Prospects for the Supply and Demand of Coal and Related Coal Transportation Issues in China [*]

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Introduction

In 2002, China produced 1,390 million tonnes, exported 85 million tonnes, imported 11 million tonnes, and consumed 1,280 million tonnes of coal. The Asian coal market must be seriously affected, and Japan's stable supply of coal will be severely damaged, if China's supply and demand status in relation to coal collapses or narrows. In general, the greatest portion of China's coal reserves is to be found in the northern and western regions, while the areas of demand are primarily located in the eastern and southern regions. Although coal is produced widely in the while country, Shanxi Province is the center of coal production in China, and transports about 200 million tonnes of coal to the areas in demand. Sanxi region (Shanxi Province, Shaanxi Province, and the western part of Inner Mongolia Autonomous Region) is expected to constitute a major supply center for coal in China and the transportation of coal from this region will be a key for the stable supply of coal within the country.

This report reviews China's prospects for the supply and demand of coal up to 2020 and examines how the transportation of coal from Sanxi region (China's major coal supply center) will be developed.

1. Status of the supply and demand for coal

1-1 Primary energy demand and dependence on coal

From 1978, the year that reforms and liberalization were initiated in the country, to 2001, China's economy grew at an average annual rate of 9.4%. Demand for primary sources of energy increased at an annual rate of 3.7%. However, the demand for primary energy changed in the latter half of the 1990s. While the economy grew at an annual rate of 7-8%, the demand for primary energy peaked at 1,380 million tce (tonnes coal equivalent) in 1996, declining thereafter up to 1999. Likewise, the proportion of coal constituting the primary source of energy in demand, which had formerly been constant at around 75% of total demand, declined from 74.7% in 1996 to 67.0% in 2001 (Fig.1-1).

1-2 Consumption and production of coal

The accuracy of Chinese statistics relating to coal supply and demand has recently been questioned, both overseas and domestically. In the 1990s, coal production was constantly below consumption levels. If the consumption figures are assumed to be close to the amounts of actual consumption, the production figures are consistently below the volumes actually produced. In fact, significantly more coal was

produced than was reported, resulting in a surplus supply, or a stock of over 200 million tonnes of coal in 1998 throughout the country (spread across all stocks, from producers to consumers), with serious repercussions for China's overall coal industry. As a consequence, the Chinese government implemented production adjustment measures against Township and Village coal mines, embarking on the semi-compulsory closure of Township and Village coal mines that had been operating outside official control. After the implementation of this policy, the gap between consumption figures and production figures grew, resulting in a disparity of 250 million tonnes between the reported figure for consumption and that for production in 2000. When imported/exported amounts are included, the demand for coal exceeded production by 300 million tonnes. In and after 2001, coal production increased sharply. The production of coal in 2002 was reported to be 1,390 million tonnes (preliminary figure), which suggests that the reported figures were for the first time close to the actual amounts produced.

Fig. 1-1   Primary energy demand and ratio of coal
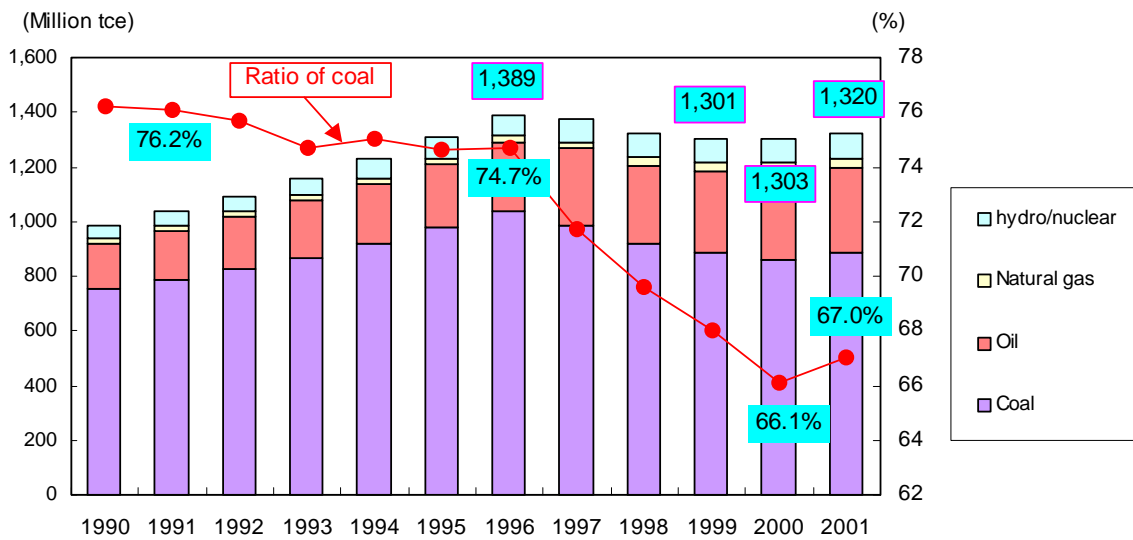
Source: Compiled from the *China Energy Statistical Yearbook* (for the respective years), China Statistics Press

Fig. 1-2   Consumption and production of coal
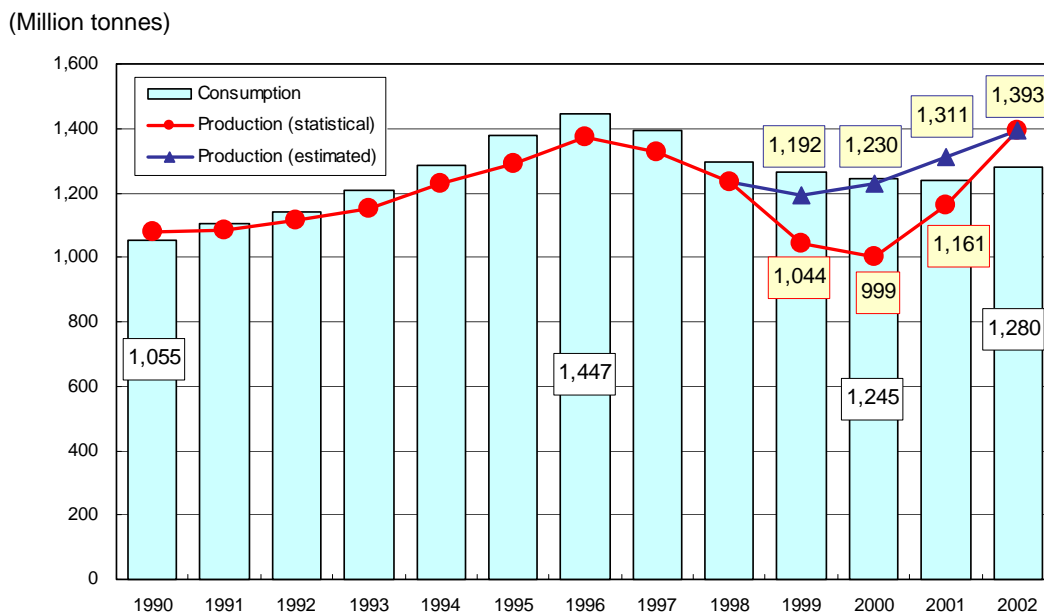
Source: Production figures are compiled from the *Coal Industry Yearbook* and the present study; consumption figures are compiled from the *China Statistical Yearbook*. The production figures for 2001 and 2002 are preliminary figures. The consumption figures for 2001 and 2002 are estimates.

Our study began estimating the volumes of production in 1999, the year after the implementation of the production adjustment policy. Our estimates indicate that the aggregation errors were 140 million tonnes for 1999, 230 million tonnes for 2000, and 150 million tonnes for 2001 (Fig. 1-2).

1-3   Imports and exports

Chinese customs statistics indicate that coal exports suddenly increased from 2000, resulting in exports of 90.94 million tonnes of coal in 2001. There are several plausible reasons for this rapid growth in coal exports: Large coalmines specifically designed for export, producing products such as Shenhua coal, began operating with an improved transportation infrastructure, enhancing their export capabilities; preferential treatment was implemented by the government to promote exports; and a sudden rise in global coal market prices in 2001 had a favorable affect on Chinese coal exports. Exports to neighboring countries, such as Korea and Japan, destinations that offered the option of cheap transportation by sea, saw a particularly large increase.

Conversely, imports have also increased since the autumn of 2001. This is due to the narrow demand/supply environment created by the temporary stoppage of domestic production for securities inspections, which have been carried out as part of security enhancement measures implemented in response to the series of mine accidents that occurred in the midst of production adjustment measures and normalization of demand/supply balances. Imports in 2002 increased to 10.81 million tonnes, primarily in southeastern coastal areas, such as Guangdong and Fujian provinces (Fig. 1-3).

2. Current status of coal transportation

2-1   Volume of coal transported

In recent years, the volume of coal being transported by rail and ship has increased rapidly. In 2000, 685.45 million tonnes of coal were transported by rail, and 188.85 million tonnes of coal were transported by ship. In 2001, rail transport reached 766.25 million tonnes, while marine transportation reached 222.05 million tonnes (Tables 2-1, 2-2).

Fig. 1-3   Import and export of coal
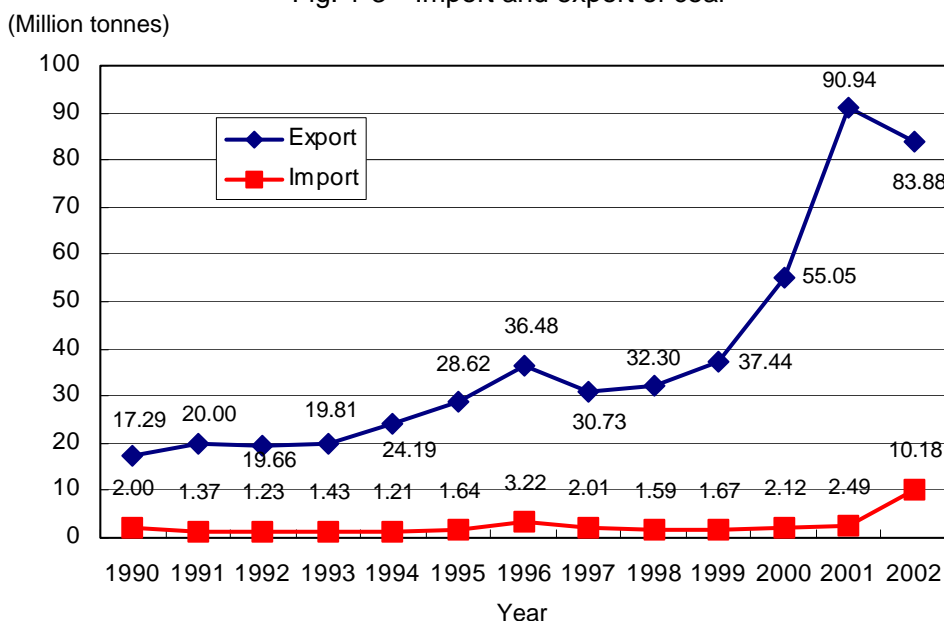
Source: Compiled from the *China Energy Statistical Yearbook*, and the *China Customs Statistics Yearbook*, China Statistics Press

Table 2-1　Regional coal transportation by national railway

(Unit: 10,000 tonnes)

	1990			1996			2000			2001		
	Total freight	Coal	Ratio(%)	Total freight	Coal	Ratio(%)	Total freight	Coal	Ratio(%)	Total freight	Coal	Ratio(%)
Huabei	45,936	27,664	60.2	51,335	31,816	62.0	53,659	31,815	59.3	59,141	36,609	61.9
	(31.4)	(44.0)		(31.8)	(44.2)		(32.4)	(46.4)		(33.1)	(47.8)	
Huadong	23,832	8,470	35.5	27,708	10,632	38.4	29,158	10,944	37.5	32,108	11,958	37.2
	(16.3)	(13.5)		(17.1)	(14.8)		(17.6)	(16.0)		(18.0)	(15.6)	
Dongbei (Northeast)	33,348	11,176	33.5	32,722	11,357	34.7	30,853	9,882	32.0	31,492	10,383	33.0
	(22.8)	(17.8)		(20.2)	(15.8)		(18.6)	(14.4)		(17.6)	(13.6)	
Huazhong	23,323	7,383	31.7	26,613	8,929	33.6	25,932	7,305	28.2	27,844	8,070	29.0
	(16.0)	(11.7)		(16.5)	(12.4)		(15.7)	(10.7)		(15.6)	(10.5)	
Xinan (Southwest)	10,651	4,136	38.8	12,592	4,976	39.5	13,596	4,880	35.9	14,708	5,391	36.7
	(7.3)	(6.6)		(7.8)	(6.9)		(8.2)	(7.1)		(8.2)	(7.0)	
Xibei (Northwest)	9,119	4,042	44.3	10,707	4,346	40.6	12,300	3,720	30.2	13,299	4,212	31.7
	(6.2)	(6.4)		(6.6)	(6.0)		(7.4)	(5.4)		(7.4)	(5.5)	
National total	146,209	62,870	43.0	161,678	72,058	44.6	165,498	68,545	41.4	178,592	76,625	42.9
	(100.0)	(100.0)		(100.0)	(100.0)		(100.0)	(100.0)		(100.0)	(100.0)	

Note:　The figures in parentheses are the respective regional proportions of the total for transported coal.
Source:　*Year Book of China Transportation & Communications* (for respective years), Year Book House of China Transportation & Communications

Table 2-2　Transportation of coal from major coastal ports

(Unit: 10,000 tonnes)

	1995	1996	1997	1998	1999	2000	For export	2001	For export
Grand total	12,491	13,781	13,392	13,702	14,957	18,885	7,339	22,205	9,760
Qinhuangdao	6,488	6,548	6,191	6,204	6,973	8,378	3,115	10,007	4,263
Tianjin	2,826	3,237	3,444	3,434	3,258	4,321	1,809	5,258	2,281
Jingtang	228	367	320	445	539	754	107	964	176
Qingdao	669	851	1,123	1,183	1,274	1,336	583	1,558	814
Rizhao	1,204	1,228	1,238	1,241	1,475	2,135	1,045	2,286	1,273
Lianyungang	799	751	760	946	1,124	1,464	493	1,569	644
Huangsi	35	31	20	15	24	33	0	18	0
Lanshan	9	10	20	31	47	216	92	117	57
Jinzhou	38	159	94	82	75	127	24	211	46
Yingkou	117	429	130	65	34	31	7	94	25
Dalian	53	109	20	18	13	5	3		
Dandong	10	55	18	8	4	0	0		
Fangcheng	0	0	0	22	117	69	47	123	181
Zhanjiang	15	6	14	8	0	3	3		
Other	0	0	0	0	0	13	11		

Note:　Exports include export coke shipped from Tianjin Port.
Source:　Figures for 1995-2000 are from the Institute of Logistics and Transportation; exports for 2000 and the grand total of exports for 2001 are provided by our Chinese counterparts.

2-2　Transportation routes

The major coal transportation routes in China connect Sanxi region (Shanxi and Shaanxi provinces, and west of Inner Mongolia Autonomous Region), which is regarded as the coal production center of the country, to the respective areas where coal is in demand, and can broadly be divided into tow categories: routes to shipping ports via marine or river transportation, and direct transportation routes to the area of demand by railway. There are three main coal transportation routes from the Sanxi region (northern, middle, and southern), based on the respective production sites. The northern route consists of the Daquin, Shuohuang, Fengshada, Jingyuan, and Jitong lines; the middle route consists of the Shitai Line; and the southern route consists of the Taijiao, Hanchang, Houyue, and Longhai lines, which are connected to the lines linking coal shipping ports and connecting southern regions and northern regions. Coal shipping ports include Qinhuangdao, Tianjin, Huanhua, and Jingtang ports, connected to the northern route; Quanwan Port, connected to the middle route; and Rizhao, and Lianyungang ports, connected to the southern route. These ports are used to transport coal for both export and domestic use (Fig. 2-1).

Fig. 2-1 Major coal transportation routes from Sanxi region
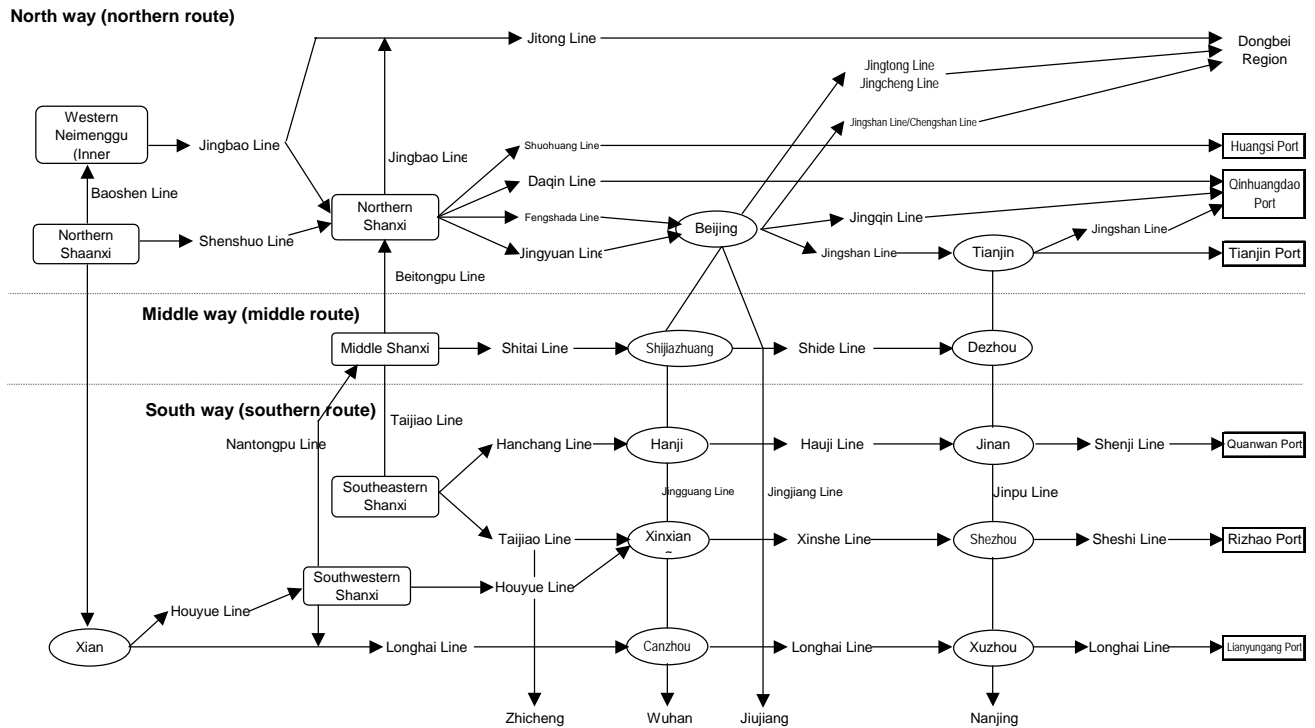
2-3 Coal transported from Sanxi

Coal transported from Sanxi region reached 234.59 million tonnes (including coal transported from the Ningxia Autonomous Region), of which 132.61 million tonnes were transported through the northern route, 51.55 million tonnes through the middle route, and 50.43 million tonnes through the southern route (Table 2-3).

Table 2-3   Coal transported from the Sanxi region (by route)

	1990	1995	1996	1997	1998	2000
External transportation from the Sanxi region (including Ningxia)	19,086	22,019	22,947	22,590	20,574	23,459
Northern route total:	9,983	12,411	13,002	12,836	11,258	13,261
Jitong Line	-	-	74	227	245	267
Daquin Line	3,318	5,496	5,926	5,907	5,652	7,568
Fengshada Line	5,086	5,332	5,421	5,262	4,069	4,356
Jingyuan Line	1,312	1,442	1,404	1,283	1,151	938
Dabao Line	267	141	177	157	141	132
Shuohuang Line	-	-	-	-	-	-
Middle route total:	4,674	4,913	4,862	4,556	4,145	5,155
Shitai Line	4,674	4,913	4,862	4,556	4,145	5,155
Southern route total:	4,429	4,705	5,083	5,198	5,171	5,043
Hanchang Line	103	72	63	134	213	117
Taijiao Line	3,271	3,519	3,691	3,627	3,490	3,425
Nantongpu Line	379	269	266	182	227	214
Zaohai Line	652	830	907	824	830	672
Houyue Line	-	-	146	425	406	611
Houxi Line	24	15	10	6	5	4

Source: Figures are from the Institute of Comprehensive Transportation.

2-4 The flow of coal between regions

An analysis of the figures for coal transported by train between separate regions indicates that 146 million tonnes were transported from Jinshaanmeng region to Jingjinji region, 58 million tonnes were transported to Huadong region, 18 million tonnes were transported to Zhongnan (middle southern) region, and 9.8 million tonnes were transported to Dongbei (north eastern) region. The transportation volumes to Jingjinji region and Huadong region include coal for domestic and overseas transit by ship through the region's ports (Table 2-4).

With regard to coal transportation by coastal route, 84.55 million tonnes were domestically shipped from Jingjinji region, where the Qinhuangdao, Tianjin, Jingtang, and Huanghua ports are located; 29.39 million tonnes were shipped domestically from Huadong region, where the Rizhao, Quanwan, Lanshan, and Lianyungang ports are located; and 1.27 million tonnes were shipped domestically from the Yingkou and Jinzhou ports in Dongbei region (Table 2-5).

Transportation by inland river occurs on the Jinghang Canal, the Changjiang and Zhunhe rivers, and other bodies of water. In 2000, 13 million tonnes of coal were transported from Shandong Province to the Changjiang River via the Jinghang Canal, and about 21.6 million tonnes were transported via the Changjiang River.

Transportation by road is mainly used for short distances (from mines without train loading facilities to freight loading stations, and from mines or coal storage centers to small-scale users that lack access to a freight train facility), primarily within each province, but also between neighboring provinces. However, small-scale mines, including Township and Village mines, at which train transportation services are unavailable, use mid-to-long distance transportation by truck. In 2000, 45 million tonnes were transported by truck from Shanxi Province, of which 27.49 million tonnes were transported to Jingjinji region, 4.09 million tonnes were transported to Huadong region, and 11.41 million tonnes were transported to Zhongnan region.

Fig. 2-2 indicates the transportation of coal between regions by railway and ship.

Table 2-4　Inter-regional coal transportation by train (2000)

(Unit: 10,000 tonnes)

	Jingjinji	Sanxi	Dongbei	Huadong	Zhongnan	Xinan	Xinganningqing	Total
Jingjinji	3,955	25	310	252	57	0	0	4,599
Sanxi	14,562	3,936	980	5,768	1,765	0	128	27,139
Dongbei	3	0	11,291	0	0	0	0	11,294
Huadong	7	0	0	10,720	215	0	0	10,942
Zhongnan	22	6	15	1,676	5,584	2	0	7,305
Xinan	0	30	0	22	1,575	3,254	0	4,881
Xinganningqing	142	182	88	77	28	1	1,861	2,379
Total	18,691	4,179	12,684	18,515	9,224	3,257	1,989	68,539

Note:　Dongbei region includes the eastern part of Neimenggu.
Source:　*Year Book of China Transportation & Communications* (for respective years), Year Book House of China Transportation & Communications
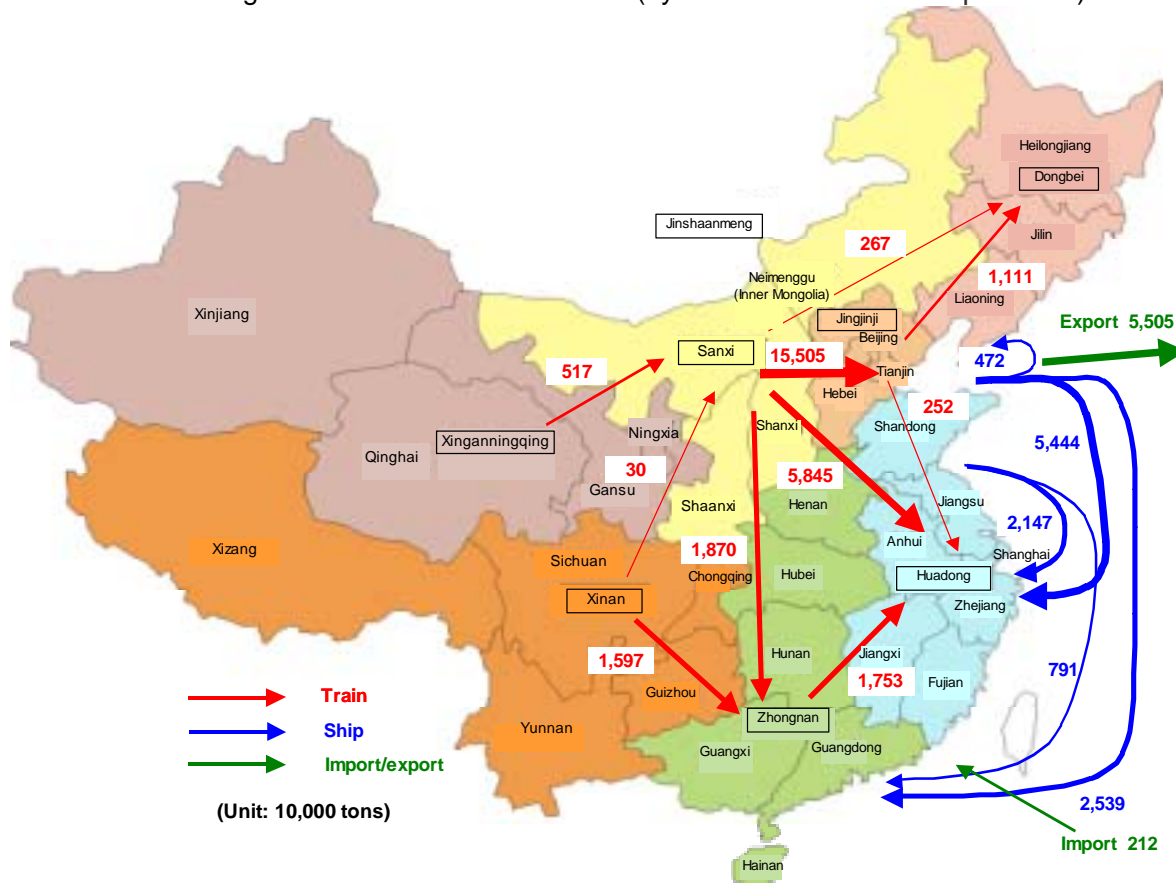
Table 2-5　Inter-regional coal transportation by marine transportation (2000)

(Unit: 10,000 tonnes)

	Total	Dongbei	Huadong	Zhongnan
Jingjinji	8,455	472	5,444	2,539
Shandong/Jiangsu	2,939	0	2,147	791
Dongbei	127	25	74	28
Zhongnan	22	0	0	22

Source:　Compiled from materials issued by our Chinese counterparts.

Fig. 2-2 The flow of coal in 2000 (by train and marine transportation)

3. Future prospects for the supply and demand for coal

3-1   Prospects for primary energy demand

3-1-1 Case configuration

In our study, we have made forecasts, based on the "BAU" and "Energy conservation" cases, in which energy conservation measures are taken into account; and the "Energy conservation and natural gas shift" case, in which the shift from coal to natural gas is taken into account.

In the Energy conservation case, energy conservation is expected to progress at an annual rate of 1.5% in and after 2006 in the sectors in which energy conservation is expected to bring significant results (Table 3-1).

The case of shift from coal to natural gas can be considered with regard to industry, residential, and commercial sectors, in addition to power generation and heating, in which

such a shift is particularly feasible. The shift from coal to natural gas is expected to increase demand for natural gas in industry by 1.0% annually, and in residential and commercial sectors by 2.0% annually. With regard to power generation and heating, the ratio of natural gas to overall fuel sources is expected to increase annually by 16% for power generation and by 10% for heat supply (Tables 3-2, 3-3).

3-1-2 Results of primary energy demand forecasts

In the case of BAU, the demand for primary energy is expected to increase from 1,260 million tce (tonnes coal equivalents) in 2000 to 1,840 million tce in 2010, and to 2,720 million tce in 2020, with an average annual growth rate of 3.8% from 2000 to 2010 (energy elasticity: 0.59) and an average annual growth rate of 4.0% from 2010 to 2020 (energy elasticity: 0.71), resulting in an average annual growth rate of 3.9% for the 20-year period from 2000 to 2020 (energy elasticity: 0.65).

When the effects of energy conservation are considered, the primary demand for energy is expected to increase from 1,260 million tce in 2000 to 1,700 million tce in 2010, and to 2,240 million tce in 2020, with an average annual growth rate of 3.1% from 2000 to 2010 (energy elasticity: 0.47) and an average annual growth rate of 2.8% from 2010 to 2020 (energy elasticity: 0.49), resulting in an average annual growth rate of 2.9% for the 20-year period from 2000 to 2020 (energy elasticity: 0.48). As a result of energy conservation, the expected amount of energy saved will be 130 million tce in 2010, and the expected amount of energy saved will be 480 million tce in 2020 (Fig. 3-1).

Table 3-1   Energy conservation coefficients

	Sector	Energy conservation ratio	Energy conservation effect (%)			
			2005	2010	2015	2020
Electricity	Industry, residential, others	1.5	100.0	92.7	86.0	79.7
Petroleum product	Industry, transportation, commercial, construction, agriculture, other	1.5	100.0	92.7	86.0	79.7
Coal	Industry, construction, agriculture, other	1.5	100.0	92.7	86.0	79.7

Table 3-2   Growth ratio of natural gas demand as a result of shift from coal

(Unit: %)

	Annual rate	2000	2005	2010	2015	2020
Industry	1.0	100.0	105.1	110.5	116.1	122.0
Residential	2.0	100.0	110.4	121.9	134.6	148.6
Commercial	2.0	100.0	110.4	121.9	134.6	148.6

Table 3-3   Ratios of coal and natural gas for power generation and heat supply

(Unit: %)

		2000	2005	2010	2015	2020
Power generation	Ratio of coal	95.0	94.4	93.3	90.8	85.6
	Ratio of natural gas	0.5	1.1	2.2	4.7	9.9
Heat supply	Ratio of coal	88.7	87.1	84.5	80.3	73.6
	Ratio of natural gas	2.6	4.2	6.8	11.0	17.7

Fig. 3-1   Prospects for primary energy demand
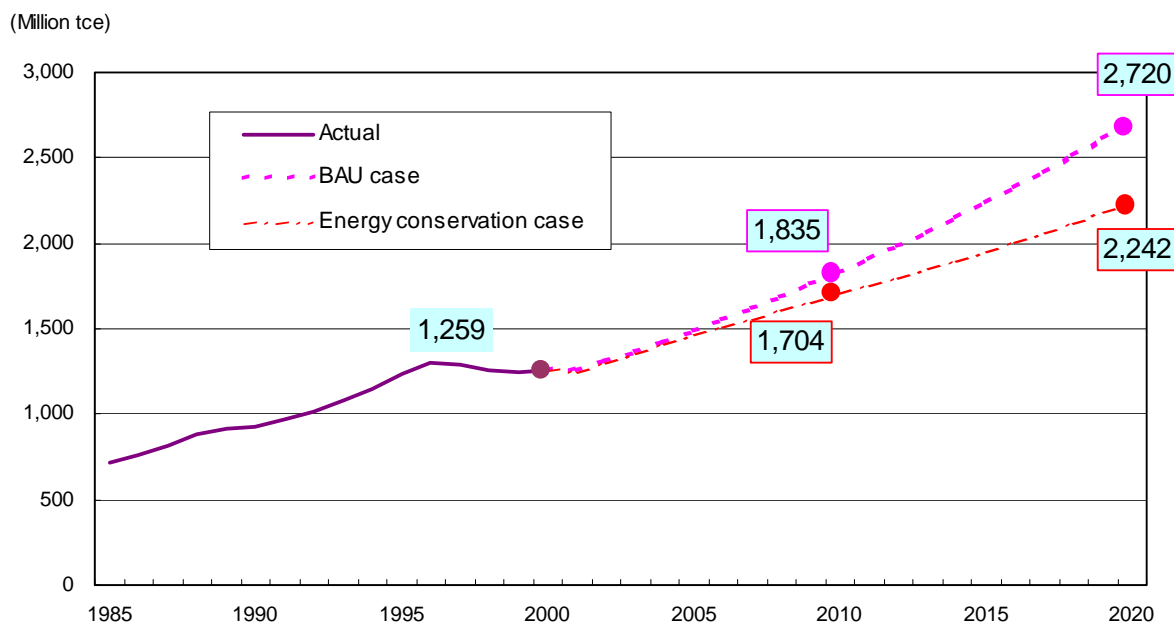
(Million tce)

(Billion yuan; million tce)

	Actual for 2000	2010	2020	Growth rate (%)			Energy elasticity		
				10/00	20/10	20/00	10/00	20/10	20/00
GDP (1995 price)	8,701	16,352	28,314	6.5	5.6	6.1			
Primary energy demand									
BAU case	1,259.3	1,835.6	2,719.9	3.8	4.0	3.9	0.59	0.71	0.64
Energy conservation case	1,259.3	1,704.8	2,242.2	3.1	2.8	2.9	0.47	0.49	0.48

3-1-3 Results of coal demand forecasts

As a result of the forecasts determined through the BAU case, coal demand is expected to increase from 890 million tce in 2000 to 1,230 million tce in 2010, and to 1,770 million tce in 2020, with an average annual growth rate of 3.3% from 2000 to 2010, an average annual growth rate of 3.7% from 2010 to 2020, and an average annual growth rate of 3.5% for the 20-year period from 2000 to 2020.

When the effects of energy conservation are considered, coal demand is expected to increase from 890 MTCE in 2000 to 1,130 million tce in 2010 and to 1,430 million tce in 2020 (all figures coal equivalents), with an average growth rate of 2.5% from 2000 to 2010, an average annual growth rate of 2.4% from 2010 to 2020, and an average annual growth rate of 2.4% for the 20-year period from 2000 to 2020.

When the effects of shift to natural gas are considered, coal demand is expected to increase from 890 million tce in 2000 to 1,120 million tce in 2010, and to 1,310 million tce in, with an average annual growth rate of 2.3% from 2000 to 2010, an average annual growth rate of 1.6% from 2010 to 2020, and an average annual growth rate of 1.9% for the 20-year period from 2000 to 2020.

As a result of energy conservation measures, savings in the demand for coal are expected to be 100 million tce in 2010, and 340 million tce in 2020. Furthermore, due to the shift to natural gas, savings in the demand for coal are expected to be 20 million tce in 2010, and 120 million tce in 2020. In addition, when energy conservation and natural gas shift measures are considered, the ratio of coal as a primary energy source is expected to decline from 70.5% in 2000 to 65.4% in 2010 and to 58.3% in 2020 (Fig. 3-2).

Fig. 3-2   Coal demand prospects

(Million tec)

(Million tce)
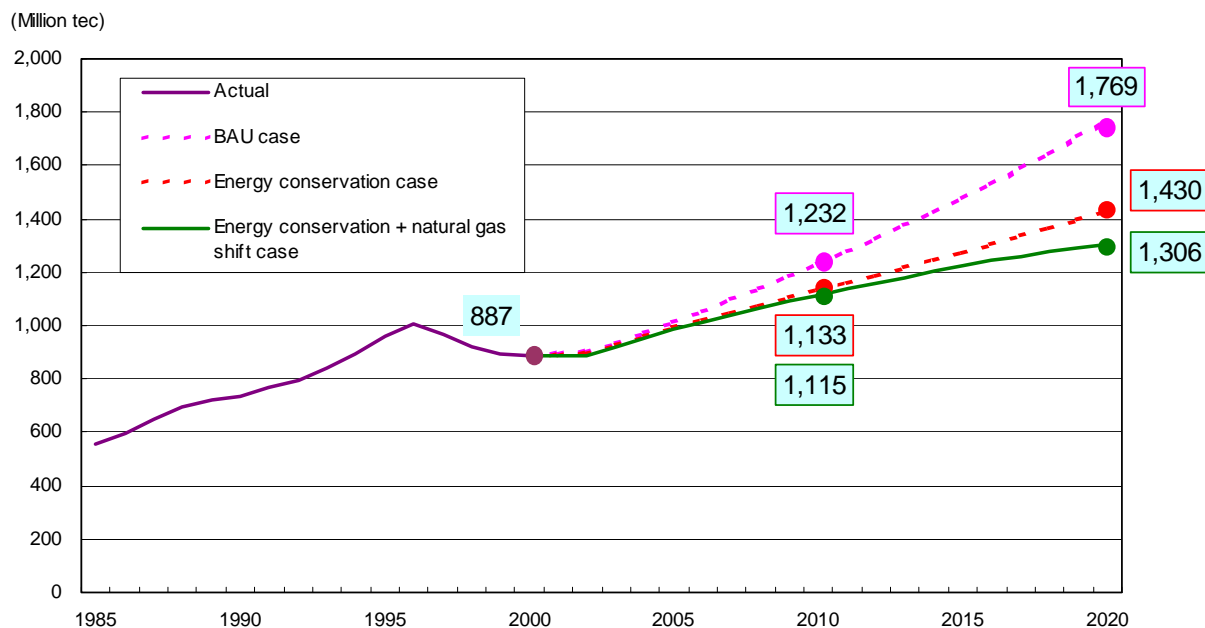
	Actual for 2000	2010	2020	Growth rate (%)		
				10/00	20/10	20/00
BAU case	887.3	1,232.1	1,769.3	3.3	3.7	3.5
Energy conservation case	887.3	1,133.1	1,430.3	2.5	2.4	2.4
Energy conservation + natural gas shift case	887.3	1,115.0	1,306.3	2.3	1.6	2.0

3-1-3 Comparisons with results forecast by other organizations

When our forecasts regarding the demand for primary energy and coal are compared to those provided by other organizations, a 2.9% growth rate for primary energy demand is forecast in our study for the 20-year period from 2000 to 2020, a 3.0% rate by the China Energy Research Institute, and a 3.0% rate by IEA. A 2.0% growth rate in coal demand is forecast in our study for the 20-year period from 2000 to 2020, a 2.0% rate by the China Energy Research Institute, and at 2.1% rate by IEA, figures that are virtually identical. Individual organizations view economic growth in China differently, however, with the China Energy Research Institute adopting a target of 7.0% by 2020 and IEA adopting a lower rate of 5.2%. Equally, while the China Energy Research Institute sees an energy elasticity of 0.43, IEA sees a value of 0.57. Our study has adopted a GDP growth rate of 6.1% and an energy elasticity value that is intermediate between the findings of these organizations (Table 3-4).

Table 3-4   Comparison of major organization forecasts

	Our study (energy conservation + natural gas conversion case)			China Energy Research Institute			IEA (reference case)		
	GDP 1995 price (billion yuan)	Primary energy (MTCE)	Coal (MTCE)	GDP 2000 price (billion yuan)	Primary energy (MTCE)	Coal (MTCE)	GDP 1995 price (billion US dollar)	Primary energy (MTCE)	Coal (MTCE)
2000	8,701	1,259.3	887.3	8,944	1,222.6	857.9	4,861	1,354.3	941.4
2010	16,352	1,704.8	1,115.0	17,595	1,640.3	1,016.4	8,484	1,855.7	1,220.0
2020	28,314	2,242.2	1,306.3	34,611	2,213.6	1,281.4	13,428	2,432.9	1,512.9
Growth rate (%)									0.3
10/00	6.5	3.1	2.3	7.0	3.0	1.7	5.7	3.2	2.6
20/10	5.6	2.8	1.6	7.0	3.0	2.3	4.7	2.7	2.2
20/00	6.1	2.9	2.0	7.0	3.0	2.0	5.2	3.0	2.4
Energy elasticity									
10/00		0.47			0.43			0.56	
20/10		0.49			0.43			0.58	
20/00		0.48			0.43			0.57	

Source: Compiled from material issued by the China Energy Research Institute and *World Energy Outlook 2002*, published by IEA.

3-2   Prospects for coal supply and demand

3-2-1 Coal demand

Calculated through a specific value (by the metric ton), coal demand is expected to increase from 1,240 million tonnes in 2000 to 1,560 million tonnes in 2020. Demand for coal for use in generating electricity will increase at an annual rate of 3.0% until 2010, with the required amount reaching 730 million tonnes in 2010. From 2010 to 2020, the demand for coal for use in generating electricity will increase at an annual rate of 2.2%, with the required amount reaching 910 million tonnes in 2020 (an increase of 370 million tonnes from 2000). The demand for use in generating electricity is expected to reach 50.0% of the total demand for coal in 2020. The demand for coal for use in heating will increase at an annual rate of 2.8% for the 20-year period from 2000 to 2020, with a projected demand of 180 million tonnes in the final year (an increase of 50 million tonnes from 2000). Demand for industrial use will grow at a meager annual rate of 1.3% and is expected to reach 430

million tonnes by 2020, resulting in an increase of 100 million tonnes from the 330 million tonnes used in 2000. Demand for commercial and residential use will decline at an annual rate of 2.7%, due to a significant shift from coal to other fuel sources (Fig. 3-3).

3-2-2 Coal supply

The energy structure of China is expected to focus on coal. The country will need to use its abundant coal resources effectively to respond to trends in coal demand, so that the domestic supply and demand balance of coal can be properly maintained. Our study bases its forecasts on the assumption that China will continue to manage the provision of sufficient levels of coal to satisfy domestic demand, in addition to exporting coal to other markets.

We have thus estimated production in the cases of "energy conservation and natural gas shift" on the assumption that exports/imports will develop as indicated below.

Fig. 3-3   Coal demand prospect by sector (Energy conservation + natural gas shift case)
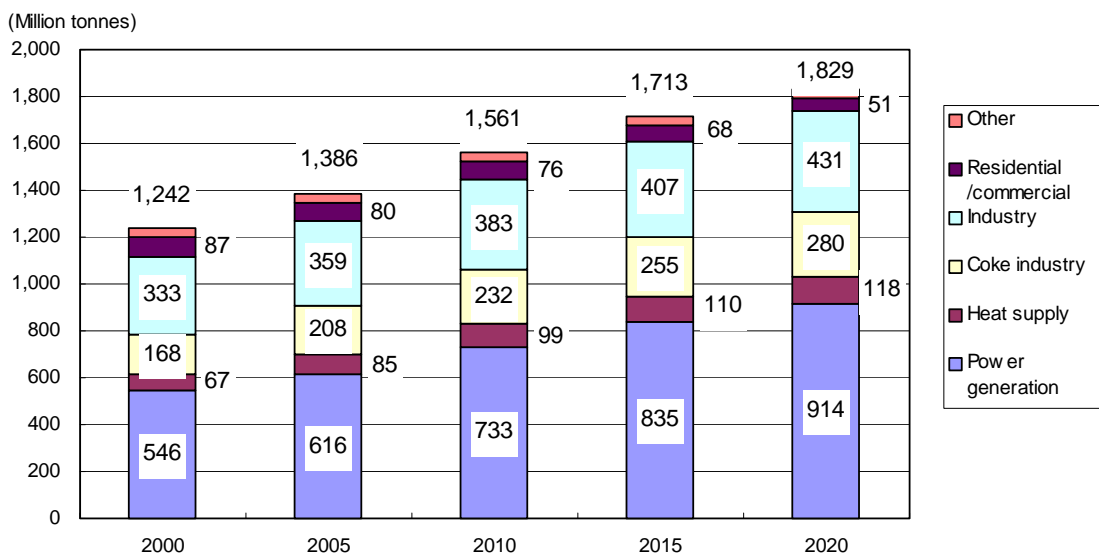
(Million tonnes)

(Unit: million tonnes)

	Actual in 2000	2010	2020	Growth rate (%)		
				10/00	20/10	20/00
Power generation	546.1	733.3	913.7	3.0	2.2	2.6
Heat supply	66.9	98.7	117.6	4.0	1.8	2.8
Coke industry	168.3	231.9	279.7	3.3	1.9	2.6
Industry	332.8	383.0	431.2	1.4	1.2	1.3
Residential/ commercial use	87.2	75.6	50.7	-1.4	-3.9	-2.7
Other	40.9	38.5	36.1	-0.6	-0.6	-0.6
Total	1,242.2	1,561.0	1,828.9	2.3	1.6	2.0

<Assumptions>
* Amount exported: 100 million tonnes/year in and after 2005
* Amount imported: Increasing at an annual rate of 5.0% in and after 2003

As a result, the level of coal production that will satisfy domestic and export demand is projected to be 1,470 million tonnes in 2005, 1,650 million tonnes in 2010, 1,790 million tonnes in 2015, and 1,900 million tonnes in 2020. In other words, five-year increments of 240 million tonnes in coal production to 2005, 170 million tonnes to 2010, 140 million tonnes to 2015, and 110 million tonnes to 2020 will be required (Table 3-5).

Table 3-5   Prospects for coal supply

(Unit: million tonnes)

	Actual	Estimate			
	2000	2005	2010	2015	2020
Domestic production	1,230.1	1,473.4	1,645.0	1,792.5	1,902.9
Import	2.1	12.5	16.0	20.4	26.0
Total supply	1,232.2	1,485.9	1,661.0	1,812.9	1,928.9
Export	55.1	100.0	100.0	100.0	100.0
Change in stock	36.6	0.0	0.0	0.0	0.0
Domestic supply	1,213.8	1,385.9	1,561.0	1,712.9	1,828.9
Domestic consumption	1,242.2	1,385.9	1,561.0	1,712.9	1,828.9
Statistical error	-28.4	0.0	0.0	0.0	0.0
Net export	52.9	87.5	84.0	79.6	74.0

Note: Domestic production for 2000 is our own estimate.

3-2-2 Prospects for coal supply and demand by region

Based on forecasts by province relating to coal supply and demand, as indicated in Table 3-7, regional production, consumption, and export/import (calculated here by "production - consumption") volumes are compiled by dividing the entire country into seven regions: Jingjinji, Jinshaanmeng, Dongbei, Huadong, Zhongnan, Xinan, and Xinganningqing (Table 3-6).

In the Jingjinji region, the level of coal consumption is expected to fall at an annual rate of 0.4% until 2020, to 138 million tonnes in 2010, and 133 million tonnes in 2020. Coal production in the region, however, is expected to increase at an annual rate of 0.6%, to 73 million tonnes in 2010 and 76 million tonnes in 2020. The amount of net imported coal from other regions will decline from the 2000 figure. In Hebei Province, consumption and production volumes will increase, but consumption and production volumes in Beijing will decrease. Consumption volume will also decrease in Tianjin.

In the Huadong region, the level of coal consumption is projected to increase at an annual rate of 2.1% until 2020. Production volumes are projected to increase at an annual rate of 2.3%, from 193 million tonnes in 2000 to 268 million tonnes in 2010, and 302 million tonnes in 2020. The level of coal consumption in the region is projected to increase from 325 million tonnes in 2000 to 416 million tonnes in 2010, and to 491 million tonnes in 2020. Net imported volume is projected to increase from 132 million tonnes in 2000 to 150 million tonnes in 2010, and to 189 million tonnes in 2020.

Table 3-6   Prospects for coal supply and demand by region

Consumption (Unit: 10,000 tonnes)

	Actual	Estimate				Growth rate (%)		
	2000	2005	2010	2015	2020	10/00	20/10	20/00
Jingjinji	14,458	13,943	13,843	13,626	13,311	-0.4	-0.4	-0.4
Jinshaanmeng	18,179	21,735	26,515	30,777	34,460	3.8	2.7	3.2
Dongbei	16,349	17,876	19,431	20,712	21,526	1.7	1.0	1.4
Huadong	32,467	37,128	41,758	45,886	49,122	2.5	1.6	2.1
Zhongnan	22,713	25,399	28,988	32,006	34,053	2.5	1.6	2.0
Xinan	14,045	15,430	16,953	18,162	18,913	1.9	1.1	1.5
Xinganningqing	6,013	7,076	8,607	10,120	11,502	3.7	2.9	3.3
Total	124,224	138,587	156,095	171,288	182,888	2.3	1.6	2.0

Production (Unit: 10,000 tonnes)

	Actual	Estimate				Growth rate (%)		
	2000	2005	2010	2015	2020	10/00	20/10	20/00
Jingjinji	6,650	7,004	7,325	7,526	7,555	1.0	0.3	0.6
Jinshaanmeng	43,900	57,753	66,727	74,674	81,135	4.3	2.0	3.1
Dongbei	14,900	15,206	16,314	17,169	17,609	0.9	0.8	0.8
Huadong	19,280	24,284	26,790	28,859	30,226	3.3	1.2	2.3
Zhongnan	15,202	16,899	17,932	18,955	19,803	1.7	1.0	1.3
Xinan	16,600	18,250	19,951	21,186	21,888	1.9	0.9	1.4
Xinganningqing	6,480	7,938	9,459	10,881	12,071	3.9	2.5	3.2
Total	123,012	147,335	164,498	179,250	190,286	2.9	1.5	2.2

Export/Import (caluculated by 'production' - 'consumption') (Unit: 10,000 tonnes)

	Actual	Estimate				Growth rate (%)		
	2000	2005	2010	2015	2020	10/00	20/10	20/00
Jingjinji	-7,808	-6,940	-6,519	-6,100	-5,756	-1.8	-1.2	-1.5
Jinshaanmeng	25,721	36,018	40,212	43,896	46,674	4.6	1.5	3.0
Dongbei	-1,449	-2,669	-3,116	-3,543	-3,916	8.0	2.3	5.1
Huadong	-13,187	-12,844	-14,968	-17,027	-18,896	1.3	2.4	1.8
Zhongnan	-7,511	-8,500	-11,056	-13,051	-14,251	3.9	2.6	3.3
Xinan	2,555	2,821	2,998	3,025	2,975	1.6	-0.1	0.8
Xinganningqing	467	862	851	761	568	6.2	-4.0	1.0
Import/export	5,293	-8,749	-8,403	-7,962	-7,398			
Total	4,081	0	-0	0	0			

Note: The totals for 2000 indicate negative figures due to changes in stock and statistical error.

In the Zhongnan region, consumption is projected to increase at an annual rate of 2.0% until 2020 while the annual production growth rate rises by a mere 1.3%. In 2010, 179 million tonnes of coal will be produced, while 290 tonnes will be consumed. In 2020, production will be 198 million tonnes and consumption 341 million tonnes. Net imported volumes will increase from 75 million tonnes in 2000 to 111 million tonnes in 2010 and to 143 million tonnes in 2020.

With regard to regions supplying coal, coal export will increase from Jinshaanmeng region, the center of coal supply in China. Production volumes in this region will increase from 439 million tonnes in 2000 to 667 million tonnes in

2010 and to 811 million tonnes in 2020, while consumption in the region will increase from 182 million tonnes in 2000 to 265 million tonnes in 2010 and to 345 million tonnes in 2020. The net exported volume will increase from 257 million tonnes in 2000 to 402 million tonnes in 2010, and to 467 million tonnes in 2020. In the southern part of the country, the exported volume from Xinan region will increase from 26 million tonnes in 2000 to 30 million tonnes in 2020, partially satisfying the demand for coal in Zhongnan region.

In the Dongbei (northeastern) region, production will slow in Liaoning and Jilin provinces. The net imported volume will increase to 39 million tonnes in 2020.

Table 3-7　Prospects for coal supply and demand by province

(Unit: 10,000 tonnes)

	2000			2010			2020		
	Consumption	Production	Export/Import	Consumption	Production	Export/Import	Consumption	Production	Export/Import
Beijing	2,331	850	-1,481	1,781	756	-1,025	962	693	-269
Tianjin	2,024	0	-2,024	1,699	0	-1,699	1,174	0	-1,174
Hebei	10,103	5,800	-4,303	10,363	6,569	-3,794	11,175	6,862	-4,313
Jingjinji	**14,458**	**6,650**	**-7,808**	**13,843**	**7,325**	**-6,519**	**13,311**	**7,555**	**-5,756**
Shanxi	10,892	32,000	21,108	15,920	43,014	27,094	19,720	48,174	28,454
Inner Mongolia	4,921	7,400	2,479	6,815	13,327	6,512	9,217	19,333	10,116
Shaanxi	2,367	4,500	2,133	3,780	10,386	6,606	5,523	13,628	8,105
Jinshaanmeng	**18,179**	**43,900**	**25,721**	**26,515**	**66,727**	**40,212**	**34,460**	**81,135**	**46,674**
Liaoning	8,155	5,700	-2,455	9,879	6,101	-3,778	10,511	6,279	-4,232
Jilin	3,395	2,100	-1,295	4,430	2,120	-2,310	5,439	2,099	-3,340
Heilongjiang	4,799	7,100	2,301	5,122	8,093	2,972	5,576	9,232	3,656
Dongbei	**16,349**	**14,900**	**-1,449**	**19,431**	**16,314**	**-3,116**	**21,526**	**17,609**	**-3,916**
Shanghai	3,649	0	-3,649	3,847	0	-3,847	4,082	0	-4,082
Jiangsu	8,066	2,600	-5,466	9,978	2,478	-7,500	11,095	2,362	-8,733
Zhejiang	4,223	80	-4,143	5,488	62	-5,426	6,723	43	-6,680
Anhui	4,867	5,100	233	5,566	6,894	1,329	6,105	8,313	2,209
Fujian	1,824	700	-1,124	2,520	1,631	-889	3,435	1,950	-1,485
Jiangxi	2,380	1,900	-480	3,029	2,069	-960	3,687	2,125	-1,562
Shandong	7,458	8,900	1,442	11,331	13,655	2,324	13,995	15,431	1,436
Huadong	**32,467**	**19,280**	**-13,187**	**41,758**	**26,790**	**-14,968**	**49,122**	**30,226**	**-18,896**
Henan	7,294	9,000	1,706	9,110	11,173	2,062	10,167	12,460	2,293
Hubei	5,083	1,100	-3,983	7,147	924	-6,223	8,680	773	-7,907
Hunan	3,364	3,700	336	4,053	4,670	617	4,825	5,519	694
Guangdong	4,840	500	-4,340	6,067	300	-5,767	7,173	177	-6,996
Guangxi	1,969	900	-1,069	2,317	862	-1,455	2,709	871	-1,839
Hainan	163	2	-161	293	2	-291	498	2	-496
Zhongnan	**22,713**	**15,202**	**-7,511**	**28,988**	**17,932**	**-11,056**	**34,053**	**19,803**	**-14,251**
Sichuan	6,840	7,600	760	8,380	9,189	809	9,047	9,327	280
Guizhou	4,588	6,000	1,412	5,498	7,196	1,698	5,803	8,124	2,321
Yunnan	2,616	3,000	384	3,075	3,566	491	4,062	4,436	374
Xinan	**14,045**	**16,600**	**2,555**	**16,953**	**19,951**	**2,998**	**18,913**	**21,888**	**2,975**
Gansu	2,148	1,800	-348	2,884	3,131	247	3,669	3,957	288
Qinghai	573	280	-293	884	430	-454	1,174	582	-593
Ningxia	1,026	1,700	674	1,654	2,184	530	2,217	2,699	482
Xinjiang	2,265	2,700	435	3,186	3,714	528	4,442	4,833	391
Xinganningqing	**6,013**	**6,480**	**467**	**8,607**	**9,459**	**851**	**11,502**	**12,071**	**568**
Total	124,224	123,012	-1,212	156,095	164,498	8,403	182,888	190,286	7,398
Import/export			**-5,293**			**-8,403**			**-7,398**
Changes in stock			**3,665**			**0**			**0**
Statistical error			**-2,840**			**0**			**0**

4. Prospects for coal transportation

4-1 Prospects for coal transportation among regions

In order to estimate the status of future coal transportation, and how the flow of coal might be realized, we have formulated the flow of coal by estimating coal transportation volumes among the regions for 2005, 2010, 2015, and 2020, based on the assumption that the current (2000) regional flow of coal will not change significantly. The estimates are based on the volumes currently transported by railway, marine transport, road, and inland river in 2000, and on the assumption that transportation volumes will increase in proportion to the increases in coal demand forecasts (production, consumption, and export/import volumes) for each region.

With respect to marine transportation, the volume of coal loaded from ports in Jingjinji region to Zhongnan, Huadong, and Dongbei regions will increase from 84.55 million tonnes in 2000 to 123.35 million tonnes by 2010, then to 152.16 million tonnes by 2020 (1.8 times the level of 2000). In addition, the volume of coal loaded from ports in Shandong and Jiangsu provinces, where the coal produced in the middle/southern parts of Sanxi region and Shandong Province is transported, will be about 48.55 million tonnes (1.7 times the 2000 level) by 2020.

A large part of the total volume of coal will be transported by railway from the Sanxi region, the national coal supply center, to each region. Transported volumes from the region will increase from 236.15 million tonnes in 2000 to 373.76 million tonnes in 2010 and to 430.40 million tonnes (1.8 times the 2000 level) in 2020 (Fig. 4-1, Fig. 4-2).

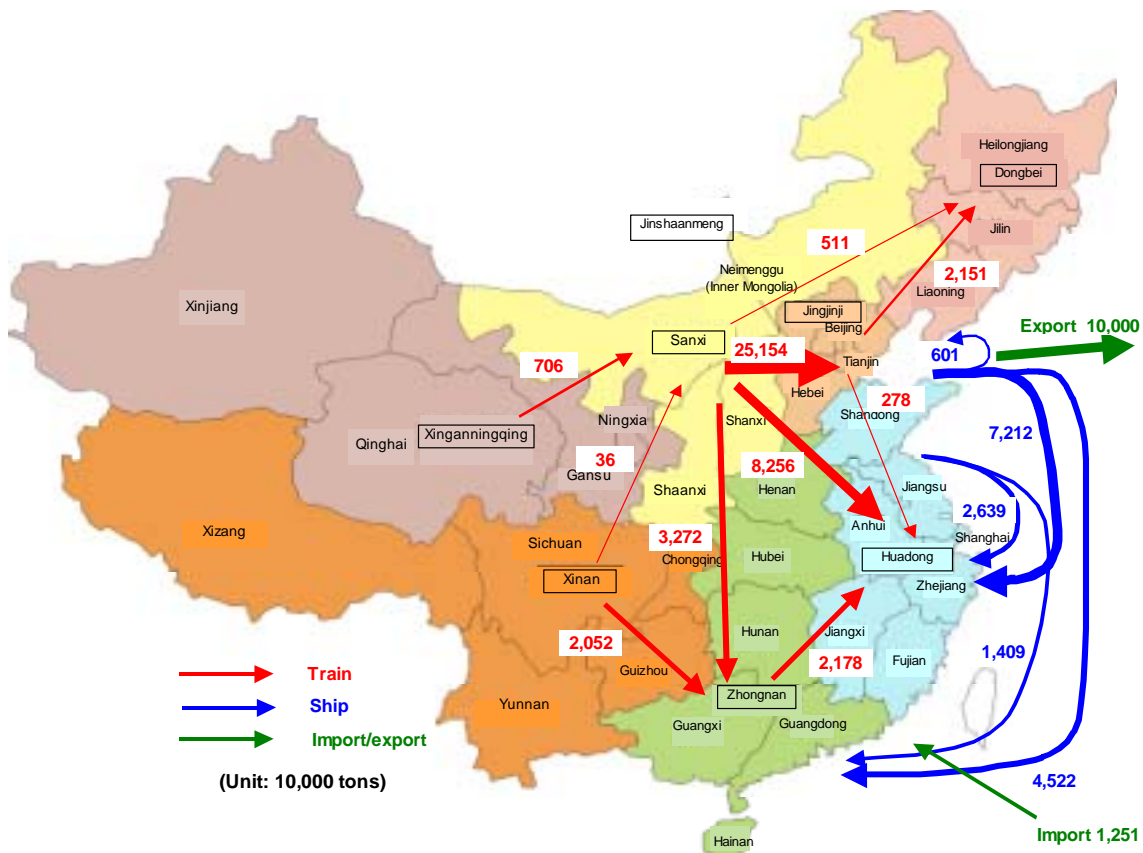Fig. 4-1　Coal flow in 2010 (by railway and marine transportation)

Fig. 4-2   Coal flow in 2020 (by railway and marine transportation)

4-2   Comparison with transportation capacity

4-2-1 Railway

The external transportation routes from Sanxi region consist of five northern lines (Daqin Line, Fengshada Line, Jitong Line, Shuohuang Line, and Jingyuan Line), one middle line (Shitai Line), and five southern lines (Taijiao Line, Houyue Line, Hanchang Line, Longhai Line, and Ningxi Line). The Shuohuang Line is planed to expand its capacity to 100 million tonnes in response to growing volumes of traffic. The Daqin line is currently being considered to expand its capacity up to 120 million-130 million tonnes. Additional transportation capacities are planed to expand on the Jingyuan and Hanchang Lines. However, with the exception of the Shuohuang and Daqin Lines (which are for the sole use of coal transportation), all other routes will experience falling coal transportation capacity, due to an overall increase in the volume of freight traffic (Table 4-1).

While external transportation volumes from Sanxi region will increase from 235 million tonnes in 2000 to 372 million tonnes in 2010

and to 428 million tonnes in 2020 (a total increase of 190 million tonnes over 20-years), the transportation capacity will expand from 306 million tonnes in 2000 to 406 million tonnes in 2010, and to 439 million tonnes in 2020 (a total increase of 133 million tonnes over 20-years, of which 100 million tonnes will be on the Shuohuang Line). In terms of the transportation capacity, the entire Sanxi region has a reserve capacity of 71 million tonnes in 2000, 34 million tonnes in 2010, and 9 million tonnes in 2020. However, a comparison of the capacities of the northern, middle, and southern routes shows that while the southern route will have sufficient capacity throughout this period, the northern route will lose its sufficiency margin by 2020, and the middle route will lose its sufficiency margin by 2010 (Table 4-2).

4-2-2 Loading ports

Although a plan with regard to coal loading ports has been tabulated up to the year 2010, the specific time frame for a construction start has yet to be determined for the period 2005 to 2010. Expansion plans after 2010 will be formulated in the future, based on actual coal

handling volumes (Table 4-3).

In Bohaiwan coast area, expansion work at the Tianjin and Huanghua ports will increase coal loading capacity by about 100 million tonnes for the ten years from 2000 to 2010. In Shandong and Jiangsu provinces, increases of about 30 million tonnes are expected. However, when loading volumes and loading capacities of coal are compared, there will be no reserve capacity for loading. Even in 2000, Shandong and Jiangsu Provinces had insufficient capacity. Coal is now loaded from berths other than coal loading berths. This situation is expected to continue for some time. In the future, however, existing ports will handle coal, such as the Lanshan and Yantai ports in Shandong Province (Table 4-4).

Table 4-1   Coal transportation capacities of external transportation routes from Sanxi region

(Unit: 10,000 tonnes)

Route	Total transportation capacity					Coal transportation capacity				
	2000	2005	2010	2015	2020	2000	2005	2010	2015	2020
Northern routes										
Daqin Line	10,000	10,000	12,000	12,000	12,000	10,000	10,000	12,000	12,000	12,000
Fengshada Line	7,000	7,000	7,000	7,000	7,000	5,200	4,600	4,300	4,200	4,200
Jitong Line	1,700	1,700	1,700	1,700	1,700	1,500	1,400	1,300	1,300	1,200
Shuohuang Line	0	6,000	6,000	8,000	10,000	0	6,000	6,000	8,000	10,000
(Shenshuo Line)	(0)	(6,000)	(6,000)	(7,500)	(9,000)	(0)	(6,000)	(6,000)	(7,500)	(9,000)
Jingyuan Line	1,800	1,800	2,200	2,200	2,200	1,000	1,200	1,500	1,500	1,500
Total	20,500	26,500	28,900	30,900	32,900	17,700	23,200	25,100	27,000	28,900
Middle route										
Shitai Line	7,500	7,500	7,500	7,500	7,500	5,700	5,500	5,000	4,800	4,500
Total	7,500	7,500	7,500	7,500	7,500	5,700	5,500	5,000	4,800	4,500
Southern routes										
Taijiao Line	5,000	5,000	5,000	5,500	5,500	4,400	4,400	4,300	4,700	4,600
Houyue Line	7,000	7,000	7,000	7,000	7,000	6,400	6,300	6,200	5,900	5,700
Hanchang Line	1,600	1,600	1,700	2,000	2,200	1,300	1,300	1,300	1,600	1,700
Longhai Line	5,800	5,800	6,000	6,500	7,000	1,500	1,400	1,400	1,400	1,500
Ningxi Line	0	2,500	2,500	3,000	3,500	0	2,100	1,600	1,600	1,600
Total	14,400	16,900	17,200	18,500	19,700	7,200	11,100	10,500	10,500	10,500
Grand total	42,400	50,900	53,600	56,900	60,100	30,600	39,800	40,600	42,300	43,900

Note: The Shenshuo Line is not included in the northern route total.
           Since the capacity between Yueshan and Xinxiang is equal to that of the Houyue Line, only the capacity of the Houyue Line is
           aggregated here.
Source: Compiled from material issued by The Institute of Comprehensive Transportation and our Chinese counterpart.

Table 4-2   Comparison of volumes and capacities of coal transportation in external transportation routes from Sanxi region

(Unit: 10,000 tonnes)

	2000			2010			2020		
	Transportation volume	Capacity	Reserve capacity	Transportation volume	Capacity	Reserve capacity	Transportation volume	Capacity	Reserve capacity
Northern route	13,220	17,700	4,480	24,844	25,100	256	29,293	28,900	-393
Middle route	5,192	5,700	508	5,839	5,000	-839	6,245	4,500	-1,745
Southern route	5,075	7,200	2,125	6,510	10,500	3,990	7,276	10,500	3,224
Total	23,487	30,600	7,113	37,193	40,600	3,407	42,813	43,900	1,087

Note: Transportation volumes through the northern, middle, and southern routes are based on estimated production volumes.

Table 4-3 Loading capacity of coal berths at major coal loading ports

(Unit: 10,000 tonnes)

	Major coal shipping ports in Bohaiwan region						Major coal shipping ports in Shandong and Jiangsu Provinces				Total
	Total	Qinhuangdao	Jingtang	Tianjin	Huangsi	Total	Quanwan	Rizhao	Lianyungang	Total	
2000	16,175	10,585	290	1,050	70	11,995	1,500	1,800	1,100	4,400	16,395
2001	21,175	10,585	290	3,050	3,070	16,995	1,500	1,800	1,100	4,400	21,395
(New addition)	(5,000)	-	-	(2,000)	(3,000)	(5,000)	-	-	-	-	(5,000)
2005	25,535	11,085	450	3,050	6,070	20,655	1,500	2,500	1,100	5,100	25,755
(New addition)	(500)	(500)	-	-	(3,000)	(3,500)	-	-	-		(3,500)
(Modification/expansion)	(860)	-	(160)	-		(160)	-	(700)	-	(700)	(860)
2010	28,685	11,585	800	3,050	6,070	21,505	1,800	4,000	1,600	7,400	28,905
(New addition)	(2,500)	-	-	-	-		-	(2,000)	-	(2,000)	(2,000)
(Modification/expansion)	(1,650)	(500)	(350)	-	-	(850)	(300)	-	(500)	(800)	(1,650)
(Reduction)	(500)	-	-	-	-		-	(500)	-	(500)	(500)

Source: Compiled from material issued by our Chinese counterparts and hearings.

Table 4-4 Comparison with coal loading capacity

(Unit: 10,000 tonnes)

	2000			2010			2020		
	Shipping volume	Capacity	Reserve capacity	Shipping volume	Capacity	Reserve capacity	Shipping volume	Capacity	Reserve capacity
Bohaiwan region	12,186	11,995	-191	18,435	21,505	3,070	21,316	21,505	189
Shandong and Jiangsu provinces	5,151	4,400	-751	7,748	7,400	-348	8,556	7,400	-1,156
Total	17,337	16,395	-942	26,183	28,905	2,722	29,872	28,905	-967

5. Issues to be addressed for coal transportation

As a domestically available resource, coal continues to be a core energy source in China. Coal demand will increase from 1,240 million tonnes in 2000 to 1,560 million tonnes in 2010, and to 1,830 million tonnes in 2020. To satisfy increasing demand, coal transportation, which consists railway and loading port, from the Sanxi region (Shanxi Province, Shaanxi Province, and the western part of the Inner Mongolia Autonomous Region) to the areas in need must be secured. However, the transportation of coal by railway from Sanxi region is expected to increase by 200 million tonnes over the 20-year period, from 240 million tonnes in 2000 to 440 million tonnes in 2020. The volume of coal loaded from ports will increase by 130 million tonnes over the same period, from 170 million tonnes in 2000 to 300 million tonnes in 2020.

Our study has revealed that the railway capacity for coal transportation from the Sanxi region will be insufficient in the future; although the southern route has some reserve capacity, the middle and northern routes will suffer from insufficient capacity. In order to transport more than 400 million tonnes of coal from Sanxi region, enhancements need to be implemented for each route, which are currently being planned or investigated. Furthermore, in order to secure a 20% reserve capacity for railway transportation, enhancements through an additional capacity of about 80 million tonnes and 30 million tonnes will be needed for the northern and middle routes, respectively. This means that the construction of new railway lines needs to be considered.

No reserve loading capacity can be expected for the ports used to load coal. In the Bohaiwan region, expansions at the Tianjin (second phase of construction) and Huanghua (third phase of construction) ports are planned in response to increasing volumes of coal handling after 2010. If these plans are implemented as scheduled, the problems of insufficient capacity can be solved. In the Shandong and Jiangsu regions, capacity will be 12 million tonnes below the required level in 2020, requiring an expansion of the existing coal berths, the construction of new coal loading ports, such as those at Lanshan and Yantai, and enhanced capacity for railway lines connected to these ports.

Unless adequate coal transportation capacity (with some reserve capacity) can be secured to

transport the projected future volumes, a transportation bottleneck will occur. As a result, the domestic coal supply and demand will be constricted and the volume of exports will be reduced. In addition, the increase of coal imports around the coastal areas (in particular the southern coastal regions), such as Guangdong and Fujian, which are close to coal exporting countries including Indonesia, may seriously affect the Asian coal market.

The consequences are potentially significant if the energy conservation and natural gas shift scenarios described in our study prove to be failures, further increasing coal consumption and transportation volumes and greatly reducing future Chinese coal exports.

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