Coal Industry in China: Evolvement and Prospects

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1. Summary

China is the biggest country of coal production and coal consumption in the world (IEA). In 1998, China produced 1250 Mt of raw coal, accounting for 27.5% of total coal production in the world, and holding 71.9% of primary energy in China (SSB). Coal provides 77% of the energy for power generation, 65% of chemical raw material, and more than 50% of commercial civilian energy. The coal industry and relative sectors offer a lot of job opportunities. The economic development and social life in China are based on domestic energy production. Coal occupies more than 90% of proven reserves of nationally conventional energy (SETC). Therefore, the coal industry will still play a dominant role in national economy and social development in a quite long period in the future.

The Chinese coal industry is a large sector set up according to the model of the former Soviet Union, which includes geologic prospecting, coal mine construction, equipment manufacture, coal mine exploitation, coal preparation, products distribution, education, scientific research, design, information service, and non-coal industry.

At the present time, the coal mines in China are divided by the ownership into three kinds: state-owned key coal mines, state-owned local coal mines, and town and village coal mines. In 1998, there were about 72,000 coal mines in the country, including 593 state-owned key coal mines, 1,640 state-owned local coal mines, and 70,000 town and village coal mines. The coal industry has 6.6 million employees, including 4.1 million people in state-owned coal mines. The state-owned key coal mines have 204 billion yuan of originally fixed assets, and the total production value of national coal mines is 146.36 billion yuan, including 89.37 billion yuan in state-owned key coal mines. There are 233 coal preparation plants in state-owned key coal mines with annual production capacity of 346.6 Mt, 36 coal mechanism plants, 25 geologic prospecting teams, 124 coal research institutes and 29 coal design institutes, totaling 10,000 people (SCIB).

The coal supply and demand in China have changed dramatically since 1997, and the coal production dropped from 1397 Mt in 1996 to 1045 Mt in 1999.

The coal industry in China is suffering reform travails and is confronted with a serious predicament. 80% of the state-owned key coal mines had losses of about 3.7 billion yuan in 1999. Coal oversupplied and prices fell. The coal payment in arrears by users had amounted to 33.1 billion yuan by the end of 1999, and 73 coal mines defaulted their staff salaries of 7.5 billion yuan, concerning millions of their employees (Pan, 2000). At the moment, coal industry is deepening further reform and quick reshuffling, and a favorable turn has appeared recently.

From a long view, coal will still be a main engine in economic growth in China, and it will become a competitive, clean and high-efficient energy.

2. Coal Resources (SETC, SCIB, SDPC)

The main coal-forming periods in China are different between the North and the South. The coal-forming period of the North was in the late Carboniferous-early Permian Epoch, early-middle Jurassic Epoch, and late Jurassic-early Cretaceous Epoch, while the South's was in the late Permian Epoch. The E'er'duo'si coal mine, which crosses the four provinces of Shanxi, Shaanxi, Inner Mongolia, and Ningxia, is the largest one in the world with more than 100 Gt of coal reserves.

According to the third coal resources prediction and evaluation in the country in 1997, there were 5.57×10^{12} tons of coal resources within a depth of 2000 m, 2.86×10^{12} tons within 1000 m were 1.007×10^{12} tons of coal reserves were proven in different degrees by geologists in 1998, 30% of which were equivalent with the proven amount in place defined by the World Energy Commission, and the rest of exploitable coal reserves

were 114.5×10^9 tons.

Of the coal reserves, soft coal makes up 75%, anthracite holds 12%, and lignite constitutes 13%. 25% of coal is suitable as raw materials for coking and producing gas, 75% for power stations. The average sulphur and ash contents of coal reserves for power stations are 1.15% and 16.84%, respectively (Dai, 1997), as shown in Table 1 and Table 2.

Coal reserves in China are distributed broadly but unevenly. All provinces except Shanghai have coal resources. 90% of national coal resources are distributed to the north of Qinling and Dabieshan, while 91% are distributed to the south of the line of Daxing'an'ling and Xuefengshan. Of total coal reserves Shanxi possesses 25.9%, Inner Mongolia 22.4%, Shaanxi 16.1%, Xinjiang 9.4%, Guizhou 5.2%, Ningxia 3.1% and Anhui 2.4%. The seven provinces and autonomous regions amount to 84.5% of the total.

Of coal reserves in 1998 there are 30% with coal seams less than 300 m deep , 40% with coal seams between 300-600 m, and 20% with coal seams of 600 m-1000 m.

The condition of excavating coal is very bad in China. The reserves suitable for open-cast mining are very few, only occupying 7% of the total reserves, and 70% of strip mines are lignite. For the moment, thin seams with thickness less than 1.3 m and seams thicker than 3.5 m have 8% and 43% of the total output, respectively. Coal seams with an inclination of more than 12 degrees have an output of 44% of the total, and 46% of mines aregassy mines (with more than 10 m^3/t/d of gas emission). The Ordovician limestone in North China threatens the excavation of its upper coal seams.

3. Coal Production

3.1 Coal Output and its Mix

Raw coal output in China was 620.0 Mt in 1980, which leaped to 1116.4 Mt in 1992, ranking first in the world by overwhelming the U.S.A. The output reached the highest of 1397.0 Mt in 1996, and it appeared to increase negatively with output dropping greatly in 1997. The output in 1999 went down to 1045.0 Mt while it was predicted to descend further to 870.0 Mt in 2000.

Owing to closing down a lot of illegal small-scale coal mines, the output of town and village coal mines deceased by 250.0 Mt to 320.2 Mt in 1999, with their proportion of national total coal output falling from 43.1% to 30.6%. The output of state-owned key coal mines dropped by 16.5 Mt to 512.7 Mt, with the proportion rising from 39.9% to 49.1%, while the output of state-owned local coal mines dropped by 16.5 Mt to 512.7 Mt, with the proportion ascending from 17.0% to 20.3% compared with 1997, as shown in Table 3.

Of the raw coal output of 1232.5 Mt in 1998, 44.9% was for coking, and 32.4% for power stations; 18.6% was classified as anthracite and 4.1% was lignite, as shown in Table 4.

Coal can be produced by all the 31 provinces, cities directly under the jurisdiction of the central government, and autonomous regions in the Chinese mainland, except Shanghai and Tianjin. In 1998, the coal output of nine provinces and autonomous regions exceeded 50 Mt, of which Shanxin has an output of 307.2 Mt, Shandong 89.77 Mt, Henan 86.91 Mt, Inner Mongolia 77.23 Mt, Heilongjiang 70.90 Mt, Guizhou 65.61 Mt, Sichuan 56.96 Mt, Liaoning 56.44 Mt, Hebei 56.37 Mt. The outputs of the nine provinces make up 70.4% of the national total. Please see Table 5. In comparison with the highest output in 1996, the output of Shanxi, Sichuan, and Henan dropped greatly in 1998, falling 42.3 Mt, 38.7 Mt, and 20.9 Mt, respectively. This mainly resulted from a lot of small-scale coal mines closing down, the quality of coal, and other factors which also affect the competitiveness.

There were 17 coal mines with output above 10 Mt in 1998, such as Datong in Shanxin; Xishan, Yangquan, Luan, Pingshuo, Jincheng, and Kailuan in Hebei; Pingdingshan in Henan; Yanzhou and Xinwen in Shandong; Hegang in Heilongjiang; Tiefa, Fuxin, and Qitaihe in Liaoning; Huaibei and Huainan in Anhui; as well as Xuzhou in Jiangsu. The output of coal mines leaped; the first five are Datong with 28.65 Mt, Yanzhou with 21.79 Mt, Kailuan with 18.65 Mt, Pingdingshan with 18.47 Mt, and Xishan with 16.12 Mt. Please see Table 6. The main indexes of the Chinese coal industry between 1981 and 1998 can be seen in Table 7.

3.2 Coal Mine Extraction

Most Chinese coal mines are excavated with mine development methods whose outputs in 1998 accounted for 96.7% of the national total.

In 1998, there were 593 state-owned key coal mines, 227 of which have annual capacities above 900 kt and constitute 73.7% of the total output, 163 of which fall between 900-300 kt and hold 18.1%, and 203 of which produce less than 300 kt and make up 8.2%. China owns a batch of large-scale coal wells with high advanced mechanization, and there are 11 coal mines with annual output above 4 Mt, of which Dongtan coal mine in Yanzhou and Daliuta coal mine of Shendong Coal Company have outputs exceeding 5 Mt. The Daliuta Coal Mine set up in 1996 adopted coal-cutting equipment from the Joy Company in the U.S.A. In 1999, Daliuta produced about 5.107 Mt of raw coal with a production of 41.5 t per employee. Their target in 2000 is to reach an annual output of 8.4 Mt with 365 employees, producing 83 t per employee, thus getting to the most advanced level in the world (CIRI, 2000(1)).

Almost all state-owned key coal mines employ the long wall mining method. The coal faces mined by the long wall method account for 96% of total mining output. China has possessed the capacity to design and manufacture by itself sets of fully-mechanized long walling equipment suitable for geological conditions with multiple coal seams. In 1998, the mechanization of coal cutting in state-owned coal mines amounted to 73.6%, while full mechanization reached 49.3%. Fully-mechanized mining technology with top-coal-caving for thick seams, created solely by China, has reached the world advanced level. In 1999, there were 23 coal mining teams adopting this technology with annual outputs exceeding 1 Mt. A coal cutting team in the Dongtan coal mine in Yanzhou has created a new record of producing about 5,057,861 tons of raw coal annually (CIRI, 2000(2)).

Most of the local state-owned coal mines adopt mining technologies with partial mechanization. The town and village coal mines usually are extracted manually, and almost half of them employ primal production patterns.

3.3 Open-cut Working

At the early period of the 80s, China began to speed up developing open-cast mines, introducing foreign capital and technologies, building up large-scale open-cut mines, including the Antaibao open-cast mine of Pingshuo in Shanxi with an annual designed capacity of about 15 Mt and an investment of $0.64 billion U.S. The Antaibao mine was set up in 1987 in cooperation with the Daoxi Coal Mine Company, a subordinate of the West Oil Company in the U.S.A. In 1991, the West Oil Company retreated from the cooperation.

In 1998, China had 70 open-cast mines with annual capacity of 52.4 Mt and an output of 40.5 Mt, constituting 3.3% of the total raw coal output (Yan *et al.*, 2000). Of these, there were 15 state-owned key coal mines with annual production capacities of 40.8 Mt, an output of 30.8 Mt, and an average stripping ratio of 4.3. The largest open-cast mine is the Antaibao coal mine in Pingshuo, which has an output of 11.81 Mt, 6612 employees, and produced 12.81 t per employee in 1998.

Chinese open-cut mines adopt multiple extraction processes. At the moment, 10 m^3 power shovels with and 108 t self-dumping cars can be manufactured by ourselves. 16 m^3 and 23 m^3 electric excavators , 154 t self-unloading trucks, and 3100 m^3/h buckwheel excavators can be produced in cooperation with foreign companies, with which an open-cast mine with an annual output of 5-10 Mt can be equipped.

In comparison with developing pits, there are some advantages to exploiting opencast mines in China:

- The investment ratio of coal tonnage in a new open-cast mine is 20%-30% lower, and its construction period is 1/4-1/3 shorter than a new open-cast mine;
- The production cost is 1/7 lower;
- Production is one time higher;
- The conditions for safe production are good;
- Coal recovery can reach as much as 95%, compared with about 50% in large-scale mines.

There are 58 Gt of unmined coal reserves and 30 Gt of prospected lignite reserves suitable to open-cast working. These coal resources are mainly located in Inner Mongolia, Shanxi, Yunnan and Xinjiang. During 1996 and 2000, the construction of national open-cut mines reached 27.9 Mt/y, accounting for 25% of national state-owned key mines under construction. It is predicted that the annual output of open-cut mines in China can come up to 80 Mt in the early 21st century and 150 Mt in 2010 (He *et al.*, 1998).

3.4 Productivity

The coal industry is one of the departments whose staff is largest. In 1998, the employees in the coal system amounted to about 6.6 million, of which the state-owned key coal mines have 2.64 million people, local state-owned key coal mines 1.46 million and coal mines belonged to TVEs estimated at 2.5 million (Yan *et al.*, 2000).

The working productivities of Chinese coal mines are very low. The coal production only reached an average value of 187 t per capita in 1998;the state-owned key coal mines value was 191 t. The figures amount to 11,890 t in America and 10,800 t in Australia (IEA, 1999). It weakens greatly the comparative advantages of cheap labor and abundant coal reserves.

3.5 Safety in Coal Mines

In the last twenty years, the coal mines in China have improved greatly their safety conditions; however, the mortality rates for accidents in coal mines are the highest in the world.

Between 1980 and 1999, the mortality rates for accidents in coal mines in China descended greatly from 8.17 to 4.54 people/Mt, of which the state-owned coal mines decreased from 4.53 to 0.966 people/Mt as shown in Table 8. But the fatal accidents in town and village coal mines are very serious. In 1999, the figure is up to 10.99 people/Mt, and there are up to 334 accidents with more than 3 deaths per accident and the total death of 2174 people. Of all the accidents gas explosions headed the list with 2075 deaths, accounting for 60% of total accidental deaths (Pan, 2000). The main reasons are that execution of the laws is not strict; small coal mines without basic safety conditions have not been closed down; some accidents have not been disposed of legitimately; safety management is weak; most fatal accidents result from violating regulations in operation; workers in town and village coal mines seldom receive training; and the educational achievement of coal mine workers is low, 50% of whom are illiterate or semiliterate.

On Nov. 7 1992, China enacted “Safety Laws in Mines,” which has been in effect since May 1, 1993. The law regulates some issues pertaining to the security guaranties of mines’ construction and operation, the safety management, safety supervision and accident disposal, as well as relative law duties in mines’ enterprises. Based on it, the coal industry revised “Safety Laws and Regulations in Coal Mines.” The State Coal Mine Safety Supervision Bureau, subordinate to the SETC, was established in Jan. 2000 in order to strengthen safety supervision in coal mines. The State Coal Mine Safety Supervision Bureau has set up 19 provincial supervision bureaus, and 68 offices in large- and medium-scale mines, forming a perpendicular management system.

3.6 Coal-related Diversified Economic Enterprises

During the mid 1980s, coal mines started to make great efforts to develop diversified economic enterprises in order to improve the economic efficiency and allocate laid-off employees. The government has extended credit of 2 billion yuan with discounted interest for supporting coal-related diversified economic enterprises since 1993. In 1998, the total turnover of coal-related diversified economic enterprises got to 53.8 billion yuan, and their employees amounted to 1.637 million people, including 43.15 billion yuan and 1.414 million people for state-owned key coal mines.

4. Coal Preparation (CPUA, Ye, 2000)

Typically only coal for coking and power generation for export was processed before the 90s. China’s coal processing capacity has increased considerably, but the ratio of raw-to-processed coal is stagnant. The development of coal preparation has been improved by a competitive coal market and more stringent laws, regulations, and standards in air environmental protection in the recent ten years.

In 1985, the country had 105 coal preparation plants with annual disposal capacity of 144.2 Mt. At the end of 1998, there were 1581 coal preparation plants with a total annual disposal capacity above 494.3 Mt and an annual disposal capacity above 30 Mt each, including 1492 plants for coking with an annual disposal capacity of 337.1 Mt and 101 plants for power stations with an annual disposal capacity of 157.2 Mt. Of these, there were 233 state-owned key coal preparation plants with an annual disposal capacity of 346.6 Mt, and 1348 local state-owned and town and village coal preparation plants with annual disposal capacity of 147.8 Mt. 3/4 of these plants have been set up since 1995, and most of them are small-scale coking coal

preparation plants.

In 1998, there were 310 Mt of raw coal processed, occupying 25.2% of raw coal output, of which 210 Mt were coal for coking, and the cleaned coal output was 140 Mt, exceeding market needs; 100 Mt of coal for power plants was processed, and its share of raw coal was 15%. The coal preparation plants for coking and power plants collectively utilized 2/3 of their capacity. The coal preparation output and share of raw coal of the state-owned key coal preparation plants as shown in Table 9.

The raw coal preparation output in 2000 is predicted to be 386 Mt with a share of raw coal of more than 40%.

At the moment, 80% of cleaned coking coal is provided to the metallurgy industry, while the rest is destined for the chemical industry, city gasification, foundries, and for export. The cleaned power coals can mainly be offered for gasification, blast furnace, generation, and export.

With the development of coal preparation, commercial coal quality has been improved enormously. Compared with 1995, the average ash and sulphur contents of cleaned coking coal decreased from 10.03% to 9.85% and from 0.85% to 0.74%, respectively; the average ash and sulphur contents of processed coal for power stations respectively dropped from 12.38% to 12.10% and from 0.74% to 0.64%; and the average ash and sulphur contents of coal for power generation descended respectively from 28% to 26%, and from 1.30% to 1.02% in 1998.

The coal preparation technologies in China have also made obvious progress. In 1998, there were 32 large-scale coal preparation plants with annual disposal capacity above 3 Mt and their total capacity of 138.6 Mt. The coal preparation plants located in Fan Ge Zhuang and Qian Jia Ying in Kailuan and Baodian in Yanzhou are the largest ones for coking with an annual disposal capacity of 4 Mt each. The largest coal preparation plant for power stations is the Antaibao plant in Pingshuo with an annual capacity of 15 Mt.

The main coal preparation method in China is jigging. 59% of coal mines use jigging, 23% employ heavy medium separation of coal, 14% adopt coal floatation, and 4% use other methods. China has had the ability to design and manufacture sets of equipment with annual disposal capacity of 4 Mt for coal preparation plants. At present, the investment cost of new-built coal preparation plants has an annual disposal capacity of 50 yuan per ton.

The share of raw coal washed in China is still on the low side. The main obstacles hindering the development of coal preparation are:

- Lack of incentive policies for coal preparation for power plants;
- The washability of raw coal in China is rather bad; moreover, the coal preparation technology falls behind, so the processed coal output ratio is low (the cleaned coking coal output ratio is 57.8%), its ash content is high, and its sale prices are much higher than raw coal.
- The comparative prices of commercial coal are irrational;
- Some time is still needed to implement rigorously the laws and regulations of air protection and emissions standards.

5. Coal Mines' Construction

China has undertaken the largest aggregate coal mine construction project in the world during the last 20 years to meet its increased need for coal. 786 coal mines with a total annual output of 344.5 Mt and each with an annual output of more than 30 kt, were built and put into operation between 1981 and 1998. By the end of 1998, there were 277 coal mines under extended construction, with total annual production capacity of 172.5 Mt. During the same period there were 92 coal preparation plants being set up with a total annual production capacity of 156.0 Mt.

Between 1981 and 1998, the total investment in coal mine construction amounted to 154.95 billion yuan. The investment composition has changed greatly, with more sources of capital. The state investment ratio fell from 69.4% between 1981 and 1985 to 14.3% between 1996 and 1998, while domestic loans went up from 6.1% to 67.8%.

In 1997, the investment per ton of the newcoal mines was 500 yuan calculated from construction to put in operation.

The coal industry is the one of the most important fields introducing foreign capital into China. The accumulative foreign capital introduced into Chinese coal mine construction reached $4.18 billion U.S., 78.6% of which are from foreign government loans. There are 23 projects utilizing foreign capital with annual production capacity of 96.4 Mt.

18 key projects in China's coal industry are under construction: five coal mines with a total annual production capacity of 17.2 Mt located in Gujiao, Yangquan, Jincheng, and Liliu in Shanxi; open-cast mines of 12.0 Mt and 5.0 Mt in Zhun'ge'er in Inner Mongolia and Pingzhuang Yuanbaoshan, respectively; three coal mines with 11.1 Mt in Yanzhou and Zhaoteng in Shandong; three mines with 8.8 Mt in Huainan and Huaibei in Anhui; five mines with 7.5 Mt in Pingdingshan, Yongxia and Zhenzhou in Henan; two mines with 2.4 Mt in Shuangyashan and Qitaihe in Heilongjiang; three mines with 3.0 Mt, 1.65 Mt and 1.8 Mt located in Huating in Gansu, Lingwu in Ningxia, and Weixia in Hebei, respectively.

The mine construction technologies in China have made great progress. The freeze sinking, shaft drilling, smooth blasting, bolting, and shotcreting have reached the advanced-world level. Large shaft drilling machines especially for coal mines have been designed by China and have equipped 47 wells with a maximum diameter of 9.3 m and the longest depth of 508 m (CST, 1997).

6. Coal Consumption

6.1 Coal Demand

With the high-speed development of the economy since the 80s, the coal demand dramatically has gone up. The domestic coal consumption in 1980 amounted to 601.1 Mt, which reached a peak of 1345.9 Mt in 1996 (according to the survey of SPDC and former Coal Industry Department). The figure started to fall to 1310 Mt in 1997. In 1999, it is about 1150 Mt.
The reasons for this large decrease in coal demand are:

- The economic growth speed slowed down. It was 9.6% in 1996; however, in 1999 it descended to 7.1%
- The structure of industry departments, including sectors, enterprises and products has changed. The energy consumption per unit of output value of industry went down an annual average of 6.3%, while the energy consumption per unit of GDP declined 4.5% on average.
- The coal quality improved. According to the survey, the thermo-value of national coal for power stations rose 300 kcal/kg on an average, which cut down the coal need above 70 Mt.
- Imported oil has proliferated. The net imported oil in 1996 was 13.93 Mt, however, it grew to 43.81 Mt in 1999.
- Closing down the small enterprises with high-energy consumption. A batch of small enterprises with high-energy consumption and heavy pollution in the sectors of power, metallurgy, construction materials, petrochemicals, etc. The power industry plans to close down small-scale coal power plants with installed capacity of 30 GW that will be replaced by new large units. It is estimated that the coal can be retrenched 40 Mt yearly.
- The end-users changed to use clean and high-efficiency energy. From 1996 to 1998, the power consumption per capita for living of inhabitants grew from 93.0 kWh to 111.2 kWh, the number of inhabitants in cities and towns using gas increased from 0.138 billion people to 0.16 billion people, and the construction area provided with district heating grew from 734 Mm^2 to 862 Mm^2.

6.2 Consumption Mix

The coal consumption mix has made great change. The proportion of coal consumed for power generation in the total coal consumption went up greatly, rising from 18.0% in 1980 to 37.4% in 1997. The coal for transportation dropped from 3.2% to 1.1% because the railway department is increasingly switching from internal-combustion to electric locomotives. The energy use in civil and commercial departments changed to high-quality energy, such as power, gas and heat, directly decreasing coal combustion; their coal consumption fell from 21.5% to 10.6% of the total coal consumed. Please see Table 10.

6.3 Coal Trade

In 1998, the inter-provinces trade volume of domestic coal was 847.8 Mt. There are six provinces

(autonomous regions) with net output exceeding 10 Mt: 277.55 Mt for Shanxi, 26.85 Mt for Inner Mongolia, 16.46 Mt for Henan, 14.97 Mt for Guizhou, and 10.30 Mt for Heilongjiang and Shaanxi. 10 provinces and cities directly under the jurisdiction of the central government and autonomous regions have more than 10 Mt of net input: 44.31 Mt for Jiangsu, 34.04 Mt for Zhejiang, 31.72 Mt for Liaoning, 30.44 Mt for Shanghai, 29.39 Mt for Hebei, 25.05 Mt for Hubei, 20.75 Mt for Tianjin, 18.20 Mt for Guangdong, 13.31 Mt for Shandong, and 12.57 Mt for Beijing. For the regional distribution of China coal consumption and production see Table 11; for coal transportation see Table 12.

The coal export by China has increased greatly since the middle 1980s (please see Table 13). The export in 1985 was 7.77 Mt, and it grew to 37.41 Mt in 1999. The coal is mainly exported to Japan, South Korea, Hongkong, and Taiwan. Little coal is imported, and only 1.58 Mt of coal in 1998 were from Australia, Russia, and South Africa. Please see Table 11.

The China National Industry Import and Export Corporation is the main agency for coal export in China, and there are other companies which can deal with export, such as the China Mines Import and Export Co., the Shenghua Group Co., and the Coal Import and Export Co. in Shanxi province.

7. Coal and Environment

The production and utilization of coal deteriorate the environment, which has become the main concern in China.

7.1 The Effect of Coal Production and Utilization on Health and the Environment

The effects of by coal production include:

- Subsidence. The subsidence of land is about 30 ha whenever mining one million tons of coal. Up to now, the total subsidence acreage exceeds 600,000 ha, 50% of which is fertile land. At the moment, the reclamation ratio of state-owned coal mines is 13%, and the ratio for mined-out area of opencast mines is 10%.
- Coal Refuse. About 130 Mt of gangue will be discharged, piling up to 3300 Mt, and occupying the lands area of 17,000 ha. Of more than 1500 gangue mountains, 125 are in spontaneous combustion. At the present, the national utilization of gangue is 300 Mt, 30% of which is for power generation, 25% for construction materials, 20% for constructing roads, and 23% for filling materials of mines.
- Methane from Coal Seams. In 1998, the methane emissions from national coal mines totaled about 8 billion cubic meters.

The effects on the environment made by coal utilization:

- The hazards of indoor pollution to health. In 1998, 78% of Chinese inhabitants still used coal and biomass for cooking and heating, which leads to indoor air pollution and undermines people's health. Its hazards can be mentioned in the same breath with smoking. In villages, air pollution indoors brings about a high proportion of diseases in the respiratory system. In 1995, the mortality rate of village inhabitants caused by respiratory disease was as high as 169.4 people in every 100,000, the leading cause of death.
- Air pollution in cities. Urban pollution in China is typically caused by soot. In 1995, the national SO_2 emissions reached 23.70 Mt, and it reduced to 20.90 Mt in 1998, 85% of which were from coal combustion. SO_2 emissions dropped further to 18.58 Mt in 1999. The national area covered by acid rain has burgeoned to over 1/3 of the state's lands. The economic losses caused by acid rain reach 110 billion yuan annually.
- CO_2 emissions. China has become the second largest country of CO_2 emission in the world. 85% of CO_2 comes from coal combustion. In 1996, CO_2 emission from coal combustion in China occupied 29% of the world total. In the last years, coal consumption in China abated greatly, subsequently, CO_2 emission lessened. The CO_2 emission from coal combustion in 1999 is estimated to fall to 120 Mt-C compared with 1996, which contributed to reduced emissions of GHGs.

7.2 Environmental Laws and Regulations

The environmental regulations concerning coal in China mainly are: Air Pollution Control (1987, revised in 1995, 2000), Water Pollution Control (1984), Solid Rubbish Environment Control (1995), Land Management Law (1986, revised in 1988, 1998), Mineral Resources Laws (1986, revised in 1996), Mines' Security Laws (1992), Regulations of Land Reclamation (1988). Of these, the most effective law on coal industry is the air pollution control law. For the emissions standards of coal power plants see Table 14.

In 1998, pollution control methods in acid rain- and SO_2-control areas in China started to be executed:

- New mines with sulphur content above 3% are forbidden; the exiting mines are restricted to produce and

requested to close down.
- The sulphur content of coal used in cities must comply with government regulations. Beijing has stipulated that the cities and their suburbs are prohibited from using coal with sulphur content above 0.5% and gas content exceeding 10% (except coal for the chemical industry, metallurgy, and power generation) since Aug. 1998.
- New coal power plants are prohibited in large and medium cities and their suburbs, except IGCC plants that produce power by heat.
- New and rebuilt power plants with sulphur contents exceeding 1% must be equipped with desulphuration facilities.

On April 29, 2000, China promulgated the second revised version of Air Pollution Control, which has been put in practice since Sep.1, 2000. The Law stipulates:
- Carrying out the total control. Confirming the control area of air pollutant emissions and key cities carrying out air pollution control. Checking and ratifying the air pollutant emissions of enterprises and institutions in the control area, and granting emission permits.
- Carrying out levying fees for air pollutant emissions.
- Restricting exploitation of coal mines with high sulphur and gas content.
- Encouraging the development and promotion of CCTs.
- The new and rebuilt power plants and other large and medium enterprises with SO_2 emissions above the emission standard or the total control indexes must be equipped with desulphuration facilities, or take other control methods.

Implementing the law will change the regional distribution of coal production. Those coal mines producing high-sulphur-content coal will be closed down, while the mines with low-sulphur-coal will increase their production. This will lead to improvements in the development of the clean coal technology, such as coal preparation, etc., to raise the coal utilization, to reduce the coal demand, and to create conditions for applying market tools such as emissions rights trading.
China has started to levy an SO_2 emission fee according to the standards of about 200 yuan per ton of SO_2 emissions in the two provinces of Guangzhou and Guizhou, Chongqing, Yibin, Nanning, Guilin, Liuzhou, Changsha, Hangzhou, Qingdao, and Yichang since 1992. From March 1, 2000, the SO_2 emission fee will be charged by 1200 yuan per ton of SO_2 emission. Levying a high SO_2 emission fee is one of the important measures for transferring the environmental costs into internalized costs. It will weaken the competitiveness of coal while strengthening the competitiveness of clean energy.

8. Reform and Reshuffle

Like Eastern Europe and Russia, the reform of the Chinese coal industry relatively lags behind other sectors because the coal industry is a typical symbol of a traditional planned economy, which is called “the latest fortress” of the old system. So the reform is very difficult and needs to take great venture.
In comparison with the countries in the period of transformation, the reform moves of the Chinese coal industry shares many common grounds with them in: opening coal prices, gradually abolishing loss subsidies, withdrawing the governmental institutes managing the coal industry, closing down enterprises with losses, pushing forward shareholding reform and reshuffling, etc. The reforms in China distinct from others are (to begin with) encouraging rural collectives and individuals to open mines.

8.1 Encouraging the development of town and village coal mines

The town and village coal mines in China include those collective and private coal mines opened by towns and villages, the collective ones opened by the state-owned coal mines, and others (such as the ones by light industry).
The town and village coal mines are the combinations of the rural economic reform with our special situations, which mainly result from broad distribution of coal resources, the transfer of large quantities of rural surplus labor, and the strong desire to get rid of poverty.
In April 1983, the State Council stipulated “8 measures speeding up the development of small-scale coal mines,” which inspired rural collectives and individuals to open mines. The town and village coal mines have been growing swiftly, their outputs in 1985 reached 283.2 Mt, increasing 113.1 Mt over the output in 1983. The highest level of 637.7 Mt was reached in 1996, which went up 4-fold compared with the output in 1980, occupying 45.6% of the national total raw coal output and amounting to 34.6% of national total output of primary energy. The newly augmenting coal output was totally produced by town and village coal mines

during 1991 and 1995.
60% of the coal produced by town and village coal mines offers supply for local consumption and 40% for sale in other places outside of the county, of which 20% was transported outside of the province which amounts to 1/4 of national inter-provinces coal output. The town and village coal mines brought about the development of rural construction materials, power industry, metallurgy, mechanism, chemical industry, food industry, transportation, and services. The output values of these sectors constitute 30% of the national total village industry values, which offer job opportunities for more than 20 million rural surplus laborers, make the remote villages break away from poverty and well-off, and provide a large amount of capital for local agricultural development.
The town and village coal mines have made a great contribution to improving the development of agriculture and social and economic development of the countryside, to alleviating the country's financial burden, to easing up the intensive energy supply, to ameliorating the pattern of coal industry, and to recycling coal reserves abandoned and unable to be exploited by large coal mines (this part of coal reserves almost occupying 30% of the outputs of town and village coal mines). They provide beneficial inspiration for the market economic system set up by the state-owned coal mines.
The main obstacles existing in town and village coal mines are: mining illegally and randomly, weak management, high casualties and mortality, and serious waste of resources. In order to facilitate their sound development and strengthen the sector management, the State Council promulgated "the management ordinances of town and village coal mines" in Dec. 1994.

8.2 Coal Price

The reform of coal prices in China has gone through a long and tortuous process. In 1992, the government decided to open the injunctive coal prices of the state-owned key coal mines, meanwhile abolishing the loss subsidies. By July 1994, all prices, except the coal for power generation, had been opened. The government still controls the coal allocation and prices for power generation of the state-owned coal mines. When the coal prices are lower than market prices the government will offer some subsidies.
Opening the prices is one of the important reforms in the Chinese energy department, which plays an important role in pushing the market reform of the coal industry. However, coal prices do not reflect the whole supply cost; together with the market's continuous weakening, the coal selling prices of most state-owned coal mines can not compensate their production cost.
The tax reform in 1994 had a great impact on coal price and coal operation. First of all, a product tax of 3% was changed into a value-added tax of 13% (the standard tax ratio is 17%), which caused coal prices (excluding the taxes) relatively to decrease, and lessened the coal revenue. So the government returns a certain ration to coal mines considering the added taxes levied on coal, and makes up the losses of key state-owned coal mines as a form of subsidies.
Secondly, the reform of the resources tax and compensating royalty. The new resources tax is trying to regulate the incomes produced by different levels of resources, to spur the rational development of resources, and to raise prices. The coal resources tax ratios are 0.3-5.0 yuan/t, the resources compensating royalty is levied at 1% of products' sales. The resources tax is levied according to output. In fact, it does not react on regulating the revenues caused by different levels of resources and heightening the coal resources' recovery rate; in reverse, it will place a heavier burden on coal mines.
The outstanding problem existing in coal prices is the very high expenditure of intermediate links. The various fees and added prices with different items levied by circulating process and local government makes the delivery prices far higher than their ex-factory prices. In June 1996, the ex-factory price of high-quality coal for the power station in Datong in Shanxi was 172 yuan/t, the price arriving at Shanghai Port via Qinghuandao Port amounts to 303 yuan/t, and the delivery price of users is much higher.
The government will also levy the railway construction fund in addition to the coal transporting fee levied by the railway department. In 1998, the fund paid by coal mines reached as high as 11.7 billion yuan, most of which was paid by the state-owned key coal mines in midwest areas.
In Aug. 1998, the average price of high-quality coal for power stations was 267 yuan/t; it dropped to 240 yuan/t in Aug. 1999 and increased again to 250 yuan/t in Feb. 2000.

8.3 The Reform of Government Institutions

The Coal Industry Department was withdrawn and reshuffled to the State Coal Industry Bureau under the leadership of SDPC during the reforming of central government institutions in May 1998. The bureau's management functions changed fundamentally: it is no longer in possession of or directly manages the state-owned key coal mines. It mainly takes charge of making the sector's planning, policies, laws and regulations, and implementing the sector's management. The staff was cut by 3/4.
There were 94 state-owned key coal mines and 206 enterprises and institutions wholly handed over to provincial government management from July 24 to Aug. 28 1998.

8.4 The Reform of the State-owned Key Coal Mines

The reform of the state-owned key coal mines is a fight of assaulting fortified positions in reforming the Chinese coal industry.

In 1992, "Enterprises Laws" started to be implemented, which elementarily confirms the enterprises' law status.

In 1995, the pilots of the modernized enterprises' system started to be set up. The Yanzhou Mineral Bureau is one of the 100 pilots; others demonstrated by the Coal Department are the Xingtai, Zhengzhou, Panjiang, Pingdingshan, and Pingshuo coal mines.

In 1997, 32 state-owned key coal mines reshuffled and set up companies. The coal mines of Yanzhou, Datong, Pingdingshan and Kainuan demonstrated enterprise groups and shareholding reform and going into the stock market.

In general, the endeavor of setting up a modernized enterprise management system in state-owned key coal mines has just started, and there is still a long way to go.

At the same time, the state-owned key coal mines implement to reduce staff and improve efficiency and strengthen competitiveness. The state-owned key coal mines cut down 1 million people during 1992 and 1999. The laid-off people went to service centers to obtain employment again. They were paid for basic life fees according the local standards, were organized to take part in training preparations for getting jobs again, and sought job opportunities through various channels. The central finance, unemployment insurance, and the enterprises-with-losses accounted for 1/3 of the life fees of laid-off people. If the two latter were not offered, the central finance would represent all the burden.

The state-owned key coal mines started to be bankrupted from 1999. This is a fateful step in the reform and reshuffling of the Chinese coal industry. The Benxi Coal Mine Company in Liaoning, the Longfeng Mine in Fushun, and 4 mines in Jixi in Heilongjiang declared bankruptcy in succession.

Of the state-owned coal mines, there are more than 120 with exhausted resources, serious losses, high sulphur and ash contents, and no market. Their total production capacity is 90 Mt annually. In 1998, they produced 50 Mt of coal with a loss of 3.5 billion yuan, occupying 88% of the total losses. More coal mines will be bankrupted in the next years.

Staff of the enterprises in bankruptcy will be paid 3 times the enterprises' average salaries for the previous half-year in the cities that they live for their rearrangement allowances. The bankruptcy fee will come from the prices of land used, assets sold off, and loss subsidies, and the insufficient parts are assisted by central finance.

8.5 Closing down illegal small-scale coal mines

Market coal prices started to increase, and the development of the town and village coal mines was uncontrollable after the State Council decided to open the coal prices in 1993. The coal output of town and village coal mines in 1996 went up dramatically 210 Mt over the output in 1992. Coal was seriously oversupplied, and the state-owned coal mines fell into an unprecedented predicament. In Nov. 1998, the State Council decided to close down 25,800 small coal mines with illegal mining and irrational layout until the end of 1999, and the decision has reduced the output by 250 Mt. The coal mines with irrational layout are those that are legally exploited in the scope of the state-owned large coal fields and produce coal with high sulphur and ash content. The country has closed down 33,220 small coal mines, decreasing output by 300 Mt as of May 15, 1995. The number of town and village coal mines was reduced from 70,000 at the beginning of 1998 to 38,000 at the end of 1999. Meanwhile the output abated from 570.4 Mt in 1997 to 320.2 Mt in 1999, and the proportion in the total output declined from 30.6% to 43.1%. 18,900 coal mines are planned to close down, cutting down output by 120 Mt.

Closing down coal mines and cutting down their production have obviously meliorated the industrial structure, and the social stocks of coal decreased by 200 Mt to 154 Mt in May 2000, while coal prices stopped falling and began to ascend again.

On the other hand, some newly appearing problems, which result from implementing administration means, cannot be neglected. The first is the issue of supporting local governments, whose revenues are mainly from these small coal mines; the second is the compensation issues concerning closing down the legal small coal mines; the third is the social issues, such as a lot of people losing their jobs the possible debt entanglements resulting from closing down the mines set up by raising money, etc.

9. Prospects

9.1 The challenges facing with Chinese industry coal industry

- Competitiveness. Coal is confronted with challenges from competitive clean energy sources in the domestic market such as hydropower, natural gas, etc. and from imported coal. In international markets, the competitiveness of exporting coal is gradually weakening, and now exporting coal seldom makes earnings and even is in losses.
- Pressure from the environment. The environmental laws and regulations are becoming more and more stringent, which has become the pivotal factor restricting expansion of coal production and utilization.
- Reform and reshuffling. There exists a series of hindrances in reforming the state-owned coal mines and closing down the mines with losses. The closed small coal mines may see a revival.

9.2 Future Coal Mines

In the predicted future, coal is still the main energy source in China, but its importance will relatively descend. It is newly predicted by experts that national coal demand in 2010 will be about 140 Mt, equivalent with the original planned output in 2000, which is completely unexpected. The coal proportion in primary energy demand will come down to about 60% in 2010. The demand for coal will be about 1800-2000 Mt in 2020, and the proportion in primary energy demand will fall to below 60%.

From a long view, the upper limits of coal supply in China will be 2700 Mt in 2050, and coal will become the clean and highly efficient energy source. 70% of coal can be provided for power generation, and the compound liquid fuels produced by coal will probably exceed 100 Mt.

9.3 Clean Coal Technologies

It is unavoidable that coal consumption in China will increase within 20-30 years. Hence, clean coal is the future of Chinese energy. Please see Table 15 about the progress of CCTs in China.

9.4 Coal Bed Methane

CBM resources are estimated to be 30-50 trillion cubic meters within the seam depth of 2000 m. The China United Coal Bed Methane Corporation (CUCBM) was established in May 1996 and planned to produce 10 billion cubic meters of CBM. The corporation actively develops international co-operation projects adopting the model of sharing output through different quotients. At the moment, the corporation has signed output-sharing contracts with Texaco, ARCO and Philips in the U.S.A. to exploit resources in Huaibei, in Anhui, and in Shanxi in cooperation with the CBM. The cooperation area totals 11,000 km^2 with predicted reserves above 500 billion cubic meters. The CBM in Huaibei has been already tried to extract, and its annual output will amount to 0.5 billion cubic meters. At the same time, CUCBM is prospecting CBM in Qinshui basin in Shanxi and in three rivers and middle parts of Liaoning, etc by themselves.

Table 1 The distribution of coal resources with sulphur contents

		The proportion of various coal classifications (%)					
Coal classifications	Average sulphur content (%)	Coal with very low sulphur content (0.5%)	Coal with low sulphur content (0.5%-1.5%)	Coal below the middle sulphur content (1.0%-1.5%)	Coal with middle sulphur content (1.5%-2.0%)	Coal beyond the middle sulphur content (2.0%-3.0%)	Coal with high and very high sulphur content (3.0%)
The national total	1.10	48.60	14.85	9.30	5.91	7.86	8.54
For power station	1.15	39.35	16.46	16.68	9.49	7.65	7.05
For coking	1.03	55.16	13.71	4.18	3.29	8.05	9.62
North China	1.03	42.99	14.40	16.94	10.74	8.88	3.57
Northeast	0.47	51.66	14.04	19.68	1.92	2.05	0.00
East China	1.08	46.67	31.14	3.70	3.20	4.72	9.21
Middle South	1.17	65.20	12.42	7.66	2.34	5.50	6.71
Southwest	2.43	13.22	10.71	7.52	2.68	17.40	43.61
Northwest	1.07	66.23	6.20	2.50	4.01	9.31	9.98

Source:[7]

Table 2 The distribution of commercial coal with sulphur contents

Coal classifications	Average sulphur content (%)	The proportion of various coal classifications (%) Coal with very low sulphur content	Coal with low sulphur content	Coal below the middle sulphur content	Coal with middle sulphur content	Coal beyond the middle sulphur content	Coal with high and very high sulphur content
The national total	1.08	43.48	18.55	12.80	6.70	6.98	5.82
For power station	1.00	42.13	21.97	15.04	10.30	3.00	4.44
For coking	1.10	45.10	16.63	10.71	3.90	9.69	7.44
North China	0.92	39.14	23.66	19.30	9.85	3.25	1.80
Northeast	0.54	50.68	16.61	3.29	2.15	3.87	0.95
East China	1.12	45.79	20.12	13.37	5.34	5.34	9.89
Middle South	1.18	61.99	11.08	10.07	4.83	7.58	4.44
Southwest	2.13	23.87	10.14	6.77	5.33	14.58	38.66
Northwest	1.42	30.21	12.66	14.22	9.21	25.13	5.75

Source:[7]

Table 3 The raw coal outputs in the enterprises of different ownership in China Unit: Mt

	1979	1980	1985	1990	1995	1996	1997	1998	1999
The national total	635.54	620.13	872.28	1079.88	1292.18	1374.08	1325.25	1232.51	1044.82
The state-owned key coal mines	357.77	344.39	406.26	480.22	482.28	537.25	529.16	503.49	512.71
Local coal mines	277.77	275.74	466.02	599.66	809.90	836.83	790.69	729.02	532.11
Of which:									
Provinces	69.76	66.16	61.95	66.43	57.30	58.81	51.88	48.08	
Special Administrative areas	45.18	42.82	50.92	58.71	62.06	63.81	66.91	62.92	
County	56.52	53.14	69.91	79.95	93.99	99.44	106.88	101.85	
Town and village	106.31	113.62	283.24	346.38	519.63	518.19	486.21	479.23	320.20
Individual				43.31	73.29	96.58	84.21	36.94	
Others				4.88	3.63	-	-	-	

Source: State Coal Industry Bureau

Table 4 Raw coal outputs of different varieties Unit: Mt

	Coking coal	Coal for power station	Anthracite	Lignite	The total
1980	308.33	158.53	128.97	24.31	620.15
1985	391.09	266.69	182.28	32.22	872.28
1990	512.77	308.17	212.85	45.51	1079.30
1995	607.49	370.86	264.33	49.50	1292.18
1996	622.77	411.14	285.65	54.52	1374.08
1997	637.56	388.96	241.57	57.17	1325.25
1998	553.87	399.22	228.65	50.17	1232.51

Note: The raw coal outputs published by the State Statistics Bureau are 1361 Mt in1995, 1397 Mt in 1996, 1373 Mt in 1997, and 1250 Mt in 1998.

Source: the State Coal Industry Bureau

Table 5 The raw coal output in provinces, the cities directly under the Jurisdiction of central government, autonomous regions during 1990-1998 Unit: 10,000 tons

	1990	1995	1996	1997	1998
The national total	107930	129218	137408	132525	123251
Beijing	1003	995	1001	980	954
Hebei	6191	7055	7409	6786	5637
Shanxi	28593	33176	34946	33038	30720
Inner Mongolia	4762	6445	7317	7909	7723
Liaoning	5101	5249	6041	5842	5644
Jilin	2610	2379	2576	2410	2123
Heilongjiang	8263	7851	8147	7547	7090
Jiangsu	2408	2549	2606	2478	2481
Zhejiang	137	113	123	115	109
Anhui	3205	4322	4642	4769	4584
Fujian	925	860	1168	782	727
Jiangxi	2027	2333	2438	2064	1981
Shandong	5995	8384	8949	9094	8977
Henan	9080	10181	10780	10028	8691
Hubei	924	1437	1521	1517	1326
Hunan	3371	4953	5093	4023	3811
Guangdong	890	1069	882	840	682
Guangxi	979	1233	1252	1097	997
Hainan	1	1.5	1.6	1.5	
Sichuan	6785	9739	9567	6222	5696
Chongqing				2787	2042
Guizhou	3695	5510	6143	6597	9561
Yunnan	2227	2789	3072	3297	3103
Xizhang	1		1.0	1	
Shaanxi	3327	3957	4613	4958	4447
Gansu	1564	2209	2221	2293	2316
Qinghai	320	228	297	328	323
Ningxia	1443	1447	1616	1699	1583
Xinjiang	2100	2693	2986	3021	2927

Source: the State Coal Industry Bureau

Table 6 Large-scale coal mines with output above 10 Mt in 1998 in China*

No.	Coal Mine	Output (Mt)	The ash content of commercial coal (%)	Staff at the end of the year (thousands of people)	The staff efficiency of raw coal (t/worker)
1	Datong	28.65	11.98	115.81	3.561
2	Yanzhou	21.79	15.89	65.52	8.896
3	Kailuan	18.65	25.00	99.16	2.454
4	Pingdingshan	18.47	24.38	78.48	3.303
5	Shanxi	16.12	15.98	65.26	5.718
6	Huaibei	14.96	21.32	84.44	1.862
7	Tiefa	14.21	30.52	47.53	6.583
8	Huainan	13.15	25.18	95.29	1.744
9	Xuzhou	12.77	21.06	80.21	2.414
10	Hegang	12.49	19.92	67.27	1.289
11	Yangquan	12.30	18.16	55.80	2.993
12	Lu'an	12.19	16.11	26.53	9.163
13	Pingshuo	11.81	17.88	6.61	12.811
14	Xinwen	11.73	19.54	59.64	2.298
15	Fuxin	11.39	22.26	54.03	2.265
16	Jincheng	10.81	15.79	26.73	6.140
17	Qitaihe	10.43	23.41	59.14	1.236

*the state-owned key coal mines

Source: Same as the State Coal Industry Bureau

Table 7 The main indexes of Coal industry during 1981-1998 in China

	1981	1990	1995	1996	1997	1998
Raw coal output (Mt)	621.36	1079.88	1292.2	1374.1	1325.2	1232.5
Of which, the state-owned key coal mines	335.05	480.22	482.3	537.3	529.2	503.5
The washed coal output for coking (Mt)	51.45	85.51	81.42	87.79	91.64	80.92
The ash content of commercial coal (%)	21.17	18.96	19.97	20.20	20.49	20.21
The refuse rate of commercial coal (%)	0.46	0.12	0.08	0.10	0.10	0.10
The ash content of washed coal (%)	10.34	10.19	10.03	9.88	9.85	9.75
The mechanized degree of mining coal in state-owned key coal mines (%)	39.77	65.10	71.6	72.0	73.3	73.6
Of which, The full mechanized degree (%)	17.67	33.50	46.7	47.2	48.4	49.3
The staff at the end of year in the coal mines opened by the units above country level (10,000 people)	463.38	546.40	508.82	499.0	487.9	460.9
Of which, the state-owned coal mines	273.12	357.15	330.84	322.3	315.7	262.9
The staff efficiency of raw coal in state-owned coal mines (t/worker)	0.870	1.217	1.780	1.923	2.079	2.18
The pit wood consumption in raw coal production (m^3/10,000 tons)	86.80	39.80	30.0	29.4	29.9	27.7
Comprehensive power consumption (kWh/t)	35.68	43.89	54.35	53.47	54.88	56.18

Note: The raw coal outputs published by the State Statistics Bureau are 1361 Mt in1995, 1397 Mt in 1996, 1373 Mt in 1997, and 1250 Mt in 1998.

Source: the State Coal Industry Bureau

Table 8 The mortality rate in coal mines accidents in China during 1980-1999 Unit: people/Mt

	1970	1980	1990	1992	1995	1996	1997	1998	1999
The total	8.20	8.17	6.76	5.25	4.85	4.55	4.68	4.67	4.54
State-owned key coal mines	7.11	4.53	1.43	1.01	1.18	1.17	1.448	1.022	0.966
State-owned local coal mines	10.50	10.19	9.06	4.22	4.89	4.02	4.015	3.760	3.458
Town and village coal mines	9.03	16.88	12.07	10.50	8.45	7.70	7.935	8.602	10.990

Source: the State Coal Industry Bureau

Table 9 The coal preparation output and share of raw coal washed in state-owned key coal preparation plants Unit: Mt

	1980	1985	1990	1995	1996	1997	1998
The total							
Raw coal washed	114.2	142.9	190.9	201.7	212.9	223.4	216.4
Share of raw coal washed (%)	18.4	16.4	17.7	15.61	15.50	16.86	17.56
Coking coal							
Raw coal washed	90.4	107.2	126.8	131.0	135.5	138.1	129.4
Washed coal output	50.8	58.2	67.4	76.4	76.9	80.9	74.9
Productivity (%)	56.16	54.31	53.19	58.33	56.75	58.56	57.83
Coal for power stations							
Raw coal washed	23.40	35.8	64.1	70.7	77.4	85.3	87.0
Washed coal output	20.50	15.7	24.8	55.0	63.0	67.4	66.1
Productivity (%)	85.90	43.81	38.71	77.84	81.31	79.04	76.05

Source: the State Coal Industry Bureau

Table 10 Coal consumption in different departments

	1980	1985	1990	1995	1996	1997
Power generation (Mt)	109.7	164.4	272.0	444.4	488.1	489.8
%	18.0	20.1	25.8	34.2	36.3	37.8
Providing heat for power stations (Mt)	16.8	14.6	30.0	58.9	63.7	62.5
%	2.8	1.8	2.8	4.5	4.7	4.7
Coking (Mt)	66.8	73.0	107.0	184.0	184.6	193.0
%	10.9	8.9	10.1	14.2	13.7	14.7
Agriculture (Mt)	15.5	22.1	21.0	18.6	19.2	19.3
%	2.5	2.7	2.0	1.4	1.4	1.4
Industry (Mt)	250.8	340.2	406.2	415.2	405.4	393.4
%	41.1	41.7	38.5	32.0	30.1	30.0
Transportation (Mt)	19.3	23.1	21.6	13.1	11.8	14.3
%	3.2	2.8	2.0	1.0	0.9	1.1
Civil and commercial use or other uses (Mt)	131.2	179.4	197.4	165.0	173.1	138.4
%	21.5	22.0	18.7	12.7	12.9	10.6
The total (Mt)	610.1	816.0	1055.2	1299.2	1354.9	1310.7
%	100.0	100.0	100.0	100.0	100.0	100.0

Note: 1. The total coal consumption during 1995 to 1997 uses the data in the report of the survey and predicted research about national coal consumption written by a research group of SDPC and Coal Industry Department.

2. The coking coal consumption in 1995 is the data surveyed in 1995, which is relatively real. The statistic data before did not include or failed to report coal consumption used by coking in indigenous methods which brought about the data low.

3. Civil coal consumption is low, and it was 135 Mt in 1995. The yearly consumption exceeds 200 Mt according to the report of Economy Daily in 4 July, 1996.

Source: the State Statistics Bureau, the report of the survey and predicted research about national coal consumption written by a research group of SDPC and Coal Industry Department in 1999.

Table 11 The regional distribution of coal consumption and production in China in 1998

	Consumption	Production
The total (Mt)	1180.0	1232.5
Regional distribution (%)		
North China	21.9	35.6
East China	14.2	12.1
Mid-south	25.3	15.3
South-west	18.4	12.6
North-west	7.6	9.4

Source: [10]

Table 12 Coal transportation in China during 1990-1998

	1990	1995	1996	1997	1998
Railway transportation					
Coal transportation volume (Mt)	628.7	637.6	720.6	703.45	640.81
The proportion in total goods transportation volume (%)	43.0	42.3	44.6	43.5	41.8
Coal turnover (Mt · km)	344640	377718	404847	389365	354208
The proportion in total goods turnover (%)	32.5	29.4	31.3	29.8	28.9
The average transportation distance (km)	548	561	562	554	553
The water carriage directly under the leadership of Transportation Department					
Coal transportation volume (Mt)	78.4	90.7	92.9	85.73	81.19
The proportion in total goods transportation volume (%)	31.2	27.2	27.8	24.7	24.0
Coal turnover (Mt · km)	159325	274678	250339	262670	287655
The proportion in total goods turnover (%)	15.1	18.2	17.0	16.2	17.5
The average transportation distance (km)	2032	3028	2696	3064	3543

Source: the State Statistics Bureau

Table 13 The import and export volumes of coal in China during 1980-1999 Unit: Mt

	Export	Import
1980	6.32	1.99
1985	7.77	2.31
1990	17.29	2.00
1995	28.62	1.20
1996	29.03	3.20
1997	30.72	2.00
1998	32.29	1.58
1999	37.41	

Source: the State Statistics Bureau

Table 14 The emission standards of air pollution for coal power plants in China

The names of pollutants	The upper limits (mg/m^3)
TSP	
Town and village	200
Suburbs	500
The old units with rest lift-span above 10 years	600
SO_2	
The sulphur content of coal 1.0	2100
The sulphur content of coal 1.0	1200
NO_x	
The boiler capacity combusting coal 100t/h	
Releasing sediment in liquid state	1000
Releasing sediment in solid state	650

Note: No requirements for boilers with capacity below 1000 t/h (that is, the units below 300 MW) for the moment.

Table 15 The progress of clean coal technologies in China

Coal preparation	The share of raw coal washed in 1998: 25.2%
Briquette	The civil briquette technologies lead the advanced world level; the popularization rate of briquette in key cities has amounted to more than 80%; the briquette processed for civil use in villages reached 59.5 Mt in 1997. The annual production capacity of briquettes for industrial material is 550,000 tons, and there are 600 production lines of gasification briquette in chemical industry in operation with an annual output of 20 Mt.
Coal Water Slurry (CWS)	The technology of producing coal water slurry has reached the advanced world level. There are about 10 CWS plants which have been set up, with total annual capacity of 2.8 Mt. Some boilers for industrial uses, kilns, and the Baiyanghe power plant in Shandong with 2 × 50 MW are in commercial demonstration
CFBC	There are more than 400 CFBCs with 35, 75 and 200 t/h. A CFBC of 410 t/h (100 MW) imported from Finland is installed at the Neijiang Power Plant in Sichuan, and a CFBC of 300 MW is planning to import.
PFBC-CC	Jiawang Power Plant has set up a middle-scale pilot plant of 15 MW, and is planning to build another pilot plant of 100 MW.
IGCC	The prophase work of commercial demonstration is being carryied out.
Air pollutants control emitted by power plants	The gas and dust emissions have been basically controlled, and there are about 65% of units equipped with electric dust catchers with dust-removing efficiency of 97%. The total capacity of flue gas desulphuration till the end of 1998 has amounted to 1.68 GW, and another 5 GW is under construction and designing.
Coal gasification	The technology of Luqi pressurization gasification for civil coal gas in big cities has been popularized in Lanzhou and Ha'er'bin, and the water gas gasification technology with two boilers has been promoted in small and middle cities; the fuel gas for industry is mainly from the coal gas produced by fixed bed generating boiler with normal pressure; large-scale fertilizer plants using chemical raw material gas have introduced Desigu gasification technology; small and middle fertilizer plants mainly use water gas with normal pressure.
Coal liquefaction	Direct liquefaction. More than 100 varieties of coal have been evaluated for their liquefaction functions, 28 varieties of coal have been tested by small-scale continuous sets with 0.1 t/d, and 14 varieties of coal with good liquefaction functions have been selected. The varieties of coal just inferior to the above are: Xianfeng coal in Yunnan, Shenhua coal and Yilan coal in Heilongjiang. At the moment, cooperation tests with Germany, America, and Japan and feasibility studies for building plants are being carryied out. The Shenhua coal can profit $18 U.S. per bucket. The sets for middle-scale pilot which utilizes indirect liquefaction technology have been set up with an annual output of 2000 tons of synthesized gas produced by coal , and the technology of methane produced by coal has matured.

Source: [12][32][33][34]

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