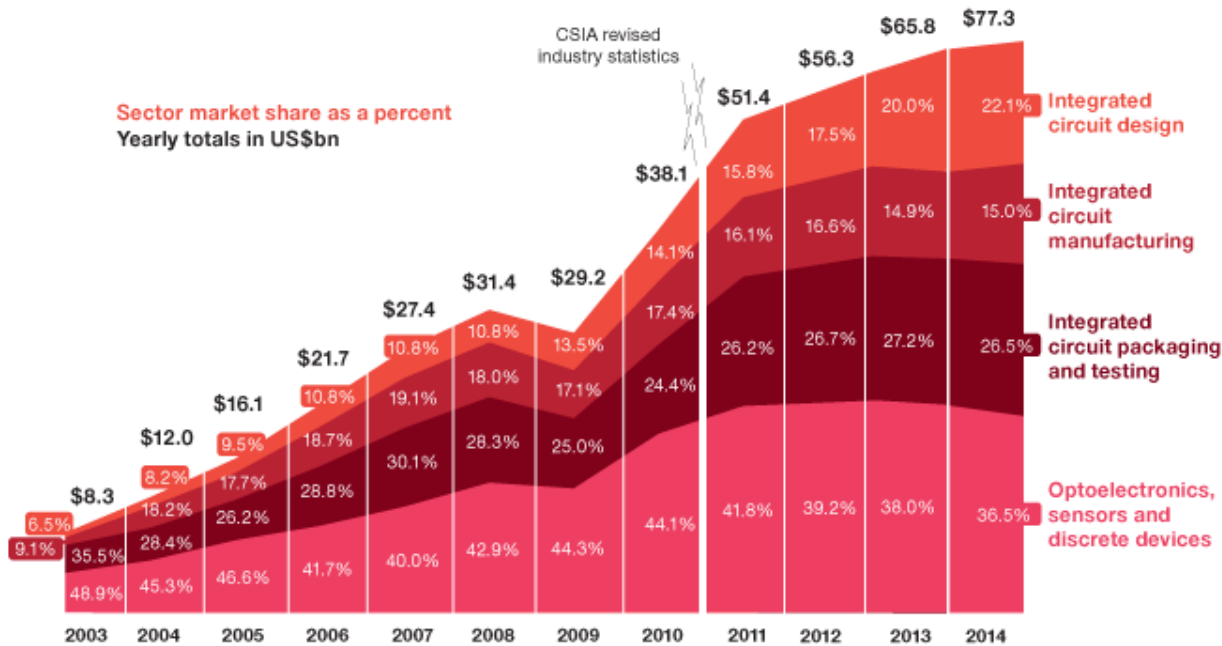
Source: CCID, CSIA

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The overall performance of China's IC (integrated circuit) industry (the sum of IC design, IC wafer manufacturing and IC packaging and testing) continued to be the major contributor to China's overall semiconductor industry growth in 2014. It grew by 20.4% in 2014 while China's O-S-D (optoelectronics-sensors-discretes) industry revenue only grew by 12.9%. Since 2010 China's IC industry revenues have more than doubled, growing 130%, while China's O-S-D industry revenues only increased by two-thirds, growing 68%. China's 2014 IC industry revenues of US\$49.1bn were nearly twice their O-S-D revenues of US\$28.2bn.

## China's semiconductor industry by sector

2003-2014



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Source: CCID, CSIA

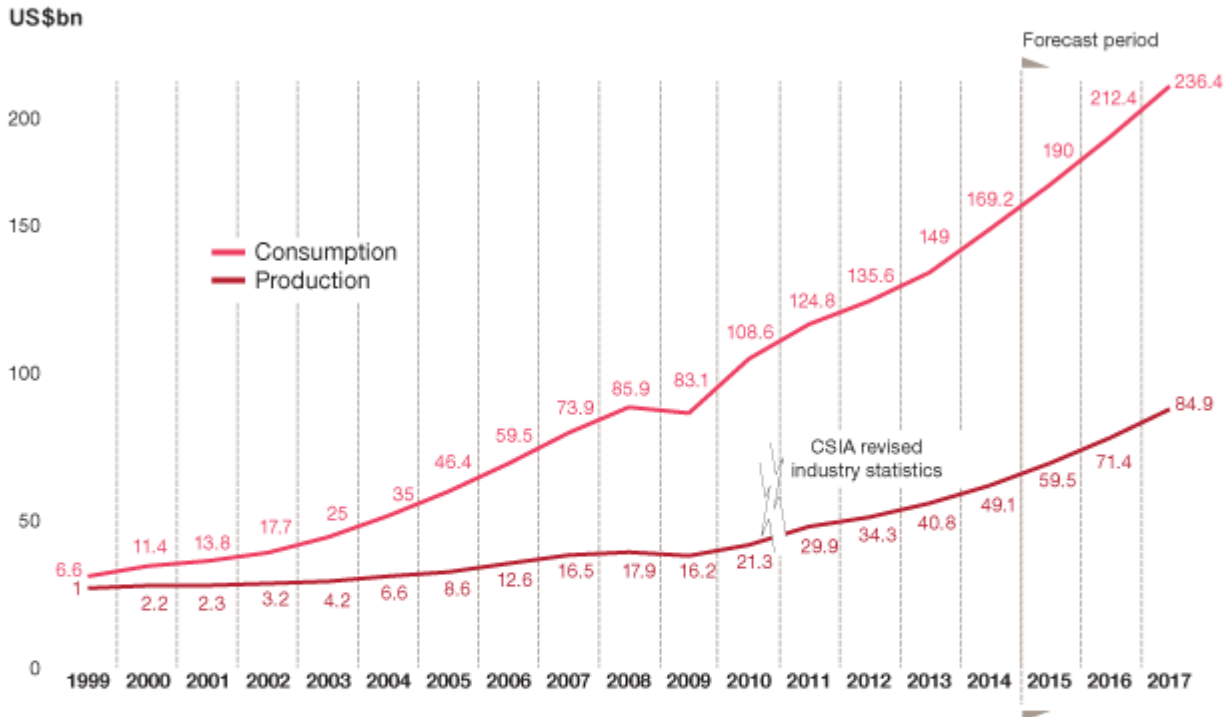
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The distribution of China's semiconductor industry revenue continued its gradual shift towards the IC sectors in 2014. From 2004 through 2014 the once small IC design sector has grown at a 33% CAGR while the larger IC packaging and test sector achieved a 19.6% CAGR. The much larger O-S-D and smaller IC manufacturing sectors have only grown at an 18% CAGR. As a result, China's three IC industry sectors have grown from 51.5% to 63.6% of China's total semiconductor industry.

During 2014 IC design grew 29.7%, IC manufacturing 18.7%, IC packaging and test 14.4% and O-S-D 12.8%, slightly changing their relative share but not the order of their distribution which became:

1. O-S-D devices 36.5%
2. IC packaging and testing 26.5%
3. IC design 22.0%
4. IC manufacturing 15.0%

## Comparison of China's integrated circuit consumption and production 1999-2017



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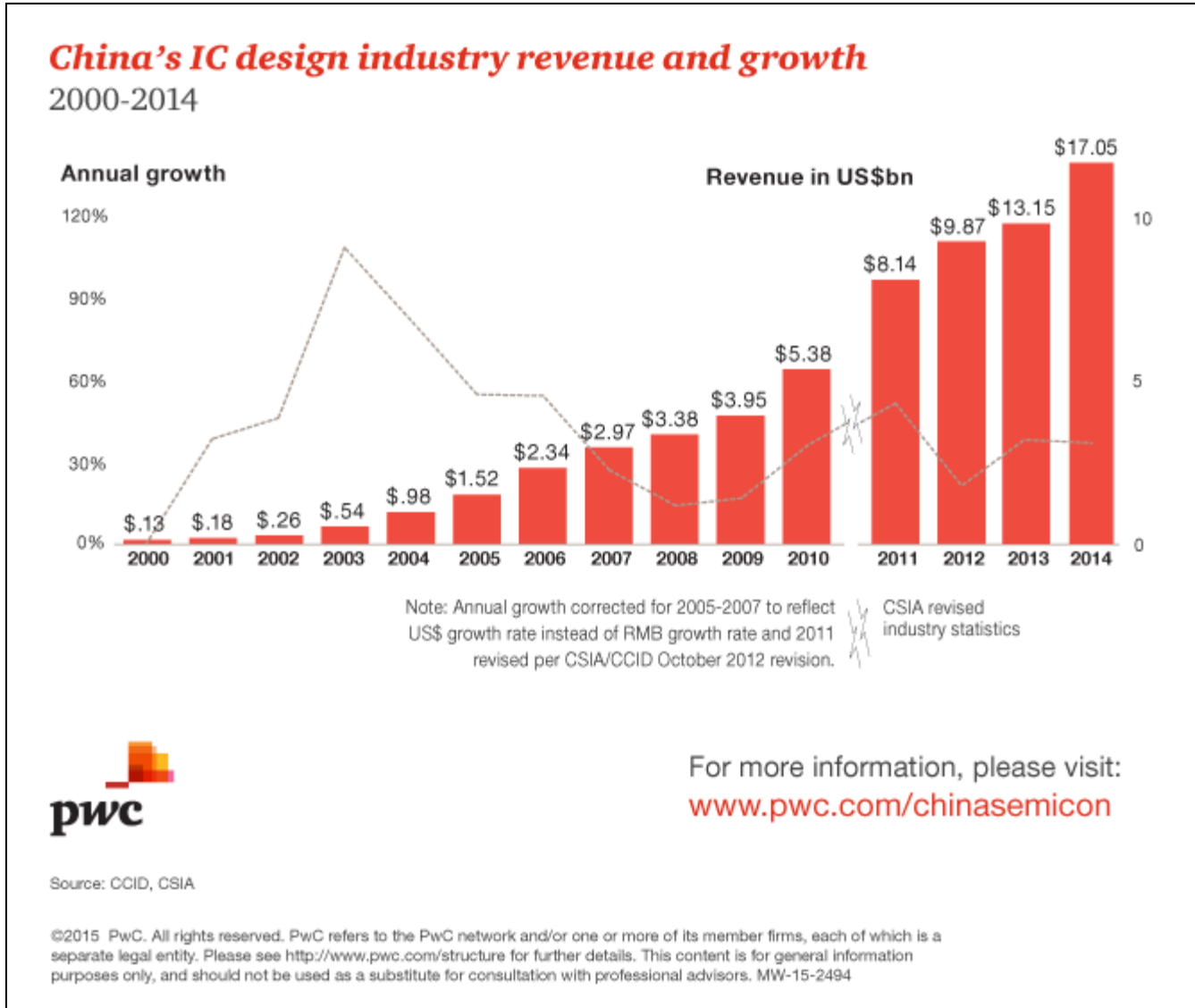
Note: Actual annual average FX rates used for 1999-2014 and 2014 average FX rate used for forecast 2015-2017

Source: CCID, CISA, PwC 2004-2015.

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China's IC consumption/production gap increased again in 2014 to a new record annual high despite all the various government plans and efforts to reduce it. This gap is the yearly difference between IC consumption and IC industry revenues. Based upon the most recent CSIA industry statistics, this annual gap grew by a further US\$11.9bn (11.0%) in 2014 to reach US\$20.1bn. During the eleven year span of our reports on China's semiconductor industry, this gap has grown from US\$20.8bn in 2003 to US\$120.1bn in 2013, widening every year except 2009. The ratio of China's IC production revenue to IC consumption has shown some improvement. It had grown with yearly variability from 17% in 2001 to a peak of 29% in 2014. According to CSIA, this ratio is now expected to increase to 36% by 2017, which is up from the 32% they had forecast for 2016 a year ago. However, this will still result in a further increase in China's IC consumption/production gap which is now forecast to reach US\$151.5bn in 2017 despite all the Chinese government's plans and efforts to reduce it. It is our belief that this gap continues to contribute to the Chinese government's ongoing initiatives to increase indigenous IC production.

## Group 3: China's design industry

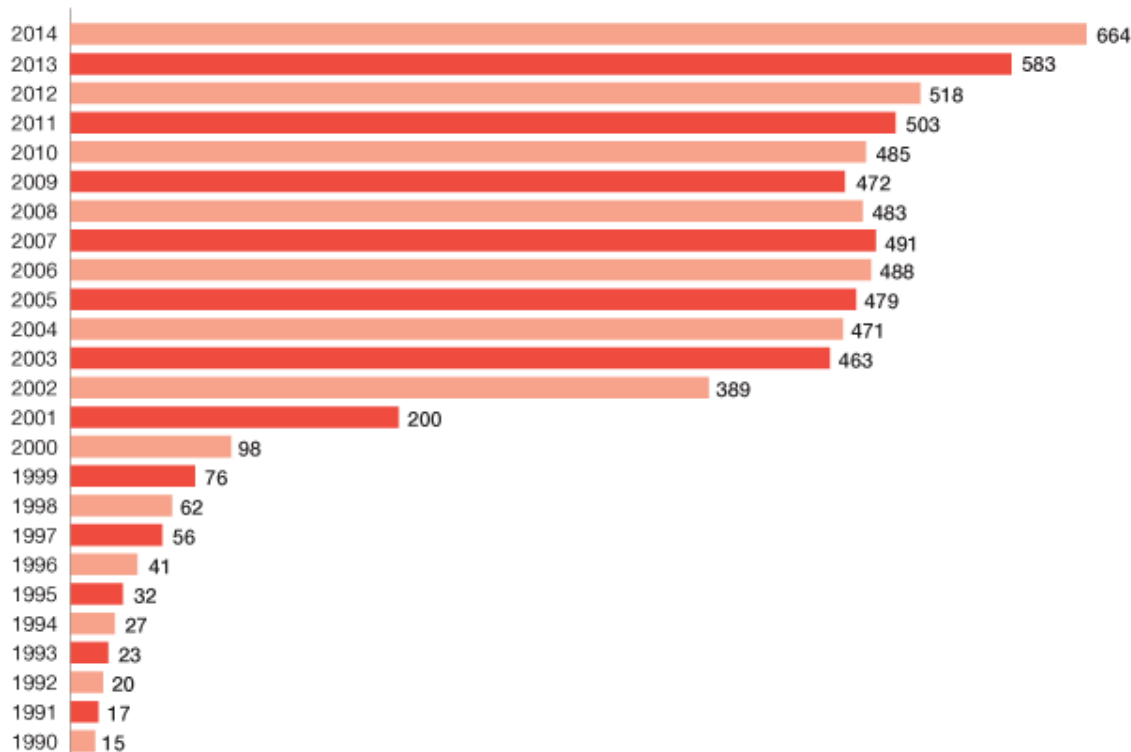


Integrated circuit (IC) design continues to be the fastest growing segment of China's semiconductor industry. It grew by 30% in 2014 to reach record revenues of US\$17.1bn. During the eleven years from 2003 through 2014 China's IC design (fabless) industry has grown at a 36.8% compound annual growth rate (CAGR) from US\$541mn to over US\$17.1bn.

According to the China Center of Information Industry Development (CCID) and the China Semiconductor Industry Association (CSIA), IC design sector revenue contributed more than 34% to China's semiconductor industry revenue growth in 2014 and has grown from 20% in 2013 to represent 22% of China's total semiconductor industry. During the last eleven years China's IC design industry has grown from representing just 0.4% of the worldwide IC market and 2.5% of the worldwide fabless IC industry in 2003 to representing almost 6% of the worldwide IC market and 19.4% of the worldwide fabless IC industry in 2014.

## Number of IC design enterprises in China

1990-2014



Source: CCID, CSIA

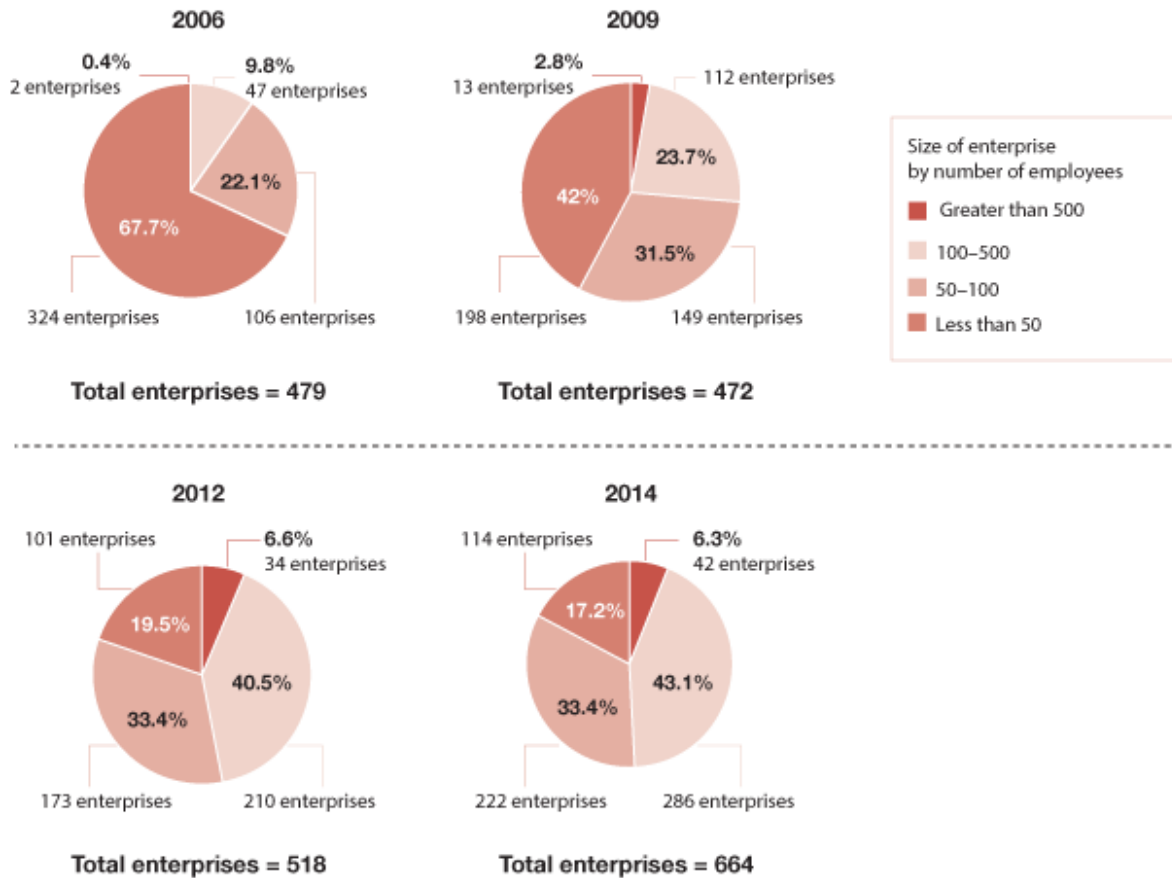
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According to the China Center of Information Industry Development (CCID), the number of China's IC design enterprises increased from 583 in 2013 to 664 by the end of 2014. That increase of 81 additional IC design enterprises during 2014 is by far the largest net increase in the last ten years. However, it has been exceeded at least two times in China's earlier semiconductor history by the reported increase of 111, and 189 IC design enterprises in 2001 and 2002. The number of reported IC design enterprises increased from less than 500 in 2010 to more than 660 in 2014. The Chinese government policy of offering tax incentives to promote the development of its semiconductor industry since the implementation of its 12th Five-Year plan in 2011 seems to have played a key role in the growth of IC design enterprises in China. There continues to be considerable debate about the size and make-up of these 664 enterprises as well as a great diversity among this group. Of the 664 IC design enterprises reported at the end of 2014 as many as 250 could be the design or research and development (R&D) units or activities of foreign invested or subsidiary multinational companies (MNC). It is still estimated that there are no more than 100, possibly less, local indigenous IC design enterprises that are truly viable fabless semiconductor companies.

## China's IC Design Enterprises by Employee Count

2006-2014



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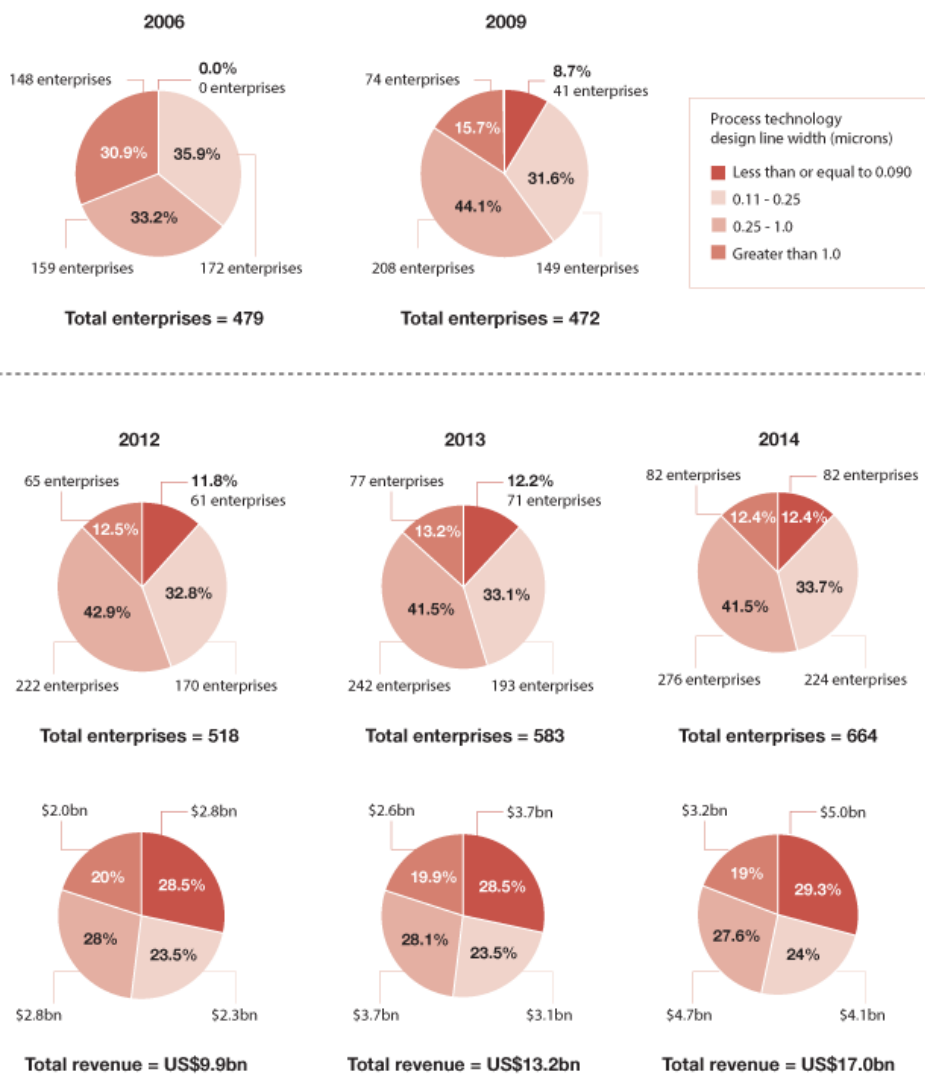
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From 2013 to 2014, employment in China's IC design sector increased along with the significant addition of IC design enterprises. According to the China Center of Information Industry Development (CCID), the total number of employees in the IC design sector increased by almost 15% in 2014 to about 147,000 with the distribution shifting slightly to the mid-size companies with 100 to 500 employees. This year-over-year growth represents relative stability in employee density, resulting from the 13.9% increase in the number of enterprises accompanied by an 11% increase in the number of employees, along with a significant, 30% increase in revenue, a slight 0.9% increase in the average number of employees per enterprise, and a positive 13% increase in average sales per employee to US\$116,000.

## China's IC Design Industry by Process Technology

2006-2014



Source: CCID

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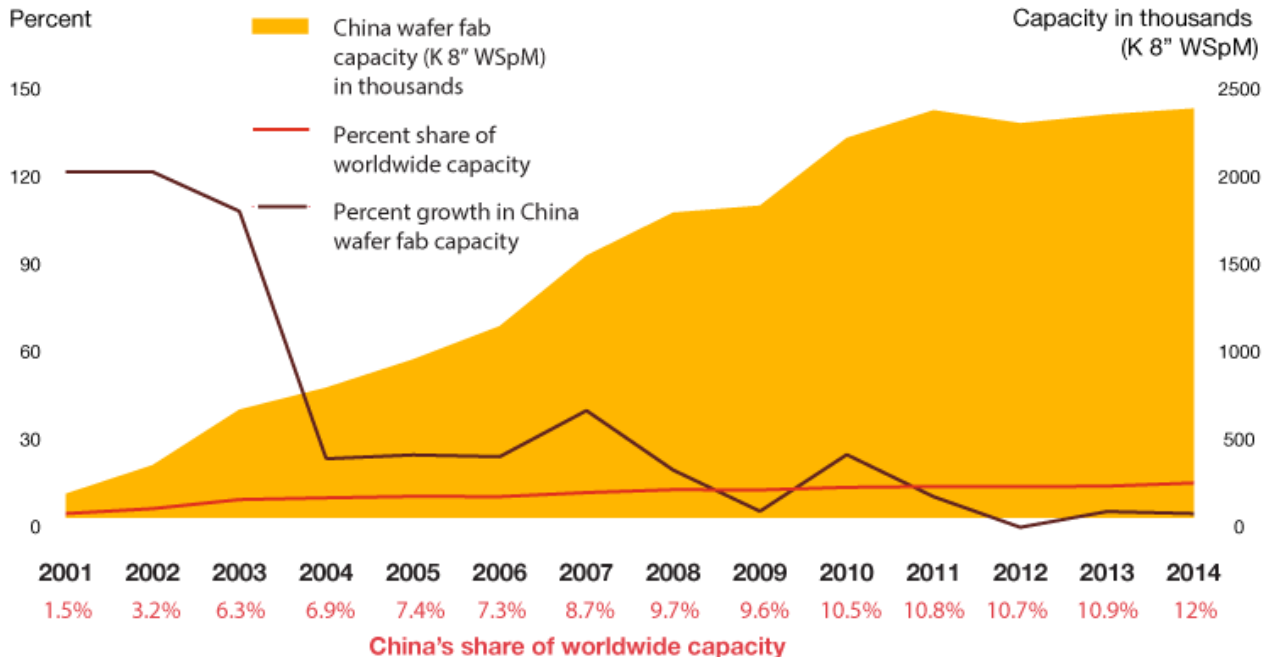
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China's IC design industry continued to make a further modest migration to finer design line widths in 2014. The number of design enterprises with design capabilities equal to or less than 0.25 microns increased by 16% in 2014 to 306 which represents slightly more than 46% of China's total IC design enterprises, up slightly from 45% in 2013. More significant, the total revenues of these enterprises with finer design line widths increased by almost 34% in 2014 to account for more than 53% of total IC design revenues.



## Group 4: China's semiconductor manufacturing

### China's wafer fabrication capacity and share of worldwide capacity – 2002-2014



Note: Capacity is in thousands of 8-inch equivalent wafer starts per month/fully ramped. This is the maximum number of wafers per month that could be started if the fab were fully equipped as defined in the fab design specifications and if the equipment were fully utilized.



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Source: World Fab Watch 2002–2013

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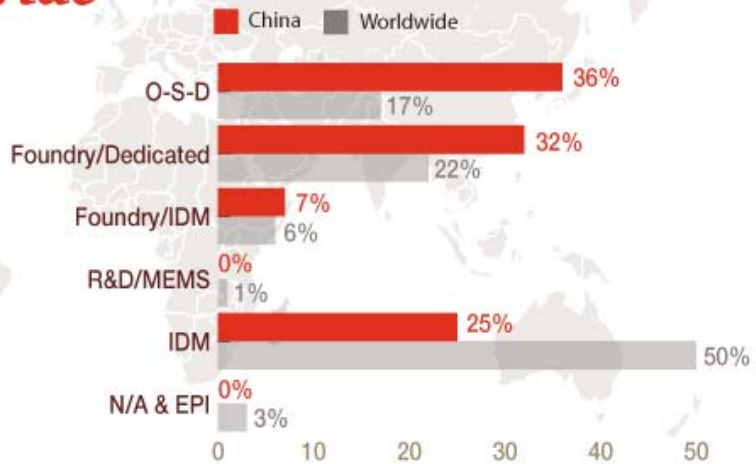
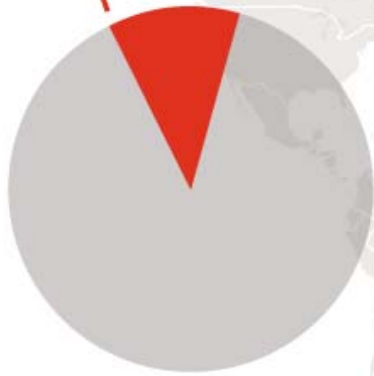
### China's wafer fabrication capacity and share of worldwide capacity – 2002-2014

China's total wafer fab capacity has remained relatively constant over the past four years from 2011 through 2014 while its share of worldwide wafer fab capacity has increased by more than a percentage point from 10.8% in 2011 to 12% in 2014. During 2014 China's number of wafer fabs in production increased from 160 to 165 with the addition of three discrete and one each IDM and R&D/MEMS fabs for a combined increase of 35K (1.5%) 8-inch equivalent wafer starts per month (WSpM). Total worldwide wafer fabs in production decreased from 1,076 to 1,040 during 2014 for a combined decrease of 157K (7.4%) 8-inch equivalent WSpM.

## Current wafer fab capacity comparison – China and worldwide

# Capacity

China's capacity is 2.3 million, or 11.7% of worldwide



Note: Capacity in thousands of 8-inch equivalent wafer starts per month. WF probability =/>> 1.0



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Source: SEMI Wafer Fab Watch, Feb. 2015

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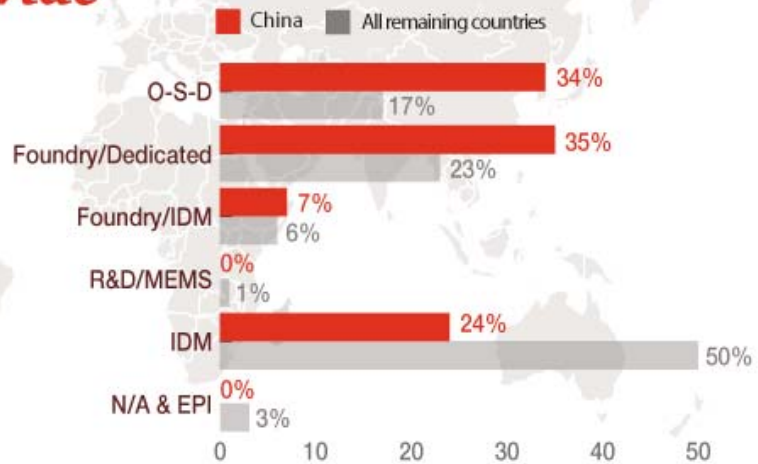
### Current wafer fab capacity comparison, China and worldwide

China's current wafer fab capacity remains notably different from worldwide in that 39% is devoted to foundry production versus 28% worldwide (Dedicated and IDM combined), 36% to O-S-D production versus 17% worldwide; and only 10 fabs are 300mm out of a total of 118 worldwide. Because China represents a disproportionately large share (25%) of both worldwide LED fab capacity and discrete fab capacity, it continued to have a much higher mix of smaller wafer size (150mm or less) and mature technology node (0.7µm or greater) fab capacity than worldwide. However, while its share of worldwide intermediate technology node (0.2 to 0.028µm) capacity decreased in 2014 by more than one percent, to 13%, its share of advanced technology node (28nm or less) was established for the first time at 5% of worldwide.

**Current and committed wafer fab capacity comparison –  
China and worldwide**

# Capacity

**China's capacity is 2.9 million,  
or 12.5% of worldwide**



Note: Capacity in thousands of 8-inch equivalent planned full-capacity wafer starts per month. WF probability => 0.8



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Source: SEMI Wafer Fab Watch, Feb. 2015

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## Current and committed wafer fab capacity comparison, China and worldwide

Current foundry production (Dedicated and IDM combined) continued to constitute the largest share of China's wafer fab capacity in 2014 at 39% of total compared to the worldwide average of 28%. Current IDM production only constituted 25% of China's wafer fab capacity, compared to 50% worldwide. That mix will only change slightly when all the committed fabs currently under construction are brought into production, with China's foundry share (Dedicated and IDM combined) increasing to 42% versus 29% worldwide and IDM share decreasing to 24% versus 50% worldwide.

## Comparison of China and all remaining countries' SPA&T resources – 2014

# Resources



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Source: Gartner

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### Comparison of China's and all remaining countries' SPA&T resources – 2014

Semiconductor packaging, assembly and test (SPA&T) nominal capacity in China was notably increased during 2014, with IC unit production increasing by more than 19% and O-S-D unit production by 12%. During the past year, China reported the closure of three SPA&T facilities; one each Switzerland, Japanese and USA SATS facility; the addition of three existing but previously not reported facilities, the opening of twenty new facilities and the consolidation of a few others, resulting in a 50% increase in reported net manufacturing floor space but with just a 9.2% increase in number of employees.

As of the end of 2014, China had 120 SPA&T facilities in operation, an increase from an adjusted total of 97 in 2013. These 120 facilities represent 22% of the total number of worldwide SPA&T facilities, 33% of worldwide SPA&T manufacturing floor space and 25% of reported worldwide SPA&T employees. As a result, China's SPA&T facilities continued to rank first in share of SPA&T manufacturing floor space—a proxy for potential manufacturing capacity—for the sixth year, noticeably ahead of Taiwan (at almost 23%) and Japan (at 10%). China's SPA&T facilities also ranked first in number of reported employees, with 25% of worldwide employees at the end of 2014, ahead of Taiwan (19%) and Malaysia (17%).



## Comparison of China and all remaining countries SATS share of SPA&T capacity – 2014

# Capacity

■ China ■ All remaining countries

Captive packaging assembly and test    Semiconductor assembly and test services (SATS)

Number of facilities



Amount of floor space



Number of employees



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Source: Gartner

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### Comparison of China's and all remaining countries' SATS share of SPA&T capacity – 2014

China's SPA&T capacity continues to be slightly more concentrated in the SATS sector than that of other regions. In 2014, 66% of China's SPA&T manufacturing floor space and SPA&T facilities were dedicated to the SATS sector versus 62% for all other countries. Eight of the ten largest worldwide SATS companies had one or more facilities in China for a total of 20 out of the 93 top ten SATS facilities worldwide. These 20 facilities accounted for 29% of the top ten SATS manufacturing floor space worldwide. One of the ten largest worldwide SATS companies is a Chinese company, Jingsu Changjiang Electronics Technology (JCET), which ranked sixth in 2014. There were two other Chinese SATS company, Tianshui Huatian Microelectronics (TSHT) which ranked 13<sup>th</sup> and Natong Fujitsu Microelectronics (NFME), which ranked 18<sup>th</sup>, within the top twenty worldwide SATS companies in 2014. In total there were 34 Chinese SATS companies, with 38 existing facilities, that accounted for 20% of worldwide SATS manufacturing floor space in 2014. Packaging assembly and test remains the largest of China's semiconductor manufacturing activities when measured in terms of value added, production revenue, employees and manufacturing floor space although this relationship is often missed because it is allocated between two separate industry sectors: the IC packaging and testing and O-S-D sectors. The composite weighted average of China's 2013 SPA&T production is now estimated to be about 58% of worldwide, up from a revised 52% in 2012.

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