The information in this section, including all research data and statistics, presented herein has been extracted from various documents and government publications. The Sponsors and the Directors have taken reasonable care to ensure that the statistical and other information have been derived from such sources.

INTRODUCTION

The metal casting industry uses molten metal to form cast metal products and components used in a wide variety of manufactured products. The metal casting parts and components are important components in thousands of consumer, commercial and industrial products such as automobiles, household appliances, recreational, hobby and leisure-time products, farm and garden equipment, electrical equipment, general hardware, power tool, computers and other business equipment, instruments, toys, novelties, and many others. Metal castings play a crucial role that ensures the industries and products can continue to develop, improve and remain competitive. Nowadays, with consumers' demand for higher quality and constant changes in consumers' tastes, consumer products are changing rapidly. To cope with constant changes and maintain competitiveness, it is essential for manufacturers to improve their production efficiency and effectiveness through development and investment in production technology via research and development and flexible production line.

The uses of cast metal products include motor vehicles, ingot molds that are re-melted later, pipes, industrial machines, farm equipment, railroad equipment, electric power equipment, and construction materials. Important distinctions within the industry revolve around the type of metal uses (ferrous or non-ferrous), the volume of castings produced (high volume production in the non ferrous sector is often done using a die-casting process) and the degree of precision required in the cast piece (different casting method offer varying level of details).

According to the presentation made by Dr. Raymond J. Donahue at "Metal Casting Technology Forum" on 18th May, 2004 at Rock Island Arsenal, Illinois, the percentages of the following end-user markets are estimated to be not less than the following: (i) automobile and light truck, 35%; (ii) internal combustion engines, 5%; and (iii) farm equipment, 5%.

According to the World Fact Book 2004, the global GDP economy is made up of three main compositions, being agriculture, industry and construction and services. In China, its industry and construction make up of over 50% of its GDP signifies the importance of metal casting industry in China. The US, Europe, Japan and China are the major metal casting consuming countries in the world. The table below summarises the general economy statistics for the US, Japan and China.

	Economy Statistics		
	The US	**China**	**Japan**
GDP *(USD trillion)*	10.98[2]	6.45[2]	3.567[2]
GDP real growth rate	3.10%[2]	9.10%[2]	2.30%[2]
GDP per capita *(USD)*	37,800[2]	5,000[2]	28,000[2]
GDP composition			
Agriculture	2.00%[3]	14.5%[4]	1.40%[5]
Industry *(Note 1)*	18.00%[3]	51.7%[4]	30.90%[5]
Services	80.00%[3]	33.8%[4]	67.70%[5]
	100.00%	100.00%	100.00%

Notes:

1. including construction industry for China.
2. 2003 estimate.
3. 2002 estimate.
4. 2002 figure.
5. 2001 estimate.

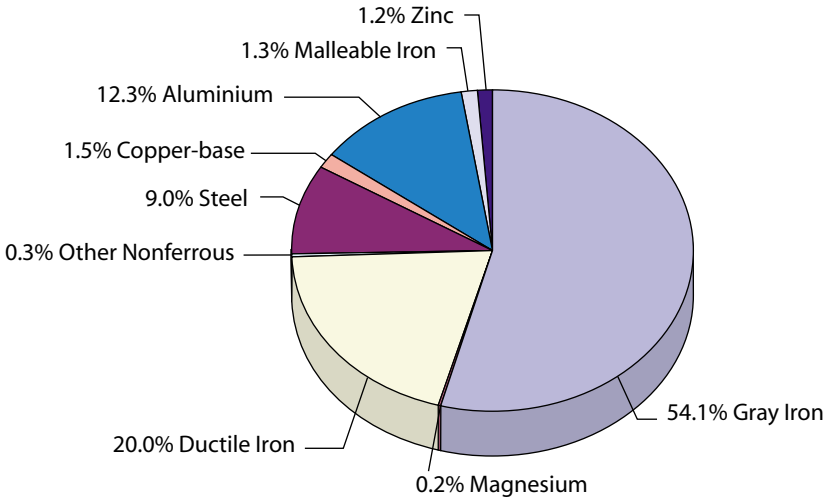
Source: The World Factbook 2004 — updated on 11th May, 2004.

Metal casting category

There are many categories of casting for use in manufacturing and construction industries. They are gray iron casting, ductile iron casting, brass, bronze and aluminium casting, die casting, investment casting, jewelry casting, precision investment, lost wax process casting, sand casting and stainless steel casting.

Materials for metal casting

Nearly every type of metal can be cast such as gray iron, ductile iron, malleable iron, steel, aluminium, bronze, brass and titanium. As illustrated in the chart below, gray iron and ductile iron are the two commonly used casting materials.



Source: Modern Casting, a publication of the American Foundry Society — December 2003 issue.

The American Foundry Society was an international organisation founded in 1896 providing support to its members in the foundry industry in the areas of technology, management and education.

Gray iron, having its fracture of a gray appearance, consists of flake graphite in a matrix consisting of ferrite, pearlite or a mixture of the two. The fluidity of liquid gray iron, and its expansion during solidification due to the formation of graphite, have made this metal suitable for the economical production of a wide range of products including many components within the aerospace, automobile, oilfield, heavy-machinery and transportation industries. Gray iron features good machinability, excellent resistance to cracking, low cost finishing options (e.g. chemical-treating, annealing, assembly), dampening characteristics and self-lubricating properties.

In an effort to create an iron with better mechanical properties than either gray or malleable iron, ductile iron is found to offer versatility and high performance at low costs and eliminate heat treatment costs. The other properties of ductile iron such as high tensile strength, yield strength and elongation combine to give ductile iron a reliable strength to weight ratio that adds up to more strength for less expense.

It is anticipated that continuous research and development to employ materials such as aluminium, magnesium, titanium, zinc, advanced copper-based and advanced ferrous alloys to produce thin wall, high-strength castings with higher precision castings and more complex shape will benefit the future development of the metal casting industry.

According to Modern Casting, an authoritative trade journal of the United States, the total world casting production in 2002 was approximately 70.209 million metric tons, of which gray iron casting production was 37.998 million metric tonnes and ductile iron was 14.053 million metric tonnes.

Source: Modern Casting, a publication of the American Foundry Society — December 2003 issue.

Metal casting is one of the most energy-intensive industries. Energy intensive processes in metal casting include melting, mould making, core making, heat treatment and other activities. The Metal Casting Industry of the Future is funding research to improve these operations and reduce melting requirement to achieve energy efficiency in these processes. This kind of research is improving yield, extending die and mould life, and reducing post-cast energy requirements.

Metal casting industry in the US

Capacity utilisation

According to American Foundry Society, the foundry industry in the US has undergone a tremendous change in the last 50 years caused by many technological and economic factors. In 1955, there were 6,150 foundries in the US. It is estimated that the industry will decline to 2,480 foundries in 2004, comprised of 80% with less than 100 employees.

Source: Modern Casting, a magazine published by the American Foundry Society.

Capacity and utilisation forecast for 2004

Metal	**Capacity** *(Tons)*	**Utilisation** *(%)*
Iron	11,930,000	81
Steel	1,510,000	83
Aluminium	2,915,000	83
Copper-Base	400,000	80
Magnesium	140,000	94
Zinc/Lead	410,000	84
Other Nonferrous	70,000	74
Investment	200,000	83
Total	**17,575,000**	**81**

Despite some new and expanded facilities, it is estimated that a loss of casting supply of 255,000 tons is to occur in 2004 vs. 2001. The table above indicates the forecast capacity and utilisation rates. A total of 3.3 million tons of surplus supply is forecast for 2004 with 2.3 million tons of that in iron foundries.

Imports continue to rise in 2004

Imports of castings are forecast to increase to 2,602,000 tons in 2004, 18% of casting shipments in the US. As shown in table below, imports of gray iron castings are expected to rise to 1.4 million tons, 29% of total casting shipments. Aluminium die casting imports are forecast to increase to 19% of shipments. Imports are forecast to rise 5% per year for the next 7 years to near 3.0 million tons, which would amount to 20% of shipments.

Source: Modern Casting, a magazine published by the American Foundry Society.

Forecast of casting imports in 2004

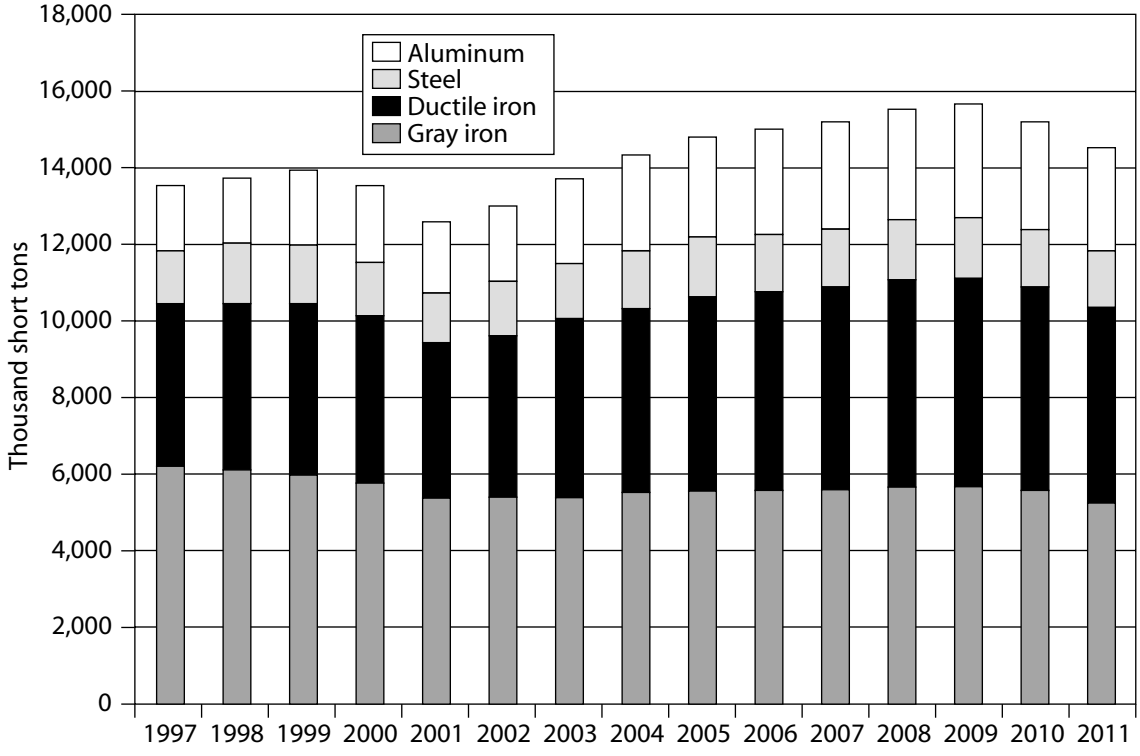
Metal	Shipments *(tons)*	Imports *(tons)*	Imports % of shipments
Gray Iron	4,891,000	1,426,000	29
Ductile Iron	2,454,000*	406,000*	17
Malleable Iron	82,000	21,000	26
Steel	1,255,000	167,000	13
Aluminium Die Cast	1,364,000	255,000	19
Aluminium PM/Sand	1,045,000	185,000	18
Brass/Bronze	321,000	64,000	20

* Not including pressure pipe.

Source: The web site of Modern Casting, a publication of the American Foundry Society.

Set out below is the table showing the historic and forecast the US casting production (1997 — 2011).

Historic and Forecast the US Casting Production, 1997-2011



Source: Stratecasts — extracted from the presentation "Industry Forecast" by Michael J. Gallagher for the Casting Industry Supplier Association on 6th April, 2002.

Stratecasts Organization was founded in the early 1980s to provide domestic and international forecasting and trends analysis and strategic planning for the metal casting industry.

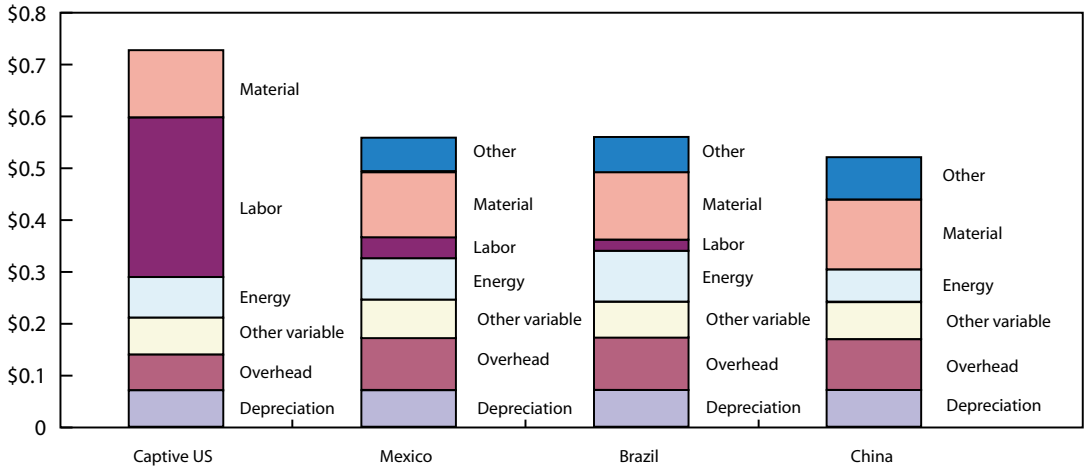
Metal casting in the PRC

According to the China Year Book 2004, the total revenue of the casting industry was about RMB 38,031 million in 2002, a 24% growth from 2001. According to an article "Reforming the Metal Casting Industry in China" by William V. Osborne of the George Washington University, there are a small number of very large firms dominating the state-owned enterprises in the metal casting industry. The largest are BaoSteel, Anshan Iron & Steel, Shougang Corp., and Wuhan Iron & Steel. These state-owned enterprises were mainly used to satisfy domestic demand and are not exposed to international operations. The biggest problem facing the PRC metal casting, in both private and state-own enterprises, is the level of quality. Quality issues are multifaceted and inherent to the technology and processes used in China. Foundries in China are generally considered at a level on par with 1960's America. In order to alleviate this issue, the Government has encouraged importation from overseas and improvement of machinery and technical knowledge, and the replacement of equipment ranging from preliminary sintering, preliminary coking, converters smaller than ten tons, blast furnaces smaller than 50 cubic meters, side blowing converters, open hearth furnaces, cupola furnaces, electric furnaces small than 10 tons, electron scanning microscopes to sand control equipment.

The casting industry has experienced a compound annual growth rate of 8.9% from 1993 to 2002. According to China Foundry Association, a national foundry organisation in the PRC, only 10% of the total annual foundry sales are for foreign trade as China's average casting technology level is still low and majorities of the foundries are badly equipped.

Global sourcing is happening all throughout manufacturing, and for large OEMs and foundries. It has become part of the cost-reduction strategy for many American and European companies nowadays. Going overseas not only allows an OEM to produce a part at a lower cost, mainly due to lower labor costs and government restriction, but it also allows the company to get a foothold in a completely new foreign market.

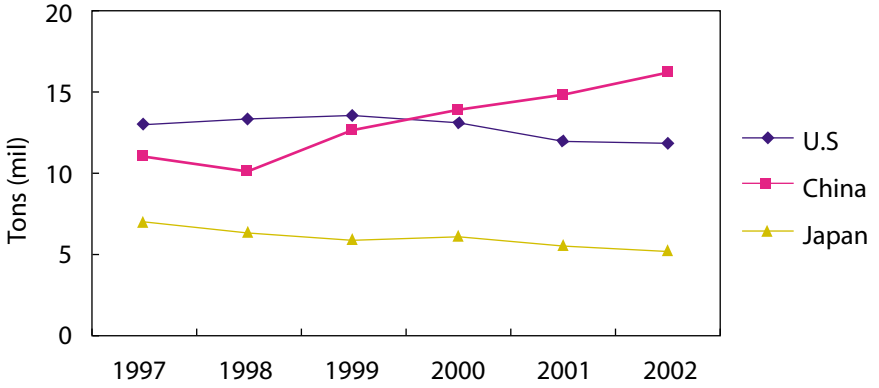
Heavy-duty blocks & heads 2002 cost comparisons



Source: Modern Casting, a publication of the American Foundry Society — December 2003 issue.

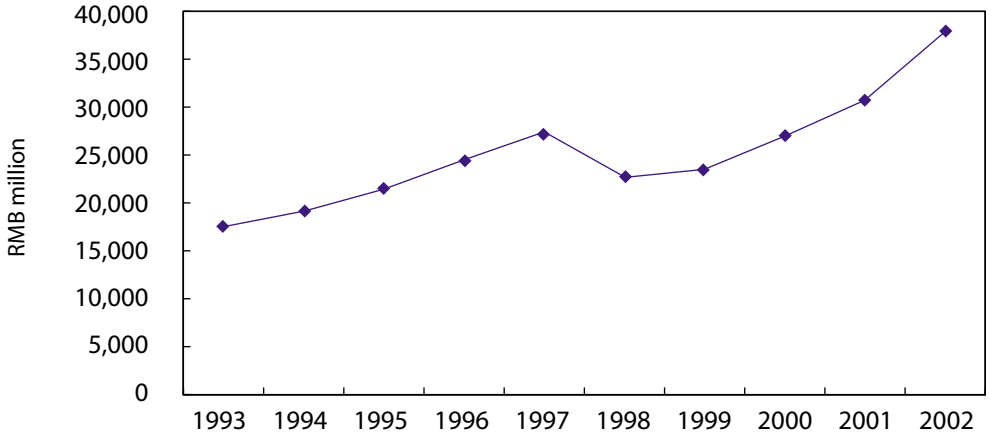
China has grown to be the largest production base for castings, with its annual casting output top in the world for three successive years. According to a survey by Modern Casting, China's output of metal castings has increased at a compound annual growth rate of 8% from 13.95 million tons in 2000 to 16.26 million tons in 2002. In 2002, China recorded its fifth consecutive growth year and casting shipments have increased 60% over the last six years.

Top 3 casting-producing nations 1997-2002



Source: Modern Casting, a publication of the American Foundry Society — December 2003 issue.

The chart below shows the total revenue growth of the casting industry from 1993 to 2002:



Source: China Markets Yearbook 1999-2004.

World motor vehicle production

As illustrated in the tables below, cars and motor vehicles constitute over 80% of the global automobile production in 2002 and 2003. At the end of 2002, China was ranked the fifth largest vehicle producing country after the US, Germany, France and Japan, according to a survey by Organisation Internationale des Constructeurs d'Automobiles, an international motor vehicle manufacture organisation founded in Paris.

World motor vehicle production by category 2002

	Light commercial	Cars	Buses	Motor vehicle	Heavy Trucks	Total	
USA	9,021,582	9,019,507	22,897	18,717,696	418,961	37,200,643	31.53%
China	801,935	1,101,696	413,815	3,286,804	969,358	6,573,608	5.57%
Japan	947,856	8,618,354	11,141	10,257,315	679,964	20,514,630	17.39%
World production	14,282,050	41,358,394	530,122	58,994,318	2,823,752	117,988,636	100.00%
	12.11%	35.05%	0.45%	50.00%	2.39%	100.00%	0.00%

World motor automobiles production by category 2003

	Light commercial	Cars	Buses	Motor vehicle	Heavy Trucks	Total	
USA	9,527,451	8,727,616	27,093	18,246,489	419,327	36,947,976	30.48%
China	821,111	2,018,875	516,700	4,443,686	1,087,000	8,887,372	7.33%
Japan	1,023,657	8,478,328	11,406	10,286,318	772,927	20,572,636	16.97%
World production	14,858,444	42,011,951	644,632	60,618,600	3,103,573	121,237,200	100.00%
	12.26%	34.65%	0.53%	50.00%	2.56%	100.00%	0.00%

Source: Organisation Internationale des Constructeurs d'Automobiles, (OICA) statistics, downloaded on 14th August, 2004

Most of the major automobile manufacturers are established in the US, Europe and Asia and their rankings for 2003 are set out below.

OICA STATISTICS COMMITTEE
World motor vehicle production by manufacturer
World ranking 2003

In units		Total	Passenger Cars	Light Commercial Vehicles*	Heavy Trucks*	Bus & Coaches*
1	General Motors (Opel-Vauxhall)	8,185,997	4,682,656	3,479,713	23,628	—
2	Ford (Jaguar-Volvo cars)	6,566,089	3,320,706	3,189,662	55,721	—
3	Toyota	6,240,526	5,369,176	638,748	232,602	—
4	Volkswagen Group	5,024,032	4,843,085	158,856	15,819	6,272
5	DaimlerChrysler (with Evobus)	4,321,603	1,819,973	2,149,526	228,461	33,643
6	PSA Peugeot Citroen	3,310,368	2,934,641	375,727	—	—
7	Nissan	2,942,306	2,363,155	448,849	130,302	—
8	Honda	2,992,526	2,868,705	53,821	—	—
9	Hyundai-Kia	2,697,435	2,275,535	92,504	144,809	184,587
10	Renault-Dacia-Samsung	2,386,098	2,110,557	275,541	—	—
11	Fiat-Iveco	2,077,828	1,619,185	337,499	115,568	5,576
12	Suzuki-Maruti	1,811,214	1,455,411	355,803	—	—
13	Mitsubishi	1,582,205	1,303,439	261,598	17,168	—
14	Mazda	1,152,578	960,935	70,958	120,685	—
15	BMW	1,118,940	1,118,940	—	—	—
16	Daihatsu	897,116	725,060	166,873	5,183	—
17	Avtovaz	699,888	699,888	—	—	—
18	FAW Group (without VW)	556,391	214,851	206,241	126,311	8,988
19	Fuji (Subaru)	544,868	458,163	86,705	—	—
20	GM-Daewoo	520,556	500,639	—	2,972	16,945
21	Isuzu	492,464	25,949	57,285	406,876	2,354
22	Dongfeng (without Citroën)	367,537	—	207,301	150,079	10,157
23	Tata (Telco)	288,998	140,670	50,617	84,108	13,603
24	Beijing AIG (without Hyundai-Isuzu)	261,868	—	245,762	16,106	—
25	SAIC (without GM&VW)	222,726	—	222,726	—	—
26	Gaz	201,399	56,783	144,616	—	—
27	Harbin Hafei Automotive	200,007	—	200,007	—	—
28	Ssangyong	159,314	144,416	6,336	—	8,562
29	Volvo-Renault Truck-Mack	153,573	—	6,762	139,613	7,198
30	MG Rover	133,557	132,789	768	—	—
31	Jinbei Auto Holdings	124,438	—	124,438	—	—
32	Changhe Aircraft Industrie	118,121	—	118,121	—	—
33	SAIC-Cherry Auto	101,141	101,141	—	—	—
34	Nanjing Auto	99,469	99,469	—	—	—
35	Manhindra&Mahindra	94,782	—	67,012	27,770	—
36	Ijmach-Avto	94,214	78,495	15,719	—	—
37	Paccar-Daf	94,099			94,099	—
38	Anhui Jianghuai Auto	93,646	—	81,569	—	12,077
39	Soueast Auto Industrial	86,655	—	86,655	—	—

In units	Total	Passenger cars	Light commercial vehicles*	Heavy trucks*	Bus & coaches*
40 Hino	83,122	—	4,141	73,591	5,390
41 Prosche	81,324	81,324	—	—	—
42 UAZ	76,897	32,748	44,149	—	—
43 Navistar	66,495			66,495	—
44 Kamaz	64,082	40,016	—	24,066	—
45 Jiangling Motors group	63,169	—	63,169	—	—
46 MAN-ERF-NEOMAN Bus	60,775	—	—	55,988	4,787
47 Scania	51,276	—	—	45,985	5,291
48 Nissan Diesel	38,848	—	490	36,736	1,622
49 Roslada	27,649	27,649	—	—	—
50 Hindustan	15,801	15,098	694	9	—
Irisbus	10,330	—	—	—	10,330
Evobus	6,587	—	—	—	6,587
Total manufactures shown	**59,486,010**	**42,621,247**	**14,096,961**	**2,440,750**	**327,052**
Others manufacturers (China, India, Russiam, Poland, Turkey....)	1,113,277				
Total production	**60,599,287**				

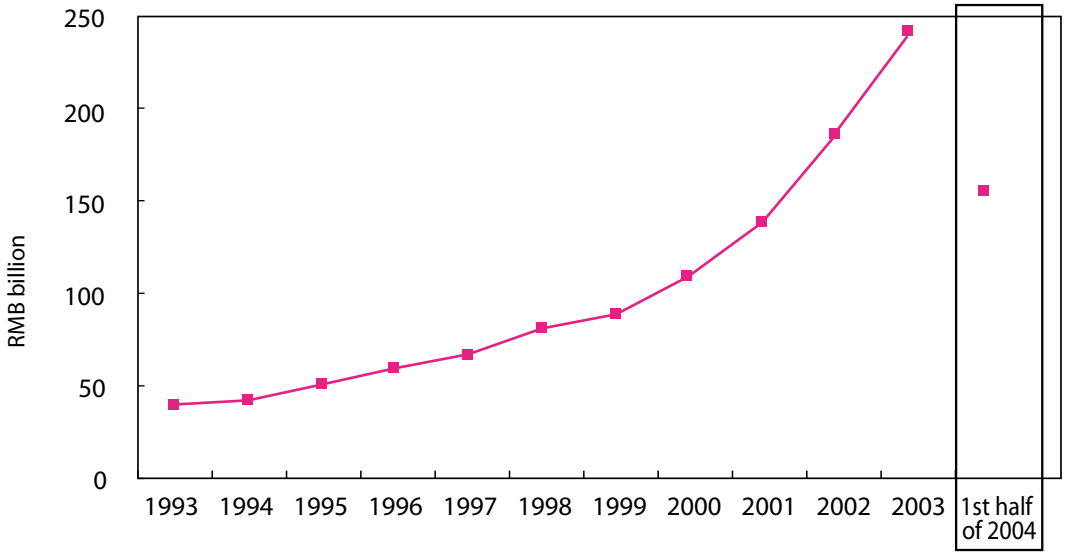
* Non homogeneous tonnage limit.

The PRC automobile parts industry

According to a report published by Research and Markets, an international market research organisation, it is noted that with China's entry into the WTO, the automobile industry is poised for a change and the automobile components industry is set to take off with it. This industry began to acquire foreign technology to improve its products and is moving to supply parts for the international market. Sales in 2002 were RMB 195.74 billion, an increase from RMB 130 billion in 2001. In 2002, there were approximately 2,800 domestic participants in this industry, with Wanxiang Group leading the market with sales of RMB 4.5 billion. The average annual growth rate over the last three years was 13.7%, while profit margins increased 25% and exports rose 32% over the same time period. However, competition is set to increase with China's new WTO status and there are close to 500 foreign car components companies operating in the PRC. With major car manufacturers like Daimler-Chrysler, BMW, Honda, and others aggressively entering the market, there will be more opportunities for component manufacturers. Foreign investment in this sector increased on an average rate of 6% annually in the past three years. Bosch, globally the No. 2 components manufacturer, has already established a nationwide network of 153 service centres. The international automobile manufacturers from the US, Europe and Japan generally enjoy (i) economies of scale; (ii) abundant resources for research and development; and (iii) integration among research, sales, and customer feedback channels.

It is mentioned in the presentation by Gene Muratore on "Castings in the Global Market" on 6th February, 2003 at AFS Southeastern Regional, as the car and truck and pump and compressors manufacturers formed about 31% and 15% respectively of the end user for metal casting in 2002, the future outlook of these two industries will have impact on the metal casting industry.

The graph below shows the total amount of automobile components in the PRC from 1993 to the first half of 2004:



Source: China Markets Yearbook (for 1993 to 2002); and "Manufacturing Industry Times Series Statistics" published by Beijing Kang Kai Information & Consultancy Co., Ltd. (for 2003 to the first half of 2004).

It is expected that the worldwide demand for automobiles will grow steadily over the next few years primarily due to accelerating global economic activity. In addition, the rapid pace of economic growth and increased industrialisation within the PRC will also lead to a stronger demand for automobiles. Volkswagen, the largest German car manufacturer in the PRC, according to Bloomberg, has become PRC's second overseas car manufacturer to obtain permission to start offering car loans in the PRC.

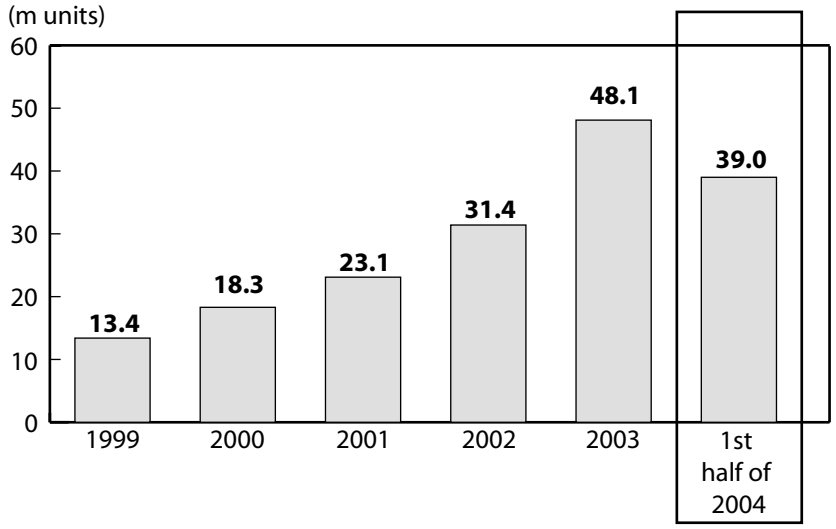
The PRC air-conditioner industry

In recent years, PRC's air-conditioner industry has developed rapidly. Air-conditioners are not only widely used in industrial buildings, but also in ordinary families. As China's living standard rises, people need to equip air-conditioners in their homes to improve living and working conditions.

The PRC air-conditioner market has grown significantly over the past few years and has great potential due to rapid development of the real estate industry in the country. The production of air-conditioners in China nowadays has accounted for approximately one third of the global total. The production volume of air-conditioners in the PRC had surged from 13.4 million units in 1999 to 48.1 million units in 2003, which experienced a compound annual growth rate of 38%.

The chart below shows the growth of the PRC air-conditioner industry from 1999 to the first half of 2004:

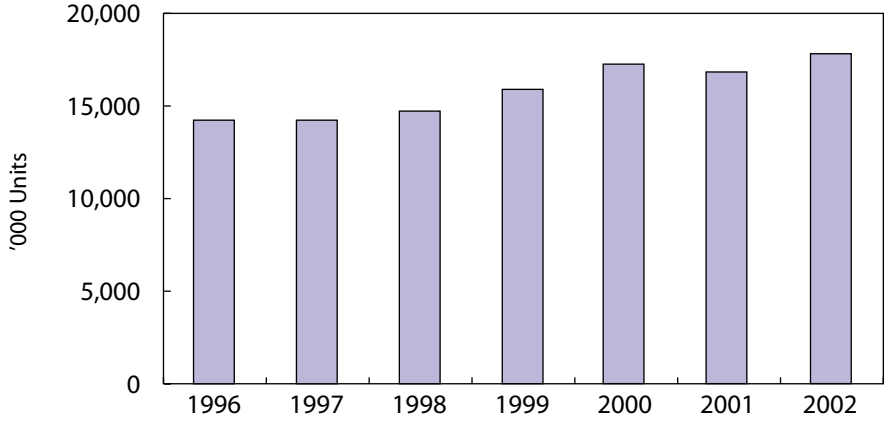
Production volume of air conditioners in the PRC from 1999 to 1H04



Source: China Monthly Statistics.

According to a research report published by Access Asia Limited, an Asian market information provider, — "Air Conditioners in China: A Market Analysis", the retail sales volume of air-conditioners in China recorded a compound annual growth rate of approximately 4% from 14.1 million units in 1996 to 17.9 million units in 2002.

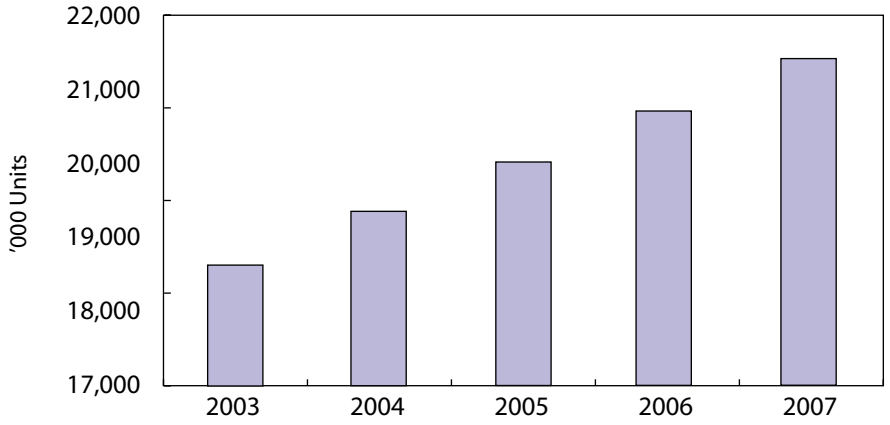
The chart below shows the trend of the retail sales volume of air-conditioners in China from 1996 to 2002:



Source: Access Asia Limited's "Air Conditioners in China: A Market Analysis" — published in August 2003.

As the real estate industry in China continues to grow, the retail sales volume of air-conditioner in China is forecasted to continue to grow at a compound annual growth rate of approximately 4% from 18.6 million units in 2003 to 21.4 million units in 2007.

The chart below shows the growth trend of the retail sales volume of air-conditioners in China from 2003 to 2007:



Source: Access Asia Limited's "Air Conditioners in China: A Market Analysis" — published in August 2003.

Air-conditioning compressors

Since 2001, the air-conditioner war of an ever-expanding volume has extended to the industry of air-conditioning compressors. According to FriedINet's "Air Conditioning Industry Report" published by Friedl Business Information and Partners, a China-based business and economic information provider, the air-conditioning compressors boasted of an output volume of 20.76 million units in 2001, 58% up over the previous year, and a sales volume of 18.84 million and a year-end stock of 2.2 million units, 3.7 times in comparison with the year before.

According to the article "China firms dominate as refrigeration market heats up" written by Toh Han Shih in the South China Morning Post, Chinese refrigeration companies have a competitive edge in the region because they manufacture their own compressors, enabling them to dominate the export outsourcing business and their home market with indigenous brands. Statistics conducted by BSRIA (a United Kingdom company providing independent and authoritative research, product testing, consultancy, management and market intelligence services) show that China's refrigeration market totalled USD 1.8 billion (HKD 14.0 billion) and industrial refrigeration accounted for about USD 350 million (HKD 2,730 million) and the market for compressors used in industrial cooling applications alone reached USD 83.1 million (HKD 648.2 million) in 2003.