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China's Macro Economic Trends and Power Industry Structure

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TABLES AND FIGURES

I. MACROECONOMIC TRENDS FOR CHINA

Main Economic Indicators and Their Growth Rates

Economic Growth

Since China adopted an open door policy in 1978, its economy has grown rapidly. Between 1980 and 1993, China's real GNP growth averaged 9.4 percent per year. Economists at the Chinese Academy of Social Sciences forecast that GNP will increase by 11.5 percent in 1994. During the rest of the decade, the Chinese government plans to reduce its annual GNP growth rate to 8-9 percent. During the 2001-2010 period, the economic growth rate is projected to decline to 6.5 percent per year. Table 1 compares China's economic growth to other Asia-Pacific Economies, and includes projections to 2010. During the 1980s, China's GDP growth rate was only second to that of South Korea. In the 1990's, China is projected to have the highest economic growth in the Asia-Pacific region.

China's rapid economic growth is due to dramatic increases in the effective labor supply and effective capital stock. For the remainder of the 1990s, the effective labor supply should continue to increase rapidly because: (1) Chinese state enterprises are over-staffed and labor system reforms will move millions of these workers into more productive activities; (2) reforms in the wage system will provide increased incentives to work harder; (3) relaxation of migration controls from rural to urban areas will cause nominal labor in the industrial sector to accelerate; (4)

differentials in personal income will increase and develop peer pressure on workers to work harder and earn more money[1]; and (5) at China's low personal income level, Chinese people are willing to trade leisure for more income as wages increase.

The effective capital stock will also increase rapidly because: (1) a large potential to improve the efficiency of China's financial system still exists; (2) foreign investment is still increasing rapidly; and (3) personal savings are increasing rapidly (the national savings rate exceeding 30 percent[2]).

Although China's overall economic growth rate has been very high, growth rates across sectors are not consistent. During the first half of 1994, the growth rate of foreign joint venture enterprises was 29 percent; the growth rate of township and village owned enterprises was 24 percent; the growth rate of other collectively owned enterprises was 10 percent; and the growth rate of state owned enterprises was only 4 percent relative to the same period last year.

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[1] A taxi driver in Shanghai told the author that he works 16 hours per day, 365 days per year -- perhaps an exaggeration, but indicative of how hard the Chinese will work when income is tied to the amount of work.

[2] By the end of 1992, China's private bank savings reached 1.1 trillion yuan ($200 billion); private cash holdings reached 350 billion yuan ($60 billion); and total private financial assets reached 1.8 trillion yuan ($310 billion). In contrast, total private financial assets were only 38 billion yuan ($7 billion) in 1978.

Inflation

Currently inflation is a major concern of the Chinese government. In the first quarter of 1994, annualized inflation was 20.1 percent nationwide. Although China's average personal income growth has been faster than the inflation rate, due to increased differences among personal incomes, the low income people, especially retired workers, found their real living standards deteriorated, and started to put political pressure on the Chinese government. The government reduced the credit supply, reduced fixed asset investments, and decreased industrial production in an attempt to control inflation. The government is also expected to impose administrative and legal measures to improve its control over inflation. However, this investment slow-down caused the domestic market to become sluggish. Sales of consumer goods were 352 billion yuan ($40 billion) during the first quarter of 1994, an increase of only 4.2 percent allowing for inflation.

Inefficient state enterprises, new value-added taxes, and consumer taxes caused speculative price increases. Overall output rose 16 percent during the first half of 1994, but state firm production rose only 4.4 percent. Further reforms of the state enterprises are critical to keep inflation under control.

Foreign Trade

China's foreign trade has increased rapidly -- between 1980 and 1993 the value of total exports increased from $18 billion to 92 billion (13.3 percent per year) and the value of total imports

increased from $20 billion to 104 billion (13.5 percent per year). During the first half of 1994, China's total exports reached $48 billion, a 30.2 percent increase over the same period last year. Total imports reached $49 billion, a 21.1 percent increase over the same period last year.

Table 2 shows the composition of imports and exports. Between 1980 and 1993, the share of primary product exports decreased dramatically from 50 percent to 18 percent while the share of primary product imports decreased from 35 percent to 14 percent. Increases in manufacturing product exports were mainly caused by increased exports of miscellaneous manufactured articles, machinery, and transport equipment. Increases in manufactured product imports were mainly led by increased imports of machinery and transport equipment. Major commodities imported (above $1 billion) include: airplanes, automobiles, steel products, crude oil, oil products, chemical fertilizer, chemical raw materials, and equipment sets.

Direct Foreign Investment

In 1986, there were only 1,498 direct foreign investment projects in China ($2.8 billion contract value). Foreign investment has grown steadily since then. While investment growth leveled off in 1989 and 1990, it increased again in 1991 (Figure 1). Since 1992, aided by the "grand tour" of the South by Deng Xiaoping, local governments throughout China have been actively soliciting foreign investment. Consequently, foreign investment in

China has boomed. In 1992 48,764 investment projects worth a value of $58 billion in contract value were concluded, and in 1993 a total of $123 billion in contract value were concluded. Actual foreign investment increased 91.5 percent from $19 billion in 1992 to $37 billion in 1993. During the first half of 1994, the contract value of foreign investment dropped 25 percent from the same period last year; though actual foreign investment increased 55 percent over the same period last year.

The number of firms with foreign investment reached 167,500 by the end of 1993. The provinces with the most foreign investment projects were: Guangdong (44,705 projects), Jiangsu (18,082), Shandong (12,561), Fujian (11,990), Zhejiang (8,085), Shanghai (8,056), Hainan (7,390), Liaoning (7,365), Beijing (6,516), and Tianjin (6,004). The foreign economies with the highest number of projects were: Hong Kong (106,914), Taiwan (20,612), the United States (11,554), Japan (7,096), Macao (4,118), Singapore (3,037), South Korea (2,321), Canada (1,495), Thailand (1,361), and Australia (1,269).

By the end of June 1994, the number of projects with foreign investment increased to 199,678; the total contract value of foreign investment reached $266 billion; and total actual foreign investment reached $77 billion.

Regional Economies and Growth Patterns

Regional economic growth rates in China differ considerably (Table 3). GNP growth rates in 1992 were above 20 percent in the

coastal provinces of Guangdong, Jiangsu, Fujian, and Hainan. If one excludes the three urban areas (Beijing, Tianjin, and Shanghai), then Guangdong Province has the highest per capita GNP, followed by Liaoning (China's largest heavy industry center) Zhejiang, and Jiangsu.

Guangdong has long been considered the engine of China's economic reforms. Its GDP, industrial production, retail sales, capital investment, and exports have had double-digit growth rates for six consecutive years. The provincial government now aims to achieve a 13.4 percent average annual GDP growth and 17-18 percent annual export growth through 2000. Between 1985 and 1992, total exports in Guangdong increased from $3.0 billion to $18.4 billion (about 30 percent per year), while imports increased from $2.4 billion to $11.2 billion (about 25 percent per year).

China's regional economic patterns and economic structural changes are shown in Table 4.

Key Manufacturing Industries

The Chinese economy is categorized into three industries: the first industry includes agriculture, forestry, animal husbandry, household sideline production, and fishery; the secondary industry includes all manufacturing sectors and the construction sector; and the tertiary industry includes services, transportation, commerce, the public sector, and all others. Between 1978 and 1993, the share of the first industry in total GDP decreased from 28.4 percent to 21.2 percent; the share of the secondary industry

increased from 48.6 percent to 51.8 percent; and the share of the tertiary industry increased from 23 percent to 27 percent.

The share of the secondary industry is much higher in China than the United States, while the share of the tertiary industry is much lower. The unit GDP energy consumption in the secondary industry is much higher than in the other industries. In 1991, China's energy consumption per million yuan of GDP in the three industries was 96 tonnes of coal equivalent (TCE), 799 TCE, and 172 TCE respectively. About 70 percent of China's total energy was consumed in the Industrial (manufacturing) sector.

In 1993, heavy industry accounted for 57 percent of China's total industrial output value and 63 percent of total industrial value added. China's heavy industry is divided into three sectors: mining, raw materials, and processing (called manufacturing in Chinese statistics). In 1992, mining accounted for about 18 percent of heavy industry's value added, while raw materials and processing each accounted for about 41 percent.

Table 5 shows that in the industrial sector, machinery (machine building, transportation equipment, electric equipment, electronic and telecommunication equipment, instrument, meters and other measuring equipment) was the top contributor to industrial value added (22%), followed by food (11%), ferrous metals (8%), textile (7%), chemicals (7%), building material (6%), and power generation (6%). In terms of primary energy consumption, however, the top five industries are the chemical industry, the iron and steel industry, the construction materials industry, the mining

industry, and the machinery industry (Table 6).

Between 1980 and 1993, China's chemical fertilizer production increased from 12 million tonnes (Mt) to 20 Mt (3.9% per year), steel production increased from 37 Mt to 89 Mt (6.9% per year), cement production increased from 80 Mt to 357 Mt (12.2% per year). China's regional production of major industrial products are shown in Table 7.

Regional Distribution Of Energy Resources

Coal is the most abundant energy source in China. It is estimated that about 4,500 billion tonnes of coal resources exist to a depth of 2,000 meters, and about 2,000 billion tonnes exist to a depth of 1,000 meters.[3] According to the former Ministry of Energy, proven coal resources based on the Chinese definition reached 967 billion tonnes in 1991, although proven reserves based on the World Energy Conference definition (Proved Amount in Place) were 290 billion tonnes. Among the proven reserves, bituminous coal accounts for 75 percent, anthracite 12 percent, and lignite 13 percent. Only 7 percent of coal reserves are suitable for open cast mining, and 70 percent of this is lignite.

In terms of regional distribution of coal, there are two ways to divide China. The first way divides China into 6 administrative areas and the second divides China into 8 regions based on coal resource concentration and economic development levels.

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[3] Unless otherwise noted, "resources" here refers to the sum of Proved Amount in Place and Estimated Additional Amount in Place defined by the World Energy Conference.

Coal Reserves

The distribution of coal reserves is based on six administrative areas in the Chinese statistics, and the distribution of coal resources is based on eight regions.

China's six administrative areas are: (1) North China (Beijing, Tianjin, Hebei, Shanxi, and Inner Mongolia); (2) Northeast China (Liaoning, Jilin, and Heilongjiang); (3) Northwest China (Shaanxi, Gansu, Qinghai, Ningxia, and Xinjiang); (4) East China (Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, and Shandong); (5) Southwest China (Sichuan, Guizhou, Yunan, and Tibet); and (6) Central South China (Henan, Hubei, Hunan, Guangdong, Guangxi, and Hainan).

Coal reserves are not distributed evenly throughout the nation. More than 80 percent of China's coal reserves are located in North, Northwest, and Northeast China. Shanxi, Inner Mongolia, and Shaanxi provinces account for 27 percent (257 billion tonnes), 21 percent (203 billion tonnes), and 16 percent (155 billion tonnes) of China's total coal reserves, respectively. In the south, coal reserves are concentrated in Southwest China (11 percent of national reserves). With total reserves of over 30 billion tonnes (3% of China's total), Guizhou Province is the most important coal region south of the Yangtze River. Coal production in Guizhou is projected to increase from 45 Mt in 1993 to 60 Mt in 2000 and over 100 Mt in 2020. About 6 percent of China's coal reserves are located in East China, where Anhui Province has the most coal reserves (25 billion tonnes). Central South China is the

most coal-deficient region, with only about 3 percent of China's total coal reserves. Figure 2 shows China's coal fields.[4]

Coal Resources

China's eight coal resource-related regions are: (1) the Central Region (Shanxi, Shaanxi, Gansu, Ningxia, and Qinghai); (2) the West Region (Xinjiang); (3) the North Region (Inner Mongolia); (4) the East Region (Beijing, Tianjin, Hebei, Shandong, Henan, and Anhui); (5) the South Region (Yunan, Guizhou, and Sichuan); (6) the Northeast Region (Liaoning, Jilin, and Heilongjiang); (7) the Southeast Region (Fujian, Jiangxi, Jiangsu, Zhejiang, Hubei, Hunan, Guangdong, Guangxi, Shanghai, and Hainan); and (8) the Southwest Region (Tibet).

China's coal resources are concentrated in the north part of the nation (Figure 3). The Central, North, and West Regions account for 86 percent of China's total coal resources.[5] However, these regions are underdeveloped economically. The social output value of these regions only accounts for 8 percent of the nation's total.[6] The South Region and the East Region account for 12 percent of China's coal resources and 35 percent of social output

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[4] Uneven coal reserves cannot be observed from the map of coal fields (Figure 2). In the south, although coal bearing areas are not rare, coal seams are thin. Therefore coal reserves are not proportional to the areas on the map.

[5] Coal resources refer to the estimated coal resources within the depth of 1,000 meters and above class E level unless otherwise defined.

[6] The total output value of all sectors is called social output value in Chinese statistics.

value, while the Northeast, Southeast, and Southwest Regions account for only 2 percent of coal resources but 57 percent of social output value.

Table 8 shows China's regional distribution of coal resources, regional economic development levels, and the regional shares of the production of major energy consuming products.

Oil and Natural Gas Resources

China's total oil and natural gas resources are estimated at about 70 billion barrels and 300 trillion cubic feet (TCF) respectively. Oil and natural gas reserves are 24 billion barrels and 50 TCF respectively. Approximately 60 percent of China's gas reserves are non-associated and 40 percent are oil-associated.

The exploration of oil and gas in China is also uneven. About 85 percent of the proven oil reserves are concentrated in the eastern portion of China and in the region north of the Yangtze River. Northeast China accounts for about half of China's total oil and gas reserves, followed by East China (18%), North China (14.4%), and Northwest China (14%). Central South and Southwest China have very little oil and gas reserves.

Hydropower Resources

China has the world's largest hydropower potential (378 GW of exploitable hydro capacity). Hydropower resources are mostly located in the Southwest: 24 percent in Sichuan Province, 18 percent in Yunnan Province, and 15 percent in Tibet. The Central

South and Northwest also have relatively rich hydropower potential, while the East, Northeast, and North have very limited hydropower resources (Table 9).

Energy Production and Consumption

Between 1980 and 1993, China's coal production, with an average annual growth rate of 4.8 percent, increased from 620 Mt to 1,141 Mt. Crude oil production increased from 106 Mt to 145 Mt (2.4% per year); and natural gas production increased from 14.3 billion cubic meters (BCM) to 16.6 BCM (less than 1% per year). Electricity generation increased from 301 billion kWh (TWh) to 816 TWh (8% per year), in which hydroelectricity increased from 58 TWh to 146 TWh (7.2% per year).

During the first half of 1994, coal production increased 5.5 percent, crude oil production increased about 1 percent, and electricity generation increased 11.3 percent over first half 1993 levels.

Most of the coal produced is consumed domestically. China only exports about 20 Mt of coal. Due to slow production growth and rapid consumption growth, the surge of crude oil and oil product imports in December 1993 made China a net oil importer for the first time since the mid 1960s.

Coal Production

China's coal mines are divided into three categories: state mines are mostly large mines managed by the Ministry of Coal

Industry; local state mines are mostly medium-size mines managed by provincial, prefectural, and county governments; and TVP mines are mostly small mines owned by townships, villages, and private individuals.

Between 1980 and 1993, China's coal production grew at an average of 4.8 percent per year, increasing from 620 to 1141 Mt. More than 70 percent of coal production increase was due to the growth of TVP mines. During the same period, the share of TVP mines in total coal production increased from 18 percent to 41 percent, the share of state mines declined from 56 percent to 41 percent, and the share of local state mines declined from 26 percent to 18 percent.

TVP mines need very low capital investment and may expand production capacity very rapidly. TVP mines also provide peasants the opportunity to earn more income and therefore are supported by local governments. Currently more than 2 million miners are working in China's TVP mines.

The major problems of the TVP mines are resource waste, the high death rate of miners, and interference on the production of state mines. Recovery rates are in the range of 10-20 percent for TVP mines, 50-60 percent for state mines, and 30-40 percent for local state mines. In 1993, the death rate at TVP mines was 8.5 people per Mt of coal production, 6-7 times higher than that of the state mines. Currently China has more than 80,000 TVP mines, and half of these are illegal. There are 25,000 TVP mines within the territory of the state mines, of which 70 percent are illegal.

During the past 15 years, around 3,000 TVP mines dug into the state mines, which caused more than 3,000 deaths and direct economic losses of 2 billion yuan.

One of the major policy issues in the coal sector is the regulation of TVP mines. In the 1980s, facing serious energy shortages and the peasants' desire to earn more income, the Chinese government, lifted most regulations on TVP mines. This led to a rapid development of TVP mines. However, the resource wastes of the TVP mines and their interference on the production of large state mines are plaguing the policy makers. As soon as the coal shortage situation is improved and peasants are relocated into different jobs as a result of diversifying rural industries, the Chinese government is likely to regulate TVP mines more strictly.

By 2000, China plans to reduce the total number of coal mines by 50 percent from about 80,000 to 40,000. The annual TVP production is planned to be restrained at 450 Mt by 2000. The government plans to reduce the average annual growth rate of TVP mines from 13 percent in the 1980s to about 1.5 percent in the 1990s. The degree to which China can actually strengthen its regulations on TVP mines is not clear at this moment. The result will be determined by the balance of short term versus long term interests, as well as local versus national interests. TVP coal production reached 472 Mt in 1993, and is increasing continuously.

The Chinese government hopes to rely more on large and medium-size coal mines to meet its coal demand. However, the current conditions at state mines are not ideal. Major problems plaguing

state mines include: (1) serious financial problems and insufficient investment in coal development; (2) low production efficiency and excess labor; and (3) insufficient capacity to transport coal to the demand areas.

Traditionally, the Chinese central government invested in state coal mines, and the state-set coal prices were far below market clearing levels. As a result, among the 89 state coal mining administrations, 86 of them (97%) are losing money. Annual losses of the state mines increased from 500 million yuan ($57 million) in 1985 to 12.4 billion yuan ($1.4 billion) in 1991. The cumulative losses of the state mines during 1985-91 were 42 billion yuan ($4.9 billion), while the total government subsidy during the same period was only 19 billion yuan ($2.2 billion). The remaining 55 percent of the losses was covered by cutting expenditures such as maintenance and exploration. This damaged the future productivity of existing mines and limited the ability to develop new mines. In 1992, the losses of the state mines were still more than 10 billion yuan, and the government subsidy was only 6 billion yuan.

In order to solve the financial difficulties of the state coal mines, the Chinese government decided to release controls on coal prices. The Chinese government also reduced its subsidy to the state mines by 2 billion yuan each year and intends to eliminate all subsidies to the state mines by 1996. Production costs of the state mines are projected to increase by 3.6 billion yuan in 1994 due to price increases of raw materials. Although the state mines

have attempted to balance their budgets, including 100,000 lay off from the current work force of 3.21 million miners, coal prices will have to increase at least 10 yuan per tonne on average to cover the reduced subsidy and increased production costs.

The electric power sector has resisted coal price increases. When the Datong Coal Administration (DCA) in Shanxi Province increased the price of coal supplied to the power plants of the North China Power Group (NCPG) by 10 yuan per tonne in late 1993, NCPG refused to accept the price. On December 30, 1993, DCA informed NCPG that if the new coal price was not accepted, it would stop supplying coal. NCPG replied that because electricity price was not allowed to increase accordingly, NCPG cannot accept coal price increases. In the New Year of 1994, DCA stopped supplying coal to NCPG. NCPG reported the situation to the central government, and stopped part of the electricity supply to DCA on January 3, 1994. On January 4, 1994, vice premier Zhou Jiahua ordered NCPG to resume normal power supply to DCA, after receiving an emergency report from the Shanxi Provincial Government. Although both power and coal supplies were resumed on January 4, 1994 after government intervention, the underlying problem was not resolved. Two options were suggested -- to keep the previous coal price and resume the subsidies on coal supplied to the power sector, and to increase the electricity price accordingly. In Northeast China, coal companies required a price increase of 32 yuan per tonne, which also was resisted by the power sector.

Coal productions are limited by China's serious railway

capacity constraints. Coal producers are normally responsible for coal transportation. When coal price controls were removed, China also reduced the railway transportation quota previously allocated to state mines. Since local coal mines have greater flexibility in spending their money than state mines, they have a comparative advantage over the state mines in gaining access to rail transportation. In fact, even before the complete release of coal price controls in 1994, the transportation quota was decreasing. As a result, coal production at the state mines in 1993 decreased by about 10 million tonnes, while coal production at the local mines increased by about 35 million tonnes.

Crude Oil and Natural Gas Production

China has increased its oil exploration and production activities since the fourth quarter of 1993, because it has become increasingly difficult to maintain current production levels at the decades-old oil fields of East China. Onshore, the second round of bidding was launched in January 1994. Offshore, the fourth round of international bidding started in 1993 and concluded in early 1994.

In 1993, oil production averaged 2.88 million b/d, and the major oil fields continued to maintain their production levels. Currently around 96.5 percent of oil production is from onshore oil fields. CNPC, China's national oil company, accounts for over 99 percent of the onshore production while CNOOC with its foreign partners, is responsible for offshore output. During the first two

months of 1994, China produced an average of 2.87 million b/d of oil, of which 34.8 percent was from Daqing, 21.7 percent from Shengli, 10.2 percent from Liaohe, 3.3 percent from offshore, and 1.4 percent from Tarim basin.

With proven oil reserves of 24 billion barrels, China's oil production is unlikely to increase sharply unless new oil fields can be developed quickly. The government claims that recoverable oil reserves in Western China are at least 220 billion barrels, but this number may be overestimated. The claim has not yet been confirmed independently or recognized internationally.

Until recently, natural gas has been overlooked as an important source of energy in China. Few provinces produce natural gas, and natural gas has never exceeded 3 percent of China's total primary energy production. Natural gas accounted for only 2 percent of total primary energy production in 1993. About 95 percent of natural gas is produced by CNPC. Recently, efforts have been made to develop the giant Shaanxi-Gansu-Ningxia gas field in Northwest China as well as the country's offshore gas.

Regional Production and Consumption of Energy

Table 10 shows the regional production of energy in 1992. Shanxi is the most important coal producer (26.6%), followed by Henan (8%), Heilongjiang (7.5%), Sichuan (6.3%), and Shandong (5.7%). Due to resource availability, the shares of Heilongjiang, Shandong, and Sichuan are expected to decrease while the shares of Shanxi, Shaanxi, and Inner Mongolia in the north and Guizhou and

Anhui in the south are expected to increase in the future.

Crude oil is mainly produced in Heilongjiang (39%), Shandong (23.6%), Liaoning (10%), Xinjiang (5.8%), and Henan (5.7%). The Chinese government's current strategy in oil development is to find new sources of oil from all over the country, especially from the western part of the country, to compensate for the likely loss of production capacity in the east.

China's natural gas is mainly produced in Sichuan (42.4%), Heilongjiang (14.6%), Liaoning (13.3%), Shandong (8.9%), and Henan (8.2%); while hydroelectricity is mainly produced in Hubei (17.4%), Sichuan (12.9%), Hunan (8.1%), Fujian (7.3%), and Guangdong (7.1%).

Table 11 shows the regional consumption of energy in 1990. Coal is consumed relatively evenly over the country, with Liaoning, Hebei, Shanxi, Shandong, Sichuan, Heilongjiang, Jiangsu, and Henan above 60 Mt, and others mostly below 40 Mt.

Natural gas is now consumed locally. In the future, China plans to construct two pipelines spanning 880 km under the South China Sea, supplying natural gas to Hong Kong and Hainan from Yacheng. A 780 km pipeline will supply 2.9 billion cubic meters of natural gas to Hong Kong each year starting on January 1, 1996. The other 100 km pipeline will supply 500 million cubic meters of gas to Hainan. An additional 900 km gas pipe-line is planned to supply natural gas from the Shaanxi-Gansu-Ningxia gas field to Beijing. The project is projected to be operational in 1997. With the completion of the first phase, the pipe-line will be able to supply one billion cubic meters of gas annually to Beijing. The

gas field in the Shaanxi-Gansu-Ningxia region is China's largest, covers about 2000 square km of gas-bearing structures. It is reportedly to have verified reserves exceeding 100 billion cubic meters (3.53 TCF).

Energy Consumption Mix and Trends

Coal currently accounts for about three-quarters of China's total primary energy consumption, and is not expected to fall below 70 percent during the 1994-2010 period. Table 12 shows projected coal consumption by sectors.

The electric power sector is a growing consumer of coal in China. Between 1980 and 1993, coal consumption in the power sector (including cogeneration) rose from 123 Mt to 390 Mt, -- an increase of 9.3 percent per year. Coal demand in China's power sector is projected to reach 600 Mt in 2000 and 930 Mt in 2010.

China has over 400,000 industrial boilers, which consume about 330 Mt of coal per year. The average efficiency is about 55 percent, 15-20 percentage points below the achievable advanced domestic level. This part of coal consumption is projected to be price elastic. Coal demand for industrial boilers is projected to increase at a slower speed to 370 Mt in 2000 and 400 Mt in 2010, due to increases in coal prices.

Between 1980 and 1993 China's steel production increased from 37 Mt to 89 Mt, with an average annual growth rate of 6.9 percent. Coal consumption in the iron and steel industry is projected to increase to 200 Mt in 2000 and 250 Mt in 2010.

Coal consumption in the domestic sector is a major source of air pollution in China and thermal efficiency in the domestic sector is very low. Currently about 75 percent of coal consumption in the domestic sector is raw coal and the efficiency is only about 15 percent. Coal demand in the domestic sector is projected to decrease to 150 Mt in 2000 and 120 Mt in 2010.

Coal production in China is currently planned by the government to reach 1.4 billion tonnes in 2000. However, even under conservative estimations, coal demand in 2000 is likely to reach 1.5 billion tonnes. The 100 Mt gap between coal demand and the current coal development plan for 2000 could cause three possible scenarios: (1) an energy shortage will slow down economic growth; (2) the increased marginal return of energy will forth the country to import energy; or (3) China will speed up its domestic energy development to meet the increased energy demand.

The first scenario is unlikely, because as stated earlier, the driving forces of China's rapid economic growth are dramatic increases in the effective labor supply and effective capital stock brought about by economic reforms. China is unlikely to let an energy shortage curb its economic growth as it did under the planned economic system in the 1970s and early 1980s.

Whether China can close the gap between coal demand and supply through increases in domestic production depends on China's future development policies in the energy and transportation sectors. Based on current policy directions, we believe that China will meet most of its energy demand through more rapid development of

domestic coal resources. In South and East China, however, substantial coal imports are likely, due to limitations of domestic transportation capacity.

Oil product consumption in China was 2 million barrels per day (b/d) in 1990. During the next three years, it grew at an average annual rate of over 9 percent and reached 2.7 million b/d in 1993. In 1993, gasoline and diesel consumption rose by 20.9 and 10.1 percent respectively. Given the rapid growth of the economy and the modernization of the country, oil consumption (as a more efficient fuel than coal) is expected to grow faster than most other energy forms for the next few years. It is estimated that total oil consumption in China will grow at an average of about 7 percent per year during the 1992-2000 period and will reach 4.4 million b/d in 2000. Depending on the level of domestic production, China will have to import around 1.0-1.3 million b/d of crude oil and products by 2000. The impact of such an imbalance is likely to be huge as the country has never before encountered large energy deficits under the central-planning regime. The government has adopted the policy of quickly expanding its refinery and petrochemical industry. This policy will increase China's dependence on foreign crude oil but reduce the dependence on oil and petrochemical products.

Although the future of natural gas consumption is subject to great uncertainty, the share of natural gas in total energy consumption is unlikely to exceed 3 percent by 2000.

Currently China has about 45 GW of hydro capacity which

generated 146 billion kWh of electricity in 1993. A main priority of the government is to develop hydropower. Total hydro capacity is projected to reach 75 GW in 2010.

In 1993, China's energy consumption mix was as follows: coal 73.58 percent, oil 19.34 percent, natural gas 1.93 percent, and hydropower 5.15 percent. By 2000, coal's share is projected to decrease to 71 percent; oil's share is projected to increase to 20.8 percent; hydropower will account for 6.2 percent; and natural gas will account for 2 percent.

Transportation Infrastructure

As mentioned before, China's energy production and consumption are critically determined by the nation's transportation capacity. The state of China's transportation sector is summarized in Tables 13-26. Table 13 shows that since 1980, the length of China's transportation routes have increased very slowly. Most transportation demands were met by improvements in the quality of the transportation system and increased transportation distance. Table 14 shows that railways and waterways are the most important means of long distance transportation in China. They represented about 40 and 45 percent of China's volume of freight (in billion tonne-km) respectively in 1992. Highways, however, are important for short distance transportation, accounting for about 75 percent of China's freight transportation (in Mt).

Within the Transportation Department System, coal accounted for 32 percent of China's total freight transportation, and 42

percent of railway freight transportation (Table 15), although coal's share of the volume of freight transportation is lower (Table 16). Freight transportation on China's principal railways in 1992 is listed in Table 17.

Shanxi Province is not only abundant in coal reserves, but also has the highest quality coals in China. Shanxi coal generally is low in ash and sulfur but high in heat content. The coal seams are thick, and mining operating and capital costs are much lower than in southern or eastern regions. Facing the choice between concentrating coal production in the north where costs are lowest or developing more expensive coal resources closer to consumption centers, the Chinese government selected the former. Therefore, transporting coal out of Shanxi Province is the major concern of Chinese planners. In 1992, coal transport through the railway system was 641 Mt (Table 18), of which around 30 percent was from Shanxi Province. In the future, the role of Shanxi in the Chinese coal market will be more important.

The Datong-Qinhuangdao line (completed in 1992) is the most important railway to ship coal from Shanxi. During 1992, 46.5 Mt of coal were shipped out of Shanxi on this line. Currently the line has reached its design capacity of 100 Mt per year. A similar line is planned to start at the Shenfu-Dongsheng coal mine at the juncture of Shaanxi and Inner Mongolia, to run across Shanxi, and to terminate at Huanghua Port in Hebei Province (820 km). A total investment of 10.7 billion yuan ($1.23 billion) is expected, and construction work is expected to last 6-7 years.

Major Chinese seaports and river ports are listed in Table 19 and Table 20 and the throughput of principal Chinese ports by cargo is given in Table 21. Information about China's civilian motor vehicles and vessels are summarized in Table 22. Tables 23 through 26 list China's regional railway, highway, waterway, and airport situations respectively.

II. POWER INDUSTRY STRUCTURE IN CHINA

Energy Policy

For a number of reasons including artificially low electricity tariffs, insufficient investment in the power sector, and insufficient capacity to produce generating equipment, China's electricity supply falls short of demand by about 20 percent, and about 120 million rural people have no access to electricity. Serious power shortages have led to the rapid growth of small, inefficient power plants and environmental pollution which accompanies them. To solve these problems, the Chinese government plans to: (1) encourage foreign and local investment in energy development, especially in the power sector; (2) rationalize energy prices (i.e. move toward market prices); (3) introduce improved technologies to increase the efficiency of energy production and utilization; (4) substitute coal for oil in electricity generation and develop cogeneration; (5) give priority to coal-fired electricity in the development of energy industries; (6) enhance the development of EHV transmission and mine-mouth power plants in north China; (7) accelerate hydropower exploitation to increase its share to 20 percent of total electricity generation; (8) develop the manufacturing and construction technology for nuclear power as soon as possible; (9) reduce coal generated environmental pollution in urban areas; (10) improve the structure and distribution of energy; and (11) place balanced emphasis on energy resource exploitation and conservation.

Foreign and Local Investment in Electricity Development

China's future requirements for investment in electricity development are shown in Table 27. Substantial capital will be required to install new capacity and retrofit existing capacity. Total foreign investment in China's power sector at the end of 1992 was about $12 billion. The largest sources of foreign investment were international financial institutions and foreign governments. Table 28 shows the power projects which have utilized or are planning to utilize foreign loans. The Chinese government hopes that the power sector will attract $25 billion in foreign investment over the 1993-2000 period (more than double the total previous foreign investment). An important shift to greater reliance of foreign private investment in China's power sector is under way. Table 29 shows the joint venture power projects (BOT or BOO) which will start construction before 2000.

The Chinese government's attitude towards foreign investment in the power sector has generated much interest from foreign investors. However, only a few private projects have been completed or are under construction so far. Disagreement regarding the internal rate of return (IRR) and difficulties in obtaining official approval for the projects are among the most important obstacles.

Chinese officials refuse to admit that there is a limitation on the IRRs of joint venture power projects and insist to negotiate on a project by project basis; however, currently if a project has an IRR above 14 percent it is very difficult to obtain approval

from the Ministry of Electric Power Industry (MEPI). Chinese officials believe that the IRR offered to the Shajiao B project is too high. In fact, the North China Power Group (NCPG) currently uses 14 percent as a ceiling and aims for 13 percent. The East China Power Group (ECPG) also has similar targets. On the other hand, most foreign investors want IRRs above 17 percent. For example, the hurdle IRR of the consolidated Electric Power Asia Ltd. (a subsidiary of Hopewell Holdings Ltd.) is currently 18 percent.

Since most foreign investors seek after-tax IRRs on equity in the 17-20 percent range, they must achieve higher off-take, reduced financing costs, and lower operating costs. In fact, a typical IRR calculation in China is often based on operations of 5,500 hours a year, while foreign developers are generally accustomed to operating coal-fired plants at 7,000-7,500 hours a year. However, it is risky for foreign investors to rely on increased generating hours to achieve desired returns because Chinese utilities have a strong incentive to permit domestic power plants to operate longer due to their lower electricity prices. Although there is a clear disagreement in terms of project IRRs between the Chinese and foreign investors, the definition of IRRs is not the same for both groups. Many foreign investors believe that a "face" IRR which is low can be calculated for a project while the "real" IRR may be much higher and more attractive.[7]

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[7] Despite the 18 percent IRR requirement of Hopewell and China's internal guidelines on IRRs, Hopewell still believes that the Shenzhen East joint venture power project will proceed,

Some foreign investors are willing to accept a lower IRR.[8] Therefore the Chinese government feel there is still sufficient foreign interest in China's power sector, although the terms offered by the Chinese are tougher than before. A Chinese official in the NCPG told the author that "we do not care how many people were dissatisfied and left; for each project, as long as one person is satisfied and willing to invest, it is enough for us."

It is difficult to obtain the approval of the State Planning Commission (SPC) and some Chinese power developers see this as the most important obstacle. An official of the NCPG complained that "some projects which satisfy both parties still take a long period of time to obtain the SPC approval or even get refused, and we don't know the reasons." Some Hong Kong power developers believe that in order to be successful in China's power sector, the foreign investor has to know some Chinese top officials.

One reason for the reluctance of the SPC to approve foreign invested power projects is their sensitivity toward being exploited and the fear that China may not have the foreign currency to pay the investors later. In China, officials will not be personally responsible if they fail to grant approval to a good project; however, if they grant approval to a bad project, they will be held accountable. Therefore, SPC officials are traditionally very

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therefore there must be different explanations of IRRs of the project.

[8] A gentleman from Hopewell told the author that the alternative to invest in a power project is to put their money in a bank and earn 6 percent interest. This might explain why some investors are willing a accept a lower IRR.

conservative.

The Chinese government wants to keep as much profit and control as possible in their own hands. Therefore, as foreign interest in China's power sector recently increased substantially, the Chinese government has tried to lower the IRRs of the joint venture projects. Since the profit rate of capital for China's power sector as a whole is currently only 2.5 percent, even a 14 percent IRR is considered high. The main argument supporting the introduction of the more expensive foreign invested power projects is that the economic costs of electricity shortages are much higher than the electricity tariffs paid to foreign developers.

The economic costs of electricity shortages vary dramatically from place to place. While marginal costs of a power shortage are difficult to calculate, it is safe to say that for most industrial electricity consumers, the economic costs of a shortage are significantly higher than electricity tariffs paid to foreign investors.

In 1993 about 240 billion yuan (US$27.6 billion) worth of industrial value added was lost due to electricity shortages in China. This translates to average economic costs of about US$0.17/kWh to the consumer. Economic costs of power shortages in coastal areas are certainly higher than those in inland areas.

According to the Asian Development Bank, the economic loss of each unserved kWh is about US$0.35/kWh in Asia. The economic costs of power shortages in Guangdong Province are estimated to be at least US$0.30/kWh, while the electricity tariffs paid to the

foreign-invested power plants are in the range of 5 to 7 US cents per KWh.

In 1994, the situation of the electricity supply in China seems to have improved substantially. Although the official projection of the average national electricity shortage is still 20 percent,[9] actual situations are much better. China Light & Power Company of Hong Kong, an exporter of electricity to China, estimated that the power shortage in China's Pearl River area is currently less than 10 percent. Officials from ECPG and NCPG admit that the electricity shortage has improved in 1994. This could be another reason that Chinese Officials are trying to get better terms on joint venture power projects.

However, the reduced electricity shortage in 1994 is partly caused by the tight credit supply in an attempt to control inflation. Due to the tight credit supply, many basic construction projects were forced to stop, many enterprises did not receive enough orders and only operated part time, which reduced their electricity demand. This situation should not last in the long run.

The seemingly reduced electricity shortage is also caused by the delay in China's electricity distribution system. Due to limited capital availability, China has been giving priority to power plant development, and to a large degree neglecting the development of the distribution system. For example, many Chinese

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[9] See the speech of Vice Minister of MEPI Cha Keming on the meeting of environment protection of national power industry, May 10, 1994.

households that want to install room air-conditioners found that the distribution system capacity was too small to bear the new load.

To meet the huge investment needs of the power sector, China also turned to local sources. Between 1980 and 1992, the share of central government investment in total power sector investment decreased from 91 percent to 30 percent. At present, the central government's share of investment in any new power project normally is not more than 30 percent, and in many cases is less than 20 percent.

Rationalization of Energy Prices

For a Sino-foreign joint venture project to be initiated in China, it must meet the developer's required rate of return and have an acceptable level of risk. In China, electricity prices are only about 2.5 US cents per kWh for most residential consumers, and are slightly higher for industrial consumers. At such low prices, even domestic power plants with much lower capital costs than imported plants find it difficult to cover all costs. In order to attract foreign investment, tariff controls on foreign-built or foreign-invested power plants have been eliminated.

In 1994, China removed price controls on coal. Even though coal producers did not increase their prices substantially, the prices paid by coal consumers did rise substantially. The difference between these new price levels is attributed in large part to the increased transaction costs of middlemen. For example,

coal prices are about 100 yuan (US$11.50) per tonne in Datong, Shanxi Province, and about 200 yuan (US$23) per tonne in Qinhuangdao. The distance by rail between Datong and Qinhuangdao is 653 km, and the railway freight rate is 5.35 fen (0.6 US cents) per tonne-km. Using these figures, the railway transportation cost should add only 35 yuan (US$4) per tonne to the Datong price. The transaction costs of middlemen account for the remainder of 65 yuan (US$7.50) per tonne.

A two-tier pricing system for crude oil was introduced in 1983, when the government established a 2 million b/d quota for the national oil industry. Output above the quota was sold at much higher "out-plan" prices which are close to international market prices. A similar two-tier pricing system was also introduced in the country's oil refining industry. In 1993, price controls on 14 small-and-medium-sized oil fields were ended. This measure reduced the quota of crude oil to 1.6 million b/d, which accounted for 55 percent of the country's total output.

In early 1994, the government planned to phase in a reform package in order to increase control over the volatile oil market. The package was scheduled to take effect on May 1, but was postponed to June 1, 1994. According to the plan, the two-tier pricing system for crude oil would remain, but both the in-plan and out-plan prices would be fixed, and the ex-refinery prices for oil products would be unified and fixed. Clearly, the plan represents an attempt to return the oil industry to government's control after the chaos of 1993 following what many saw as a too-rapid attempt to

deregulate prices.

Foreign Exchange System Reforms

In January 1994 China eliminated the official exchange rate of 5.7 yuan to the U.S. dollar because it was far below the swap market exchange rate of 8.7 yuan to the U.S. dollar. The current exchange rate of about 8.7 yuan to the U.S. dollar more closely reflects the open market exchange rates.

In addition to a currency devaluation, a national inter-bank foreign exchange trading system was recently established in China. Joint venture projects approved by the State Planning Commission will be reviewed for approval of foreign currency debt service and equity returns by the State Administration of Exchange Control (SAEC). Once approved, the SAEC will issue an annual approval to the joint venture company for the conversion of yuan (RMB) into foreign currency at designated foreign exchange banks. This system has officially replaced the former swap center system and direct payment in foreign currency.

While most agree that recent reforms in China's exchange system reduce exchange convertibility risk, Chinese officials and foreign investors differ regarding the effectiveness of annual re-approval. Although the Chinese government has made it clear that approval is likely if a project is encouraged by the State Planning Commission (such as those involving power stations, railways and wharfs) foreign investors are uncomfortable with the risk that SAEC may refuse to approve at a future date. Some type of well-defined

legal protection of exchange convertibility must be worked out in the near future.

Project Approval Process and Legal Reforms

After months of effort in China to formulate guidelines for foreign investment in the power sector, the approval process for joint ventures in the power sector has become more transparent. The process normally involves the local power bureau, MEPI, and various other related ministries; and ultimately requires approval by the State Planning Commission.

A joint venture power project in China is generally approved by the Ministry of Foreign Economic Relations and Trade (MOFERT), or by institutions entrusted by MOFERT. Steps in the approval process include: (1) project listing, (2) preliminary approval, (3) final review, and (4) SAEC approval. Project listing is often obtained exclusively by the Chinese partner in a potential joint venture project; it is based on a Chinese-produced feasibility study. Preliminary approval incorporates the initial agreements for fuel supply and power purchase along with modifications to the feasibility study. In the final review, the feasibility study is completed and capital cost estimates are finalized.

In November 1993 China's first set of rules governing the supply of electricity nationwide were released. This represented the beginning of legal regulation of the power industry. The rules provide better protection of the interests of foreign investors. Reportedly, China will eliminate its near-monopoly control over the

power industry and will run its power plants in line with international conventions by 1998. Such efforts would further encourage foreign investment into China's power sector.

Introduction of Advanced Technologies to Improve Thermal Efficiency

Between 1980 and 1992, the thermal efficiency of coal-fired power generation in China increased only 2 percentage points, from 27.4 percent to 29.3 percent. Such a low thermal efficiency of power generation is caused mainly by electricity shortages and a pronounced lack of capital. Due to the severe capacity shortages, some of the world's oldest power plants remain in operation in China. China currently has 30 GW of small and low-efficiency coal-fired generators, with average thermal efficiency of less than half of the high-efficient generators.

China's MEPI plans to increase average thermal efficiency of power generation to 33 percent by 2000. This will be achieved by introducing high-efficient generators and by retrofitting low-efficient generators. As a matter of MEPI policy, newly-installed coal-fired generators in the inter-provincial power networks should have a thermal efficiency above 37 percent (or less than 330 grams of coal equivalent per kWh (gce/kWh)). Newly-installed power plants will use mainly 300 MW and 600 MW units for domestically manufactured generators, and 350 MW and 660 MW units for imported generators. During the 1990s China plans to retrofit or eliminate 18.5 GW of the small, low-efficient power plants. However, past experience has shown that when electricity shortages are serious,

small and medium-sized, low-efficient power plants will proliferate, while old power plants will continue in service even though they should be retired.

Development of Coal-Fired Electricity

According to the government, most future fossil-fuel based power stations will be coal-fired. Existing oil-fired units will be converted to coal-fired whenever possible and no new oil-fired power stations will be built in general. During the 1990s, the share of coal-fired power in total electricity generation is projected to be in the range of 71-73 percent and the share of oil and gas-fired electricity is projected at only 4-5 percent. In southern China, especially in Guangdong Province, tight transportation capacity prevents coal supply from meeting demand, thus substantial oil-fired capacity may be installed regardless of the government policy.

The Chinese government plans to build power plants close to the coal mines and transmit the electricity in an effort to decrease coal transportation problems. Shanxi Province alone will build new mine-mouth power plants with an overall capacity of 18 GW. Most of the electricity generated will be transmitted to other provinces.

Coal washing can also alleviate the pressure to reduce coal transportation. Only 18 percent of the coal in China is washed. The Ministry of Coal Industry seeks to increase the percentage of washed coal to reduce the burden on coal transportation.

Figure 4 illustrates China's power development and distribution plans. Mine-mouth coal-fired power plants will be developed in east Inner Mongolia to send electricity to northeast China [1]; in west Inner Mongolia to send electricity to Beijing [2], in north Shanxi Province to send electricity to Tianjin [3], in southeast Shanxi to send electricity to Shandong [4] and Jiangsu [5]. Hydropower will be developed at the Three Gorges Project to send electricity to East China [6], Central China [7], North China [8], and Sichuan Province [9]. Hydropower will also be developed in Guizhou [10], Yunnan [11], and Guangxi [12] to send electricity to Guangdong Province.

Installed Generating Capacity and Mix

Installed power capacity in China increased from 66 GW to 181 GW between 1980 and 1993 (Table 30). The share of coal-fired capacity increased from 51 percent to 66 percent, while the share of hydropower capacity decreased from 31 to 25 percent. Installed capacity is projected to reach 300 GW in 2000 and 530 GW in 2010 under the medium scenario (Table 31). The share of coal and hydro capacity is projected to remain at about the same level during the 1990s (Table 32). Between 2001 and 2010, coal's share of total capacity is projected to decrease gradually to about 60 percent due to the introduction of nuclear power in southeast China.

Thermal Power

China's thermal power plants are mainly coal-fired. By the end of 1992, of the 94 large thermal power plants (600 MW and larger) shown in Table 33 (which accounted for about half of China's total thermal capacity) only two were oil-fired and 8 of them were duel-fired (coal and oil). Oil-fired capacity accounted for only 1.4 percent of China's total thermal capacity. All of the 24,415 MW of large thermal plants under construction or planned are coal-fired.

Small oil, gas, and diesel generators will probably be installed in the rapidly growing areas. For example in Shenzhen, the largest special economic zone in China, oil-fired power plants using imported oil have been constructed in recent years.

Natural gas is mainly consumed in China's chemical industry. Power generation accounts for only about 6.6 percent of total gas consumption, but is projected to increase in the future. Currently the share of gas in thermal electricity generation is insignificant (less than 1 percent). The Chinese realize the advantage of using natural gas as the fuel to generate electricity. However, the supply of natural gas is currently uncertain. If substantial natural gas reserves are discovered, China is likely to move more quickly to natural gas plants. The LNG form of natural gas is, however, considered too expensive.

Nuclear power development has progressed slowly in China. So far, only two nuclear power plants have been built in China, with 2.1 GW of capacity in operation. The 300 MW Qingshan Nuclear Power

Station in Zhejiang Province was domestically designed and constructed. The second plant is the imported Daya Bay Nuclear Power Station in Guangdong Province -- a joint venture with Hong Kong Light and Power Company.

Nuclear power development has recently gained momentum in China due to electricity shortages and continued coal transportation bottlenecks. China also desires the international status associated with a nuclear power sector. China has ambitious plans to have 35 GW of nuclear power capacity installed by 2010. Table 34 shows the location, size, status and technology sources of China's plans. It is important to note that China's large nuclear expansion plans appears overly ambitious. Domestic nuclear technology is still in the demonstration stage and imported nuclear power plants are very expensive. Electricity from Daya Bay will cost about 9 US cents per KWh, while residents in most cities only pay 2.5 US cents per KWh. The capital cost of Daya Bay Power Plant is about $2200/KW and the estimated capital cost of the planned Yangjiang Nuclear Power Plant (an imported plant in Guangdong) is $1727/kw.

Most nuclear capacity is planned for Guangdong Province which is located far from both coal fields and hydro sites. The rapid economic growth and the serious electricity shortages in this export oriented province increase the appeal of nuclear power.

China's nuclear capacity is unlikely to exceed 7 GW by 2000. Most of the planned nuclear capacity will be installed later. We project total nuclear capacity in China at 15-25 GW by 2010.

Hydropower

China's theoretical hydropower potential is 676 GW, of which the exploitable potential is estimated at 378 GW. Now only about 12 percent of exploitable hydropower resources are utilized.

China currently has 90 GW of large hydro projects (with capacities of over 2 GW) in the planning stage. Even though China has installed about 25 GW of hydro capacity since 1980, the share of hydro capacity has decreased. The higher capital costs of hydropower, the location of major resources far from load centers, the decentralization of the power industry, and the high discount rate of investors are the major factors that have impeded hydropower exploitation. Although the government's plans call for a significant increase in hydropower's share in the future, it is projected to remain at the current level of about 25 percent until 2010. Total hydro capacity is projected to reach 140 GW in 2010.

As shown in Table 35, at the end of 1992, China had 42 hydropower stations with capacities of 250 MW and larger, with a total existing capacity of about 19 GW and an additional 16 GW under construction. The average annual operating hours of these plants is estimated around 4,060 hours.

In July 1993, the State Council officially approved the proposal of the Three Gorges Hydropower Project. The project will eventually add 18.2 GW (26X700 MW) capacity. Average annual electricity generation is designed to reach 84.7 TWh, or 4654 hours of average annual operation. The project will be completed in 17 years, with the first phase generation planned in 11 years. The

budget of this key project is projected to be within 50 billion yuan in May 1993 price ($5.8 billion).

Fuel Consumption of Power Generation and Impact on Trade Balance

In 1991, coal accounted for about 91 percent of total fuel needs of China's power generation and oil accounted for only 8 percent. Since 1992, coal consumption in the power sector has been growing over 35 Mt per year, therefore currently coal's share of fuel consumption in the power sector is estimated even higher. Since most fuels consumed in the power sector are domestically produced, they have no direct impact on China's trade balance.

Currently, domestically manufactured power generating equipment can only meet 70-75 percent of China's needs. China plans to add an average of 17 GW per year of installed capacity between 1994 and 2000. The Ministry of Machinery Industry (MMI) will have difficulty meeting this target for power generators (its current capacity is only about 9 GW per year). This imbalance has created a large market for foreign manufacturers of power generation equipment. Importing the required equipment will have a significant impact on China's trade balance. Domestic capital available for power development is estimated to be around 25-30 percent short of actual needs. If foreign investment is invited to cover the shortfall, about $3 billion per year of foreign investment will be needed. Assuming a 15 percent IRR, China's foreign currency expenditure will have to increase about $450 million per year. Unless China can successfully extend its

export-oriented industries its current trade deficit (currently at $12 billion per year) will increase.

Installed Generating Capacity by Province

Installed power capacity by province is given in Table 36. Power sector development in selected provinces are described below:

Guangdong Province

By the end of 1993, installed capacity in Guangdong Province increased to 14.65 GW, but the electricity shortage was still estimated around 30 percent. Installed capacity in Guangdong is planned to increase to 32.13 GW by 2000 and 81.15 GW by 2010. Coal is and will continue to be the main fuel used in Guangdong's power generation. Since the province has only limited coal reserves, substantial coal supplies originate from Shanxi and Inner Mongolia and are shipped through the port of Qinhuangdao. Only small quantities of coal have been imported thus far, and no imports are planed in 1994. However, new coal-fired power plants now under consideration are expected to use imported coal.

Coal-fired power plants (21.18 GW) at a cost of $30 billion are planned for Guangdong Province. The following four projects are under negotiation:

(1) Zhuhai: Ultimate planned capacity of 3,960 MW (6X660); the first phase (2X660) has been under negotiation since early last year it involves GE, Bechtel, Foster-Wheeler, Westinghouse, Combustion Engineering, ABB and Babcock & Wilcox, GEC Alsthom,

Siemens, and Mitsubishi. Zhuhai is a joint venture with Hong Kong magnate Li Kashing in which the local government has 55 percent equity.

(2) Taishan: Planned capacity of 5,280 MW (8X660) and the first phase of 2X660 MW. The project may involve Hong Kong investors.

(3) Shanwei: Planned capacity of 5,280 MW (8X660) and the first phase is 2X660 MW. Currently three developers are competing for financing: Entergy of New Orleans, Marubeni and NEI.

(4) Shenzhen East: This 6,660 MW (10X660) project has a planned first phase of 4X660.

Guangdong is also looking for foreign investors in its second nuclear power plant (2X1000 MW).

Fujian Province

By the end of 1992, total generating capacity in Fujian was 4,018 MW, of which 57.4 percent was hydro. Capacity is planned to reach 6,000 MW by 1995 and 10,850 MW by 2000. A total of 9,345 MW of new projects will be under construction during the 1996-2000 period, including 1,200 MW of nuclear capacity and 1,745 MW of hydro capacity. Fujian has limited coal reserves (only 0.11 percent of China's total) but is rich in hydropower resources. The total exploitable hydro resources in Fujian are 10,750 MW. Currently about 35 percent of hydro resources have been exploited.

Shandong Province

By the end of 1992, Shandong's installed capacity (units of 0.5 MW and above) reached 9,667 MW. Electricity generation in 1992 was 56.6 TWh. By 2000, Shandong plans to add 10,000 MW additional capacity, including the joint venture power projects in Rizhao (700 MW), Laicheng (1,200 MW), Zouxian (1,200 MW), Shiheng (600 MW), Shiliquan (600 MW), and Heze (600 MW).

Shanxi Province

Installed capacity in Shanxi Province was 8.47 GW in 1993. Over 20 percent of the electricity generated in Shanxi is transmitted to other areas. In Shanxi, a total of 22 GW of new coal-fired power plants are planned. Shanxi Province has reportedly signed a contract with an American company to build a power plant in Yangcheng to transmit electricity to Jiangsu Province. Negotiations are being conducted with foreign investors concerning another power station in the same city, which will transmit electricity to Guangdong Province. Shanxi is soliciting U.S. and Hong Kong companies to build a power station in Changzhi to supply electricity to Shandong Province and to build a station in Yangquan to supply electricity to the southern part of Hebei Province. In addition, the rights to develop a power station in Hequ designed to transmit electricity to Beijing, Tianjin and Tangshan were made available to foreign investors along with seven other power stations. Each power station has a planned capacity of 2,000 MW and requires investment of some 10 billion yuan ($1.15

billion).

Inner Mongolia

By October 1993, installed capacity in Inner Mongolia reached 4.67 GW. It is projected that installed capacity will reach 8 GW by 1995. Inner Mongolia has rich coal reserves (proven reserves of 210 billion tonnes, ranking second in China). Among the 8 key open-cast coal mines in China, 6 are located in Inner Mongolia.

Provinces in the Southwest

In the southwest (Sichuan, Guangxi, Guizhou, and Yunnan), hydroelectricity development is accelerating. By the end of 1992, total installed capacity increased to 20.2 GW, of which 9.6 GW are hydropower. A total of 65 hydropower plants (120 GW) are planned in this region and currently 11 plants (10.81 GW) are installed or under construction. In the 1996-2000 period, 6 large hydropower stations (20 GW) will begin construction. Three 500 KV transmission lines have been built to supply electricity to South China.

Provinces in the Northwest

In the northwest (Shaanxi, Gansu, Ningxia, Qinghai, and Xinjiang), both hydropower and coal-fired mine-mouth power plants have been developed. By the end of 1992, total installed capacity in this region reached 14.4 GW and electricity generation in 1992 was 60 TWh. By the end of July 1993, this region had 434 power

plants (0.5 MW and above), of which 259 (5,506 MW) were hydro plants and 175 (8,413 MW) were thermal plants. A total of 37 power plants are owned by the Ministry of Electric Power Industry (27 are thermal power plants (6,835 MW) and 10 are hydropower plants (4,598 MW)). A total of 19 large and medium-size hydropower stations have been scheduled in the Yellow River which will increase total hydro capacity to 15.74 GW after 2000.

Electricity Generation and Consumption by Province

Table 37 shows China's regional electricity generation and consumption. The provinces that export the majority of electricity are Shanxi, Hubei, Inner Mongolia, and Qinghai; the provinces that import a large quantity of electricity are Beijing, Tianjin, Liaoning, Hunan, and Zhejiang.

China's regional electricity utilization capacities are listed in Table 38. Overall, industry accounted for 62 percent of total power utilization capacity, agriculture -- 16.3 percent, residential -- 9.5 percent, and others -- 12.2 percent.

Urban Household Possession of Electric Appliances

China's commercial energy is consumed primarily by the nation's urban population. Economic reforms since 1978 have promoted China's urbanization process. China's urban population increased from 172 to 334 million between 1978 and 1993, while the share of the country's urban population increased from 17.9 to 28.1 percent.

The growth rate of energy consumption in China's residential sector was slightly higher than urban population growth. While the share of residential energy consumption decreased slightly from 15.9 percent in 1980 to 15.4 percent in 1991, residential consumers began switching to higher quality energy sources during the period. Between 1980 and 1990, the share of coal in total residential energy consumption decreased from 90 percent to 80 percent, while the share of electricity increased from 4.5 percent to 12 percent.

Table 39 shows China's regional urban household possession of electric appliances. Possession rates for home appliances in China is still very low, but is growing rapidly. In the future, it is projected that room air-conditioners and hot-water heaters will become major consumer items for Chinese urban households. A recent survey of 35 large-and-medium cities indicated that about 12 percent of the sampled population own air-conditioners and 28 percent plan to buy air-conditioners (People's Daily Overseas Edition 5/18/94).

Electricity Consumption per Unit of GNP

China's average electricity consumption per 1,000 yuan of GDP[10] (in 1993 constant price) rose from 206 kWh in 1980 to 260 kWh in 1993. Table 40 shows that unit GNP electricity consumption is relatively low in energy-poor areas such as Hainan, Guangdong, Zhejiang, Xinjiang, and Fujian but is relatively high in energy-

[10] China's GNP and GDP values are very close. In 1992, the difference between GDP and GNP was only 0.066 percent, therefore we use GDP or GNP according to availability.

rich areas such as Ningxia, Gausu, Shanxi, Qinghai, Shaanxi, and Inner Mongolia.

In the near future, China's electricity consumption per unit GNP in constant terms is projected to increase for the following reasons:

(1) Unit GNP electricity consumption is calculated by dividing total electricity consumption by GNP. The residential electricity consumption is also included. Residential electricity consumption is restrained by the government and therefore is very low. In the future, along with the improvement of peoples living standards, the government will release its restriction on residential electricity consumption and electricity intensive appliances (such as air-conditioners, electric stoves, and electric heaters) will be accepted by Chinese households.

(2) China will become more and more dependent on oil imports. To reduce the reliance on oil imports, electricity will be used as a substitute for oil. For example, diesel engines can be substituted with electric motors and electric stoves can replace LPG stoves. This would replace imported oil with domestic coal generated electricity.

(3) China's TVP enterprises have been growing very rapidly. In the initial stage, TVP enterprises tend to use backward and labor intensive technologies which are not electricity intensive. With the modernization and electrification of the TVP industry, unit GNP electricity consumption of TVP enterprises is projected to increase.

Electricity Consumption by Sectors

China's electricity consumption by sector is shown in Table 41. In 1991, 88.5 percent of electricity was consumed in production sectors, the residential sector and the commercial sector accounted for only 8 and 1.3 percent respectively. However, the shares of residential and commercial sector consumption have been increasing over time. The annual growth rate of electricity consumption in the industrial sector averaged 7.4 percent during the 1980-1991 period, while the electricity consumption growth rates in the residential and commercial sectors were 16.1 and 16.5 percent respectively. If sectoral electricity consumption growth follows the same trend in the 1992-2010 period, then the residential sector's share of electricity consumption will increase to about 15 percent by 2000 and 26 percent by 2010 (Table 42).

In 1992, the share of the residential sector electricity consumption increased to 8.5 percent and the share of the commercial and government sectors combined increased to 5.8 percent (Table 43).

Description of Existing Power Networks and Grids

China has five power networks (each covering 3 to 5 provinces) and 10 provincial power grids (Table 44). By 2000, the Chinese government plans to create a united power network by connecting the Northeast China Power Network (NEPN), the North China Power Network (NCPN), the East China Power Network (ECPN), and the Central China Power Network (CCPN) with 500 kV tie lines.

The Northeast China Power Network

The NEPN covers Liaoning, Jilin, Heilongjiang, and the eastern part of Inner Mongolia. Northeast China is China's major heavy industry base. Economic development in the northeast is largely dependent on the development of the electric power industry. Installed generating capacity in the NEPN is scheduled to increase from 25 GW in 1992 to 46 GW by 2000.

This area lacks primary energy resources. In 1992, hydropower capacity accounted for 17.4 percent of total capacity; and hydroelectricity accounted for only 6.8 percent. Most of the hydro resources in Jilin and Liaoning have been utilized. Remaining hydro resources are mainly located in the border rivers and unexploitable in the near future. Around 30 Mt of coal is imported into this region each year because coal production is lower than demand.

Most new power plants in the NEPN will be installed close to the coal mines in Inner Mongolia (three strip mines which produce lignite), in the east part of Heilongjiang (four major coal mines), in Liaoning (the Tiefa Mine), and in Jilin (the Huichun Mine). Power plants will also be installed close to major ports and railways.

Transmission lines in the NEPN are mostly 220 KV lines. In recent years, however, 500 KV lines have gradually become the transmission backbone of the network, and will further be expanded to supply electricity from mine-mouth power plants to city areas (Figure 5).

The North China Power Network

The NCPN covers Hebei, Shanxi, Beijing, Tianjin, and the western part of Inner Mongolia. At the end of 1992, NCPN had 63 power plans, with a total generating capacity of 25,000 MW. The total length of transmission line of 110 kV and above reached 33,215 km. Total generating capacity in this region is planned to reach 32,000 MW by 1995 and 50,000 MW by 2000.

This region is rich in coal but poor in hydropower resources. A total of 33,800-35,500 MW (17 plants) coal-fired power plants, 1,080 MW hydro plants, and 1,100-1,400 MW pumped storage hydropower plants will begin to be constructed between 1993 and 2000.

500 KV transmission lines have been put into operation to transmit electricity from Shanxi to the load center around Beijing and a tight-tied 500 KV backbone connecting Beijing, Tianjin, Hebei, Shanxi, and Inner Mongolia will be formed (Figure 6).

The East China Power Network

The ECPN covers Shanghai, Jiangsu, Zhejiang, and Anhui. Installed capacity in the ECPN reached 33,000 MW by the end of 1993. This network has five 600 MW units and nineteen 300 MW units. Total generating capacity is planned to reach 55,000 MW and total 500 kV transmission lines will reach 5,000 km by 2000. Currently 88 percent of electricity is from coal-fired plants, 6 percent from oil-fired plants, 5 percent from hydropower stations, and less than one percent from the Qingshan Nuclear Power Plant.

This region is deficient of primary energy. Coal reserves

here account for only 3.7 percent of the nation's total, and hydro resources only 1.8 percent. In the near future, 7 large thermal power plants will be constructed along the east coast, which will include sixteen 600 MW (or higher) units and fourteen 300 MW units.

The ECPN has 73,000 km of transmission lines of 35 kV and above. A network of 500 KV transmission lines was installed (Figure 7), stretching from Jiangsu in the east, Anhui in the west and converging in Shanghai. Tiehuangping Pumped-storage Power Station, Beilungang, Shidongkou (II), Waigaoqiao, and Changshu power plants will be connected with a 500 KV system. The first 500 KV HVDC transmission line in China was built linking Gezhouba Hydropower Station in Hubei with Nanqiao Substation in Shanghai.

The Central China Power Network

The CCPN consists of Hubei, Hunan, Henan, and Jiangxi. At the end of 1992, this network had a generating capacity of 24,150 MW (hydro capacity accounted for 38 percent of total). This region has 50,000 MW of exploitable hydropower resources (84 percent are concentrated in Hubei and Hunan). This region also has 24.5 billion tonnes of proven coal reserves, and 84 percent of them are located in Henan Province.

Between 1991 and 2000, CCPN plans to add 30,320 MW of generating capacity -- 87 percent will be thermal capacity. The following projects are open to foreign investors: (1) Jinggangshan Thermal Power Plant (2X300 MW) in Jiangxi Province, (2) Yiyang Thermal Power Plant (2X300 MW in the first phase and a total of

1,200 MW) in Hunan Province, (3) Huanggang Thermal Power Plant (2X300 MW in the first phase and a total of 1,200 MW) in Hubei Province, (4) Yahekou Thermal Power Plant Phase II (2X600 MW) in Henan Province, (5) Yongchen Thermal Power Plant (2X300 MW) in Henan Province, (6) Huangshi Thermal Power Plant Expansion Project (2X300 MW) in Hubei Province, and (7) Nanchang Thermal Power Plant Expansion Project (2X300 MW) in Jiangxi Province.

At the end of 1992, there were ten 500 KV transmission lines with a total length of 2,183 km in this network (Figure 8). Upon completion of the Three Gorges Project early in the next century, two circuits of 500 KV HVDC lines will be built to supply power to the East China Power Network, and several circuits of AC lines will be built to provide electricity to the Central China area and Sichuan Province.

The Northwest China Power Network

The Northwest China Power Network (NWPN) consists of Shaanxi, Gansu, Qinghai and Ningxia (Figure 9). At the end of July 1993, this network had 13,000 MW of generating capacity, 4,182 km of 330 KV transmission lines, 3,326 km of 220 KV lines, and 14,047 km of 110 KV lines. Generating capacity is planned to reach 20,000 MW by 2000.

The northwest has rich hydropower resources, as well as rich coal resources. Exploitable hydropower resources are 20,000 MW. Coal reserves in Shaanxi, Ningxia, and Gansu are 380, 70, and 8 billion tonnes respectively.

The South China Electric Power Corporation

In order to promote hydroelectricity development in the southwest and transmit electricity to the east, the South China Electric Power Corporation (SCEPC) was established to provide power to Guizhou, Yunnan, Guangxi, and Guangdong Provinces. The four provincial power grids were interconnected in July 1993, when electricity was transmitted from the west to the east (Figure 10).

Major hydropower projects currently under construction include: (1) Tianshengqiao I and II (2,520 MW); and (2) Longtan I (4,200 MW). A 1,261 kg 500 kV transmission line will be constructed between Guiyang and Guangdong.

The Guangdong Power Grid has 500 KV lines linking Shajiao Power Plant to Jiangmen, and most of cities in the province are linked up with 220 KV lines. Guangdong is linked up with Guangxi by 220 KV lines and is also interconnected with Hong Kong and Macao (Figure 11).

Other Provincial Power Grids

At the end of 1992, the Sichuan Power Grid (SPG) had a generating capacity of 7,716 GW, of which hydropower accounted for 33.6 percent. Sichuan has very rich hydropower resources. Exploitable hydropower resources are 91,660 MW and only 4 percent have been exploited. Due to transportation difficulties, the high sulfur coal produced in Sichuan is consumed locally. The first imported FGD equipment was installed in SPG's Luohuang Power Plant. SPG is interconnected with Gansu and Guizhou by 220 KV lines and

with Yunnan by 110 KV lines.

The Shandong Provincial Power Grid has developed very rapidly. 500 KV transmission lines have emerged in Shandong, along with the construction of large thermal power plants in recent years (Figure 12). At the end of 1992, Shandong had 33,041 km of transmission lines above 35 kV, and 602 km above 500 kV. Figure 13 shows China's Fujian Provincial Power Grid.

Transmission System Capacity

China has, for the most part, adopted 500/220/110/35/10 KV levels for its transmission lines. Table 45 shows China's transmission lines and substation capacity. The highest voltage in Northeast China, North China, East China, Central China, Shandong, and Guangdong is 500 KV. 500 KV transmission lines in Guangxi, Guizhou, and Yunnan are under construction. The highest voltage in the NWPN is 330 KV. Along with the construction of the Laxiwa hydro power station (4 GW) in the western portion of the Yellow River, the inter-network tie line between Northwest and North China Networks will have to be built. In South China, Tianshengqiao Station (II) on the Hongshui River will provide electricity to Guizhou, Guangdong and Guangxi through 500 KV lines and will be connected to Yantan Station, Guangzhou Pumped-Storage Station and Daya Bay Nuclear Power Station with 500 KV lines.

The first 500 KV HVDC transmission line, from Gezhouba hydropower station in Hubei to Nanqiao substation with a designed capacity of 1.2 GW and 1,044.5 km in length, was commissioned in

1990. HVDC lines will link major hydropower resources to load centers (usually more than 1,000 km, some even up to 2,000 km), will supply electricity across the sea, and will link regional power networks in the future.

Technology Sophistication

Table 46 shows that in 1992 about half of China's thermal capacity was composed of units above 100 MW each, and half of China's hydro capacity was composed of units above 40 MW each. The most common thermal generator sizes were 200 MW, 100 MW, and 125 MW. In 1992, the number of 600 MW units increased to six; the number of "principal units" (200 MW and above) increased to 241 (60 GW in total capacity) and accounted for 36 percent of China's total generating capacity (compared to 24 percent in 1987).

Currently China has about 30 GW of low-efficiency coal-fired capacity -- the specific coal consumption of these units is over 100 percent higher than that of the larger high-efficiency units. In the 1990s, China plans to replace 18.5 GW of the low-efficiency units with high-efficiency units.

Table 47 shows the energy efficiency trends of China's power industry. Currently China's power plants (6 MW and larger) have an average efficiency of about 29 percent (419 gce/KWh), only modestly higher than the 27.4 percent (448 gce/KWh) in 1980. The overall average efficiency (including all power plants) is only 26 percent. Present efficiency is about 20-25 percent lower than the efficiency of modern power plants located in industrialized countries where

efficiencies are as high as 35-37 percent. The Chinese government intends to increase the average efficiency to 33 percent (370 gce/KWh) by 2000.

Selected other major features of the Chinese power industry are also listed in Table 47. Line (transmission and distribution) loss rates are rather stable at about 8 percent. Average annual operating hours are decreasing over time, with thermal plants averaging 5,451 hours (62%) and hydro 3,675 hours (42%).

Electricity Tariffs

Before 1985, electricity tariffs were under strict government control -- essentially they were fixed. Profits decreased almost 40 percent between 1980 and 1991. The profit rate of the power industry is now only 2.5 percent. Rising fuel costs were an important factor in the rapid profitability decrease of the power industry in the 1980s.

Since 1985, China has used the following multi-rate system: (1) power plants financed by the central government and used "in-plan" coal supplies sold their electricity at the state base prices (in-plan); (2) power plants purchasing high priced fuels were allowed to sell electricity at prices substantially above state fixed tariffs; and (3) some power plants simply charged a processing fee to convert fuels to electricity for their customers, who were responsible for the fuel supplies.

Most older power plants are able to make modest profits because of low capital charges due to state subsidies and/or low

interest rates. However, under fixed electricity tariffs, new power plants have not been able to cover their costs. In order to attract foreign investors and local investors, a new tariff system called "old electricity-old price, and new electricity-new price" has been adopted in China.

Currently, electricity prices throughout China usually consist of three components: (1) the state base prices; (2) a guidance price differential; and (3) a schedule of additional fees and surcharges. These components are added to form the "administered" (in-plan) consumer tariffs and the "guidance" (out-plan) consumer tariffs.

The state base prices are the base prices charged for central government financed power plans. The structure and level of these prices were fully revised in 1993 for the first time since 1976.

A guidance price differential is charged by non-central government financed power plants to reflect their higher costs.

Price levels are different between areas, and typically vary from 0.2 to 0.4 yuan/kWh ($0.023-0.046/kWh), although higher prices are observed occasionally. Prices are lower in poor inland provinces and higher in the fast-developing coastal provinces. In Jiangsu Province, for example, the state base price in 1993 was 0.30-0.35 yuan/kWh ($0.035-0.04/kWh). The guidance price differential was 0.125 yuan/kWh in Nanjing Prefecture, and 0.09 yuan/kWh in Changzhou. The additional fees include: (1) a 0.003 yuan/kWh charge on all consumers in China to help finance the Three Gorges hydropower project; (2) a 0.02 yuan/kWh surcharge for a

provincial power construction fund; and (3) a 0.03 yuan/kWh surcharge for local power construction funds managed by prefectural governments.

The administered price refers to the state base prices plus various fees and surcharges, while the guidance price includes all three components. In Jiangsu Province, about one half of electricity is sold at the administered price, and the other half at the guidance price.

China hopes to abolish the existing two-track price system in 4-6 years. Tariff reforms have been introduced in Shenzhen, located in Guangdong Province. In Shenzhen, electricity tariffs are based on total costs plus a 15 percent "social average profit rate," which results in an average tariff of about 0.54 yuan/kWh ($0.06/KWh).

Unfortunately, the annual price reviews conducted at the municipal, provincial and state levels continue to ignore the true costs. The price as currently negotiated reflects the costs in the previous year. The Chinese government acknowledges the chaotic nature of the current situation and the need to continue reform.

Conclusions

This report has provided national and province level details of economic, energy and electricity patterns in China with long term projections. The detailed information contained in the tables in this report can be useful to obtain a better understanding of the economic and energy situation at the province level. This

information should be useful in targeting priority investment areas.

There is little doubt that China will require substantial injections of foreign capital to sustain the high growth rates in electricity demand projected in this report. Foreign investments in the power sector are expected to account for 20-30 percent of all investments in the power sector over the 1993-2010 period.

The Chinese government at both the national and provincial levels, has made a series of policy reforms aimed at promoting more foreign investment in the power sector. There is no doubt that there are many risks and barriers to investing in the coal industry and the power sector of China. The allowable internal rate of return on investments remains a sticking point in most negotiations. However, companies that wait until the risks are completely removed will find few viable investment opportunities.

The terms offered to foreign investors in 1994 appear to be somewhat tougher, and may partially reflect less urgency to attract more foreign investment in the short term (electricity shortages have moderated in many areas during the first half of the year).

Table 1. Economic Growth in Asia-Pacific Economies

	GDP in US$ Million (Constant 1985 Prices)				GDP Growth (%)		
	1980	1990	2000	2010	80--90	91-2000	2001-2010
Australia	137000	187450	247068	319367	3.2	2.8	2.6
China	148452	343576	776820	1458197	8.8	8.5	6.5
Hong Kong	25520	48940	83597	149709	6.7	5.5	6.0
India	162891	285389	447460	728865	5.8	4.6	5.0
Indonesia	63540	118529	226709	406001	6.4	6.7	6.0
Japan	1118220	1684370	2422284	3351416	4.2	3.7	3.3
Malaysia	24343	43314	85205	152590	5.9	7.0	6.0
New Zealand	19070	23030	30950	39619	1.9	3.0	2.5
Philippines	32738	38433	51651	76456	1.6	3.0	4.0
South Korea	62020	151202	297437	532665	9.3	7.0	6.0
Taiwan	44865	94259	176937	302234	7.7	6.5	5.5
Thailand	28391	59844	129199	231375	7.7	8.0	6.0
Viet Nam*	5727	9152	18003	35415	4.8	7.0	7.0
Total	1872777	3087488	4993320	7783909	5.1	4.9	4.5

* in 1991 Prices

Sources: Electric Utilities Data Book 1993 (ADB); Coal Information 1992; and EWC projections.

Table 2. Composition of China's Imports and Exports

	Export (in $million)		Growth (%/yr)	Import (in $million)		Growth (%/yr)
	1980	1993	80-93	1980	1993	80-93
Total	18119	91763	13.29	20017	103950	13.51
1. Primary products	9114	16675	4.76	6959	14216	5.65
Food and live animals	2985	8408	8.29	2927	2208	-2.14
Beverages and tobacco	78	901	20.71	36	245	15.91
Inedible raw materials (excluding fuel)	1711	3052	4.55	3554	5442	3.33
Fossil fuels, lubricants and related materials	4280	4109	-0.31	203	5819	29.45
Animal and vegetable oils, fats and waxes	60	205	9.92	239	502	5.87
2. Manufacturing products	9005	75088	17.72	13058	89735	15.98
Chemicals and related products	1120	4624	11.52	2909	9708	9.71
Manufactured goods classified by material	3999	16396	11.46	4154	28545	15.98
Machinery and Transport equipment	843	15285	24.97	5119	44987	18.20
Miscellaneous manufactured articles	3043	38783	21.63	876	6495	16.66
Share in total value	Export (%)		Changes in Share	Import (%)		Changes in Share
	1980	1993	93-80	1980	1993	93-80
1. Primary products	50	18	-32	35	14	-21
Food and live animals	16	9	-7	15	2	-12
Beverages and tobacco	0	1	1	0	0	0
Inedible raw materials (excluding fuel)	9	3	-6	18	5	-13
Fossil fuels, lubricants and related materials	24	4	-19	1	6	5
Animal and vegetable oils, fats and waxes	0	0	0	1	0	-1
2. Manufacturing products	50	82	32	65	86	21
Chemicals and related products	6	5	-1	15	9	-5
Manufactured goods classified by material	22	18	-4	21	27	7
Machinery and Transport equipment	5	17	12	26	43	18
Miscellaneous manufactured articles	17	42	25	4	6	2

Source: China's Customs Statistics December 1993; and China Statistical Yearbook 1993.

Table 3. China's Main Indicators Of National Economy by Province

	Population (million) End of 1992	GNP in 1992 Value (Billion yuan)	Growth (%/yr)	Per Capita (1000 yuan)	Investment in fixed assets 1992 (B yuan)	Actual Foreign Investment (1992) ($millon)
China	1172	2393	13.0	2.04	785	19202
Beijing	11	71	11.6	6.45	26	362
Tianjin	9	41	11.7	4.47	17	263
Hebei	63	116	13.9	1.84	32	113
Shanxi	30	52	12.8	1.74	16	54
Inner Mongolia	22	38	11.0	1.71	14	8
Liaoning	40	130	11.7	3.23	43	680
Jilin	25	51	13.0	2.03	15	75
Heilongjiang	36	86	6.6	2.37	24	73
Shanghai	13	107	14.9	7.92	36	899
Jiangsu	69	198	26.5	2.86	74	1463
Zhejiang	42	122	18.9	2.88	44	277
Anhui	58	72	17.4	1.24	19	55
Fujian	31	71	20.4	2.26	19	1466
Jiangxi	39	56	15.4	1.43	12	122
Shandong	86	198	19.5	2.30	60	1027
Henan	89	121	13.7	1.37	31	53
Hubei	56	100	12.1	1.80	25	211
Hunan	63	92	12.3	1.47	23	135
Guangdong	65	229	22.0	3.51	94	4746
Guangxi	44	57	18.3	1.31	14	199
Hainan	7	14	23.3	2.07	9	515
Sichuan	110	149	12.9	1.36	40	112
Guizhou	34	33	9.2	0.99	7	20
Yunnan	38	51	10.9	1.33	15	29
Tibet	2	3	7.1	1.46	1	
Shaanxi	34	49	8.7	1.45	13	46
Gansu	23	30	9.7	1.30	8	0
Qinghai	5	8	7.4	1.83	3	1
Ningxia	5	8	7.5	1.61	3	4
Xinjiang	16	38	13.1	2.42	17	54

Source: China Statistical Yearbook 1993.

Table 4. China's Regional National Income by Sectors

	Share in National Income (%)									
	Agriculture		Industry		Construction		Transport		Commerce	
	1985	1991	1985	1991	1985	1991	1985	1991	1985	1991
Beijing	8.9	10.9	62.8	60.8	11.2	8.5	4.4	5.4	12.7	14.4
Tianjin	8.2	11.1	64.8	61.1	6.7	5.7	6.6	8.2	13.8	13.9
Hebei	34.5	29.4	47.3	51.0	6.0	5.3	4.2	4.9	8.1	9.4
Shanxi	24.8	20.7	51.7	55.5	10.3	7.5	6.0	6.1	7.2	10.2
Inner Mongolia	43.9	42.7	33.2	35.8	8.9	8.3	5.9	7.6	8.1	5.6
Liaoning	16.7	20.8	65.9	60.2	6.2	6.6	5.3	5.2	6.0	7.3
Jilin	32.9	34.1	49.2	49.8	6.7	6.1	4.1	4.1	7.2	5.9
Heilongjiang	26.5	25.5	55.6	56.2	7.7	7.2	5.1	4.2	5.0	6.9
Shanghai	4.5	5.0	73.1	71.8	3.4	5.2	4.0	6.0	15.0	12.0
Jiangsu	32.6	27.0	51.7	57.0	6.1	5.5	2.7	3.9	6.8	6.6
Zhejiang	33.3	28.1	47.4	51.7	5.5	6.5	3.5	3.7	10.3	10.1
Anhui	50.3	36.8	33.7	47.7	5.9	6.7	3.4	3.5	6.6	5.4
Fujian	40.8	36.9	36.5	41.7	7.9	6.7	4.4	4.9	10.3	9.7
Jiangxi	47.6	47.5	33.7	35.7	7.2	4.9	4.2	4.4	7.2	7.5
Shandong	41.8	38.5	43.2	47.9	6.0	5.8	2.5	2.8	6.5	5.1
Henan	45.3	39.7	35.5	39.6	6.5	6.6	4.1	4.2	8.6	9.8
Hubei	39.5	39.5	42.1	43.7	5.9	4.7	2.8	3.3	9.7	8.7
Hunan	48.4	45.3	34.1	36.4	5.5	5.8	3.3	4.3	8.7	8.3
Guangdong	37.9	30.1	35.3	47.3	8.2	6.4	4.5	4.8	14.1	11.5
Guangxi	49.1	50.3	29.9	32.7	5.8	4.6	2.9	3.4	12.2	9.0
Hainan		58.2		18.1		11.0		4.0		8.7
Sichuan	44.9	42.2	36.0	36.7	7.0	7.0	2.5	2.9	9.6	11.2
Guizhou	46.3	46.8	35.0	35.7	6.9	5.8	4.0	3.2	7.8	8.6
Yunnan	47.0	43.3	33.3	41.7	6.4	4.6	2.4	2.0	11.0	8.4
Tibet	69.7	64.2	8.2	7.7	14.6	12.1	0.0	3.7	7.5	12.4
Shaanxi	35.2	33.9	43.7	46.0	8.5	8.3	4.2	6.2	8.4	5.7
Gansu	29.6	29.4	44.1	43.6	7.7	6.5	6.4	4.9	12.2	15.6
Qinghai	33.9	33.6	33.2	38.7	16.5	11.0	4.0	3.7	12.5	13.0
Ningxia	37.1	33.9	37.1	41.2	12.3	8.7	5.3	6.1	8.2	10.2
Xinjiang	44.9	43.2	31.7	32.2	8.9	9.0	3.2	4.2	11.3	11.3

Source: China Statistical Yearbook 1993; 1987.

Table 5. China's Major Manufacturing Industry in 1992

	Output Value (Billion yuan)	(%)*	Value Added (Billion yuan)	(%)*	Sales (Billion yuan)
Total	2772	100	767	100	2587
Light Industry	1222	44	291	38	1095
Heavy Industry	1551	56	476	62	1492
Mining	163	6	83	11	150
Raw Materials	636	23	194	25	637
Processing	751	27	199	26	706
Branch of Industry					
Machine, Equipment, Electronics**	656	24	165	22	621
Food, Beverage, Tobacco, Forage	309	11	82	11	295
Ferrous Metals	208	8	58	8	212
Textile	290	10	55	7	242
Chemicals and Allied Products	191	7	51	7	173
Building Materials	142	5	49	6	133
Power, Steam, and Hot Water	102	4	48	6	127
Petroleum Processing	90	3	22	3	87
Medical and Pharmaceutical Products	57	2	16	2	50
Non-Ferrous Metals	71	3	14	2	53
Chemical Fibers	37	1	12	2	39
Paper Making and Paper Products	49	2	11	1	46
Coking, Gas and Coal Products	9	0	1	0	10

* As percentage of China's total.

** Including Machine Building Industry, Transportation Equipment, Electric Equipment and Machine Electronic and Telecommunications Equipment, Instruments, Meters and other Measuring Equipment.

Source: China Statistical Yearbook 1993.

Table 6. Major Energy Consuming Industries in China

	Percent of Total Consumption						Total Consumption
	Chemical	Iron and Steel	Construction Material	Mining	Machinery	Power	
Energy*							(MTCE)
1985	10.6	10.0	10.5	7.5	5.4	3.3	767
1990	11.1	10.7	9.8	7.9	4.6	3.9	987
1991	11.1	10.7	9.8	8.1	4.5	4.1	1038
Coal							(Mt)
1985	6.4	8.0	10.6	7.7	3.4	20.4	816
1990	6.9	7.7	9.4	8.4	2.8	25.6	1055
1991	6.9	7.9	9.3	8.8	2.7	27.0	1104
Fuel Oil							(Mt)
1985	14.2	10.9	8.8	2.2	3.4	33.6	28
1990	16.3	12.8	9.2	4.2	2.4	24.2	34
1991	16.1	12.4	9.7	4.8	2.4	22.5	35
Gasoline							(Mt)
1985	3.4	1.3	3.2	7.0	6.6	0.6	14
1990	3.0	1.5	2.9	6.8	5.7	0.7	19
1991	3.0	1.4	2.7	5.9	5.3	0.8	22
Diesel							(Mt)
1985	7.7	0.9	3.0	4.3	4.1	6.7	19
1990	2.6	1.2	3.1	5.5	3.1	5.0	27
1991	2.2	1.3	3.5	5.1	3.6	4.3	29
Natural Gas							(BCM)
1985	32.0	4.0	1.4	28.7	4.6	4.5	13
1990	31.8	6.2	1.7	24.8	2.4	1.8	15
1991	34.9	5.0	1.9	26.2	3.3	0.8	16
Electricity							(TWh)
1985	12.5	8.8	5.4	10.5	7.8	14.3	412
1990	11.8	8.9	5.3	10.8	5.9	14.2	623
1991	11.4	8.6	5.3	10.8	5.5	14.6	680

* Total energy consumption excludes energy converted into secondary energy.

Source: SSBC, China Statistical Yearbook, 1993, pp482-491.

Table 7. China's Major Industrial Products Production by Province

	Production in 1993					
	Fertilizer 000 tons	Steel Mt	Cement Mt	Fiber 000 tons	TV* Million	Automobile* 000
China	20160	88.7	356.7	2215	28.7	10667.0
Beijing	112	7.1	4.1	32	0.6	137.9
Tianjin	86	2.2	1.6	83	1.4	75.7
Hebei	1398	5.3	22.3	31	0.2	3.8
Shanxi	774	3.1	9.5	25	0.0	0.7
Inner Mongolia	136	3.4	3.6	7	0.3	0.2
Liaoning	562	14.0	19.5	157	0.7	60.8
Jilin	283	1.1	6.6	35	0.2	145.1
Heilongjiang	361	1.2	7.0	120	0.1	15.8
Shanghai	314	12.9	3.6	280	4.4	70.0
Jiangsu	1326	3.1	27.3	613	6.0	101.0
Zhejiang	693	1.4	22.2	151	2.2	15.7
Anhui	1128	2.8	16.1	13	1.1	11.3
Fujian	439	0.6	8.7	32	1.4	3.4
Jiangxi	327	1.5	7.9	39	0.6	25.3
Shandong	1555	3.3	39.7	96	0.5	17.3
Henan	1743	2.4	17.6	79	0.4	8.3
Hubei	1571	7.2	13.8	24	0.2	151.2
Hunan	1204	2.2	17.3	38	0.4	22.1
Guangdong	527	1.7	40.2	219	4.3	29.3
Guangxi	491	0.8	12.3	19	0.2	37.2
Hainan	5	0.0	1.1	14	0.1	0.7
Sichuan	2093	6.8	22.6	59	1.8	67.9
Guizhou	508	0.7	4.0	6	0.4	7.4
Yunnan	910	1.2	7.3	6	0.2	16.4
Tibet						
Shaanxi	568	0.7	7.1	16	0.8	7.5
Gansu	298	1.1	5.4	18	0.1	
Qinghai	120	0.4	0.8			0.8
Ningxia	290	0.0	1.2	3		
Xinjiang	340	0.5	4.3	2	0.1	

* 1992 production

Source: A Statistical Survey of China, 1994; and China Statistical Yearbook, 1993.

Table 7. China's Major Industrial Products Production by Province (continued)

	Production in 1992					
	Fertilizer 000 tons	Steel Mt	Cement Mt	Fiber 000 tons	TV Million	Automobile 000
China	20479	80.9	308.2	2130	28.7	10667.0
Beijing	97	5.8	4.0	37	0.6	137.9
Tianjin	79	1.8	1.4	84	1.4	75.7
Hebei	1384	5.0	19.4	30	0.2	3.8
Shanxi	803	2.8	8.2	27	0.0	0.7
Inner Mongolia	134	3.1	3.2	8	0.3	0.2
Liaoning	628	13.5	16.4	171	0.7	60.8
Jilin	301	1.0	5.7	34	0.2	145.1
Heilongjiang	405	1.2	6.5	119	0.1	15.8
Shanghai	299	12.3	3.5	287	4.4	70.0
Jiangsu	1446	2.7	22.8	551	6.0	101.0
Zhejiang	737	1.2	19.7	150	2.2	15.7
Anhui	1162	2.6	12.4	15	1.1	11.3
Fujian	473	0.6	7.5	36	1.4	3.4
Jiangxi	330	1.3	6.9	25	0.6	25.3
Shandong	1547	2.8	31.6	72	0.5	17.3
Henan	1698	2.1	18.8	72	0.4	8.3
Hubei	1458	6.8	12.6	29	0.2	151.2
Hunan	1240	1.8	15.0	41	0.4	22.1
Guangdong	633	1.5	32.2	182	4.3	29.3
Guangxi	459	0.7	11.7	20	0.2	37.2
Hainan	1	0.0	0.9	16	0.1	0.7
Sichuan	1994	6.1	20.0	66	1.8	67.9
Guizhou	515	0.6	3.7	5	0.4	7.4
Yunnan	968	1.0	6.6	6	0.2	16.4
Tibet	0		0.1			
Shaanxi	555	0.6	6.7	23	0.8	7.5
Gansu	329	0.9	4.9	19	0.1	
Qinghai	123	0.4	0.7			0.8
Ningxia	321		1.1	4		
Xinjiang	356	0.5	3.8	3	0.1	

Source: China Statistical Yearbook 1993.

Table 8. Regional Distribution of Coal Resources and Economic Development Levels

	Units	Central	West	North	East	South	Northeast	Southeast	Southwest
Coal Resources									
Resources (<1000M)*	BT	686	558	505	112	134	25	18	0
Share of China	%	34	28	25	6	7	1	1	0
Resources (<1500M)*	BT	1237	1282	912	222	269	54	24	1
Share of China	%	31	32	23	6	7	1	1	0
Resources (<2000M)*	BT	1934	2023	1407	400	332	79	28	1
Share of China	%	31	32	23	6	5	1	0	0
Economic Indicators Share of China									
Social Output Value	%	6.0	1.1	1.4	26.0	8.9	13.0	44.0	0.1
Industrial Output Value	%	5.0	0.8	1.3	26.0	7.6	13.0	46.0	0.0
Steel Production	%	6.0	0.5	3.8	23.0	9.3	23.0	35.0	0.0
Electricity Generation	%	12.0	10.0	2.5	26.0	9.0	15.0	35.0	0.1
Cement Production	%	7.0	1.2	1.1	26.0	10.2	11.0	41.0	0.0
Fertilizer Production	%	8.0	1.5	0.7	29.0	15.7	7.0	37.0	0.0
Coal Production	%	31.0	1.9	3.8	25.0	12.2	14.0	12.0	0.0
Coal Consumption	%	12.0	1.6	3.4	28.0	11.3	17.0	26.0	0.0

* Coal resources within the depth of 1,000, 1,500, and 2,000 meters accordingly.

Source: Energy of China, June 1994.

Table 9. Distribution of Exploitable Hydropower Resources

		Capacity (MW)	Share of China	Generation (TWh)	Share of China	Annual Operating Hours
Northeast Power Network	NEPN	12045	3.1	38.4	2.0	3187
Liaoning		1633	0.4	5.6	0.3	3419
Jilin		4379	1.1	11.0	0.6	2502
Helongjiang		6032	1.6	21.9	1.1	3623
North China Power Network	NCPN	6920	1.8	23.2	1.2	3356
Beijing, Tianjin, Hebei		1837	0.5	4.2	0.2	2274
Shanxi		2640	0.7	10.7	0.6	4053
Inner Mongolia		2443	0.6	8.4	0.4	3418
East China Power Network	ECPN	5634	1.5	17.5	0.9	3103
Shanghai, Jiangsu		98	0.0	0.3	0.0	3179
Zhejiang		4655	1.2	14.6	0.8	3128
Anhui		882	0.2	2.6	0.1	2960
Central China Power Network	CCPN	60971	15.7	228.5	11.9	3748
Henan		2929	0.8	11.2	0.6	3811
Hubei		33095	8.5	149.4	7.8	4514
Hunan		19838	5.1	48.9	2.5	2464
Jiangxi		5109	1.3	19.1	1.0	3730
Northwest Power Network	NWPN	33403	8.6	144.5	7.5	4327
Shaanxi		5507	1.4	21.7	1.1	3941
Gansu		9110	2.4	42.4	2.2	4659
Qinghai		17991	4.6	77.2	4.0	4292
Ningxia		795	0.2	3.2	0.2	3977
Shandong Provincial Grid	SDPG	108	0.0	0.2	0.0	2200
Fujian Provincial Grid	FJPG	7051	1.8	32.0	1.7	4541
Guangdong Provincial Grid	GDPG	6390	1.6	24.0	1.2	3753
Guangxi Provincial Grid	GXPG	14183	3.7	63.9	3.3	4509
Sichuan Provincial Grid	SCPG	91665	23.7	512.3	26.7	5589
Yunnan Provincial Grid	YNPG	71168	18.4	394.5	20.5	5543
Guizhou Provincial Grid	GZPG	12918	3.3	65.2	3.4	5051
Xinjiang Autonomous Region	XJAR	8535	2.2	46.0	2.4	5387
Xizang Autonomous Region	XZAR	56593	14.6	330.0	17.2	5832
Total		387582	100.0	1920	100.0	4955

Source: Electric Power Industry in China, 1992.

Table 10. China's Energy Production by Province

	Production of Energy in 1993					
	Coal		Crude Oil		Electricity	
	Mt	% of total	Mt	% of total	TWh	% of China
China	1141.20	100.0	144.92	100.0	815.85	100.0
Beijing	8.21	0.7		0.0	13.72	1.7
Tianjin		0.0	5.17	3.6	12.26	1.5
Hebei	60.52	5.3	5.02	3.5	48.37	5.9
Shanxi	309.71	27.1		0.0	40.76	5.0
Inner Mongolia	51.47	4.5	1.01	0.7	23.48	2.9
Liaoning	51.62	4.5	14.30	9.9	49.21	6.0
Jilin	24.09	2.1	3.38	2.3	23.51	2.9
Heilongjiang	73.53	6.4	55.90	38.6	35.19	4.3
Shanghai		0.0		0.0	36.98	4.5
Jiangsu	25.06	2.2	0.86	0.6	51.28	6.3
Zhejiang	1.39	0.1		0.0	29.81	3.7
Anhui	35.94	3.1		0.0	26.52	3.3
Fujian	9.67	0.8		0.0	19.59	2.4
Jiangxi	23.55	2.1		0.0	14.30	1.8
Shandong	68.92	6.0	32.70	22.6	60.50	7.4
Henan	87.29	7.6	7.63	5.3	43.17	5.3
Hubei	8.59	0.8	0.81	0.6	39.76	4.9
Hunan	44.44	3.9		0.0	26.92	3.3
Guangdong	8.98	0.8	3.51	2.4	54.94	6.7
Guangxi	10.42	0.9	0.03	0.0	17.32	2.1
Hainan	0.02	0.0		0.0	2.44	0.3
Sichuan	81.42	7.1	0.16	0.1	45.96	5.6
Guizhou	44.66	3.9		0.0	14.21	1.7
Yunnan	23.73	2.1	0.14	0.1	17.21	2.1
Tibet		0.0		0.0		0.0
Shaanxi	33.88	3.0	1.16	0.8	20.37	2.5
Gansu	16.65	1.5	1.48	1.0	22.75	2.8
Qinghai	2.23	0.2	1.08	0.7	6.80	0.8
Ningxia	12.84	1.1	0.21	0.1	8.78	1.1
Xinjiang	22.33	2.0	10.34	7.1	9.36	1.1

Source: A Statistical Survey of China 1994.

Table 10. China's Energy Production by Province (continued)

	Production of Energy in 1992				
	Coal Mt	Crude Oil Mt	Natural Gas BCM	Electricity TWh	Hydropower TWh
China	1116.00	142.10	15.79	753.95	130.66
Beijing	10.00			14.23	0.24
Tianjin		4.92	0.41	9.81	0.02
Hebei	63.00	4.19	0.33	45.71	0.54
Shanxi	297.00		0.07	38.42	0.60
Inner Mongolia	50.00	1.00		22.23	0.11
Liaoning	54.00	13.88	2.11	48.91	3.24
Jilin	25.00	3.44	0.17	20.40	3.87
Heilongjiang	84.00	55.66	2.29	34.68	0.63
Shanghai				34.76	
Jiangsu	25.00	0.92	0.03	48.12	0.03
Zhejiang	1.00			28.41	5.85
Anhui	34.00	0.04		23.62	0.93
Fujian	9.00			17.66	9.47
Jiangxi	21.00			14.36	3.68
Shandong	64.00	33.46	1.44	56.62	0.02
Henan	90.00	8.10	1.26	40.55	1.48
Hubei	9.00	0.77	0.08	36.72	22.70
Hunan	36.00			24.48	10.62
Guangdong	10.00	2.86		45.90	9.28
Guangxi	11.00	0.03		15.31	7.40
Hainan				1.98	0.76
Sichuan	71.00	0.14	6.71	41.94	16.83
Guizhou	42.00		0.04	12.94	5.21
Yunnan	24.00	0.12	0.04	15.58	9.13
Tibet				0.36	0.26
Shaanxi	34.00	1.02	0.03	18.91	3.02
Gansu	15.00	1.98	0.04	20.03	8.71
Qinghai	3.00	1.06	0.05	4.98	3.45
Ningxia	14.00	0.20	0.01	7.66	0.84
Xinjiang	22.00	8.32	0.68	8.68	1.76

Source: China Statistical Yearbook 1993.

Table 11. China's Energy Consumption by Province

	Energy Consumption in 1990				
	Total MTCE	Coal Mt	Crude Oil Mt	Natural Gas MCM	Electricity TWh
China	987.0	1055.2	114.9	15015	623
Beijing	27.1	24.1	5.5	274	17
Tianjin	20.7	17.9	4.4	366	12
Hebei	61.2	78.8	3.8	20	35
Shanxi	47.1	76.6	1.4	0	26
Inner Mongolia	24.2	39.5	1.0	60	12
Liaoning	78.6	82.5	12.2	2042	46
Jilin	35.2	40.2	3.7	98	19
Heilongjiang	52.9	65.2	7.5	2247	30
Shanghai	31.8	27.4	8.0	0	26
Jiangsu	55.1	62.2	7.0	38	41
Zhejiang	25.8	24.9	3.2	0	23
Anhui	27.6	34.3	2.3	0	19
Fujian	14.5	13.1	1.2	0	14
Jiangxi	17.3	22.7	1.3	0	13
Shandong	68.3	72.6	10.4	1439	45
Henan	52.1	61.0	3.3	1389	34
Hubei	40.0	33.4	5.4	426	28
Hunan	38.2	39.6	2.7	306	23
Guangdong	40.7	29.9	10.5	0	36
Guangxi	13.1	15.6	1.0	0	13
Hainan	1.2	0.7	0.2	0	1
Sichuan	63.5	66.5	1.8	5682	35
Guizhou	21.3	27.1	0.8	28	10
Yunnan	19.5	21.9	1.0	0	12
Shaanxi	22.4	27.3	1.3	7	17
Gansu	21.7	18.6	2.5	33	18
Qinghai	5.1	4.7	0.5	51	4
Ningxia	7.1	8.9	0.5	7	6
Xinjiang	20.6	18.4	3.4	502	7

Source: China Energy Statistical Yearbook 1991.

Table 12. Projection of China's Coal Demand by Sector, 1993-2010

	1993		2000		2010	
	(Mt)	(%)	(Mt)	(%)	(Mt)	(%)
Electricity Generation	390	35	600	40	930	47
Industrial Boilers	330	29	370	25	400	20
Iron and Steel	140	12	200	13	250	13
Residential	167	15	150	10	120	6
Cement and Bricks	83	7	150	10	250	13
Others	12	1	30	2	35	2
Total	1122	100	1500	100	1985	100

Source: East-West Center Coal Project.

Table 13. Length of China's Transportation Routes and Average Distance of Freight Transportation

	Length at Year End (1,000 km)					Growth Rate (%/year)	
	1970	1980	1990	1992	1993	70-80	80-92
Railway (in Operation)	41	49.9	53.4	53.6	53.8	2.0	0.6
Multiple track	6.5	8.1	13	13.7		2.2	4.5
Electric Railway	0.3	1.7	6.9	8.4		18.9	14.2
Highway	636.7	888.3	1028.3	1056.7	1083.5	3.4	1.5
High Quality	23	157.9	260	301.7		21.2	5.5
Inland Waterway	148.4	108.5	109.2	109.7	109.7	-3.1	0.1
1 m and Deeper	57.4	53.9	59.6	61.4		-0.6	1.1
Airline	40.6	195.3	506.8	836.6	960.8	17.0	12.9
International	4.4	81.2	166.4	303	278.7	33.8	11.6
Pipeline	1.2	8.7	16	15.9	16.4	21.9	5.2
	Average Distance of Freight Transportation (km)					Growth Rate (%/year)	
	1970	1980	1990	1992	1993	70-80	80-92
Total	304	479	807	827		4.7	4.7
Railway	525	526	725	655		0.0	1.8
Highway	24	34	56	54		3.5	3.9
Waterway	366	1184	2113	2082		12.5	4.8
Civil Aviation	954	1573	2173	2330		5.1	3.3
Pipeline	78	467	393	417		19.6	-0.9

Source: A Statistical Survey of China; and China Transportation Yearbook 1993, p464, p472.

Table 14. China's Freight Transportation by Type

	Freight Transportation (million tonnes)					Growth Rate (%/year)	
	1980	1985	1990	1992	1993	80-90	80-93
Total	5465	7458	9706	10459	11067	5.9	5.6
Railway	1113	1307	1507	1576	1627	3.1	3.0
Highway	3820	5381	7240	7809	8280	6.6	6.1
Waterway	427	633	801	925	980	6.5	6.6
Pipeline	105	137	158	148	180	4.1	4.2
Civil Aviation	0.09	0.20	0.37	0.58	0.69	15.3	17.1
	Share of Freight Transportation (%)						
	1980	1985	1990	1992	1993		
Total	100.0	100.0	100.0	100.0	100.0		
Railway	20.4	17.5	15.5	15.1	14.7		
Highway	69.9	72.1	74.6	74.7	74.8		
Waterway	7.8	8.5	8.3	8.8	8.9		
Pipeline	1.9	1.8	1.6	1.4	1.6		
Civil Aviation	0.002	0.003	0.004	0.005	0.006		
	Volume of Freight (Billion tonne-km)					Growth Rate (%/year)	
	1980	1985	1990	1992	1993	80-90	80-93
Total	1203	1813	2621	2922	3043	8.1	7.4
Railway	572	813	1062	1158	1196	6.4	5.8
Highway	76	169	336	376	418	16.0	14.0
Waterway	505	770	1159	1326	1367	8.7	8.0
Pipeline	49	60	63	62	61	2.5	1.7
Civil Aviation	0.14	0.42	0.82	1.34	1.66	19.3	20.9
	Share of Volume of Freight Transportation (%)						
	1980	1985	1990	1992	1993		
Total	100.0	100.0	100.0	100.0	100.0		
Railway	47.5	44.8	40.5	39.6	39.3		
Highway	6.4	9.3	12.8	12.9	13.7		
Waterway	42.0	42.5	44.2	45.4	44.9		
Pipeline	4.1	3.3	2.4	2.1	2.0		
Civil Aviation	0.0	0.0	0.0	0.0	0.1		

Source: A Statistical Survey of China 1994; and China Transportation Yearbook 1993, p.465.

Table 15. Freight Transportation of the Transportation Department by Cargo in 1992

	Freight Transportation (million tonnes)				
	Total	Railway	Highway	Waterway	Pipeline
Total	2969	1523	675	624	148
Coal	949	641	153	156	0
Mineral Building Materials	368	119	107	142	0
Petroleum	294	67	5	74	148
Iron and Steel	175	85	70	20	0
Metal Ores	143	93	11	38	0
Grain	139	64	43	32	0
Non-Metal Ores	130	82	16	33	0
Chemical Fertilizers and Pesticides	76	38	23	14	0
Cement	74	41	22	12	0
Timber	58	34	14	9	0
Salt	24	12	6	6	0
Other	540	247	204	88	0
National Total	10458	1576	7809	925	148
Share of Transportation Department	28	97	9	67	100
	Share of Freight Transportation (%)				
	Total	Railway	Highway	Waterway	Pipeline
Total	100	100	100	100	100
Coal	32	42	23	25	0
Mineral Building Materials	12	8	16	23	0
Petroleum	10	4	1	12	100
Iron and Steel	6	6	10	3	0
Metal Ores	5	6	2	6	0
Grain	5	4	6	5	0
Non-Metal Ores	4	5	2	5	0
Chemical Fertilizers and Pesticides	3	3	3	2	0
Cement	2	3	3	2	0
Timber	2	2	2	1	0
Salt	1	1	1	1	0
Other	18	16	30	14	0

Source: China Transportation Yearbook 1993.

Table 16. Volume of Freight Transportation of the Transportation Department by Cargo in 1992

	Volume of Freight (Billion tonne-km)				
	Total	Railway	Highway	Waterway	Pipeline
Total	2551	1155	37	1298	62
Coal	599	358	9	233	0
Mineral Building Materials	82	47	3	33	0
Petroleum	226	46	1	118	62
Iron and Steel	146	82	3	62	0
Metal Ores	198	45	1	152	0
Grain	308	72	2	234	0
Non-Metal Ores	95	44	1	50	0
Chemical Fertilizers and Pesticides	112	32	2	78	0
Cement	29	20	1	8	0
Timber	67	51	1	15	0
Salt	17	12	0	4	0
Other	671	347	13	311	0
National Total	2920	1158	376	1326	62
Share of Transportation Department	87	100	10	98	100
	Share of Volume of Freight (%)				
	Total	Railway	Highway	Waterway	Pipeline
Total	100	100	100	100	100
Coal	23	31	23	18	0
Mineral Building Materials	3	4	7	3	0
Petroleum	9	4	2	9	100
Iron and Steel	6	7	8	5	0
Metal Ores	8	4	3	12	0
Grain	12	6	5	18	0
Non-Metal Ores	4	4	2	4	0
Chemical Fertilizers and Pesticides	4	3	5	6	0
Cement	1	2	4	1	0
Timber	3	4	3	1	0
Salt	1	1	1	0	0
Other	26	30	37	24	0

Table 17. Freight Transportation of Principal Trunk Railways in 1992

	Freight Transportation			
	Million Tonnes	(%)	Billion Tonne-km	(%)
Total	561	100	970	100
Beijing-Guangzhou	81	14	229	24
Datong-Taiyuan&Yuci-Mengyuan	78	14	23	2
Lianyungang-Lanzhou	51	9	101	10
Harbin-Dalian	43	8	78	8
Xiuwen-Yueshan-Xinxiang	42	7	9	1
Beijing-Shenyang	42	7	117	12
Tianjin-Shanghai	38	7	142	15
Shijiazhuang-Taiyuan	37	7	19	2
Harbin-Manzhouli	29	5	21	2
Beijing-Baotou	25	4	47	5
Qingdao-Jinan	25	4	22	2
Hangzhou-Zhuzhou	22	4	41	4
Yueshan-Zhicheng	18	3	27	3
Harbin-Suifenhe	10	2	17	2
Beijing-Qinhuangdao	6	1	14	1
Zhicheng-Liuzhou	5	1	15	2
Yanzhou-Shijiusuo	3	1	4	0
Shijiazhuang-Dezhou	3	0	11	1
Shanghai-Hangzhou	2	0	11	1
Heze-Yanzhou	1	0	2	0
Xinxiang-Heze	0	0	2	0
Datong-Qinhuangdao		0	17	2
National Total	1576		1158	
Share of the 22 lines	36		84	

Source: China Transportation Yearbook 1993, p491.

Table 18. China's Coal Transportation Through State Railways in 1992 (in million tonnes)

	Arriving Provinces																														
	Beijing	Tianjin	Hebei	Shanxi	Inner Mon.	Liaoning	Jilin	HeilongJ.	Shanghai	Jiangsu	Zhejiang	Anhui	Fujian	Jiangxi	Shandong	Henan	Hubei	Hunan	Guangdong	Guangxi	Hainan	Sichuan	Guizhou	Yunnan	Shaanxi	Gansu	Qinghai	Ningxia	Xinjiang	Total
Total	20	20	110	21	17	62	30	46	1	48	11	26	7	11	49	23	33	15	13	10	0	21	6	6	13	11	2	6	2	641
Beijing	3	2	1			0		0		0					1															7
Tianjin		0	0																											0
Hebei	3	2	25		1	3	0	0	0	1	0	0			1	0	1	0												37
Shanxi	14	14	78	21	2	14	2	0	0	15	2	5	1	1	22	6	8	3	1	2					2	0	0	0		214
Inner M.	0	2	5		12	4	2	7																		0		1		32
Liaoning					1	29	1	1																						31
Jilin					0	2	14	0																						16
Heilong.					1	9	11	38																						59
Shanghai											1		0																	1
Jiangsu									0	12	2	1	0	0	1	0														16
Zhejiang											1																			1
Anhui									0	6	2	17	1	0																26
Fujian											0		4																	4
Jiangxi										0	1	0	0	6			0	0	0	0										8
Shand.		0	0						0	3	2	1	0	1	24		0	0												32
Henan		0	0			1	0		0	6	1	2	0	1	1	18	19	2	2	1					0					54
Hubei											0		0	0			0		0	0										1
Hunan														0			0	9	1	1										11
Guangd.																			6											6
Guangxi																			0	4										4
Hainan																					0									0
Sichuan														0			2	0	0	0		20		0	0					23
Guizhou											0		0	0			1	0	2	1		1	6	1						13
Yunnan											0		0					0	0	0		0		6						6
Shaanxi										5	0	0		0		0	2	0							10	0				17
Gansu										0							0								0	5	1			6
Qinghai																											1			1
Ningxia	0	1	0		0	1	0			0					0							0			1	3	0	5	0	11
Xinjiang																										2			2	4

Note: a number 0 reflects transportation less than 0.5 Mt, while a blank space reflects no shipment.

Table 19. Major Chinese Seaports

	Throughput (Mt/Year)			Productive Use			Non-Productive Use	
				Number of Berths		Length	Number of	Length
	1978	1992	1993	Total	10,000 t	(M)	Berths	(M)
Total	198.3	603.8	676.5	1444	342	143185	242	16432
Dandong		1.0		5	1			
Dalian	28.6	59.1	59.6	55	28	10045	20	4147
Yingkou	0.3	5.1	6.8	19	7	2590	20	81
Qinhuangdao	22.2	81.2	78.1	24	22	5506	11	636
Tianjin	11.3	29.3	37.2	50	34	8983	7	709
Longkou		5.8		12	3			
Yantai	4.6	11.1	11.9	24	9	3324	2	200
Weihai		1.4		6	1			
Qingdao	20.0	31.3	35.5	42	22	8368	3	553
Shijiusuo (Rizhao)		12.0	13.2	9	5	1827	7	320
Lianyungang	5.9	13.6	14.2	19	15	3527	6	850
Shanghai	79.6	163.0	176.0	131	63	17387	84	3466
Ningbo	0.0	43.7	53.2	37	17	5074	15	773
Zhoushan		2.7		24	2			
Haimen		3.9		8				
Wenzhou		4.4		17	2			
Fuzhou		6.7		25	3			
Quanzhou		2.2		41				
Xiamen		6.5		51	6			
Shantou	1.5	4.6	6.6	12		1215	3	49
Shekou		6.6		24	7			
Chiwan		4.3		8	4			
Guangzhou	10.5	54.6	65.5	101	22	9570	26	1419
Zhanjiang	9.5	16.4	19.5	23	18	3982	9	821
Haikou	0.8	4.1	5.8	13		1442		
Basuo	3.1	3.8	3.8	8	4	1412		
Sanya	0.5	0.4	0.7	5		602	2	113
Beihai		1.3		5	2			
Fangcheng		3.3		10	8			
Others		20.5		636	37	58331	27	2295

Source: A Statistical Survey of China 1994; China Transportation Yearbook 1993, p517; and Statistical Yearbook of China, 1993, p542-543.

Table 20. Major Chinese River Ports (year-end figure)

	Throughput (Mt/Year)	Number of Berths 1992	
	1992	Total	10,000 t
Total	267.2	3312	30
Harbin	2.6	11	
Shahezhi	1.0	17	
Jiamusi	1.5	13	
Congqing	4.1	49	
Pailing	0.7	19	
Wanxian	1.1	12	
Badong	0.3	26	
Yichang	2.4	16	
Zhicheng	2.0	11	
Shashi	1.4	16	
Yanli	0.3		
Chenlingji	5.6	5	
Huonghu	0.2		
Wuhan	16.7	34	
Huangshi	1.3	13	
Wuxiu	0.6	23	
Jiujiang	6.5	8	
Anqing	6.9	13	
Chizhou	1.4	10	
Tongling	1.7	10	
Wuhu	3.4	26	
Maanshan	3.5	14	
Nanjing	46.7	46	13
Zhenjian	13.5	19	4
Gaogang	2.5	15	1
Jiangyin	3.3	11	
Zhangjiagang	5.3	10	7
Nantong	12.5	31	5
Others	118.4	2834	

Source: China Transportation Yearbook 1993, p517; Statistical Yearbook of China, 1993, p542-543.

Table 21. Throughput of Principal Chinese Ports by Cargo in 1992

	Seaports (Mt)			River Ports (Mt)			Total (Mt)
	Total	Output	Input	Total	Output	Input	Throughput
Total	604	315	289	267	121	146	871
Coal	200	119	80	66	35	31	266
Petroleum and Natural Gas	107	64	43	47	20	27	155
Crude Oil	76	45	31	36	14	22	112
Metal Ores	50	15	35	19	5	14	69
Iron and Steel	26	10	16	13	6	6	38
Mineral Building Materials	30	8	22	58	20	38	88
Cement	13	9	4	6	5	1	19
Timber	9	3	6	4	2	2	13
Non-Metal Ores	18	10	8	21	13	8	39
Chemical Fertilizers and Pesticides	22	5	17	5	3	2	27
Salt	7	3	4	2	0	1	8
Grain	41	22	19	8	3	5	49
Mechanical Products	11	6	5	1	0	0	12
Chemical Material and Products	8	4	4	2	1	1	10
Nonferrous Metal	1	1	1	0	0	0	2
Light Industry Products	14	7	6	3	1	1	16
Food Products	8	4	5	3	1	2	11
Others	37	23	14	11	5	6	48
Share of Total	100	100	100	100	100	100	100
Coal	33	38	28	25	29	21	31
Petroleum and Natural Gas	18	20	15	18	17	19	18
Crude Oil	13	14	11	14	12	15	13
Metal Ores	8	5	12	7	4	9	8
Iron and Steel	4	3	5	5	5	4	4
Mineral Building Materials	5	3	8	22	17	26	10
Cement	2	3	1	2	4	1	2
Timber	2	1	2	2	2	1	2
Non-Metal Ores	3	3	3	8	11	6	4
Chemical Fertilizers and Pesticides	4	2	6	2	2	1	3
Salt	1	1	1	1	0	1	1
Grain	7	7	7	3	2	3	6
Mechanical Products	2	2	2	0	0	0	1
Chemical Material and Products	1	1	1	1	1	1	1
Nonferrous Metal	0	0	0	0	0	0	0
Light Industry Products	2	2	2	1	1	1	2
Food Products	1	1	2	1	1	1	1
Others	6	7	5	4	5	4	6

Source: China Transportation Yearbook 1993, p519.

Table 22. China's Civilian Motor Vehicles and Vessels

	Number of Vehicles (1,000)			Annual Growth Rate	
	1978	1988	1992	1978-1992	1988-1992
Total	1358	4644	6917	12	10
Passenger Vehicles	259	1304	2262	17	15
Large	88	299	381	11	6
Small	171	1004	1881	19	17
Freight Trucks	1002	3179	4415	11	9
General Freight		3089	4279		8
Special Freight		90	136		11
Other Specialized Trucks		73	103		9
Specific Purpose Trucks		89	139		12
Wheel Tractors		3916	5371		8
Walk Tractors		2513	2592		1
	Number of Vessels (1,000)			Growth Rate	Units
	1980	1990	1992	1980-1992	
Total	296.8	425.9	386.7	2	1000
Net Carrying Capacity	19.9	38.4	40.8	6	Mt
Passenger Capacity	0.6	1.2	1.2	5	Million
Drawing Power	1.5	1.8	1.8	2	Million KW
Motor Vessels	64.3	325.9	302.3	14	1000
Net Carrying Capacity	12.8	29.1	31.2	8	Mt
Passenger Capacity	0.5	1.1	1.2	7	Million
Drawing Power	1.5	1.8	1.8	2	Million KW
Barges	119.5	82.5	71.3	-4	1000
Net Carrying Capacity	6.0	9.1	9.4	4	Mt
Passenger Capacity	0.1	0.1	0.0	-6	Million
Sailing Boats	113.0	17.6	13.1	-16	1000
Net Carrying Capacity	1.2	0.2	0.1	-16	Mt

Source: Statistical Yearbook of China 1993, p532, p537.

Table 23. China's Railway Transportation by Region in 1992

	Length of Railway (1,000 km)				Freight Transportation			
	State Owned		Local Owned		State Owned		Local Owned	
	Total	Operating	Total	Operating	(Mt)	(Billion t-km	(Mt)	(Billion t-km)
Total	68.50	53.57	5.66	4.51	1523	1155	53.1	2.70
Beijing	1.61	1.02	0.03	0.03	29	27	0.2	0.00
Tianjin	0.80	0.47	0.15	0.11	19	25	5.4	0.26
Hebei	4.76	2.98	0.86	0.64	110	141	6.7	0.23
Shanxi	3.39	2.33	0.12	0.11	245	50	2.4	0.12
Inner Mongolia	5.80	5.07	0.01	0.01	72	53	0.8	0.00
Liaoning	4.95	3.56	0.26	0.21	146	102	2.5	0.11
Jilin	3.80	3.47	0.01	0.01	65	41	0.6	0.00
Heilongjiang	6.53	4.99	0.53	0.49	133	73	1.6	0.21
Shanghai	0.39	0.24			14	4		
Jiangsu	1.29	0.74			43	33		
Zhejiang	1.21	0.90			19	17		
Anhui	2.28	1.67	0.11	0.09	44	49	3.3	0.13
Fujian	1.03	1.02			21	13		
Jiangxi	1.94	1.58	0.06	0.06	26	23	0.6	0.02
Shandong	3.04	2.05	0.21	0.18	83	63	3.1	0.21
Henan	3.88	2.13	1.76	1.40	87	112	7.2	0.59
Hubei	2.16	1.69	0.19	0.13	40	49	1.3	0.07
Hunan	2.90	2.27	0.33	0.25	48	64	1.2	0.08
Guangdong	1.19	0.69	0.39	0.32	42	21	7.1	0.29
Guangxi	1.81	1.67	0.42	0.31	23	28	6.6	0.29
Hainan	0.24	0.22			4	0		
Sichuan	2.88	2.88	0.19	0.16	67	42	2.5	0.09
Guizhou	1.48	1.42			25	21		
Yunnan	1.64	1.59	0.02	0.02	22	10		
Shaanxi	2.18	1.83			30	36		
Gansu	2.35	2.22			26	37		
Qinghai	1.10	1.09			5	3		
Ningxia	0.45	0.43			14	6		
Xinjiang	1.41	1.34			18	13		

Source: China Transportation Yearbook 1993, p483-485.

Table 24. China's Highway Transportation by Region in 1992

	Length of Highway (1,000 km)		Freight Trucks		Special Freight		Freignt Transportation	
	Total	Grade	Number 1,000	Tonnage 1,000t	Number 1,000	Tonnage 1,000t	Freight (Mt)	Volume (Billion t-km)
Total	1057	787	4279	17604	135.88	742.33	7809	375.6
Beijing	11	10	166	516	4.08	41.08	310	6.4
Tianjin	4	4	105	372	5.97	7.94	161	4.4
Hebei	47	42	305	1469	11.62	81.33	522	30.1
Shanxi	32	26	205	808	3.25	14.63	398	21.1
Inner Mongolia	44	34	100	485	3.49	17.46	197	10.3
Liaoning	42	40	279	1190	15.25	79.51	563	17.3
Jilin	27	25	112	415	4.17	24.17	165	5.7
Heilongjiang	48	46	180	815	23.02	103.59	225	10.1
Shanghai	4	4	88	341	3.30	21.58	262	4.3
Jiangsu	25	23	205	1100	2.35	15.31	374	19.5
Zhejiang	30	24	123	681	2.48	41.95	305	14.2
Anhui	31	27	121	501	2.08	10.41	307	16.2
Fujian	42	31	81	335	1.88	15.09	213	10.4
Jiangxi	34	20	82	322	0.02	0.11	113	6.2
Shandong	43	42	331	1166	9.05	53.85	403	23.9
Henan	45	41	219	912	6.30	20.72	316	18.2
Hubei	48	27	140	699	4.42	24.30	402	13.8
Hunan	58	28	151	594	1.75	7.93	320	17.5
Guangdong	56	40	383	1263	1.99	11.96	764	43.2
Guangxi	37	21	91	363	1.27	6.03	140	11.2
Hainan	13	9	22	84	0.06	0.66	69	2.1
Sichuan	99	56	254	933	4.65	18.32	532	23.3
Guizhou	32	12	67	254	1.34	5.16	132	5.1
Yunnan	60	52	127	571	3.46	14.31	263	14.5
Tibet	22	8	17	92	0.50	2.00	6	0.6
Shaanxi	38	30	98	387	5.16	21.59	106	6.6
Gansu	35	24	76	292	0.09	0.36	97	6.0
Qinghai	17	12	27	128	0.53	6.87	25	1.9
Ningxia	8	8	24	92	0.67	4.08	24	1.4
Xinjiang	26	22	101	424	11.68	70.06	93	9.9

Source: China Transportation Yearbook 1993, p483-485.

Table 25. China's Waterway Transportation by Region in 1992

	Freignt Transportation		Motor Vessels		Barges		Sailing Boats	
	Freight (Mt)	Volume (Billion t-km)	Number	Tonnage 1,000t	Number	Tonnage 1,000t	Number	Tonnage 1,000t
Total	925	1325.6	302313	31226	71255	9437.76	13123	141.51
State	295	1190.2	1496	19121	2423	2823.05		
Tianjin	1	0.2	204	174	517	77.60		
Hebei	4	4.5	1397	126	38	24.70	1093	28.54
Shanxi	1		289	4	1		26	0.25
Inner Mongolia			189	3	23	2.52		
Liaoning	3	4.8	680	423	64	11.70		
Jilin		0.1	195	0	107	24.02		
Heilongjiang	2	0.4	245	3	242	86.89		
Shanghai	34	3.2	5337	134	4921	190.95		
Jiangsu	156	28.1	118793	3167	30191	1946.85		
Zhejiang	96	21.2	56296	1416	7233	430.47	62	0.90
Anhui	43	9.5	28149	1529	4272	471.48	3	0.06
Fujian	13	9.9	4714	865	89	16.60	282	4.58
Jiangxi	10	2.7	7131	291	545	93.76	708	2.25
Shandong	8	4.8	4012	370	4338	370.94	224	3.06
Henan	3	0.8	3147	235	331	35.29	2	0.09
Hubei	30	11.1	6092	270	3170	828.52	377	0.81
Hunan	38	5.4	12017	333	3295	189.48		
Guangdong	145	12.3	33408	1739	4635	632.60	266	13.90
Guangxi	17	6.4	11023	516	509	115.08	413	10.68
Hainan	3	2.7	1104	409	86	20.12	121	10.08
Sichuan	21	6.9	4206	74	3860	992.03	6248	54.42
Guizhou	1	0.4	748	8	262	35.27	2162	8.12
Yunnan	1	0.1	602	7	71	14.42		
Tibet								
Shaanxi		0.0	606	5	26	3.06	836	2.35
Gansu		0.0	164	1	1	0.01	300	0.42
Qinghai								
Ningxia			69	0	5	0.38		
Xinjiang								

Source: China Transportation Yearbook 1993, p483-485.

Table 26. Major Chinese Airport Transportation in 1992

	Number of Flight in (1,000)		Freight (1,000 tonnes)		Passenger in (1,000)	
	Total	Foreigh	Total	Foreigh	Total	Foreigh
Total	513.8	18.8	985.6	73.9	52025.1	2246.4
Guangzhou	66.5	0.8	171	2	9015.1	59.311
Beijing	68.0	9.7	187	39	8699.677	1261.931
Shanghai	50.7	3.0	187	22	6152.441	402.111
Chengdu	24.7	0.2	46	0	2232.857	11.93
Xiamen	19.6	1.0	32	2	2160.887	116.903
Guilin	14.7	0.9	20	1	1734.804	79.195
Shenzhen	16.2		22		1661.108	
Xian	18.2	0.1	29	0	1659.703	1.058
Kunming	11.9	0.2	20	0	1407.547	24.823
Hangzhou	13.2	0.5	21	1	1330.013	55.607
Haikou	9.4		15		1291.294	
Shantou	8.0		18		1107.745	
Shenyang	10.8	0.1	18	0	1040.717	16.025
Nanjing	10.4	0.5	14	1	1036.498	51.593
Fuzhou	10.3		17		1026.488	
Wuhan	12.9		14		1023.166	
Congqing	22.2		17		1018.556	
Dalian	9.0	0.4	23	2	862.208	48.541
Harbin	8.2	0.5	15	2	848.892	52.267
Urumqi	8.4	0.2	13	0	825.938	17.497
Wenzhou	6.8		6		591.274	
Qingdao	4.8		10		541.685	
Changsha	7.4		7		509.832	
Guizhou	4.0		5		378.887	
Changchun	3.6		6		369.36	
Lanzhou	6.6		6		347.986	
Tianjin	12.4	0.6	13	2	302.435	44.882
Ningbo	4.2		4		286.029	
Nanning	2.6		3		277.376	
Hefei	11.4		3		261.476	
Nanchang	4		2		244.593	
Zengzhou	4		3		244.082	
Taiyuan	2.733		3.2049		228.406	
Lhasa	1.79		5.0694		211.611	
Yantai	2.478		2.8609		206.31	
Zhanjiang	1.832		1.5045		182.066	
Huhehaote	11.967	0.11	1.4315	0.0688	153.102	2.714
Meixian	1.528		1.0326		148.65	
Jinan	2.634		1.9552		147.737	
Huangshan	3.556		1.2793		143.556	
Keshi	0.736		1.4103		113.03	

Table 27. China's Investment Needs for Electricity Development, 1994-2000.

Installed Capacity (GW)

	Total	Coal-fired	Hydro	Nuclear	Other	CCTs (I)	CCTs (D)
1993	181	118	45	2.1	15.9	0.7	0
2000	300	195	75	7	23	13	41
2010	530	320	140	25	45	65	114

New Capacity (GW)

	Total	Coal-fired	Hydro	Nuclear	Other	CCTs (I)	CCTs (D)
1994-2000	119	77	30	4.9	7.1	12.3	41
2001-2010	230	125	65	18	22	52	73
1993-2010	349	202	95	23	29	64	114

Capital Cost of New Capacity and Retrofitting Capacity ($billion)

	Total	Coal-fired	Hydro	Nuclear	Other	CCTs (I)	CCTs (D)
1994-2000	91.1	51.9	27.0	7.4	2.4	1.0	1.4
2001-2010	194.0	81.9	58.5	42.0	4.8	4.4	2.4
1994-2010	285.1	133.8	85.5	49.4	7.2	5.5	3.8
Average (1994-2010)	15.8	7.4	4.8	2.7	0.4	0.3	0.2
1994-2000	11.4	6.5	3.4	0.9	0.3	0.1	0.2
2001-2010	19.4	8.2	5.9	4.2	0.5	0.4	0.2

Notes: (1) U.S. dollars ($) refer to constant 1994 U.S. dollars.

(2) Cost assumptions are as follows:

Hydro	900	$million/GW installed
Nuclear	1500	$million/GW retrofitted
Coal-fired	600	$million/GW installed
Other	400	$million/GW installed
	17	% coal-fired retrofitted within 7 years
	40	% coal-fired retrofitted within 17 years
Retrofit	166	$million/GW retrofitted
CCTs (Imported)	85	$/KW
CCTs (Domestic)	33	$/KW
Exchange rate	8.7	yuan per U.S. dollar

Table 28. Power Projects Using Foreign Loans

Project	Capacity (MW)	Schedule	Loan ($million)	Source	Location
Total	40030		9079		
Hydropower	24730		3821		
Lubuge	600	84--90	141	World Bank	Yunnan
Shuikou	1400	87--97	240	World Bank	Fujian
Yantan	1210	84--93	52	World Bank	Guangxi
Ertan (Phase I)	3300	91--2000	380	World Bank	Sichuan
Tianhuangping	1800	93--97	300	World Bank	Zhejiang
Longtan (Phase I)	4200	94--2002	350	World Bank	Guangxi
Hongjiadu*	540	95--2001	200	World Bank	Guizhou
Wuqiangxi	1200	88--96	200	OECF (Japan)	Hunan
TSQ-II	880	84--93	478	OECF (Japan)	Guizhou
Shisanling PS	800	90--95	100	OECF (Japan)	Beijing
TSQ-I	1200	92--2000	160	OECF (Japan)	Guizhou
Guangzhou PS (P-I)	1200	88--94	200	France	Guangdong
Geheyan	1200	88--93	108	Canada	Hubei
Guangzhou PS (P-II)*	1200	93--97	361	ADB, Others	Guangdong
Lingjintan*	240	94--99	100	ADB	Hunan
Mianhua tan	600	95--2002	200	ADB	Fujian
Zhangjiawang PS	600	95--2001	250	ADB	Hebei
Thermal Power	15300		4799		
Beilungang	1200	86--93	390	World Bank	Zhejiang
Wujing	600	88--92	190	World Bank	Shanghai
Zouxian	1200	92--96	310	World Bank	Shandong
Yanshi	600	92--95	200	World Bank	Henan
Yangzhou*	1200	93--97	300	World Bank	Jiangsu
Ligang	700	88-92	245	Spain & Italy	Jiangsu
Ezhou*	600	92--95	250	OECF (Japan)	Hubei
Sanhe*	600	93--96	250	OECF (Japan)	Beijing
Jiujiang*	600	93--96	250	OECF (Japan)	Jiangxi
Hejin*	600	94--97	250	OECF (Japan)	Shanxi
Nanjing	600	89--92	241	Former USSR	Jiangsu
Jixian	1000	89--93	430	Former USSR	Tianjin
Suizhong	1600	90--95	650	Former USSR	Liaoning
Yimin	1000	90--95	430	Former USSR	Inner Mongolia
Wentuozi	2000	Agreed	na	Former USSR	Liaoning
Shidongkou No.2	1200	88--92	413	EDC, USA	Shanghai
Power Transmission			460		
TSQ-II-Guangzhou	500kv 1050km	88--93	116	OECF (Japan)	
TSQ-II-Guiyang	500kv 285 km	88--92	24	OECF (Japan)	
TSQ-I-Guangzhou*	500kv 1100km	94--98	140	OECF (Japan)	
Outgoing Lines for* Ertan Hydro*	500kv 2500km	94--98	180	World Bank	

Note: *Project financing is still in the process of negotiation

Source: Electric Power Industry in China, 1993; 1992.

Table 29. The Joint Venture Power Projects (BOT, BOO) Which Will Start Construction Before 2000

Project	Capacity (MW)	Unit Size (MW)	Location
A. Thermal Power			
1. Waigaoqiao (II)	1600	800 or 1000	Shanghai
2. Jiaxing (II)	2400	600	Zhejiang
3. Ligang (II)	700	350	Jiangsu
4. Ligang (III)	1200	600	Jiangsu
5. Shidongkou (II)	1200	600	Shanghai
6. Yangcheng	2400	600	Shanxi
7. Tuoketuo No.2	2640	660	Inner Mongolia
8. Daihai	2400	600	Inner Mongolia
9. Datong No.2	1200	600	Shanxi
10. Shalingzi (II)	1200	600	Hebei
11. Shuangyashan	1200	600	Heilongjiang
12. Zhuhai	1320	660	Guangdong
13. Beihai	700	350	Guangxi
14. Xidu	1320	660	Jiangsu
15. Rizhao	700	350	Shandong
16. Shiliquan	600	300	Shandong
17. Laicheng	1200	600	Shandong
18. Shiheng (II)	600	300	Shandong
19. Heze (II)	600	300	Shandong
20. Meizhouwan	700	350	Fujian
21. Songyu	700	350	Fujian
22. Hanchuan (II)	600	300	Hubei
23. Pinggu	1200	600	Beijing
24. Liaoning (Expansion)	600	300	Liaoning
25. Shenmu	2640	660	Shaanxi
26. Dalian (II)	700	350	Liaoning
27. Dandong	700	350	Liaoning
28. Nantong (II)	700	350	Jiangsu
29. Fuzhou (II)	700	350	Fujian
30. Yuyang (II)	700	350	Hunan
31. Shidongkou No.2 (II)	1200	600	Shanghai
32. Luohuang (II)	700	350	Sichuan
33. Shantou (II)	700	350	Guangdong
34. Yingkou (II)	1200	600	Liaoning
Total	38920		

Source: Electric Power Industry in China, 1993 (MEPI)

Table 30. Electricity Generating Capacity and Energy Mix in China, 1980-1993.

	Installed Capacity				Electricity Generation				GNP
	Total (GW)	Hydro (%)	Thermal (%)	Coal (%)	Total (TWh)	Hydro (%)	Thermal (%)	Coal (%)	Growth Index
1980	66	31	69	51	301	19	81	59	100
1981	69	32	68	51	309	21	79	59	105
1982	72	32	68	52	328	23	77	59	114
1983	76	32	68	54	351	25	75	59	125
1984	80	32	68	55	377	23	77	63	150
1985	87	30	70	58	411	23	78	65	162
1986	94	29	71	61	450	21	79	69	176
1987	103	29	71	62	497	20	80	70	194
1988	115	28	72	63	545	20	80	70	218
1989	127	27	73	64	585	20	80	70	224
1990	138	26	74	66	621	20	80	71	236
1991	151	25	75	66	678	18	82	72	253
1992	165	25	75	66	742	18	82	72	285
1993	181	25	75	66	816	18	82	72	322
Growth 1980-93	8.1				8.0				9.4

Sources: (1) Electric Power Industry in China, 1991, 1992; (2) Energy in China, 1992; and (3) People's Daily (Overseas Edition), various issues, 1993, 1994.

Table 31. Projections of Electricity Generating Capacity in China, 1994-2010.

Year	Installed Capacity (GW)			Electricity Generation (TWh)		
	High	Medium	Low	High	Medium	Low
1993	**181**	**181**	**181**	**816**	**816**	**816**
1994	196	192	188	891	877	866
1995	215	207	199	972	943	920
1996	237	223	210	1062	1013	977
1997	260	240	221	1159	1089	1037
1998	286	258	234	1265	1170	1101
1999	314	278	247	1381	1258	1169
2000	**345**	**300**	**261**	**1508**	**1352**	**1241**
2001	372	317	272	1613	1429	1296
2002	401	336	285	1726	1510	1353
2003	431	355	298	1847	1596	1413
2004	465	376	311	1976	1687	1475
2005	500	398	325	2114	1783	1540
2006	539	422	339	2262	1885	1608
2007	580	447	355	2421	1992	1680
2008	625	473	371	2590	2106	1754
2009	673	501	387	2772	2226	1831
2010	**725**	**530**	**405**	**2966**	**2352**	**1912**

Note: Assumptions for various scenarios are as follows:

	High		Medium		Low	
	1994-2000	2001-2010	1994-2000	2001-2010	1994-2000	2001-2010
GNP Growth	9.0%	7.0%	8.5%	6.5%	7.0%	5.0%
Elasticity	1.1	1.1	0.9	0.9	0.8	0.8
Capacity Growth	9.9%	7.7%	7.7%	5.9%	5.6%	4.5%
Generation Growth	9.2%	7.0%	7.5%	5.7%	6.2%	4.4%

Source: East-West Center, Program on Resources: Energy and Minerals, Coal Project, Honolulu, Hawaii, 1994.

Table 32. Projection of Installed Power Capacity by Fuel

	1980		1993		2000		2010	
	GW	Share	GW	Share	GW	Share	GW	Share
Total	66	100	181	100	300	100	530	100
Coal	34	51	118	65	195	65	320	60
Hydro	20	31	45	25	75	25	140	26
Oil & Gas	12	18	15	8	20	7	40	8
Nuclear	0	0	1	1	7	2	25	5
Other	0	0	2	1	3	1	5	1

Source: Energy in China, 1992; Electric Power Industry in China 1991-1992; People's Daily Overseas Edition, and EWC Coal Project estimates.

Table 33. Principal Thermal Power Plants by the End of 1992 (600 MW and above)

NO.	Name	Location	Network	Capacity (MW)			Fuel
				Design	Existing	Size	
Total				85617	61202		
1	Qinghe	Liaoning	NEPN	1300	1300	100, 200	coal, oil
2	Jinzhou	Liaoning	NEPN	1200	1200	200	coal
3	Liaoning	Liaoning	NEPN	1050	1050	50, 200	coal, oil
4	Dalian	Liaoning	NEPN	700	700	350	coal
5	Tieling	Liaoning	NEPN	1200	600	300	coal
6	Suizhong	Liaoning	NEPN	1600		800	coal
7	Yingkou	Liaoning	NEPN	600		300	coal
8	Changshan	Jilin	NEPN	693	693	200	coal
9	Jilin	Jilin	NEPN	850	850	100, 200	coal, oil
10	Shuangliao	Jilin	NEPN	600		300	coal
11	Fularji No.2	Heilongjiang	NEPN	1200	1200	200	coal
12	Mudanjiang	Heilongjiang	NEPN	820	820	100, 210	coal
13	Shuangyashan	Heilongjiang	NEPN	820	820	200, 210	coal
14	Harbin No.3	Heilongjiang	NEPN	1600	400	200, 600	coal
15	Daqing	Heilongjiang	NEPN	600	400	200	coal
16	Hegang	Heilongjiang	NEPN	600		300	coal
17	Yuanbaoshan	Inner Mongolia	NCPN	900	900	300, 600	coal
18	Tongliao	Inner Mongolia	NCPN	1200	800	200	coal
19	Fengzhen	Inner Mongolia	NCPN	800	400	200	coal
20	Yimin	Inner Mongolia	NCPN	1000		500	coal
21	Dalate	Inner Mongolia	NCPN	660		330	coal
22	Gaojing	Beijing	NCPN	600	600	100	coal
23	Shijingshan	Beijing	NCPN	600	600	200	coal
24	Dagang No.1	Tianjin	NCPN	640	640	320	oil
25	Dagang No.2	Tianjin	NCPN	640	640	320	coal
26	Junliangcheng	Tianjin	NCPN	840	640	200	coal,oil
27	Jixian	Tianjin	NCPN	1000		500	coal
28	Douhe	Hebei	NCPN	1550	1550	125,250	coal
29	Xingtai	Hebei	NCPN	1290	1200	200	coal
30	Matou	Hebei	NCPN	850	850	100,200	coal
31	Shang'an	Hebei	NCPN	700	700	350	coal
32	Shalingzi	Hebei	NCPN	1200	600	300	coal

Note: Units below 100 MW are not included, except for the Liaoning Power Plant.

Source: Electric Power Industry in China, 1993.

Table 33. Principal Thermal Power Plants by the End of 1992 (continued)

NO.	Name	Location	Network	Capacity (MW)			Fuel
				Design	Existing	Size	
33	Xibaipo	Hebei	NCPN	1200		300	coal
34	Shentou	Shanxi	NCPN	1300	1300	200	coal
35	Shentou No.2	Shanxi	NCPN	1000	500	500	coal
36	Datong No.2	Shanxi	NCPN	1200	1200	200	coal
37	Zhangze	Shanxi	NCPN	1040	1040	100, 210	coal
38	Shidongko	Shanghai	ECPN	1200	1200	300	coal
39	Shidongko No.2	Shanghai	ECPN	1200	1200	600	coal
40	Wujing	Shanghai	ECPN	950	825	100, 300	coal
41	Minhang	Shanghai	ECPN	818	818	110, 125	coal
42	Baoshan	Shanghai	ECPN	700	700	350	coal,BFG
43	Waigaoqiao	Shanghai	ECPN	1200		300	coal
44	Jianbi	Jiangsu	ECPN	1625	1625	100, 300	coal
45	Xuzhou	Jiangsu	ECPN	1300	1300	125, 200	coal
46	Wangting	Jiangsu	ECPN	1100	1100	300	coal,oil
47	Nantong	Jiangsu	ECPN	700	700	350	coal
48	Ligang	Jiangsu	ECPN	700		350	coal
49	Nanjing	Jiangsu	ECPN	600		300	coal
50	Changshu	Jiangsu	ECPN	1200		300	coal
51	Beilungang	Zhejiang	ECPN	1200	600	600	coal
52	Zhenhai	Zhejiang	ECPN	1050	1050	125, 200	coal, oil
53	Taizhou	Zhejiang	ECPN	750	750	125	coal
54	Pingwei	Anhui	ECPN	1200	1200	600	coal
55	Huaibei	Anhui	ECPN	950	750	125, 200	coal
56	Huainan	Anhui	ECPN	600	600	120, 125	coal
57	Luohe	Anhui	ECPN	600	600	300	coal
58	Fuzhou	Fujian	FJPG	700	700	350	coal
59	Zouxian	Shandong	SDPG	1200	1200	300	coal
60	Shiheng	Shandong	SDPG	735	735	300	coal
61	Shiliquan	Shandong	SDPG	625	625	125	coal
62	Huangtai	Shandong	SDPG	925	925	100, 300	coal
63	Longkou	Shandong	SDPG	600	600	100, 200	coal
64	Xindian	Shandong	SDPG	600	600	100, 200	oil

Table 33. Principal Thermal Power Plants by the End of 1992 (continued)

NO.	Name	Location	Network	Capacity (MW)			Fuel
				Design	Existing	Size	
65	Huangdao	Shandong	SDPG	670	670	125, 210	coal
66	Hualu	Shandong	SDPG	1200	600	300	coal
67	Weifang	Shandong	SDPG	600		300	coal
68	Yaomeng	Henan	CCPN	1200	1200	300	coal
69	Jiaozuo	Henan	CCPN	1224	1224	200	coal
70	Sanmenxia	Henan	CCPN	600		300	coal
71	Hanchuan	Hubei	CCPN	1200	600	300	coal
72	Qingshan	Hubei	CCPN	674	674	100, 200	coal, oil
73	Jingmen	Hubei	CCPN	600	600	100, 200	coal
74	Yangluo	Hubei	CCPN	600		300	coal
75	Yueyang	Hunan	CCPN	700	700	350	coal
76	Jinzhushan	Hunan	CCPN	600	600	125	coal
77	Shimen	Hunan	CCPN	600		300	coal
78	Jiujiang	Jiangxi	CCPN	650	650	125, 200	coal
79	Ginling	Shaanxi	NWPN	1050	1050	125, 200	coal
80	Weihe	Shaanxi	NWPN	1200	600	300	coal
81	Puchen	Shaanxi	NWPN	660		330	coal
82	Jingyuan	Gansu	NWPN	800	800	200	coal
83	Daba	Ningxia	NWPN	600	600	300	coal
84	Luohuang	Sichuan	SCPG	700	700	350	coal
85	Chongqing	Sichuan	SCPG	696	696	200	coal
86	Jiangyou	Sichuan	SCPG	660	660	330	coal
87	Qingzhen	Guizhou	GZPG	658	658	200	coal
88	Huangpu	Guangdong	GDPG	1100	1100	125, 300	coal, oil
89	Shajiao A	Guangdong	GDPG	1200	900	200, 300	coal
90	Shajiao B	Guangdong	GDPG	700	700	350	coal
91	Shajiao C	Guangdong	GDPG	1980		660	coal
92	Shaoguan	Guangdong	GDPG	624	624	200	coal
93	Zhujiang	Guangdong	GDPG	600		300	coal
94	Shenzhen	Guangdong	GDPG	600		300	coal

Table 34. Nuclear Power Development Plans

Plant Name	Location	Capacity (MW) Planned	Existing	Schedule Status	Technology Options
Total in 2010		35000			
Total in 2000		7000			
Total in 1994			2100		
Qingshan I	Zhejiang	300	300	82-91	Domestic
Qingshan II	Zhejiang	1200	0	Construction	Domestic
Qingshan III	Zhejiang	1200	0	Planning	Domestic
Zhejiang II	Zhejiang	2000	0	Planning	Imported
Daya Bay	Guangdong	1800	1800	87-93 (94)	France
Shantou I	Guangdong	2000	0	Planning	Imported
Shantou II	Guangdong	4000	0	Planning	*na*
Yangjiang I	Guangdong	4000	0	Planning	Imported
Yangjiang II	Guangdong	2000	0	Planning	*na*
Guangdong IV	Guangdong	6000	0	Planning	*na*
Wentuozi	Liaoning	2000	0	Planning	Russia
Dongfang I	Hainan	350	0	Planning	Domestic
Dongfang II	Hainan	350	0	Planning	Domestic
na	Fujian	*1200*	0	Site Selection	*Domestic*
na	Jiangsu	*1500*	0	Site Selection	*Domestic*
na	Jiangxi	*900*	0	Site Selection	*Domestic*
na	Shandong	*1200*	0	Site Selection	*Domestic*
na	Southwest	*1200*	0	Site Selection	*Domestic*
na	Other	*1800*	0		*Domestic*

Note: Numbers and technology options in italics are estimated by the author.
Source: China Daily, Asian Energy News, China Newsletter, and Energy in China 1992.

Table 35. Large Hydropower Stations (250 MW and above)

NO.	Name	River	Location	Capacity (MW)		Generation (TWh)	Operating Hours
				Design	Existing		
1	Shuifeng	Yalujiang	Liaoning	630	630	3.93	6238
2	Fengman	Songhuajiang	Jilin	639	639	1.96	3067
3	Yunfeng	Yalujiang	Jilin	400	400	1.75	4375
4	Baishan	Songhuajiang	Jilin	1500	1500	2.04	1360
5	Laohushao	Yalujiang	Jilin	390	390	1.20	3077
6	Panjiakou	Luanhe	Hebei	390	390	0.56	1446
7	Xin'anjiang	Xin'anjiang	Zhejiang	663	663	1.86	2808
8	Fuchunjiang	Qiantangjiang	Zhejiang	297	297	0.93	3129
9	Jinshuitan	Quijiang	Zhejiang	300	300	0.49	1633
10	Wan'an	Ganjiang	Jiangxi	400	500	1.05	2625
11	Shaxikou	Shaxi	Fujian	300	300	0.96	3200
12	Shuikou	Mingjiang	Fujian	1400		4.95	3536
13	Zhaxi	Zishui	Hunan	448	448	2.20	4916
14	Fengtan	Youshui	Hunan	400	400	2.04	5100
15	Dongjiang	Laishui	Hunan	500	500	1.32	2640
16	Wuqiangxi	Yuanshui	Hunan	1200		5.37	4475
17	Danjiangkou	Hanjiang	Hubei	900	900	3.83	4256
18	Gezhouba	Changjiang	Hubei	2715	2715	14.10	5193
19	Geheyan	Qingjiang	Hubei	1200		3.04	2533
20	Sanmenxia	Huanghe	Henan	250	250	1.31	5240
21	Xinfengjiang	Xinfengjiang	Guangdong	293	293	1.17	4000
22	Guangzhou PS	Tributary of Liuxi River	Guangdong	1200		2.38	1983
23	Dahua	Hongshuihe	Guangxi	400	400	2.05	5125
24	Yantan	Hongshuihe	Guangxi	1100		5.37	4882
25	Gongzui	Daduhe	Sichuan	700	700	4.12	5886
26	Baozhusi	Bailongjiang	Sichuan	700		2.28	3257
27	Tongjiezi	Daduhe	Sichuan	600		3.21	5350
28	Ertan	Yalongjiang	Sichuan	3300		17.00	5152
29	Wujiangdu	Wujiang	Guizhou	630	630	3.34	5302
30	Tianshengqiao-II	Nanpanjiang	Guizhou/Guangxi	880	880	4.92	5591
31	Tianshengqiao-I	Nanpanjiang	Guizhou/Guangxi	1200		5.38	4483
32	Lubuge	Huangnihe	Yunnan/Guizhou	750	750	2.75	3667
33	Dongfeng	Wujiang	Guizhou	510		2.42	4745
34	Manwan	Lancangjiang	Yunnan	1000		5.48	5480
35	Yanguoxia	Huanghe	Gansu	396	396	2.15	5429
36	Liujiaxia	Huanghe	Gansu	1225	1225	5.58	4555
37	Bikou	Bailongjiang	Gansu	300	300	1.46	4867
38	Qingtongxia	Huanghe	Ningxia	272	272	1.04	3824
39	Ankang	Hanjiang	Shaanxi	800	800	2.86	3575
40	Longyangxia	Huanghe	Qinghai	1280	1280	5.98	4672
41	Lijiaxia	Huanghe	Qinghai	2000		5.90	2950
42	Shisanling PS	Wenyuhe	Beijing	800		1.2/1.65	1781
Total/Average				35257	19147	143	4060
Total Capacity Under Construction (MW)			16110				
Share of China's Total Hydro Capacity (%)			47				

Source: Electric Power Industry in China, 1993.

Table 36. China's Installed Power Capacity by Province

	Power Capacity at Year End							
	Total (GW)		Growth 80-90		Hydro (GW)		Growth 80-90	
	1980	1990	(GW)	(%/yr)	1980	1990	(GW)	(%/yr)
China	65.87	137.89	72.02	7.67	20.32	36.05	15.73	5.90
Beijing	1.91	2.43	0.52	2.44	0.25	0.27	0.02	0.85
Tianjin	1.50	2.02	0.52	3.00		0.01	0.01	
Hebei	3.15	6.67	3.52	7.78	0.17	0.42	0.25	9.36
Shanxi	2.48	5.89	3.41	9.03	0.21	0.23	0.02	1.07
Inner Mongolia	1.23	3.89	2.66	12.20	0.02	0.03	0.01	3.54
Liaoning	5.17	8.56	3.40	5.18	0.88	1.17	0.28	2.83
Jilin	2.29	4.78	2.49	7.62	0.83	2.20	1.38	10.27
Heilongjiang	2.47	6.13	3.66	9.52	0.13	0.19	0.06	3.76
Shanghai	3.19	5.80	2.61	6.16				
Jiangsu	3.51	9.89	6.38	10.91	0.03	0.03	0.00	1.39
Zhejiang	2.71	6.12	3.41	8.49	1.69	2.33	0.65	3.30
Anhui	1.76	4.06	2.30	8.71	0.40	0.52	0.12	2.71
Fujian	1.73	3.88	2.15	8.40	1.25	2.17	0.93	5.72
Jiangxi	1.55	2.96	1.41	6.68	0.74	1.10	0.35	3.94
Shandong	3.49	8.63	5.14	9.47	0.07	0.08	0.00	0.69
Henan	3.54	6.17	2.63	5.72	0.40	0.47	0.06	1.48
Hubei	2.95	7.06	4.11	9.12	1.55	4.75	3.20	11.83
Hunan	3.16	5.44	2.28	5.59	1.90	3.00	1.09	4.64
Guangdong	3.03	8.28	5.25	10.57	1.86	2.68	0.82	3.74
Guangxi	1.78	3.43	1.65	6.77	1.13	1.89	0.76	5.26
Hainan		0.81	0.81			0.29	0.29	
Sichuan	3.97	7.49	3.52	6.56	2.00	3.43	1.43	5.54
Guizhou	1.53	2.81	1.28	6.29	0.72	1.53	0.81	7.84
Yunnan	1.63	3.38	1.75	7.56	1.11	2.19	1.08	7.04
Tibet	0.07	0.15	0.08	8.58	0.05	0.11	0.06	7.59
Shaanxi	1.68	2.86	1.19	5.49	0.26	0.57	0.31	8.06
Gansu	2.78	3.82	1.04	3.22	2.08	2.34	0.26	1.17
Qinghai	0.21	1.66	1.46	23.22	0.05	1.35	1.30	39.31
Ningxia	0.52	0.93	0.41	5.97	0.27	0.28	0.00	0.07
Xinjiang	0.84	1.90	1.07	8.55	0.26	0.45	0.18	5.48

Source: China Energy Statistical Yearbook 1991.

Table 37. Electricity Generatiion and Consumption by Province

	Generation (TWh) 1980	Generation (TWh) 1990	Generation (TWh) 1992	Consumption (TWh) 1985	Consumption (TWh) 1990	Export (TWh) 1990
China	300.6	621.2	815.9	410.9	622.3	-1.0
Beijing	10.7	12.5	13.7	12.6	17.4	-4.9
Tianjin	6.3	9.5	12.3	9.6	12.4	-2.9
Hebei	19.6	36.9	48.4	24.4	35.4	1.5
Shanxi	12.0	31.4	40.8	16.4	25.5	5.9
Inner Mongolia	4.9	17.0	23.5	7.0	12.2	4.8
Liaoning	29.9	43.6	49.2	34.8	46.2	-2.6
Jilin	11.2	17.5	23.5	14.0	19.1	-1.6
Heilongjiang	12.9	29.5	35.2	19.9	29.6	-0.1
Shanghai	20.6	28.4	37.0	20.5	26.5	1.9
Jiangsu	16.1	40.5	51.3	27.7	41.2	-0.7
Zhejiang	8.1	20.9	29.8	14.7	23.0	-2.2
Anhui	9.6	19.4	26.5	12.8	18.6	0.9
Fujian	5.0	13.7	19.6	7.7	13.7	0.0
Jiangxi	5.8	12.1	14.3	8.5	12.8	-0.6
Shandong	18.6	44.6	60.5	26.3	44.9	-0.2
Henan	16.0	31.9	43.2	22.8	33.8	-1.9
Hubei	13.1	34.0	39.8	19.3	28.1	5.9
Hunan	11.9	20.1	26.9	15.6	22.7	-2.5
Guangdong	11.3	34.4	54.9	18.4	35.9	-1.5
Guangxi	5.4	12.6	17.3	8.2	12.6	0.0
Hainan		1.4	2.4		1.4	0.0
Sichuan	16.4	34.3	46.0	23.2	35.0	-0.8
Guizhou	4.5	10.4	14.2	7.3	10.3	0.1
Yunnan	5.6	12.6	17.2	7.6	12.5	0.1
Tibet	0.2	0.3				0.3
Shaanxi	7.9	15.0	20.4	11.2	17.0	-2.1
Gansu	12.0	17.1	22.8	12.6	17.8	-0.6
Qinghai	0.8	7.1	6.8	1.7	4.2	2.8
Ningxia	1.9	5.6	8.8	2.5	5.5	0.1
Xinjiang	2.4	7.0	9.4	3.8	7.0	0.0

Source: China Statistical Yearbook 1993; China Energy Statistical Yearbook 1991.

Table 38. Electricity Utilization Capacity by Province in 1990

	Generation Capacity 1990 (GW)	Electricity Utilization Capacity in 1990 (GW)				
		Total (GW)	UG Ratio*	Industry (GW)	Residen. (GW)	Agricul. (GW)
China	137.89	347.41	2.52	215.51	33.06	56.64
Beijing	2.43	11.05	4.55	5.09	0.55	1.72
Tianjin	2.02	7.41	3.68	4.09	0.39	1.79
Hebei	6.67	17.49	2.62	8.50	1.28	5.76
Shanxi	5.89	13.69	2.32	8.45	0.68	2.68
Inner Mongolia	3.89	5.65	1.45	3.40	0.68	0.85
Liaoning	8.56	23.78	2.78	16.36	2.92	1.41
Jilin	4.78	10.05	2.10	6.17	1.81	0.74
Heilongjiang	6.13	13.72	2.24	9.55	1.60	1.13
Shanghai	5.80	16.99	2.93	11.68	1.15	1.55
Jiangsu	9.89	26.62	2.69	15.69	2.05	6.44
Zhejiang	6.12	14.67	2.40	8.84	1.69	2.75
Anhui	4.06	9.92	2.44	6.46	0.76	2.09
Fujian	3.88	3.88	1.00	2.40	0.43	0.44
Jiangxi	2.96	6.36	2.15	3.87	0.66	1.26
Shandong	8.63	23.68	2.74	14.31	1.71	5.66
Henan	6.17	21.40	3.47	12.51	2.61	4.03
Hubei	7.06	16.99	2.41	10.55	1.06	3.74
Hunan	5.44	20.24	3.72	16.15	1.03	2.06
Guangdong	8.28	20.55	2.48	11.07	3.99	2.11
Guangxi	3.43	7.63	2.22	4.88	1.36	0.78
Hainan	0.81	0.38	0.46	0.15	0.03	0.01
Sichuan	7.49	18.04	2.41	11.51	2.51	2.06
Guizhou	2.81	3.51	1.25	2.19	0.28	0.26
Yunnan	3.38	5.15	1.52	3.37	0.46	0.67
Tibet	0.15					
Shaanxi	2.86	9.41	3.29	5.27	0.58	1.78
Gansu	3.82	10.86	2.84	7.76	0.41	1.76
Qinghai	1.66	1.93	1.16	1.36	0.13	0.21
Ningxia	0.93	2.20	2.37	1.52	0.10	0.47
Xinjiang	1.90	3.86	2.03	2.38	0.16	0.49

* UG Rario=Utilization Capacity/Generation Capacity.

Source: China Energy Statistical Yearbook 1991.

Table 39. Urban Household Possession of Electric Appliances by Province

	Possession of Appliances per 100 Households in 1992					
	A/C	Refrige.	Color T.V.	B&W T.V.	Washer	Fan
	1992					
China	1.19	53	75	38	83	146
Beijing	0.60	101	101	40	96	125
Tianjin	1.00	86	90	40	85	115
Hebei	0.34	58	82	34	88	129
Shanxi	0.20	34	73	31	86	67
Inner Mongolia	0.29	25	69	35	82	30
Liaoning	0.04	54	79	38	84	51
Jilin	0.00	30	68	43	87	43
Heilongjiang	0.06	29	63	44	81	28
Shanghai	2.20	93	89	49	71	196
Jiangsu	1.04	59	70	52	90	251
Zhejiang	1.79	87	78	46	76	265
Anhui	0.86	60	61	51	80	223
Fujian	0.72	62	73	40	81	230
Jiangxi	0.64	48	55	62	64	211
Shandong	0.27	68	78	34	82	169
Henan	1.39	47	71	36	83	198
Hubei	1.22	70	70	46	91	216
Hunan	0.76	61	63	44	81	240
Guangdong	11.29	64	88	26	87	364
Guangxi	0.38	50	61	57	84	299
Hainan	0.00	25	69	21	54	133
Sichuan	0.51	58	78	32	85	173
Guizhou	0.59	57	78	33	92	91
Yunnan	0.59	36	76	34	89	33
Tibet	3.00	35	99	3	67	2
Shaanxi	1.41	43	79	30	83	120
Gansu	0.62	34	74	25	86	33
Qinghai	0.23	27	85	21	92	2
Ningxia	0.16	45	94	15	95	65
Xinjiang	0.40	47	77	26	88	38

Source: China Statistical Yearbook 1993.

Table 40. Electricity Consumption Per Unit of GNP by Province

	GNP (Billion yuan) 1990	Electricity Consumption (TWh) 1990	Unit GNP Consumption (kWh/1000 yuan) 1990
China	1723	622	361
Beijing	50	17.41	348
Tianjin	31	12.42	399
Hebei	84	35.42	423
Shanxi	40	25.55	641
Inner Mongolia	29	12.18	425
Liaoning	96	46.22	479
Jilin	39	19.08	484
Heilongjiang	66	29.64	451
Shanghai	74	26.47	356
Jiangsu	132	41.18	313
Zhejiang	84	23.03	275
Anhui	61	18.57	306
Fujian	47	13.67	293
Jiangxi	42	12.77	306
Shandong	133	44.87	337
Henan	90	33.82	378
Hubei	79	28.13	355
Hunan	70	22.67	323
Guangdong	147	35.90	244
Guangxi	39	12.56	320
Hainan	10	1.40	147
Sichuan	115	35.02	305
Guizhou	25	10.32	406
Yunnan	40	12.46	315
Tibet	2		
Shaanxi	37	17.03	454
Gansu	23	17.78	758
Qinghai	7	4.22	636
Ningxia	6	5.50	900
Xinjiang	25	7.00	278

Source: China Statistical Yearbook 1993, 1992; China Energy Statistical Yearbook 1991.

Table 41. China's Electricity Consumption by Sector

	1980		1991		Change in Share
	(TWh)	(%)*	(TWh)	(%)*	80-91 (%)
Total	301	100.0	680	100.0	0.0
(1) Production Sectors	283	94.2	602	88.5	-5.7
(a) Agriculture	33	11.0	48	7.1	-4.0
(b) Industry	241	80.2	526	77.3	-2.9
Light Industry	39	12.8	110	16.2	3.3
Heavy Industry	202	67.3	416	61.2	-6.2
(c) Construction	5	1.6	7	1.1	-0.5
(d) Transportation	3	0.9	12	1.7	0.8
(e) Commerce	2	0.6	9	1.3	0.8
(2) Government	7	2.3	24	3.5	1.2
(3) Residential	11	3.5	54	8.0	4.5
Within the Industrial Sector:	1985**		1991		85-91
Mining	43	14.4	74	10.8	-3.6
Food, Beverage, Tobacco, Forage	11	3.6	20	2.9	-0.7
Textile	19	6.2	26	3.8	-2.4
Paper Making and Paper Products	8	2.7	13	1.9	-0.8
Power, Steam, and Hot Water	59	19.6	99	14.6	-5.0
Petroleum Processing	4	1.3	8	1.2	-0.2
Coking, Gas and Coal Products	1	0.3	2	0.3	0.0
Chemicals and Allied Products	51	17.1	78	11.4	-5.7
Medical and Pharmaceutical Products	2	0.8	5	0.8	0.0
Chemical Fibers	3	1.1	7	1.0	-0.1
Building Materials	22	7.4	36	5.3	-2.0
Ferrous Metals	36	12.1	59	8.6	-3.5
Non-Ferrous Metals	17	5.8	29	4.3	-1.5
Machine, Equipment, Electronics***	32	10.7	37	5.5	-5.2

* As percentage of China's total.

** The categorization of industries changed in 1985.

*** Including Machine Building Industry, Transportation Equipment, Electric Equipment and Machinery Electronic and Telecommunications Equipment, Instruments, Meters and other Measuring Equipment.

Source: China Statistical Yearbook 1993, 1987.

Table 42. Electricity Consumption and Projection by Sector

	Electricity Consumption Share (%)				Growth
	1980	1991	2000	2010	80-91
Industry	80.2	77.3	70.1	56.5	7.4
Agriculture	11.0	7.1	4.6	2.5	3.4
Residential	3.5	8.0	14.7	25.9	16.1
Construction	1.6	1.1	0.8	0.5	4.2
Transportation & Communication	0.9	1.7	2.8	4.3	14.5
Commercial	0.6	1.3	2.5	4.6	16.5
Government	2.2	3.5	4.6	5.8	12.0
Total Consumption (TWh)	300.6	680.0	1350.0	2350.0	7.7

Source: China Statistical Yearbook, 1993, 1987; Electric Power Industry in China, 1992; and EWC estimations.

Table 43. China's Electricity Consumption by Sector in 1992

	Electricity Consumption	
	(TWh)	(%)*
Total	746	100.0
(1) Heavy Industry	456	61.2
(2) Light Industry	119	15.9
(3) Residential	63	8.5
(4) Agriculture	51	6.8
(5) Government and Commerce	43	5.8
(6) Transportation	13	1.8
Total Industry	575	100.0
Electric Power	111	19.4
Chemical	105	18.2
Ferrous Metals	70	12.2
Machine, Equipment, Electronics	48	8.4
Building Materials	45	7.8
Non-Ferrous Metals	37	6.5
Coal Mining	36	6.2
Textile	28	4.9
Petroleum Processing	26	4.6
Paper Making and Paper Products	14	2.4
Others	54	9.4

Source: Electric Power Industry in China 1993.

Table 44. Electricity Capacity and Generation of 15 Networks

	Installed capacity 1992			Generation 1992			Average	Load
	Total (MW)	Thermal (MW)	Hydro (%)	Total (TWh)	Thermal (TWh)	Hydro (%)	Annual Hours	Factors (%)
Northeast Network	24913	20578	17.4	113.6	105.9	6.8	4559	84.5
North China Network	25000	23900	4.4	112.7	111.4	1.1	4508	90.6
East China Network	30770	27793	9.7	135.0	127.5	5.6	4387	87.8
Central China Network	24150	15070	37.6	114.0	77.2	32.3	4720	89.5
Northwest Network*	13919	8413	39.6	59.7	42.3	29.1	4288	82.2
Shandong Grid **	9667	9617	0.5	56.6	56.6	0.0	5857	87.8
Fujian Grid	4018	1711	57.4	17.7	8.2	53.6	4395	83.3
Guangdong Grid	10825	7240	33.1	45.9	36.6	20.2	4240	83.8
Guangxi Grid	3203	1336	58.3	15.3	8.1	47.0	4780	83.6
Sichuan Grid	7716	5123	33.6	41.9	25.1	40.1	5435	82.9
Yunnan Grid	3084	1354	56.1	15.6	6.5	58.6	5052	82.6
Guizhou Grid	2390	1415	40.8	12.9	7.7	40.3	5414	86.3
Hainan Grid	643	439	31.7	2.0	1.2	38.4	3081	
Xinjiang Grid	2459	1867	24.1	8.7	6.9	20.3	3525	
Xizang (Tibet) Grid	164	45	72.6	0.4	0.1	71.9	2171	
Total of 15 Networks	162921	125900	22.7	752	621	17.4	4615	88.0

* Capacity as of July 31, 1993.

** Capacity of 0.5 MW and above.

Source: Electric Power Industry in China, 1993; and Ministry of Electric Power Industry 1994.

Table 45. China's Transmission System Capacity

Overhead Transmission Line Length in 1992 (km)							
35 kv	66 kv	110 kv	154 kv	220 kv	330 kv	500 kv	Total
243,924	40,370	127,895	147	82,070	4,253	8,660	507,319
High Voltage Substation Capacity in 1992 (MVA)							
KV		35-66	110	154	220	330	500
No. of Transformers		36,860	7,232	4	1,215	31	119
No. of Substations		19,942	3,969	2	713	17	31
Capacity (MVA)		135,780	164,120	160	131,940	6,360	30,880

Source: Electric Power Industry in China 1993.

Overhead Transmission Line Length in 1991 (km)							
35 kv	66 kv	110 kv	154 kv	220 kv	330 kv	500 kv	Total
228,953	40,039	123,481	145	77,454	4,024	7,981	482,077
High Voltage Substation Capacity in 1991(MVA)							
KV		35-66	110	154	220	330	500
No. of Transformers		35,014	6,234	4	1,104	29	88
No. of Substations		19,057	3,709	2	649	16	23
Capacity (MVA)		134,380	151,880	160	119,580	5,880	21,490

Source: Electric Power Industry in China 1992.

Table 46. Indicators of China's Major Generating Units (in 1992)

Fossil-Fired Units (100 MW and above)

Rating (MW)	No.of units	Capacity Total (MW)	Capacity Share (%)	Generation Average (MWH)	Generation Total (TWh)	Generation Share (%)	Annual Operating Hours	PLF %	Weighted Average EAF (%)	Weighted Average EFOR (%)
100	110	11000	17	595866	66	17	5959	68	88.42	3.11
110	6	660	1	758634	5	1	6897	79	91.08	1.82
120	2	240	0	560083	1	0	4667	53	60.52	17.86
125	74	9250	14	769516	57	15	6156	70	86.20	4.65
200	122	24400	37	1206571	147	38	6033	69	81.74	7.15
210	9	1890	3	1118779	10	3	5328	61	80.54	6.80
250	2	500	1	1697704	3	1	6791	78	85.92	2.59
300	35	10500	16	1712948	60	16	5710	65	76.82	10.97
320	3	960	1	702246	2	1	2195	25	71.23	35.94
330	2	660	1	981298	2	1	2974	34	47.29	14.04
350	10	3500	5	1983869	20	5	5668	65	84.47	1.30
362	3	1085	2	1316769	4	1	3641	42	70.38	16.12
600	3	1800	3	2855594	9	2	4759	54	68.34	12.86
Sub-total	323	66445	100		385	100				
Share of thermal			53			62				

Hydropower Units (40MW and above)

Type	No.of units	Capacity Total (MW)	Capacity Share (%)	Generation Average (MWH)	Generation Total (TWh)	Generation Share (%)	Annual Operating Hours	PLF %	Weighted Average EAF (%)	Weighted Average EFOR (%)
Axial	54	4844	26	441777	24	38	4925	56	91.47	0.11
Francis	139	13625	74	283673	39	62	2894	33	91.64	1.48
Sub-total	193	18469	100		63	100	3427	39	91.58	0.96
Share of hydro			45			48				

Source: Electric Power Industry in China, 1993.

EAF: Equivalent availability factor. EFOR: Equivalent forced outrage rate.

Table 46. Indicators of China's Major Generating Units (continued) (in 1991)

Fossil-Fired Units (100 MW and above)

Rating (MW)	No.of units	Capacity Total (MW)	Capacity Share (%)	Generation Average (MWH)	Generation Total (TWh)	Generation Share (%)	Annual Operating Hours	PLF %	Weighted Average EAF (%)	Weighted Average EFOR (%)
100	105	10500	18	587017	62	18	5870	67	87.86	1.97
110	6	660	1	730862	4	1	6644	76	82.32	2.19
120	2	240	0	557684	1	0	4647	53	65.49	12.84
125	68	8500	15	789630	54	16	6317	72	86.19	4.10
200	112	22400	39	1191425	133	39	5957	68	80.57	7.28
210	6	1260	2	1074632	6	2	5117	58	70.71	13.20
250	2	500	1	1910778	4	1	7643	87	92.75	0.92
300	28	8400	14	1745572	49	14	5819	66	81.01	8.62
320	2	640	1	1120885	2	1	3503	40	75.22	12.12
330	1	330	1	540788	1	0	1639	19	48.52	28.88
350	10	3500	6	1760540	18	5	5030	57	78.14	6.14
600	2	1200	2	2316610	5	1	3861	44	57.18	18.03
Sub-total	299	58130	100		338	100	5782	66	82.24	6.15
Share of thermal		51			61					

Hydropower Units (40MW and above)

Type	No.of units	Capacity Total (MW)	Capacity Share (%)	Generation Average (MWH)	Generation Total (TWh)	Generation Share (%)	Annual Operating Hours	PLF %	Weighted Average EAF (%)	Weighted Average EFOR (%)
Axial	53	4748	27	423438	22	34	4727	54	93.07	0.41
Francis	134	12701	73	329642	44	66	3478	40	92.17	0.43
Sub-total	187	17448	100		67	100	3818	44	92.47	0.42
Share of hydro		46			53					

Source: Electric Power Industry in China, 1992.

EAF: Equivalent availability factor. EFOR: Equivalent forced outrage rate.

Table 47. Main Indicators of Power Industry (6 MW and above)

	1980	1985	1986	1987	1988	1989	1990	1991	1992
Net Coal Cons. (g/kwh)	448	431	432	432	431	432	427	423	419
Efficiency	27.4	28.5	28.4	28.4	28.5	28.4	28.8	29.0	29.3
Plant use (%)	6.44	6.4	6.5	6.7	6.7	6.8	6.9	6.9	6.9
Thermal	7.65	7.8	7.8	7.9	7.9	8.1	8.2	8.1	8.1
Hydro	0.19	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Line Loss Rate (%)	8.93	8.2	8.2	8.5	8.2	8.0	8.1	8.2	8.2
Utilization Hours	5078	5308	5388	5392	5313	5171	5036	5030	na
Thermal	5775	5893	5974	6011	5907	5716	5413	5451	na
Hydro	3293	3853	3882	3771	3710	3691	3800	3675	na

Source: Energy in China, 1992.

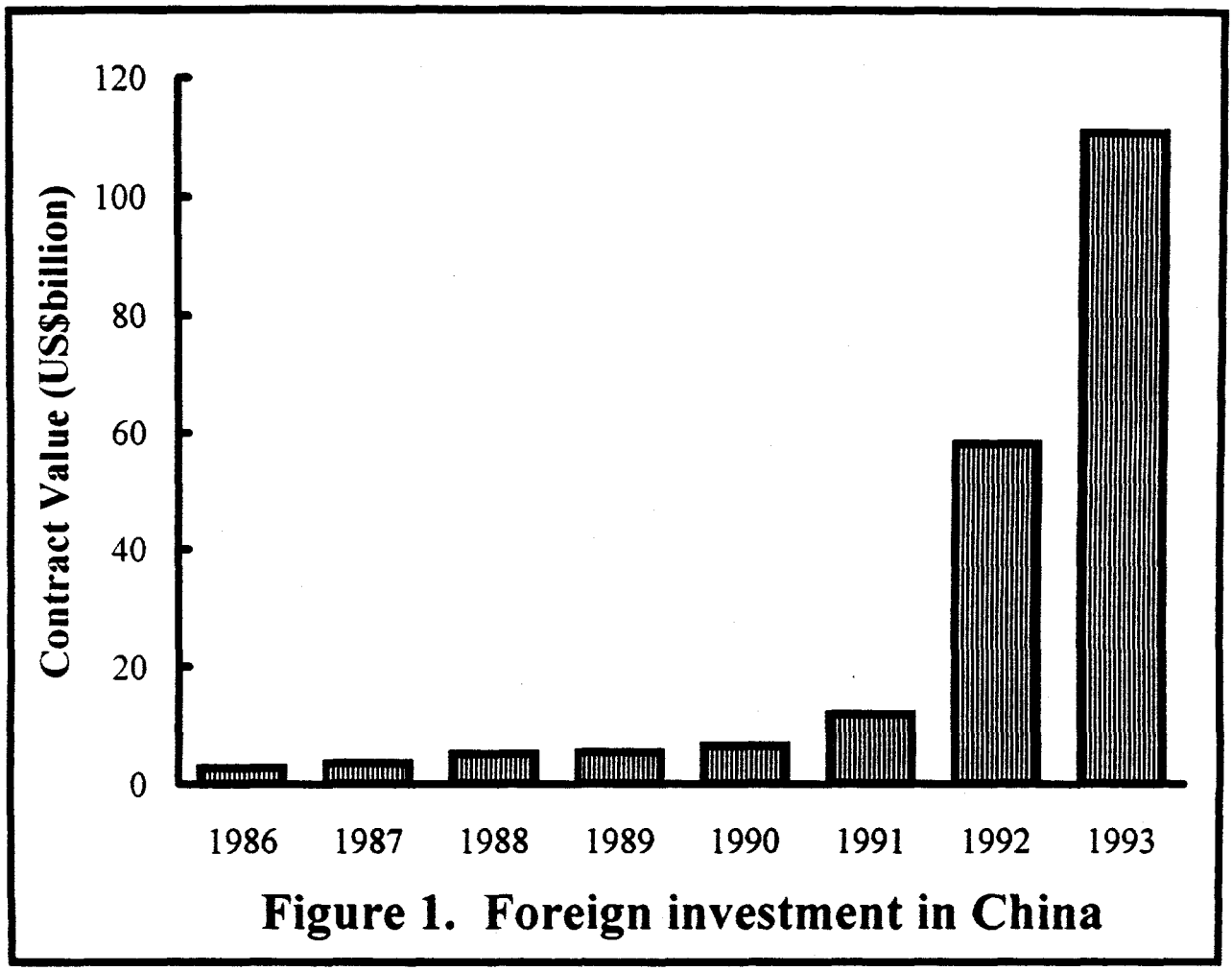

Figure 1. Foreign investment in China

Figure 2. China's Coal Fields

1-Shanxi and Shaanxi; 2-Inner Mongolia; 3-Guizhou; 4-Anhui and Shandong

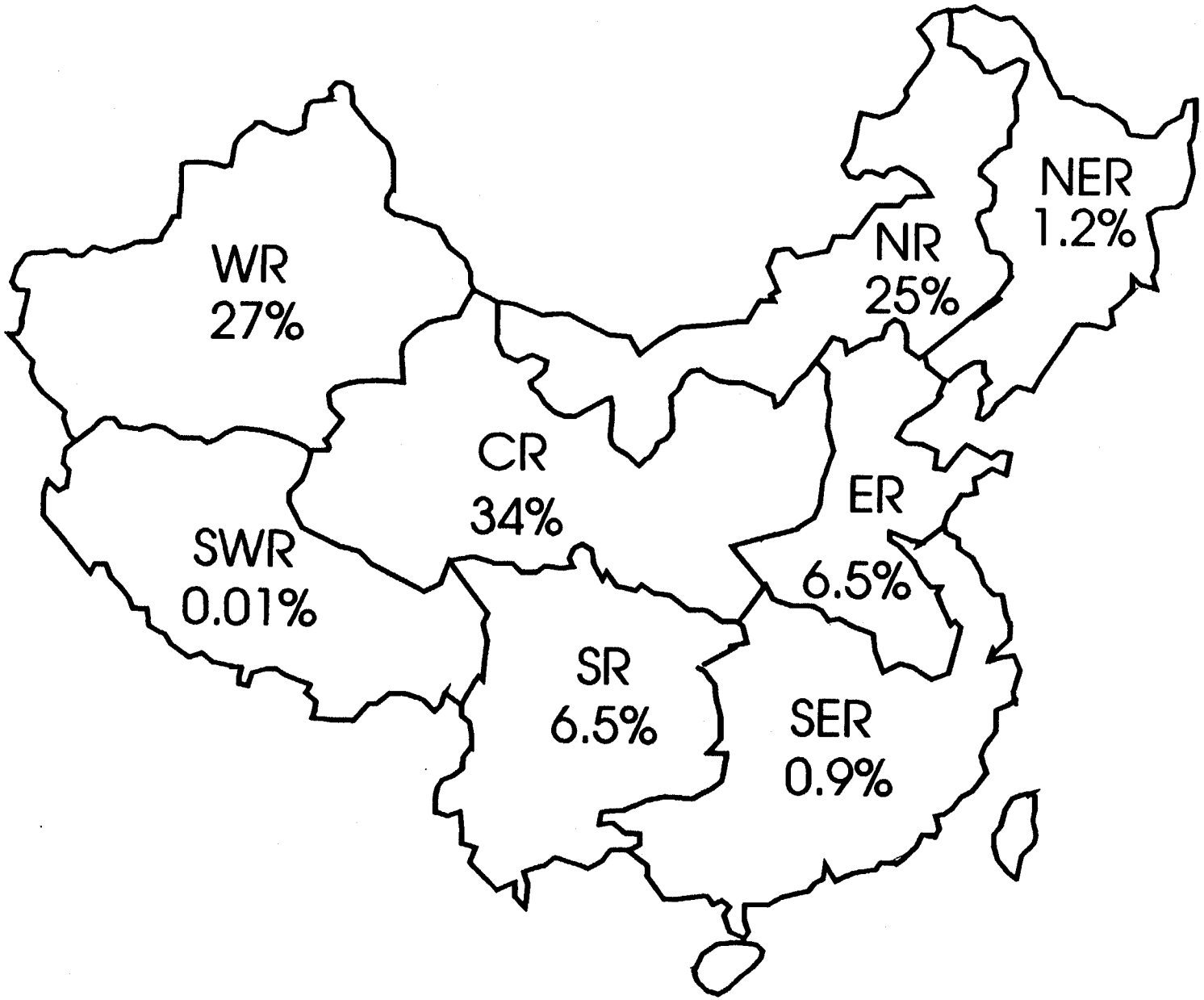

Figure 3. Distribution of China's Coal Resources

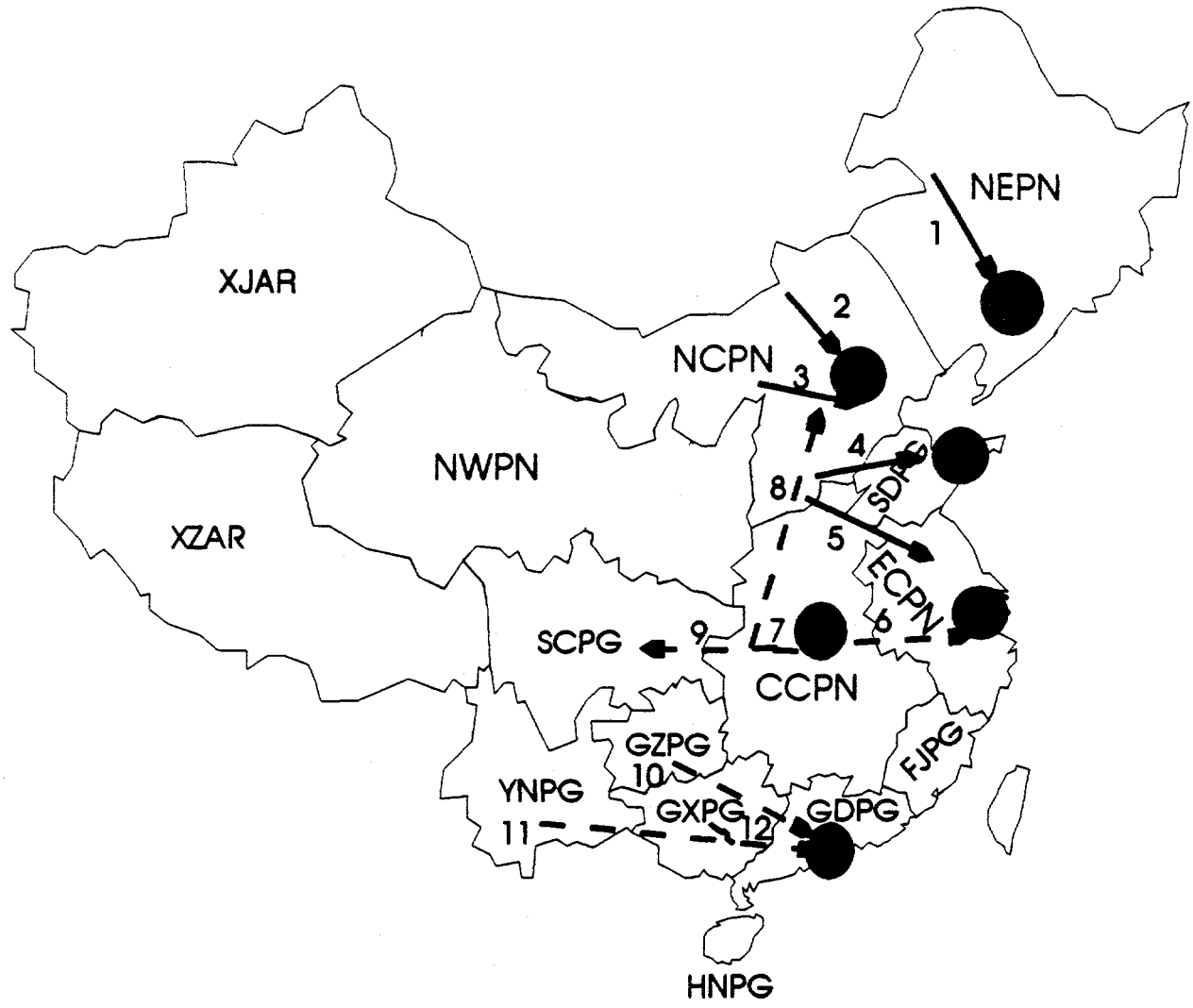

Figure 4. Planned major electricity transmission

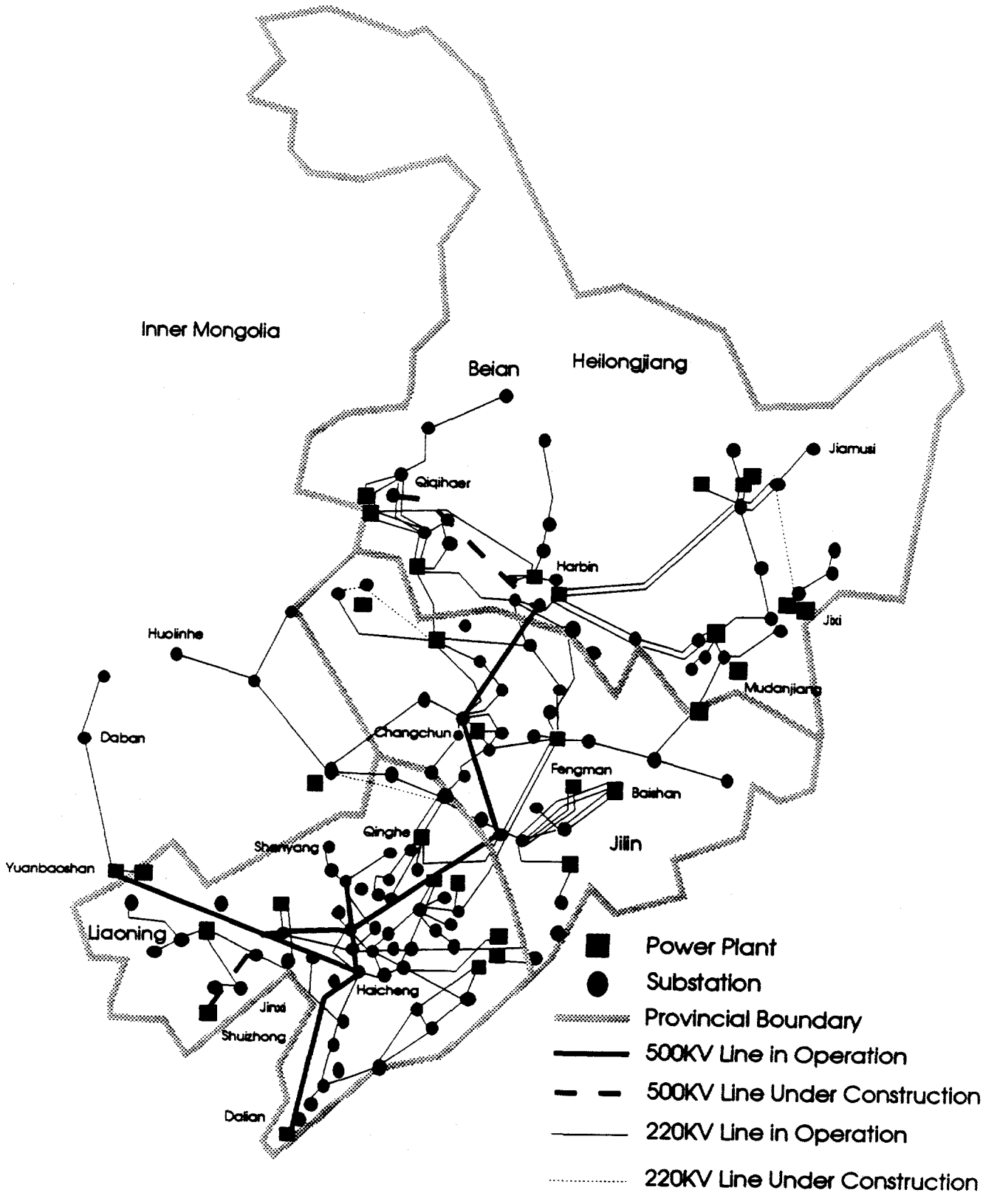

Figure 5. The Northeast China Power Network

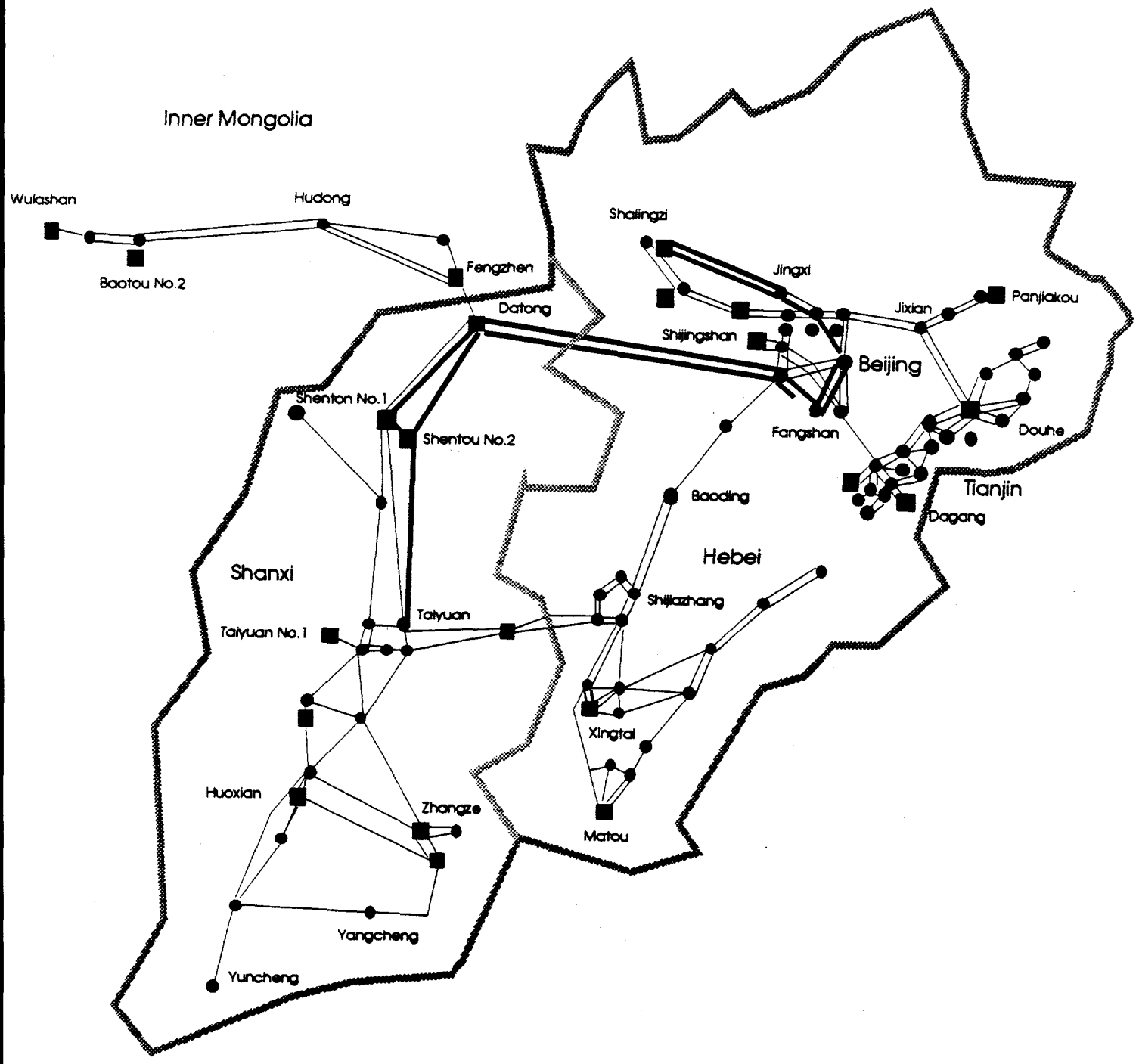

Figure 6. The North China Power Network

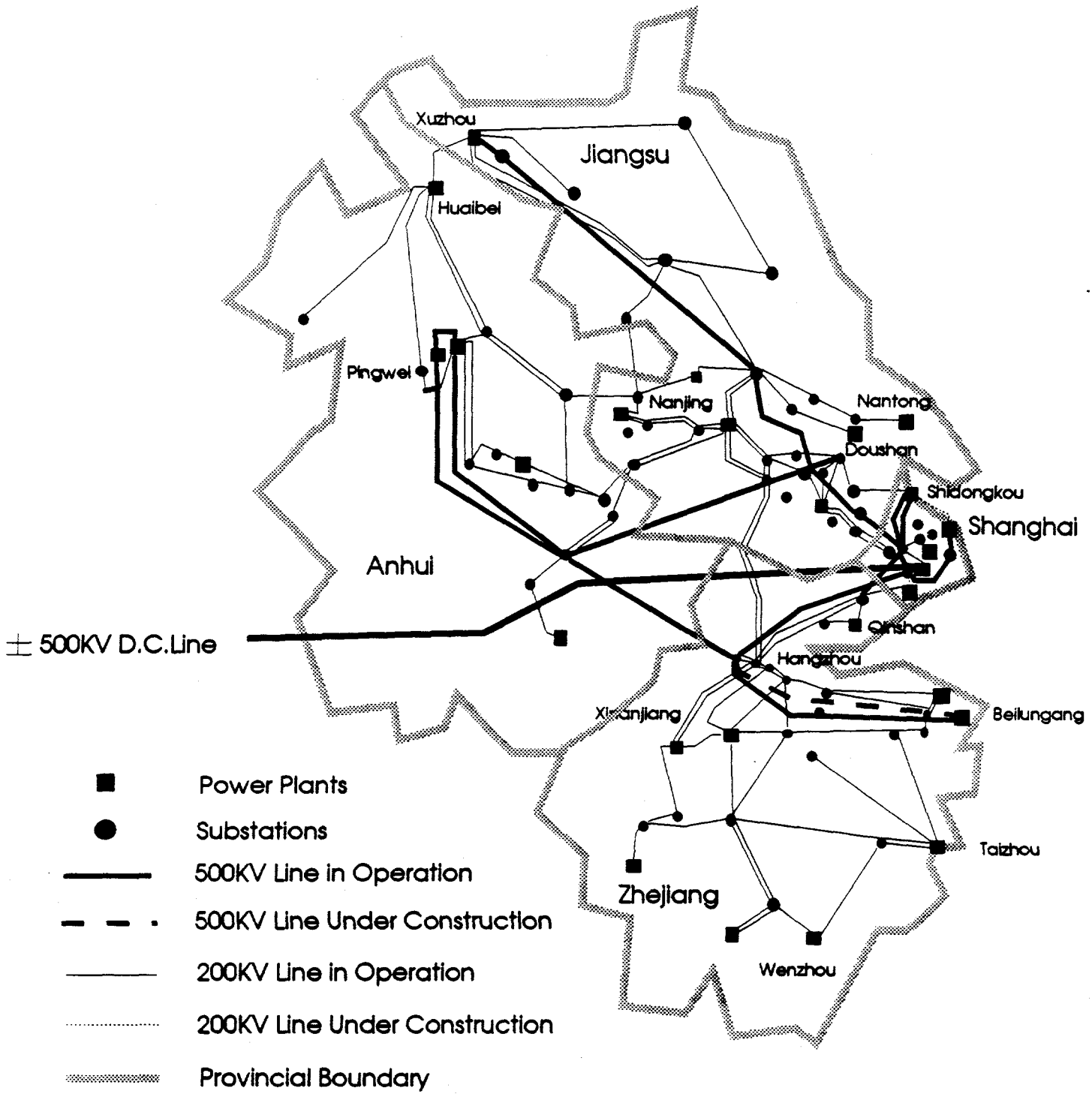

Figure 7. The East China Power Network

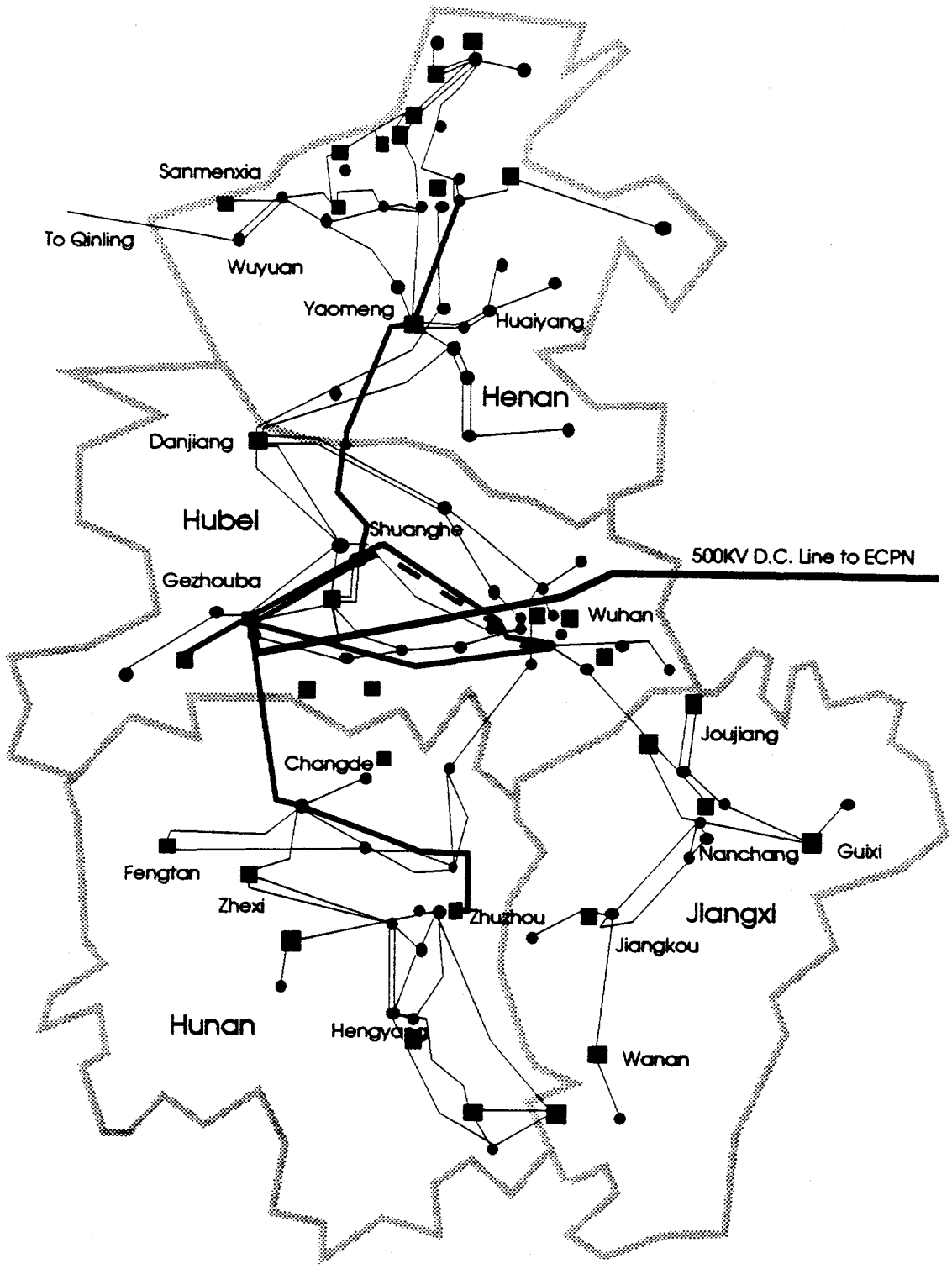

Figure 8. The Central China Power Network

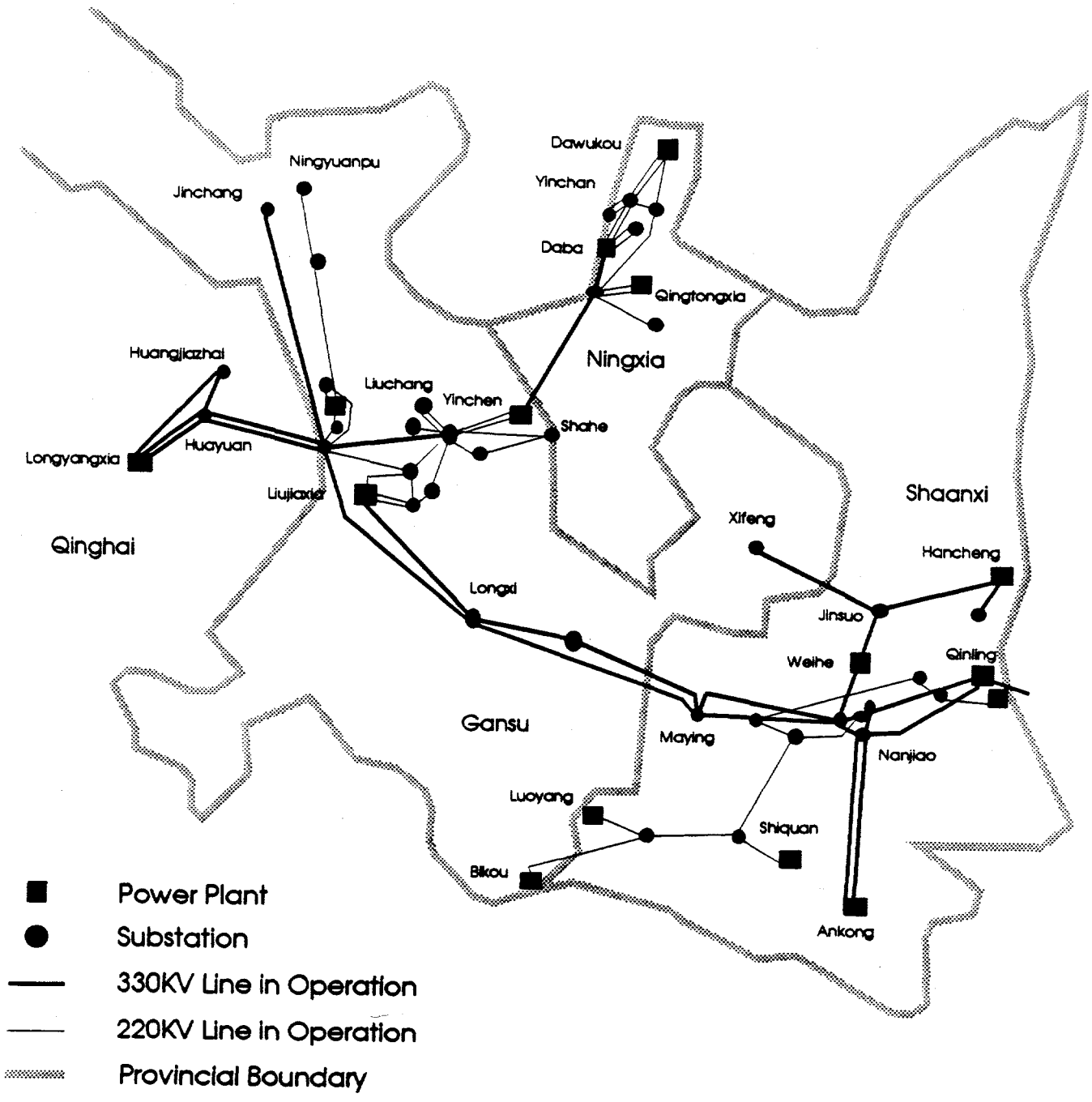

Figure 9. The Northwest China Power Network

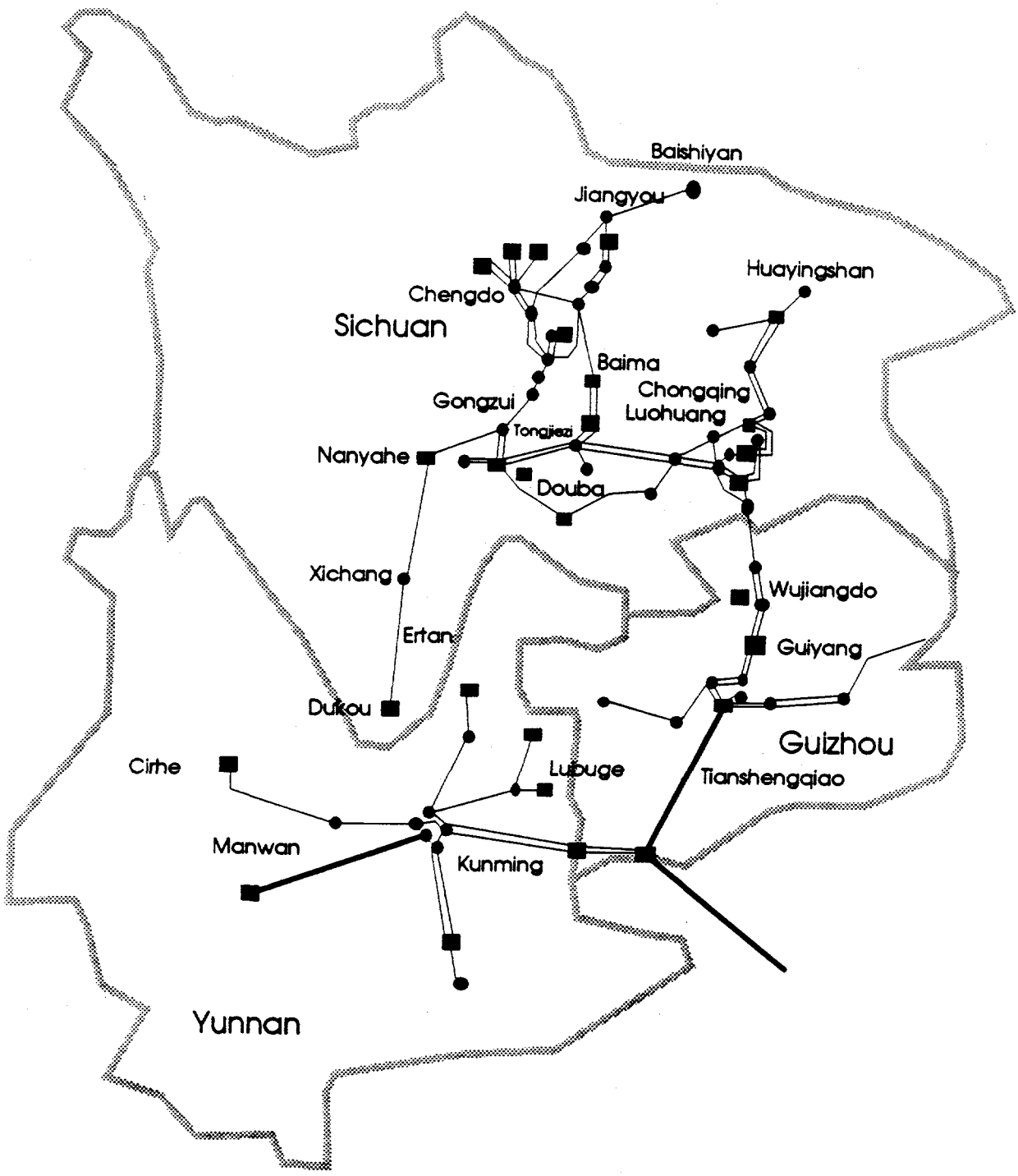

Figure 10. The Sichuan, Yunnan, and Guizhou Power Grids

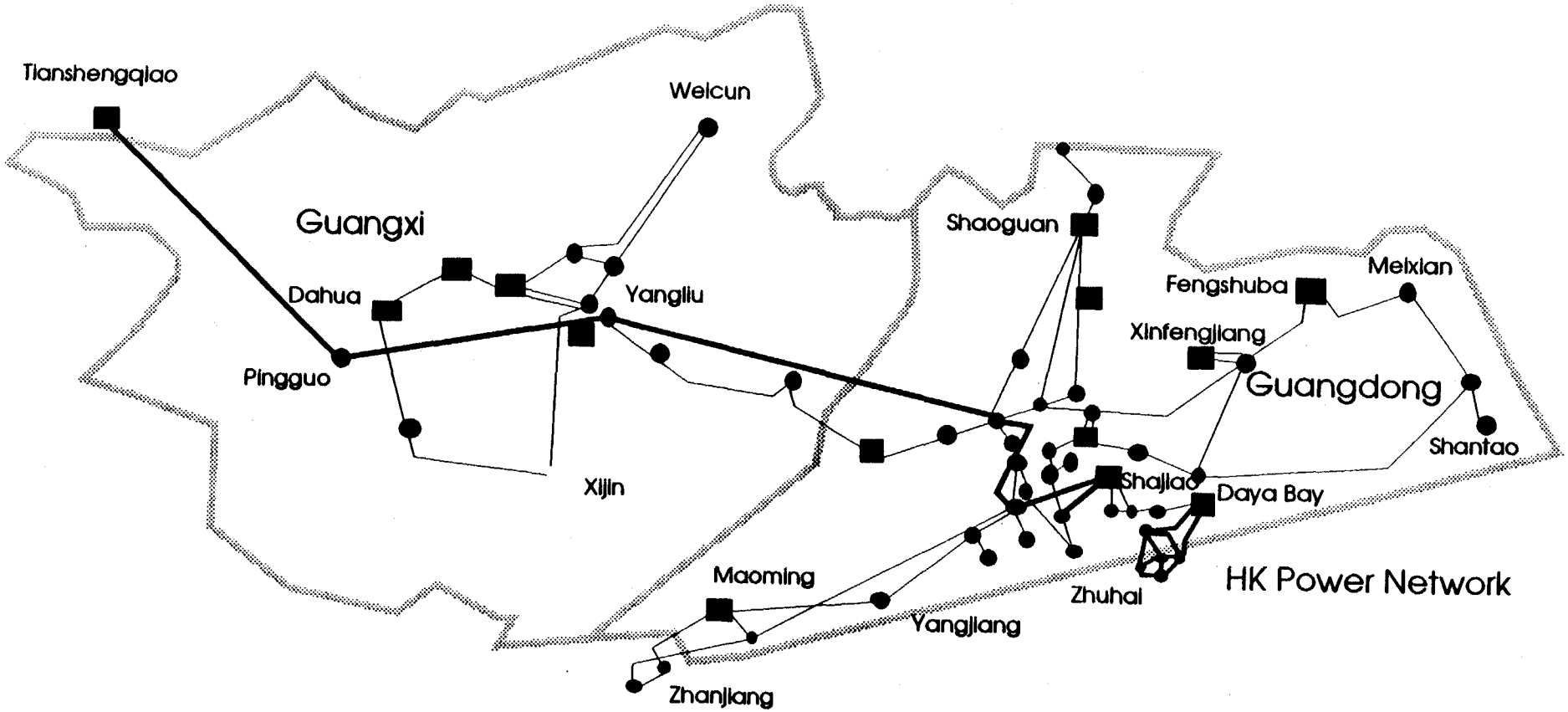

Figure 11. The Guangdong and Guangxi Power Grids

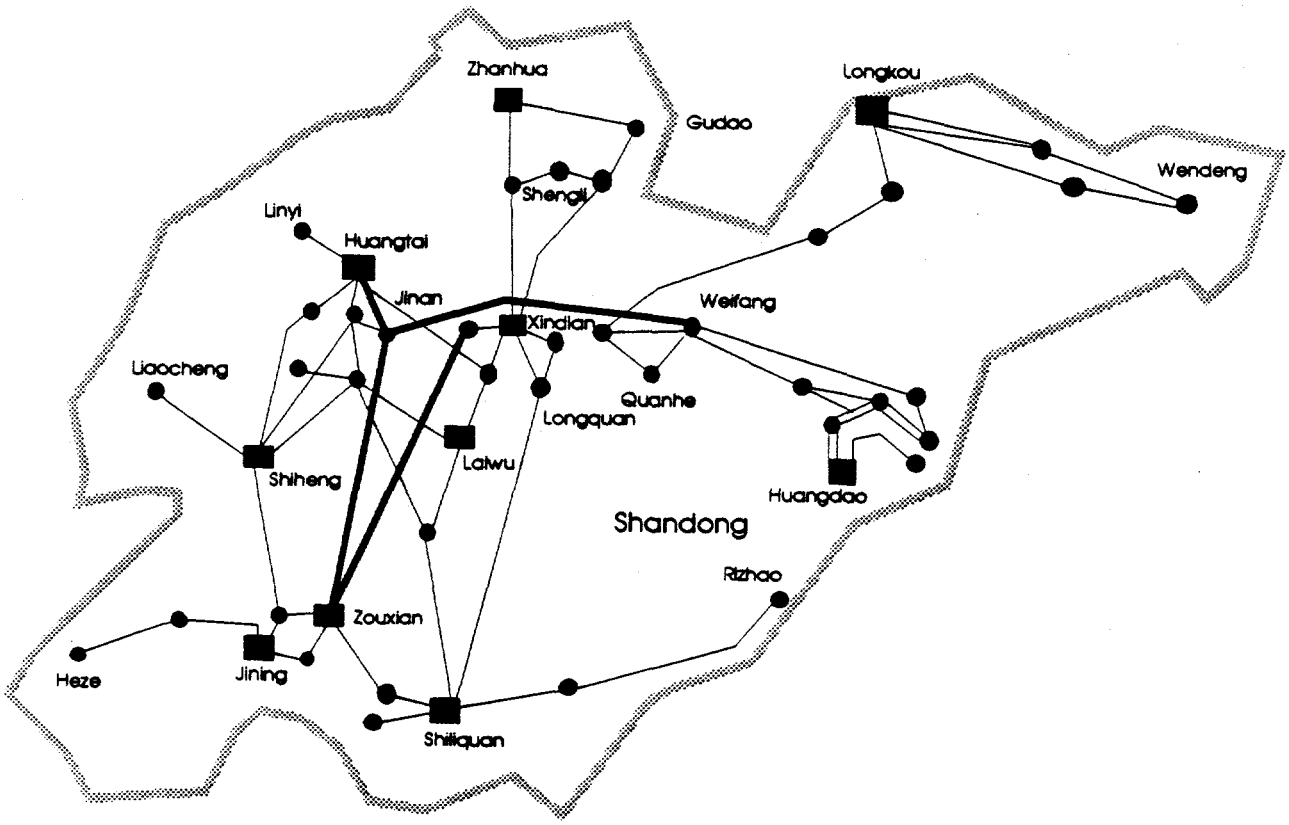

Figure 12. The Shandong Power Grid

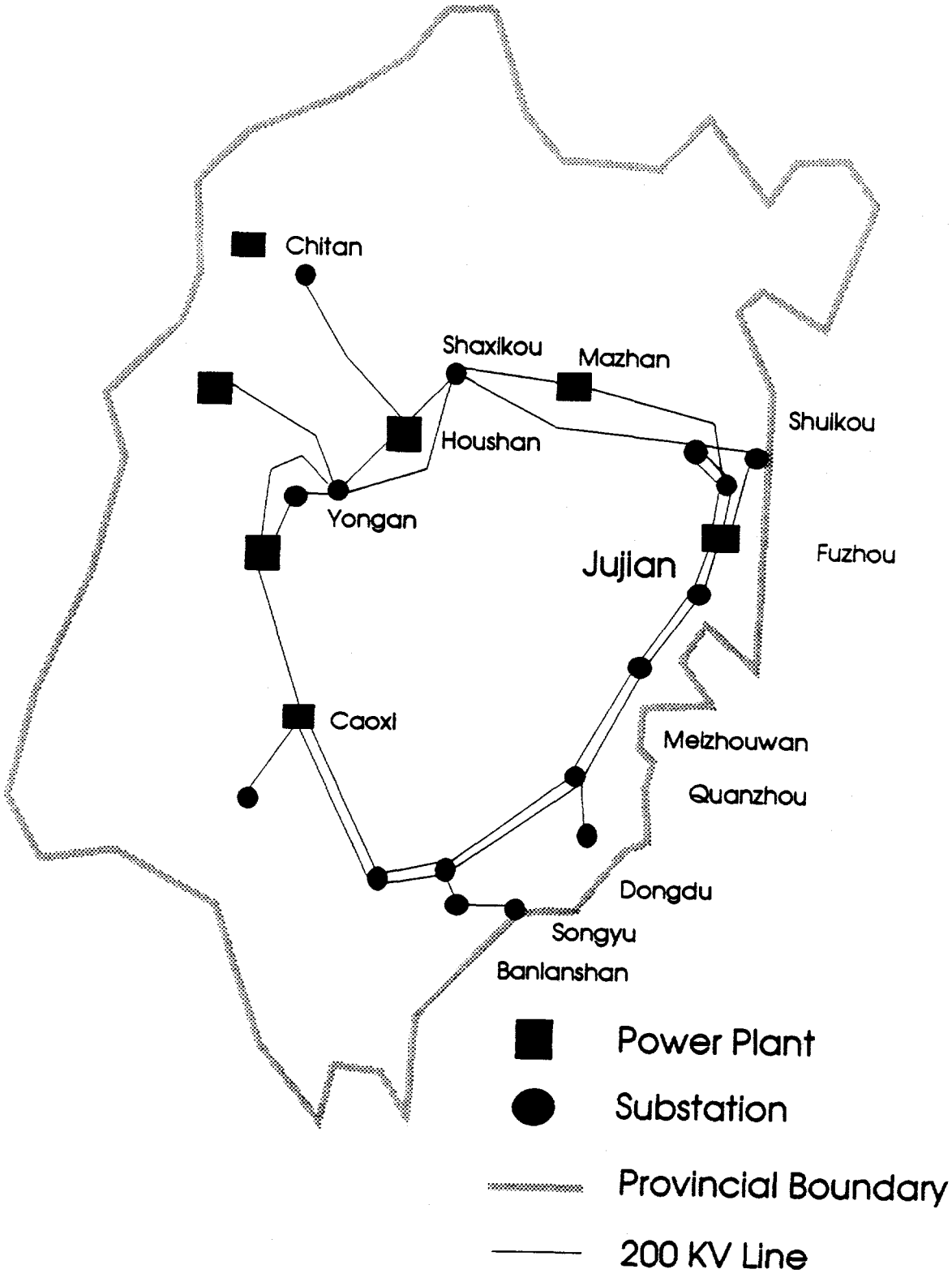

Figure 13. The Fujian Power Grid