Challenges and Opportunities for Low Carbon Development of Chinese Steel Industry

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PLAN FOR FUTURE STUDY FOR DEVELOPMENT

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Contents

I  Review and outlook of Chinese steel industry

II Challenges and opportunities for low carbon development of Chinese steel industry

III Roadmap of low carbon development of Chinese steel industry

IV MPI——your reliable partner
I Review and outlook of Chinese steel industry
In 2016, the world crude steel output was 1.6285 billion tons increased by 0.6% y-o-y, which was more than 1.6 billion tons in 4 consecutive years since 2013 showing a small fluctuation.

In 2016, Chinese crude steel output was 808.4 million tons increased by 1.2% y-o-y, accounted for 49.6% of the world output based on 49.4% in 2015.

From January to September 2017, crude steel output of 66 countries was 1.2669 billion tons increased by 5.6% y-o-y. Chinese crude steel output was 638.73 million tons increased by 6.3% y-o-y, accounted for 50.4% of total output of main steel producing countries. Crude steel output of other countries was 628.185 million tons except for mainland China, increased by 5.9% y-o-y.
As the biggest steel producing and consuming country in the world, China recognizes and performs responsibility to address overcapacity of the steel industry, although that is the common problem worldwide. China proposed and participated in organizing G20 GFSEC (GLOBAL FORUM ON STEEL EXCESS CAPACITY) to set a good example for addressing overcapacity.

In virtue of implementation of supply side structural reform to address overcapacity, China not only set an image of responsible power in the world, but also improve profitability of steel enterprises. Steel enterprises have to improve effective supply driven by innovation complying with new development idea.

In 2016, world crude steel output was 1.6285 billion tons with capacity utilization rate of 69.3%. China eliminated excess capacity of more than 65 million tons making contribution to improve utilization rate of 1.9 points, while that of other regions except for China was -2.3 points. **115 million tons eliminated in two years**
1.3 Review of Chinese steel production and consumption

Chinese steel production and consumption has passed four stages since establishment of the PRC in 1949.

- **Phase 1:** Fluctuating development in the initial stage;
- **Phase 2:** Stable development in the beginning stage;
- **Phase 3:** Leap forward development in the accelerating stage;
- **Phase 4:** Innovation development in the era of reduction.
The steel industry, as one of the most competitive Chinese manufacturing industries, has already achieved “5G”.

“5G”

- Good price
- Good product
- Good brand
- Good service
- Good scale
Chinese steel industry enjoys the world’s largest and most dynamic domestic demand. In 2016, actual steel consumption in China was about 670 million tons accounted for about 45% of total steel consumption in the world;

China, as the largest and most dynamic steel market will not be changed over a long period, which was the strongest foundation for Chinese steel industry to maintain and improve their competitiveness.
1.4 Competitiveness of Chinese steel industry

The complete industrial system has led to great development of Chinese steel industry.

- Competitive steel enterprises, such as BaoSteel, HBIS, ShaSteel etc.
- Upper stream supporting industries including iron ore, coal, power etc.
- Down stream consumers including building, machinery, automobile etc.
- Trade
- Auxiliary materials
- Agent
- Engineering
- Facilities
- Construction

Cultivation and scientific research base of metallurgical talents such as University of Science and Technology Beijing, Northeast University, Central Iron & Steel Research Institute etc.

Third party professional consulting institutions such as MPI.
1.4 Competitiveness of Chinese steel industry

**Professional colleges:** University of Science and Technology Beijing; Northeastern University

**Professional scientific research institutions:** Central Iron & Steel Research Institute; Institute of Process Engineering

**Enterprise research institutes:** BaoSteel research institute and WISCO research institute

Professional technical staff
Professional management staff
Professional research and development staff

**Consulting institute**

Professional consulting institution: MPI
Professional trading group: Minmetals
Professional design and construction group: MCC

**Innovative platform**

The whole industry has established 16 national key laboratories, 5 project laboratories, 12 project technical centers, 10 project research centers, 33 enterprise technical centers and 17 innovative enterprises.

**University and institute**

Professional technical staffs
Professional technical transfer staffs
Professional project application staffs

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http://www.mpi1972.com
1.4 Competitiveness of Chinese steel industry

Most advanced equipments

Advanced process and technical equipment and concept of systemization and integration have laid a solid foundation for the rapid development of Chinese steel industry.

**Systemization:** The integrated and systematic optimization and upgrading are being more and more valued.

**Green development:** The energy saving and environmental protection technologies and facilities are applied widely.

**Precision:** The product dimension control and controlled rolling and cooling technologies are promoted rapidly.

**Continuity:** The continuous casting and rolling processes and technologies are optimized constantly, and the process completeness is constantly upgraded.

**Large scale:** The ratio of advanced capacity to total capacity of coking, sintering, iron making, steel making and steel rolling increased constantly.

**Automation:** One-key automatic steel making as well as Level II and Level III of steel rolling are applied widely.
Intensified market competition push the steel companies to strengthen sense of service and to improve service ability and skill in order to occupy a larger market share by differential service.

1.4 Competitiveness of Chinese steel industry

- Timely service
1.4 Competitiveness of Chinese steel industry

- Expected to be the leader of the world steel industry over 100 years.

- China: accelerated industrialization and urbanization based on $10^9$ population promote China to become the core of the world steel industry;
- It is not likely to see another country or region with $10^{10}$ population in the future, or it is difficult to see accelerated industrialization and urbanization even if there is another country or region with $10^9$ population;
- It is predicted that Chinese steel industry will be the leader of the world steel industry for 100 years, even longer than the period have been occupied by the UK and USA.

Main route of transfer of the world steel industry

- From the historical view, there are three countries have produced half of world crude steel and maintained the leadership i.e. the United Kingdom in West Europe, the United States in North America and China in East Asia, which illustrates the main route of transfer of the world steel industry.
China will move from high speed to high quality growth and continue to press ahead with supply-side structure reform. More effort are made to accelerate industrial restructuring and upgrading. The principal contradiction has evolved from one between the ever-growing material and cultural needs of the people and backward social production to that between unbalanced and inadequate development and the people’s ever-growing needs for a better life.

THE STEEL INDUSTRY PROVIDES AN ESSENTIAL SUPPORT TO MEET PEOPLE’S INCREASED NEEDS FOR A BETTER LIFE

- Insist on excess capacity elimination, inventory and leverage remove, cost reduction, shortcoming improvement, optimization of resources configuration and expansion of high-quality additional supply to realize dynamic balance of supply and demand.

The report delivered in the 19th National Congress of the Communist Party of China on Oct 18th 2017
Further excess capacity elimination and accelerate deleverage.

Optimize industrial layout, develop one belt, multi points and network.

Promote optimization and industrial management and reform of SOE.

Strengthen innovation on technologies, management and development mode.

Satisfy steel demand for rural construction and agricultural modernization.

Promote international industrial cooperation.

1.5 Requirements for the steel industry in the new era of socialism with Chinese characteristics
1.6 Chinese steel industry in an era of reduction

- The subject of development of the steel industry will be changed from increase and expansion into reduction and adjustment.

- Chinese steel demand up to 2020 and 2030 is predicted based on analysis of downstream industries and GDP consumption intensity. From a medium/long-term view, Chinese steel consumption will show a peak round and descending channel, as well as fluctuation and rebound in individual year will not be excluded.

![Crude steel output, Pig iron output, Scrap consumption for steel making, Iron ore demand charts](http://www.mpi1972.com)
1.7 Development orientation of Chinese steel industry

- Environmental friendly
- Consolidation & Coordination
- Quality first
- Differential
- Diversified operation
- Standardization
- Service oriented
- Intelligent
- Internationalization

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Challenges and opportunities for low carbon development of Chinese steel industry
2.1 Opportunities—ecological civilization highly valued by Chinese government

According to the work report issued in the 19th National Congress of CPC, China should be an important participant, contributor and leader of the world ecological civilization construction.

Accelerate systematic reform of ecological civilization.

- Formulate regulations and guidance for green production and consumption; establish and complete green circular economy system;
- Set up market oriented green technical innovation system and develop green finance;
- Establish clean, safe and efficient energy system;
- Promote comprehensive conservation and circular utilization of energy resources.

Two stages (2020-2050)

- Stage 1: from 2020 to 2035
  Struggle for another 15 years based on building a well-off society in an all-round manner to realize the socialist moderation basically.

- Stage 2: from 2035 to the middle of 21st Century
  On the basis of basically realizing modernization, strive for 15 years to build a prosperous, strong, democratic, civilized and beautiful socialist modern country.
2.2 Opportunities——policies support and guidance

### National policies

<table>
<thead>
<tr>
<th>Policies</th>
<th>General targets</th>
<th>Implementation period</th>
<th>Description of green development policies of steel industry</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Self-Independent Contribution of China</strong></td>
<td>CO₂ emission hitting the peak in 2030; non-fossil energy accounts for about 20%; CO₂ per unit GDP decreased by 60%-65% based on that in 2005.</td>
<td>2020-2030</td>
<td>1. Formulate control targets and action plan; 2. Formulate emission standards; 3. Improve energy efficiency by energy conservation.</td>
</tr>
<tr>
<td><strong>Guidance on Excess Capacity Elimination of the Steel Industry</strong></td>
<td>Eliminate crude steel capacity of 100-150 million tons; solid progress of industrial restructuring; significant improvement of energy utilization efficiency, product quality and supply of high-end products; better profitability.</td>
<td>2016-2020</td>
<td>Steel capacity fail to comply with environmental, energy consumption, quality, safety and technological standards should exit in compliance with rules and regulations.</td>
</tr>
<tr>
<td><strong>Work Plan of Greenhouse Gas Emission Control in the 13th Five-year Period</strong></td>
<td>CO₂ emission per unit GDP in 2020 decreased by 18% based on that in 2015; effective control of total C emission.</td>
<td>2016-2020</td>
<td>1. Effective control of total C emission; 2. Management and control of C emission quota.</td>
</tr>
<tr>
<td><strong>Comprehensive Work Plan of Energy Saving and Emission Reduction in the 13th Five-year Period</strong></td>
<td>Control of intensity and total volume; energy consumption of GDP decreased by 15%; total energy consumption control with 5 billion tons standard coal.</td>
<td>2016-2020</td>
<td>1. Steel capacity fail to comply with environmental, energy consumption, quality, safety and technological standards should exit in compliance with rules and regulations. 2. Energy utilization efficiency meet or nearly meet the world advanced level; 3. Stepped energy utilization; 4. Comprehensive energy consumption per ton steel production ≤560kgce/t.</td>
</tr>
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</table>

- Low carbon development targets up to 2020 and 2030; control targets in respect of intensity and total volume;
- Eliminate backward capacity as per rules and regulations;
- Improve energy utilization efficiency.

http://www.mpi1972.com
2.2 Opportunities——policies support and guidance

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<td><strong>Industrial Action Plan on the Climate Change</strong></td>
<td>Up to 2020, CO₂ emission per unit industrial added value will decrease by about 50% based on that in 2005 and the industrial system characterized by low carbon emission will be formed basically.</td>
<td>2012-2020</td>
<td>1. Guided by policies and plan; standards formulation and delicacy management. 2. Promotion and application of secondary energy recycling. 3. Pilot sample of CCS, low carbon park and enterprises.</td>
</tr>
<tr>
<td><strong>Implementation Guidance of Green Manufacturing Project</strong></td>
<td>Advanced level of green manufacturing; establishment of green manufacturing system; energy consumption, water consumption and pollutants &amp; C emission reduced significantly comparing with that in 2015.</td>
<td>2016-2020</td>
<td>Encourage promotion and application of sintering fume recycling, by-product gas utilization, raw materials substitute, process optimization etc.</td>
</tr>
<tr>
<td><strong>National Plan on Climate Change</strong></td>
<td>CO₂ emission per unit GDP decreases by 40%-45% based on that in 2005; non-fossil energy accounts for about 15% of primary energy consumption; forest area and reserves increases by 40 million hectare and 1.3 billion m³ based on that in 2005.</td>
<td>2014-2020</td>
<td>1. Control capacity; 2. Product upgrading; 3. Promote high pressure and temperature CDQ, coking coal wetting, sintering surplus heat power generation, energy comprehensive utilization etc. 4. Develop EAF process using scrap. 5. Total emission in 2020 nearly the same as that in the end of 12th Five-year period.</td>
</tr>
<tr>
<td><strong>Adjustment and Upgrading Plan of the Steel Industry</strong></td>
<td>Significant achievements of supply side structural reform of the steel industry up to 2020; Change Chinese steel industry from large into strong up to 2025.</td>
<td>2016~2020</td>
<td>1. Implement green upgrading, develop circulate economy and promote green consumption. 2. Total energy consumption decreases by more than 10%; comprehensive energy consumption per ton steel production≤560kgce/t; total pollutants emission decreases by more than 15%; fresh water consumption per ton steel production ≤3.2m³/t; SO₂ emission per ton steel production ≤0.68kg; comprehensive slag utilization rate ≥90%.</td>
</tr>
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◆ Accelerate promotion and application of advanced energy saving and low carbon technologies;  
◆ Develop EAF process using scrap’; 
◆ Pilot sample of CCS, low carbon industrial park and enterprises.

http://www.mpi1972.com
Steel companies in Hubei, Tianjin, Shanghai, Guangdong and Chongqing among of 7 pilot zones participated in carbon market, crude steel output of which accounted for 11% of total output in 2016. Many steel companies participated in the experimental trade and completed the contract successfully to form a solid foundation of low carbon transformation.

A national carbon trade market is being launched. The steel industry is preparing in different aspects of data submission, carbon verification, quota distribution research etc.

Carbon trade market has been experimentally launched since 2011 covering the area of 480,000 m$^2$ involving the population of 199 million. Up to September 2017, the pilot carbon market in 7 provinces contributes the trade volume of 197 million CO$_2$ equivalent with turnover of about 4.5 billion RMB. Both carbon trade and intensity in the pilot zone dropped.
2.3 Opportunities—capability of low carbon development

Many years experience with significant achievements

➢ Total volume: from 2007 to 2016, Chinese crude steel output increased by 108% with annual growth of 7.6%; total energy consumption increased by 93% with annual growth million tons standard coal have been saved according to product energy saving rate.

➢ Intensity: both comprehensive energy consumption and C emission per ton steel production decreased with drop of about 3% from 2013 to 2015.

➢ Structural reform: from 2011 to 2015, Chinese steel industry eliminated backward iron making capacity of 90.89 million tons and steel making capacity of 94.86 million tons, exceeded 44.3% and 50.6% respectively comparing with the targets.
2.3 Opportunities——capability of low carbon development

- **High efficiency process**

From 1980 up to now, steel making process is adjusted and optimized to become a continuous, compact and light system.

- CCM ratio in key steel companies was 99.71% up to 2014.
- Shaft furnace has been eliminated completely up to the end of 2002.
2.3 Opportunities——capability of low carbon development

- Advanced process equipments

- Main equipments in key large/medium-scale companies reached international advanced level;
- Refer to key steel companies, capacity of coke oven with 5m and above accounts for 48% of total coking capacity, capacity of blast furnace with 1000 m³ and above accounts for 65% of total iron making capacity, and capacity of BOF with 100 tons and above accounts for more than 56% of total steel making capacity.
Wide application of advanced technologies

- Wide application of key technologies such as CDQ, dry dedusting, sintering surplus heat recovery, dry TRT, high efficiency PCI, regenerative combustion, fully combustion gas power generation, hot charge & delivery etc.
- Largest number of sintering surplus heat recovery unit, CDQ unit and TRT unit in the world.
- The largest unit low calorific value fuel and steam combined circulate power generator in the world.
2.3 Opportunities—capability of low carbon development

Improvement of energy management

- **Energy resources management**: from experience oriented management to modern management.
- **Energy saving management system**: from department to comprehensive management system covering the whole company.
2.3 Opportunities—capability of low carbon development

**Baowu**
- Green design and manufacturing methodology and standards system;
- Research on improvement of calorific value of BF gas and CO₂ capture and utilization;
- Solar photovoltaic power generation.

**TISCO**
- Integrated innovative circulating technologies.

**Shougang**
- Establishment new C management system and process;
- Application of new technologies;
- Research on C capture and recovery.

**Others**
- Dazhou Steel: methanol generation by coke oven gas;
- Jianlong Group: natural gas generation by coke oven gas;
- Sha Steel and Ma Steel: solid waste treatment by hearth furnace;
- Zhongjin Taihang Mining: Shaft furnace iron direct reduction by coke oven gas.

- Many Chinese steel companies not only possess advanced idea of low carbon development, but also made fruitful practice already.
2.3 Opportunities—supported by advanced available low carbon technologies

Analysis and Rating of Potential of Low Carbon Technologies Adopted in the Steel Industry

MPI rated the technologies according to mature level, reliability, application, development potential, impact to the whole industry, promotion, investment etc.

103 technologies available to be adopted to improve energy efficiency, among of which 3 for raw materials preparation, 10 for coking, 18 for sintering, 3 for pelletizing, 19 for iron making, 15 for steel making, 14 for steel rolling and 21 for energy & power. It is predicted to reduce 200kgCO₂/t steel production based on existing level if all technologies applied and promoted as per the master schedule.
2.3 Opportunities — industrial development promotes energy structure adjustment

- Scrap increase rapidly
- Passed scale expansion
- Stricter environmental protection requirements and promotion of power reform.
As the biggest steel producing country in the world, Chinese crude steel output accounts for nearly 50% of the world total output. Energy consumption and CO2 emission of the steel industry accounts for about 12% to 15% of total volume in China.

BF-BOF iron & steel making process, mainly consumes coal and coke is the dominant process.

Follow the rules of industrial structure transformation and development. It is not possible to be realized in a short term.
More difficult with higher cost;
Big gap of emission reduction cost among different technologies, which will impact promotion of certain technologies.
2.4 Challenges——self innovation of key process technologies and facilities

Chinese steel industry should pay more attention on self innovation of basic research and advanced technologies although it has already gained outstanding achievements. Key process technologies and facilities are still mainly learned abroad and insufficient innovation conversion is still the restriction for the further development of the whole industry.

- **Support technologies** integration centering on energy saving technologies and upgrading of steel demand for high-end facilities;
- **Implement combined innovation** mode covering production, education, research and application;
- **Establish national innovation platform** for the steel industry by means of market operation and diversified cooperation;
- **Develop the national innovation sample steel companies** and set up industrial base dominated by the steel industry;
- **Encourage coordinated innovation** among advantaged steel companies, colleges, design institutes and down stream customers.
III Roadmap of low carbon development of Chinese steel industry
3.1 Prospect of low carbon development of Chinese steel industry

Internal

**Short-term:**
- Implement green modification and lean management to improve energy utilization efficiency;
- Remove backward facilities;
- Emphasize scrap utilization to reduce iron and steel ratio;
- Further processing to increase added value.

**Medium/Long-term:**
- Significantly increase scrap utilization and develop EAF steel;
- Application of clean energy such as renewable energy, solar energy etc.
- Develop low carbon smelting technologies.

External

**Short-term:**
- Form industrial chain together with some related industries such as chemical, construction materials etc;
- Whole life cycle assessment including steel consumption reduction, long service life, green consumption etc;
- Accelerated development of environmental protection industry.

**Medium/Long-term:**
- Develop CCS and applied in the steel industry.
3.2 Orientation of low carbon development—green modification

- High efficiency environmental treatment technologies
  - Organized waste gas treatment technologies
  - Unorganized waste gas treatment technologies
  - Waste water treatment technologies

- High efficiency energy saving and low carbon technologies
  - C reduction technologies
  - C-free technologies
  - C removal technologies

- High efficiency recycling technologies
  - Production reducing technologies
  - Solid waste comprehensive utilization technologies

Coordination of these three categories.
3.2 Orientation of low carbon development —— lean management

- High efficiency management structure;
- Professional team
- Training

Concept of zero waste, zero emission and zero pollution.

Energy management system
- Benchmarking、BAT
- Performance improvement

Environment management system
- Monitoring system
- Summary management system
- Energy management center
3.2 Orientation of low carbon development —— Developing a Circular Economy

**Circular economy**

**Features**
- Resource saving
- Recycling

**“3R” Rules**
- Reduction
- Reuse
- Recycling

**Development mode**
- Small circle by enterprises;
- Medium circle by regions;
- Big circle by society

**Details**
- Energy saving
- Clean production
- Ecological park
- Circular society

**Aims**
- Eliminate conflict between environmental protection and economic development
- Maximum reduce impact of human activity to the environment

**1. Enterprises**
Fully use resources and promote clean production from the source of production.

**2. Regions**
Extend producing chain.

**3. Society**
Combine industry and agriculture as well as production and consumption by ecological chain to realize sustainable production and consumption.
3.2 Orientation of low carbon development —— Developing a Circular Economy

- Research on integrated technologies of clean steel manufacturing with high efficiency and low cost;
- Sample of new generation steel plant;
- H analysis and high value utilization;
- Seawater desalination and chemical utilization;
- Gas recovery and power generation;
- Slag processing and construction utilization;
- Surplus heat for urban utilization etc.
3.2 Orientation of low carbon development —— Developing a Circular Economy

**Diagram of Circular Economy of Zhanjiang Steel—Zhongke Refining and Chemical Project**

- **4 rules**
  - Ecological benefit
  - Operational
  - Dynamic development
  - Innovative practice

- **5 systems**
  - 2 enterprises
    - Integration of steel and chemical industries
    - Processing extension and supporting service
    - Intensive city
    - Ecological and environmental protection

- **6 projects**
  - Mutual supply of Hydrogen and fuel
  - Industrial gas joint project
  - Chemical-Steel Thermal and Power joint project
  - Solid waste treatment and recycling project
  - Water integration project
  - Information integration project

**Industrial coupling system**

- Economical town system
- Refining and Chemical
- Iron and steel

**Extension and supporting system**

**Ecological and environmental protection system**

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Eliminate the capacity, not comply with regulations, industrial policies or criterions by means of strict enforcement and supervision in environmental protection, energy resources, quality, safety and technologies in order to promote healthy and sustainable development of steel enterprises, which represented by more space given by environmental protection, high profitability contributed by energy conservation, big market share relied on quality and brand, substantial security supported by safe production and solid foundation depended on technologies improvement.

Provide a smooth channel to encourage steel enterprises to remove capacity by means of reduction on the enterprises’ own initiative, M & A, transformation, international cooperation etc emphasizing the enterprises without production or cannot survive. It is also strictly prohibited to restart the production once market becomes better.

2月4日，国务院发布《关于钢铁行业化解过剩产能实现脱困发展的意见》

设置五条红线，凡是有一项不达标的钢铁产能必须退出

污染物排放达不到《钢铁工业水污染物排放标准》等相关要求的钢铁产能，实施按日连续处罚，情节严重的，责令停业、关闭

对能耗达不到相关强制性标准要求的钢铁产能，应在6个月内进行整改，确需延长整改期限的可提出不超过3个月的延期申请，逾期未整改或未达到整改要求的依法关停退出

立即关停并拆除400立方米及以下炼铁高炉、30吨及以下炼钢转炉、30吨及以下炼钢电炉等落后生产设备，对生产地条钢的企业，要立即关停，拆除设备

对钢材产品产品质量达不到强制性标准要求的，依法查处并责令停产整改，如果在6个月内未整改或整改后仍不合格，则要依法关停退出

对未达到企业安全生产相关标准要求的钢铁产能，要立即停产整改，如果在6个月内未整改或整改后仍不合格，则要依法关停退出
3.2 Orientation of low carbon development —— promote high efficiency utilization of scrap

- In 2017, Chinese steel reserves is about 7.8 billion tons, the same expected to be 10 billion tons up to the beginning of the 14th Five-year, and to be 12 billion tons up to the beginning of the 15th Five-year.
- It is estimated that annual scrap output in China is more than 100 million tons, the same expected to be more than 200 million tons at the end of 14th Five-year or in the 15th Five-year.
- Development of EAF steel in China will pass three stages briefly i.e. Primary stage: percentage of EAF steel in China will be 15%-20%; rapid growth: percentage of EAF steel will increase from 20% to 30% as well as slow down and balance: percentage of EAF steel reaches a new balance complying with varied conditions at that time refer to market, resources, environment, technologies, power etc.
3.2 Orientation of low carbon development ——develop steel further processing

- Changed the steel industry from conventional production-oriented manufacturing into service-oriented manufacturing;
- Set up a bridge between steel companies and end users;
- Develop steel further processing characterized by industrial extension and modern service.

Solution 1
Establish resources, process and sense of worth meet the targets and industrial characteristics.

Solution 2
Clear direction; familiar with the sector and target customers; further understanding of industrial rules and resources distribution.

Solution 3
Be capable of handling target business; professional team to deal with specific business.

Solution 4
Diversified and innovative system i.e. cross sector development of steel companies by means of joint venture, M & A etc.
3.2 Orientation of low carbon development —— intelligent manufacturing

Accelerate integration of network, procurement, R & D and service to reduce comprehensive cost of industrial chain.

Integrate production, logistics, equipments and energy by timely data collection and information share to optimize resources allocation and reduce energy consumption and cost.

Improve utilization rate of equipments and materials by means of automation, integration and intelligence modification to improve productivity and proportion of high quality products.
3.2 Orientation of low carbon development —— life cycle assessment based on steel products

Life cycle green design technologies

Green design and green manufacturing LCA and application

Analysis on modification potential of whole process energy saving and Optimized production plan based on LCA
3.2 Orientation of low carbon development ——new energy promotion as per local conditions

Renewable Energy Development Plan in the 13th Five-year Period

Renewable energy indicators: By 2020, all renewable energy power generation installed 680 million kilowatts, accounting for 27% of total electricity generation.

Green Plant Construction Requirement

- The plant has an energy management system;
- The plant built photovoltaic power plant;
- The plant uses low-carbon, clean new energy;
- Renewable energy is used instead of non-renewable energy when feasible;

Bayuquan Steel: 11 wind power generators with installed capacity of 15750 KW, and power generation of 79.83 million kWh in total; utilization rate of unit turbo is more than 80%; annual generation of photovoltaic is about 146000 kWh with productivity of about 80%.

Baowu Group: Sample photovoltaic power generation project with capacity of 50MV.
3.2 Orientation of low carbon development ——Energy-saving, Environmental Protection Industry

Integrated environmental project service covering design, manufacturing, construction and operation characterized by innovative mode and recycled resources.

Energy-saving and environmental protection products: R & D, manufacturing and processing of core environmental equipments emphasizing De-S, Denitration and dedusting; establish producing base capable of manufacturing, fitting and assembling to improve market share.

Integration of steel companies and urban development
1. Environmental products utilization;
2. Urban waste water utilization
3. Urban reclaimed water utilization
4. Waste recycling to realize zero discharge.

Jinan Steel
1. Stepped water utilization;
2. EPC of water treatment;
3. Internal pollution charge;
4. Zero discharge of living waste water

Tangshan Steel
1. Modernized water treatment center;
2. Utilization of reclaimed water;
3. Waste water further treatment

TISCO
1. Water consumption management;
2. Utilization of reclaimed water;
3. Utilization of urban waste water;
4. Wet air cooling technology

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3.2 Orientation of low carbon development ——reservation of advanced energy saving technologies

Advanced low carbon technology is becoming the core competitiveness of a country, a sector and an enterprise.

Promote and accelerate self independent innovation to develop, reserve and adopt advanced energy saving technologies complying with transformation and upgrading of Chinese steel industry such as slag surplus heat recovery and recycling, complex iron making and coking, coordinated optimization of material flow, energy flow and information flow (big data), CO₂ capture, utilization and storage etc. Pay more attention to the application cost. And implement combined innovation mode covering production, education, research and application.
Consulting headquarter of government institutions
Guide in steel industry
Brain trust of enterprises planning

Authorized qualification: MPI was established under the approval of the State Council in 1972, which is one of the first engineering consulting institutes with First-grade qualifications.

Excellent references: MPI has already finished more than 5,000 projects providing service for more than 200 government departments, industrial associations, more than 400 metallurgical companies and more than 50 overseas enterprises.

Human resources: The employees who have obtained doctor’s and master’s degrees account for 90% of the staff, those who have been awarded high-level technical titles account for 70% of the staff, and those who are state registered consulting engineers, senior technicians or who enjoy special government subsidy account for 50% of the staff.
Advantages of MPI

- Familiar with market situation, clients’ requirements and development of down-stream industries
- Understand government policies
- Rich experience in consulting of metallurgical industry
- Energetic team with specialties covering whole process of metallurgical industry
- Strong innovative power, quick response, high efficiency
- Client-oriented, wide range of contacts, integrated service

China Metallurgical Industry Planning and Research Institute

http://www.mpi1972.com
Main body together with two drives

- Planning and Consulting
- Standardization
- Intelligent Manufacturing
Consulting headquarter of government institutions

MPI undertook basic research of preparation of development plan of steel industry from the 5th Five-Year Period up to the 13th Five-Year Period. MPI also participated in formulation of important industrial policies such as Development Policy of the Steel Industry, Adjustment and Rejuvenation Plan of the Steel Industry etc. MPI has assisted MIIT completing the research on formulation of development plan of the steel industry in the 13th Five-Year Period.
Guide in steel industry: MPI takes lead in China in carrying out market investigation and medium and long term demand forecasts of the iron and steel products. It also organizes the drafting of the Provisional Regulations for Feasibility Study and Economic Assessment of Investment Projects in Iron and Steel Industry and Technical and Equipment Policy for iron and steel industry.

Brain trust of enterprise planning: MPI has already accomplished over 5,000 cases of general planning and consulting services for hundreds of large and medium metallurgical enterprises. MPI participated in planning and research of major domestic steel projects such as Caofeidian of Shougang, Bayuquan of An Steel, Zhanjiang of Bao Steel, Fangchenggang of WISCO etc, as well as completed five-year development plan for many Chinese steel companies.
Development plan in the 13th Five-year Period

Since the end of the 12th Five-year Period, MPI prepared strategic development plan in the 13th Five-year Period for many steel companies such as WISCO, HBIS, Shandong Steel, Benxi Steel, Baotou Steel, Shaanxi Steel, Valin, Rockcheck, Guizhou Steel Rope, Huinan Steel etc.

Specific plan helping companies to improve competitiveness

New business fields include: green development plan, environmental diagnosis, research on One Belt One Road and going abroad of steel enterprise, further processing plan, diversified business development plan, research on cost reduction and efficiency improvement, logistics optimization, management improvement, intelligent manufacturing, E-commerce, mechanism reform, human resources optimization etc.
International cooperation and service

MPI has provided such consulting service as market research, feasibility study and equipment purchasing for Singaporean, Indonesian and China’s Taiwan and Hong Kong companies who wish to establish joint ventures or solely foreign founded enterprises in China. MPI have provided service and participated in the research of such projects as the construction of Zimbabwe steel plant, Australian direct reduction iron project, Malaysia and Indonesia’s technical service. In recent years, MPI participated actively in consulting of national development plan together with China Development Bank carrying out site investigation in Australia, Africa, South America, CIS, Southeast Asia etc, in order to provide reference for decision-making.
China Steel Series Report
China Steel Series Report is a kind of industrial consulting report sincerely prepared by MPI on the basis of rich experience accumulated from more 1800 cases including annual and quarterly forecast report, market analysis report of long products, plate and pipe, as well as market analysis of iron ore, coke, non-ferrous metal and ferroalloy.

Information service
MPI provides additional information service for customers of China Steel Series Report including monthly report, daily highlights, industrial observation etc to ensuring more convenient and comprehensive service.

China Metallurgical Industry Planning and Research Institute
**MPI’s effort to promote low carbon development**

### Topic research
- Carbon verification, target break-up, emission coefficient research, technical support etc cooperate with NDRC, the Ministry of Science and Technologies, the Ministry of Environmental Protection, Quality Inspection Bureau etc.

### Methodology formulation
- Participate in formulation of calculation methodology for the steel and coking industry;
- Participate in standard formulation of greenhouse gas emission calculation and submission of steel companies.

### Consulting
- Tailored energy saving and low carbon development plan for steel companies

### Research on carbon quota distribution plan
- Set up industrial carbon emission data base;
- Industrial carbon emission data analysis;
- Research and formulate carbon quota distribution plan.
MPI’s effort to promote low carbon development

- **2008**: Research and Calculation of CO$_2$ Emission of Key Large/Medium-scale Steel Enterprises with Capacity of more than 5 million tons

- **2009**: Research and Calculation of CO$_2$ Emission of Key Large/Medium-scale Steel Enterprises with Capacity of more than 2 million tons

- **2010**: Break-down and Implementation Plan of CO$_2$ Emission Intensity per unit GDP Decreased by 40%-45%

- **2011**: Research on Potential of CO$_2$ Emission Reduction of Industrial Kiln and Furnace and Pollutants Coordinated Control

- **2012**: Research on CO$_2$ Emission Coefficient of the Steel Industry

- **2013**: Research on Supporting Technologies of Emission Reduction of Chinese Emission Intensive Industries
  - Climate Technology Needs Assessment
  - Research on Key Emission Reduction Technologies of Chinese Steel Industry
  - Calculation Methodology of Guidance of Calculation of Greenhouse Gas Emission of Chinese steel companies
  - Calculation Methodology of Guidance of Calculation of Greenhouse Gas Emission of Chinese Coking companies
  - Low carbon development plan for steel companies such as Xiangtan Steel, Eastern Special Steel, Nanjing Steel etc.

- **2014~now**: Low carbon development plan for steel companies such as Xiangtan Steel, Eastern Special Steel, Nanjing Steel etc.
MPI’s effort to promote low carbon development

Key Tasks of Low Carbon Development

1. Analysis on basic data of carbon emission of the steel industry; research on low carbon development route.
2. Research on strategies, policies and development of low carbon development of Chinese and overseas steel industries.
3. Promotion and application of advanced and available low carbon technologies.
4. Strategic low carbon development plan for steel companies.
5. Carbon finance and carbon asset management of the steel companies.
MPI’s clients

China Metallurgical Industry Planning and Research Institute

http://www.mpi1972.com
Thank you for your attention!

MPI is your reliable partner

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