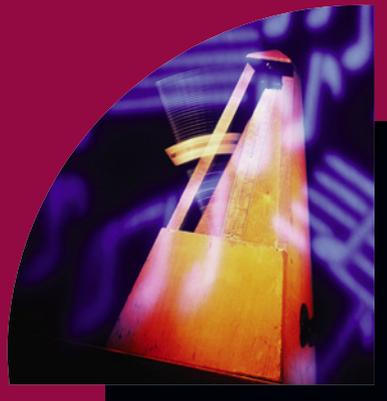


IMPULS



IMPLICATIONS OF THE 12TH FIVE YEAR PLAN FOR GERMAN MACHINERY MANUFACTURERS

Stiftung für den Maschinenbau,
den Anlagenbau
und die Informationstechnik



Jörg Nürnberg, Dr. Thomas Wang

IMPLICATIONS OF THE 12TH FIVE YEAR PLAN OF CHINA FOR GERMAN MACHINERY MANUFACTURERS

Dieses Forschungsvorhaben wurde gefördert
von der IMPULS-Stiftung des VDMA

Shanghai, Frankfurt, April 2012

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ZU DIESER STUDIE

China unternimmt enorme Anstrengungen, um im Maschinenbau technologisch weiter aufzuholen und Marktpositionen auszubauen. Schon heute ist das Land mit einem Umsatz von 563 Milliarden Euro weltgrößter Maschinenbauer und hat auch seinen Anteil an den weltweiten Maschinenexporten auf inzwischen fast zehn Prozent ausgebaut.

Der 12. Fünf-Jahres-Plan (2011 bis 2015) gibt wichtige Hinweise, in welchen Feldern China in den nächsten Jahren strategische Schwerpunkte setzen und seine Aktivitäten noch verstärken will. China verfolgt das klare Ziel, die Abhängigkeit von ausländischen Technologien zu reduzieren („Independent Innovation“), Umwelt und Ressourcen zu schonen und den F&E-Anteil am Bruttoinlandsprodukt massiv zu steigern. In sieben strategischen Bereichen werden bis 2015 1,2 Billionen Euro investiert: Elektromobilität, neue Energien, Produktionstechnik für High-End-Erzeugnisse, umweltfreundliche und energiesparende Technologien, neue Werkstoffe, Biotechnologie und neue IT. Im Durchschnitt sollen diese sieben Branchen um 24 Prozent p.a. wachsen. Dabei sollen diese Schlüsselindustrien regional konzentriert und konkrete Ziele auch für einzelne Unternehmen vorgegeben werden.

All dies hat weitgehende Implikationen für den deutschen Maschinenbau, sowohl für die vor Ort produzierenden als auch die von Deutschland aus exportierenden Unternehmen. Deshalb hat die IMPULS-Stiftung des VDMA die Droege Group China Ltd. beauftragt, die Auswirkungen der Strategien und Vorhaben im 12. Fünf-Jahres-Plan auf die Geschäftsmöglichkeiten in China und den globalen Wettbewerb im Maschinenbau zu analysieren. Die geplanten Vorhaben in 27 Teilbranchen der sieben strategischen Industrien werden analysiert und ihre Auswirkungen auf einzelne Teilbranchen des deutschen Maschinenbaus geprüft. Dabei ergibt sich eine hohe Betroffenheit von Teilbranchen wie Thermo- und Prozesstechnik, Gießereimaschinen, Verfahrenstechnik, Fluidtechnik, Produktionseinrichtungen für die Solar- und Windkraftindustrie, Präzisionswerkzeuge, Werkzeugmaschinen oder Formenbau.

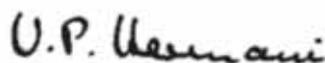
Die vorliegende Studie ist eine der detailliertesten Untersuchungen über die Auswirkungen des 12. Fünf-Jahres-Plans auf Sektoren der chinesischen Industrie sowie den deutschen und weltweiten Maschinenbau. Die Unternehmen des deutschen Maschinenbaus bekommen konkrete Hinweise, in welchen Feldern sich neue Geschäftsmöglichkeiten erschließen (oder auch verschließen) und in welchen Bereichen mit einem weiteren Erstarren des chinesischen Wettbewerbs zu rechnen ist.

Wir bedanken uns bei den Autoren der Studie, Herrn Dipl.-Ing. Jörg Nürnberg und Herrn Dr. Thomas Wang, für die fundierte Studie, zu der neben der üblichen Recherchearbeit eine Vielzahl von Interviews mit Regierungsstellen, Verbänden, Instituten und Unternehmen in China geführt wurden. Die Ergebnisse sind von großem Wert für die Unternehmen des deutschen Maschinenbaus.

Frankfurt, Juni 2012



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1 MANAGEMENT SUMMARY

“Achieving sustainability” is the phrase that describes most comprehensively the goals of the 12th five year plan (12-5). Six pillars frame 12-5 (see Figure 1-1) and address issues like achieving social equality, restructuring the economy to be more independent from government investments and export over to the improvement of education levels up to the softening of the concentration of economic power. Everything is geared towards creating a well-nourished base of citizens to take the next leap in growing from an extended workbench into an innovative manufacturing powerhouse which will not only be able to sustain the next technological developments but to drive certain industries.

These industries are spelled out in 7 so called strategic industries which represent 27 sub-industries. These will be supported with an economic program of CNY 10 trillion, i.e. € 1.2 trillion. This program would double the relevance of these strategic industries to represent about 8% of China’s expected GDP in 2015 of CNY 80 trillion if everything goes according to plan. Then, these strategic industries would be as big as the total GDP of South Korea or Mexico was in 2010. The magnitude of this program will change the face of some industries and will have a strong effect on the sector of machinery and engineered products.

Of course, change does not happen in a heartbeat and despite the great achievements of China in reclaiming its role in the world economy during the past year the tasks of the past were easy, compared with what lies ahead. The government expects that the transition that had been initiated during the 11th 5 year plan focusing on R&D and homegrown innovation will continue to be a major theme in the 13th 5 year plan.

However, in order not to get stuck in a “transition trap”, among others, the role of State owned enterprises (SOEs) needs to be redefined to achieve real leaps in productivity, private companies need to be given access to financial resources priced with risk premiums, and the process of grooming national champions needs to be redefined. It goes without saying that many of the subsidies earmarked for innovation, technology upgrading and productivity increase are mainly accessible for Chinese companies. However, many of these activities will lead to a number of opportunities for mechanical engineering companies. For German companies in the industry of mechanical engineering there is no time to waste to adapt to the 12-5 plan as it provides opportunities but also posts threats at the same time. Already, a few Chinese companies like Sinovel and Shenyang Machine Tool are trying to get in pole position in certain sectors, and China will continue to con-

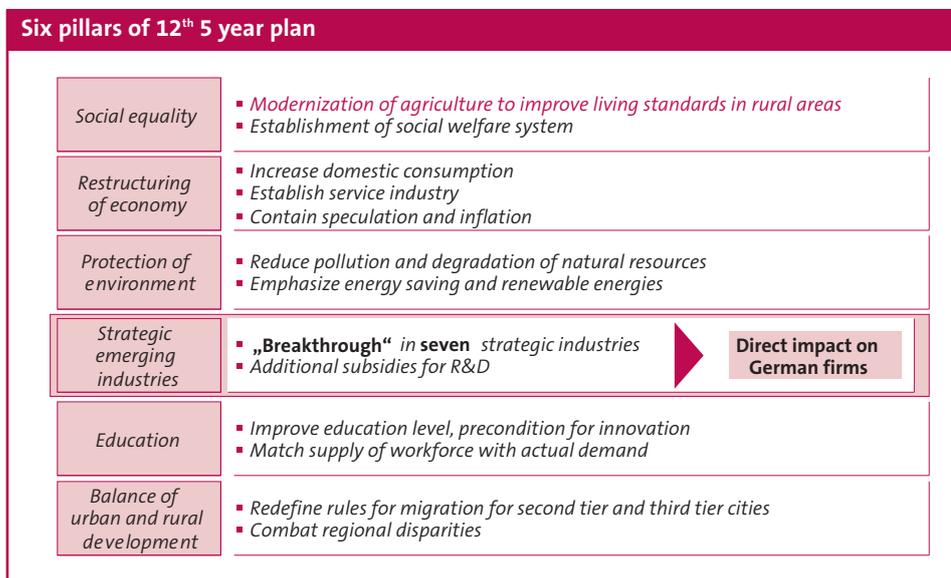


Figure: 1-1

concentrate resources regionally to achieve better synergies. For this reason Shenyang is undergoing a major development geared towards growing an annual production base of more than CNY 100 billion in the machine tool industry. The capacity being built up will of course satisfy local demand but will be also geared towards export as the “going out” program by the central government is still strong. R&D will play a major role in capturing export markets and China will triple its R&D spending during the next 5 years as shown in Figure 1-3. If innovation cannot be developed independently then there are always the means of acquiring technology via M&A activities as seen in the past months.

Although strategic implications of the 12-5 plan are different for each company and depend strongly on the relevant industry, specific product portfolio, geographical set-up and competitive environment, a few areas can be singled out that need to be addressed in order for German companies to have a chance to benefit from 12-5 plan.

Products need to be tailored

Even within the 7 strategic high-tech industries the perception of what is required can differ; many features usually required by customers in Europe, USA and Japan are still seen as needless by Chinese customers. Hence, offerings that are modular with a focus on bare necessities will be very appealing to Chinese companies.

In addition, add-on equipment could be offered in different qualities to make the base equipment competitive not only technologically but also in financial terms.

Commodity markets need to be served

Groundbreaking innovation will keep German firms ahead of Chinese competitors in the high-end segment of mechanical engineering; the low-end business is often already happily served by Chinese competition. To offer attractive entry level products at competitive prices and reasonable margins, value engineering, low cost country sourcing and low cost country manufacturing are needed. At the same time a 2nd brand strategy could avoid cannibalizing high-end brands.

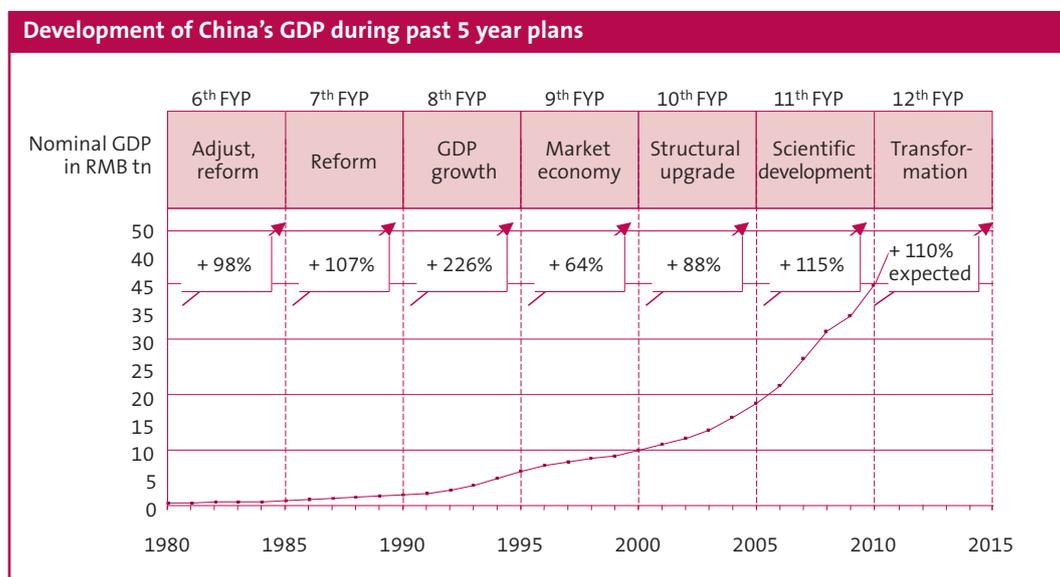


Figure: 1-2

R&D funding under 12-5						
	R &D = 1.5% GDP	R&D @ 2% GDP; GDP nominal growth rate 16.1%				
Year	2010	2011	2012	2013	2014	2015
GDP	39.8	46.2	53.6	62.2	72.2	83.8
R&D	0.6	0.9	1.0	1.2	1.4	1.7
	1.5%	1.9%	1.9%	1.9%	1.9%	2.0%

Figure: 1-3

Services will be appreciated

In many industries, China is not a profitable service market yet. However, tailored services will strive over the next years and will set companies apart. These offerings can range from additional training and retraining to increase yield and efficiency but could also include tailored maintenance contracts and go as far as financing facilities or similar.

Customers want to be served

The vast geographical spread of China, even considering only the highly populated and economically important coastal regions, is often a challenge for companies. However, Chinese buyers are getting more sophisticated and are expecting to talk not only to equipment specialists but also to discuss technical requirements for their respective applications with experienced sales engineers. Equipment manufacturers need to become solution providers to specific needs of customers in the down-stream industries. This requires not only sufficient well educated and experienced resources on hand. Furthermore it means that sales teams need to be able to provide more and more application development. Many times selling via traders or distributors will remain only viable in combination with a strong resource support of the OEM.

Increased (localized) R&D

In line with the above and the 12-5 plan R&D is the key to remain ahead of competition. Continuous groundbreaking innovation from German firms is a must. However, it becomes more and more important to be able to react to local customers' adaptation requirements quickly; hence a local R&D team becomes increasingly important.

In addition, being locally involved in R&D allows German firms to participate in local innovation centers as planned under the 12-5 plan to educate staff, influence local certification requirements and understand the current local development streams on a very detailed level. Also, the focus on R&D gives German firms the opportunity to collaborate in certain aspects with Chinese firms. This will provide the opportunity to participate indirectly in Chinese R&D funding and to position the German brand as technology provider for China.

This document can by no means cover the implications of the 12-5 plan in sufficient depth for all effected sub-industries. In fact out of the 27 sub-industries only 12 are described in this document.

If greater insights, more details and further discussions are required for firms to conclude their specific reaction towards the 12-5 plan, the authors will be happy to engage in further discussions.

2 INTRODUCTION

2.1 OVERVIEW OF 12TH 5 YEAR PLAN

The development of the 12-5 plan is a continuous process. It has gone through several rounds of decentralized development and centralized decision making processes. They can be summarized according to eleven phases which spanned as long as two and half years. The process was initiated as early as March 2008 with a Mid-term evaluation:

- 1) **Mid-term evaluation (March 2008 — December 2008):**
State Development Planning Commission (SDPC) initiated mid-term evaluation on the implementation of the 11-5 plan. This involved participations from different levels— ministry, provincial government, and independent third party. The objective was to assess experiences from previous 5-year plans, as basis for the 12-5 year plan.
- 2) **Field study (Dec. 2008 — Dec. 2009):**
Based on the mid-term evaluation results, SDPC proposed a tentative framework of the 12-5 plan, which was comprised of 39 topics covering 8 areas. Thousands of scholars and experts conducted research on several hundred topics, and the proposed framework was the result of the several-million-words reports.
- 3) **Draft of “Fundamental Concepts” (Dec. 2009 — Feb. 2010):**
SDPC drafted the “fundamental concepts”. After receiving feedback from different ministries and provincial governments, the amended fundamental concepts were proposed to the Central Political Committee (CPC), which is one of the key organs deciding on the 12-5 plan.
- 4) **Draft of “Suggestions” (Feb. 2010 — Dec. 2010):**
The drafting of “suggestions” was led by CPC. Members of CPC, National People’s Congress, and National Committee of the Chinese People’s Political Consultative Conference conducted comprehensive field trips as to get firsthand data and relevant information for the 12-5 plan.
- 5) **Approval of “Suggestions” (Oct. 2010):**
The “suggestions” of the 12-5 plan were approved by the Fifth Plenary Sessions of 17th Central Committee of the Communist Party.
- 6) **National Planning Experts Commission discussion (Oct. 2010 — Jan. 2011):**
SDPC organised several discussions involving the National Planning Experts Commission. The results of the meetings were submitted to National People’s Congress as key references for the draft of “Outline”.
- 7) **Draft of “Outline” (Oct. 2010 — Feb. 2011):**
SDPC drafted the “Outline” of the 12-5 plan taking various views and suggestions of different provincial governments and industrial associations into account as well as the results from the National Planning Experts Commission discussions.
- 8) **Public discussion (Jan. 2011 — Mar. 2011):**
A number of hearings and public discussions were held to elicit different views from the public at various levels.
- 9) **Approval of draft of “Outline” (Mar. 2011):**
Figure 2-1: Overview of roles and interactions among involved parties

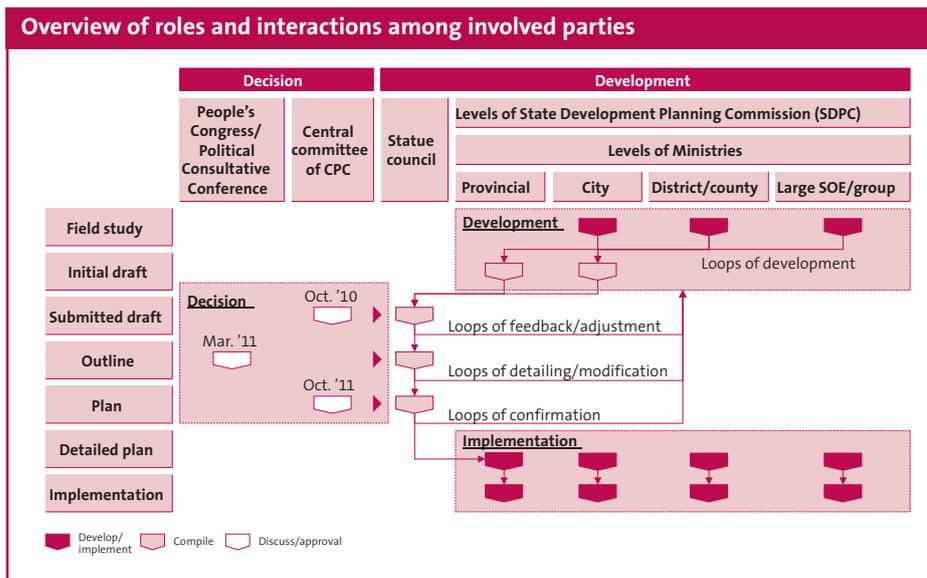


Figure: 2-1

The draft of "Outline" was approved by the Fourth Plenary Sessions of 11th National People's Congress. Critical suggestions were incorporated so as to prepare for the release of the finalized "Outline".

10) Release of "Outline":

"Outline" of the 12-5 plan was officially released.

11) Implementation

Figure 2-1 illustrated the roles and interactions among involved parties in the 12-5 plan making process. The detailed plan was finalized by February 2012, and the 12-5 plan will enter the implementation stage after then. Even after April 2012 detailed plans will be released, and thus the close monitoring of newly announced detailed plans is one of the core project tasks.

As for the focus of the 12-5 plan, there are 6 key themes: social equality, restructuring of economy, protection of environment, strategic emerging industries, education, and balance of urbanization and rural development. Their focuses and objectives are as follows:

- Social equality refers to the establishment of a comprehensive social welfare system. The government will accelerate the modernization of the agriculture segment to improve the living standards of people in rural areas.
- Restructuring of economy aims to increase in domestic consumption, to establish a wide spread service industry, and to contain speculation and inflation.
- The objective of protection of environment is to reduce pollution and degradation of natural resources while emphasizing energy saving and renewable energies.
- The theme of strategic emerging industries focuses on the achievement of making China and Chinese firms recognized contributors with "breakthrough" developments and success in 7 strategic industries (i.e. clean energy vehicle, new energy, high-end equipment manufacturing, energy conservation, new material, biotechnology, and new IT).

These 7 strategic industries are further broken down into 27-sub-industries which are addressed by the government with detailed plans for future developments. The government will provide substantial subsidies and numerous forms of relief supporting among others research and development and the general growth in these industries and sub-industries. These measures and will have direct impact on German firms. Therefore, this research project focuses on the expected development within the strategic emerging industries and the resulting implications for German firms.

Figure 2-2 depicts the strategic industries with their relevant 27 subsegments.

- Education highlights the improvement of education level and precondition for innovation. This is to match the supply of workforce with actual demand.
- Balance of urbanization and rural development stands for the redefinition of rules for migration for second tier and third tier cities so as to combat regional disparities.

The general trends of 12-5 policy targets are observed as below in four major aspects:

Demand-associated policies

1. Strong promotion of market demand especially for new energy sectors and environmental conservation sectors
2. Policy measures range from subsidies to equipment users, exemption of (consumption) taxes, and social security/complementary infrastructures
3. Nonetheless overcapacity/scattered development will be contained.

Supply-associated policies

1. Stringent requirements for equipment makers to become industrial leaders, push out smaller/scattered firms, and therefore increase concentration level
2. Policies measures range from exemplary projects roll-out, subsidies to leading players, promotion of capital market involvement, and industrial based creation

3. Nonetheless the government will still withhold its direct involvement and will remain as “ruler” rather than “player”.

Innovation/Industrialization-associated policies

1. Extremely high focus on independent innovation and local substitution; detailed technological gaps are often listed and local leading players would be assigned for R&D responsibilities
2. In most cases the target is to close the gap with global leaders, however there are cases, where the Chinese government would like to take a leap development and become the global technology leader.

Foreign investment-associated policies

1. Revision of Foreign Investment Guidance Directory from 2007 to 2011 version welcomes more industries to invest in China with a stronger focus on more advanced technologies and products that show a considerable value addition in China
2. Chinese government remains “open” and “fair” to a large extent in terms of limited market protection and direct subsidy to competitors
3. Policy continuity so as to ease foreign investment

Overview: 7 strategic Industries and their 27 sub-industries			
Industry	Segment	Industry	Segment
I Clean energy vehicle	1 OEM	V New material	15 High strength light alloy
	2 Key component		16 High performance iron steel
	3 Vehicle infrastructure		17 Functional films
II New energy	4 Solar		18 New battery materials
	5 Wind		19 Carbon fiber
	6 Nuclear	20 Rare-earths	
	7 Biomass	VI Biotech	21 Bio-manufacturing
8 Smart grid	22 Bio-material		
III High end equipment	9 Aviation		23 Bio-IVD
	10 High-speed railway	24 Bio equipment (non IVD)	
	11 Oceanic equipment	VII Energy conservations	25 Environmental protection
12 Intelligent equipment	26 Resource recycling		
IV New IT	13 Internet of things		27 Energy saving
	14 Flat panel/high performance IC		

Figure: 2-2

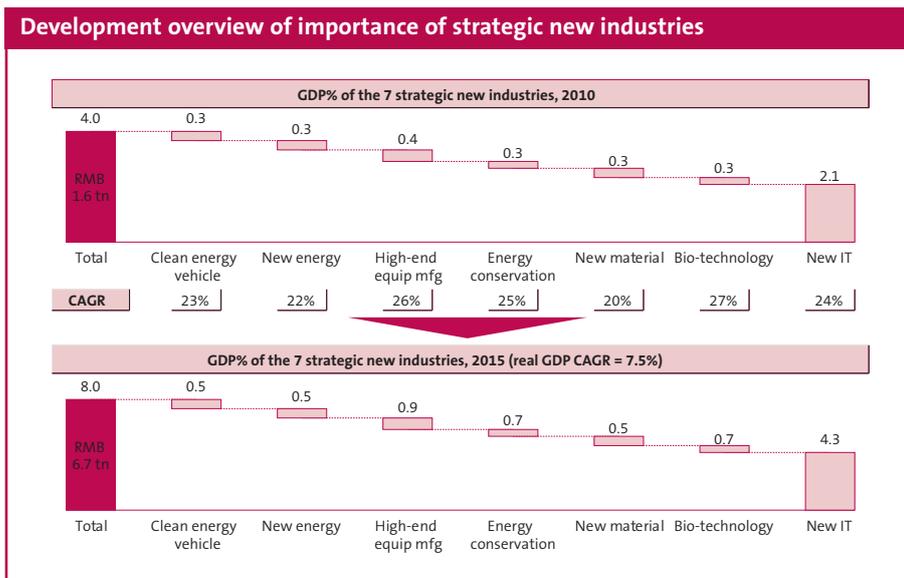


Figure: 2-3

The 12-5 plan has various policies that either stimulate foreign investments or protect local players in the 7 emerging industries. In general, the Chinese government is more selective when it comes to foreign involvements and has a high demand on technology. The policies can be grouped into 5:

Infrastructure: China will invest more resources in developing logistics and complementary public services, such as charging stations for clean energy vehicles. Also, information and financial services will be further improved. In order to enhance local firms' capabilities, the government is to raise standards and encourage the collaboration with laboratories and research institutions.

Foreign competitors: The government prefers foreign investments in some listed areas. To enter these protected sectors, foreign firms are required to form joint ventures with Chinese companies. The main objectives of attracting foreign investments are upgrading local technologies and acquiring advanced foreign technologies.

Local SOEs/ private firms: The government sets priority in local procurement aiming to protect Chinese companies. Tax reduction and direct firm subsidies are provided in addition to increase their competitiveness. Industry consolidation will be accelerated to enhance production capacities, efficiency and effectiveness. As a result of the policies' structures, SOEs will be the main beneficiaries of the 12-5 policies.

Customers: The government will provide direct subsidies to consumers as an incentive to boost demand. Consumption tax will be exempted for certain products.

Suppliers: China will build up several regional supply bases and industry zones, creating large company eco-systems. Tax exemptions will be granted to suppliers of key components.

In total, the Chinese government will invest 10 trillion CNY in the emerging industries, especially in energy-related sectors. In specific, 3 trillion CNY are earmarked for energy conservation. Another 2 trillion CNY investment will be put into new energy related sectors. The clean energy vehicle industry will receive 100 billion CNY investments. The strong policy support emphasizes again the government's target to achieve technology and innovation breakthroughs in the emerging industries.

In line with the growth of total investments, the Chinese government intends to enhance its R&D investments in the 7 strategic industries as well. In the year 2010, overall R&D investments were 600 billion CNY, accounting for 1.5% of the GDP. However, in the 12-5 period, the government will increase the percentage of R&D investments to GDP from 1.5% to 2%. Assuming the real GDP will grow at the rate of 8%, which is equivalent to a nominal GDP growth of 16.1%, GDP would reach approximately 84 trillion CNY in 2015. This would result in a total of 1.7 trillion CNY worth of R&D investments. Compared to 2010's figure, China's annual R&D investments would be tripled by the end of 2015.

Figure 2-3 shows the percentage of each individual industry's contribution to GDP for the 7 emerging industries. The total portion in GDP will be doubled between 2010 and 2015, increasing from 4% to 8%. This would result in a nominal increase in GDP contribution of the 7 strategic industries by 320% from today 1.6 trillion CNY to 6.7 trillion CNY in 2015. The size of the strategic industries of 12-5 would be comparable to Mexico's entire nominal GDP as of 2010.

The sector New IT alone would account for half of this value, constituting 4.3% of the GDP in 2015, representing the biggest strategic industry. In comparison, the well referenced strong growing automotive industry of China contributed 10% of the country's GDP in 2010.

The regional focus of the 7 strategic industries as well is described in the 12-5 plan and Table 2-1 shows the top 3 provinces for each strategic industry. In general, economically developed regions will take more responsibilities and receive more support in the development of these industries, while resource-abundant regions will leverage their natural advantages. In specific, Beijing, Shanghai, and Anhui are provinces that will focus on the development of clean energy vehicles, since these are China's key automotive bases. Focused provinces in new energy industry are Sichuan, Ningxia, and Hebei. The main reason for this is that all of them match with the natural resource allocation. The high-end equipment manufacturing will be highlighted in provinces of Hunan, Shanxi, and Shanghai. Provinces with high energy consumption, such as Beijing, Shandong, and Shanghai, will focus on energy conservation sector while the new material industry will be associated with provinces with abundant resource allocation, like Shaanxi, Hunan, and Liaoning. The biotech sector will be emphasized in Guangdong, Zhejiang, and Shanghai. These provinces have advantages in R&D and manufacturing capability. Developed regions, such as Beijing, Shanghai, and Guangdong will focus on the new IT industry.

Table 2-1: Comparison of provincial focus on the 7 emerging industries

	Focused province 1	Focused province 2	Focused province 3
1. Clean energy vehicle	Beijing	Shanghai	Anhui
2. New energy	Sichuan	Ningxia	Hebei
3. High-end equipment	Hunan	Shanxi	Shanghai
4. Energy conservation	Beijing	Shandong	Shanghai
5. New material	Shaanxi	Hunan	Liaoning
6. Biotech	Guangdong	Zhejiang	Shanghai
7. New IT	Beijing	Shanghai	Guangdong

2.2 RELEVANCE TO VDMA SECTORS

According to our researches and evaluations, several VDMA sectors will be more affected by the China 12-5 plans than others. Corresponding sectors are separated into 4 major levels based on different association levels.

Table 2-2 lists 10 VDMA chapters which are directly addressed in 4 strategic industries in the 12-5 year plan. The plan breaks down the industries further into 27 strategic sub-industries of which 6 target directly 10 VDMA chapters. These 10 chapters will experience the most direct and most focused change in terms of industry structure, technology development and government incentives. China's special focus on energy savings and environmental protection will raise significant influence on sectors like recycling technology and waste treatment.

The VDMA chapters listed Table 2-3 are those being highly impacted by the 12-5 policies. Association scores are evaluated as the number of industrial segments associated to certain VDMA sectors. Association scores equal to or higher than 5 are defined as highly affected sectors. Industrial furnace manufacturers and large industrial plant manufacturing industry may be affected greatly by China's 12-5 plan, mainly due to their applications in new materials and the new energy industry. China's ambitions in high-end manufacturing and clean energy vehicle industry in turn will affect corresponding VDMA sectors like actuators, dies and molds, precision tools, machine tools, etc.

Table 2-2: Impact on VDMA chapter – directly targeted sectors	
VDMA chapter	Directly named Sub-Industry ¹⁾
1. Air -pollution control	Energy conservation – Environmental protection and Energy conservation – resource recycling
2. Wastewater Technology	
3. Recycling Technology	
4. Waste Treatment and Recycling technology	
5. Flat Panel Displays	New IT – New flat panel display
6. Offshore Equipment	High -end equipment -Oceanic Equipment
7. Marine and Offshore Equipment Industry	
8. Machine Tools and Manufacturing Systems	
9. Laser and Laser Systems for Materials Processing	High end equipment – Intelligent equipment
10. Photovoltaic equipment	New energy – Solar
¹⁾ Sub-Industries are expressly mentioned in 12-5 plan	

Table 2-3: Overview of impact on VDMA sectors – highly affected sectors	
VDMA sectors	Association score ¹⁾
1. Industrial Furnace Manufacturing	13
2. Large Industrial Plant Manufacturing	10
3. Industrial Valves	8
4. Actuators	7
5. Dies and Molds	7
6. Electronics Production Equipment	7
7. Thermo Process Technology	7
8. Casting Machines	6
9. Foundry Machinery	6
10. Cutting Tools	6
11. Power Transmission Engineering	6
12. Precision Tools	6
13. Recooling Technology	6
14. Surface Treatment Technology	6
15. Vacuum Technology	6
16. Lasers and Laser Systems for Materials Processing	5
17. Metal Shaping	5
18. Valves	5
¹⁾ No. of segments associated to VDMA sectors, according to Droege evaluation; total = 27	

The VDMA sectors listed in Table 2-4 are those being moderately impacted by the 12-5 policies. Association score equals to 3 or 4 are defined as medium affected sectors. 20 VDMA sectors fall into this category. It should be noted that some VDMA sectors are very niche and very relevant to a few of the 27 sub-segments of the strategic industries only, and therefore although the asso-

ciation score is low, the impact to the single sector can still be high. Corresponding sectors include but are not limited to the air-pollution control, and metallurgical plants. On the other hand, the biotechnology industry and the new IT industry would exert a medium level impact to VDMA sectors due to their indirect linkage to machinery equipment.

Table 2-4: Overview of impact on VDMA sectors – medium affected sectors	
VDMA sectors	Association score ¹⁾
1. Air-pollution Control	4
2. Compressors, Compressed Air and Vacuum Technology	4
3. Engines and Systems	4
4. Length Measuring Technology	4
5. Mining Equipment	4
6. Process Plant and Equipment	4
7. Pumps and Compressors	4
8. Robotics	4
9. Robotics + Automation	4
10. Agricultural Machinery	3
11. Ceramics Machinery	3
12. European Ceramic Technology Suppliers	3
13. Composite Technology	3
14. Gas Welding, Cutting and Allied Processes	3
15. Glass Technology	3
16. Heat Pump Technology	3
17. Jigs and Fixtures	3
18. Machine Vision	3
19. Metallurgical Plants and Rolling Mills	3
20. Materials Handling and Logistic Technology	3
¹⁾ No. of segments associated to VDMA sectors, according to Droege evaluation; total = 27	

The VDMA sectors listed in Table 2-5 are those being the least impacted by the 12-5 policies. Associations scores equal or below 2 are defined as minimum affected sectors. For equipment sectors where China has already developed advanced capability, the 12-5 plan has not included them into the promotion focus.

As a result, these corresponding VDMA sectors are not directly affected, and are classified into minimum affected sectors. Typical sectors include food and packaging machines, textile machines, stone equipment, etc.

Table 2-5: Overview of impact on VDMA sectors – least affected sectors	
VDMA sectors	Association score ¹⁾
1. Air -handling Technology	2
2. Air Conditioning Technology	2
3. Displays	2
4. Drying Technology	2
7. Process Engineering, aseptic	2
8. Refrigeration Technology	2
9. Construction Equipment	1
10. Machinery for Man-made Fibre Production	1
11. Packaging Machinery	1
12. Pharmaceutical + Cosmetic Machinery	1
13. Polymer Electronics	1
14. Productronics	1
15. Building Material Machinery	0
16. Finishing (washing, bleaching, dyeing) Machinery	0
17. Firefighting Equipment	0
Other VDMA sectors ...	0
¹⁾ No. of segments associated to VDMA sectors, according to Droege evaluation; total = 27	

2.3 OVERVIEW OF DETAILED SUB-SEGMENT RESEARCH

The 7 strategic emerging industries mentioned before are broken further down into 27 addressable segments as is shown in Table 2-6. In order to identify specific policies and to assess the impact on German companies, practitioners have to revert back to subindustries. Only this will allow to tailor strategies to the adapted environment.

The research project has compiled information on all 27 segments addressed in the 12-5 plan but only the most relevant segments have been listed in this report including a detailed policy research and background of the market and competitive environment in China based on the 12-5 plans.

For less relevant segments additional information will be provided upon request at a slightly less detailed level. The structure and contents of research fields included in different levels of reports are illustrated in Figure 2-4.

According to Figure 2-4, the policy researches and market studies could be roughly divided into 5 steps for each levels of segment importance, which are market overview, competitive landscape, technical development, industrial integration, and strategic implication. In each of the 5 steps, corresponding 12-5 policies under a topic are studied in all the reports regardless of the importance level. The current market size, competitors and strategic implications are also studied for each level. All these contents are essential and basic in the reports. Apart from which, the

Industry	Segment
I. Clean energy vehicle	1. OEM
	2. Key component
	3. Vehicle infrastructure
II. New energy	4. Solar
	5. Wind
	6. Nuclear
	7. Biomass
	8. Smart grid
III. High end equipment	9. Aviation
	10. High -speed railway
	11. Oceanic equipment
	12. Intelligent equipment
IV. Energy conservation	13. Environmental protection
	14. Resource recycling
	15. Energy saving
V. New material	16. High strength light alloy
	17. High performance iron steel
	18. Functional films
	19. New battery materials
	20. Carbon fibre
	21. Rare -earth
VI. Biotech	22. Bio -manufacturing
	23. Bio -material
	24. Bio -IVD
	25. Bio equipment (non IVD)
VII. New IT	26. Internet of things
	27. Flat panel/ high performance IC

greatest difference falls in the first and second part, i.e. the market overview part and the competitive landscape part. Trading situations in both the product market and production equipment, and industrial growth driving factors and risks are only described for mid and highly-important industrial segments. Moreover, highly important industrial segments look into the market structure, key local customers and competitors' information, and more detailed studies in the 3rd and the 4th part. (i.e. the technical development part and the industrial integration part). The 27 segments are sorted by their importance to VDMA firms in Table 2-7. To determine the importance we have taken the number of affected sectors and the impact on the relevant sectors into account.

Report structure	Segment importance			
	High	Mid	Low	
1 Market overview	12-5 policies that stimulate market/demand	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	Industry current size and forecasted growth	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	Industrial growth driving factors and risks	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
	Industry sub-segment/market structure	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Key customers/geographical location	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Trade (only for raw material processing e.g. Uranium)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2 Competitive landscape	12-5 policies that support equipment making	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	Leading competitors, ownership, key products	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	Equipment trading/German portion	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
	Competitors' location/concentration	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3 Technical development	12-5 policies that promote innovation/upgrade	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	Specific gaps, targets, responsible developers	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4 Industrial integration	12-5 policies that advocate industrialisation	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	Value chain positioning, upstream/downstream M&A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5 Strategic implication	12-5 policies that address foreign investment	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	SWOT analysis/strategic recommendations	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Figure: 2-4

It is demonstrated in Table 2-7 that the overall importance level of each industrial segment is obtained from the integrated evaluations in the number of VDMA related sectors, as well as the weight of impact on the related sectors. Among all the 27 segments to be further studied, 6 are of high importance level: EV OEM (Clean Energy Vehicle-Original Equipment Manufacturer) indu-

stry, solar power industry, wind power industry, aviation industry, high-speed railway industry, and intelligent equipment industry. Besides, 15 of the 27 industrial segments are of mid importance, and the remaining 6 are of low importance. All segments' importance level is assigned for prioritizations of studies, so as to add the maximum value to VDMA members.

Table 2-7: Overview of relevance of sub segments

Segment	No. ¹⁾	Weight ²⁾	Overall
1. EV OEM	10	High	High
2. EV key component	2	High	Mid
3. Vehicle infrastructure	2	Mid	Low
4. Solar	14	High	High
5. Wind	14	High	High
6. Nuclear	11	Mid	Mid
7. Biomass	16	Mid	Mid
8. Smart grid	3	High	Mid
9. Aviation	16	High	High
10. High -speed railway	12	High	High
11. Oceanic equipment	13	Mid	Mid
12. Intelligent equipment	16	High	High
13. Environmental protection	5	High	Mid
14. Resource recycling	6	High	Mid
15. Energy saving	7	High	Mid
16. High strength light alloy	19	Mid	Mid
17. High performance iron steel	19	Mid	Mid
18. Functional films	7	High	Mid
19. New battery materials	5	Mid	Low
20. Carbon fiber	5	Mid	Low
21. Rare -earth	9	Low	Low
22. Bio -manufacturing	9	Low	Low
23. Bio -material	8	Mid	Mid
24. Bi o-IVD	2	High	Mid
25. Bio equipment (non IVD)	7	Mid	Mid
26. Internet of things	5	Mid	Low
27. Flat panel/ high performance IC	18	Mid	Mid

¹⁾ No. of VDMA related sectors according to Droege evaluation; total = 86 ²⁾ Weight of impact on the related sectors according to Droege evaluation

2.4 RESEARCH METHODOLOGY

The project has undergone comprehensive desktop research that covered all the 7 strategic emerging industries at different levels. Figure 2-5 shows the overview of the secondary data coverage.

The analyses are based on good industrial data availability, which is up to at least city level. In specific, the clean energy vehicle industry and the high-end equipment manufacturing industry have the most detailed data, which are even at the group level available. For instance, the published 12-5 plan for SA-IC group in the clean energy vehicle industry, and the 12-5 plan for Sinopec group in the oceanic equipment industry (sub-industry of the high-end equipment industry) have been studied and taken into consideration. The data availability is corresponding to the degree of policy finalization and release status. It can be seen from Figure 2-5 that plans and policies up to provincial level are all finalized. Many of the national level policies were only finalized in March 2012. Only policies for new material industries had been finalized earlier. Since the desktop studies have covered all 7 strategic industries based on detailed and released policies with

minimum revision possibility on national level only, it should be safe to draw the conclusion that the studies can provide high level of insight and credibility in all levels. All weblinks for released or draft policies on different levels are available in the appendix of this report.

In addition to secondary data research more than 50 interviews have been conducted with regards to each strategic industries with government officials, relevant association representatives, affected companies and technological and political research institutes. Interviewees cover wide fields from the government to practitioners, in order to ensure the indepth and reliability of the study. The project focuses particularly on the interviews with government departments, since the views from government are more relevant to the 12-5 policies. Interviews with corresponding industry associations also play an important role, since they are able to give a thorough picture for the whole industry. The new energy industry and the high-end equipment industry have been paid the most attention to, since 11 interviews are planned for each of them.

		Degree of availability/detailing				Degree of finalisation/release status			
		National	Provincial	City	Group	National	Provincial	City	Group
a	Clean energy vehicle	✓	✓	✓	✓	●	●	●	●
b	New energy	✓	✓	✓	□	●	●	●	○
c	High-end equip manufacturing	✓	✓	✓	✓	●	●	●	●
d	Energy conservation	✓	✓	✓	□	●	●	●	○
e	New material	✓	✓	✓	□	●	●	●	○
f	Biotechnology	✓	✓	✓	□	●	●	●	○
g	New IT	✓	✓	✓	□	●	●	●	○

○ initial draft / not approved
● Finalised / released

Figure: 2-5

3 MAJOR INDUSTRY SEGMENT STUDIES

12 out of the 27 strategic industries were selected for further research. The selection is based on their level of importance and industry coverage. Hence all 6 highly important segments as well as some of the medium important segments are analyzed below. All the 7 industries are covered by at least one segment.

3.1 INTELLIGENT EQUIPMENT

3.1.1 MARKET OVERVIEW

The development of CNC (Computer Numerical Control) machine tool is mentioned in the 12-5 plan with regard to two kinds of equipment, the machine tools and the intelligent equipment. Machine tools are equipment for machine manufacturing, while intelligent equipment is manufacturing equipment with the functions of perception, analysis and decision making. Machine tools which are at the same time intelligent equipment are defined as NC machine tools (Numerical Control machine tool), which are automatic machine tools with program control systems.

From the supportive 12-5 plan for machine tools, the corresponding statements of the equipment can be broken down as NC machine tools and Non-NC machine tools, where CNC machine tools are high-end NC machine tools. Besides, according to the 12-5 plan regarding intelligent equipment, the corresponding statements of the equipment can be broken down into CNC machine tools, key basic components, intelligent instruments & control systems, and intelligent special equipment. Relevant to this chapter are NC machine tools from the machine tool segment and CNC machine tools from the intelligent equipment segment.

POLICY SUMMARIES

The government is supporting high-end equipment, new energy and new IT, and encourages to develop the equipment manufacturing industry.

Downstream industries being promoted are:

Automotive industry

Automobiles and components

Machinery industry

1. Power equipment
2. Construction machinery
3. Mining equipment

Military industry

1. Aviation equipment
2. Aerospace equipment
3. Ocean equipment

Other industries

Electronic equipment (New IT)

Types of intelligent equipment under the government's support:

1. High-end CNC machine tools, such as NC metal cutting machine tools
2. Key basic components, such as rolling bearings, hydraulic components, and optoelectronic devices
3. Intelligent instruments and control system, such as electro-technical instruments and automobile instruments
4. Intelligent special equipment, such as robots and intelligent agricultural machinery

Table 3 -1: Overview of machine tools used in downstream industries	
Downstream industries	Machine tools used in downstream industries
Automobile and component	Special NC machine tools Flexible production lines
Power equipment	Large NC machine tools Heavy NC boring - milling machines CNC machine centers Large floor type boring-milling machine
Mining equipment	Large plano milling machines Large NC lathes
Co nstruction equipment	Medium and small-sized NC lathes Medium-sized CNC machine centre NC milling machines
Aviation equipment	CNC machine centre Precision NC lathes Multi-axis boring-milling machine centre
Military equipment	NC lathes plane milling and boring machines

High-end CNC machine tool technology is considered to be the most important area of intelligent equipment. Special funds will be provided to promote the application of intelligent equipment. Therefore, high-end CNC machine tools will be the key products promoted under 12-5. The market size of intelligent equipment in China was 300 billion CNY in 2009, yet the expected market size will be 1,000 billion CNY by 2015, with a CAGR (Compound Annual Growth Rate) of 22.2%. The proportion of intelligent equipment among all types of equipment will reach 30% by 2015.

The large demand of machine tools is initiated by downstream industries. From 2002 to 2010, China was the biggest machine tool market for imported machine tools as well as in general use of machine tools. Referring to the policies regarding the development of the downstream industries, the expected demand of high-end machine tools during the 12-5 period will be extremely high.

The automotive industry, machinery industry and military industry are three major downstream industries in need of CNC machine tools. The automotive industry is the biggest market of CNC tools, accounting for 45% of the market as of 2010. Both the machinery industry and military industry consumed 20% of the market, whe-

reas the remaining 35% were other corresponding industries, such as the electronic equipment (New IT) industry as indicated in policies.

The different kinds of machine tools used in different downstream industries are listed in Table 3-1.

The application area of machine tools in the Chinese market is not comparable to the global market. The application area of lathes contributed as much as 39% of the total market and was the biggest among all machine tools. However, major machine tools used in western countries are boring-milling machine, machine centers and grinding machines. The market share of boring-milling machines currently in China is only 10%, but the percentage internationally is 24%. The share of machine centers and grinding machines in the international market are 22% and 17% respectively, roughly 10% higher than those in China. Machine centers are mainly used for multi-surface high precision parts, boring-milling machines are usually for large case parts, and grinding machines are usually used in high precision parts. The development of boring-milling machines, machine centers and grinding machines are the trend and target of the upgrading of Chinese equipment manufacturing industry. Their growth rates are much higher than the average growth speed in the industry.

3.1.2 COMPETITIVE LANDSCAPE

The 12-5 policy indicates that financial support will be provided for the development of the machine tool industry, especially for independent technology R&D in the area of NC machine tools where output is growing fast.

The manufacturing industry of machine tools in China is developing quickly as well. The output value is steadily growing at the CAGR of 26% in recent years, from 347.2 billion CNY in 2008 to 553.7 billion CNY in 2010. Also, China has become the country with the highest machine tool output in 2009. With further growth expected at a rate of 8% annually, the 2015 target is set at 800 billion CNY by the 12-5.

The growth of annual unit output in China is also increasing. The number of units manufactured in 2008 was 620,000, despite a small decrease in 2009, the number increased to 760,000 in 2010 by 11%.

The development trend of NC machine tool output is even more powerful, both in output value and number of units. The relative value of NC machine tools among all machine tools was 35.3% in 2005 but it increased to 51.9% in 2010, with an annual growth rate of over 10%. The number of Chinese NC machine tool output was only around 47,000 units in 2005. Until 2010 the output soared to 224,000 units, 30% of the total output units of that year with a CAGR as high as 37%.

POLICY SUMMARIES

In 12-5, subsidies will be increased to support the independent R&D of high-end NC machine tools, such as intelligent equipment. The first newly developed product can receive a subsidy of up to 50% of the R&D input, and the average subsidies are expected to reach between 25% and 30%.

Insurance for machine tool manufacturers will be provided to develop independent products.

2015 target in output value of machine tools

- The annual capacity of NC machine should reach 250,000 units by 2015
- The localization rate of medium-grade CNC systems should reach 40% and high-grade CNC systems should reach 10% by 2015
- The export value of machine tools and components should reach 11 billion USD in 2015, among which machine tools should account for about 40%.
- The industrial value added rate of machine tool industry should reach 30%
- Foster leading enterprises with core competitive strength and famous brands

Major machine tool products to be promoted

1. Medium and high-grade CNC systems
2. Four types of machine mainframes
3. Functional units & machine tool parts
4. Cutting tools, Measuring tools & instruments
5. Abrasives & ultra-hard material & products.

Types of medium & high-grade CNC systems to be promoted

1. All digital, open and high-performance NC system devices and servo driving devices, as well as their supporting servo motors, spindle motors, electric spindle components, linear motors and torque motors
2. High-resolution grating rulers and encoders
3. High reliability intelligent machine tool electrical apparatus, digital display units

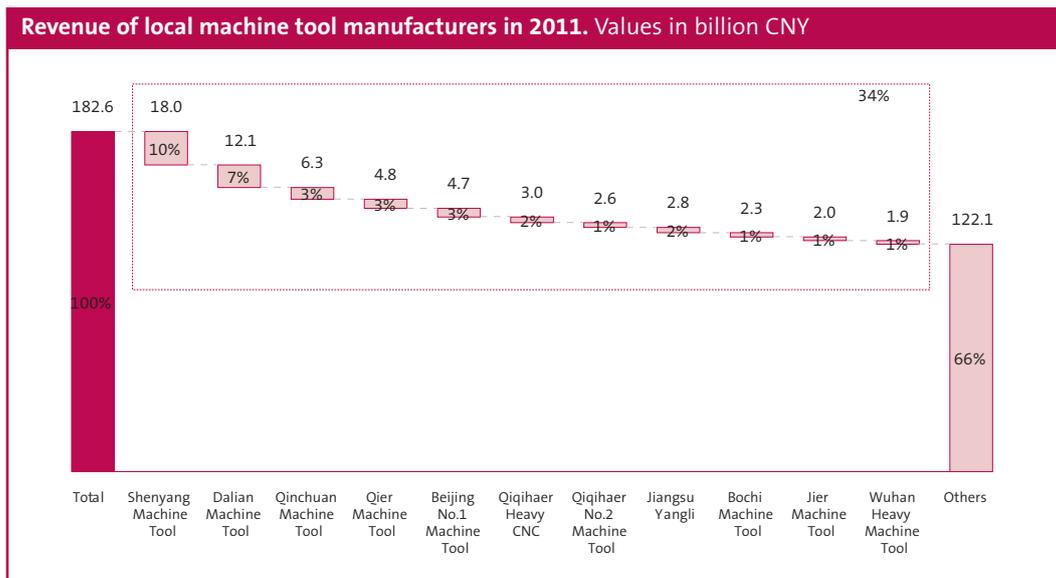


Figure: 3-1

According to what is shown in Figure 3-1, the machine tool manufacturer market in China is only slightly less concentrated than only a few years ago. In 2011 the quantity of local manufacturers larger than CNY 5 million per year had risen to 6,367, most of which are state-owned enterprises. Figure 3-1 shows that Shenyang Machine Tool is leading the market in terms of revenue, followed closely by Dalian Machine Tool in 2011 with annual revenues of 18.0 billion CNY and 12.1 billion CNY respectively.

Especially Shenyang Machine Tool has developed very strongly in the past 3 years and has almost doubled its turnover from CNY 10 billion in 2008 until today. Qinchuan Machine Tool was in 3rd place far behind with a revenue of CNY 6.3 billion but also with a strong growth over the past years. All other manufacturers in the market had a market share of less than 3%. In 2011, 22 Chinese manufacturers had an output value of more than CNY 1 billion and accounted for more than 40% of the total Chinese output. The top 10 accounted for 33% of the total local output. While in 2008, Shenyang Machine Tool was ranked 7th and Dalian Machine Tool 9th globally, in 2011 Shenyang will be most likely the largest machine tool manufacturer in the world.

The leading local manufacturers for different types of machine tools are listed in Table 3-2. It could be indicated that some local manufacturers have already developed some advanced products. For the categories of machine tools listed, at least two powerful competitors are in the market. It should also be mentioned that Shenyang Machine Tool is specialized in both lathes and drilling & boring machines. Qinchuan Machine Tool is specialized in grinding machines and gear cutting machines.

Machine tools	Leading manufacturers
Lathes	Shenyang Machine Tool Qiqihaer Heavy CNC Bochi Machine Tool Jinan First Machine Tool
Milling machine	Beijing No. 1 Machine Tool Changzheng Machine Tool
Drilling and boring machine	Kunming Machine Tool Qier Machine Tool Wuhan Heavy Machine Tool Shenyang Machine Tool
Grinding machine	Hangzhou Machine Tool Shanghai Machine Tool Huadong CNC Qinchuan Machine Tool
Gear cutting machine	Qinchuan Machine Tool Chongqin Machine Tool

Table 3-3: Leading players in CNC systems and CNC machine tools				
Values in billion CNY				
	Company	Ownership	'11 revenue	Advanced products
CNC Sys-tems	Huazhong CNC	listed	0.4	Various CNC systems for different machine tools, servo drives, servo motors
	GSK	Private	1.3	Various CNC system for different machine tools, servo drives, servo motors
	KND CNC System	Private	-	Various CNC system for different machine tools, servo drives, servo motors
	Dalian Dasen NC	Private	-	Medium and high-end CNC systems
	Washing	Private	-	Various CNC system for different machine tools, servo drives, servo motors
CNC Ma-chine Tool	Shenyang MT	SOE	18.0	NC lathes, NC boring and milling machine, machine centers, NC drilling machine and laser cutting machine
	Kunming MT	listed	1.7	Horizontal boring machine, floor type CNC boring and milling machine
	Qinchuan MT	SOE	6.3	Gear grinders, cylindrical grinders and thread grinders
Source: CMTBA (China Machine Tool & Tool Builders' Association), EMIS				

The leading Chinese CNC machine tool and CNC system manufacturers are listed in Table 3-3.

Competitors in the CNC system market are similar in advanced products, but the products are different among the three CNC machine tool competitors. Among all the leading CNC system players, only Huazhong CNC is a SOE, while all the leading CNC machine tool manufacturers are SOE's. Fanuc (Japan) and Siemens (Germany) are the global leaders of CNC system, with the global market share of 50% and 20% respectively.

The majority of NC machine tools produced in China are low-end products. 70% of the high-end CNC system market in China is taken by foreign leading manufacturers. The export value of NC machine tools was 260 million USD in 2009, which decreased from 500 million USD in 2008, but increased again to 490 million USD in 2010. The small value and volatile trend indicate that NC machine tools from China have low global competitive strength so far. The average price per exported machine was only 32,000 USD in 2008, which decreased to 31,000 USD in 2009, and then 29,000 USD in 2010. This reflects an annual decline of 4.8%.

High-end types of NC machine in China are highly dependent on imports. The import value of NC machine tools was 2.9 billion USD in 2008, decreased to 2.5 billion USD in 2009, and rose again to 3.4 billion USD in 2010 with an increasing trend in 2011. It is expected that Chinese imports of NC machine tools will continue to increase.

The average price per import machine was 172,000 USD per unit in 2008, soared to 289,000 USD in 2009, and then consolidated at 205,000 USD per unit in 2010. Here as well, a trend of increasing prices for imported machinery and therefore higher quality imports is visible.

3.1.3 INNOVATION & INDUSTRIALIZATION FOCUS

The government wants to invest more into the expanding market, and try to foster rather some large players to lead the market. Independent R&D of key technology is encouraged by financial support of various kinds and UNISPAR (University-Industry-Science Partnership). Innovation systems are also planned to be built up. Besides, a complete value chain of the industry is planned to be built up to better integrate upstream and downstream resources.

POLICY SUMMARIES

Supportive Policies

- Set up innovation systems to support independent R&D for key technology
- Special projects to support key technology R&D

Increase the investment in R&D. For leading firms, the percentage of R&D spending from revenue should be no less than 4%

Technology R&D

Basic and generic technology

1. CAD/CAE/CAM technology¹
2. Technology to increase the stability and length of machine tool services
3. Machine tool static and dynamic measurement technology, thermal deformation and compensation technology, NC machine tool production process and equipment researches

Key technology

1. Direct drive technology
 2. High speed machining technology
 3. Precision machining technology
 4. Multiaxis and combined machining technology
 5. Intelligent technology
 6. Network production technology
- Process technology will be a concern in 12-5

UNISPAR (University-Industry- Science Partnership)

Set up innovation systems:

1. In order to foster and certify leading enterprises
2. Need to be market-oriented
3. Enterprises, universities and research institutes involved

Professional talent training project:

1. Attract and train high-level technical talents
2. Improve the trainings to mechanics
3. Foster demonstrative manager-level professionals

Industrialization and industry integration

Complete value chain

1. Encourage to form complete NC machine tool value chain
2. Encourage the industrialization of key equipment

Enterprise fostering

1. Some leading enterprises or groups with core competitive strength, establish some advanced production bases with international competitive strength
2. Some medium and small-sized enterprises with competitive strength on special products

¹) CAD refers to Computer-Aided Design; CAE refers to Computer-Aided Engineering; CAM refers to Computer-Aided Manufacturing

3.1.4 RECOMMENDATIONS TO GERMAN FIRMS

POLICY SUMMARIES

Beneficiary

Imports of high-end machine tools will continuously be encouraged by the Chinese government to acquire high-end machine tool technology

Discriminating

- Independent R&D in technology with IP is encouraged
- Encouragement to increase the percentage of localization
- Exports of local equipment are encouraged
- Imports of certain machine tools that Chinese manufacturers are making progress in will be limited by import tariffs and value-added taxes

The market opportunity in China is attractive. German firms have big advantages in high-end technology, but have limitations from the Chinese government. The current Chinese market situations could be seen as below:

Market A number of downstream industries formed a large market of NC machine tools, and the development of the market stimulated the fast growing of high-end CNC machine tool market. Supply The output of machine tools in China increases fast in both value and number of units, and the growth in NC machine tools is even greater. However the NC machine tools produced in China are still lagged behind from the global advanced technology, especially in CNC machine tools.

Policy The corresponding policies mentioned in the 12-5 plan can be concluded as: 1. to promote downstream industries of machine tools 2. to focus on the development of CNC machine tools 3. to increase the localization rate of CNC systems 4. to provide subsidies and insurance to support technology developments and to foster leading enterprises.

Importing high-end-machine tools will continuously be welcomed, but will be limited by types of machine tools. German firms may want to capitalize on their big advantages in technology to obtain the potential market. From the research regarding the Chinese market above, the following can be summarized for German manufacturers:

Strengths German firms are still far advanced in high-end machine tool technology, especially in CNC machine tool technology. Also process technology and stability are considered great advantages in this respect.

Weaknesses: Local players have advantages due to:

1. Government support on procurement and finance
2. Reverse-engineering capability (i.e. cheap R&D) Reverse engineering will make some high-end technology developed or obtained easily and less expensive for Chinese players.
3. Local network and familiarity in the whole value chain.

Opportunities The expected large demand in high-end machine tools in China during the 12-5 period will be a great opportunity for corresponding German players to expand in the market, especially in CNC machine tools.

Threats The fast development of key local competitors due to the support from the government in various forms will be the biggest threat. There are also limitations of importing products from the Chinese government to protect local players. Apart from that, Chinese competitors will compete not only in China, but in overseas markets as well, especially emerging markets for low-end products.

In order to capture the opportunities, three main areas should be considered among others: Product and service portfolio realignment, optimized sales network, and increased (localized) research and development.:

Product and service portfolio realignment A market of such magnitude as China requires to tailor the product and service offerings to the specific needs of the targeted customers. Despite the fact that latest technology is required many features that are usually offered to customers in Europe, USA and Japan are seen as needless by Chinese customers. Hence, offerings that are modular with a focus on the bare necessities will be very appealing to Chinese companies. In addition, add-on equipment could be offered in different qualities to make the equipment look even more competitive not only for technological requirements but also in financial terms.

Although Germany will remain untouchable in the high-tech machine tool area for quite some time, low-end business is more and more taken away by Chinese competition. Here an appropriate and attractive answer for the market needs to be found employing value engineering and low cost country sourcing and manufacturing. At the same it needs to be assessed if a 2nd brand strategy can be employed to capture the lower-end market without cannibalizing the very profitable high-end brands.

In addition services should be tailored to Chinese customers. Offerings can range from additional (re-)training to increase yield and efficiency on the German machines but should also include tailored maintenance contracts and go as far financing facilities via leasing arrangements or similar.

Optimized sales network Chinese buyers are getting more and more sophisticated and are expecting to talk not only to equipment specialists but to discuss their technical requirements with in the respective application experienced sales engineers. More often than not is the equipment manufacturer seen as a solution provider to specific needs of customers in the down-stream industries. This requires not only that sufficient well educated and experienced resources are available in China but also that sales are able to provide more and more application development up to a certain level. Selling via traders or distributors still remains a viable channel for this but needs to be supported more and more through own resources of the OEM.

Increased (localized) research and development In line with the above and the 12-5 plan R&D is the key to remain ahead of the Chinese competition. So efforts must not decrease in this area. However, it becomes more and more important to be able to react to local customer requirements quickly, hence a local R&D becomes increasingly important.

In addition, being locally involved in R&D allows German firms to participate in local innovation centers as planned under the 12-5 plan to educate staff, influence local certification requirements and understand the current local development streams on a very detailed level. Also, the focus on R&D gives German firms the opportunity to collaborate in certain aspects with Chinese firms. This will provide the opportunity to participate indirectly in Chinese R&D funding and to position the German brand as technology provider for China.

3.2 HIGH PERFORMANCE IRON STEEL

3.2.1 MARKET OVERVIEW

POLICY SUMMARIES

General policy guidelines

HPIS is encouraged to be used in high-speed railway, urban rail transit, ocean equipment and offshore oil exploitation, new energy, ultra-high voltage grid equipment, and energy saving and environmental protection vehicle industries in the 12-5 plan.

Supporting policies for HPIS

Supports will be provided to:

1. Independent R&D
2. New product industrialization
3. Infrastructure, logistics facilities

Supporting measurements include:

1. Tax deduction
2. Subsidies for R&D to HPIS companies
3. Support key projects

High-performance iron steel (HPIS) refers to the steel with high quality and high performance, which are specially used for high-end equipment manufacturing and other key projects. HPIS usually refers to special steel in the 12-5 plan.

Comprehensive policy is expected for high-performance iron steel industry. As much as 100 billion CNY of special fund will come from both the government and corresponding enterprises. Promoted industries in need of special steel in the 12-5 plan are: 1. High end equipment industry, which includes the high-speed railway industry, the ocean equipment industry, and the aviation industry; 2. New energy industry, which includes the nuclear power equipment industry and the UHV grid equipment industry; 3. Energy-saving vehicle industry. Therefore, large demand of special steel is expected during the 12-5 period.

Nevertheless, the proportion of special steel is small in China. The output of steel in China was around 0.6 billion tons in 2010, almost half of the global output. Yet the percentage of special steel was only 5%, which is far smaller compared with the global average rate at 15% to 20%. Furthermore, around 80% of the special steel products in China are low-end products. High-end special steel such as tool steel, die steel and high-speed steel, however, depend largely on import.

Table 3-4 lists the market share of each industry that special steel is used in China. Currently 40% of the total special steel output is used in the automobile industry, followed up closely by the machinery industry which accounts for 32% of the market share. The market share used in other industries are relatively lower, that 13% of the special steel are used in the petro-chemical industry, and only 4% and 3% are used in the aviation military and the railway industries respectively. High-speed steel seems to be the most widely used type of special steel that is essential in both the automobile industry and the railway industry.

Table 3-4: Market share of special steel by industry		
Industry	Market share	Type of special steel used
Automobile	40%	High-speed steel
Machinery	32%	Structural steel
Petro-chemical	13%	Alloy steel
Aviation Military	4%	Precision alloy steel
Railway	3%	High-speed steel
Others	8%	-

Table 3-5: Overview of the 2015 target production capacity of highend special steel by category			
Values in million tons			
Category	Capacity	Percentage	Detailed description
Seamless tube	0.5	6%	Large diameter thick wall seamless tube for ultra super critical boilers
Corrosion-resisting steel tube	0.1	1%	Special corrosion-resisting steel tube for vessels
Corrosion-resisting steel	1.0	12%	Special corrosion-resisting steel for vessels
Steel for high-speed railway	0.05	0.6%	Key steel for high-speed railway wheels, axles and bearings
Steel for basic parts	3.0	38%	Durable pinion steel, bolting steel, die steel, spring steel, bearing steel and high-speed steel for basic parts
Steel for automobile sheet	3.0	38%	High strength auto sheet, including DPT, TRIP, TWIP, hot forming and the third generation auto steel
Others	0.35	4%	Amorphous strip and high permeability oriented silicon steel
Total	8.0	100%	

The targets of high-end special steel capacity have been proposed in the 12-5 plan as listed in Table 3-5. The designed target capacity of all types of high-end special steel is 8 million tons, from which the steel for basic parts and for automobile sheet are the two categories to reach the most of the capacity. 3 million tons of capacity for each category is expected, which would account for about 80% of the total target capacity. 1 million tons of capacity in Corrosion-resisting steel is also planned. All other categories such as Seamless tube, Corrosion-resisting steel tube and Steel for high-speed railway would be added to reach the total capacity of 1 million tons.

The general information of the major special steel manufacturers such as their annual output, products and advantages are listed in Table 3-6. The Citic Pacific Special Steel Group leads the market as of year 2009, and the main products that each manufacturer specializes in vary largely. All these manufacturers listed are state-owned enterprises, which may indicate that the support from the government is fairly important to this industry in China.

Table 3-6: Overview of Chinese major special steel manufacturers Values in million tons		
Local manufacturer	Output¹	Main products and advantages
Citic Pacific Special Steel Group	3.95	The largest special steel enterprise in China. Various products including special steel long products, special plates and special pipes
Tianjin Pipe Corporation	2.73	Various special pipes
Taigang Stainless Steel	2.23	Stainless steel, the largest stainless steel enterprise in the world
Wuyang Iron Steel	2.12	Special plates, the largest and most technologically advanced alloy plate enterprise in China
Bao Steel	1.95	High-end special steel, including high alloy steel, special alloy and stainless steel, the second largest stainless steel enterprise in China
Hebei Iron and Steel Group	1.75	Various automobile steel
Dongbei Special Steel Group	1.38	High-end special steel, the crucial manufacturer in the biggest production base in China for highend special steel
Xining Special Steel Group	1.14	Major structural steel provider, has independent coal and iron ore resources
1) Output in 2009		



Figure: 3-2

Source: ASKCI

The regions of distribution of special steel manufacturers are demonstrated in Figure 3-2. It could be found that as much as 70% of the local manufacturers are located in Eastern China. Central south China is the second largest region in number that the manufacturers are located in, but it only observes 13% of the total number. The percentages in all other regions are under 10%. Undisputedly, the East China region is the most concentrated and the principal region in terms of the special steel industry in China.

3.2.2 COMPETITIVE LANDSCAPE

The Chinese government aims to upgrade the technology of metallurgical equipment. Back to the 11-5 plan, the government has published several policies to raise the self-supply proportion and to eliminate obsolete low-grade equipment. The targeted proportion of domestic supplies of metallurgical equipment was 90% for large metal tube rolling equipment and 80% for distribute control systems. The types of equipment eliminated during the 11-5 period are: 1. Converters under 20 tons (iron-alloy converters not included) 2. Electric furnaces under 20 tons (machine casting electric furnaces not included) 3. High alloy steel electric furnaces under 10 tons. Policies to raise the self-supply rate and to eliminate outdated equipment are expected to continue during the 12-5 period. The detailed market situation of metallurgical equipment in China is discussed as below.

The metallurgical equipment industry in China is highly concentrated. The top 7 players in the Chinese market in 2010 are all state-owned enterprises and have taken over 80% of the total output value. Dalian Heavy Industry led the market with the output value of 17.2 billion CNY in 2010, over 20% of the total output value. It is taking big share in smelting equipment output. North Heavy Industry, Taiyuan Heavy Machinery, Citic Heavy Industry and China First Heavy Industry generated the 2nd place to 5th place respectively, and their market shares are all among 10% to 15%. China First Heavy Industry, China National Erzhong and Taiyuan Heavy Machinery are taking big shares in the output of rolling equipment.

POLICY SUMMARIES

New generation of metallurgical equipment to be promoted

- Equipment with new generation of controlled rolling and cooling technology
- Large complete sets of electric furnace equipment
- Strip continuous casting equipment

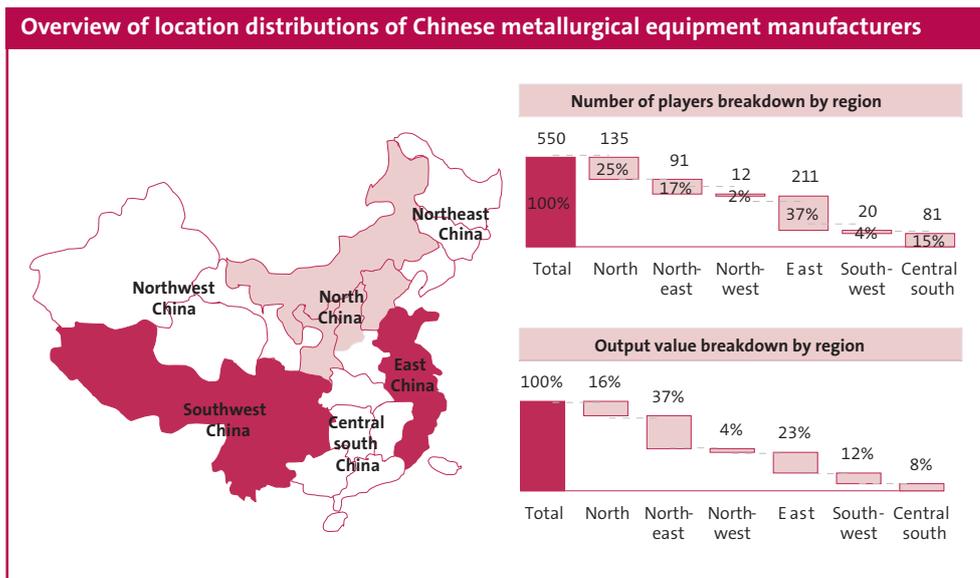


Figure: 3-3

Source: China CIR

Distinguishing the output value of metallurgical equipment by product categories, about 41 billion CNY of the output was smelting equipment, which accounted for roughly 48% of the total output of 85 billion CNY. Yet about 44 billion CNY of the output was rolling equipment, which was slightly bigger than that of smelting equipment.

The top 3 global metallurgical equipment manufacturers, SMS, Siemens VAI, and Danieli, have generated more than half of the world output in 2009, among which SMS and Siemens VAI, two German firms led the market with the market share of about 18% respectively. Besides the top 3, other world top manufacturers include Tenova (Italy), Mitsubishi-Hitachi Metals Machinery (Japan) and JP Steel Plantech (Japan), etc. The two Japanese manufacturers accounted for about 9% of the global output value. The world's top 3 players have big advantages in high-end equipment. They can supply complete sets of production lines for metallurgy companies, while other small players, including Chinese players can only supply individual machine.

POLICY SUMMARIES

Key technology to be promoted in 12-5

Key production technology

- High clean smelting technology for special steel
- Electroslag casting technology
- Vacuum metallurgy technology
- Solidification technology for homogenization and grain refining
- Accurate composition control technology
- Modeling technology
- Accurate heat treatment technology

Key process technology

- Large forging production line technology
- Ultra-large dimension round billet continuous casting technology
- Special steel plate heat treatment
- Production line for high grade special steel section, stainless & seamless tube and alloy-steel wire

• UNISPAR

Designing institutes and academic institutes are encouraged to cooperate with steel groups and metallurgical equipment manufacturers for the R&D of key technology.

• Industry integration

Encouragement to develop competitive strong metallurgical equipment manufacturers and technology services.

The distribution of metallurgical equipment manufacturers is greatly different from that of special steel manufacturers if we compare Figure 3-3 with Figure 3-2. The number of manufacturers in Eastern China is still the biggest, but not too much bigger than that in the northern and NE region. The numbers of players in these three regions are 211, 135 and 91 out of totally 550 respectively. Moreover, when looking into the output value, the value in north-eastern China is biggest, accounting for which accounts for 37% of the total output. However the eastern and northern regions contribute only 23% and 16% of the total output value respectively, despite the large amount of manufacturers. Even though, these three regions account for about 80% of the country's total output both in value and number of manufacturers. The eastern, north-eastern and northern China regions are the three most concentrated regions for metallurgical equipment manufacturers. Jiangsu in Eastern China, Liaoning in NE China and Hebei in Northern China are the three biggest provinces for metallurgical equipment manufacturing.

The imports and exports of metallurgical equipment are also studied by product categories. The total export value in year 2009 was 1617 million USD, slightly higher than that of imports which was 1361 million USD. Rolling equipment contributed for about 60% of the total value of exports, yet 84% of the imported products were rolling equipment in terms of value. The exported value of smelting equipment was almost three times as much as the imported value. The majority of imports in China are rolling equipment.

3.2.3 INNOVATION & INDUSTRIALIZATION FOCUS

UNISPAR (University-Industry-Science Partnership) will be encouraged for the development of the listed key technology, and to break through the bottleneck of some key technology. Designing institutes such as Baosteel, Ansteel, WISCO and academic institutes such as Dongbei University, USTB (University of Science & Technology Beijing) and Yanshan University are encouraged to cooperate with steel groups and metallurgical equipment manufacturers for the R&D of key technology. In addition, technology services as well as some leading manufacturers are expected for the integration of the iron steel industry in China.

3.2.4 RECOMMENDATION TO GERMAN FIRMS

Foreign firms receive no special discriminations from the 12-5 plan as published, but no special benefits as well. Co-operation and localizations are always welcome. From the research regarding the Chinese market and the 12-5 policies regarding the iron steel industry, some conclusions for German manufacturers could be drawn in the following aspects:

Strengths German firms are advanced in high-end technology and complete sets of production lines comparing to Chinese players. They also provide better services such as equipment maintenance to customers.

Weaknesses Local players have advantages in

1. The government's support for major metallurgical equipment manufacturers, since the vast majority of which are SOE's
2. Reverse-engineering capability (i.e. cheap R&D), which will make some high-end technology developed or obtained easily and less costly by Chinese players
3. More familiar with the local network which includes the local government, upstream suppliers, downstream customers and retail customers.

POLICY SUMMARIES

Beneficiary

- Encourage the cooperation between local players and foreign players on technology and management
- Encourage international cooperation on low carbon manufacturing technology
- Encourage key equipment imports

Discriminating

Encourage to raise the domestic rate of supply on high-end types of metallurgical equipment

Opportunities The large demand in high-end metallurgical equipment in the Chinese market would be a great opportunity for the German manufacturers to expand.

Threats The fast development of key local competitors would become the greatest threat to German manufacturers. The Chinese government plans to raise the self-supply percentage on high-end equipment, which supports the growing of local manufacturers. Moreover, in regarding to the high value of exports, local competitors may not compete only in China, but overseas markets as well – especially in the emerging countries.

To better utilize the advantages in high-end technology for the German competitors to expand in China and keep the competitors at distance, the current Chinese market situations should be studied. These could be concluded as below:

Market The government encourages the vast development of downstream industries using high-end steel, such as certain high-end equipment, and nuclear energy industry etc. The total output of steel in China is quite big, but the percentage of special steel is as small as 5% of the total output. It is expected that China tries to generate significant demand of special steel during the 12-5 period.

Supply Local metallurgical and rolling equipment manufacturers mainly produce low-end and individual equipment machines. It is a good signal to German competitors entering the market that they have huge advantages in high-end technology and complete sets of equipment manufacturing.

Policy Comprehensive policy is expected for high-performance iron steel industry that HPIS is encouraged to be used in several industries. The government also wants to push the domestic-supply for high-end types of equipment. UNISPAR and key technology R&D will also be promoted.

To catch the attractive market opportunity, efficient sales strategies and cost reduction plans are expected. Possible solutions may include sales organization improvements and business divesting. Sales organization improvements are recommended to help to attract target customers and to obtain local market share. Business divesting can also be considered to reduce the cost.

Sales organization improvement Due to the demand from downstream industries, the demand of special steel is expected to be large during the 12-5 period. Special steel companies have different customer groups from general steel companies, and they usually need high-end metallurgical equipment. Therefore, German firms should set up special sales organization particularly for the special steel industry with special metallurgical equipment, especially high-end metallurgical equipment.

Business divesting Chinese manufacturers are growing fast so that they have caught up with German firms on some low-end metallurgical equipment. Besides, Chinese manufacturers have the advantage of lower cost. Therefore, German firms can consider divesting lower-end metallurgical equipment like rollers to Chinese manufacturers, so that they can reduce the cost and focus on high-end equipment. Potential buyers for the business could be tier 2 Chinese manufacturers. Taiyuan Heavy Machinery, which is advanced in rolling equipment, could be a good choice. It is located in Taiyuan and eager to expand fast.

3.3 OCEAN EQUIPMENT

3.3.1 MARKET OVERVIEW

China is ambitious in developing offshore oil and is planning to achieve breakthrough in deep water field. In year 2010, the output of offshore crude in China was 50 million tons. The targeting yearly output by the end of the 12-5 period (i.e. year 2015) will be 100 million tons, with a CAGR of 15%. Big investments are expected in the development of China offshore oil during the 12-5 period.

POLICY SUMMARIES

The government investments in the ocean equipment industry will be as much as 250 to 300 billion CNY during the 12-5 period. Around 30 offshore oil fields will be set up, and most of them will be built on continental shelves and slopes. These planned oil fields will include 70 platforms and 10 FPSOs (floating production, storage & offloading). 2 to 3 deep water oil fields are also planned.

The large demand on offshore oil is pushing local players to expand fast. The driving factors in the industry are: 1. Due to the increasing demand of oil, the percentage of external dependence on oil reached 53.7% in 2010. 2. Onshore oil resource is limited, and about 60% of the newly discovered oilfields are in the sea. 3. Current policies encourage offshore oil production, and the government has abolished the limitation to non-local developers in offshore oil exploring in 2004. 4. The high price of oil has made it easier to cover the high cost of offshore oil explorations.

As a result, new local players are entering the offshore oil market. For example, Petro-China and Sinopec, the top 2 petroleum companies in China who focus mainly on onshore oil, are taking actions in offshore oil developments. Besides, Overseas M&A (merge and acquisition) is becoming the new trend. A typical example is China National Offshore Oil Corporation (CNOOC). CNOOC is ambitious in overseas M&A, targeting Nigeria, US and Norway players. From 2005 to 2010, four successful M&A cases in oil concession and offshore drilling were performed.

Big players have already had comprehensive plans to be implemented in the 12-5 period. CNOOC is, and will still be the biggest developer of offshore oil in China. It has set up the target during the 12-5 period that domestic output capacity will be 30 to 35 million tons, while overseas capacity being over 30 million tons. Moreover, 100 billion CNY is planned to be invested into domestic oilfields by year 2015.

PetroChina and Sinopec are two new players in the market. PetroChina is planning to set up totally four semi-submersible drilling platforms in South China Sea by year 2020, and among which two are subjected to be put in use by 2015. It is also cooperating with China Shipbuilding Industry Corporation (CSIC) on ocean equipment R&D. Moreover, 60 billion CNY is to be invested into offshore oil explorations and productions. Offshore oil engineering base is to be built up in Qingdao, and supportive bases in Hebei and Hainan are also part of the plan. Sinopec, on the other hand, is targeting an output capacity of 5 million tons in Bohai Sea area by 2015. An offshore oil technology test centre has already been established in Shengli Oil Field. It is also subjected to explore the deep water oil resource in the South China Sea. Drilling platform (BMPC375) is being produced in Singapore. Besides, a geophysical vessel has also been purchased.

3.3.2 COMPETITIVE LANDSCAPE

POLICY SUMMARIES

- **Financial support** The government will encourage financial institutions to provide more capital sources to manufacturers, such as in the form of financial leasing. It will also support leading manufacturers to go IPO or issue bonds to raise funds.
- **Overseas M&A** Mergers and acquisitions of overseas companies in the corresponding fields are also encouraged.

The government has set up targets in both output value and global market share. The Chinese yearly output value in ocean equipment was 3.8 billion USD, while the targeted output by year 2015 is 19 billion USD, with a CAGR of about 38%. Besides, China aims to take much greater share in the global ocean equipment market in ten years' time. Its current global market share is only 7%, but by 2015, the targeted progress will be 20%. And this is expected to reach as much as 35% by year 2020.

The effectiveness of financial support will be crucial in order to guarantee a high growth rate in output, whereas overseas M&A would help to raise the global market share. The detailed Chinese market structure regarding ocean equipment could be found as below

Table 3-7 shows that most of the local manufacturers are SOE's with different kinds of equipment and ability focuses. They have all the advantages in technological, financial and other government supports beyond privately owned ones. The only mentioned privately owned enterprise is Rongsheng. The manufacturer is specialized in auxiliary equipment, which is comparatively low-end in the Chinese market.

Table 3-8 shows the position in the global ocean equipment value chain of major countries. It is easy to find that the designing industry and high-end components industry are almost monopolized by European, the US and Japanese players, with US players being involved in both the industries. Yet German players are mainly expertise in the key component industry. On the other hand, Korea and Singapore lead the high-end of the manufacturing industry, whereas China is in the low-end, which is the lowest end in the ocean equipment value chain.

Table 3-7: Overview of players by ocean equipment segments

Equipment segment	Equipment involved	Companies	Descriptions
Drilling platform	<ul style="list-style-type: none"> • Jack-up drilling platform (Jack up) • Semi-submersible drilling platform (Submersible) • Drillship 	<ul style="list-style-type: none"> • CSIC • China State Shipbuilding Corporation (CSSC) • China International Marine Containers (CIMC) 	<ul style="list-style-type: none"> • CSIC is advanced in Jack up, Submersible & FPSO • CSSC is advanced in deep water equipment with strong designing abilities • CIMC entered the market via M&A Ya Yantai Raffles
Production equipment	<ul style="list-style-type: none"> • FPSO • Tension leg production equipment (TLP) • Spar production equipment (SPAR) 		
Auxiliary equipment	<ul style="list-style-type: none"> • Exploration ship • Crane ship • Pipe-laying ship • Shuttle tanker 	<ul style="list-style-type: none"> • Zhenhua Heavy Industries • COSCO Shipping • Rongsheng (Private enterprise) 	<ul style="list-style-type: none"> • Zhenhua acquired F&G for advanced designing abilities • COSCO is adept in EPC project contracting

Table 3-8: China's position in global ocean equipment value chain			
	Country	Player	Advanced product
Designing	US	Diamond offshore	Jack up, semi -submersible, drillship
	Norway	Aker Kvaerner	Semi -submersible, FPSO, drilling equip
	Holland	GustoMSC	Jack up, semi -submersible, FPSO, drillship
	Italy	Saipem	Semi -submersible
	Japan	MODEC	Semi -submersible, FPSO
Key Components	US	National Oilwell	Winch, mud pump, rotary table
		GE	Electrical device
		Caterpillar	Motor for ocean equipment
	Germany	Siemens	Electrical device
		MAK (M&A by Caterpillar)	Motor for ocean equipment
Manufacture	Korea	Hyundai	Jack up, semi -submersible, drillship
		Samsung	Semi -submersible, FPSO, drilling equip
	Singapore	Keppel	Jack up, semi -submersible, FPSO, drillship
		Victory Marine	Semi -submersible
	China	CSIC	Jack up, Semi -submersible & FPSO

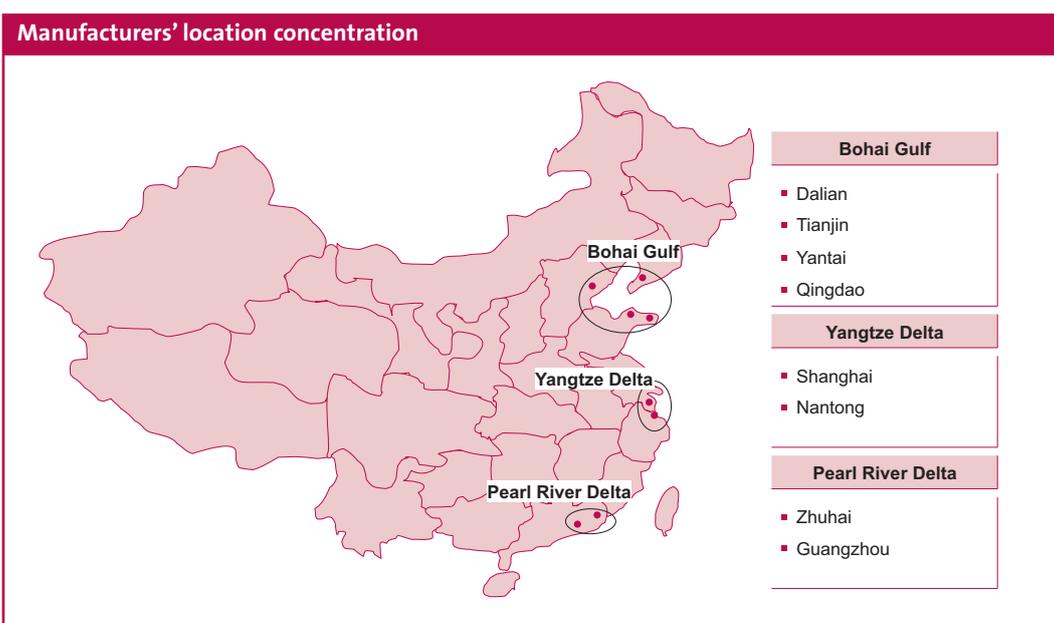


Figure: 3-4

When looking into the geographical locations, the distributions of the local equipment manufacturers are concentrated in three coastal areas: the Bohai gulf, the Yangtze delta and the Pearl River delta, as is illustrated in Figure 3-4. The detailed sites distribution is: 1. Four cities along the Bohai gulf: Dalian, Tianjin, Yantai and Qingdao. 2. Two cities in the Yangtze River delta: Shanghai and Nantong. 3. Two cities in the Pearl River delta: Zhuhai and Guangzhou. All these areas are fast in economic development and along the coast.

The contrast of the exporting and importing situations in manufacturing equipment is quite obvious. The value of exports soared rapidly during the period of year 2006 to year 2010 with a CAGR of 94%, from 65 million USD in 2006 to as high as 921 million USD in 2010. On the contrary, the value of imports in manufacturing equipment decreased tremendously, from 696 million USD in 2009 to 29 million USD in 2010. It is indicated that most of the local demand on floating, submersible drilling and production platforms can be satisfied by local manufacturers.

POLICY SUMMARIES

Innovation Policies

Explorations

1. Large ships for deep-water physical explorations
2. Large ships for deep-water geological explorations

Drillings & productions

1. 3000m level semi-submersible drilling platforms
2. 3000m level semi-submersible drilling ships
3. 3000m 2*8000-ton level crane ships
4. Deep-water remote operated vehicles (ROV) & autonomous underwater vehicles (AUV)

Auxiliary equipment

1. 5000-ton level barges
2. High power anchor handling towing supply vessels (AHTS)

Supportive Policies

- Setting up world-class laboratories and R&D centres
- Trainings of cross-disciplinary R&D talent leaders through the building up innovation platforms and major projects
- Rewards to the first independently developed machines (detailed terms to be defined)
- Co-operate with insurance companies to insure new independent products

Industrialization Policies

UNISPAR (University-Industry-Science Partnership)

Policies promote the establishment of the industry society. This will be dominated by the leading enterprises. Research institutions, universities and professional technical service companies will also be involved. Policies promote the reformation of the enterprise incentive system, and will create better conditions to attract overseas talents.

Value chain positioning

Policies promote the ocean equipment players to aim at high-end of the value chain. Policies promote the grasping of general designing technology and construction technology, so that China players will be more capable to control other parts of the value chain.

3.3.3 INNOVATION & INDUSTRIALIZATION FOCUS

Promoting policies will be introduced to support the innovation and industrialization of ocean equipment technologies. The government encourages technology developments as shown in the policy summary below.

Ocean equipment is related to a number of academic disciplines, and most of which are of high technology. Therefore UNISPAR (University-Industry-Science Partnership) is extremely important in China's ocean equipment industry, where cooperation and supports from academic institutions are essential. The adequacy of professional talents is also a key factor in the industrial development.

Chinese competitors are normally involved in low-end manufacturing, which is the lowest end of the ocean equipment value chain. The designing industry and high-end components are monopolized by European and American players, while Korea and Singapore lead the high-end manufacturing. The detailed Chinese market structure regarding ocean equipment can be found in Table 3-9.

Table 3-9 shows that most local privately-owned companies are specialized in the parts & service companies. Only three manufacturers are involved in designing, and the two bigger ones are both state owned enterprises. Additionally, the products that each manufacturer specializes in are quite different. It could be expected that relevant foreign manufacturers will output more of their designing advantages and will benefit from the prosperity of the parts and service segment of ocean equipment in China.

Table 3-9: Overview of Chinese ocean equipment designing firms and parts & service firms

	Firm	Products
Designing firms	Zhenhua F&G (SOE)	Jack up, Semi-submersible (Zhenhua, M&A, F&G)
	CSIC No. 708 Institute (SOE)	Jack up, Semi-submersible, FPSO
	Shanghai Bestway (Private)	Project contract and supervision
Parts & service firms	China Offshore oil Service (SOE)	Exploring, drilling, production and ship service
	Offshore Oil Engineering (SOE)	Offshore oil mining and related project
	Kingdream (SOE)	Drill bit and other equipment
	Yantai Jereh (Private)	Cuttings re-injection equipment, pump, compressor
	Asian Star (Private)	Anchor (No. 1 in the world)
	Bode (Private)	Electric automation products
	Juli Sling (Private)	Sling

3.3.4 RECOMMENDATION TO GERMAN FIRMS

China is eager to obtain advanced technology from foreign players, yet the government is also trying to promote the expansion of local players. Therefore, technical co-operation is strongly promoted in 12-5. The policies that describe expectations to foreign investments could be concluded.

The corresponding Chinese market researches could be concluded as below:

POLICY SUMMARIES

Beneficiary Policies

- Encourage technology transfers of global ocean equipment to China
- Encourage foreign companies and designing institutions to set up joint venture R&D institutions in China

Discriminating Policies

- Local players are encouraged in overseas M&A, and to co-operate with global leading designing companies
- Financial supports for local players only

Market

1. Large demand in ocean equipment will be generated from the urgent demand in offshore oil
2. Three major Chinese petroleum companies already have comprehensive plans on offshore oil exploitation. Therefore, German players will have fewer opportunities due to the fast growth of Chinese competitors. However, the advanced technology, especially in parts and key components such as electrical devices and bearings, should make it easy for the German companies to enter the market by cooperating with local developers and manufacturers.

Supply

1. China aims to take 20% share of the global ocean equipment market
2. Currently China is in the low end of manufacturing chain, behind Korea and Singapore. It could be found that the advantage of the German competitors remains in technology. However, behind the proposal of expansion plan are certain measurements favorable to local competitors.

Policy

1. 250 to 300 billion CNY will be invested into offshore oil explorations
2. Financial support will be provided to ocean equipment manufacturers
3. Independent R&D will be promoted by rewards and insurances.

With all these supportive policies to local competitors, it might be difficult for German firms to take much advantage of 12-5 plan.

According to the existing conditions and situations described above, recommendations to German companies would be sales organization improvements and product portfolio realignment.

Sales organization improvement

China's urgent demand of offshore oil will generate big demand in ocean equipment during the 12-5 period, yet the quantity of ocean equipment compared with other high-end equipment will usually be much smaller. Sales organization need to be improved to grasp the attractive but seldom market opportunities and to strive for target customers. Sales distribution networks and skills will need to be improved to fulfill the expected large demand in ocean equipment and components. Besides, since the three major Chinese players and potential customers are all state-owned enterprises, the intense competitions with local companies will push the German firms to improve the efficiency of sales organization to acquire customers.

Product portfolio realignment

China aims to take 20% of the market share in the global ocean complete equipment market by year 2015. However, German firms are advanced in ocean equipment components rather than complete ocean equipment. For example, Siemens is specialized in electric devices. Therefore a suitable product portfolio in ocean equipment components is recommended to play the advantage and reduce cost. In general, the product portfolio for German players should focus on their advanced components, such as electric devices and motors.

3.4 WIND POWER

3.4.1 MARKET OVERVIEW

The government plans to reduce incentives on wind power operations according to the 12-5 policies regarding Wind Power industry. From the policies listed, it could be inferred that the government is trying to contain the previously loose-developed wind power resources and aims to achieve higher concentration of exploration and hence higher efficiency. Although the calling off of electricity subsidy is somewhat negative news for equipment makers, the new focus on offshore wind power development would generate much more market opportunity for equipment.

In the global market, Chinese accumulative wind power installed capacity has overtaken the USA in 2010 and became the first in the world. By the end of 2010 a total of 44.7 GW of wind turbines have been installed in China, which accounts for 22% of the world total accumulative installed capacity, followed by the USA, Germany, Spain and other markets. Additionally, China and USA are the world's top 2 wind power markets, accounting for a total percentage of 42%.

POLICY SUMMARIES

The central government is to get in-volved in stricter project control. Pre-approval for wind power projects < 50 MW was required only on provincial level before 2011, and National Energy Administration (NEA) got involved for 50 MW above only. However, current regulation requires projects to get pre-approval from both provincial and NEA even if they are below 50 MW size

Subsidies are decreasing. The abundance of wind resource is classified by four levels, and the unified prices are 0.51, 0.54, 0.58, 0.61 CNY/KWH respectively for each level, representing an average subsidy of 0.22 CNY/KWH. Yet this subsidy would be reduced progressively till year 2020.

Offshore wind energy generation would become the new focus. New plan on off-shore wind power plant is about to be released. In year 2011, NEA has already released regulations that indicate: 1. sea area limitation, 2. turbine power should be no less than 3MW. Currently many new project tenders are lined up and pending for publish. NEA will soon kickstart the bidding process and award to EPCs/key equipment providers.

The huge accumulative installed wind power capacity in China was developing at a drastic speed just in the past 5 years: the number was only 2.6 GW in year 2006, leading to a CAGR (Compound Annual Growth Rate) of more than 100%. Moreover, the planned installed capacity in China by the end of year 2015 is as aggressive as 100 GW, which still indicates a CAGR of 22% on top of 'current huge base. In addition, the number in year 2020 will reach 200 GW, i.e. a CAGR of 19% from year 2015.

However, according to the same forecast from China Wind Power Outlook 2011, despite the focus of 12-5 plan on offshore wind power exploration, the expected installed capacity of onshore wind power generation will still dominate the overall wind power market and generate 95% of the total installed capacity, i.e. 95 GW by 2015.

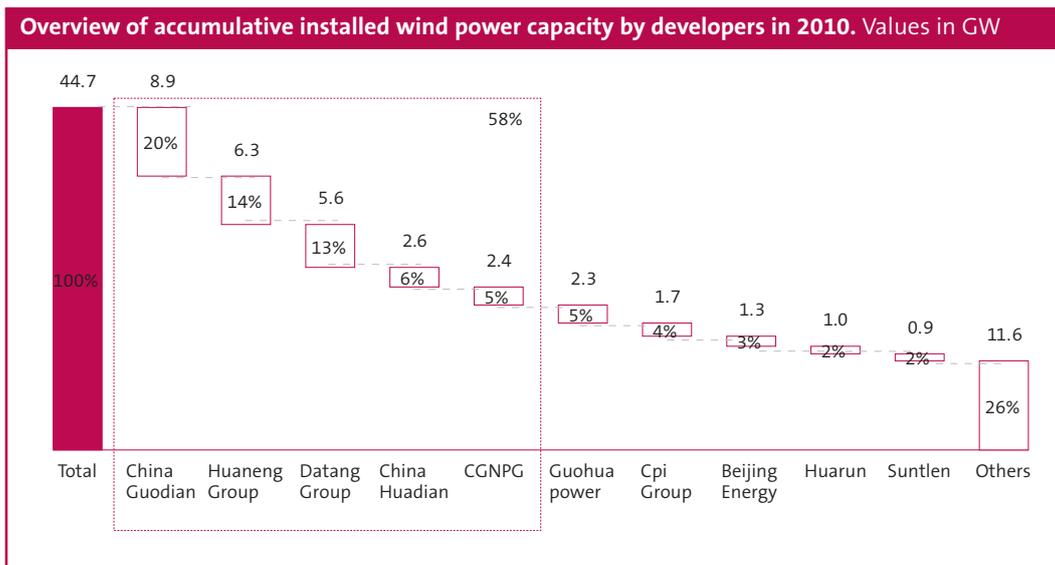


Figure: 3-5

Source: China wind power outlook 2011

Figure 3-5 showed the top ten wind plant developers in China wind energy market. China Guodian, a wholly owned SOE, leads the market with 8.9 GW's accumulative installed capacity, followed by Huaneng Group and Datang Group. The top five developers contributed 58% of the Chinese total installed capacity in 2010, while the top ten contributed about 85%, which indicated a high level of concentration. Though foreign developers are not permitted to build up wind plants directly, they may still be active via co-operation with local developers.

The major wind power bases and their development target are shown in Figure 3-6. The eight major bases account for 70% of the total 12-5 target installed capacity. The West Inner Mongolia base is the largest in terms of planned installed capacity. In addition, the top 4 bases in West Inner Mongolia, Gansu, Hebei and Xinjiang would have the planned capacity of more than 10 GW by the end of 12-5 period. It should also be mentioned that there are 2 bases in Inner Mongolia, which contribute in total 20 GW in 12-5 plan. Among all the bases, those in Inner Mongolia, Xinjiang and Gansu are rich in onshore wind resource, while those in Jiangsu, Shandong and Hebei are rich in offshore wind resource due to geographic locations.

POLICY SUMMARIES

Subsidies stopped The Wind Power Equipment Industrialization Special Fund Regulation was called off by end of 2010. Consequently, corresponding subsidy to wind power equipment manufacturers were cancelled. The subsidy was meant for the first 50 machines they manufactured.

Stricter requirements on grid-connection In year 2010, national energy administration released the Wind Power Station Power Forecast Regulation. According to which, by January 1st 2012, all wind power stations connected to the grid must build up power forecasting and generation plan reporting systems, otherwise operations will not be allowed.

New entry standard for equipment manufacturers China will issue new entry standards for wind power equipment manufacturers, which would include stricter requirements on production scales and manufacture performances.

3.4.2 COMPETITIVE LANDSCAPE

The 12-5 plan guidelines indicated that the Chinese government will be stricter on equipment manufacturing industries, mainly due to over-capacity. The detailed Chinese market structure regarding wind power is described as below:

The wind turbine equipment manufacture industry is highly concentrated in China. The top 3 players, Sinovel, Goldwind and Dongfang had 4.3, 3.7 and 2.6 GWs installed capacity respectively in year 2010, and have taken a total of 57% share of the market. All the five top manufacturers reached over 1 GW of installed capacity. On the other hand, Vestas and Gamesa are the only two sizable foreign players in the market but both with installed capacities less than 1 GW. To conclude, local turbine manufacturers have taken most of the market share in 2010.

Majority of Chinese players are small manufacturers. 58% of the total 60 players' annual outputs are less than 50 units. Moreover, among the players whose output units are above 100, 65% produce 100 to 500 units per year. Only 7 local manufacturers were able to produce over 500 equipment units in year 2010, which was quite low in both absolute the value and percentage. New policies have therefore set higher market entrance barriers, which may lead to a harder time for small local manufacturers.

The number and distribution of wind turbine production bases are illustrated in Figure 3-7. If we compare Figure 3-7 with Figure 3-6, it can be concluded that wind turbine production bases are located close to rich wind resource areas. Over 5 production bases are located in both Inner Mongolia and Jiangsu province. Inner Mongolia is the richest in wind resource, and that is why the most number of production bases are located there. Jiangsu has formed a most developed manufacturing chain. At least 3 production bases are under operation in each of Gansu, Jilin, Xinjiang, Hebei and Tianjin by the end of year 2010.

Chinese turbine equipment manufacturers are becoming global leaders in terms of installed capacity. 7 out of world's top 15 manufactures in 2010 are from China. Among which, Sinovel, Goldwind, Dongfang and Unitedpower are 4 of the top 10 world manufacturers, with yearly installed capacity of 4.4, 3.7, 2.6 and 1.6 GW respectively. It should also be mentioned that Sinovel produces 11% of the world total installed capacity in 2010, not far away from the 14% share of Vestas and reached the 2nd place.

Nevertheless, the majority of capacities produced by China manufactures were covering the domestic market only. Though 4 out of 10 world's top players are from China as mentioned, there is

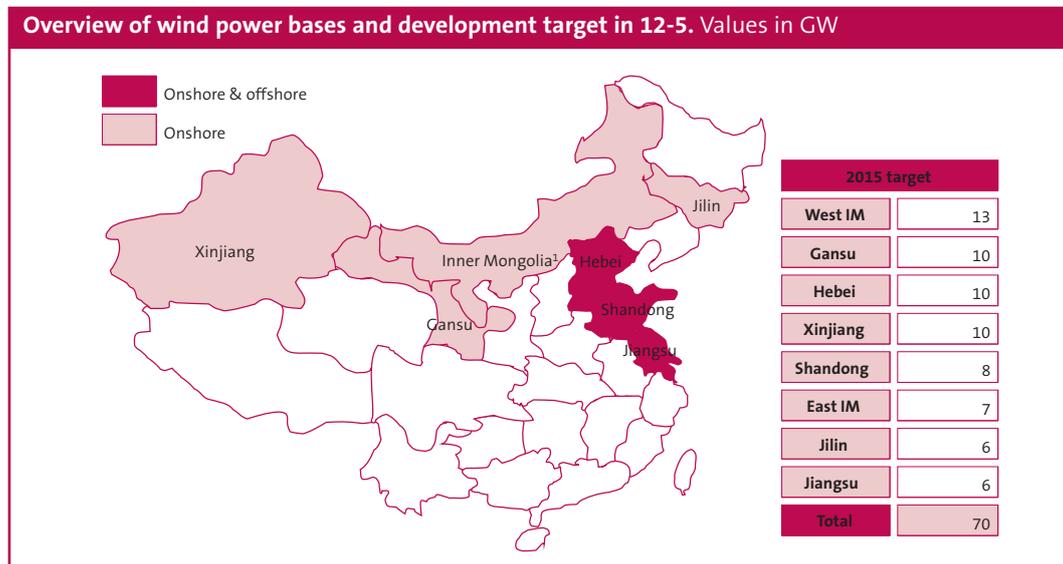


Figure: 3-6

1) Inner Mogolia includes two bases: East & West

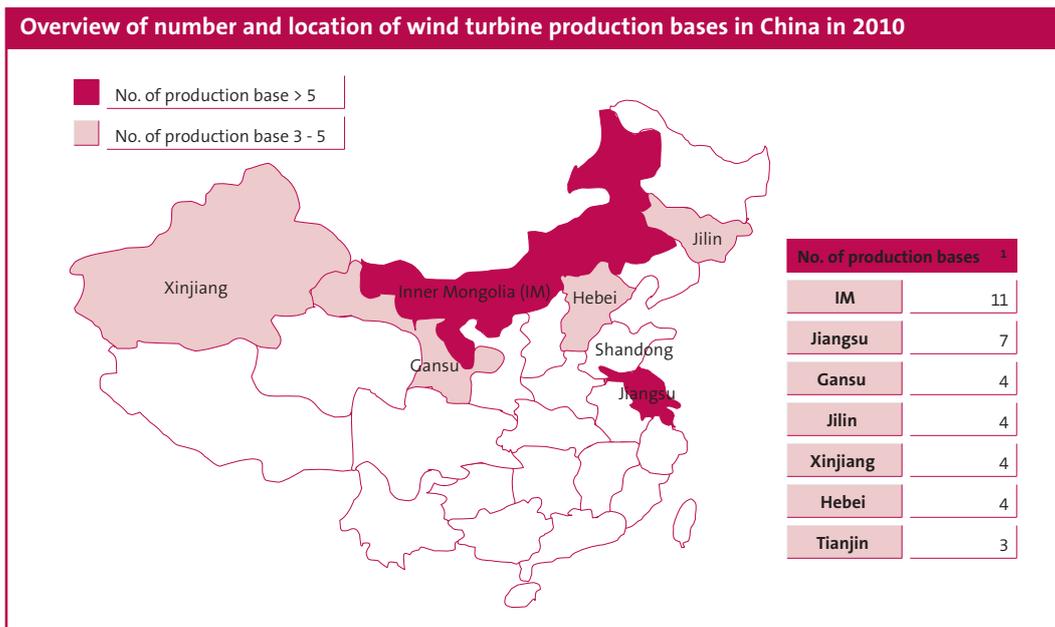


Figure: 3-7

1) Calculated from top 11 player's production bases

still a large gap towards major international players in terms of global market coverage. For instance, Vestas, Gamesa and Suzlon are leading global players. Turbine equipment products from these manufacturers are covering most of the leading wind power countries. Enercon, GE and Siemens are some top leading area players. Enercon's products are covering most of the Germany and France market, whereas Siemens products are widely installed in UK and Canada. On the contrary, all of the top 4 mentioned Chinese leading companies only concentrate on the domestic market.

Table 3-10: Top 5 wind turbine export destinations from China

Rank	Country	Value (Million USD)	% of total
1	Australia	19.4	34%
2	India	10.1	18%
3	USA	9.9	18%
4	Germany	3	5%
5	Chile	2.9	5%

Source: UN Comtrade Database (2010)

As such, the international trade value has always been small due to local players' domestic focus. Further, both export and import values have decreased tremendously since year 2008, according to Figure 3-8. The possible reasons include:

- 1) the expanding demand of Chinese local wind turbine market dropped the export quantity and value;
- 2) the developments of local suppliers, both in number of players and capacities, which led to an import decrease;
- 3) some foreign players have launched local production in China, which replaced imported equipment as well; and
- 4) the economic crisis in western countries has negatively affected both international supply and demand.

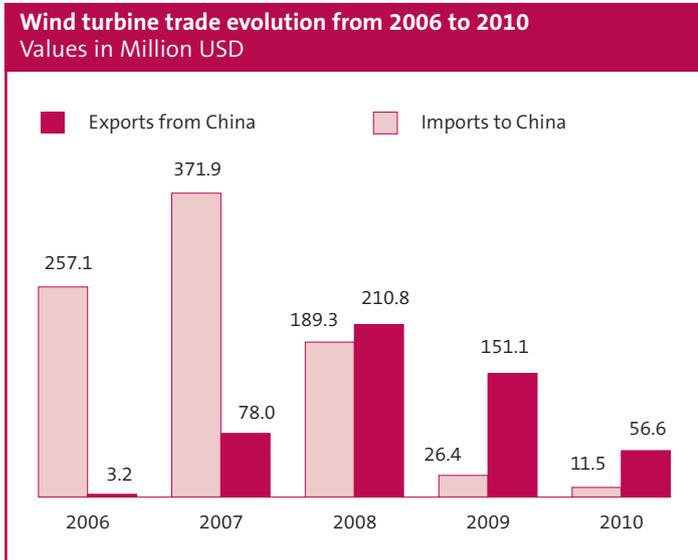


Figure: 3-8

Source: UN Comtrade Database (2010)

Rank	Country	Value (Mn USD)	% of total
1	Denmark	4.3	37%
2	Finland	2	18%
3	Germany	1.4	13%
4	Sweden	1.3	11%
5	France	1.1	10%

Source: UN Comtrade Database (2010)

Table 3-10 and Table 3-11 indicated that Chinese manufacturer's export and import on wind turbine equipment were very small in year 2010. Australia was the top export destination, with a total exported value of only 19.4 million USD, and this was as much as 34% of the total 2010 wind turbine equipment export value. Similar story happened to import, where China imported a total of only 4.3 million USD from Denmark, the No. 1 import origin, which singly contributed 37% of the total import value. Germany was the No. 4 export destination with a value of 3 million USD, as well as the No. 3 import origin with a total value of 1.4 million USD.

Despite the low value of imported turbine installed capacity, China depended largely on foreign supplies for key components. Figure 3-9 illustrates the value and growth of key components in both exports and imports, and both indicated that China has strong external dependence. Yet the value of imports is greater in most of the stages, with a much higher growth rate, especially in controlling equipment, transmissions and bearings.

3.4.3 TECHNOLOGY STRENGTH & INNOVATION

From the promoted technological areas, it can be inferred that the Chinese government has set ambitious target to close the technical gap with leading equipment suppliers in the next 5 years. On the other hand, the China wind power market is entering into a new stage of industrial upgrade. The trend would be achieving independent R&D, quality-oriented and sustainable development plans. The upgrade would focus on three major areas:

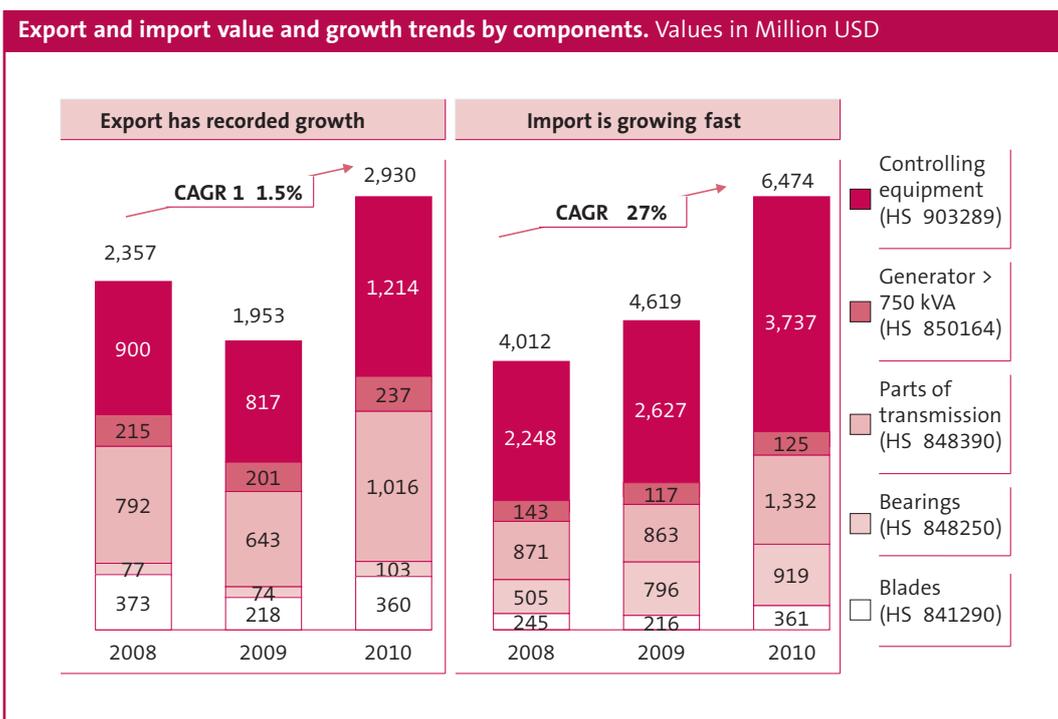


Figure: 3-9

Source: COMTRADE

POLICY SUMMARIES

Policies that promote innovations and industry upgrades

High power turbines and technology regarding grid-connection will be promoted. During the 12-5 period, the Chinese government has announced that 1 billion RMB is to be invested to support key technology according to the 863 plan.

Special fund would be invested in certain technology, which includes:

1. Industrialization of high power (i.e. 7MW) turbines and key component technology.
2. Prototypes of extra high power (i.e. 10MW) turbines and key component technology.
3. Test technology on turbines and components, test platforms on large transmission chains, bearings and pitch systems.
4. Advanced wind turbine airfoil development, with applications to blades (>10MW).
5. Key technology on designing, constructions and operations of large onshore and offshore wind farms.
6. Key technology on connecting wind power to the grid.

The 863 Plan: Special plans and grants to support high tech by the government

Technology on key components Currently most of the Chinese local manufacturers purchase technology IP (intellectual properties) from foreign players. Therefore, the mass production was conducted without full understanding of the corresponding technology. Since some of the key component technology is still lagging behind, the 12-5 plan encourages independent technology on greater amount of component types. Technology of some key components such as converters would become the new focus.

Turbine quality Local manufacturers focus mostly on product quantity in the past few years. Lack of deep considerations in machine life-time quality was a common problem. Chinese manufacturers would put more emphasis on quality improvement guided by the 12-5 plan. However some lead time is needed for product quality improvement and for global market development.

Grid-connections In the past several years, local manufacturers did not have enough considerations regarding grid-connections and only focused on equipment production. Only a small share of wind turbine installed capacity are connected to the grid currently. In the 12-5 plan, stricter and more detailed requirements on grid-connection will be carried out. One of the most important requirements is that LVRT (Low Voltage Ride Through) technology is required to be added into products.

Moreover, high power turbines and offshore turbines are the two new technology development focuses released by the 12-5 plan. Besides, grid connection technology will receive more attention during the 12-5 period due to government's high emphasis, and easy-connection to grid is required to turbine development.

Local players are trying to grasp these development opportunities.

High power turbine developments High power turbines are needed especially for low speed wind resource bases. The average power per machine has been increasing year by year. In 2006 it was only 920 KW per machine, and by 2010 the number reached to 1,467 KW per machine.

Offshore wind technology By end of year 2010, 6 local manufactures were able to produce offshore wind turbines with capacity larger than 3 MW, namely Sinovel, Goldwind, Shanghai electric, Mingyang, United power and Huachuang. It is worth noticing that Sinovel is now developing 10MW-level wind turbines and Goldwind is developing 6MW-level wind turbines.

Chinese manufacturers have advantages and disadvantages in different component fields. Independent technologies have been applied to blades and generators, while technology in gear cases and converters will receive more attention.

POLICY SUMMARIES

Horizontal Integrations Policies

In the 12-5 plan, policies limit the new entrant of turbine manufacturer industry. It was also suggested that 8 to 10 major players will be reasonable.

Up/downstream Integration Policies

In the 12-5 plan, policies encourage strong market players to cover the whole value chain. However at the same time, the government is cautious on the possible monopoly, since most of the big players are SOE's.

Advantages

Blades More than 20 local manufacturers can produce MW level blades. Moreover, 5 manufacturers can produce >2 MW-level blades. For instance, Zhongfu Lianzhong is able to produce 5MW-62meters blades, which is a globally leading technology

Generators About 10 local manufacturers have mass production abilities. For instance, XEMC is able to produce 5MW permanent magnet synchronous generator, which is the biggest in the world.

Disadvantages

Gear cases Mass production has just been localized for a short while. Gpower and NGC are two of the exceptions which are able to achieve mass production.

Converters The local technology development regarding converters is somewhat similar to that of gear cases. Domestic mass production has just been started, and Corona and Sungrow are two of the leading manufacturers.

3.4.4 INDUSTRIALIZATION

The major problems currently being faced by the industry are overcapacity and large number of small players in the industry. The total number of local wind turbine manufacturers is around 60, with 50 of them sharing less than 15% market. Additionally, lack of cash flow and independent advanced technology are also major challenges. The current trend is that major wind farm developers have begun to integrate turbine manufacturers. For example, Datang has acquired Huachuang wind power, and China Guodian has set up United Power, a wholly owned subsidiary, to enter into the turbine equipment market. On the other hand, an increasing number of turbine manufacturers have begun to produce some components by themselves. In the future, large turbine manufacturers and integrated developers will be the trend in the wind power industry. The government has showed clear intention to integrate the wind turbine manufacturing industry, both horizontally and vertically.

Table 3-12: Overview of upstream expansions on blades

Company	Tech. source	Usage	Actions
Goldwind	M&A GCL Jiangsu	Self-use	1.5MW blades project with M&A GCL Jiangsu & Xilin
Dongfang	EUROS	Self-use/ for sale	Test-production of blades for DF100, DF90 and DF93
Mingyang	Dewind, Aerodyn	Self-use/ for sale	Project with annual capacity of 300 units in Jilin
United power	Aerodyn, GH	Self-use	First 3MW-49m blade launched to the market
XEMC	Holland Darwin	Self-use	Cooperate with Nantong Dongtai to make blades

Furthermore, wind turbine equipment manufacturers are turning into comprehensive service providers. After the first stage of rapid development on wind power, more services are expected in China wind power market. Product suppliers shall gradually change to comprehensive service providers. An ideal supplier should not only be a seller of wind turbine generator systems, but also a wind power service provider, as well as a wind farm investor. For example, Goldwind is cooperating with HeWind and Longyuan power in wind farm investments.

Information from Table 3-12 indicated that though the majority of technology source are not from independent R&D, blades are widely chosen to be self-produced by most of the local manufacturers to achieve cost control and efficiency.

3.4.5 RECOMMENDATION TO GERMAN FIRMS

According to the 12-5 policies regarding expectations to foreign investments, there should be fewer limits for foreign players in the 12-5 period. Since local players have no advantages in high power turbines and off-shore turbines, the Chinese government would welcome foreign players to enter the market. Responding to the new policies promptly, some foreign players have set up their production bases and have chosen local suppliers to reduce the cost. There are also foreign players who are trying to get project awards via collaboration with developers. For instance, Gamesa was chosen by utility Longyuan—the world's third-largest wind farm developer—as a partner to develop wind projects. Additionally, some foreign component suppliers take an active part in cooperating with local players, e.g. Timken and XEMC have built up a JV company.

The global experiences & technological advantages will provide German firms with more opportunities in the following three aspects:

Key component market Though Chinese players are growing fast on the key component technology, they still lag behind in quite a few areas. German competitors would need to keep the investment on R&D to ensure their leading positions on the key component technology. Possible products with comparative advantages may include converters and main bearings.

High-end turbine market Chinese players still lag behind on high power wind turbines and offshore wind turbines. Therefore, German competitors would need to keep their advantages in high power and offshore wind turbine manufacturing, and try to take the opportunity to expand in the market.

Common component supplier market Chinese component makers are qualified for some general components. German firms may choose certain qualified component manufacturers as their suppliers. These products could include generators, blades and gearing cases.

To sum up, in order to enter or expand in the market regarding wind power generation in China, German competitors need to keep the advantages on high-end products and to reduce the cost.

POLICY SUMMARIES

Beneficiary Policies

The requirement of localization rate over 70% has been abolished from year 2009 on. Most attention will be paid to high power turbines and offshore turbines during the 12-5 period.

Discriminating Policies

The government would mainly encourage technology transfers only.

Market

When looking into the Chinese market trends, the planned growth rate of installed wind power capacity in the 12-5 and 13-5 periods will slow down, while the expected newly installed capacity is still large. Furthermore, the installed capacity for offshore wind power will grow fast though still comparatively small in terms of capacity. Both of the two market signs would affect German competitors positively in market entering and expanding, especially in the offshore wind power turbine equipment field.

Supply

In terms of market supply, several large local wind power equipment manufacturers already exist, and mainly supply the local market. Therefore it may be easier for German competitors to cooperate with local suppliers especially to tap onto global market.

Policy

New policy releases bring both good and bad news to German competitors. New wind power projects will be more strictly controlled, and subsidies will be gradually reduced. For wind power equipment manufacturers, subsidies will be stopped, strict requirements on connection to the grid will be released. Also, offshore wind power technology and grid connection technology will be promoted. All this would lead to a higher market entrance barrier. Nevertheless, since German competitors have more advanced technology and stricter industrial processes in common, the mentioned policies should not bring many difficulties.

Sales improvement is crucial to keep the advantage in high-end equipment. This includes two major aspects:

Multi-brand strategy Chinese local wind power equipment manufacturers are growing very fast and four of them were among the global top 10 in terms of newly installed wind power capacity in year 2010. In addition, the Chinese local manufacturers are trying to expand in the global market. Therefore, it is expected that German manufacturers will face fierce competition not only in the Chinese market but also globally. German firms may wish to use multibrand strategy to react to the competition.

German firms should use self-owned brands to compete in the high-end equipment market in China to obtain market share and profit. These may include high power and offshore wind power equipment and key components such as gear cases and bearings.

German firms should consider low-end brands to compete with Chinese players both in China and globally, especially in other emerging countries, on middle-end equipment in the big and fast growing market. These may include low power wind power equipment, blades and generators.

Sales organization improvement The new trend of the demand of wind power equipment in China is high-power wind power equipment and offshore wind power equipment. Local wind power equipment manufacturers such as Sinovel are developing high power wind power equipment. However, the current sales organization of German manufacturers focuses on middle and low power onshore wind power equipment. Therefore, sales organization of German manufacturers should be improved to catch up and meet with the new trend.

Sales organization should be improved to target the customers with big demand in high power wind equipment and offshore wind equipment. For instance, China Longyuan Power is building up the biggest offshore wind farm in China. Corresponding German manufacturers interested in expansions in China may look for opportunities to cooperate with Longyuan or other wind farm developers.

Business divesting

Chinese wind power equipment manufacturers are developing fast on the technical level of the equipment, which means German firms are losing their advantages in low-end wind power equipment and components, such as blades and generators. German competitors may consider divesting the low-end businesses to Chinese players and free up capital for higher returns from e.g. other advanced products.

The potential buyer for blade businesses is Zhongfu Lianzhong, who is the local leader of blade manufacturing and has subsidiaries in Freistaat Thüringen, Germany.

The potential buyer for generator businesses is XEMC, who is one of local leading permanent magnet synchronous generator manufacturers located in Xiangtan, Hunan province.

3.5 SOLAR POWER

3.5.1 MARKET OVERVIEW

POLICY SUMMARIES

Guidelines:

1. Integrated planning
2. Optimized industry layout
3. Healthy development

Enterprise fostering

- 1 to 2 polycrystalline silicon companies with capacity of 50 thousand tons, and 2 to 4 companies with capacity of 10 thousand tons
- 1 to 2 PV cell companies with capacity of 5GW, and 8 to 10 companies with capacity of 1GW
- 1 to 2 solar companies with revenue of over 100 billion CNY, 3 to 5 companies with revenue of over 50 billion CNY

Employment

The number of employment in solar power industry will reach 1 million in 12-5

Solar power industry will continue to be one of the focuses in 12-5. Implied from policies published, expected measurements to promote the solar power industry are: 1. New policies for feedin tariff, while feedin tariff law may also be expected 2. Moderate subsidies for users of solar power 3. "Golden Sun" program will be continued, which will be further discussed below 4. Application of solar energy products will be promoted, which may include but not be limited to the applications on agriculture, transportations and construction areas.

As mentioned above, it is expected that the more efficient "Golden Sun" program will be implemented during the 12-5 period.

What is the Golden Sun Program?

The Golden Sun Program was jointly started by MoF (Ministry of Finance), MoST (Ministry of Science and Technology) and NEA (National Energy Administration) in July 2009. The program plans to financially support certain demonstrative projects, which should be with no less than 500MW PV power capacity within 2 to 3 years. The estimated investment for the Golden Sun Program is around 10 billion CNY. The developer and PV cell suppliers of each project will be chosen by tender biddings. Therefore, the company who guarantees the lowest electricity price gets the project.

Implementation of Golden Sun projects

Currently half of the Golden Sun projects have been suspended. This was largely due to the developer's low bidding price, long payback period and the high cost of the components. Some low-quality components are found to be used in Golden Sun Projects to save the cost.

Golden Sun Program will be continued during the 12-5 period

The total capacity installation target is no less than 1 GW after 2012. The government will subsidize 50% of the cost for key components used in the Golden Sun and BIPV (building integrated PV) programs, where the BIPV program is not included in subsidy policies previously. Besides, 40 to 60 thousand CNY of subsidies will be implicated to other project-related costs. On the other hand, stricter supervisions will be implemented to regulate the Golden Sun project during the 12-5 period, including auditing and evaluation processes, standards for subsidy applications, and standards for components production.

The Chinese solar power capacity is expected to grow fast during the 12-5 period. In 2010, the cumulative installed capacity was only 0.8 GW which represented 2.2% of the global PV installations. By year 2015, the expected installed capacity will reach 10 GW, with 3 GW of which are BIPV's. The year 2020 target, however, is 50 GW, with half of which are BIPV's. The CAGR will be as high as 66% and 38% respectively. But it should be mentioned that the targeted cumulative installed solar power capacity in 2015 was raised to 15 GW according to the 12-5 plan for renewable energy. The details of the 12-5 target regarding the cumulative installed capacity will be released later.

When looking into the PV cell market, the global output was 18 GW in 2010. China has made 9 GW PV cells, which is half of the global number, among which thin-film PV cells are included. In 2010, 90% of the Chinese total output was for exporting. Only 0.9 GW PV cell produced in China were used domestically, which is 10% of the total output. In contrast, Germany only has taken 2.52 GWs' output, which accounted for 28% of the

total output capacity. Yet it should be noted that in 2010, serious over capacity of PV cells was found in China, since orders from abroad decreased dramatically due to the reduction of subsidies for solar power products in Germany and other countries. Currently the global solar power generating industry is highly depended on government policies and the global economy. During the 12-5 period, it is expected that more proportion of PV cells produced in China being sold domestically only.

Based on the fact that most of the Chinese PV products were for exporting, the Chinese PV cell producers took a big share in the global market in 2010. Four Chinese producers were listed in 2010 top 10 global PV cell producers, which are Suntech, JA Solar, Trina and Canadian. Suntech led the global market of 1.57 GW of output, closely followed by JA Solar with 1.46 GW. These two accounted for about 17% of the total world output capacity. Trina was on the 5th place with the output of 1.06 GW, while Canadian was on the 8th place. However in 2011 the output of Chinese producers may decrease a lot due to the reduced demand from foreign countries. Moreover, the top ten producers contributed about 60% of the total world output, which indicated that the industry is slightly concentrated.

3.5.2 COMPETITIVE LANDSCAPE

POLICY SUMMARIES

Policies promoting equipment manufacturing

- Encourage to use domestic key equipment for poly-silicon wafers, silicon ingot wafers & silicon wafers, and crystal silicon cell slices & components
- Encourage to use equipment that can improve the product quality, raise photoelectric conversion efficiency, and reduce energy consumption

The government is aiming to foster some local leading solar power equipment manufacturers during the 12-5 period through the policies listed above. It expects 3 to 4 solar power equipment manufacturers on the market, with the annual sales in solar power equipment greater than 1 billion CNY by 2015. It also expects to raise the localization rate of key solar power equipment. The value chain illustrated below will show the key types of equipment in crystal silicon PV cells.

It is illustrated in Figure 3-10 that the crystal silicon PV cell value chain can be divided into seven steps, of which steps 3 to 6 are providing key equipment to PV cells. Growth furnaces, cleaning equipment, wire saws, PECVD, screen printers and welding machines as listed are considered as the most important types of equipment for PV cell manufacturing, due to the high cost and advanced technical level of the equipment. Among which the solar cell equipment and PV module equipment used in steps 5 & 6 are of high technology. Therefore the technology and equipment involved in these two steps are the most crucial part in PV cell manufacturing.

For thin-film PV cell manufacturing, PECVD (Plasma Enhanced Chemical Vapour Deposition) for turning glass to modules is the most important equipment in the value chain. The PECVD equipment also takes the highest proportion in cost. Sadly high-end PECVD equipment is monopolized by foreign leading players. Yet Chinese manufacturers are trying to develop high-end PECVD equipment currently. Certain leading local manufacturers, such as the CETC 48th Research Institute and Beijing Sevenstar, already have the ability to make low-end PECVD's.

The solar power equipment manufacturing industry in China is generally small and of low-end. The output value in 2010 was only 4 billion CNY, 6% of the global output of around 68 billion CNY. However the planned output value of solar power equipment in China by the end of the 12-5 period is 10 billion CNY. The estimated CAGR will be 20%. Among the 4 billion CNY output in 2010, the value of crystal silicon growth equipment accounted for 58% of the total output value, which reached as much as 2.3 billion CNY.

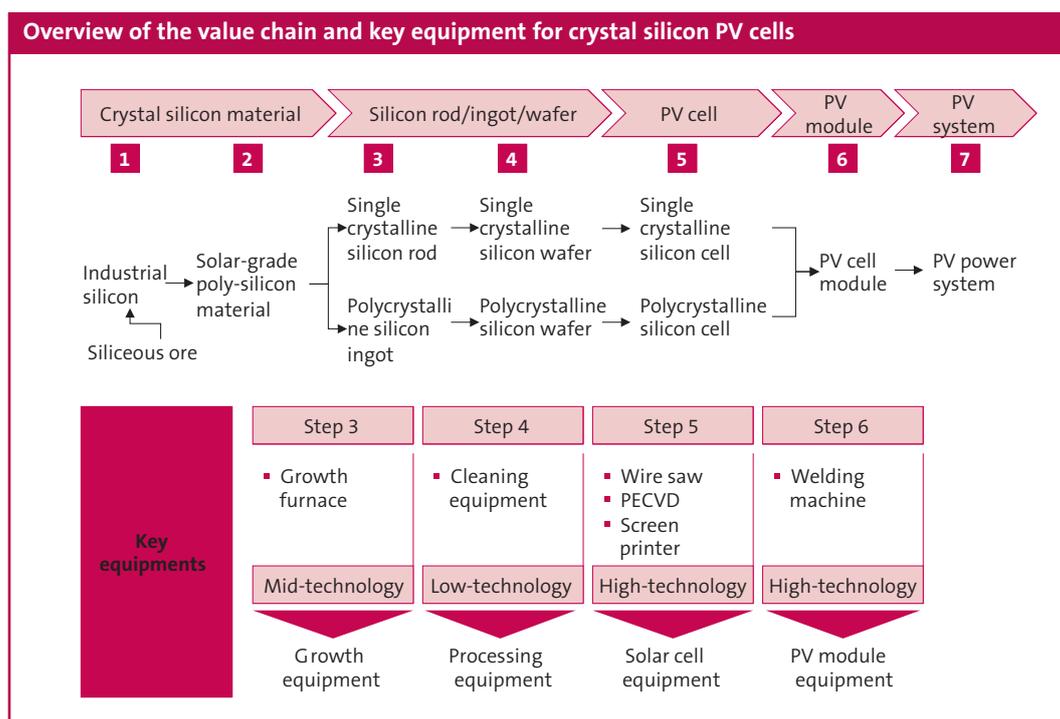


Figure: 3-10

Source: Production technology and application future of crystal silicon PV cells

Table 3-13: Overview of major local solar power equipment manufacturers
Values in billion CNY

Local manufacturer	Ownership	Revenue ¹⁾	Key products
CETC 48th Research Institute	SOE	4.0	Diffusion furnace, etching equipment, PECVD
Beijing Jingyi Century	SOE	0.6	Single/poly crystal furnace
Jinggong Science & Technology	Private	1.0	Poly crystal ingot furnace
Beijing Sevenstar	Private	0.8	Cleaning/etching equipment, crystal furnace, PECVD
Huasheng Tianlong	Private	0.5	Single/poly crystal furnace
Apollo	Private	2.8	Complete production line
Beijing JYT	Private	1.1	Single/poly crystal furnace
Shanghai Hanhong	Private	0.7	Single/poly crystal furnace, silicon sorter
Crystal Growing Technology	SOE	0.1	Single crystal furnace
Sun SEMI	JV	0.3	Single crystal furnace

¹⁾ in cludes other products, not limited to solar power equipment

The output value of crystal silicon solar cell equipment was 1.1 billion CNY, about 26% of the total output. The value in crystal silicon processing equipment and thin-film solar cell equipment, however, was fairly little, where each accounted for 8% of the total output value respectively. Though the current outputs concentrate on crystal silicon growth equipment, the proportion of high-end equipment is expected to rise during the 12-5 period.

The product portfolio and basic financial information of major Chinese manufacturers are listed in Table 3-13. The products of most of the local equipment manufacturers are focused on furnace products. Frankly there are more privately-owned manufacturers in the market than state-owned enterprises. CETC 48th Research Institute is a SOE that leads the market with differentiated products. Apollo leads the privately-owned companies in revenues and it has products for the complete production line. The world's top 10 solar power equipment manufacturers are shown in Figure 3-11. Manufacturers from the US, Germany and Switzerland are leading the market. Applied Materials, a US manufacturer, leads the market with the annual revenue of 1.4 billion USD, over 14% of the world total output value. The top 10 manufacturers accounted for about 56% of the world total output, indicating that the market is slightly concentrated. Chinese manufacturers are growing

but are still small compared to manufacturers worldwide. The 48th Research Institute of CETC is the only and the first Chinese firm that is listed as one of the world's top 10 PV equipment suppliers, with the annual output of 0.29 billion USD.

In year 2010, among the 4 billion CNY of mentioned output value in solar power equipment, only 2% were for exports. The 3.9 billion CNY of equipment, which accounts for about 98% of the total output value, was for domestic use only. The surprisingly low export rate may increase during the 12-5 period. China has already begun to export single crystalline silicon growing furnaces, diffusion furnaces and plasma etchers, mainly to the Asian market.

The listed import structure in Table 3-14 indicated that high-end solar power equipment in China is highly dependent on imports. The proportions of imports in automatic screen printers, automatic sorting machines, automatic solar cell welding machines, and flat plate PECVD coating equipment were extremely high. Also, the situation regarding multi wire saws and polycrystalline silicon ingot furnaces were not too much better. Frankly the production in furnaces and etchers are much more localized, since all of these kinds of equipment are of comparatively lower technology.

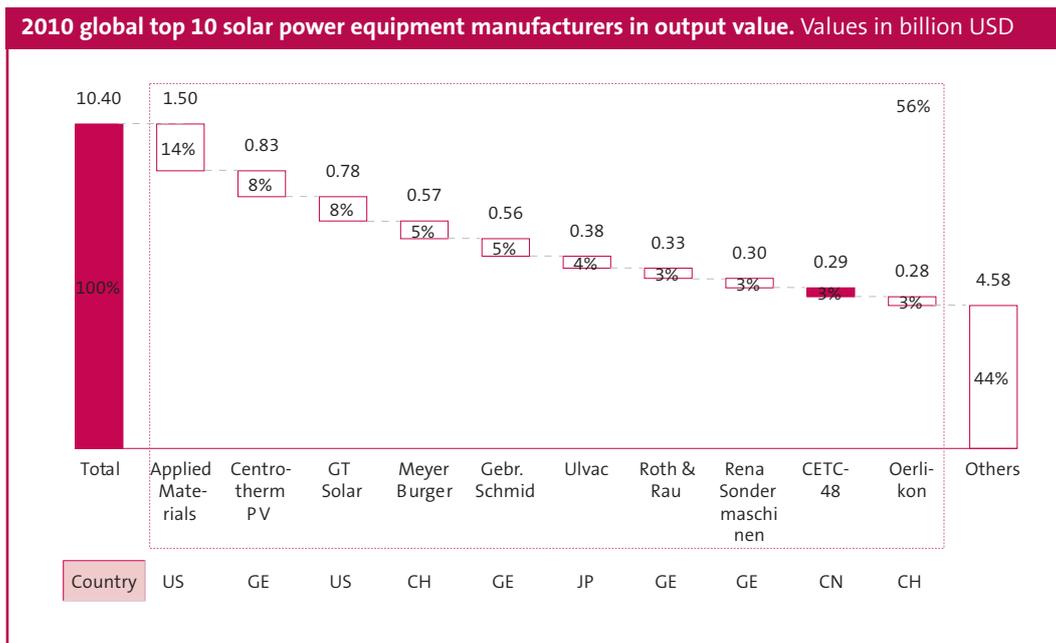


Figure: 3-11

Source: Solarbuzz

Table 3-14: 2010 Chinese import ratio for different equipment

Rank	Products	Percentage
1	Aut. screen printers Aut. sorting machines Aut. solar cell welding machines Flat plate PECVD coating equipment	> 90%
2	Multi wire saws	> 80%
3	Polycrystalline silicon ingot furnaces	> 50%
4	Single crystalline silicon growing furnaces	< 5%
5	Diffusion furnaces Plasma etchers	~ 0%

POLICY SUMMARIES

Target guidelines

1. Low energy consumption
2. High efficiency
3. Automation
4. Focus on production process

Key technology promoting

Strongly promoted technology

1. Flat plate PECVD
2. Automatic screen printers
3. Automatic sorting machines

Generally promoted technology

1. Tubular PECVD
2. Fast sintering furnaces

UNISPAR (University Industry Science Partnership)

The industrialization of key types of equipment will be promoted in 12-5, including equipment for poly crystal silicon ingots and wafers, crystal silicon solar cells and thin film solar cells. Cooperation in the whole value chain of solar power will also be promoted.

Industrial integration

Encourage leading firms to M&A small firms and integrate other resources.

3.5.3 INNOVATION & INDUSTRIALIZATION FOCUS

The government aims to foster 3 to 4 solar power equipment manufacturers with the annual sales of solar power equipment being greater than 1 billion CNY by the end of the 12-5 period. Co-operation as well as technology certifications will be encouraged since the solar equipment technology in China is lagging behind too much. To narrow the gap with international leading companies mentioned in step 5 of Figure 3-10 regarding the solar PV cell manufacturing process (i.e. PV cell equipment), the listed key technology in the policies will be promoted.

3.5.4 RECOMMENDATION TO GERMAN FIRMS

Both global co-operation and local protection are to be promoted according to the policies. German firms may want to take their big advantages in technology to obtain the potential market, and to keep competitors at distance on high-end types of equipment. From the Chinese market and policies research above, we may come to some conclusions for German solar power equipment manufacturers in the following aspects:

Strengths German manufacturers are advanced in high-end types of solar power equipment, such as screen printers and PECVD's. Also, German manufacturers are experienced in solar power systems, which is not that developed among the Chinese competitors.

Weaknesses Local players have advantages in financial supports from the government, the reverse-engineering capability (i.e. cheap R&D), and the low production cost. Reverse engineering will make some high-end technology developed or obtained easily and less expensive by Chinese players. Besides, local manufacturers are more familiar with the local market, including the local government, upstream suppliers, downstream customers and retail customers.

Opportunities The growth rate of the Chinese solar power market is expected to be high during the 12-5 period. The solar power industry is among the industries which the government is trying to develop in all aspects. What makes the market even more promising for advanced German players is that local players are not yet capable in many high-end types of equipment.

Threats The threats for German competitors entering the Chinese market may include the overcapacity of Chinese PV cell market, and the fast development of key local competitors due to the government's guiding policies. Besides, Chinese competitors are expanding in the international market, especially in emerging markets. This may challenge the global market share for German competitors. Changeable global economy and global demand will also be crucial facts that affect the market.

German firms are much more experienced, and have big advantages in high-end equipment technology and services. German manufacturers should make full use of their advantages in high-end solar power equipment field. The current Chinese market situations could be seen as below:

POLICY SUMMARIES

Beneficiary

Local players will be encouraged to develop technology by both independent R&D and technology transfers

Global cooperation will be encouraged, and investment environment will be improved

Neutral

Policies that encourage local players to make use of international fund and professional talents from abroad

Discriminating

Policies that encourage local manufacturers to expand in global market, e.g. overseas M&A
Policies that aim to raise the localization rate of PV cell manufacturing equipment to 80% in 12-5

Market

The current cumulative installed solar power capacity in China is small, yet it will grow to 15 GW by 2015, with a high CAGR of 66%. This may need the support from and the co-operation with foreign advanced technology, including the technology and modern sense of service from Germany. Nevertheless, China is producing 50% of global PV cells, 90% being destined for exports. This means the amount of domestic made products are far beyond the domestic market needs, which may lead to a limited market for foreign competitors.

Supply

Solar power equipment manufacturing industry in China is small in supply, which only took 6% share of the global output in year 2010. Furthermore, most of the local equipment manufacturers focus on low-end types of equipment, such as single crystalline silicon growing furnaces. There should be a great chance for German manufacturers entering the market with their advanced high-end products and mass-production capability.

Policy

Solar power installations will continue to be supported, but the entrance to PV cell industry will be limited during the 12-5 period. Solar power equipment manufacturing will also be promoted, especially for high-end types of equipment. It is not quite good news to German manufacturers that the government will try to support local firms at any time. Measures such as technological co-operation and joint venture may be considered at suitable occasions.

Sales organization improvement and joint venture are recommended to respond to the new trend of China's demand for solar power equipment during the 12-5, Business divesting can be considered as well to save costs.

Sales organization improvement Due to the recession of the global solar power industry, and the overcapacity of silicon wafer and PV cells in China, most of China's silicon wafer and PV cells producers will focus onto the local market, which would be more than adequate to meet the local demand. Therefore, although China's solar power industry will grow fast during the 12-5 period, it is expected that the demand of solar power equipment will not be so big as the demand of solar power installations. In order to react to the shrinking demand in the solar power equipment market in China, and to fully play the advantage on high-end solar power equipment, German firms should improve the sales organization.

The sales organization should be focused on the leading local silicon wafer and PV cell manufacturers, since small manufacturers may be eliminated or it is impossible for them to update the production line.

The sales organization should focus on high-end equipment, since local manufacturers are more likely to purchase for low-end equipment from local suppliers to save the cost.

Joint venture Leading local players like CETC-48 are developing fast and trying to catch up the global trend, especially in middle and low-end solar power equipment. In addition, local silicon wafer and PV cell manufacturers are becoming more likely to purchase for middle and low-end solar power equipment from local supplier to save cost. Therefore, in order to maintain the market share in the middle and low-end equipment market and to avoid the disadvantage of high cost, German firms should consider collaboration opportunities with local players. Potential collaborator may include CETC-48, which is a state-owned enterprise located in Changsha. Its considerable market share in China and the good relationship with the government might bring extra benefits to German co-operators.

Business divesting German manufacturers are losing advantages in middle and low-end solar power equipment like crystal silicon growth furnaces and diffusion furnaces. Therefore, business divesting can be considered by German firms to save cost and to focus on their advanced products. Tier 2 local solar power equipment manufacturers, such as Beijing JYT, are ideal potential buyers. Since tier 2 local solar power equipment manufacturers have the ambition to develop fast, but are not as advanced in equipment and businesses as leading manufacturers, they will be in need of the equipment divested from German firms.

3.6 NEW ENERGY VEHICLE

POLICY SUMMARIES

Subsidy supports for buyers

National special funds will be provided to promote the purchase of energy-saving and new energy vehicles (ESNEV) and subsidy support will be provided by local government of pilot cities as well.

Other support policies are expected to be provided by local governments at various levels, including preferential license fee, road toll, parking fee and charging fee.

Tax deduction & exemption for buyers

PEV (pure electric vehicle) and PHEV (plug-in hybrid electric vehicle) are exempt from the vehicle purchasing tax from 2011 to 2020. Half of the vehicle purchasing and consuming tax of MHEV (moderate hybrid electric vehicle) and FHEV (full hybrid electric vehicle) will be deducted from 2011 to 2015.

3.6.1 MARKET OVERVIEW

Subsidies, tax deductions and other supportive policies to new energy vehicle buyers will be provided in the 12-5 period to promote the purchase of energy-saving and vehicles using new energy sources.

In addition to the policies listed above, the Chinese government has launched the “10 cities, 1,000 vehicles” program to promote new energy vehicles in major cities. This program was started in 2009 by MoST (Ministry of Science and Technology), MoF (Ministry of Finance), NDRC (National Development and Reform Commission) and MIIT (Ministry of Industry and Information Technology) with a total duration of 3 years. Financial subsidies are provided to demonstrate the operation of 1,000 new energy vehicles in 10 cities each year. 13 pilot cities were selected in 2009, which are: Changchun, Beijing, Dalian, Jinan, Shanghai, Hefei, Wuhan, Chongqing, Changsha, Hangzhou, Nanchang, Kuming and Shenzhen. In addition, 7 cities were selected in 2010 and 5 in 2011. There are currently totally 25 cities in this program. However, the duration of the program is considered too short and most manufacturers hope the program could be continued.

Before focusing on the new energy vehicles' market, China's automotive market will be shortly introduced in this study. China's automotive market is growing fast, particularly since 2008. Figure 3-12 shows the development of the production and sales volume from 2006 to 2011.

The production and sales volumes have an almost parallel development path. The development since 2008 had a significant CAGR of almost 40%. In spite of the rapid growth, China's automotive market still has a huge potential due to its low vehicle ownership level. Figure 3-13 gives an overview of the vehicle ownership level in different countries in 2010.

Selected countries with higher vehicle ownership level are picked out to be compared with that in China. It could be found from Figure 3-13 that although China has become the world's biggest automobile market, its vehicle ownership per capita is still far behind that of the developed countries, and also much lower than the world's median level. The market potential in China therefore remains very large.

In China, the vehicle ownership level of a region is directly proportional to its GDP. Shanghai is a special region where the vehicle ownership level is not proportional to the GDP due to the expensive license plates. Figure 3-14 gives the 5 regions with the highest GDP and highest vehicle ownership level in China.

Beijing/Tianjin/Hebei, Shangdong, Jiangsu, Zhejiang and Guangdong are the top 5 regions with the highest GDP in China, and they have also the highest vehicle ownership level. The vehicle ownership level in Shanghai was just 2% in 2009 which is very low compared to the level of the 5 top regions.

The development of China's automobile market is facing many problems. The crude oil price rose from 20 USD/barrel in 2001 to over 100 USD/barrel in 2012. China is also trying to reduce its CO₂ emission per vehicle from 185 g/km in 2009 to 161 g/km by 2015. The resource limitation and environmental protection pressure are forcing China to develop energy-saving and new energy vehicles. The demand for energy-saving and new energy vehicles is expected to increase. The market size was 2,300 units in 2006, yet the market size in 2010 increased to 14,300 units, with the CAGR of 44%. It should be noted that the market development of new energy vehicles is by far not as fast as expected. To achieve the aggressive target set by the government, optimistic estimation in the market demand of 977,000 units in 2015 have been put forward, which seems to be a big challenge. Dramatic increase in capacity and market size may possibly happen in 2014 and 2015.

Yet, due to the vagueness of the market development, close attention needs to be paid to the actual market development and policy trends.

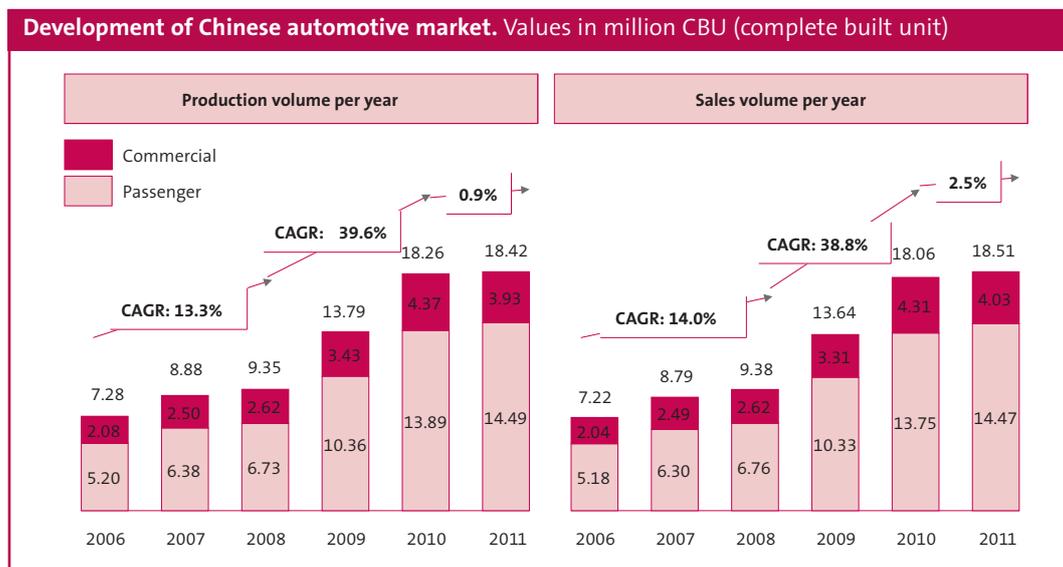


Figure: 3-12

Source: National Bureau of Statistics of China

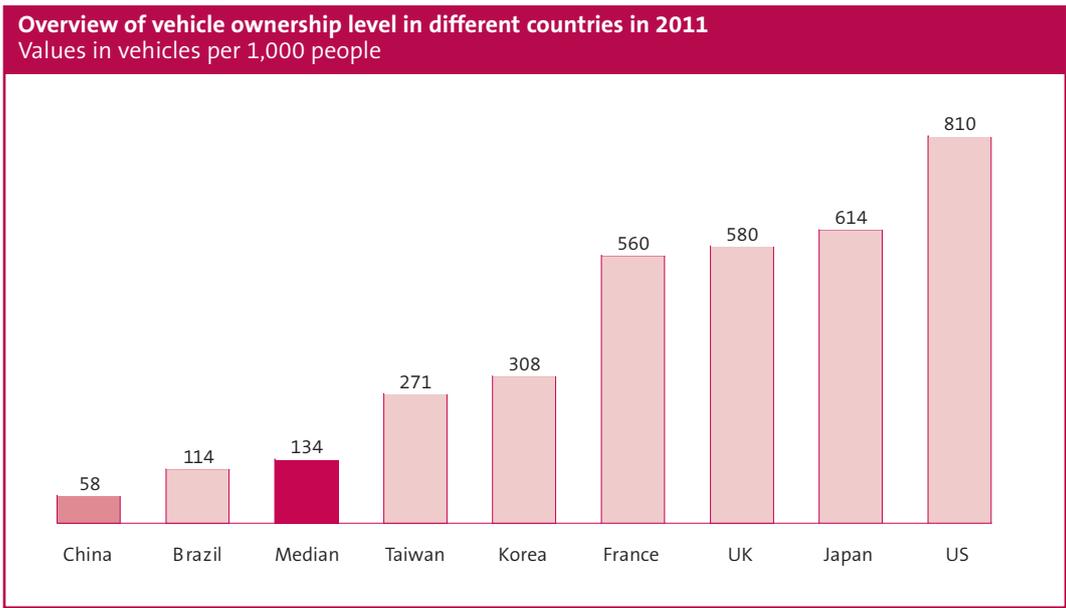


Figure: 3-13

Source: World Bank data, own calculations

The estimated demand structure by type of vehicles in 2015 for energy-saving and new energy vehicles is very different. The market share of energy-saving and new energy cars is expected to be 97% in 2015. 950,000 out of 977,000 completely built ESNEV units will be energy-saving and new energy cars. Private cars will be the most relevant segment of energy-saving and new energy vehicles. In contrast, only 22,000 units will be new energy buses, and 5,000 units for new energy trucks. In the energy-saving and new energy car segment, HEV is estimated to account for 37% of the total 950,000 units, while EV being 63%.

The most relevant key components of new energy vehicles include power battery and its management system, motor and its control system, and the power chain control system. The cost of the power battery and its management system account for ca. 20%, the motor and its control system being another ca. 20%, and the power chain control system accounts for ca. 40% of the cost of an HEV. It is obvious that the cost of these key components will affect the cost and the success of the new energy vehicles to a large extent. Moreover, the lack of key technologies, especially power control systems, is restricting the development of new energy vehicles.

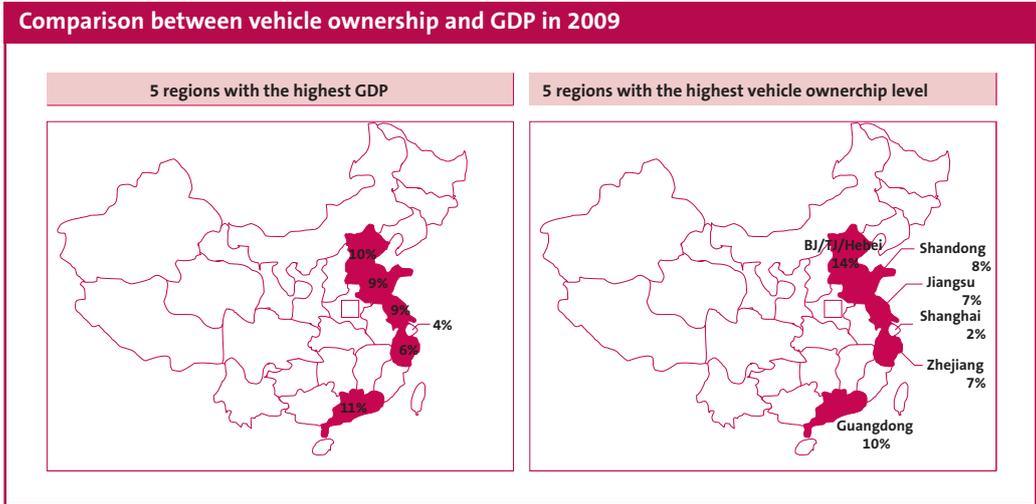


Figure: 3-14

Source: National Bureau of Statistics of China

China's automobile component market is currently dominated by foreign companies. The foreign portion is above 60% in the automobile components market, 80% in the personal car components market and 90% in the high-tech components (such as automobile electronics and motors) market.

If the expected market size of new energy vehicles could actually be achieved in 12-5, the market of key components would also grow rapidly. For example, if the expected new energy vehicle market size of 500 thousand units could actually be achieved, the market of power batteries for new energy vehicles would reach 30 billion CNY with an estimated average power battery system price of 60 thousand CNY.

3.6.2 COMPETITIVE LANDSCAPE

There are various types of energy-saving and new energy vehicles (ESNEV). They can be roughly divided into 5 types of vehicles, where different countries focus on different types. Japan is focusing on electric vehicles, while USA on bio-fuel vehicles and plug-in hybrid electric vehicles, and the EU focus on clean diesel vehicles. Like Japan, China is also focusing on electric vehicles, which consists of hybrid electric vehicles, pure electric vehicles and fuel electric vehicles.

Local companies have begun to develop energy-saving and new energy vehicles. Table 3-15 gives an overview of the status quo and plans of local manufacturers.

POLICY SUMMARIES

Targets of energy-saving and new energy vehicles

By 2015: The population of PEV and PHEV should reach 500,000 units. The population of MHEV and FHEV will reach 1 million units. Each passenger car should have a micro-hybrid system with automatic start and stop functions

By 2020: Government aims to cultivate 1 to 2 energy-saving and new energy vehicle groups with a capacity of over 1 million units and 3 to 5 groups with a capacity of over 500,000 units.

Corresponding supportive policies

Funding: National special funds of 100 billion CNY has been planned for energy-saving and NEV and key component companies and projects for the next 10 years, 20% for energy-saving vehicles, 30% for NEV and 50% for key technology R&D and industrialization. Government also promotes social capital investments in NEV industry and supports eligible key component companies to get listed and issue cooperate bond. Local governments such as Shandong government also provide financial support.

Tax support: From 2011 to 2020, the value-added tax for energy-saving and new energy vehicle and component companies will be adjusted to 13%. R&D cost can be deducted from the tax.

Government procurement: By 2015, the proportion of NEV of the government vehicle procurement should be above 10% and energy-saving vehicles above 50%.

Corresponding supportive policies —Exemplary projects

- Establishment of the new energy vehicle and key components industrialization base in Jiading, Shanghai with a special support fund of 1 billion CNY
- Establish the new energy vehicle industrialization exemplary base in Yanchen, Jiangsu
- Establish new energy vehicle key components R&D and industrialization base in Changzhou
- New energy vehicle industrialization bases in Shenzhen and Foshan to be constructed

Table 3-15: Overview of status quo and plans of local manufacturers		
Company	Status quo	Plan
FAW	Small batch production, including hybrid buss and hybrid cars	HEV capacity of 11 thousand units and hybrid bus capacity of 1000 units by 2012
SAIC Motor	Hybrid cars already on the market, PEV on the market in 2012	N/A
Dongfeng Motor	Hybrid buses included in the national product catalogue	N/A
Changan	Mass production for hybrid cars since 2009	New energy vehicle capacity of 150 thousand units by 2014 and 500 thousand units by 2020
Chery	Mass production for hybrid cars, finished prototype design for PEV and PHEV	N/A
BYD	PEV have been used as taxi since 2010	N/A
FOTON	mall batch production for hybrid buses since 2008	Capacity of 20 to 40 thousand units for all new energy vehicle types by 2011

The majority of local new energy vehicle manufacturers are SOEs, except BYD. The key products are PEV and HEV. BYD is the leading company in the local new energy vehicle industry, and its accumulated quantity of F3DM (PHEV) is more than 1,000 units by now. However, BYD is still quite small compared with the 20,000 units of Nissan Leaf (PEV) and the 5,000 units of Chevrolet VOLT (PHEV).

China will foster the development of its own industry and is developing industry bases with leading new energy vehicle manufacturers. Figure 3-15 gives an overview of the 8 energy-saving and new energy vehicle industry bases.

German automobile companies are taking actions to cooperate with Chinese local players and some relationships have already been built up. Following are some examples of the co-operation projects:

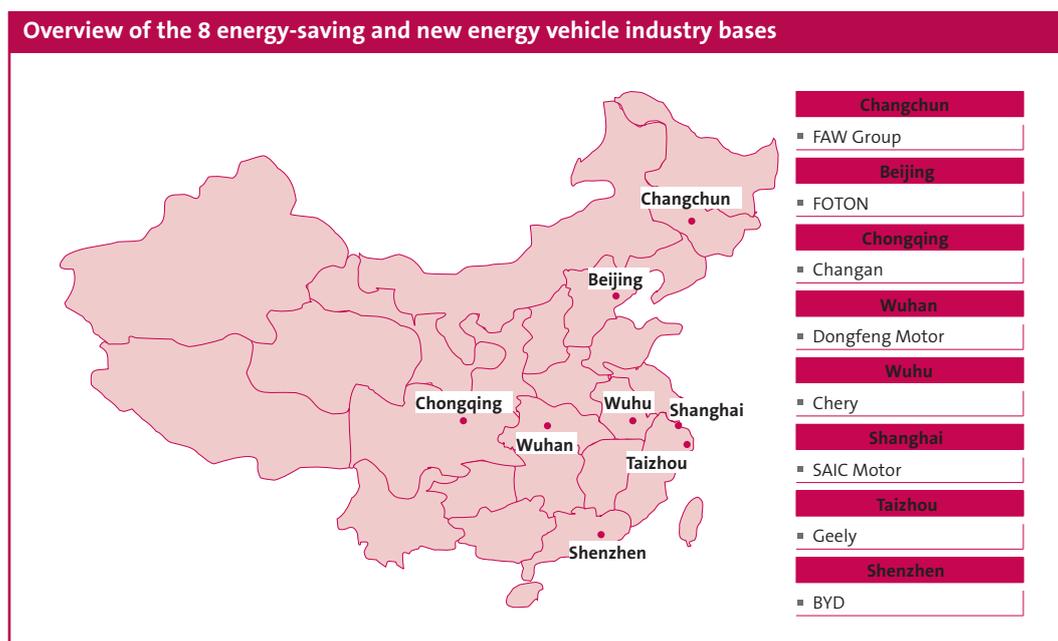


Figure: 3-15

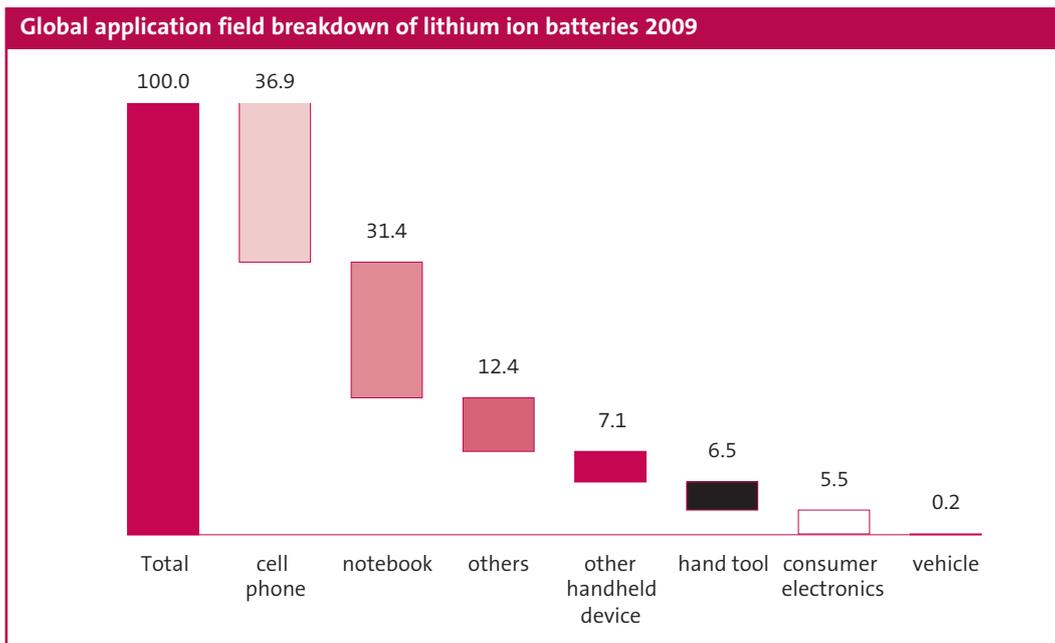


Figure: 3-16

BYD & Daimler:

BYD signed an agreement with Daimler in 2011, and a 50-50 joint venture would be established with a total 600 million CNY investment. BYD will share its core technology of PEV and the first PEV will be launched in 2013.

Volkswagen (partner not declared):

According to the “Global EV Strategy” of Volkswagen in 2010, Volkswagen will transfer its HEV and PEV technologies to China. The PEV made in China will be launched between 2013 and 2014.

BAIC Group & Daimler:

The first domestic-made Benz new energy car will be launched by BAIC Group in 2014.

Shanxi Automobile & R.STAHL:

Shanxi Automobile signed an agreement with R.STAHL to develop new energy road sweepers together, using HEV technology.

The power battery is considered as the “heart” of new energy vehicles and the lithium ion battery is widely used as the new energy vehicle power battery in China. Lithium ion batteries have many different applications which is shown in Figure 3-16.

The application of lithium ion batteries in the new energy vehicle field is yet very limited due to the small market size of new energy vehicles. But

each new energy vehicle needs far more power batteries than other devices. Thus the new energy vehicle industry, which is expected to grow, will affect the lithium ion battery market to a large extent.

The global lithium ion battery production center is being transferred to China. The lithium ion battery companies are located mainly in three areas in China: the Yangzi delta, the Pearl River delta and the Beijing/ Tianjin/ Tangshan area. In the future, the companies tend to move to Middle and West China for resource and cost advantages.

Most of the local players in China have just stepped into the new energy vehicle key components field. Table 3-16 gives the information of some leading local players in this field.

China’s vehicle components industry is lagging behind. Key technologies of batteries, motors and electric control systems depend on imports. There are huge performance gaps between domestic and foreign key components such as the low efficiency of drive systems, the long charging time and short life time of batteries. China is also weak in battery system integration technologies, mass production process designs, production process quality and cost control. Government is trying to solve the technology and industrialization problems in 12-5. Detailed policies will be analyzed in the next chapter.

Table 3-16: Local leading players and their brief information		
Name	'10 Revenue (million CNY)	Key strength
Zhongxin Guoan 000839	2,000	Tele-communication, network, lithium ion battery and material, battery management system
Topband 002139	891	Motor and its intelligent controller, power automation system equipment, electronic intelligent controller
Ningbo Yunsheng 600366	1,900	Automotive electronics
BYD 002594	48,400	Battery industry leader, motor and electric control
Broad-Ocean Motor 002249	2,200	Fan motor, intelligent motor, permanent magnet synchronous EV motor with an expected 30 thousand units capacity in 2012
Fangzheng Motor 002196	516	Leader of micro & special motors, 875 million CNY investment in the 300 t/a electric vehicle motor production project

3.6.3 INNOVATION AND INDUSTRIALIZATION FOCUS

POLICY SUMMARIES

Industrialization:

Chinese government is trying to establish an integral industrial system of the new energy vehicle industry by 2020:

Value chain positioning

- Establish vehicle shared test platform and product development database
- Establish patent system of the whole value chain
- Develop technology standards
- Establish key component industrial system

Horizontal integration

- Promote the cooperation with global new energy vehicle manufacturers
- Develop large key component enterprise groups
- 4-5 core enterprises for batteries, motors and powertrain control systems respectively and in-dustry concentration above 60% by 2015 and 80% by 2020
- Develop production equipment and encourage imports of advanced equipment

Up/downstream integration

- Establish an efficient vehicle common technology sharing mechanism
- Promote joint R&D of OEMs and battery firms and charging equipment manufacturers
- Raise localization rate of key materials for batteries and complete the battery industrial chain

Supportive policies

- Construct R&D platforms for common technology and power system technology
- Build an independent development system for new energy vehicles
- Tax deduction and exemption of the income from new energy vehicle technology development, transfer and service
- Establish the alliance of vehicle companies, components companies and research institutes

R&D targets

- Grasp vehicle key technologies: system integration technologies and vehicle common technologies for PEV, HEV and FCV with independent IP and development capability and reach internationally advanced level
- Acquire design optimization, mass production and cost control technologies of engines and power modules for new energy vehicles (motors, batteries, management systems etc.)
- Build power module production system
- Achieve 10 billion Ah high-performance single vehicle battery production capacities

The Chinese government is introducing various support policies to realize a breakthrough in key technologies and to foster industrialization.

An electric vehicle industry alliance was established in 2010 and core enterprises strengthened their co-operation in the key components field. A new energy vehicle international alliance was also established by FOTON, IBM and other foreign companies. 12-5 policies also aim to promote industry restructuring. The current industry situation could be described in 3 aspects:

- **Value chain positioning:**

China began to develop the new energy vehicle industry early, and an elementary value chain for new energy vehicle industry has already been formed. But China began its new energy vehicle production with the assembly, key technologies and key components are therefore lacking. Hence there are huge performance gaps between domestic and foreign products.

- **Horizontal integration:**

Currently, the new energy vehicle OEM development is self-serving. The co-operation with global OEMs is just about to start. The component industry is generally scattered and the industry entry barrier for batteries is low. New energy vehicle key components industrial clusters are being constructed.

- **Up/downstream integration:**

The co-operation of OEMs and components companies on battery and other components are popular. BYD is strong in both new energy vehicle OEM and power battery manufacturing. 80% of the key materials of lithium ion batteries rely on import. Many components and materials for motors and powertrain control systems rely on imports, too. The production equipment level is also low.

An annual capacity of 100 thousand units is needed to realize the industrialization; otherwise the cost would be too high. But it's very difficult for Chinese local players to reach the goal since the average annual capacity per model of traditional cars is only 28 thousand units now. Toyota is planning to set up a new energy vehicle production base in Tianjin in 2014 or 2015 with an annual capacity of 100 thousand units.

3.6.4 RECOMMENDATION TO GERMAN FIRMS

Co-operation intentions from German OEMs and component companies are welcome, but there are also limitations.

German manufacturers have a strong background based on the German investment plan of € 14 billion for new energy vehicle innovation and the release of national development plan for electric mobility in Germany (Nationaler Entwicklungsplan Electromobilitaet). Already a national electric vehicle platform has been established and first innovation alliances as "Lithium ion battery LIB 2015" by BASF, Bosch, Evonik, Volkswagen, LiTec and 60 research institutions and industry practitioners have been implemented with an investment of € 360 million from the industry and € 60 million from the German Federal Ministry of Education and Research.

Hence, the German companies' competitive situation could be seen through a SWOT analysis.

Strengths:

German companies have accumulated technologies and talents in the field of traditional vehicles and they also have rich experience in complete vehicle manufacturing. Furthermore, they have good co-operation experiences with Chinese vehicle manufacturers. The same direction and

POLICY SUMMARIES

Beneficiary

In 12-5 plan, the cooperative development and shared technology between local companies and foreign companies will be promoted, including:

1. Joint R&D on common basis and advanced technologies
2. Promote the use of global resources to grasp key technologies
3. Promote foreign manufacturers to establish joint venture R&D institutes

In 2011, Chinese and German government issued a statement that China and Germany would be strategic partners on electric vehicles

Discriminating

Certain limitations for German OEMs on traditional vehicle cooperation may be applied in the energy-saving and new energy vehicle field too.

Promoted areas

- Battery: energy density $\geq 110\text{Wh/kg}$, life cycle ≥ 2000 , foreign portion no more than 50%
- Battery management system
- Motor management system
- Integrated EV electronic control
- EV drive motor (peak power density $\geq 2.5\text{kW/kg}$, efficient zone: 65%, working area efficiency $\geq 80\%$)
- Automotive DC/DC (input voltage 100V-400V)
- High power electronic component (IGBT voltage $\geq 600\text{V}$, current $\geq 300\text{A}$)
- PHEV electromechanical coupling drive system

similar targets allow the further co-operation between China and Germany. Sino-German strategic partnership has been further intensified and expanded in 2011. Both sides agreed to forge the strategic partnership on electric cars with a project between Volkswagen and its Chinese FAW and a factory in Foshan. Furthermore, Sino-German Forum on Electric Vehicles was established in 2010. This partnership gives German companies more chances than other foreign companies.

Weaknesses:

European OEMs have advantages in clean diesel models, not HEV/PEV. Germany began to develop electric vehicles later than some other countries such as Japan and they have currently no apparent advantages in this field. The high price of German automobile component is another weakness of them.

Opportunities:

China's big demand in passenger cars and the trend that gasoline cars are being substituted by energy-saving and new energy cars is providing great opportunities. Key components of new energy vehicles are also for the first time included in promoted areas of Catalogue for the Guidance of Industries for Foreign Investment 2011.

Threats:

Local players have been developing fast in the past few years and they receive government procurement and financial support which German companies do not have. More threats come from the uncertain new energy vehicle market development and the unclear policy stimulating effect. The foreign portion of vehicle battery joint ventures could not be more than 50%. German companies are also facing threats from Japanese leading players and Chinese local companies. BYD, for example, has become quite strong in the lithium ion battery field.

To sum up, co-operation with local OEMs are a must for German firms.

Forge Sino-German strategic partnership:

To achieve more opportunities than other foreign companies, the Sino-German strategic partner relationship on electric vehicle should be further followed.

Co-operation with local companies:

Currently, joint venture or other forms of co-operation with local players are still the only choice for German firms to enter the Chinese new energy vehicle market, due to Chinese government's limitation. On the other hand, early development of Chinese OEMs focuses on PEV and HEV. Thus German firms can also benefit from some of the technology cooperations. Major German firms have already begun to cooperate with local OEMs. For instance BYD is cooperating with Daimler, and BAIC Group with Benz. Joint ventures in the new energy vehicle component field are especially promoted by the Chinese government due to the lack of key technologies and key components for new energy vehicles in China. Other co-operation forms such as the establishment of technology R&D platforms could also be considered.

Local sourcing:

China's new energy vehicle industry was developed early, so certain component suppliers already have mature technology and products for new energy vehicles. Therefore, local sourcing can be considered by German firms to save the cost. Parts supplier candidates may include BYD for its battery products. BYD, located in Shenzhen, is one of the leading companies in new energy vehicle OEM and batteries.

Business divesting:

China aims to improve its technology level of key components of new energy vehicle, and Chinese companies have begun to acquire foreign companies. For example, Chongqing Machinere&Electronics Holding(Group),LTD began to acquire Hyva Group in Holland and Chongqing textile Holding (Group),LTD began to acquire SaarGummi Group in Germany in 2010.

3.7 HIGH SPEED RAILWAY EQUIPMENT

POLICY SUMMARIES

Normal speed railway

The normal railway network will continue to grow from a total length of 84,000 kilometers in 2010 to 92,000 kilometers in 2015, with a CAGR of 1.8%. Its share in the whole railway network, however, will drop from 92% to 77%.

High speed railway

The railway network for high speed trains (i.e. speed > 200 km/h) is expected to quadruple to a total length of 28,000 kilometers, representing a CAGR of 33.5%. In the year 2015, it will make up 23% of the whole railway network.

3.7.1 MARKET OVERVIEW

China plans to increase its railway network from 91,000 kilometers to 120,000 kilometers by the end of 2015, corresponding to the CAGR of 5.7%. The total planned investments will amount to 3.5 trillion CNY during the 12-5 period. The focal market segment is high speed railway because China aims to enhance its fast and comfortable passenger transportation.

Continuous, substantial high speed railway network expansion has been planned for the next 5 years. Figure 3-17 shows the annually planned increase in length for high speed rail network. The length of railway with designed speed between 200 and 250 km/h will increase by 12,900 kilometers from 2008 to 2016, while the increased length for railway with designed speed between 300 and 350 km/h will be 15,500 kilometers. Data clearly indicates that railway for speed more than 300 km/h is more preferable by the Chinese government and it will account for 55% of total high speed railway network. This could be an encouraging sign for German firms, because the higher the speed of the railway network will be the better the technology will have to be. Hence, German firms will have better chances to promote their products and services.

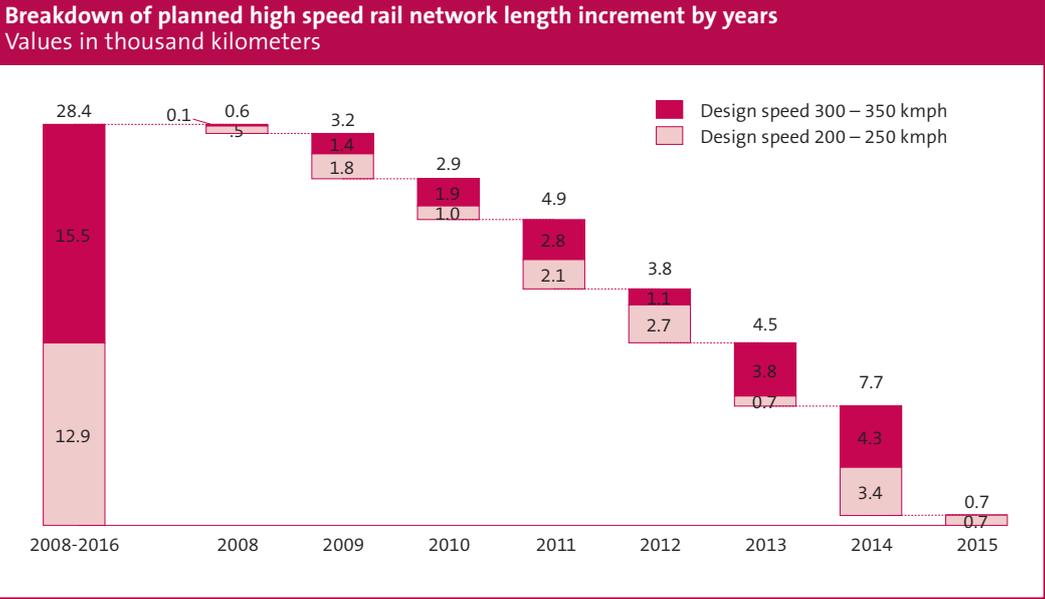


Figure: 3-17

Source: Statistical Centre, China Railway Bureau

Except for the increasing interest in the nationwide railway network, China also plans significant investments in urban track transportation. The number of cities operating with urban tracks will increase from 12 in 2010, to 28 in 2015, and then to 40 in 2020. The total length of urban tracks will grow from 1,400 kilometers in 2010 to 3,000 kilometers in 2015, with an investment of 1.2 trillion CNY. Another investment of 3.0 trillion CNY will be made to further expand the urban track length to 7,000 kilometers by the end of

2020. This is mainly driven by the expanding fiscal budget of local government which is a result of the growing GDP and taxation income. To cool down the enthusiasm in urban track investments, the State council has regulated that only cities with fiscal revenues of more than 10 billion CNY and with a population more than 3 million can apply for the development of urban track transportation. Nonetheless, such “taking-off” period of urban track transportation means huge opportunities for equipment manufacturers.

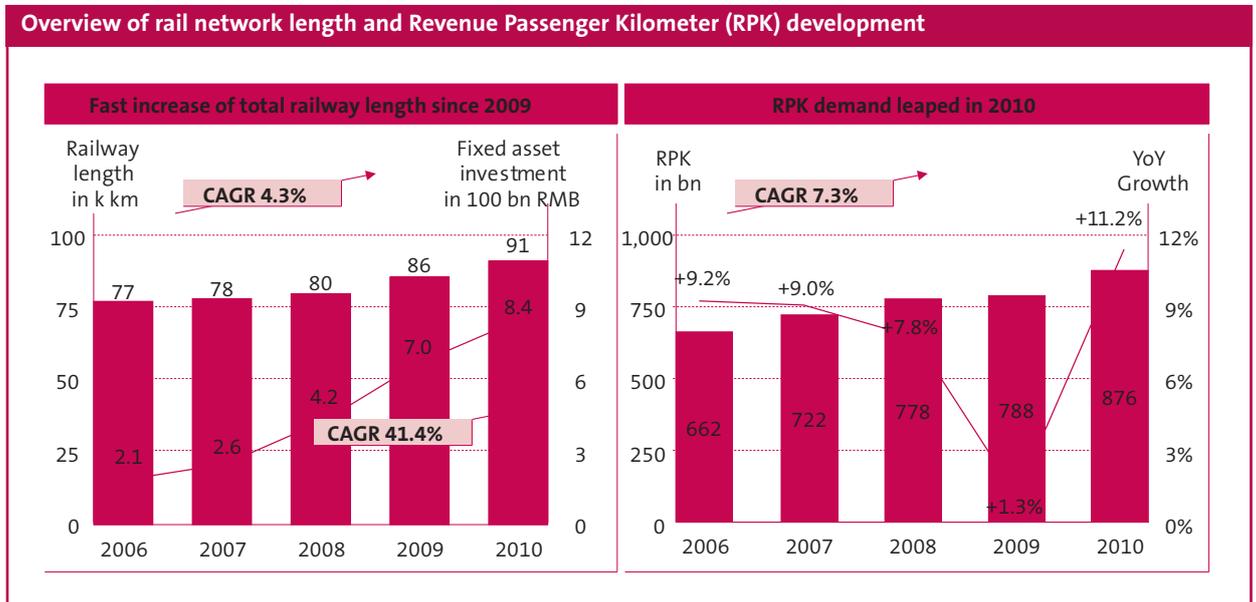


Figure: 3-18

Source: China Statistical Bureau, Statistical Centre, China Railway Bureau

Currently, there are 18 railway bureaus in China, and the vast majorities are located in provincial capitals. The most of the railway bureaus are located near the east coast of China, such as Shanghai and Guangzhou. The big inland hubs include Qinghai, Wuhan, Chengdu, and Urumqi.

Figure 3-18 shows an overview of rail network length and Revenue Passenger Kilometer (RPK) development. The government has invested huge amounts into fixed assets in the past few years. It has grown from 210 billion CNY in 2006 to 840 billion CNY in 2010, with a CAGR of 41.4%. By comparing the growth of railway length, it shows that there is about one year lead time from fixed asset investments to operating railway length. RPK have increased from 662 billion in 2006 to 876 billion in 2010, with a CAGR of 7.3%. A significant demand leap was observed in 2010, associating with an 11.2% growth from the previous year. The data reveals that the length of the operating railway network has a direct link to RPK development, implying meeting unsatisfied demand.

Figure 3-19 illustrates the comparison between the increase in railway network length and number of trains and number of cabins. It shows that the number of new cabin units and CRH trains is in general proportional to the increasing length of high speed railway. Therefore, the demand for cabins can be estimated via the proxy of length of high speed railway. There are currently 480 CRH trains and 5,800 cabin units in operation in China's railway network. On average, there are 12 cabins on every train, and this translates into an average of 0.6 cabin unit for every kilometer length. For the relatively more condensed route between Beijing and Shanghai, there are currently 90 pairs of CRH trains and 1,380 cabin units in operation. This means that every kilometer length in that route is covered by an average of 1.1 cabin units. The global benchmark shows that Japan has 4.2 cabin units per kilometer while the figure in Germany is 2.4 cabin units per kilometer. Even without railway length development, China's demand for cabin units could still grow 4 times. This shows that new trains and cabins can still be introduced to meet increasing RPK in China.

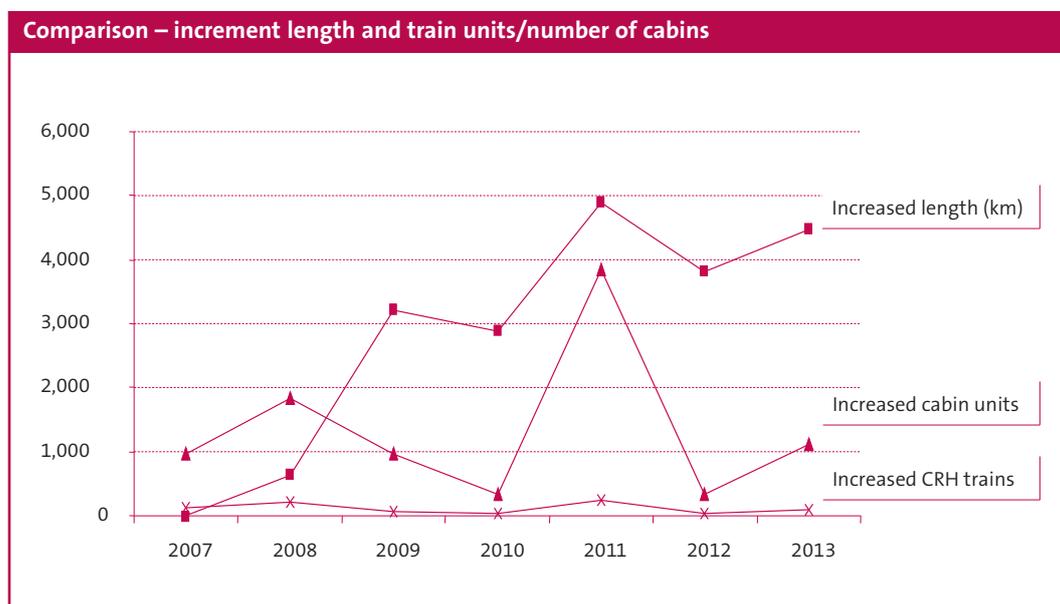


Figure: 3-19

Source: Statistical Centre, China Railway Bureau

3.7.2 COMPETITIVE LANDSCAPE

Figure 3-20 demonstrates the overview of China's import and export of railway cabins and locomotives. In the past few years, China has seen tremendous growth in export of OEM rail cabins and locomotives while the import volume has decreased significantly. In 2008, China exported just 0.1 million USD rail locomotives and 2.5 million USD self-propelled railway cars. The figures have grown to 365.5 million USD and 184.1 million USD in 2010, associating with a CAGR of 6,046% and 858%, respectively. The strong growth of export has demonstrated the Chinese OEM's development in technology and market. On the other hand, the import value of rail locomotives has dropped from 116.4 million USD in 2008 to 24.6 million USD in 2010, with a CAGR of -54%. The value of imported self-propelled railway cars, however, has seen smooth growth from 2008's 15.9 million USD to 2010's 55.7 million USD, resulting in a CAGR of 87%. This could imply a larger technology gap in self-propelled cars when compared to rail locomotives.

Despite the increased OEM export, China is still relying heavily on the import of key components. Figure 3-21 describes the overview of China's import and export of railway key components. It clearly showed that the import of railway key components has been increasing in the past few years, with the smallest CAGR being 55%. However, China's export of components is at a relatively small scale, and it is on a descending trend. As a result, the development of key components will continue to be the focus of 12-5 year plan for railway equipment.

As for the value chain of high speed train industry, railway bureaus are the railway operators in China and are divided according to jurisdictional areas. In total, there are 18 bureaus, such as Beijing Railway Bureau and Shanghai Railway Bureau. They would raise demands for rail networks and trains. OEMs and tier 1 players are main equipment providers for railway operators. OEMs design and manufacture locomotives, passenger trains, high-speed trains, and urban mass transit vehicles,

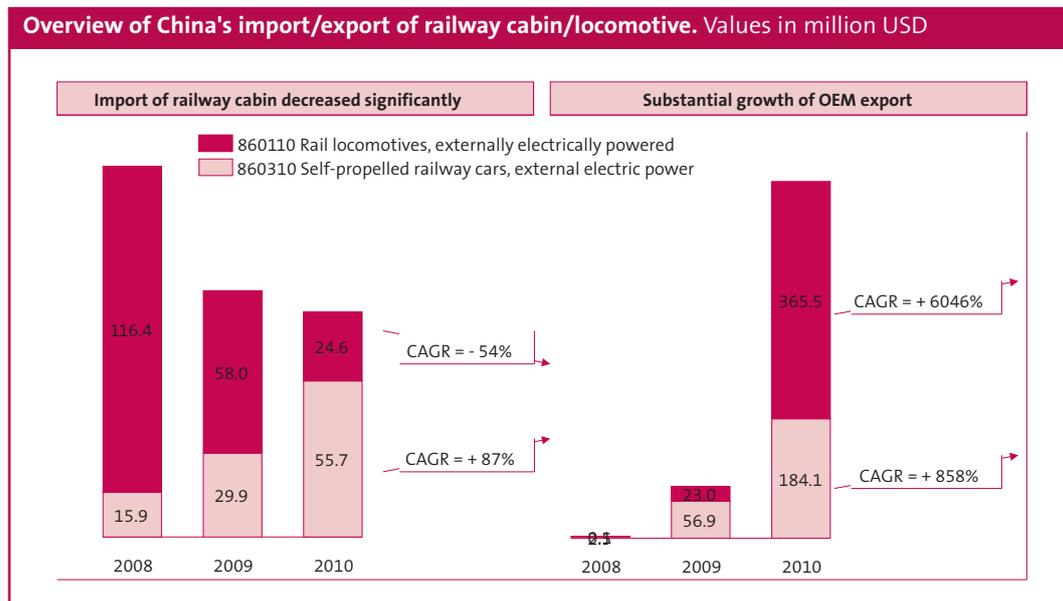


Figure: 3-20

Overview of China's import/export of railway key components. Values in million USD

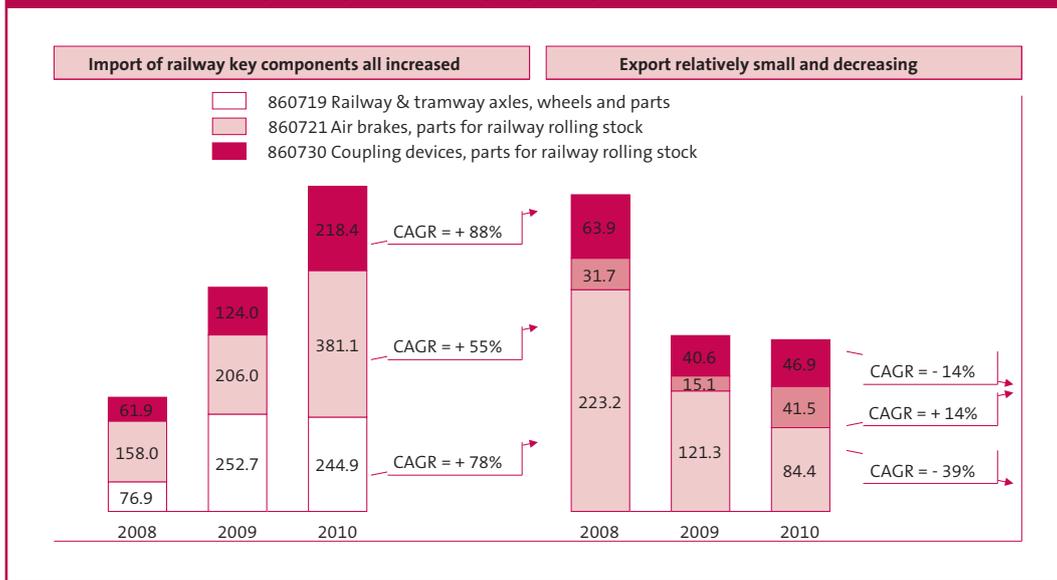


Figure: 3-21

Table 3-17: Overview of OEMs for CRH high speed trains

Group	Sales '10, bn CNY	OEMs	CRH Models	Technology sponsor	Ownership	Sales '10, bn CNY
China South Railway: (CSR)	64.9	Bombardier Sifang Power Transportation Ltd. (BST)	CRH1A, CRH1B, CRH1E, CRH380D, CRH380DL	Bombardier	JV: CSR 50%, Bombardier 50%	5.6
		Qingdao Sifang Locomotive Co., Ltd (QSL)	CRH2A, CRH2B, CRH2C, CRH2E, CRH380A, CRH380AL	Kawasaki	Subsidiary, CSR 97.2%	16.6
		Nanjing Puzhen Vehicles Co., Ltd (NPV)	CRH6	Alstom	Subsidiary, CSR 100%	3.5
	
China North Railway: (CNR)	62.2	Tangshan Railway Vehicles Co., Ltd (TRV)	CRH3C, CRH380B, CRH380BL	Siemens	Subsidiary, CNR 100%	10.3
		Changchun Railway Vehicle Co., Ltd (CRV)	CRH380B, CRH380BL, CRH380C, CRH380CL, CRH5A	Siemens & Alstom	Subsidiary, CNR 93.29%	10.8
	

Table 3-18: Overview of production plan of China CRH380 trains					
Model	Technology Sponsor	OEMs	Manufacturing started	Cabin Number	Train Quantity
CRH3C	Siemens	CNR: Tangshan Railway Vehicles	2008	8	60
CRH380B	Siemens	CNR: Tangshan Railway Vehicles	2010	8	20
CRH380BL	Siemens	CNR: Tangshan Railway Vehicles	2010	16	70
CRH380B	Siemens	CNR: Changchun Railway Vehicles	2010	8	40
CRH380BL	Siemens	CNR: Changchun Railway Vehicles	2010	16	70
CRH380C	Siemens	CNR: Changchun Railway Vehicles	2011	8	20
CRH380CL	Siemens	CNR: Changchun Railway Vehicles	2011	16	60
CRH380A	Kawasaki	CSR: Qingdao Sifang Locomotive	2010	8	40
CRH380AL	Kawasaki	CSR: Qingdao Sifang Locomotive	2010	16	100
CRH380D	Bombardier	BST: Bombardier Sifang Power	2012	8	20
CRH380DL	Bombardier	BST: Bombardier Sifang Power	2012	16	60

Table 3-19: Overview of tier 2 suppliers for locomotives/cabin	
Power network/infrastructure	Cabin/material
<ul style="list-style-type: none"> ▪ Name: XJ Group Corp. ▪ Ownership: Listed (000400) ▪ '10 Revenue: 3,855 mn CNY ▪ Key product: electric power equipment and system solutions for power generation, railway and industries 	<ul style="list-style-type: none"> ▪ Name: Jinxi Axle ▪ Ownership: Listed (600495) ▪ '10 Revenue: 1,737 mn CNY ▪ Key product: accessories for cabin/locomotive, axle, precision casting parts, maintenance services
<ul style="list-style-type: none"> ▪ Name: Guodian Nanjing Automation ▪ Ownership: Listed (600268) ▪ '10 Revenue: 2,376 mn CNY ▪ Key product: electric power equipment and system solutions for power generation, railway and industries 	<ul style="list-style-type: none"> ▪ Name: Zhuzhou Times New Material Technology ▪ Ownership: Listed (600458) ▪ '10 Revenue: 2,320 mn CNY ▪ Key product: accessories for cabin/locomotive, rubber and plastic products, anti-vibration, bridge support
<ul style="list-style-type: none"> ▪ Name: Qingdao TGOOD Electric Co., Ltd. ▪ Ownership: Listed (300001) ▪ '10 Revenue: 530 mn CNY ▪ Key product: special rail substation (e.g. GSM-R), cubical type substation, solutions for power/rail network 	<ul style="list-style-type: none"> ▪ Name: South Huiton Co., Ltd. ▪ Ownership: Listed (000920) ▪ '10 Revenue: 1,446 mn CNY ▪ Key product: springs, casting products and other equipment for railways

covering both inter-city and intra-city transportation. Tier 1 players mainly supply systems directly to OEMs, while they are supplied by many tier 2 and tier 3 players. Tier 1 firms are dominated by foreign suppliers, such as Alstom (FR), Siemens (GE), GE (USA), and Glatrösch (GE).

Table 3-17 shows the overview of OEMs for CRH high speed trains. Only 5 OEMs under the umbrella of China South Railway (CSR) and China North Railway (CNR) are authorized to manufacture CRH trains. CSR includes Bombardier Sifang, Qingdao Sifang, and Nanjing Puzhen Vehicles. CNR includes Changchun Railway Vehicle and Tangshan Railway Vehicles.

Table 3-18 shows the overview of planned production starts of China CRH380 trains. It shows that OEMs have transferred and adopted foreign technologies for cabin manufacturing. Among foreign technology sponsors, Siemens is a major contributor.

Table 3-19 shows tier 2 suppliers for locomotives

and cabins. Some local tier 2 firms have achieved substantial development. For example, XJ group, Guodian Nanjing Automation, and Qingdao TGOOD Electric are the main suppliers of power network and infrastructure. Jinxi Axle, Zhuzhou Times New Material Technology, and South Huiton are the major suppliers of cabin and material.

3.7.3 INNOVATION & INDUSTRIALIZATION FOCUS

China aims to become globally competitive in railway technology. As for high speed rail and tram equipment, independent innovations have already been adopted by CRH train, such as bullet train head design, traction drive, brake system, pantograph-catenary, air-tightness, anti-vibration, and noise-control. Large sized road-maintenance machinery has been successfully developed. China also achieved batch production of electric locomotive 7.2 MV/6 axes, 9.6 MV/8 axes, and 9.6 MV/6 axes. When it comes to network operation, some of the noteworthy achievements are catenary system design and analysis platform for simulation of vibration and disturbance, dust removal/collection equipment for tunnel, and field application of failure unit autodetect and analysis, and GSM-R network monitoring and maintenance. The 12-5 will continue the successful achievements during the 11-5 period to further enhance China's global competitiveness.

3.7.4 RECOMMENDATION TO GERMAN FIRMS

For the railway equipment segment, foreign investments are welcome as far as they go into key technology areas to enhance mainly development capabilities of local firms. As the government continuously expands the railway network, more trains and cabins will be put into use in the future. Due to the heavy dependence on imported key components and technologies, this means a good window opportunity for foreign firms with advanced technologies and skills. However, the growth rate of RPK may become slower than the growth rate of the railway network in the years to come. The competition between air, train and cars is getting stronger. Therefore, close monitoring of the train market is necessary, and the investment plan should be conducted in a conservative way. The positive factors for foreign investment in this area are:

POLICY SUMMARIES

High speed rail/tram equipment

Policies highlight the focus on

1. Cargo locomotive with large loading capacity (25 tons)
2. High-speed cargo locomotive development
3. Infrastructure and material R&D to fit the high-speed, large capacity locomotive
4. Market differentiation of trains/cabins to fit different customers' needs, such as 200 km/h traction locomotive

Network operation Policies

emphasize the following aspects

1. Improve signalling technology, further improvement of CTCS (Chinese Train Control System)
2. Intelligence dispatching of passenger/cargo trains for improved locomotive utilisation and profitability
3. Further enhance technology level of rail infrastructure incl. main line, bridge, tunnel

POLICY SUMMARIES

Promoted areas

Joint Ventures:

- R&D, design and manufacturing of cabin OEM and key components (traction drive, control system, brake system) for high-speed rail and urban tram
- R&D, design and manufacturing of complementary service facilities and equipment for high-speed rail and urban tram
- R&D, design and manufacturing of rail track and bridge equipment for high-speed rail and urban tram
- R&D of information system and signalling
- R&D of hazard control: noise and pollution reduction

No investment restrictions:

Component manufacturing/maintenance

Demand

1. The government advocates an aggressive network development which is supported by increasing RPK once the railway is built.
2. The order placement for new trains and cabins is confirmed till 2013, and additional demand is highly possible in an aim to increase the cabin density.
3. German products have already been widely applied in different types of cabins and infrastructures

Supply

1. The local manufacturing structure is transparent, enabling focused market development and penetration.
2. The capability development of local OEMs will increase the supply of cabins and equipment to global market, indicating more demand for foreign key components and parts.
3. Siemens has set the first mover advantage in China's railway segment. Its technology has been widely adopted, and the good reputation will result in more demand in the future. In addition, project references in Europe are well accepted in China and can be leveraged as a market penetration tool.

However, foreign investors have to pay special attention to some negative factors in the railway equipment segment.

Demand

1. Frequent amendment to announced fixed-asset investment on railway infrastructures/trains is observed.
2. Frequent accidents not only reduce potential RPK, but also limit the density level of high speed railway.
3. There are growing concerns that the increased ticket price would put pressures on operating cost and hence limit the purchasing power of operators.

Supply

1. OEMs are from only two state-owned groups. The monopoly position would weaken the bargaining power of German tier 1 and tier 2 suppliers.
2. There is a fast development of local competitors, and they usually have rather strong network in the local market.
3. The government prefers local content. This may further post high import duty for relevant applications.

Depending on the position in the value-chain, different strategies should be adopted by foreign firms who are competing in China's railway equipment segment.

For Tier 1 firms:

Policy trends

1. Despite the fluctuation in the amount, the government has made substantial investments in the railway industry. This could result in subsequent pull effect as well as maintenance and service demand.
2. Strict joint venture requirements still apply to foreign investments. However, Chinese government is expecting increased technology transfer and absorption.

Competitive situation

1. German firms have to compete with various global players. Each of them has its own technology, platform, and project/model reference.
2. Local OEMs may engage in reverse engineering so as to develop their own subsidiaries into main tier 1 suppliers.

As a result, German firms should carefully differentiate generations of products and technology platforms for sustainable competitiveness. Also, they could focus on developing local tier 2 and tier 3 suppliers so as to provide local sourcing opportunities and cost advantages. Since China is building a more complete value chain for railway equipment, German companies are advised to develop China into an export base for other countries, thus expanding the market.

Policy trends

1. Tier 2 and tier 3 players are equally beneficiaries from the government's investment plan, but there might be some time lags of the market responses to the investments.
2. It is an encouraging sign that there are fewer restrictions imposed for upper stream players. Neither is there direct support for local competitors.

Competitive situation

1. The monopoly position of major OEMs would weaken the bargaining powers of German tier 1 and tier 2 suppliers.
2. Local competitors are developing fast and they usually form strong relationships within the local market.

Therefore, German firms should pay close attentions to local competitors' development, especially in the area of basic manufacturing, such as axle, gears, and casting. Firms should not be satisfied with meeting the market demand through exporting to China, the localization strategy needs to be put on the CEO agenda. For firms who already have plants in China, they could engage in potential sales network realignments and operational performance improvements.

3.8 AVIATION EQUIPMENT

POLICY SUMMARIES

Fleet number target

In year 2005, the fleet number in China (excluding Hong Kong and Macao) was 863. This number has grown rapidly to 1,597 in 2010, with a CAGR of 13.1%. The targeting fleet number by the end of the 12-5 period will be 2,750, associated with a CAGR of 11.5%. This goal will be achieved through government subsidy and capital injection from SOE.

Airport number target

The airport number in China (excluding for military purposes) was 142 in 2005. This number has reached 175 in 2010, with a CAGR of 4.3%. The targeting airport number by the end of the 12-5 period will be 230, associated with a CAGR of 5.6%. A large portion of investments will be made in the Western region. This will mainly increase the national flights, from which will benefit the regional aircraft market.

Number of trips target

The number of trips was 138 million in 2005. After a dramatic growth in 2010, the number reached 268 million, reaching 268 million with a CAGR of 14.2%. The targeting number of trips by the end of the 12-5 period will be 450 million, associated with a CAGR of 10.9%. The government will support achieving the target via coordination on tourism and promotion for new routes.

Low-altitude space opening

In 2010 the government approved low-altitude (< 1,000 m) airspace opening for general aviation market. It aims to boost general aircraft numbers from 1,010 units in 2010 to more than 2,000 units in 2015. Regulations on space controls to surveillance and free fly will be correspondingly freed up.

3.8.1 MARKET OVERVIEW

Chinese government has set ambitious targets and provides supporting policies for the aviation industry. Significant investments are expected in the development of Chinese airlines and airports, and this will support the aviation equipment market during the 12-5 period.

Especially for low-altitude space regulations, government has been addressing major bottlenecks since 2000. The general aviation infrastructures have seen a series of developments. Government's strong support further ensures market development in commercial aircraft segment.

Aviation plays a more important role in China's transportation industry, and it is taking up increasing shares from rail and water segment. Figure 3-22 showed the breakdown of revenue passenger kilometer (RPK) and its development in the past 12 years.

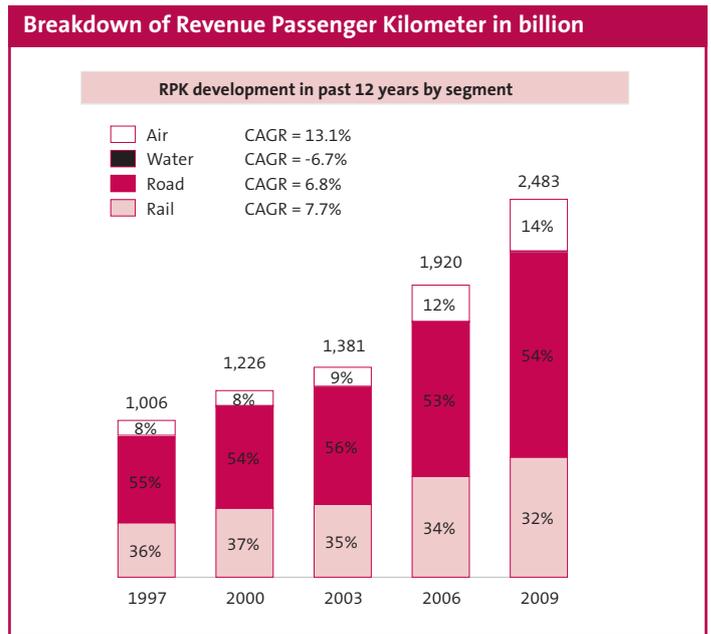


Figure: 3-22

Source: China Statistical Yearbook 2009

The data suggested that aviation takes up more percentage of total transportation volume, with a CAGR of 13.1%. In year 1997, aviation only accounted for 8% of the total transportation volume. The figure has grown to 14% in 2009, and aviation is the only segment that sustained year-on-year growth over the past 12 years. Road transportation has consistently occupied more than half of the total transportation volume, with a CAGR of 6.8%. This indicated that road still remains the key transportation measure for Chinese.

In recent years, railway is a fast growing segment, with a CAGR of 7.7%. However, since the total demand also increased dramatically, its market share has actually been reduced. Waterbased RPK has always been insignificant, and it is associated with a negative CAGR of -6.7%.

As for aviation segment, the market has a preference for single aisle aircrafts. Figure 3-23 shows the overview of China fleet breakdown by aircraft type.

The data demonstrated that the fleet number of single aisle aircrafts represents the biggest portion of the whole fleet, growing from 316 in 2000 to 885 in 2009. It is also associated with the largest CAGR of 10.8%. All these indicated that single-aisle aircraft represents the largest and fastest growing segment. The key drivers for single-aisle aircraft are:

POLICY SUMMARIES

Low-altitude policy development

- 2003:** State Council released the new regulation for general aviation, simplifying approval procedures
- 2007:** Approval for operation of general aviation decentralised, tourism, medical, commercial purpose allowed
- 2008:** Test opening of low-altitude in Pearl-Delta area and Northeast China (1,000 meter altitude)
- 2009:** 15 measures to boost general aviation market by CAAC, covering infrastructure construction, operation, HR training, manufacturing, and subsidy
- 2010:** airport fee restructuring, reducing 40+% operating/parking fees
- Nov. 2010:** Plan to achieve substantial utilisation of low-altitude aviation by 2020
- 2011:** Hainan province started test opening of low-altitude aviation

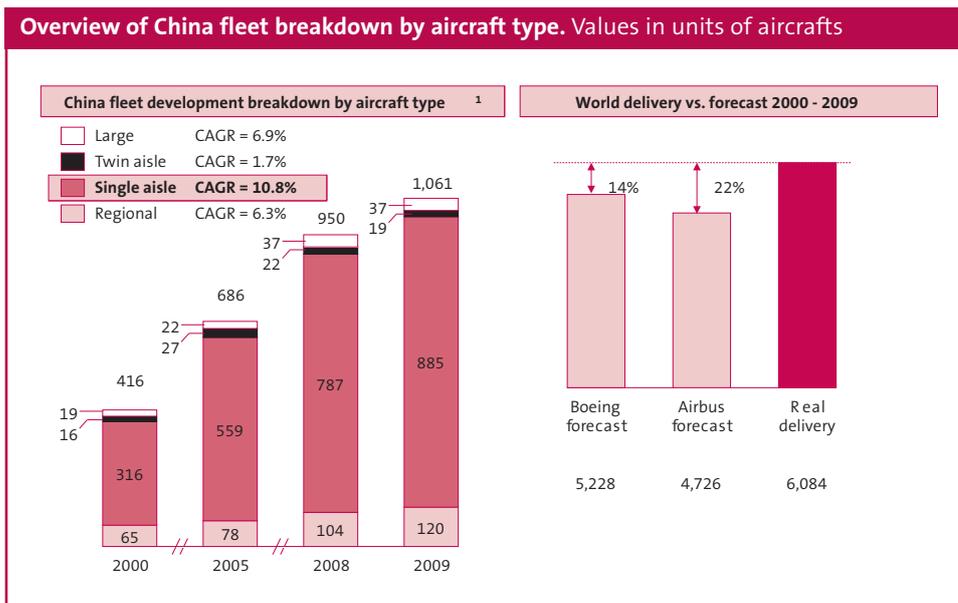


Figure: 3-23: China Statistical Yearbook 2009, large = Boeing 747, 2-aisle = Boeing 767, Single = Boeing 737/757, A320, MD 90; Regional = seat < 90; not included: large – A340/A380; 2-aisle-B777, A300/330

1. Fast growth of budget airlines
2. Development of emerging economies
3. Replacement of fleet.

In the following years, intense competition can be expected among manufacturers for this type of aircraft. This will implicate stringent requirements to suppliers.

Figure 3-24 showed the fleet development in Chinese airlines. The top 3 Chinese airline firms are China Southern, Air China, and China Eastern. These major players control more than 60% of the fleet in China. China Southern airlines ranked

no.1 in existing and increased aircraft numbers. Market followers are catching up leaders by increasing their fleet numbers. Shenzhen Air and Shanghai Air had a fleet growth of more than 10% from 2008 to 2009. Therefore, both market leaders and followers would be attractive to aircraft manufacturers. It is worth noticing that small players are more cost sensitive. For example, Shenzhen Air outsourced seat production only to local firms. Besides, consolidation is expected for smaller players so that the combined entity could achieve economy of scales.

Despite the financial crisis the Chinese Airline industry has recovered strongly. Figure 3-25 shows EBT (earnings before tax) development of three major Chinese airlines. The data indicates that EBT in these firms has seen dramatic growth from previous years. The CAGR ranges from the lowest of 44% to the highest of 102%. In Nov. 2010, these major airlines have announced purchasing plans. Air China will buy 20 engines from GE, and 4.5 billion USD will be invested in purchasing 10 units of Airbus 330 and 10 units of Airbus 350. China Southern Airlines will spend 3.8 billion USD to buy 6 units of Airbus 330 and 30 units of Airbus 320. China Eastern Airlines will buy 30 engines from GE.

In 2010, the number of aircrafts in China was 1,597, and the capacity hour/day was 12. The following assumptions are necessary for the forecast of aircraft increment demand in 20 years:



Figure: 3-24

Source: China Statistical Yearbook, CAAC

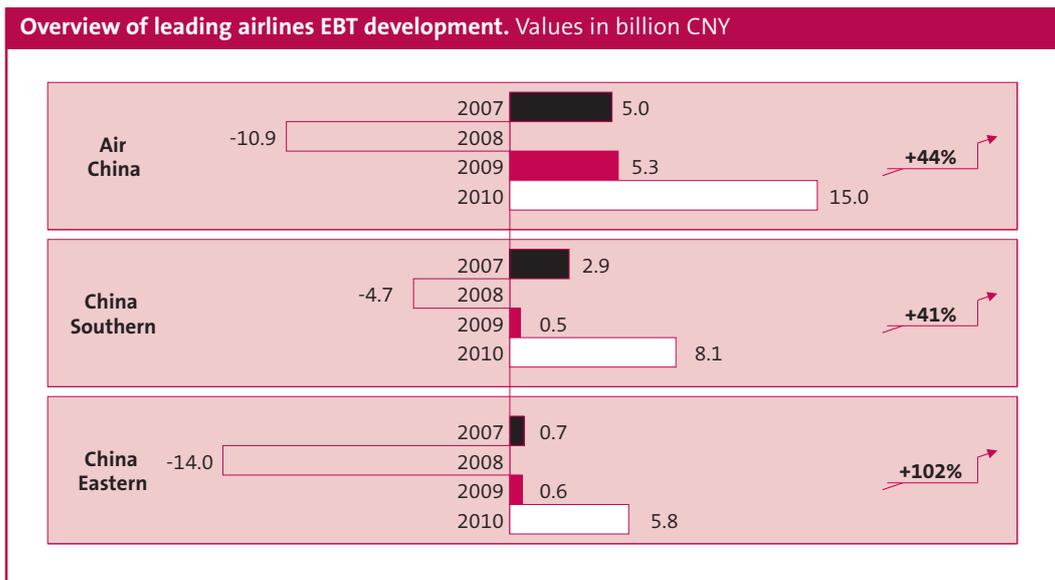


Figure: 3-25

Source: EMIS

- (1) RPK is 3.1 times that of 2010;
- (2) Utilization hours increases from 9.3 to 11 hours/day;
- (3) Utilization RPK/ASK improves from 80% to 90%; and
- (4) Aircraft size will keep stable with no significant change.

As a result, the demand for new aircrafts would be 3,721 units.

In 2010, there were 763 aircrafts that had served less than five years. 349 aircrafts had served between five to ten years. And 485 aircrafts had been used for more than 10 years. Given airlines will keep a standard replacement and aircraft life span from 25 to 30 years, the new aircraft numbers for replacement demand would be estimated at 694.

Hence, the total demand for new fleet is the combination of new demand and replacement demand. Therefore, China's demand for aircrafts in the next 20 years will be around 4,415 units, i.e. 3 times more than today.

Similar to the current preference, the new demand will also be dominated by single-aisle fleet. It is estimated that the number of single-aisle aircrafts will reach 3,135 units in China by the end of 2030, accounting for 71% of the total fleet. They are mainly for covering domestic market needs and represent the fastest development. The twin-aisle aircraft will grow to 927 units, they are targeting

at market among key domestic cities and mid-distance within Asia. The number of large aircrafts will reach 88 units. They are mainly for long distance/inter-continental flights, so their development is the slowest among all types of aircrafts. The regional aircrafts will be 265 units. They will also develop at a comfortable speed due to more airports in tier 3 – 5 cities.

3.8.2 COMPETITIVE LANDSCAPE

The 12-5 plan guidelines indicated that the Chinese government will support the “take-off” of the Chinese aviation equipment industry. It keeps continuity from the previous 5-year plan, and focuses more on OEM capability and high level of localization rate.

Figure 3-26 reveals the information of China's aviation trade market. As for export, small aircrafts account for the majority volume, increasing from 17 units in 2007 to 78 units in 2010. The export of large aircrafts was rather weak, with only 18 units being exported in 2010. When it comes to import, the pattern is reversed. Large aircrafts are the main targets of import. The number has increased from 152 units in 2007 to 195 units in 2010. The import of small aircrafts was relatively weak, with 72 units being imported in 2010. The total number of imported aircrafts was 344 in 2010, and it was more than 3 times the number of exported aircrafts. This proves that the key aviation market in China is still dominated by foreign manufacturers.

POLICY SUMMARIES

Civil aviation OEM

China will complete the construction and roll-out of A320 assembly in China. The marketing of local-made ARJ-21 will be further strengthened and its aim is to penetrate into global market. The government will focus on independent innovation of C919, which is a single-aisle craft that competes with A320 and Boeing 737.

Aviation component/value chain

The main focus is to increase the localization of key components, esp. aerospace engines. China will push industrialization and economy of scale on aviation electronic system, air-borne system and components. China will increase subcontracting for global firms, promote aircraft maintenance, and develop corresponding systems.

Satellite production and application

The government will speed up R&D on payload system of satellite, increase local content, and promote export of OEM satellite. Main focus will be put on application-driven development of satellite for purposes such as GPS, Satellite TV, and remote sensing. Resources will also be spent on the research and prototype on new generation of carrier rocket.

Aviation/aerospace materials

The government will push the industrialization on ceramic material, resin material, and functional coating material. R&D efforts will be spent on light and high strength alloy, high temperature alloy, high performance carbon fibre and composite.

The total import value of large aircrafts in China reached 10.4 billion USD in 2010, among which USA accounted for 5.0 billion USD, France 3.0 billion USD, and Germany 2.0 billion USD. These three countries together made up 96% of China's import value in 2010. There were 195 units of aircrafts imported to China in 2010. 94% of the total imported units came from the three major countries, with USA exporting 94 units, France 50 units, and Germany 39 units.

In the local OEM market, production was about to take off. Currently, China has been developing three types of aircrafts—MA60, ARJ21, and C919.

MA60 is a turboprop regional plane. It has 52 to 60 seats, with unladen weight of 13.7 tons. Total units delivered and in backlog are around 100. ARJ21 is a turbofan regional plane, with unladen weight of 25 tons. Two versions are available either with 90 or 105 seats. There were 340 units of order backlog by the end of 2010. It is expected to get its air worthiness certificate in June 2012.

C919 is a turbofan single-aisle plane, with unladen weight of 41 tons. It offers choice of either 156 or 168 seats. There were 235 units of order backlog by March 2012. The air worthiness certificate is expected to be obtained in 2016. All these projects call for special attention from German manufactures, because the challenges from local companies will get more and more intense in the near future.

Table 3-20 describes the outbound investments from local manufacturers. Not being satisfied with exploring the local market, Chinese aviation manufacturers are aiming to influence global supply chain through overseas M&A. The two exemplary cases are Xi'an Aircraft Industry's acquisition of FACC and AVIC General Aircraft's acquisition of Cirrus Aircraft. Specifically, AVIC General Aircraft is going to produce about 80 units of commercial aircraft in the next 5 years. These supply Chinese firms not only with increased market shares, but also advanced technological capabilities. Local manufacturers are ambitious to participate in global competition as full-fledged players. This will be realized through the establishment of manufacturing base and R&D center to facilitate the development of their own aircrafts. Future M&A will include the filed in operation and service. This is to form the full integrated value chain from operation to design, and then to manufacturing. German firms should thus establish close collaboration with local manufactures for not only domestic, but also global general aviation market.

Table 3-21 provided a list of leading local manufacturers in the aviation industry and their associated information. The major players belong to AVIC and have listed subsidiaries. This further illustrated that China competitors are about to develop a complete value chain for aviation production for especially general aviation. German firms are well advised to be prepared for this trend.

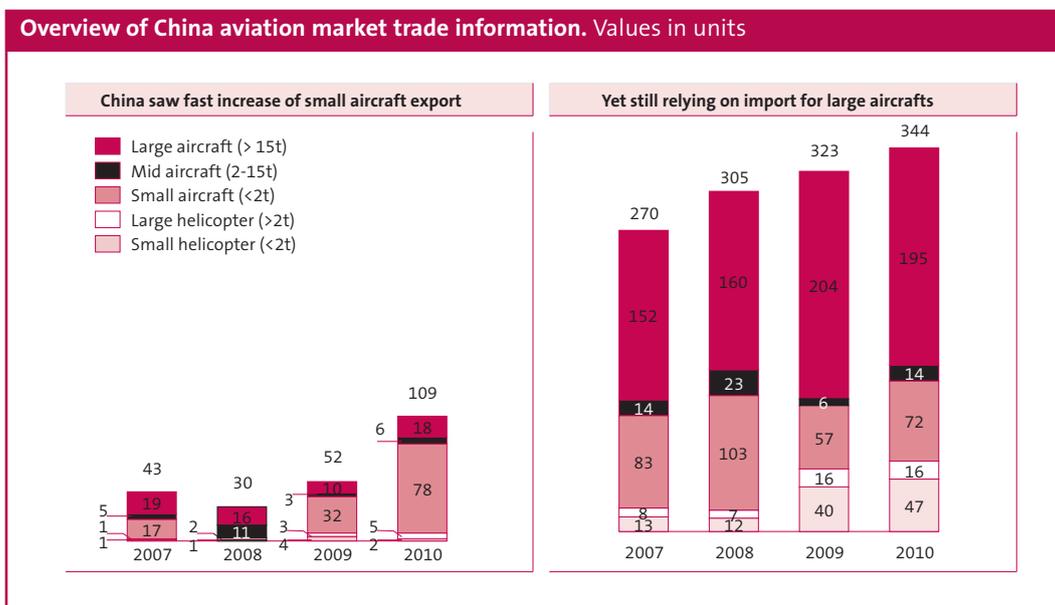


Figure: 3-26

Source: UN Comtrade

Table 3-20: Overview of outbound investment from local manufacturers	
Target	Buyer
<ul style="list-style-type: none"> Name: FACC (Austria) Date: Dec. 2009 Key products: composite components, interiors Major customers: Airbus, Boeing, Bombardier, Embraer Financials '09: total asset 276 mn €, EBIT 6.4 mn € Purchasing value: 100 mio € for 91.25% share 	<ul style="list-style-type: none"> Name: Xi'an Aircraft Industry (Group) Co. Ltd Key products: MA60, vertical stabilizers, assembly Major customers: Military, airlines (Boeing, Airbus) Financials '09: total asset 17 bn CNY, 316 mn CNY Aim: move up value chain, complementary products Note: first overseas M&A of China aviation industry
<ul style="list-style-type: none"> Name Cirrus Aircraft (US) Date: Mar. 2011 Key products: general aircrafts SR 20/22/22T Major customers: private customers Market position: no. 2 in general aircraft OEM, 5,000+ units Deal structure: 100% share acquisition 	<ul style="list-style-type: none"> Name: AVIC General Aircraft Co., Ltd. Key products: general aircraft, automotive parts Major customers: registered in 2009, SOP June 2011 Financials: total asset 30 bn CNY, exp rev. by '17 100 bn CNY via acquisitions Aim: complementary manufacturing base in CN/USA Note: first overseas aviation OEM M&A

Source: News clips, company websites

Table 3-21: Overview of leading players and brief information	
OEM	Component/tier 1
<ul style="list-style-type: none"> ▪ Name: AVIC – Xi’an Aircraft Industrial Group ▪ Ownership: SOE with listed subsidiary (000768) ▪ '10 Revenue: Group > 12 bn CNY, subsidiary 10.5 bn ▪ Key product: military crafts, general aviation crafts, components for Airbus/Boeing 	<ul style="list-style-type: none"> ▪ Name: AVIC Xi’an Aero-Engine (Group) Ltd ▪ Ownership: SOE with listed subsidiary (600893) ▪ '10 Revenue: 4.3 bn CNY ▪ Key product: engine production and repair services
<ul style="list-style-type: none"> ▪ Name: AVIC – Chengdu Aircraft Industrial Group ▪ Ownership: SOE with listed subsidiary (002190) ▪ '10 Revenue: Group > 10 bn CNY, subsidiary 302 mn ▪ Key product: military crafts, subcontracting for Airbus/Boeing, will play a major role in ARJ – 21/C919 	<ul style="list-style-type: none"> ▪ Name: AVIC Chengdu CAIC Electronics ▪ Ownership: SOE ▪ '10 Revenue: 2.8bn CNY ▪ Key product: sensors, air data analysing system
<ul style="list-style-type: none"> ▪ Name: AVIC – Harbin Aircraft Industrial Group ▪ Ownership: SOE with listed subsidiary (600038) ▪ '10 Revenue: Group 6.5 bn CNY, subsidiary 2.3 bn ▪ Key product: helicopters, general aircraft 	<ul style="list-style-type: none"> ▪ Name: AVIC Shanxi Hongyuan Aviation Forging Co. ▪ Ownership: SOE ▪ '10 Revenue: 1.2 bn CNY ▪ Key product: forging parts

3.8.3 INNOVATION & INDUSTRIALIZATION FOCUS

China aims to catch up technology for aircraft key component and OEM manufacturing. As for military aircraft, China has successfully developed, manufactured, and equipped a third-generation fighter, i.e., J10. A fourth generation fighter, J20, has recently begun its test fly. Chinese aircrafts used to be equipped with the Russian engine AL-31FN, but are gradually changing to a local made WS-10B since 2011. When it comes to civil aviation equipment, there are relatively more developments in general aviation in terms of OEM and key components. However, China is rather weak in producing large civil aircraft, especially on aircraft engine and certain key components. It is currently involved in sub-contracting of large civil aircraft for Boeing and Airbus, but it remains at a quite limited level. The 12-5 plan promotes innovations and technology upgrades for aviation equipment, with a focus on key technology breakthroughs especially for large civil aircraft:

The government shows clear intention to promote the full coverage of industrial value chain. 12-5 policies that describe the restructuring and infrastructure preparation are:

POLICY SUMMARIES

Military aircraft Policies

Promote to become a competitive provider of military aircraft with independent innovation. It aims to achieve a fully developed industrial chain from key components to assembled aircraft. Policies promote the achieving breakthrough technologies in multiple aspects, such as avionics and engines.

Civil aviation equipment Policies

Promote the adoption of an integrated R&D approach, which includes basic research, application research, and product development. Policies promote collaboration with foreign firms on especially avionics through C919 project. Independent innovation is also promoted with supporting policies.

POLICY SUMMARIES

Overall umbrella of Aviation Industrial Corporation

Subcontracting:

1. Enhance subcontracting collaboration with global players, expand subcontracting scope/volume
2. Develop related service sector, improve asset utilization, operating performance and profitability

Tier 2 accessory product:

1. Promote accessory products manufacturing, private investment welcome
2. Improve product quality and reliability, being capable to serve the industrial value chain

Tier 1 component supplier:

1. To meet with OEM plant criteria in terms of R&D, manufacturing and integration
2. Special focus in aerospace engine, landing gear and airborne equipment

OEM:

1. Marketing of regional jets, incl. ARJ 21, MA 60, MA 700, Y-8/F600;
2. OEM to lead the industrial bases in Xi'an, Chengdu, Harbin and Shanghai

3.8.4 RECOMMENDATION TO GERMAN FIRMS

As for aviation equipment segment, foreign investment is promoted to a limited scope because the Chinese government wants to have more control over this strategic industry. However, this does not mean there is no opportunity for investment. Foreign investment is still welcome, especially for component manufacturing in non-sensitive areas. The policies that describe expectations of foreign investments are on the right.

Previous data has shown that aviation is a highly attractive market. As Chinese airlines expand to meet domestic demand, more aircrafts are needed in the near future. Also, the ambition of local aircraft manufacturers can be translated into more demands on key components and parts. This means a good window of opportunity for German firms to ride the current wave of aviation "take-off" of China. The positive factors for foreign investment in this area are:

Demand

1. There is consensus on the forecast for the large demand of aircrafts. Droege, Boeing, and CAAC predicted that there is a need for more than 4,000 aircrafts in the next 20 years.

2. The backlog of aircrafts means more components and parts are required in the future.
3. China's large GDP, increasing disposable income, and rapid urbanization form positive underlying triggers for the demand.

Supply

1. German firms may observe abundant opportunities for local collaboration given local OEMs' immature development stage.
2. foreign firms could further utilize China as a supply base for not only domestic market, but also export to a global scale, especially emerging countries.

On the other hand, foreign investments have to pay special attentions to some negative factors in the aviation industry.

Demand

1. Due to insufficient technology development, China is yet to develop and manufacture a jumbo jet. This will, to some extent, limit its utilization of relevant aviation products.
2. Chinese airline firms are still sensitive to the competition from railway. They are cautious in purchasing large quantity of aircrafts due to the uncertainties of demand.
3. General aviation segment depends strongly on government policies, which has great power on the control over demand.

POLICY SUMMARIES

Areas promoted with Chinese majority

1. Single-aisle aircraft and regional jet
2. Civil helicopter (>= 3 ton)

Joint Venture

1. General aircraft
2. Civil helicopter (< 3 ton)
3. Aircraft engine and components manufacturing
4. Auxiliary power system design and manufacturing
5. Avionics design and manufacturing (for civil usage)

Areas without investment restrictions

1. Component manufacturing and maintenance for civil craft
2. Helicopter component manufacturing
3. Airport facility equipment, simulation and test equipment

Restricted areas with Chinese majority

General aviation for photography and mine exploration

Supply

1. In the initial stages, local OEM and airlines are focusing mainly on low-end products. Since German firms' strengths are at high-end components and parts, it would mean limited penetration rate for German firms.
2. Owing to technology development, there is fast development of local competitors, especially in subcontracting, tier 1, and tier 2 segments.

Figure 3-27 shows an overview of aircraft manufacturing output versus subcontracted products. Currently, the subcontract products account for less than 5% of the total manufacturing output. And the segments of subcontract product and local industrial output are growing at a similar speed. This will change in the next five years.

It is estimated that the subcontract product will make up more than 12% of the total manufacturing output, with a CAGR of 39%. This is mainly due to the fact that Boeing is committed to increase local sourcing and C919 project requires foreign suppliers to localize. Therefore, this means that subcontracting is one of the most promising collaboration approaches. The fast growing segment of subcontracted products would accelerate the demand for German fabrication and engine technologies.

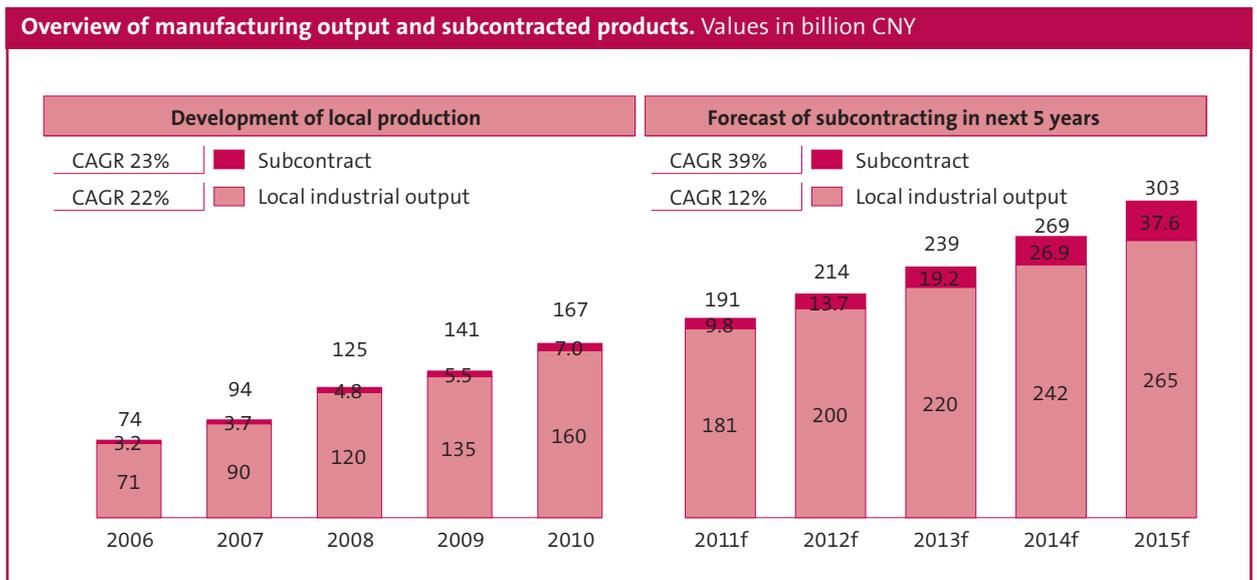


Figure: 3-27

While US and French firms are dominating the core tier 1 aviation market, only Liebherr Aerospace GmbH is engaged in collaboration for the ARJ 21 on landing gears. Honeywell, Parker Hannifin, Hamilton Sundstrand, and Moog While GE, Rockwell, Goodrich, Eaton and CFM are addressing motion control systems, avionics, auxiliary power units, landing gears, lighting as well as engines on the C919 and ARJ21 project.

German firms need to focus on certain segments for competitive advantage. Considering their strengths, they should focus on structural bodies and supporting areas, such as airport equipment, adopting localization strategies and looking for local partners who are in need of tier 2 and tier 1 component.

3.9 BIOMASS ENERGY

3.9.1 MARKET OVERVIEW

As early as during the 11-5 period, China had set development goals for its biomass energy industry. Figure 3-28 showed the stocktaking of the 11-5 plan achievement.

Except the targets for power generation capacity and bio diesel production, all other targets were not achieved during “11-5” period. There are mainly two reasons.

First, the government did not provide explicit policy support for the industrial development. Second, private investment was restrained due to the fear of market uncertainties and profitability risks.

Therefore, the Chinese government has set concrete targets and quantified monetary incentives in the 12-5 plan, hoping to exert direct impacts on all biomass energy sectors. The forecast of the industry and the output breakdown according to different sectors are released. As for tangible targets, a dramatic growth is planned for biomass energy industry in the next 5 years, especially for the development of biomass fuel power plants. The 2015 power capacity target is set at 13 GW, of which agricultural biomass being 8 GW, garbage burning 3 GW, and bio gas 2 GW. Growing from totally 5.5 GW in 2010, this represents a CAGR of 18.8% for the capacity development. The 2020 target for these three sectors will reach 30 GW.

Besides, the government has set tangible targets for the fuel utilized volume. The 2015 target for bio-ethanol is 3.5 million tons, bio-diesel 1 million tons, and solid fuel 10 million tons. Growing from totally 2.8 million tons in 2010, this will result in a CAGR of 38.9%. The fast growth of biomass energy industry will bring huge demand for relevant equipment and machineries.

The explicit plan sets aside 4.8 billion CNY as central government subsidy for biomass energy industry during the 12-5. In total, 200 counties will be chosen as “green energy exemplary county”, each of them receiving government subsidy. The ongrid power price of biomass energy is regulated by the government so as to assure firms’ profitability and to attract more investments. The detailed policies are listed on the right.

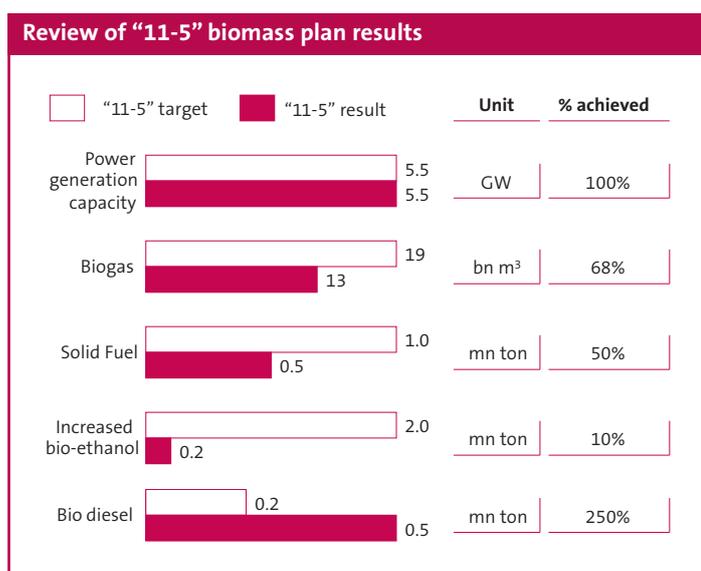


Figure: 3-28

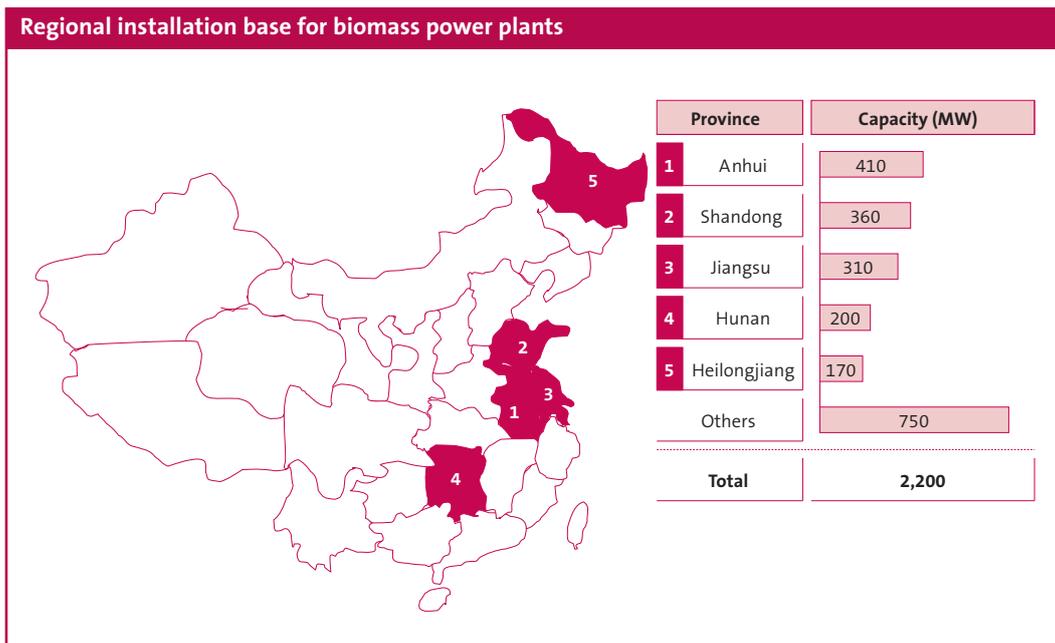


Figure: 3-29

Biomass power generation currently concentrates in a few provinces. Figure 3-29 maps the regional bases of biomass power plant. The total capacity for direct-burning power plant is 2.2 GW, i.e. 40% of total biomass power plant capacity. Provinces Anhui, Shandong, Jiangsu, Hunan, and Heilongjiang account for 66% of the total installed power generation capacity.

3.9.2 COMPETITIVE LANDSCAPE

The 12-5 plan does not provide direct government subsidies to local equipment manufacturers. The free market mechanism will be adopted for the development of equipment manufacturers.

The trading of biomass related machinery has shown slight decline. Figure 3-30 shows the export and import value of biomass related equipment. China's overall export decreased from 2008's 198 million USD to 2010's 134 million USD, with a CAGR of -18%. Nonetheless, China has demonstrated substantial development in central heating boilers export, and it has been increasing continuously, quintupling the figure between 2008 and 2010. On the other hand, the equipment import to China was unstable. It reached the largest volume of 372 million USD in 2009, but it then decreased dramatically to 198 million USD in 2010. China's strong policy support for other green energy industries, such as solar and wind, might have caused the weak demand for biomass related machineries in the recent years.

POLICY SUMMARIES

Agricultural biomass

The on-grid price is set at 0.75 CNY/kWh.

Garbage burning

The government will loosen the entry permit for garbage burning power plants. Garbage disposable fee will also be applied.

Bio gas

Direct subsidy will be provided to bio gas power plants.

Bio-ethanol

Direct subsidy will be provided to bio-ethanol power plants.

Bio-diesel

Direct subsidy will be provided to bio-diesel power plants.

Solid fuel

Direct subsidy will be provided to solid fuel power plants.

POLICY SUMMARIES

Market making

The government aims to improve the transparency of biomass resources' geographical allocation. It will assess and improve logistics for collection and pre-processing of biomass resources (e.g., straw).

Exemplary project

Special funds will be provided for exemplary projects with technical break-throughs, exemplary project promotions, and talent training.

Diversified investment/promote new entrant

Government funds will be provided to pilot areas and to attract entrepreneurs. The policies promote the investment from practitioners and venture capital/private equities. The government supports firms' financing via stock and bond in domestic/foreign markets

Despite the substantial decrease of equipment import in the previous years, Chinese government's ambitious biomass development target would mean huge business opportunities for equipment manufacturers. According to the 12-5 plan, China will develop additional capacity of 4.6 GW for agricultural biomass power plants and additional capacity of 2.2 GW for garbage power plants. Assuming each of these power

plants has the installed capacity of 30 MW, this would result in 150 new agricultural biomass power plants and 70 new garbage power plants. This amounts to an investment of 41 billion CNY.

Besides, the 12-5 plan will increase a total of 700,000 KW to the existing capacity of biogas power plants. This could create 50 new biogas power plants, which necessitate around CN 2 billion investment. Therefore, the total investment in the biomass industry will reach about CNY 43 billion. It is estimated that CNY 8.6 billion will be spent on equipment. Specifically the investment in power generator sets will reach CNY 4.2 billion, representing the largest equipment segment. The investment in gasification system will be CNY 2 billion, and another CNY 2.4 billion will be spent on pelleting machines. All these stand for substantial market for manufacturers of relevant equipment.

Table 3-22 lists the leading equipment manufacturers and integrated OEMs/operators. It is also worthwhile to notice that the majority manufacturers are SOEs, accounting for 60% of the market share. 30% of the market share are controlled by local private firms, and the remaining 10% are occupied by foreign firms. The low penetration rate of private firms is mainly due to the risks associated with market fluctuation and profitability. However, it is expected that the development in private sector will flourish in the next years to come.

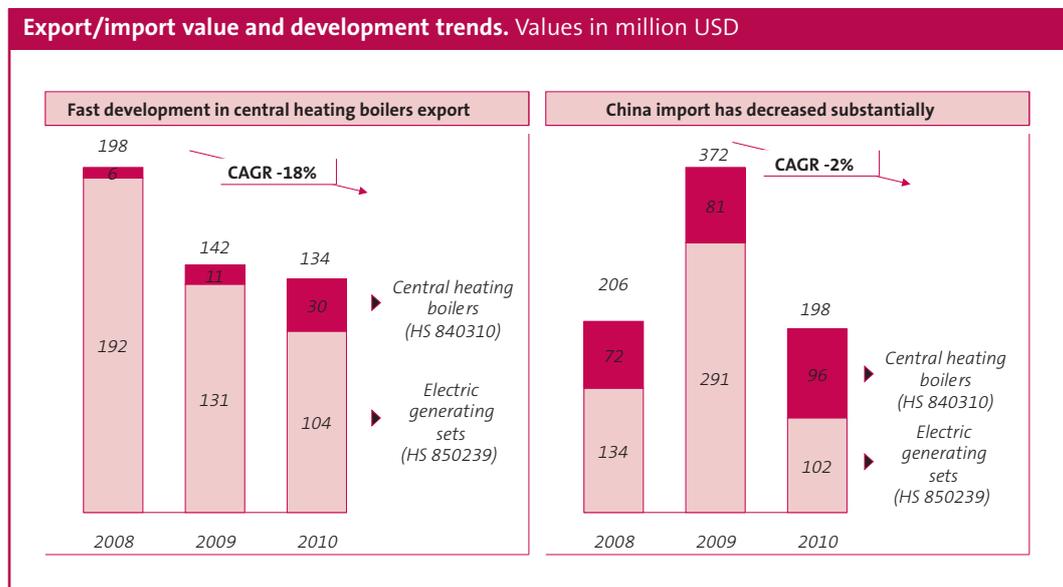


Figure: 3-30

Note: Trading numbers include not only biomass-related equipment. The detailed breakdown is not available due to HS code limitations.

Table 3-22: Overview of leading players and brief information	
Equipment manufacturer	Integrated OEM/operator
<ul style="list-style-type: none"> ▪ Name: Wuxi Huaguang Boiler Co. Ltd. ▪ Ownership: Listed (600475) ▪ '10 Revenue: 3,156 mn CNY ▪ Key product: Biomass boilers, garbage boilers, gas purification equipment 	<ul style="list-style-type: none"> ▪ Name: Wuhan Kaidi Electric Power Co., Ltd ▪ Ownership: Listed (000939) ▪ '10 Revenue: 3,359 mn CNY ▪ Key product: Biomass power plants and related equipments; environmental protection equipments
<ul style="list-style-type: none"> ▪ Name: Anhui Shengyun Machinery Co. Ltd. ▪ Ownership: Listed (300090) ▪ '10 Revenue: 424 mn CNY ▪ Key product: Garbage boilers, gas purification equipment 	<ul style="list-style-type: none"> ▪ Name: DP Cleantech ▪ Ownership: Private (with 20% SOE share) ▪ '10 Revenue: not revealed ▪ Key product: biomass/garbage power plants EPC and service provider

3.9.3 INNOVATION & INDUSTRIALIZATION FOCUS

China will focus on customised technologies that fit into Chinese market situation. High industrialisation will also be promoted. The 12-5 policies that encourage innovation and technology upgrade are as listed.

3.9.4 RECOMMENDATION TO GERMAN FIRMS

Due to the uncertainties in biomass energy market and suspiciousness of profitability, the equipment import has been declining in the past few years. Nonetheless, the government remains as "open" and "fair" to a large extent. Direct subsidy to competitors is rare. The fast growth in biomass industry which is forecasted by the 12-5

plan means good opportunities for foreign firms who are exporting spare parts and advance technologies. The policies that describe expectations to foreign investments could be concluded as:

The significant increase of expected industry output suggested that the market is still rather attractive. The policy continuity of 12-5 plan towards foreign investment allows longterm strategy planning for German firms. But they have to take the market risks into consideration because the local market is quite different from that in Germany. Therefore, companies should adopt cautious approaches to entering the Chinese market. The positive factors for foreign investment are:

POLICY SUMMARIES

Specific technological development

Policies highlight the focus on

1. Endurable mold for straw compressing
2. Equipment for tar reduction during gasification
3. Machinery for collecting and pre-processing straw

Specific R&D direction

Policies emphasize the following aspects

1. Low capacity high efficiency power generator set equipment (so as to increase geographical coverage and reduce needs for logistics of raw materials)
2. Improved biogas infrastructure building: ferment pool, raw material pre-processing, and biogas processing

Industrialization

Policies promote the completion of value chain which includes raw material collection, storage, transportation, material feeding, combustion grate, boiler, and auxiliary.

POLICY SUMMARIES

Supportive Policies

Policies emphasize the following aspects

1. Invest in talent training and supporting infrastructure (e.g. technological consulting services)
2. Include key technological development projects into national science and technology plan
3. Develop special national program for industrialization of biomass equipment manufacturing and crucial equipment development
4. Develop technological base and regional roll-out program in agricultural-focused provinces (e.g. Heilongjiang, Henan, Sichuan, Anhui, and Hunan)

Neutral policies towards foreign investment

- Support both private and foreign investments to enter biomass operation as well as equipment manufacturing segment
- Promote technology transfer, especially for the listed special focus technologies

Demand

1. Government's quantified biomass growth targets and central fund will kick-start the market growth.
2. "Go green" is a slogan that also receives local governments' special supports.
3. On-grid electricity price of 0.75 CNY/kWh is attractive for investment into biomass power plant.

Supply

1. There are only a few local producers. The relatively close market would lead to fewer competitions.
2. Local firms are less experienced in real application of biomass technology. This is mainly due to the lack of industrialization and inadequacy of R&D investments.

On the other hand, foreign investments have to pay special attentions to some negative factors in the biomass energy industry.

Demand

1. The lesson learnt from 11-5 year plan is that private investors need to be attracted.
2. Difficulties in raw material collection and transportation need to be overcome.

Supply

1. Chinese market is different from that in Germany, so the localization and customization of certain equipment are critical.
2. Leading local players have acquired foreign technology via overseas acquisition, especially in Denmark.

German equipment providers need to closely monitor local market development and Chinese equipment provider development. Depending on the position in the industrial value chain, component makers and set equipment producers are facing a different competitive environment than EPCs, and therefore different strategies are necessary.

For key component makers and set equipment producers **policy trends** are that the Chinese government promotes the import of key components and technologies into China.

Competitive situation

1. Leading local players are competitive in the domestic market and also global market.
2. Local firms are limited by their technology level and short development history.

German firms are well advised to look for market niches and to establish collaboration with local players.

When it comes to EPCs and technical consulting firms the **competitive situation** is:

1. Leading local players are competitive in not only domestic market, but also global market.
2. Local firms have acquired deep knowledge of certain technology streams and application situations.

Due to the imminent threats from local competitors, German firms could choose to form a collaboration with local companies so as to increase their reach to the market. As such, they could also share the risks in both market and technology with local players.

3.10 ENVIRONMENTAL PROTECTION

3.10.1 MARKET OVERVIEW

Chinese government is highlighting the importance of environmental protection with concrete investment plans. Abundant funds will be set aside for the investments in environmental protection with special focus on liquid, gas, and solid pollution controls. The general policy guidelines are:

In year 2010, the output of environmental protection market was 975 billion CNY. Gas pollution control, water/other liquid pollution control, and solid waste processing represented three major sectors, and they accounted for market share of 44%, 39%, and 9% respectively. The targeting annual output by the end of the 12-5 period will be 2 trillion CNY, with a CAGR of 15.5%. It suggested that huge planned investment and tightening environmental protection standards will drive the market in the years to come.

Despite the large volume of the market, the environmental protection industry is scattered with numerous players and large workforce. There are a total of 35,000 companies who are currently involved in the environmental protection. However, only 8,000 of them make annual revenue larger than CNY 5 million, representing 67% revenue of the industry. The geographically spread needs of environmental protection companies are the main cause of this phenomenon, and this indicates promising business development in relation to outsourcing and consolidation. The total workforce is 3 million, with an average of 8 employees per company. The average annual output of the individual employee is CNY 325,000.

As for the machinery demand, desulphurization equipment and dust collectors have been widely adopted by steel firms and power plants for gas pollution control. Denitrification equipment and integrated gas purification set-equipment need to be further developed. Water and other liquid pollution control are heavily used by chemical,

POLICY SUMMARIES

Investments

The total planned investment in the environmental protection will be around 1,400 billion CNY during the 12-5 period, with a drastic growth of 121% compared to the 11-5 period. Especially, the investments in water filtering/purification plants will reach 150 billion CNY, and the investments in other liquid filtering/purifying plants will be around 250 billion CNY. The investments in denitrification of power plants will be about 200 billion CNY. The desulphurization has already been rolled out during 11-5, and another 80 billion CNY will be supplemented during the 12-5 period. The garbage burning rate is expected to increase more than 20%. In some pioneer cities, the need for recycling of solid waste will increase by 10%-12%. This will be associated with an investment of 55 billion CNY. A significant portion of investment fund will come from the government for public infrastructure building and allowance to equipment/service users like power plants.

2015 Target

The expected annual output of the industry will grow at a CAGR of 15% to 20%, to reach 2 trillion CNY in 2015. Four key pollutants are expected to be reduced by 10% SO₂, chemical oxygen demand (COD), ammonia nitrogen, nitrogen oxides.

Incentives

The government is determined to enforce the reduction requirement, and there will be no leeway for local government protection. Industrial firms who adopt de-nitrification/ desul-phurisation equipment will receive incentive in the form of discounted price.

paper, textile firms. They have already adopted high polluted water purification and ceramic filtering machine, while Membrane Bio-Reactor (MBR) and high-density recalcitrant pollutants purification need to be further designed. In processing of solid waste, municipal solid waste burning set-equipment and sludge drying system have been popularized among petrochem and construction companies, but improvements are still needed for municipal solid waste burning set-equipment (>600t/d) and coprocessing of solid waste with cement rotary kiln. When it comes to other types of pollution control in industries such as nonferrous metals and power plants, monitoring equipments for ammonia nitrogen/BOD and mobile/emergency pollution processing equipments have been frequently utilized. However, technologies in relation to online monitor of heavy metal/volatile organic components and magnetic wave/noise pollution control need further refinements.

3.10.2 COMPETITIVE LANDSCAPE

The 12-5 plan guidelines indicated that the Chinese government will promote local production and in the meantime regulate the competitions. The target setting takes into consideration current local companies' technical strength.

12-5 plan points out the general direction, while detailed policies vary in different cities and provinces. Local governments have shown interests in detailed beneficiary policies, and these policies will have direct and quantifiable impacts on the market. Some representative local government policies are concluded.

As for Chinese manufacturers of environmental protection equipment, it is estimated that there are around 4,000 firms currently engaging in this industry. Among these firms, about 1,100 firms are up-to-size. The total work-force is 0.3 million, with an average of 75 employees per company. The average annual output of individual employee is 460,000 CNY. All these demonstrate a relatively higher concentration level of the equipment manufacturing segment when comparing to environmental protection operators.

Table 3-23 showed brief information of the leading Chinese manufacturers of environmental protection equipment. It is easy to find that these leading players have emerged from both SOE and private sectors. By comparing the revenue in 2010, it is obvious that sector of gas pollution control equipment is more integrated than other two sectors.

Figure 3-31 illustrates the values of environmental protection equipment export and import. Although gas filtering and parts for filtering sector have seen more than 30% increase in export, imports have also grown at equal speed, indicating that it is difficult for local firms to meet domestic customer demands for this type of equipment. However, the development of local technology has enabled 80% increase in export of liquid filtering/purifying equipment, and this also decreased the import of such equipment.

By looking at above mentioned general information of Chinese environmental protection equipment manufactures and import/export data of this equipment, it could be inferred that the Chinese players are also aiming to tap onto the global market in the near future. Several emerging trends are underpinning such inference. First, local supply has met most of the domestic demands. China has reduced import scope to only a few high-end equipment. Second, technology gaps between Chinese firms and foreign firms are closing due to the intellectual property filing and technology transfer from foreign firms. Governmental incentives to independent innovation is another key to the technology advancement. Third, local firms' have developed multiple series of equipment for a wider range of pollutant control, which effectively completes their sector coverage. For example, there is significant development in environment monitoring and magnetic wave protection. Forth, Chinese firms are leveraging their accumulated domestic experience to explore overseas market. In some cases, they are entering the service market. They have started fullset equipment export to emerging countries, such as Indonesia and India. More overseas engineering, procurement, and construction (EPC) projects have been awarded to Chinese firms, especially in power plant sector.

POLICY SUMMARIES

Market making The government will strengthen the environmental protection standard and enforce strict implementation. Authorized institutes will be built for measuring, monitoring, certificating of pollutant control and equipment manufacturing firms.

Exemplary project Exemplary projects will be set up, and they will receive government subsidy, especially the petrochemical and steel industry. These projects have focuses on local-branded firms with independent intellectual property rights

Diversified investment Government will set funds for pilot areas in an effort to attract entrepreneurs. Regulations will encourage the investments from practitioners and venture capital/private equities. Besides, firms' financing via stock/bond in domestic/foreign markets will be supported

Direct beneficiary policy "Directory of Promoted Environmental Protection Equipments and Products" and "List of Responsible Firms for Development of Environmental Protection Equipments" will be complied, serving as incentives for firms who are active in the environmental protection. Also, for qualified firms, 100% income tax will be waived for the 1st to 3rd years and 50% income tax will be waived for the subsequent 4th to 6th years.

Jiangsu Yixing city was the very first city that focuses on the environmental protection industry. There are 1,400 firms involved in the industry, among which 22 firms have sales more than 100 million CNY. Jiangsu expects to reach 25 billion CNY of total output and to develop environmental operation-integrated full value chain in 2015. It will focus mainly on water purification section, with fully-fledged manufacturing chain that includes EPC firms, equipment makers and spare parts producers.

Hunan Yueyang is the leading city in paper making industry. Hunan aims to reduce COD/SO₂ by 10% and to increase relevant industry output to more than 10 billion CNY during the 12-5 period.

Henan "1358" project has been launched, aiming to increase the environmental protection industry output to 170 billion CNY, and found 80 key firms with sales more than 100 million CNY by the end of 2015. One industrial base will be established in Luoyang. Three industrial zones will be set up in Zhengzhou, Xuchang and Xinxiang. Allies will be formed among five industries: solid waste, water, monitoring instrument, dust/dentrification, material/products.

Sichuan The 2015 target is to set up 1 or 2 industry bases with sales more than 100 billion CNY. "1+6" project has been launched. Sichuan targets on being the first province for environmental protection equipment sales. It will focus on 6 industry clusters: large equipment, resource recycling, lighting product, instrument, white goods recycle, and Va-Ti recycle base.

Despite the rapid development of Chinese firms in both domestic and global environmental protection equipment market, German firms still gain significant advantages against Chinese counterparts.

Figure 3-32 demonstrates that the total import from Germany to China has grown very fast, especially in gas filtering and parts for filtering sector. On the other hand, the export from China

to Germany is negligible (USD 64 million). The German-made parts are four times more expensive than local made one, suggesting a strong competitive position which is mainly originated from great reliability and quality of these key parts. As for the trade of equipment, China only imports more water control equipment. This is mainly due to limited technological development of local manufacturers.

Table 3-23: Overview of leading Chinese manufacturers of environmental protection equipment		
Liquid	Gas	Solid
Name: Origin water Ownership: Listed (300070) '10 Revenue: 500.5 mn CNY Key product: MBR integrated chain	Name: Longking Ownership: Listed (600388) '10 Revenue: 3,344.7 mn CNY Key product: Desulph./de-nitrific.	Name: Jintongling Ownership: Listed (300091) '10 Revenue: 587.8 mn CNY Key product: garbage burning sets
Name: Vontron Ownership: Private '10 capacity: 7.5 mn square meter Key product: RO membranes	Name: Feida Environmental Ownership: Listed (600526) '10 Revenue: 1,562.1 mn CNY Key product: Gas set equipment	Name: Shengyun Machinery Ownership: Listed (300090) '10 Revenue: 424.1 mn CNY Key product: sludge drying equip.
Name: CEEP Ownership: Listed (300172) '10 Revenue: 281.4 mn CNY Key strength: leading EPC firm		Name: CISEI Ownership: S OE '10 Revenue: 1,500 mn CNY Key product: EfW1 (from Martin Co.)

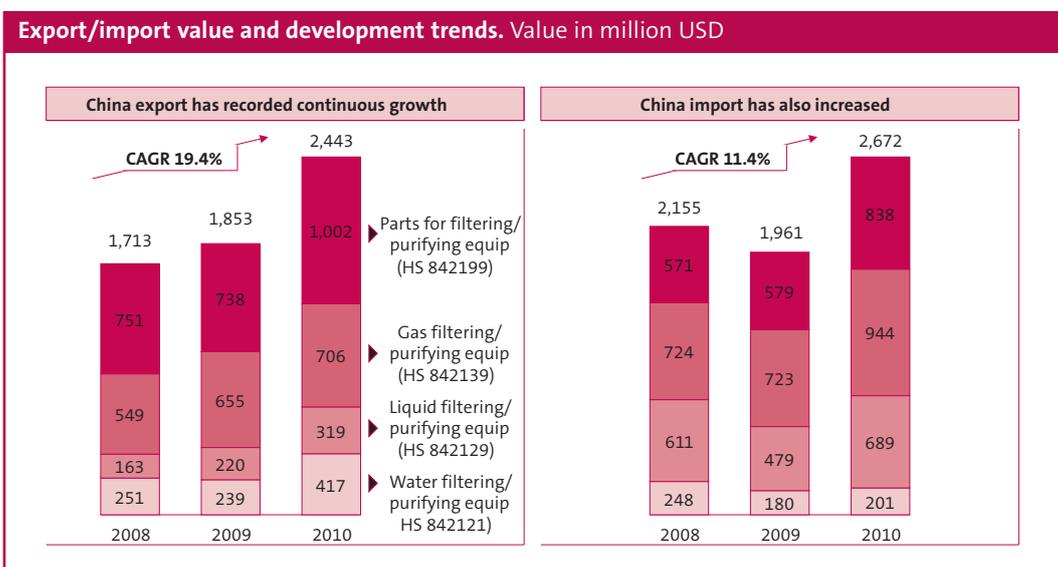


Figure: 3-31

Trading with Germany. Value in million USD

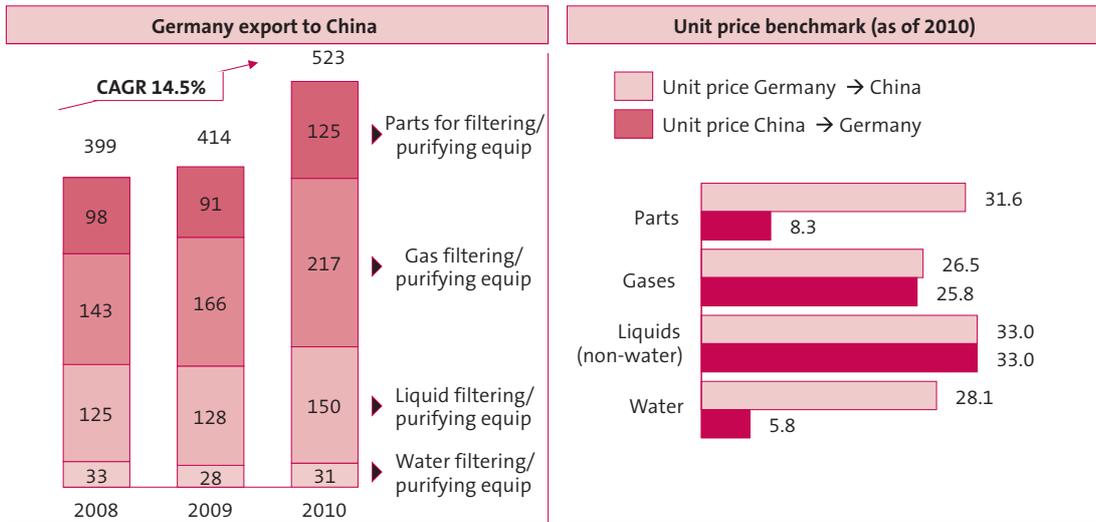


Figure: 3-32

3.10.3 INNOVATION & INDUSTRIALIZATION FOCUS

Promoting policies will be introduced to facilitate innovation and technology upgrade. Though detailed plan has not been released yet, the target and approach have shown a clear development path. 12-5 plan highlights the need for restructuring of the environmental protection industry.

Currently, many Chinese manufacturers are originated from heavy machinery industries or are spin-offs from customer industries. As such, their technical levels are relatively low, and they focus mainly on manufacturing and labor intensive stages. The end products are midlow end equipment.

POLICY SUMMARIES

Innovation policies

The government encourages technology developments in the following aspects.

Gas pollution control 1. Integrated equipment for desulfurisation, denitrification, removal of mercury for boilers 2. Rotary kiln purification and recycling set equipment 3. SCR denitrification system for pyroplant

Water/other liquid pollution control 1. Municipal waste water denitrification/de-phosphor deep processing set equipment 2. MBR 3. High-density recalcitrant pollutants purification

Solid waste processing 1. Municipal solid waste burning set-equipment >600t/d 2. Co-processing of solid waste with cement rotary kiln 3. Thermal decomposition processing equipment for household garbage

Supportive Policies

- R&D investment aims to increase from 1.5% to 3% of industry output, which amount to around 200 bn CNY during “12-5” period
- Integrated innovation platform via: National laboratories/engineering centers, national research institutes/monitoring centers, national research programs, technology alliances for correlated technical innovations/crucial technologies, promote horizontal collaboration among universities/research institutes and industrial practitioners
- Though government is the main promoter for the platform, the participation party will be mainly made up with practitioners

POLICY SUMMARIES

Restructuring Policies

Value chain positioning Policies promote to establish full value chain coverage and move to high-end equipment. Seven to ten full-fledged groups are to be set up. Sixty-eight firms will be assigned with the development of high-end equipment. Policies promote technology transfer and absorption.

Horizontal integration Policies promote acquisition and creation of leading players, aiming to increase level of concentration in the industry. Policies promote regional clusters and equipment manufacturing bases. SMEs will be encouraged to focus on services and peripheral production.

Up/downstream integration Policies promote contracted services on environmental protection, pioneer in water. Policies promote franchise model for pollution control service provider. Policies promote integrated solution providers with EPC, operation and consulting.

The environmental protection industry in China is scattered, with only a few leading players emerged from listed and SOE firms. SMEs account for almost three quarter of total number of firms. SMEs contribute only 20% of the whole revenue, and their average sales are around 10 million CNY.

The majority of manufacturers are restrained to equipment manufacturing with limited product range. Only leading players have started to migrate to solution provider or covering multiple value chains. However, outsourcing, contracted service, and EPC are not commonly seen in Chinese firms. The government shows clear intention to regulate and develop the industry into a pillar industry.

3.10.4 RECOMMENDATION TO GERMAN FIRMS

As for policies for foreign environmental protection equipment manufacturers, Chinese government remains “open” and “fair” to a large extent. Direct subsidy to competitors is rare, and it is restrained to a niche segment only. The attitude applies to both environmental protection equipment industry and its customer sectors. Therefore, the policy continuity of 12-5 plan towards foreign investment allows long-term strategy planning for German firms. The policies that describe expectations to foreign investments could be concluded as below.

The SWOT analysis for German equipment manufacturers is:

Strength

1. German firms are good at designing complex equipment, and project reference can still keep Chinese players at an arm's length
2. German manufacturing process control ensures consistency and reliability in the final product, which Chinese players are yet to catch up with.

Weakness Local players have advantages in

1. Strong networking esp. in more rural areas
2. Reverse-engineering capability (i.e. cheap R&D)
3. Low cost advantage and fast response to service, penetrate into mid-end market already.

Opportunities

1. Customer industry is booming and size will be doubled
2. Chance to participate in national projects and set exemplary practice in the customer industry
3. Sell off certain technologies for exchange of market/capital.

POLICY SUMMARIES

Beneficiary Policies

- high-end equipment via tariff adjustment
- Promote industry transferring (i.e. local high-end production/local research/innovation center)
- Directory for supported items (not released yet)

Neutral Policies

Support both private and foreign investments to enter municipal utility sector like waste processing

Discriminating Policies

“List of responsible firms for development of environmental protection equipment” comprised of mainly local players and local research institutes

Threats

1. Fast development of key local competitors due to government's guiding policy
2. Local competitors will compete not only in China, but overseas markets – especially emerging countries.

Different strategies can be adopted by German firms. They are illustrated as follows:

Foster product and service innovation

For firms who are suitable for this strategy, quality, performance, efficiency and reliability are the key parameters that differentiate themselves from Chinese counterparts. Local competitors cannot provide integrated system solutions covering the entire machinery value chain from design and manufacturing of equipment sets to EPC and maintenance services. To maintain the competitive edge in the years to come, these German firms need to invest in R&D capabilities and to strengthen existing and future products and technologies, because competition in China's machinery industry is increasingly driven by innovation. Besides, they have to monitor industry developments closely since local competitors are also upgrading their technological capabilities, buying and integrating foreign technologies. To protect themselves from unfair competition, firms need to push for faster innovation and technologies that become obsolete more quickly, reducing the risk of products being copied and reversely engineered.

Review production/assembly opportunities in China

German firms need to review carefully the opportunities in China, because exporting into emerging markets where top foreign manufacturers are already producing locally, is likely to only be successful in the short run. On the other hand, domestic, lower-cost manufacturing capacities are an integral part of expanding market presence and improving competitiveness, thus exploiting cost advantages. As for the choice of manufacturing in China or Eastern Europe,

although cost structures in both investment locations are similar and Eastern Europe is geographically and culturally closer to Germany and the German way of doing business, China offers the combination of abundant low cost labour (especially in West China) and a large domestic market with significant opportunities in the years to come. To establish production capabilities in China, German firms can engage in OEM sub-contracting of selected low to medium-tech products in China to enhance production efficiencies and increase overall profitability. Also, they could roll out manufacturing Joint Venture or greenfield WOFE to maximise ground presence and avoid having to compromise on operational control.

Optimize product/service offering

German firms can focus on optimizing their product and service offerings. Given Chinese manufacturers' limited technological capabilities, the demand for advanced and high-performing equipment has traditionally been met by foreign, imported machines. Besides, completely integrated systems and solutions remain less challenged by local competitors, implicating another path for sustaining competitive advantage. The key to success in Chinese market is to understand and incorporate China specific customer requirements and adapt equipment specifications and pricing structure if necessary. German firms have to notice that the equipment of the same quality as Chinese-made and engineered machines is losing its unique selling point, so foreign manufacturers cannot compete on price only. In order to gain sustainable growth, firms need to concentrate on market and product development, adopting a generalist approach towards competing in various Asian markets. Also, they may localise part of R&D efforts so that they could continuously work on adapting product/service offering to increase competitiveness by avoiding overengineering.

3.11 NEW FLAT PANEL AND NEW IC

3.11.1 MARKET OVERVIEW

A series of financial support for the new IC (Integrated Circuit) industry is expected to make significant progress during 12-5 period.

The national policies regarding new flat panel are not yet available. However, since Foshan (Guangdong province) is one of the major regions of new flat panel manufacturing, the corresponding policies are listed below for reference.

According to the policies from the Foshan local government as listed above, it may be implied that comprehensive policies regarding the new flat panel industry are expected nationwide during the 12-5 period. The current status and forecast of the Chinese IC and flat panel market are discussed as below. As an emerging market of the IC industry, China had a very high CAGR of 16% during the 11-5 period. The local IC output value in China was 1440 billion CNY in 2010, whereas it is estimated to be 3300 billion CNY

in 2015. The value will be doubled with an even higher CAGR of 18% during the 12-5 period. On the other hand, the IC industry in China focuses mainly on low-end products, whereas high-end IC product market is developing fast. With the growing demand of high integration density IC and the wide-spread use of high power IC in energy saving and emission reduction areas, high-performance IC industry is having a prosperous future in China. To achieve the target of the local IC industry, especially for the development of high-end IC industry by the end of the 12-5 period, the Chinese government plans to invest USD 25 billion during 12-5.

The Chinese government is ambitious in the development of the FPD (Flat Panel Display) market. In 2010 the total value of output of the FPD products in China was only USD 7.5 billion. The Chinese market will grow from USD 12 billion in 2011 to USD 50 billion in 2015, to capture more than 30% of the global market share. In year 2011, the output value in China is estimated to be only about 12% of the world total output. The global market is subjected to grow with the five-year

POLICY SUMMARIES

- In 2015, the annual **2015 target for new IC** output volume of IC blocks will reach 150 billion, the sales revenue will reach 330 billion CNY, and the average growth rate in 12-5 will be 18%
- For the industry structure, in 2015 the portion of designing will be raised to around 1/3, the portion of manufacturing and assembly & test will be around 2/3
- In 2015, there is desired to be 5 to 10 designing firms with the yearly revenue above 2 billion CNY, 1 to 2 manufacturing firms with revenue above 20 billion CNY, and 2 to 3 assembly & test firms with revenue of above 7 billion CNY

Supportive policies for new IC industry in 12-5

Tax preference for new IC in 12-5

Preference of value-added tax, business tax and corporate income tax will be provided for firms in the IC industry. Important projects or firms with high-end technology will get more preference, e.g. for the IC manufacturing firms who produce IC of less than 0.8 micrometers, the corporate income tax will be exempted for the first two years that it earns a profit, and half of corporate income tax will be exempted for the third to the fifth year

Supportive policies for investment and finance

- Central government will provide financial support to important IC projects
- PE and VC are encouraged to support development of small and medium sized enterprises
- Local government will provide loan services to IC firms to ensure adequate funding

POLICY SUMMARIES

Supportive policies of Foshan for new flat panel in 12-5

Financial support

- The government will set up special fund to support the development of new flat panel industry
- Social funds and capital sources such as PE/VC will be encouraged to invest into new flat panel industry

Talented personnel guarantee

- Set up talents fostering system to support the development of new flat panel industry
- Improve the talents' potential of development and encourage them to start business on new flat panel industry

Innovation system

- Encourage the co-operation of leading firms for key technology breakthrough
- Encourage to cooperate with global players to transfer and to absorb advanced technology
- Encourage the patent application of LCD and OLED firms

The new flat panel promoted in 12-5

- TFT-LCD panels and modules
- PDP panels and modules
- OLED (organic light emitting diode) display devices

CAGR of 11%, yet most of the growth will be contributed by China. The CAGR of the rest of the world is estimated to be only 4% while the estimated CAGR in China is as much as 43%. However, the majority of output in the global FPD market will still be from Japan, Korea and Taiwan.

When looking into the international trade situation in IC products, both the CAGR of the import value and export value from 2008 to 2010 are around 10%, yet the value of import is much larger than the value of export. The value of import of IC products in year 2010 was 346 billion USD, growing from 282 billion USD in 2008, while the value of export in the same year was only 64 billion USD, growing from 53 billion USD in 2008. The values are the summary of all related products with different HS codes. IC products in China depend largely on import.

The values of imports and exports in LCD panel products, an important part of flat panel products, have also been studied. Apart from those of IC products, both the values of import and export fluctuated with an increasing trend during the period of 2008 to 2010, where both values decreased in year 2009. The value of import of LCD panel products in 2010 was USD 47 billion, while the value of export was USD 27 billion, which did not differentiate that much as that of IC products. Though the value of export is rising with a larger

margin, it could be concluded that the LCD panel products in China also depend on the international market.

3.11.2 COMPETITIVE LANDSCAPE

The published policies implied that the government's support in electronic equipment manufacturing will be strengthened during the 12-5 period. To better utilize the policies, the corresponding production equipment and the Chinese equipment market is studied.

POLICY SUMMARIES

Supportive policies for electronic equipment manufacturing

- Increase financial support
- Enlarge international cooperation
- Enhance independent innovation capability

Encouraged equipment for new IC in 12-5

Key equipment machines reach the technological level of equal or less than 12 inches and 32 nanometres

Encouraged equipment for new flat panels in 12-5

Special manufacturing and testing equipment for TFT-LCD, PDP and OLED

The manufacturing processes and types of equipment involved in each process are illustrated in Figure 3-33. The production processes of ICs are more complicated than those of flat panels and require different types of equipment. The IC production can be separated into three main processes: wafer manufacturing, chip processing (former processes) and assembly and finishing (later processes). Five to seven sub-processes are involved in each of the three processes, and which all require different manufacturing equipment. On the other hand, the manufacturing processes of flat panels only include three processes: developing & etching, coating & capsulation, and inspection & testing. Some major Chinese local equipment manufacturers and their basic information are listed in Table 3-24. Two of the listed manufacturers produce either IC or flat panel products. The CETC 45th research institute, a state-owned enterprise, is one of the major suppliers for IC products, whereas Qingda Tianda, a privately-owned enterprise, is one of the major suppliers for flat panel products. The other two listed suppliers, Beijing Sevenstar and the CETC 2nd research institute are the major suppliers for both IC and flat panel products. Compared with global manufacturers, Chinese manufacturers are smaller and focus on low-end equipment.

Similar to IC product import and export values discussed above, both the CAGR of the import value and export value in IC production equipment from year 2008 to year 2010 were around 17%, yet the value of import is much larger than the value of export. The value of import in IC equipment in 2010 was 14.9 billion USD, raised from 11.0 billion USD in 2008; while the value of export was only 2.5 billion USD, raised from 1.8 billion USD in 2008. The values are the summary of all related products with different HS codes. The IC production equipment in China depends highly on import. On the other hand, the import value exceeds the export value of flat panel production equipment tremendously, both in absolute value and growth rate. The import value in 2010 was as much as 2347.9 billion USD, with the three-year CAGR of 36%. In contrast, the export value in 2010 was only 9.8 billion USD growing from 7.5 billion USD in 2008 with the CAGR of 14%. It might be safe to draw the conclusion that the flat panel production equipment in China depends highly on import.

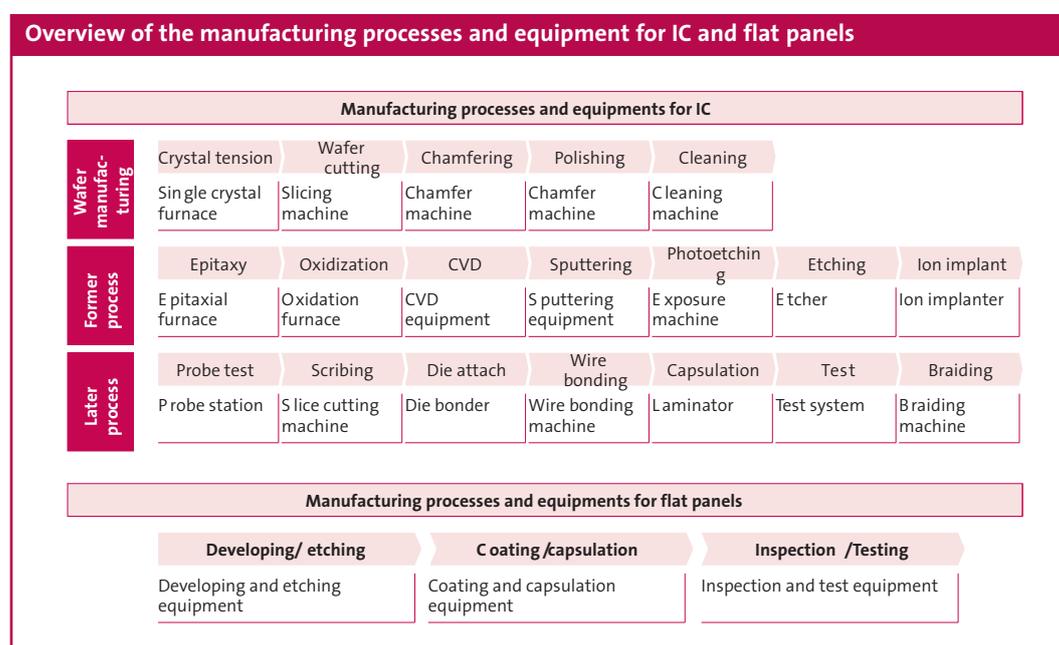


Figure: 3-33

Table 3-24: Overview of major local equipment manufacturers				
	Name	Ownership	Equipment focus	Key products
Single equipment producer	CETC 45th research institute	SOE	IC	Silicon wafer cleaning equipment, Probe test equipment
	Qingda Tianda	Private	Flat panel	Screen printers, Cutting machine and test equipment
Multiple equipment producers	Beijing Sevenstar	Listed (300091.SZ)	IC Flat panel	IC: Cleaning equipment, CVD equipment and etcher Flat panel: handling system and cleaning machine
	CETC 2nd research institute	SOE	IC Flat panel	IC: welding machine, cutting machine, cleaning equipment Flat panel: scribing machine, cleaning equipment

3.11.3 INNOVATION & INDUSTRIALIZATION FOCUS

Independent R&D is to be put into the most important position according to the policies regarding the industrial innovation and industrialization. Key technology for key equipment will be pro-

moted during 12-5. Financial support will be provided, collaborative R&D in corresponding industries in the whole value chain, as well as in supportive research institutions and other resources are encouraged.

POLICY SUMMARIES

Industrialization

Supportive policy in 12-5

Promote the industrialization of key equipment (detailed supportive policy to be released)

Industrialization of electronic equipment

- Encourage the collaborative R&D of manufacturers, research institutions and universities, to promote the industrialization of key equipment and technology
- Encourage electronic firms (i.e. IC and flat panel firms) to collaborate with equipment manufacturers, in order to promote the application of new equipment

Innovation

Supportive policies in 12-5

- Increase the government's investment to support the R&D of special electronic equipment
- National special project will be initiated to support the R&D of key equipment for IC and flat panel
- Social funds will also be encouraged to invest in the R&D of electronics equipment to promote the localization of key equipment

Promoted IC equipment in 12-5

- Enhance the R&D of key IC manufacturing equipment machines with the technological level of equal or less than 8~12 inches
- Develop manufacturing equipment machines for compound semiconductors using GaAs, InP, GaN, and SiC.

Promoted flat panel equipment in 12-5

- Develop self-supply ability of TFT-LCD transferring and cleaning equipment
- Increase the input of R&D for wet/dry etching machine and liquid crystal pour machine

3.11.4 RECOMMENDATION TO GERMAN FIRMS

To conclude the policies listed, the global co-operation on the R&D of IC and flat panel manufacturing equipment is encouraged by the Chinese government, technology transfers and localizations are also welcomed. From the research regarding the Chinese market and the 12-5 policies regarding the IC and flat panel industry, some conclusions for German manufacturers could be drawn in the following aspects:

Strength

German firms are advanced in certain technology for IC and flat panel production equipment, especially in high-end types of technology such as MOCVD equipment technology.

Weakness

Local players have advantages in

1. The government's financial support, and sometimes there will be government procurement opportunities
2. Reverse-engineering capability (i.e. cheap R&D), which will make some high-end technology developed or obtained easily and less costly by the Chinese competitors.

Opportunities

The Chinese government strongly supports the development of new IC and flat panel industry, and has made a board target in the 12-5 plan. The IC and flat panel products and production equipment in China depend largely on import, especially the flat panel production equipment.

Threats

The fast development of major local competitors might always be the threats to international competitors. Local players may expand fast with the support and preference of the government.

The market opportunity in China is attractive. German competitors shall keep the advantages in high-end equipment to grasp the market opportunity in China. To better utilize the advantages for expansions in China, the current Chinese market situations should be studied. These could be concluded as below:

Market

The local output value of IC and flat panel products in China is targeted to be doubled during the 12-5 period. Nevertheless, the IC and flat panel products depend much on import currently, where the value of import exceeds the value of export.

Supply

There are some local suppliers in China for both IC and flat panel production equipment. However, compared with global equipment manufacturers, Chinese manufacturers are smaller and most of them focus only on low-end types of equipment. Moreover, the IC and flat panel manufacturing equipment in China depend highly on import, where the value of import is much larger than the value of export.

Policy

Tax preference and other means of support will be provided for the development of IC and flat panel industry. Financial support will be provided to local manufacturers to raise their independent innovation capability. Collaborative R&D is encouraged especially for the development of key technology.

POLICY SUMMARIES

Beneficiary

- Encourage local manufacturers to cooperate with global manufacturers on equipment designing and manufacturing
- Encourage global equipment manufacturers to set up production, R&D and service centres in China

Discriminating

- Encourage local equipment manufacturers to acquire key technology by global cooperation and M&A
- Encourage to raise the localization rate of key equipment

To catch the attractive market opportunity, sales strategy improvements and reasonable cost reduction strategies are expected. Sales organization improvement is recommended to help attract target customers and to obtain the local market share in the expanding market. Local sourcing and sub-contracting for low-end equipment can also be considered to reduce the cost.

Sales organization improvement

Due to the large demand of high-end IC and FPD equipment in China during the 12-5 period, as well as the fast growing of local equipment suppliers, the sales organization of German manufacturers should be improved to meet the new demand and compete with local equipment suppliers. Their sales organization should focus more on the customers' demand of complete production lines, as well as high-end equipment such as MOCVD.

Local sourcing

In regarding to the fast growing of Chinese manufacturers, some local IC or flat panel production equipment manufacturers can be chosen as sub-contracting manufacturers. The subcontracted equipment could be low-end equipment like cleaning machines which are low-end but essential for a complete production line. German firms can save cost by sub-contracting the business to local manufacturers. The potential subcontractor could be Sevenstar in Beijing, who is a listed company and produces both IC and FPD cleaning machines with big market shares.

3.12 BIOMEDICAL IN-VITRO DIAGNOSTICS INDUSTRY

3.12.1 COMPETITIVE LANDSCAPE

China's current IVD (In-Vitro Diagnostics) market is still quite small and its share in the global IVD market is only 2% to 4%. The national average annual personal consumption expenditure is less than 2 USD, only 17% of the global average. The market potential is therefore very huge and the Chinese IVD market is growing fastest among the world. The annual industry output is expected to grow at a CAGR of 15-20% to reach CNY 26 billion in 2015 while the global market is growing at a CAGR of 5-7%.

The market size of IVD in China is expected to be doubled in the 12-5 period. Since IVD devices are the focus in this study, the market size of IVD devices is individually studied. Chinese IVD market accounted for 9.5 billion CNY in 2008 and is growing more and more rapidly to reach around 33 billion by the end of the 12-5 period. The CAGR is expected to be above 16%, far over the CAGR of the global IVD market. IVD devices' market size has a similar development path, although the market size is less than 20% of that of reagents. The expected output value is 4.5 billion CNY in 2015, growing from 1.8 billion CNY in 2008.

POLICY SUMMARIES

IVD (In-Vitro Diagnostics) reagents already gained policy support in 11-5 period, and IVD industry is further considered as strategic emerging industry and receives policy support for all industry segments in the 12-5 plan.

The government is continuously investing in the healthcare system, and China's medical reform policy strengthens the support in rural medical treatment system.

The centralized government procurement of medical devices is also stimulating the market.

An expected total 167 million CNY investment from 863 plan is flowing into IVD industry.

In-Vitro diagnostics could be divided into clinical immunoassay, clinical chemistry diagnosis, blood and body fluid diagnosis, molecular diagnosis, microbiological diagnosis and other diagnosis according to different diagnostic methods. The whole Chinese IVD market accounted for totally 12.2 billion CNY in 2010. Clinical immunoassay took the first place with 4.1 billion, tightly followed by clinical chemistry diagnosis with 3.9 billion. These two sectors are the most relevant and have over 65% of the market share altogether.

Customers of IVD products include 19,700 hospitals, 39,000 township hospitals, 300 blood banks, body check centers, independent test laboratories and a large number of private users. Customers' demand is polarized: big hospitals need efficient high-end systems while primary hospitals and private users need small and simple diagnostic products with timely and accurate report. The demand keeps rising and is driven by different factors, such as the rapid development of China's economy, China's huge and aging population, bigger government investment in medical service and the medical reformation policy.

3.12.2 COMPETITIVE LANDSCAPE

Policy support for local IVD companies was rare in the past and this has been changed since 11-5. 12-5 policies aim to develop local IVD manufacturers.

Chinese IVD industry, starting in the 1980s with the production of reagents, has been developing fast in the past 20 years. More than 400 companies are currently active in the industry. Domestic products cover almost all main categories of the industry now and the market share of domestic products keeps growing. Technology level has also been improved and there are a few local industry leaders now. Yet the local production is still not that strong compared to foreign competitors. Foreign companies, especially giant international groups, have over 50% market share and dominate the high-end market. Figure 3-34 depicts IVD industry concentration in 2010 in China. Foreign portion of the market was above 50%. Giant international enterprise groups are dominating the market. The most representative companies

POLICY SUMMARIES

Market making

The government is investing continuously in the healthcare system, e.g. centralized procurement of medical devices for rural areas since 2006, and further investment in primary healthcare system in 2009-2011. The government is also developing the IVD standard system.

Exemplary projects

Application demonstration projects of innovative medical device products and demonstration projects of digital medical care help promoting IVD products. Exemplary IVD Projects, including technologies, devices, reagents and systems, receive government subsidies e.g. the list of exemplary IVD projects and targets in 863 plan: "863 plan of development of IVD key devices/systems".

Preventing vicious competition

The government is also preventing vicious competition through raising the industry entry barrier, and is trying to enhance the industry concentration and to improve the competitiveness of local players in the global market.

are: Roche, Siemens Healthcare, Abbott, Beckman Coulter and Sysmex. Roche, for example, enjoys its No.1 place with a 13.1% market share. Among all the Chinese companies, Mindray is quite impressive with a 3% market share and global competitiveness in quite a few fields.

There are currently a few local industry leaders in the market with over 20 year's development. Table 3-25 shows some of them and gives a brief information on them.

Most of the local leading companies are listed companies. The only private company, Wantai Biotechnology, was the first that started to supply IVD devices in 2011. Mindray is the most representative local industry leader. It does not only provide high-performance IVD products, but also penetrated into more than 190 countries.

Mindray's R&D approach is impressive and it even established a national level R&D center.

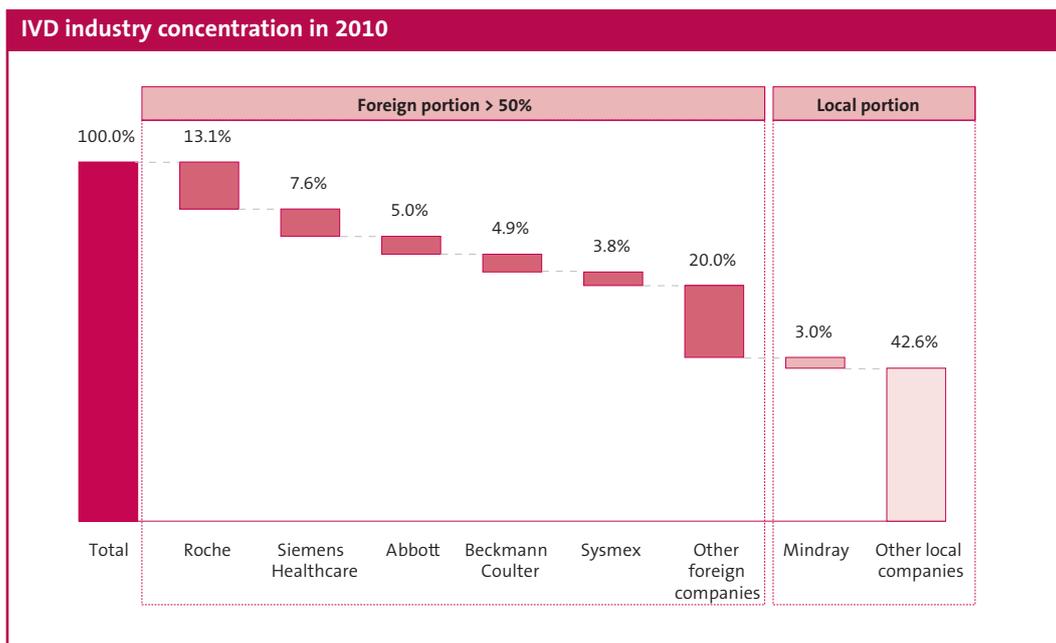


Figure: 3-34

Source: GlobalData: In Vitro Diagnostic Market, China, 2010

Name	'10 Revenue	Key strength
Kehua Biotechnology 002022	781.3	Industry leader in many sectors e.g. PCR, immunoassay, clinical chemistry etc.
Fosun Phama 600196	4,555.4	Biochemical analysis system, microbiological analysis system, PCR (Fosun Diagnostics)
BIOSINO HK 08247	229.3	High quality kit series, penetration into southeast Asia market
Mindray MR	4,752.3	Blood cell analyzer (biggest domestic market share), automatic biochemical analyzer, establishment of national R&D center, penetration into over 190 countries
Wantai	350.0	Reagent and material, started to supply device in 2011
Daan Genetics 002030	370.0	PCR, automatic biochemical analyzer, blood cell analyzer etc.

3.12.3 INNOVATION AND INDUSTRIALIZATION FOCUS

To achieve the technology upgrade goals, Chinese government is also promoting the collaboration among universities, research institutes and industrial practitioners, as well as huge R&D investments. Spontaneous collaboration is also taking place. The establishment of China IVD industry Research and Innovation Alliance is an example. Technology platforms and innovation and industrialization bases are also being constructed.

12-5 policies aim to promote IVD industry restructuring, too. The current industry restructuring situation could be observed in the following 3 aspects:

Value chain positioning: China's IVD industry has a relatively short history.

Local manufacturers began with reagent production and stepped into the device manufacturing field later. This may be one of the reasons why they generally have a low technology level and provide mostly low-end devices. The high-end market is dominated by foreign companies.

POLICY SUMMARIES

Industrialization:

Chinese government promotes the development of high-end devices and high-performance integrated analysis systems (device and reagent combined). The government is also trying to increase the industry concentration level and encouraging company acquisition to create bigger, stronger and more competitive industry leaders. According to this strategy, a few less competitive companies should disappear and competitiveness of local players is expected to rise in general in the long term. The development of the whole value chain, from raw materials, core components to IVD systems, is also promoted.

Innovation:

12-5 policies aim to promote innovation and technology upgrade and improve local players' innovation capacity. The general R&D targets include:

1. Breakthrough key technologies of IVD devices and reagents
2. Development in automation and integration, personalization and point-of-care testing (POCT)
3. R&D of innovative products with independent intellectual property rights and globally competitive high performance products
4. Breakthrough in high-end products as integrated chemiluminescence's immunoassay system
5. Development of dedicated IVD devices for the primary medical system, such as immunoassay analyzer, hematology analyzer, or biochemical analysis

A total 167 million CNY investment from 863 plan is flowing into IVD industry and the corresponding crucial 863 projects include:

1. Integrated automatic chemiluminescence's immunoassay diagnostic system
2. Automatic biochemical analysis system
3. Integrated POCT analysis system
4. Automatic analysis system based on immunological methods
5. High-performance hematology analyzer
6. Medical flow cytometers
7. Automatic microbiological analyzer based on fluorescence analysis technology

Horizontal integration: Chinese IVD industry is generally scattered. There are more than 400 companies in this industry and around 60 of them have device production capacity. Most companies are medium to small-sized. The situation in the global market is different. To increase industry concentration through M&A in the medical device field is the global trend. The global IVD market is also dominated by a few giant international enterprise groups with absolute advantages in R&D, technology, sales and management. These groups have already continued their M&A paces in the Chinese market and local companies are facing a more severe competition situation.

Up/downstream integration: Local companies rely on foreign companies in raw material procurement. Raw material is therefore very expensive and the high raw material cost limited the development of local players. On the other hand, leading players started to provide products and services in a wider range.

3.12.4 RECOMMENDATION TO GERMAN FIRMS

Chinese government remains “open” and “fair” to a large extent. Foreign investments receive no certain discrimination, neither special benefit.

The policies to promote international co-operation are quite general and valid in almost all medical device fields. Government procurement issue occurs of course often in government procurement and could not be considered as a severe and real discrimination. Regulation policies are much more serious. Foreign companies should therefore pay more attention to Chinese regulation system of IVD products and keep updating the information. For German IVD manufacturers, some conclusions could be drawn in the following aspects:

Strength German companies’ strength could be seen in two aspects: Big German Groups (like Siemens Healthcare) provide products and services in all IVD sectors and have absolute advantages in technology, marketing and R&D while medium-sized German companies focus on certain sectors and play as industry leaders.

Weakness High price is their biggest weakness. Chinese companies provide cheaper products with good after sales services (but mainly in reagents and in middle and low-end market).

Opportunity German companies’ opportunity is quite obvious. China’s IVD market is growing much faster than any other countries in the world. Moreover, the high-end market would grow progressively in the next 5 years due to the huge population base and the low equipment level.

POLICY SUMMARIES

Beneficiary

International cooperation is generally promoted, e.g. cooperation of local and international companies, joint R&D and technology transfer, imports of certain high-end medical devices and utilization of oversea resources, especially talents.

Discriminating

Local companies, have priority in government medical device procurement, if they provide products in the same quality. The regulation system of IVD products from State Food and Drug Administration (SFDA) is different compared to FDA and EC, and the regulations are complicated, scattered and developing. Further, SFDA doesn’t provide information and explanation relating to IVD laws and regulations in foreign languages.

Threat The threats are of course not ignorable. The Chinese competitors are getting stronger. Chinese government planned huge investments in IVD R&D and aimed to enhance the localization rate of high-end products and to increase the local industry concentration. But due to the current development situation, German companies still have significant advantages compared to domestic companies in the next few years and would keep their position for quite a long time.

To sum up, in order to keep the position and achieve a bigger market share in the booming market, German companies need to keep their advantages in high-end products and to reduce the cost. Sales improvement is crucial to keep their position and this includes three main aspects:

Product portfolio realignment: The changing regulations need to be closely monitored. Chinese government is promoting complete analysis systems and this is the strategy German firms should follow to act as full solution provider. Furthermore, since the rural medical system gains special focus in 12-5, the development of devices dedicated to rural market should be considered.

Local M&A: Company M&A is the global trend and it is also the case in China. Chinese local players are also getting stronger. To keep their position, German firms should keep acquiring local companies to expand their market share, possess more local sales channels and improve their production capacity. Kehua Biotechnology, for example, is the industry leader in many sectors and could be considered as a co-operation partner.

Cost reduction may not be that crucial like sales improvement, but German companies also need to reduce cost to keep their position. Improving technology level of local companies provides local sourcing chances. Mindray, for example, has by far a good reputation in the global market. Chinese government is also promoting international co-operation and technology transfer. The localized R&D and production can also help to reduce the cost.

4 CONCLUSION

4.1 CHINA'S OVERSEAS DIRECT INVESTMENTS

There are increasing cases of overseas direct investment by Chinese enterprises, and overseas M&A is playing a more important role in China's overseas direct investment. Overseas M&A in the machinery field is becoming more active, and following are some examples related to German companies:

Chongqing Light Industry & Textile Group acquired SaarGummi Group in Germany with 68 million EUR in 2011, and obtained the core automotive sealing technologies.

Ningbo Joyson Holding acquired 74.9% shares of Preh GmbH in Germany in 2011, a leading company in the automotive electronics field.

Sany Group and CITIC Fund acquired 100% shares of Putzmeister Group in Germany early 2012, leader in the concrete machinery field, with 360 million EUR. Sany Group owns 90% shares and CITIC Fund 10%. XCMG Construction Machinery Co.,Ltd is also planning to acquire Schwing Group in Germany.

A driving factor of the phenomena is that the Chinese government tends to encourage and support Chinese enterprises to invest in the overseas market ("go out" strategy) through the reform of corresponding policies. Generally speaking, the regulation policies are becoming more simplified and more financial supports are provided.

4.1.1 REGULATION POLICY REFORM FROM CHINESE GOVERNMENT

Different government departments play different roles in the procedure of Chinese enterprises' overseas investments. The related government departments and their newly released regulation policies, as well as the impacts as below:

Normally, Chinese investors need the approvals from State Administration of Foreign Exchange (SAFE), National Development and Reform Commission (NDRC) and Ministry of Commerce (MOFCOM) for their overseas direct investments. Corresponding regulations from these government departments have been amended in the recent years, and the development trend is to delegate the approval authority, simplify the approval process and highlight the administration priority.

SAFE

The SAFE and its branches supervise and administer the balance and registration of foreign currency funds for domestic institutions in the process of their overseas direct investments. The reform trend is to liberalize the outflow of foreign exchange for overseas investments. It has released The Regulations on Foreign Exchange for Domestic Institutions' Overseas Direct Investment in July 2009. Comparing to the regulations released in 2006, the newly released policies differentiates in four major points, mainly aims to deregulate foreign exchange control in order to provide adequate capital to domestic enterprises, and to simplify the application process.

- Enlarged the source of foreign exchange for overseas direct investment. The fund for overseas direct investments can be from self-owned foreign currency funds (i.e. foreign exchange accounts such as current account and capital account), legal remittances and loans from both home and abroad, foreign currency or commodities purchased by RMB, intangible assets, and profits from overseas direct investment, etc.

- Follow-up financial support will be provided to enterprises conducting overseas direct investment. The new policy made it clear that domestic enterprises can provide commercial loans and corporate guarantees to the overseas enterprise it invested in.
- A certain percentage of the total investment amount is allowed to be remitted out as up-front cost in the planning stage.
- The audit of the source of foreign exchange changed from prior review to registration afterwards. The administration of the remittance in the SAFE has been changed from “Approval” to “Registration”. Domestic institutions only need to submit paperwork to designated banks, and remittances can be processed after the bank’s approval.
- Before 2004, any overseas investment project with 1 million USD or above invested by a Chinese party was subject to NDRC’ approval. Under the Measures in 2004, resource development projects with 30 million USD or above invested by a Chinese party and non-resource development investment projects with 10 million USD or above invested by a Chinese party are subject to NDRC’ approval. The Notice on the Delegation of approval authorities of overseas investment projects issued in 2011 further delegates the approval authority to provincial-level counterparts of NDRC and raises the limits to 300 million USD of resource development projects, and 100 million USD of non-resource development projects to NDRC. NDRC retains the approval authority to special projects such as projects in the countries with which PRC does not have diplomatic relations.
- The procedure was also simplified. Instead of approving the project proposal and feasibility study report, NDRC only approves the project application report and focuses on the principal investor, the investment direction and the compliance of the project, no longer the economic and technological feasibility.

The first two changes may help domestic enterprises to obtain enough funds for overseas direct investments, whereas the latter two modifications would ease the application procedure, and therefore raise the enthusiasm of overseas direct investments.

NDRC

NDRC examines and approves overseas investment projects, including new establishment, acquisition and merger, equity purchase, capital increase and reinvestment of all kinds of PRC domestic artificial persons, and through their overseas holding enterprises or organizations. With the approval from NDRC, the domestic investors shall carry out the relevant formalities of foreign exchange, customs, entry and exit administration and tax matters. The fundamental regulation is The Interim Measures for the Administration of Examination and Approval of Overseas Investment Projects issued by NDRC in 2004, which already delegated the approval authority and simplified the approval procedure and content:

MOFCOM

MOFCOM is responsible for examining and approving domestic enterprises to invest and establish enterprises abroad (except for financial enterprises). With the approval from MOFCOM, the domestic investors shall go through the formalities of foreign exchange, banks, customs and foreign affairs. The new Administration Measures of Overseas Investments issued by MOFCOM in 2009 has replaced Provisions on the Approval of Overseas Investments to Start a Business in 2004.

- The new policy provides more precise approval power division between MOFCOM and its provincial counterparts. MOFCOM only retains the approval authority of significant and sensitive overseas investments, including investments with Chinese party's investment amount of 100 million USD or more or investments in the crossborder infrastructure construction area.
- Under the new measures, most overseas investments obtain the "Approval Certificate" three working days after submitting the application. The procedure is much shorter than before.
- MOFCOM only examines the overall impacts of an overseas investment such as the impacts on bilateral political, economic and trade relationships or the effects on the national economic security. The enterprise is responsible for the economic and technological feasibility of the investment.

Furthermore, MOFCOM issued China's overseas industry investment guide in 2009 and keeps updating it regularly. This guide not only provides information relating to cooperation and investments in these countries (regions), but also points out problems that might occur to Chinese enterprises carrying out business there with necessary tips and recommendations. The guide currently includes 165 countries (regions).

SASAC

It should be noted that the approval process particularly for central state-owned enterprises is different from that of general domestic enterprises in overseas direct investment. The overseas investments projects of the enterprises directly under the Central Government Administration need to obtain the approval from State-owned Assets Supervision and Administration Commission (SASAC) of the State Council and keep their record in NDRC and MOFCOM.

Central state-owned enterprises are most active in China's overseas M&A. Various problems occurred to them, such as the vicious competition among some enterprises in certain overseas acquisition projects, the huge loss of overseas business due to their low overseas operation and risk control capability, or the rent seeking phenomena. Therefore in 2010, SASAC issued The Notice on carrying out special inspections of central state-owned enterprises' overseas M&A. It carried out more detailed and stricter measurements to contain their overseas direct investments. From then on, SASAC would participate in the selection and determination procedure of central state-owned enterprises' foreign acquisition targets. SASAC would also examine the adequacy and legibility of the feasibility study report, the detailed due diligence audit, the capital verification, the financial audit and the overseas M&A contract. SASAC learned the enhancing management of central state-owned enterprises from the Temasek mode in Singapore to a certain extent. The stricter regulation of SASAC in the overseas M&A activities of central state-owned enterprises will not slow down the M&A paces of these enterprises. On the contrary, the deeper involvement of SASAC helps to strengthen the risk control and management, reduce the chance of problem occurrence, and improve the success rate and the efficiency of the M&A activities.

Financial Support

Apart from the government regulations and approval process, the financing problem is one of the biggest challenges for most overseas investment projects. Overseas investment projects need financial supports from various sources and some government agencies play important roles in this field.

CBRC

China Banking Regulation Commission (CBRC) regulates the financial supports for overseas investment projects from banks. CBRC released The Guidelines for Risk Management of the Merger Loans of Commercial Banks in December 2008, and required eligible commercial banks to provide necessary financial supports to qualified Chinese enterprises, for their industrial restructuring, upgrade and integration in the overseas market. To avoid possible risks, designated banks are required to check the source of foreign currency in overseas direct investment before international remittance transactions.

Financial Institute Support

Policy-oriented financial institutions will increase their financial support to overseas investment projects encouraged by the state, and will support domestic enterprises to raise funds through such measurements as issuing stocks & bonds both home and abroad, project financing and Syndicated loan in 12-5. For instance, Bank of China offers project financing and Syndicated loan services to enterprises for overseas direct investments. In the case that Geely bought Volvo in 2011, consortium leading by Bank of China Zhejiang branch and London branch offered 5-year loans of about 1 billion USD to Geely to support its acquisition.

Funds

Funds, sometimes with government background, also provide financial support in overseas acquisitions. For example, China Investment Corp. (CIC), a wholly state-owned company, was established in 2007 and manages the investment business of foreign exchange funds. It is said that CIC will receive an additional up to 50 billion USD replenishment to help the fund to accelerate its M&A activities in Europe and other regions. Chinese government will authorize CIC to develop a long-term management framework for its obtained foreign exchange reserves. Information also indicates that the People's Bank of China is planning to create an investment vehicle to manage an investment fund of 300 billion USD directly under SAFE.

Direct Subsidies

In 12-5, the "going out" enterprises will obtain special funds through direct subsidies and loan subsidies, according to The notice on the declaration of special funds for foreign economic and technical cooperation in 2011 issued by MOF and MOFCOM. Certain projects, such as direct investment projects in the equipment manufacturing industry, have priorities when applying for the subsidies. The equipment manufacturing include general equipment, dedicated equipment, transportation equipment, electronic machinery and apparatus, communication equipment, computer and other electronic equipment, scientific instrument, office machinery and other equipment.

Direct subsidies include subsidies for: 1. the early-stage expenses such as consulting fees and feasibility study expenses; 2. the shipping premium of resources to be shipped back; 3. the personal accident insurance and training expenses for "going out" staffs; 4. the emergency expenses abroad. Loan subsidies are provided to investment projects which have been operated for above 1 year. For a same enterprise involved in several direct investments, it may obtain a total subsidy of up to 30 million CNY. To apply for the subsidies, the applicant project is required to obtain approvals from relating Chinese government departments and the foreign country (region) where the project will be carried out. The investment amount of the project from the Chinese party should be 1 million USD or above, and the single loan amount should be 3 million CNY or above.

It could be seen that the subsidies provided to Chinese enterprises aim to help and support them to better prepare for their overseas investment and to better operate their overseas business. The enterprises also receive subsidy supports in emergency situations in the overseas market. This policy helps to dispel concerns of Chinese enterprises over overseas investments and to raise their incentives to invest overseas.

Internationalization of CNY

The internationalization of CNY is a long-term strategy in China. With the value of export in China became the 1st place in the world, an increasing number of countries have accepted CNY as the currency of payment. Particularly in Southeast Asia, CNY has become hard currency in some countries. Crossborder trade settlement in CNY service was permitted in some pilot cities since 2009, whereas it was released in the whole country in August 2011. Moreover, on the international counterparty side, the service was extended to all countries and regions in 2011, after being piloted in Hong Kong, Macao, and ASEAN (Association of Southeast Asian Nations) since 2009. The internationalization of CNY has great impacts on Chinese overseas investment. The barrier of regulations in foreign exchange would be avoided, which may inspire the overseas investments of privately-owned enterprises. Additionally, settlement procedures will be simplified, and exchange losses could be avoided. The competitiveness of Chinese enterprises could be increased. Therefore the volume and value of Chinese overseas investment would hugely expand.

The internationalization of CNY began from 2007 and the pace is quite pleasant. Hong Kong plays a crucial role in this process. It is the biggest offshore RMB (CNH) center which accounts for 78% of the total international CNH transaction. In August 2011, direct investment in CNY and RMB QFII (Qualified Foreign Institutional Investor) was proposed in Hong Kong as a 12-5 target. Up to 24 billion CNY of treasury bonds has been issued in Hong Kong since 2009. Chinese domestic enterprises are also allowed to issue bonds in CNY in Hong Kong since August 2011. As a global financial center, Hong Kong's experienced financial institutions and professional talents well supported and speeded up the internationalization of CNY. The development of CNH business in Hong Kong implied the effectiveness and determination of the Chinese government. The fastpaced internationalization of CNY is a strong support of overseas investments for Chinese enterprises.

4.1.2 PUBLIC RELATIONS

By far, most overseas M&A projects are carried out by state-owned enterprises. The massive M&A activities of Chinese state-owned enterprises led to the concerns from foreign governments and people about Chinese government's political intention. Due to the prejudice to China, foreign government and citizens may resist the acquisition and there are already many unsuccessful M&A cases because of this. For example, China Minmetals Corporation tried to acquire Noranda Inc. in Canada in 2004, and China National Offshore Oil Corporation tried to acquire Unocal Corporation in the USA in 2005. Both cases went unsuccessfully due to political concerns such as the national security.

The Chinese government is paying great attention to public relations (PR) in the global market. In the circumstance of increasing tones about the "China threat theory", government PR is helping domestic enterprises involved in overseas investments to reduce the resistance and to improve the national image to foreign public, enterprises, unions and government. Three major strategic tools are used: 1. spokesperson, who releases information to add the credibility of the government; 2. international lobbying, which effectively spreads positive and accurate information against unilateral reports, in order to win the global confidence; 3. international events like the Beijing Olympic Games and the Shanghai Expo show an open, progressive, peaceful, harmonious and collaborative national image to the world.

In addition to the PR efforts from the government, domestic enterprises are also making huge progress in public relations in their overseas investments. Take Sinosteel for example. In the case that Sinosteel buys Mid-west in Australia, successful PR was an important factor in the acquisition. Sinosteel keeps contact and communication with local government authorities and personnel through major media in Australia and the internet, so as to ensure the information from Sinosteel could be fully understood and accepted, and any doubts or misunderstandings could be explained and clarified in time.

4.1.3 RECOMMENDATIONS TO GERMAN ENTERPRISES

It is obvious that the Chinese government is making great efforts on encouraging overseas direct investments in recent years. The “go out” strategy of Chinese enterprises is important in the 12-5 period. Eased application and approval procedures are applied, more adequate financial supports are provided, and PR has been put more emphasis on.

In regarding to the above information and analyses, it is important that German firms keep an open attitude to M&A and other direct investments from China. The policy trend and M&A cases show that more Chinese enterprises are willing to and have the means to acquire overseas enterprises.

Probably, manufacturers who focus on niche and high-end products would not be too much affected by direct investments from China. Localization in China is more practical for these types of enterprises, where cooperation like local sourcing, technology transfer and joint ventures could be considered.

To the manufacturers whose products with less leading advantages, or in the cases that Chinese players are financially and technologically stronger, mergers and acquisitions from China may be considered. Especially, large listed and state-owned enterprises have resource and financial strength in highly concentrated industries in China, such as energy, mining and other natural resource industries. It should be acknowledged that German firms have large advantages in Chinese overseas investments. In general, “German firm” is the synonym of good quality and good reputation to Chinese buyers. Besides, the advanced technology and processing skills, especially in machinery and heavy industry fields are always attractive to Chinese buyers. The already-built-up sales channels and other commercial relationships in the European market will also add vast value to Chinese enterprises that aim to expand globally. Therefore, it may not be wise for German enterprises to resist the purchase or other kinds of investments from China, as long as suitable chance and appropriate price is offered. Business divesting may help the enterprise to focus on more profitable businesses. In certain circumstances, actively looking for buyers in China through some experienced and reliable agent may also be considered.

Table 4-1: Summary of 12-5 plan recommendations

		Internal	Strong/healthy	Weak/distressed
External				
	De-mand	High (+)	<ul style="list-style-type: none"> Local R&D/meet market specific requirement Local production/assembly to capture market Joint venture for beneficiary policy entitlement 	<ul style="list-style-type: none"> Sales network realignment Product portfolio realignment Operational performance improvement
Moderate (-)		<ul style="list-style-type: none"> Joint ventures to share market risks China for export base for other countries 	<ul style="list-style-type: none"> Close monitoring, scanning for market niche Technology transfer Offering of technical services 	
Competition	Fierce (-)	<ul style="list-style-type: none"> Differentiate production technology generations Foster product and service innovation Multi-brand for direct competition with locals 	<ul style="list-style-type: none"> Divest unprofitable business arms High-end focus/market retraction and protection 	
	Moderate (+)	<ul style="list-style-type: none"> Subcontracting to China Acquisition of local leading competitors 	<ul style="list-style-type: none"> Close monitoring of local competitors Local sourcing/supplier development 	

4.2 SUMMARY OF RECOMMENDATIONS

It can be implied from the published policies that German firms will witness many policy changes. It is important to adapt their own strategies to react to these changes, in order to expand in the Chinese market. Outside-in views of potential strategic recommendations to VDMA members are provided as below.

General strategic recommendations to corresponding German firms by different internal development status and varied external circumstances are given out in Table 4-1. Recommendations are customized based on specific demand & supply and competition situations at subsegment level. Frankly speaking, strongly and healthily developed German firms in China may want to raise the localization rate and to build up joint ventures to expand the market, and may want to compete with local players by differentiating products, technology or brands and acquisitions. Weakly and distressfully developed German firms, however, may want to realign the structure of the whole product chain and react quickly to the new market trend. Anyhow, VDMA members and corresponding companies will still need to choose feasible strategies based on their own external positions and internal strengths and weaknesses.

APPENDIX – POLICY REFERENCES

Industry	Name	Level ¹	Release party	Status ²	Web link
Intelligent Equip.	12-5 Plan for high-end equipment	N	NDRC, MIIT	D	-
	12-5 Plan for intelligent equipment	N	NDRC, MIIT	D	-
	Guidance for the development of intelligent equipment	N	NDRC, MIIT, MoF	R	http://www.whdpc.gov.cn/dispxxnr.asp?id=480942
	12-5 Plan for machine tool	N	MIIT	R	http://www.chinaequip.gov.cn/2011-07/22/c_131002068.htm
High Perform. Iron Steel	12-5 Plan for new material	N	MIIT, NDRC	D	http://www.cnstock.com/index/cj/201111/1684508.htm?page=1
	12-5 Plan for iron steel industry	N	MIIT	R	http://www.miit.gov.cn/n11293472/n11293832/n11293907/n11368223/14303771.html
	Shanghai action scheme on industrialization of new material (2009 to 2012)	P	Shang-hai EIC	R	http://www.sheitc.gov.cn/gxjscopy-hxdfa/511162.htm
	Guideline on the development of high-performance metal material technology of Anhui province	P	Anhui Dep. of Sci. & Tech.	R	http://www.ahkjt.gov.cn/topic/xxcyjszn/webinfo/2010/07/1278061945541149.htm
	12-5 Plan for solar PV industry	N	NEA	D	http://www.newenergy.org.cn/html/0119/961142470.html
Ocean Equip.	Ocean equipment industry innovation and development strategy	N	NDRC, MIIT	R	http://www.sdpc.gov.cn/zcfb/zcfbtz/2011tz/t20110916_434286.htm
	Guidance to ocean equipment project (first List)	N	MIIT, NDRC	R	http://www.miit.gov.cn/n11293472/n11293832/n12845605/n13916973/14051439.html
	12-5 Plan for ocean equipment	N	MIIT, NDRC	D	http://www.cnaec.com.cn/Info/Show.asp?ID=7314583
	Long-term plan for Ocean equipment	N	MIIT, NDRC	D	http://www.cssc.net.cn/component_news/news_detail.php?id=9079

Industry	Name	Level	Release party	Status	Web link
Wind Power	Policy on the price of wind power electricity	N	NDRC	R	http://www.sdpc.gov.cn/zcfb/zcfbtz/2009tz/t20090727_292827.htm
	Access standard on wind power equipment manufacturing industry	N	MIIT	D	http://www.miit.gov.cn/n11293472/n11295142/n11299138/13101665.html
	Interim measures for special funds of wind power equip. industry	N	MOF	R	http://www.gov.cn/gzdt/2008-08/23/content_1077641.htm
	Implementation details on development of offshore wind power	N	NEA, SOA	R	http://www.mlr.gov.cn/zwgk/flfg/hyglflfg/201107/t20110726_910004.htm
	Chengdu 12-5 plan on new energy	C	Cheng-du EIC	R	http://www.chengdu.gov.cn/Gov-InfoOpens2/detail_allpurpose.jsp?id=bbrDJPm0YmKYm3t6lrkH
Solar Power	12-5 Plan for solar PV ind.	N	NEA	D	http://www.newenergy.org.cn/html/0119/961142470.html
	2011 policy on “Golden Sun” pioneer project	N	MoF, MoST, NEA	R	http://jjs.mof.gov.cn/zhengwuxinxi/zhengcefagui/201106/t20110627_567263.html
	Policy for feed-in tariff of solar PV electricity	N	NDRC	R	http://www.sdpc.gov.cn/zcfb/zcfbtz/2011tz/t20110801_426501.htm
	12-5 Plan for PV industry	C	Dep. of Planning Hefei	R	http://hfpi.gov.cn/n1070/n304559/n310801/n314296/19287571.html
	12-5 plan for renewable energy	N	NEA	R	http://wenku.baidu.com/view/eb73347302768e9951e7387b.html?from=rec&pos=1&weight=56&lastweight=19&count=4

Industry	Name	Level	Release party	Status	Web link
New Energy Vehicle	Industry plan for energy conservation and new energy vehicle (2011 to 2020)	N	MIIT	D	http://wenku.baidu.com/view/1626f8d7360cba1aa811da5f.html
	Notice about the subsidy for energy-efficient vehicle	N	MoF, MIIT, NDRC	R	http://www.sdpc.gov.cn/rdzt/js-jyxsh/t20100916_371336.htm
	Allowance policy adjustment for energy-efficient vehicle	N	MoF, MIIT, NDRC	R	http://jjs.mof.gov.cn/zhengwuxinxi/tongzhigonggao/201109/t20110915_594056.html
	Allowance policy for individual to buy new energy vehicle	N	MoF, MIIT, NDRC, MoST	R	http://www.sdpc.gov.cn/zcfb/zcfbqt/2010qt/t20100603_351147.htm
	Energy-saving and new energy vehicle industry development plan	N	MIIT	D	-
	Development plan of Sci. and Tech. in 12-5	N	MoST, NDRC	R	http://www.most.gov.cn/tztg/201107/t20110712_88217.htm
	Key high-tech fields supported by the state	N	MoST, MoF, state admin. of tax	R	http://www.most.gov.cn/mostinfo/xinxifenlei/fgzc/gfxwj/gfxwj2008/200811/t20081129_65744.htm
	Financial support of key component of new energy vehicle	P	Finance Bureau Shan-dong	R	http://www.sdcz.gov.cn:8090/sdczww/sitesman/sdczww/channels/redianzhuan-lan/zhuanfangshitiaojiougou/dwdocumentsfs.2011-11-16.5004064268/
	Joint statement of Sino-German strategic partnership on electric vehicle	I	China and Germany	R	http://www.gov.cn/ldhd/2011-06/29/content_1895454.htm
High Speed Railway	Mid-long Term Plan of China Railway (2010 modified version)	N	MOR	R	http://www.china-mor.gov.cn/tljs/tlgh/201012/t20101228_732.html
	China's National Sci. and Tech. Development Plan of the 12-5	N	MoST	R	http://www.gov.cn/gzdt/2011-07/13/content_1905915.htm
	The 11-5 Plan for Railway	N	MOR	R	http://www.china-mor.gov.cn/tljs/tlgh/201012/t20101228_730.html

Industry	Name	Level	Release party	Status	Web link
Aviation Equip.	China Civil Aviation Development 12-5 Plan	N	CAAC	R	http://www.caac.gov.cn/i1/l2/201105/t20110509_39615.html
	China's National Sci. and Tech. Development Plan of the 12-5	N	MoST	R	http://www.gov.cn/gzdt/2011-07/13/content_1905915.htm
	Guide Directory for Foreign Investment	N	SDPC	R	http://www.sdpc.gov.cn/yjqz/W020110402572378735076.pdf
	The 12-5 Plan for Hi-end Equipment	N	MIIT	P	-
	Planning Guideline for Industrial Cluster Development of Shaanxi Province	P	Shaanxi Gov.	R	http://www.shaanxi.gov.cn/0/1/65/364/1198/90076.htm
	Aerospace Industrial Cluster Dev. Plan of Chengdu City	C	Cheng-du Gov.	R	http://www.cdgy.gov.cn/article/uploadfiles/200809/航空航天产业.doc
Biomass Energy	Plan for Renewable Energy Mid-Long term Development	N	SDPC	R	http://www.ccchina.gov.cn/WebSite/CCChina/UpFile/2007/20079583745145.pdf
	Notification on complete the pricing policy for agricultural biomass and forest biomass power generation	N	SDPC	R	http://www.sdpc.gov.cn/zcfb/zcfbtz/2010tz/t20100728_363362.htm
	12-5 Plan for Biotechnology Development	N	MoST	R	http://www.most.gov.cn/fggw/zfwj/zfwj2011/201111/t20111128_91115.htm
	Agri. Biomass Industrial Development Plan (2007-2015)	N	MOA	R	http://www.moa.gov.cn/zwlm/zwdt/200707/t20070703_845507.htm
	Forest Biomass Energy Development Plan (2011-2020)	N	-	D	-
	12-5 Plan for Renewable Energy	N	-	D	-

Industry	Name	Level	Release party	Status	Web link
Environ-mental Protect	National Env. Protection 12-5 Sci. & Tech. plan	N	MEP	R	http://www.mep.gov.cn/gkml/hbb/bwj/201106/t20110628_214154.htm
	List of responsible firms for development of environmental protection equipments	N	CAEPI, CAMIE	R	http://www.caepi.org.cn/announcement/28011.shtml
	12-5 Plan for Energy Saving and Environment Protection	P	Guang-dong SDPC/EIC	R	http://www.gdet.gov.cn/flxx/jnjh/zcfg/201111/P020111107615520984864.doc
	12-5 Plan for Energy Saving and Environment Protection	N	SDPC, MIIT, MoE	D	http://www.china-esi.com/Special/ZT11/
New Flat Panel & New IC	12-5 plan for new IT industry	N	MIIT, NDRC	D	http://www.docin.com/p-239418349.html
	12-5 plan for IC industry	P	Shan-dong EIC	R	http://www.sdetn.gov.cn/dzxxc/zcwj/webinfo/2011/06/1307955055893041.htm
	12-5 plan for electronic info. manufacturing industry	P	Shang-hai EIC	R	http://www.sdetn.gov.cn/dzxxc/zcwj/webinfo/2011/06/1307955055893041.htm
	12-5 plan for new flat panel industry	C	Hefei Gov.	R	http://hfac.gov.cn/n1070/n304559/n310801/n314296/19306584.html
Bio-medical IVD	Development plan of biotechnology in 12-5	N	MoST	R	http://www.gov.cn/gzdt/att/att/site1/20111128/001e3741a2cc103d851d01.doc
	Development plan of Sci. and Tech in 12-5	N	MoST	R	http://www.gov.cn/gzdt/2011-07/13/content_1905915.htm
	Development plan of medicine in 12-5	N	MoST	R	http://www.most.gov.cn/fggw/zfwj/zfwj2011/201111/t20111115_90869.htm
	Special plan of the medical device industry in 12-5	N	MoST	R	http://www.most.gov.cn/fggw/zfwj/zfwj2011/201201/t20120118_92018.htm

Industry	Name	Level	Release party	Status	Web link
Over-seas Direct Investments	The Regulations on Foreign Exchange for Domestic Institutions' Overseas Direct Investment	N	SAFE	R	http://www.safe.gov.cn/model_safe/laws/law_detail.jsp?ID=8040400000000000,29
	The Interim Measures for the Administration of Examination and Approval of Overseas Investment Projects	N	NDRC	R	http://www.ndrc.gov.cn/zcfb/zcf-bl/zcfbl2004/t20051010_44801.htm
	The Notice on the Delegation of approval authorities of overseas investment projects	N	NDRC	R	http://www.sdpc.gov.cn/zcfb/zcfbtz/2011tz/t20110318_399946.htm
	Admin. Measures of Overseas Investments	N	MOFCOM	R	http://www.mofcom.gov.cn/aarticle/b/bf/200903/20090306103210.html
	China's overseas industry investment guide	N	MOFCOM	R	http://fec.mofcom.gov.cn/gbzn/gobiezhinan.shtml
	The notice on carrying out special inspections of central enterprises' overseas M&A	N	SASAC	R	http://www.sasac.gov.cn/n1180/n20240/n7290826/11863955.html
	The guidelines for risk management of the merger loans of commercial banks	N	CBRC	R	http://www.gov.cn/ztl/2008-12/09/content_1172887.htm
	The notice on the declaration of special funds for foreign economic and technical cooperation in 2011	N	MoF, MOFCOM	R	http://qys.mof.gov.cn/zhengwuxinxi/gongzuotongzhi/201104/t20110428_542832.html

LIST OF ABBREVIATIONS

ASEAN	Association of Southeast Asian Nations	COD	Chemical Oxygen Demand
ASK	Available Seat Kilometer	COMTRADE	United Nations Commodity Trade Statistics Database
AVIC	Aviation Industry Corporation of China	CPC	Central Political Committee
BAIC	Beijing Automotive Industry Corp.	CRH	China Railway High-speed
BIPV	Building Integrated Photovoltaic	CSIC	China Shipbuilding Industry Corporation
BMPC375	Model number of new jack-up drilling rig produced by Sinopec	CSR	China South Railway
Bn	Billion	CSSC	China State Ship-building Corporation
BOC	Bank of China Ltd.	CVD	Chemical Vapor Deposition
BOD	Biochemical Oxygen Demand	DPT	Die Penetration Test
BST	Bombardier Sifang Power Transportation Ltd.	EBT	Earnings Before Tax
CAAC	Civil Aviation Administration of China	EIC	Commission of Economy and Information
CAD	Computer-Aided Design	EMIS	Emerging Markets Information Service
CAE	Computer-Aided Engineering	EPC	Economic and Planning Council
CAEPI	China Association of Environmental Production Industry	EPC	Engineer, Procure, Construct
CAGR	Compound Annual Growth Rate	ESNEV	Energy-Saving and New Energy Vehicles
CAM	Computer-Aided Manufacturing	EU	European Union
CAMIE	China Association of Machinery Industries for Environmental Protection	EV	Clean Energy Vehicle
CBRC	China Banking Regulation Commission	EV	Electric Vehicle
CEO	Chief Executive Officer	FAW	First Auto Works
CETC	China Electronic Technology Group Corporation	FCV	Fuel Cell Vehicle
CH	Switzerland	FHEV	Full Hybrid Electric Vehicle
CIC	China Investment Corp	FOTON	Beiqi Foton Motor Co., Ltd.
CIMC	China International Marine Containers	FPD	Flat Panel Display
CMTBA	China Machine Tool & Tool Builders' Association	FPSOs	Floating Production, Storage & Offloading
CN	China	FYP	Five Year Plan
CNC	Computer Numerical Control	GDP	Gross Domestic Product
CNH	offshore CNY, CNY trade in Hong Kong	GE (company)	General Electric Co.
CNOOC	China National Offshore Oil Corporation	GE (country)	Germany
CNR	China North Railway	GPS	Global Position System
CNY	China Yuan (Chinese currency unit)	GW	Giga-watt
		HEV	Hybrid Electric Vehicle
		HPIS	High-Performance Iron Steel
		HS code	The Harmonization System Code
		IC	Integrated Circuit
		IGBT	Insulated Gate Bipolar Translator
		IP	Intellectual Properties

IPO	Initial Public Offerings	PR	Public Relations
IT	Information Technology	PRC	The People's Republic of China
IVD	In-Vitro Diagnostics	PV	Photovoltaic
JP	Japan	QFII	Qualified Foreign Institutional Investor
JV	Joint Venture	R&D	Research and Development
KW	Kilowatt	RMB	Renminbi (Chinese currency unit)
KWH	Kilowatt Hour	RPK	Revenue Passenger Kilometer
LCD	Liquid Crystal Display	SAFE	State Administration of Foreign Exchange
LVRT	Low Voltage Ride Through	SAIC	Shanghai Automotive Industry Corporation
M&A	Merger and Acquisition	SASAC	State-owned Assets Supervision and Administration Commission
MBR	Membrane Bio-Reactor	SDPC	State Development Planning Commission
MEP	Ministry of Environmental Protection	SDPC	State Development Planning Commission
MHEV	Moderate Hybrid Electric Vehicle	SFDA	State Food and Drug Administration
MIIT	Ministry of Industry and Information Technology	SMEs	Small and Medium-size Enterprises
Mn	Million	SO2	Sulfur Dioxide
MOA	Ministry of Agriculture	SOA	State Ocean Administration
MOCVD	Metallo Organic Chemical Vapor Deposition	SOE	State Owned Enterprise
MODEC	Mitsui Ocean Development & Engineering Company Inc.	SWOT	Strength, Weakness, Opportunities, Threats
MoF	Ministry of Finance	TFT-LCD	Thin Film Transistor Liquid Crystal Display
MOFCOM	Ministry of Commerce	TLP	Tension Leg Production equipment
MOR	Ministry of Railways	TRIP	Transformation-Induced Plasticity
MoST	Ministry of Science and Technology	TWIP	Twinning Induced Plasticity
MW	Mega-watt	UN	United Nations
NC	Numerical Control	UNISPAR	University-Industry-Science Partnership
NDRC	National Development and Reform Commission	US/USA	United States of America
NE	Northern East	USD	United States Dollar
NEA	National Energy Administration	USTB	University of Science & Technology Beijing
NEV	New Energy Vehicles	VC	Venture Capital
OEM	Original Equipment Manufacturer	VDMA	Verband Deutscher Maschinen – und Anlagbau
OLED	Organic Light Emitting Diode	WISCO	Wuhan Iron and Steel (Group) Corp.
PCR	Polymerase Chain Reaction	WOFE	Wholly Owned Foreign Enterprise
PDP	Plasma Display Panel	XEMC	Xiangtan Electric Manufacturing Corp. Ltd.
PE	Private Equity		
PECVD	Plasma Enhanced Chemical Vapour Deposition		
PEV	Pure Electric Vehicle		
PHEV	Plug-in Hybrid Electric Vehicle		
POCT	Point Of Care Test		

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