CHINA'S ENERGY PROBLEMS: PRESENT AND FUTURE

SEIICHI NAKAJIMA

INTRODUCTION

ECONOMIC development is the greatest task that confronts China and the fact that such development ultimately hinges upon energy and transportation has been repeatedly emphasized by Premier Zhao Ziyang.

With regard to energy, coal and electricity are in short supply at present. The energy shortage has been a great obstacle to the development of the economy and the improvement of the people's living conditions, as it is said that the gross industrial production could be immediately increased by nearly 20 per cent were there a sufficient supply of energy. It has also been reported that the energy shortage in the rural areas is so serious that of 170 million farm households, 80 million suffer from an energy shortage for three to six months of the year [13, Jan. 22, 1981, p. 3].

This paper summarizes the present situation and the prospects for China's energy problems on the basis of official data provided by China. It needs to be pointed out at the outset that there are many unclear aspects due to some inconsistencies in the published figures and to the paucity of information on consumption. As for future prospects, since detailed economic plans have not been revealed, this paper will cover the period up to 1985, a period in which certain inferences can be made on the basis of present conditions. One final qualifying remark: Some 290 million tons of standard coal equivalent of non-commercial energy (such as chaff, dung, and methane gas) is produced in China [7, Sept. 1, 1980, p. 1] and accounts for approximately one-third of that country's total energy. However, this category of energy is excluded from this study due to insufficient data, and this paper thus focuses only on the four sectors: coal, oil, natural gas, and electricity.

I. ENERGY IN GENERAL

A. *Energy Resources*

China's energy resources are shown in Table I. It is reported that Chinese coal reserves (meaning proven reserves, as does the term throughout this paper) of 610 billion tons rank third in the world following the United States and the Soviet Union. Oil at 6.8–7.0 billion tons puts China in eleventh place, natural gas at about 230 billion m^3 (cubic meter) ranks twenty-third, and hydraulic reserves of 680 million kw (kilowatt) stand first in the world [19].

TABLE I

ENERGY RESERVES (AS OF THE END OF 1980)

	Coal (Billion Tons)	Oil (Billion Tons)	Natural Gas (Billion m^3)	Hydropower (Gw)
Possible reserves	1,400	60.0		
Proven reserves	610	6.8–7.0	230	680[a]
Commercially exploitable reserves	40	2.3	178	370[b]
Already exploited		0.7		19[c]

Source: Compiled from [19].

[a] Potential.

[b] Capable of being developed with existing technology.

[c] Already developed.

TABLE II

ENERGY PRODUCTION AND CONSUMPTION, 1949–81

Year	Production (Million Tons of Standard Coal Equivalent)	Consumption (Million Tons of Standard Coal Equivalent)	Gross Industrial and Agricultural Production (Million Yuan at 1952 Prices)	Energy Consumption per Million Yuan (Tons)
1949	23.5	23	46,600	49
1950	31.2	32	57,500	56
1952	48.39	45	82,700	54
1957	96.75	96	138,800	69
1962		165	143,100	115
1965	188.78	189	221,800	85
1970		292	350,300	83
1975	484.75	453	516,600	88
1976	505		522,400	
1977	557.43	521	586,000	89
1978	625.35	569	655,400	87
1979	644.07	586	714,600	82
1980	637.23	587	769,600	76
1981	630.63		804,200	

Source: [17].

Note: The standard coal equivalent is as follows: 1 ton of raw coal=0.71 ton; 1 ton of crude oil=1.43 ton; 1 m^3 of natural gas=1.33 kg; and 1 kwh of electricity=0.44 ton [16].

As for coal, even if only one-half of proven reserves are assumed to be commercially exploitable, potential in comparison to the present annual production of about 600 million tons is colossal, and there are already 40 billion tons which can be readily developed. As for oil and natural gas, a relatively smaller portion is commercially exploitable. Thus should the present annual production of 100 million tons of oil and 14,000 million m^3 of natural gas continue to be extracted, commercially exploitable reserves will be exhausted in less than twenty years. As for hydropower, although there is as much as 370 gw (gigawatt) which can be developed, no more than 20 gw has been developed to date. In other words, China has abundant coal and hydraulic resources, but the oil and natural gas reserves thus far proven are relatively limited.

B. *Energy Production*

Energy production increased nearly twenty-seven times from 23.5 million tons of standard coal equivalent in 1949 to 630 million tons in 1981, the average annual growth rate being 10.8 per cent, exceeding the growth rate of 9.4 per cent in gross industrial and agricultural production during the same period (see Table II).

By and large, energy production steadily increased until 1978. This was due mostly to the rapid increase in oil production. In the past four years, however, electricity alone has increased annually while oil production has slagged and there has been virtually no growth in coal production. In fact, entire energy production in these four years has gradually declined from a 640 million-ton peak in 1979 to the 630 million tons for 1981. In terms of the type of energy produced, the share of coal in 1957 was 96 per cent but it has since declined to around 70 per cent. On the other hand, oil which had a share of only about 2 per cent in 1957 has soared to about 23 per cent. Natural gas and electricity account for small shares amounting of 3–4 per cent.

C. *Energy Consumption*

There is no big gap between energy production and consumption in China. In 1980 the gap stood at about 50 million tons (see Table III), of which approximately 20 million tons went to oil exports while the bulk of the remainder was the result of increased coal stocks.

Figure 1 shows energy consumption by sector. Industrial consumption at about 380 million tons, took 62.5 per cent of the total, nonproductive purposes 15.5 per cent (predominantly coal) followed by communications and transportation with 5.1 per cent, agriculture with 4.4 per cent, and loss — which exceeded 60 million tons—about 10 per cent.

It may be pointed out in passing that the total consumption by sector calculated from the demand side as shown in Figure 1 amounts to 610.63 million tons, 27 million tons more than the total energy consumption calculated from the supply side. This discrepancy might be the result of such factors as differences in calculation method for determining loss.

D. *Energy Balance*

Does China maintain a supply-demand balance in energy? It can be said that there is no fundamental imbalance in this sphere, judging from the fact that economic development has been pursued with hardly any energy imports (oil was partially imported before the 1970s). Nevertheless, when such factors as per capita energy consumption and the correlation between industry and energy are compared with those of the advanced nations, the supply is certainly less than the potential demand.

When energy consumption by industry and energy production by energy type are compared in terms of efficiency, transportation, pollution ,and other aspects, it becomes clear that the proportion of oil to overall energy consumption should

TABLE III

PRODUCTION AND CONSUMPTION BY ENERGY TYPE, 1975–81

(1,000 tons)

	1975		1979		1980		1981	
	Production	Consumption	Production	Consumption	Production	Consumption	Production	Consumption
Coal								
Raw coal	482,000		635,300	594,370	620,130	594,000	620,000	
Standard coal equivalent	342,220		451,060	422,000	440,290	421,740	440,200	
Oil								
Crude oil	77,060		106,150	84,160	105,950	88,350	101,220	
Standard coal equivalent	110,200		151,790	120,350	151,510	126,340	144,740	
Natural gas[a]	8,850		14,500	14,500	14,300	14,000	12,740	
Standard coal equivalent	11,770		19,290	19,290	19,020	18,620	16,940	
Electricity (hydropower)								
Electric power production[b]	47,600	47,600	50,100	50,100	60,300	60,300	65,550	65,550
Standard coal equivalent	20,870	20,870	22,000	22,000	26,000	26,000	28,750	28,750
Total (standard coal equivalent)	485,060	453,000	644,140	583,640	637,230	587,100	630,630	

Source: Compiled from Chinese official data.

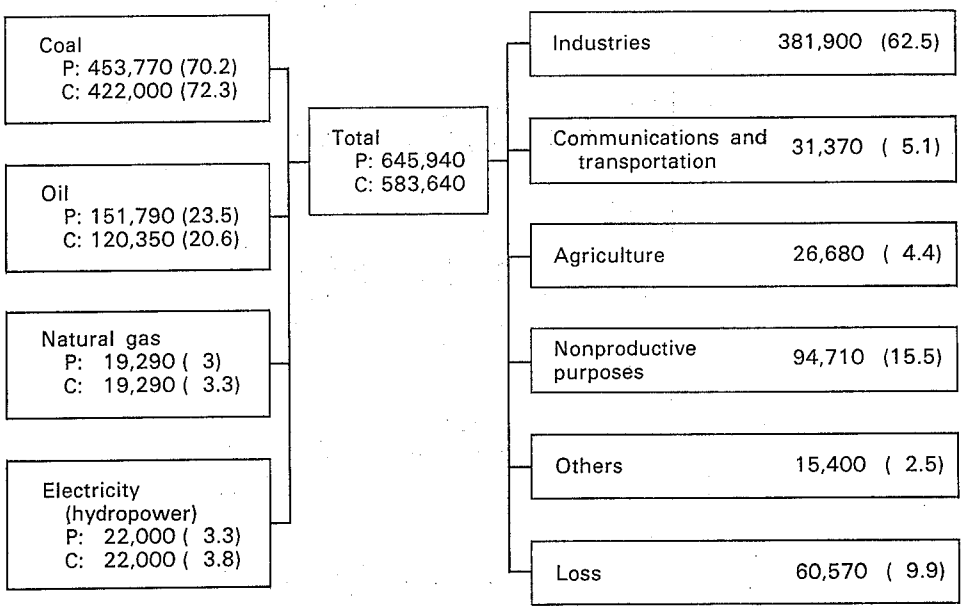
Note: Refer to the note appended to Table II for calculation of standard coal equivalents.

[a] Million m^3.

[b] Gwh

Fig. 1. Energy Demand and Supply, 1979

(1,000 tons of standard coal equivalent)



Sources: Compiled from [17] and Table III.
Notes: 1. P: Production; C: Consumption.
2. Figures in parentheses indicate percentage shares.

be higher. However, viewed from the basis of resources (reserves, conditions of distribution, transportation, etc.), it can be said that coal will have to continue to be maximally exploited for some time to come.

E. *The Development of Energy Resources*

The development of energy requires heavy investment and special priority has been given such investment in the past few years (see Table IV).

The investment in energy during the First Five-Year Plan period totaled 8,800 million yuan, or 16 per cent of the overall budget. The same level was maintained in the Second Five-Year Plan (16.9 per cent) and the Third Five-Year Plan (16.8 per cent) [18]. The 20 per cent level was exceeded for the first time in 1976 when investment reached 20.8 per cent, and the proportion was 22.9 per cent, 26.9 per cent, and 24.3 per cent in 1977, 1978, and 1979, respectively, thus approximating one-quarter of the total capital construction investment in recent years.

These gross figures, however, conceal the facts that development costs have doubled since the 1950s and the priority of recent investment has changed. In the First Five-Year Plan, more than 40 per cent of energy investment was allocated to coal, 37 per cent to electricity, and 23 per cent to oil. However, in 1979 priority was shifted in favor of the particularly problematic electricity sector with 42 per cent going to electricity, 30 per cent to oil, and 28 per cent to coal.

TABLE IV
INVESTMENT IN ENERGY, 1953–80

(Million yuan)

	1953–57	1958–62	1963–65	1966–70	1970–75	1976–80
Coal	2,968	8,698	2,515	4,665	9,074	13,625
	(5.4)	(7.3)	(6.2)	(5.1)	(5.4)	(6.1)
Oil	1,198	2,510	1,644	3,884	8,900	13,142
	(2.2)	(2.1)	(4.1)	(4.2)	(5.3)	(5.9)
Electricity	2,978	8,888	2,207	6,860	12,939	21,874
	(5.4)	(7.5)	(5.5)	(7.5)	(7.7)	(9.8)
Total	7,144	20,096	6,366	15,409	30,913	48,641
	(13)	(16.9)	(15.8)	(16.8)	(18.4)	(21.8)
Total national investment (all sectors)	54,996	118,667	40,374	91,471	168,037	224,275

Sources: *Zhongguo tongji nianjian, 1981* [China statistical yearbook, 1981].
Note: Figures in parentheses indicate percentage shares in national investment outlay.

As for future development, the government is going to concentrate investment in specific subsectors so that quick results can be obtained. Premier Zhao Ziyang has pointed out that insofar as coal is concerned, short-term emphasis is to be placed on improvement and expansion of existing mines while the development of new coal mines is to center around small- and medium-scale mines, with large-scale mines to be developed later. Regarding the regions of development, the focus is to be placed on the provinces of Shanxi, Henan, Shandong, Anhui, Heilongjiang, and Guizhou and the Inner Mongolia Autonomous Region. As for oil, in addition to the technological improvement of existing oil wells, funds are to be concentrated on the development of new oil fields as well as on the survey and exploration of oil and natural gas. In electricity, the priority is to be gradually shifted to hydraulic power [20].

It is now clear that capital investment and technology transfer from abroad is to be actively promoted for the exploration and development of energy. In addition, joint ventures are being pursued in coal mining between provinces that lack reserves but have the funds and provinces with the resources, so that long-term supply of coal can be secured in return for development.

F. *Problems*

1. *Cost*

Although China has never publicized energy prices, it would appear that while oil and electricity prices are high, the coal price is maintained at a low level. This fact is reflected in the profit ratios. The profit-cost ratio of oil in 1978 was 73 per cent, while that of electricity was 69 per cent [12, p. 210] (the profit-sales ratio was 40 per cent and 31 per cent, respectively [8, p. 55]). On the other hand, coal had profit ratios of a mere 0.7 per cent and 1 per cent, respectively. It would, therefore, appear that no matter how much the production of coal is increased, large profits are out of the question.

Nevertheless, there is a tendency toward a narrowing of the price gap between

TABLE V
GROSS OUTPUT VALUE BY ENERGY TYPE, 1952–79

	1952	1957	1965	1975	1979
Coal:					
Gross output value (million yuan)	830	2,060	3,600	9,000	11,810
Production (1,000 tons of standard coal equivalent)	46,860	93,010	164,720	342,220	450,850
Gross value per ton (yuan)	17.7	22.1	21.9	26.3	26.2
Oil:					
Gross output value (million yuan)	180	800	4,510	17,980	24,960
Production (1,000 tons of standard coal equivalent)	630	2,090	16,730	110,200	151,790
Gross value per ton (yuan)	286	383	270	163	164
Electricity:					
Gross output value (million yuan)	430	1,170	4,310	12,470	17,670
Production (1,000 tons of standard coal equivalent)	3,200	8,460	29,650	85,880	123,680
Gross value per ton (yuan)	134	138	145	145	143

Source: Compiled from [23].
Note: Refer to the note appended to Table II for calculation of standard coal equivalents.

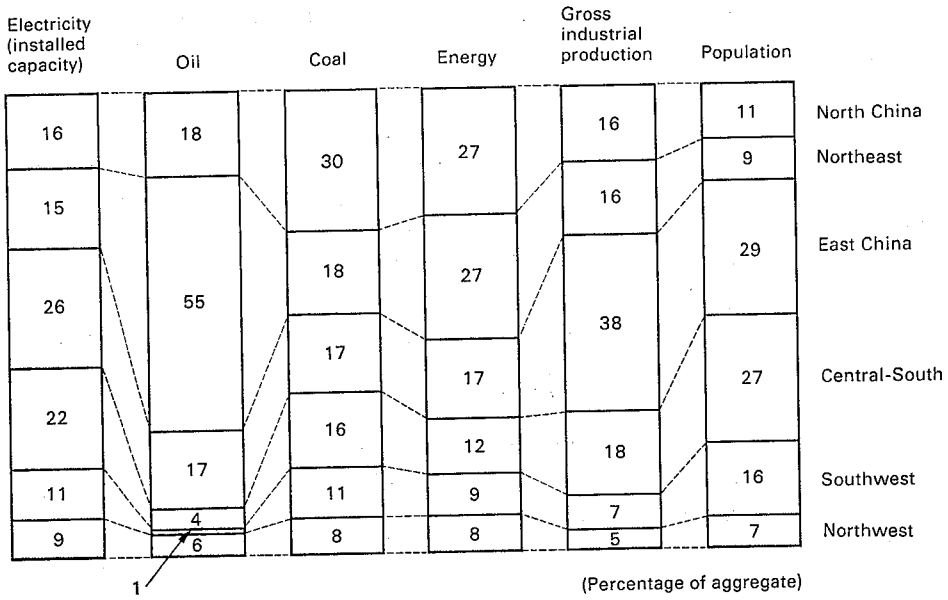
coal and oil. Over the period from 1953 until the present, the price of coal went up by 65 per cent, while the prices of electricity (for industrial users) and gasoline went down by 17 per cent and 13 per cent, respectively, thus the price ratio of these three changed from 1:9.9:59.3 in 1953 to 1:4.9:31.1 at present [3, p. 5].

Price differentials can be indirectly confirmed by comparing the gross value of output per unit (see Table V). The gross value of coal output per ton of standard coal equivalent gradually increased from 22.1 yuan in 1957 to 26.2 yuan in 1979, while that of oil decreased from 383 yuan in 1957 to 164 yuan over the same period. As for electricity, there was hardly any change from 1952 to 1979, the figures being 134 and 145 yuan, respectively. The relative price of oil (the coal price being set at 1) decreased from 17.3 in 1957 to 6.3 in 1979, while that of electricity was 5.5 in 1979 (in Japan these relative prices are 2 and 10, respectively). Thus, again we see that coal price is kept extremely low in China.

2. *Regional imbalance*

It appears that there is no extreme imbalance throughout the country, though coal and electricity are insufficient. However, when each province is studied, there are some provinces with abundant energy surplus and those with insufficient energy. In view of the fact that the development of each region hereafter will, to a large extent, be based upon the energy supplies available, the regional

Fig. 2. Economy by Major Region (1980)



Source: Compiled from Chinese official data.
Note: The definition of economic region is as follows: North China—Beijing Municipality, Tianjin Municipality, Heibei Province, Shanxi Province, and the Inner Mongolia Autonomous Region; Northeast—the provinces of Liaoning, Jilin, and Heilongjiang; East China—Shanghai Municipality, the provinces of Jiangsu, Zhejiang, Anhui, Jiangxi, Fujian, and Shandong; Central-South—the provinces of Henan, Hubei, Hunan, and Guangdong and the Guangxi Zhuang Autonomous Region; Southwest—the provinces of Sichuan, Guizhou, and Yunnan and the Xizang Autonomous Region (Tibet); and Northwest—the provinces of Shaanxi, Gansu, and Qinghai and the Ningxia Hui and the Xinjiang Uygur autonomous regions.

imbalance presents a serious problem for China where the transportation sector is particularly underdeveloped.

When the regions are examined individually (see Figure 2), there is hardly a single one in which industrial and energy production are well-balanced. North China and the Northeast appear to have energy surplus. However, the major part of this surplus in North China consists of Shanxi coal while that in the Northeast resides in crude oil from the Daqing Oil Field. Thus, these areas are still short of other energy resources needed to meet specific demands. East China, which accounts for a 38 per cent share of China's gross industrial production, is very short of energy. Thus it can be said that without all-out development of the energy supply economic development as a whole cannot be pursued.

II. COAL

A. *Production*

There are approximately 2,200 coal mines managed by county and higher-level

TABLE VI

COAL PRODUCTION, EXPORT, AND NEWLY INCREASED CAPACITY, 1949–81

(1,000 tons)

	Production			Export	Newly Increased Capacity
	National Mines	Local Mines	Total		
1949			32,430		
1952			66,490		
1957			131,000		
1965	170,000	62,000	232,000		
1970	247,830[a]		354,000		
1975	289,000		482,000		
1978	342,000	276,000	618,000	3,120	11,510
1979	357,620	277,680 (106,290)	635,300	4,630	13,560
1980	344,390	275,740 (113,620)	620,130	6,270	8,290
1981			620,000		12,430

Source: Compiled from Chinese official data.

Note: Figures in parentheses indicate the production of commune-brigade mines.

[a] 1971 figure.

governments. At the national level, there are eighty-four Mining Bureaus under the Ministry of Coal Industry [13, Apr. 18, 1981, p. 1] with 580 mines whose production is distributed by the state.[1] Of such national mines, there are twenty-six with an annual production of 5–10 million tons, ten mines with 10–20 million tons and two mines, namely, Datong and Kailuan, producing over 20 million tons a year.

Although the scale of the county mines is smaller than that of the national mines, there are 1,634 county operations with a total production capacity of 180 million tons. In addition there were approximately 20,000 small-scale mines run by communes and production brigades at one point. However, many of these mines operated at a deficit, and faced quality and transportation problems and it seems that quite a number have been closed down during the readjustment period.

Table VI shows that coal production increased from 130 million tons in 1957 to 230 million tons in 1965, and from 480 million tons in 1975 to 620 million tons in 1980. It is doubtful, however, that an increase of more than 60 million tons (which is almost equivalent to the annual consumption in Japan), was achieved for the years 1975, 1977, and 1978. Production exceeded the 600 million-ton mark for the first time in 1978 but from then until 1981 remained more or less stationary at 620 million tons with a peak production of 635 million tons in 1979.

Of the 620 million tons produced in 1980, 56 per cent was produced by national mines and 44 per cent by local mines, of which 113.62 million tons were produced by the commune-brigade mines. It is striking that there was close

[1] The coal production capacity of the national mines is about 290 million tons.

to a 7 per cent annual increase in production by the commune-brigade mines, while the total production of national and local mines decreased. Thus, although the commune-brigade mines are not without their problems, they cannot be ignored.

Classified by quality, in 1979 about 484 million tons or 76 per cent of the coal produced was bituminous coal, 126 million tons or 20 per cent anthracite coal, and about 25 million tons or 4 per cent lignite. It is noteworthy that there has been a great increase in the production of anthracite coal. Moreover, it is said that coking coal amounted to 180 million tons or 50 per cent of total production in 1970 and nearly 330 million tons or 52 per cent in 1979. However, it is estimated that the proportion of high-grade coking coal is less than one-third of overall coking coal output.

As of 1979, the major coal-producing provinces were concentrated north of the Yangtze River. Shanxi Province in particular produced 130 million tons in 1979, or more than one-fifth of the national production (in 1978 it produced one-sixth). Henan Province ranked second with about 58 million tons, and Hebei Province third with 53.5 million tons. When the provinces of Liaoning, Heilongjiang, and Shandong—which produce over 40 million tons each—are added in, the combined production of these six provinces alone comes to 60 per cent of national production.

B. *Consumption*

The quantity of coal consumed is more or less in proportion to production. In 1980, however, consumption remained almost the same despite a decrease of 15 million tons in production, and this resulted in the reduction of stocks. In the past year or two, the demand for coal has been increasing due to a campaign to conserve oil generally as well as to the imposition of strong restrictions on the use of oil as fuel. Sludge and natural coke are sometimes being utilized as substitutes.

In terms of consumption by sector (see Table VII) 72 per cent goes for industrial use and 17 per cent for nonproductive purposes. These two sectors combined thus account for about 90 per cent of consumption. Breaking down industrial consumption, we find that thermal power plants and the steel industry use 19 per cent and 15 per cent, respectively, together consuming nearly half of the entire amount going for industrial use. There is a large 25 million-ton loss, of which the loss during railroad transportation is particularly great.

C. *Development*

The investment in coal over the thirty-two-year period from the establishment of the People's Republic of China until 1980, amounted to 44,900 million yuan, and capacity was increased by 380 million tons for an average annual increase of 11.87 million tons [23, p. IV-61]. Recent development costs have risen sharply; while the investment cost for coal development per ton during the First Five-Year Plan was 56 yuan, it reached 119 yuan during the Fourth Five-Year Plan. In 1980, 1,350 million yuan was invested in new coal mines [24, p. 26],

TABLE VII
ENERGY CONSUMPTION BY SECTOR, 1979

	Coal (1,000 Tons)	Oil (1,000 Tons)	Natural Gas (Million m³)	Electricity (Gwh)
Industry	446,150 (72)	59,020 (66)	12,000 (82.8)	204,700 (72.6)
Coal	23,680 (3.8)	20 (0.02)		16,900 (6)
Oil	490 (0.08)	8,150 (9.1)		9,400 (3.3)
Electricity	118,930 (19.2)	18,180 (20.3)	3,000 (20.7)	19,400 (6.9)
Coke	91,970 (14.8)			
Metallurgy	20,970 (3.4)	5,170 (5.8)	1,200 (8.3)	46,300 (16.4)
Machinery	18,580 (3)	1,890 (2.1)		19,600 (7)
Chemicals	38,990 (6.3)	8,670 (9.7)	4,400 (30.3)	48,300 (17.1)
Construction materials	25,460 (4.1)			9,400 (3.3)
Other heavy industry	66,130 (10.7)	8,700 (9.7)	2,700 (18.6)	
Light industry	40,950 (6.6)	6,830 (7.6)	700 (4.8)	35,400 (12.6)
Communications and transportation	26,090 (4.2)	8,430 (9.4)		1,300 (0.5)
Agriculture	3,510 (0.6)	9,690 (10.8)		24,400 (8.7)
Nonproductive purposes	106,000 (17.1)	4,090 (4.6)	2,200 (15.2)	23,200 (8.2)
Rural villages	40,000 (6.5)	890 (1)		8,100 (2.9)
Others	12,620 (2)	2,930 (3.3)		5,000 (1.8)
Loss	25,050 (4)	5,330 (6)	300 (2)	23,300 (8.3)
Total	619,420	89,490	14,500	282,000
Export	2,560	13,450		

Source: [17].
Note: Figures in parentheses indicate percentage shares.

but capacity was increased by only 8.29 million tons [23, p. IV-63]. This suggests that the unit development cost reached 163 yuan in 1980.

However, there is a big regional difference in development costs. It is reported that while the development cost per ton at present remains at only about 29 yuan in Shanxi Province, it is over 100 yuan in Hubei Province [24, p. 30]. At one stage there was a dispute as to whether emphasis should be placed on Shanxi Province with its low development costs but significant transportation problems or on the southern regions with fewer transportation difficulties but high development costs. The dispute was settled in favor of Shanxi Province, and consequently measures are being taken to raise that province's railway transport capacity from the present 120 million tons to 190 million tons (as for coal transportation, the present capacity of 85 million tons will be increased to 150 million tons) [1, p. 6].

D. *Problems*

1. *Transportation*

As has already been suggested, among the problems surrounding coal, that of transportation is particularly serious. Premier Zhao Ziyang has pointed out: "The building of the energy industry and transport should go hand in hand, with the latter starting up a bit earlier. Only thus can excavated coal, for

instance, be moved out in time" [21, p. 18]. By way of concrete example, it is reported that as of the end of 1981, there were 30 million tons of coal stocked in Shanxi Province alone which could not be transported.

Of the 620 million tons of coal produced in 1980, 415 million tons were transported by railway [22, 1981 edition, p. 317], and accounted for some 38 per cent of total railway cargo. Coal movement exerts serious pressure upon transportation: 70 per cent of the tonnage handled by Taiyuan Railway Bureau in Shanxi Province is coal, and over half of the tonnage moved by Beijing Railway Bureau, which handles one-sixth of the country's total rail tonnage, is also coal. Hence from the viewpoint of the transportation sector alone, the prospect of more coal may be less than welcome. However, viewing the overall Chinese economy, the coal transportation problem is a problem that must be solved.

One of the measures taken to circumvent this problem if not to solve it, is the current construction of large-scale thermal power plants at various coal mines so that energy can be sent out in the form of electricity to the consumption areas.

2. *Retarded mechanization*

At present, small-scale coal mines are scarcely mechanized at all, and even at national mines the ratio of mechanization was only 32.5 per cent in 1978 [6, Aug. 25, 1979, p. 1], 36.8 per cent in 1980,[2] and 39.8 per cent in 1981 [6, Jan. 5, 1982, p. 1]. Over the past several years a special effort has been made to mechanize mines, and 1,200 pieces of ordinary coal extraction equipment and 223 comprehensive coal extraction facilities (of which 171 were imported) have been, or are being installed [23, p. IV-61]. The productivity of priority coal mines has been increased through the installation of comprehensive coal extraction facilities with nearly three times the capacity of ordinary coal extraction equipment [6, June 20, 1981, p. 1].

3. *Shortage of coal washing factories*

More than 80 per cent of the raw coal produced in China is used without being washed [8, p. 28]. There are 176 coal washing factories at present with a total potential washing capacity of 100 million tons. However, the actual output of coal washing factories in 1980 was a mere 58.66 million tons [23, p. IV-61], under such circumstances, coal quality must be problematic.

It is recognized that, should the coal be washed prior to being transported, transportation loads would be reduced by 20–30 per cent, but it seems that there is insufficient capital to cover coal washing investments.

E. *Supply and Demand Prospects*

1. *Supply*

Coal production capacity has increased during the past several years at a rate of around 11 million tons annually (see Table VI), and it is expected that this rate of increase will be maintained from now on. Capacity and actual production

[2] New China News Agency, January 8, 1981.

do not necessarily coincide, however. Even though the increases in actual production, on the whole, were greater than the increases in capacity, it will be very difficult to sustain production increases of over 20 million tons per year.

At the national conference on capital construction in the coal industry in June 1981, it was stated that production would be started at about forty new coal mines over the next five to six years [13, June 26, 1981, p. 1]. Included among the mines to be developed, are such major ones as the Liangzhun Coal Mine (15 million tons capacity) to be developed independently by China, the Huolinhe Coal Mine (20 million tons) to be developed with the cooperation of West Germany, and the Gujiao and Yanzhou coal mines to be developed with the cooperation of Japan. Although the total capacity of these mines is expected to be more than 100 million tons, it is now clear that they will not all be developed by 1985. It is assumed that those which start operation by 1985 will at most produce an additional 50 million tons. But small- and medium-scale coal mines with favorable conditions are also likely to be developed, and thus it may be estimated that total production in 1985 will be 670–80 million tons, 50–60 million tons greater than the present output.

2. *Demand*

Oil production remained at a constant level of about 100 million tons in the four years 1978–81, and it has been announced that this level will be maintained for several years to come [20]. It has also been reported that should oil production remain constant, there will be a mounting energy shortage unless coal production is increased by 10 million tons annually [13, Sept. 10, 1980, p. 3].

What are the prospects for 1985 demand by sector? First of all, thermal power plants, the biggest coal users, consumed 130 million tons in 1980. However, in view of the campaign to switch from oil-generated to coal-generated electricity and the construction of large-scale coal-fueled power plants, at least 170 million tons of coal will be required for electricity production in 1985.

In the metallurgy and coke sector, most of the coal is consumed by the steel industry. It seems that there will not be a big increase in iron production during the readjustment period; rather, the existing facilities will be improved. Thus, even if iron production in 1985 reaches 40 million tons, coal consumption need not be much greater than it is now, if technological improvements can be made and the quality of raw coal upgraded. Thus total coal consumption in the metallurgy and coke sector is likely to remain at the level of 110 million tons. With the emphasis in the chemical industry being shifted from coal chemistry to petrochemistry, it seems unlikely that this industry will consume more coal than is used now.

Judging by present trends, it can be assumed that there will be a continued emphasis on light industry for at least the next several years. However, consumption by this industry is not so large. Should there be a continuous growth of 6–8 per cent annually, the 1985 consumption by this sector will be about 60 million tons, or about 20 million tons greater than at present.

In the transportation sector, about 9,000 steam locomotive engines will be

operating in 1985 (steam locomotives are still being produced), and coal to fuel them will increase to 30 million tons from the present 26 million tons.

Large quantities of coal have been consumed for nonproductive purposes, the major portion for heating and home use. Since the present regime considers improvement in the people's living standards to be its major task, it must give priority to energy supplies for the people. It can therefore be projected that there will be a demand for nearly 150 million tons in 1985 for home use and daily living requirements.

Apart from the chemical industry, then, coal consumption by the various sectors will be considerably expanded by 1985, and it will be necessary to increase coal production by around 100 million tons if all the increased demands are to be met. Although an increased production of 70–80 million tons might be sufficient to meet the demand if the energy saving campaign achieves some success, losses are reduced, and the stocks on hand are drawn upon, even that level of production increase will be a formidable task.

III. OIL

A. *Production*

The quantity of oil produced in China has soared remarkably from 1.46 million tons in 1957 to 11.31 million tons in 1965, 30.03 million tons in 1970, 77.06 million tons in 1975, and 101.22 million tons in 1981. Self-sufficiency was achieved in 1965 [13, July 14, 1981, p. 5] and in 1973 China became an oil exporting nation. Annual growth in production averaged over 20 per cent by the first half of the 1970s, however, from 1978 to 1981 output was kept at about 100 million tons (see Table VIII), and the forecast is for it to stay at the same level for several more years. The underlying assumption is that facing the diminishing reserves in already developed oil fields, the demand would be suppressed through the measures to economize on its consumption as well as to shift back to greater use of coal. Therefore, should there be an intention to increased oil production, an increase to the tune of 5 per cent is attainable.

It is reported that there are sixteen major oil fields in China [13, Apr. 22, 1982, p. 1]. Available production figures for 1980 were as follows: the Daqing Oil Field produced nearly half of the total with 51.5 million tons (1981 production was 51.75 million tons; this oil field has now produced over 50 million tons for six consecutive years); the Shengli Oil Field followed with 17.58 million tons (17 per cent); and the Jizhong (Renqiu) Oil Field was next with 16.03 million tons (about 15 per cent). These three oil fields alone, therefore, produced approximately 80 per cent of the national output. Additional major fields included the Liaohe Oil Field with 5 million tons, the Karamai Oil Field with 3.91 million tons, the Dagang Oil Field with 2.91 million tons, the Henan (Nanyang) Oil Field with 2.3 million tons, and the Qianjiang (Jianghan) Oil Field with about 2 million tons.

TABLE VIII
OIL AND NATURAL GAS PRODUCTION, OIL EXPORT, AND NEWLY INCREASED OIL PRODUCTION CAPACITY, 1949–81

	Oil (1,000 Tons)				Natural Gas Production (Million m³)
	Production	Refined Production	Export	Newly Increased Capacity	
1949	121				
1952	436				8
1957	1,458				70
1965	11,310				1,100
1970	30,030		190		
1975	77,060		9,880		8,850
1978	104,050	70,700	11,310	10,000	13,700
1979	106,150	71,460	13,430	8,000	14,500
1980	105,950	75,380	13,310	5,750	14,300
1981	101,220	73,765		5,190	12,740

Source: Compiled from Chinese official data.

Of the 105.95 million tons of crude oil produced in 1980, 75.38 million tons were refined, about 12 million tons were used unrefined, 13.31 million tons were exported, and the remaining 5 million tons were counted as loss.

Products of refining included 10.77 million tons of gasoline, 18.38 million tons of diesel oil, and 2.08 million tons of lubricating oil, as well as 40.17 million tons of other oils (mainly heavy). Out of such refined products, 4.2 million tons were exported [22, 1981 edition, p. 251].

B. *Consumption*

In China, 84 per cent of the crude oil produced is consumed domestically [13, May 21, 1981, p. 5]. Table VII shows the consumption pattern by sector. Of the total 66 per cent goes to industry, 11 per cent to agriculture, about 9 per cent to transportation, and nearly 5 per cent to nonproductive purposes. Six per cent is lost.

Thermal power plants, the biggest oil users, consume 30 per cent of the total used in industry, followed by the chemical industry with 15 per cent, light industry with 12 per cent, and the metallurgy industry with 9 per cent. The oil industry itself consumes 14 per cent.

In 1979, 34.75 million tons of oil were consumed for fuel. Although 35 per cent of it was burned without refining, the intention of the authorities is that the use of oil for fuel will be reduced to the minimum and that wherever possible coal will be substituted for oil as a fuel.

C. *Development*

It is pointed out that oil production will ultimately be reduced by 8 million tons annually if present conditions persist [11, p. 9]. It is necessary, therefore, to develop and extend the oil fields even to maintain production at its present levels.

Investment in the industry, which was 4,500 million yuan in 1978, was reduced

to 3,600 million yuan in 1979, its proportion to the total investment in energy declining from 9.3 per cent to 7.2 per cent (see Table IV). The capacity newly developed in the past several years has also gradually declined, from 10 million tons in 1978 to 5.19 million tons in 1981 (see Table VIII). This does not denote a dim future for the oil industry, however. Rather, the present energy policy places emphasis upon hydropower and coal (especially coal mines), while in the oil industry itself priority is given to surveys and exploration for future use rather than to immediate development requiring great amounts of capital. Development is likely to be kept at a minimal level in this way for sometime to come. It now also seems that while onshore oil fields will continue to be managed domestically, the development of offshore oil fields which are not only very costly but also uncertain in terms of prospects must become totally dependent upon foreign capital and technology.

D. *Problems*

There are several problems associated with the exploitation of oil as a major energy source: the uncertainty stemming from the fact that production can stagnate; the underdevelopment of survey and exploration technology, especially with regard to offshore development; lack of capital; inadequate downstream processes in the petrochemical industry; and the securing of an export quantity. None of these problems are susceptible to easy solutions.

Regarding oil supply, unlike coal, electricity, and natural gas where demand exceeds the available supply, the domestic demand for oil is currently satisfied even though oil exports cannot be increased at present. Thus there is no urgent problem in this area.

E. *Supply and Demand Prospects*

1. *Supply*

As stated already, a policy to stabilize oil production at the 100 million-ton level for several years has been announced, and thus it is most unlikely that 1985 production will exceed this figure by much. Domestic demand can somehow be met with this production level. For example, should demand grow the added requirements can be covered by the substitution of more coal for fuel oil.

The major factor underlying the adoption of such a policy may be that production at the Daqing Oil Field has begun to diminish. The Daqing Oil Field has proved reserves of 2,500 million tons [22, 1980 edition, p. 75], of which 30 per cent or 750 million tons are currently exploitable. Since 570 million tons were produced by 1981, the exploitable reserves can only last for several more years. As new oil fields have been discovered in the vicinity, it is very unlikely that production will cease. Nevertheless, with the future of Daqing itself uncertain, it becomes necessary to develop a large-scale oil field which can replace it. And although such oil fields as Shengli, Renqiu, Liaohe, Henan, and Qianjiang are capable of producing several million tons more than at present, they cannot possibly turn out the quantities produced by Daqing. In addition, even if large-scale oil fields were to be discovered in Xinjiang Uygur Auto-

nomous Region or Qinghai Province, this would not change the prospects for the near future because of development and transportation problems.

Much is therefore expected of the offshore oil fields. In addition to successful test borings of three wells in Bohai Gulf in 1981 undertaken with Japanese cooperation, drilling has also met with success at the offshore site of Zhujiang as well as in the vicinity of Hainan Island. However, these areas are still in the stage of exploration, and full-scale operations will not be started before 1985. Moreover, it is reported that the maximum production will be several million tons. Thus, offshore oil fields are likely to become dependable sources only around the turn of the next decade.

2. *Demand*

Certain things can be said regarding oil consumption by sector in 1985. Firstly, oil consumption by thermal power plants declined gradually from about 18 million tons in 1979 to about 16 million tons in 1980. Despite the subsequent measure to convert from oil-generated to coal-generated electricity, there will still be a demand for about 10 million tons of oil in 1985 because the conversion will be hampered by lack of capital and there are some regions for which the conversion would not be economic.

Secondly, the chemical industry, which consumed 8.67 million tons in 1979, will consume more oil in the years to come partially due to the supply priority it enjoys. However, judging from the present scope of ethylene installations as well as future construction plans, the 1985 demand here, too, would be about 10 million tons.

Light industry, which consumed 6.83 million tons in 1979, is now also being given priority in supply of energy. Given accelerated development, the 1985 demand will reach nearly 10 million tons.

In transportation, it is estimated that the number of automobiles will increase from 1.8 million vehicles in 1980 to about 2.5 million in 1985. This, however, does not mean that there will be a corresponding increase in gasoline consumption. If wasteful use were to be largely eliminated and energy conservation progresses as a result of technological improvements, the 1985 demand in this sector would not be much greater than 10 million tons.

Finally, in agriculture, oil consumption for agricultural machinery, especially tractors and pumps, is large. However, since tractor production is on the decline and there is not likely to be any sudden increase in the production of oil-powered pumps, the necessary amount in 1985 will be about 10 million tons.

Given these various considerations, despite the fact that the demand in many sectors will be expanded, the overall demand will not be increased if the consumption by thermal power plants is drastically reduced and if the use of oil for fuel is severely controlled. Consequently, even if production stays at roughly the same level, it will still be possible to export about 10 million tons.

F. *Natural Gas*

The news pertaining to natural gas is sparse compared to that for coal, oil, and electricity. Natural gas production soared from 70 million m^3 in 1957 to

1,100 million m^3 in 1965, 8,900 million m^3 in 1975, and 14,300 million m^3 in 1980. In terms of proportion, however, the contribution of natural gas to the total energy supply was almost zero in the 1950s and was a mere 3 per cent even in 1980.

Approximately half of China's natural gas is produced in Sichuan Province, the other major producing areas in the Southwest being Yunnan Province and Guizhou Province. Gas is also produced by such large-scale oil fields as Daqing and Shengli.

As shown in Table VII, 83 per cent of the natural gas produced is consumed by industry, 15 per cent goes for nonproductive use (mainly city gas), and the consumption by agriculture and transportation is nearly zero. In industry, the chemical industry consumes one-third of the total, the bulk of it being used as raw material for ammonia synthesis plants introduced from abroad. It is reported that operational plants are not working to capacity due to a lack of raw materials. Following the chemical industry in consumption, thermal power plants take 25 per cent of the natural gas and the metallurgy industry 10 per cent. The demand in the chemical industry will expand further in the years to come, with about 5 billion m^3 being required in 1985.

As is the case with oil, natural gas reserves are also being exhausted at the present stage and production cannot be increased quickly. Thus increased demand in some sectors of industry would have to be handled by substitution of other energies.

IV. ELECTRICITY

A. *The Overall Situation*

1. *Power plants*

As of the end of 1980, there were 2,870 power plants with an installed capacity of over 500 kw in China. Of these, 1,530 are hydropower plants and 1,340 are thermal [22, 1981 edition, p. 252]. Plants with an installed capacity of 250 mw (megawatt) and above, classified as large-scale power plants in China, number seventy-four, of which fifty-six are thermal and eighteen are hydro. The total installed capacity of the large-scale power plants is 32,000 mw, nearly half the entire production capacity. The largest thermal plant is the Qinghe Power Plant in Liaoning Province, with an installed capacity of 1,100 mw, while the largest hydropower plant is the Liujiaxia Hydropower Plant generating 1,225 mw. There are also other large-scale power plants under construction, namely, the Second Datong Thermal Power Plant with a capacity of 1,200 mw and the Gezhouba Hydropower Plant with 2,715 mw.

There are altogether 210 medium-scale power plants with installed capacities of 25–250 mw for a total capacity of 19,420 mw. The combined total of 284 large- and medium-scale power plants thus comprise 10 per cent of the total number of significant power plants, but account for over 80 per cent of total electricity generating capacity. The remaining 90 per cent consists of approximately 2,000 small-scale power plants with installed capacities of 500–25,000 kw,

and a total capacity of 12,000 mw. The average capacity per plant is 6 mw.

Apart from the plants discussed above, there are approximately 90,000 small hydropower plants, but their total combined capacity is only about 7 gw (gigawatt). The average capacity per plant thus is 80 kw, but power plants with installed capacities of only several kw are included. It appears that these are controlled by authorities below the provincial level.

2. *Installed capacity*

Although there are several reports pertaining to installed capacity as of the end of 1980, which give figures ranging from about 59 to 66 gw, the appropriate figure is considered to be 62.94 gw, which is the aggregate for the individual provinces [22, 1981 edition, p. 252]. The total installed capacity of large hydropower plants of 5 gw or more is 16.87 gw [7, Sept. 11, 1981, p. 3], and that of small plants 6.93 gw [10, June 15, 1981, p. 1]. Thus hydropower plants of both categories have a capacity of 23.8 gw which comes to 38 per cent of total installed capacity. The thermal power plants have a capacity of 39.14 gw or 62 per cent.

Not all those plants are operating efficiently. Among the thermal plants, low- and medium-voltage plants account for 12 gw [13, Nov. 16, 1981, p. 5], and their generating efficiency is poor owing to obsolete facilities and a high rate of coal consumption. On the other hand, due to the electricity shortage, the thermal plants were operational for 5,956 hours in 1979 and 5,775 hours in 1980, 10 per cent longer than similar plants in Japan. Moreover, it is reported that the plants in Shanghai and Beijing operate for more than 7,000 hours.

Due to the occurrence of periods of water shortage, hydropower plant utilization averaged 3,112 hours in 1979 and 3,293 hours in 1980. Small hydropower plants of less than 500 kw, however, averaged only 1,833 hours.

The distribution of generating facilities by province was clarified for the first time recently. The province with the greatest installed capacity is Liaoning Province with 4.99 gw, followed by Sichuan with 3.73 gw and Hubei with 3.46 gw. There are seven provinces with a capacity of over 3 gw and another seven with 2–3 gw [22, 1981 edition, p. 252]. Generating capacity does not necessarily coincide with electricity production of course. The regions with many thermal power plants tend to produce more electricity. For example, the installed capacity of Zhejiang Province, which has many hydropower plants is 2.51 gw, with an production of 8,100 gwh (gigawatt hour). However, Shanxi Province which has many thermal power plants has an installed capacity of 2.38 gw which is less than that of Zhejiang Province, but the electricity production of 12,000 gwh is 50 per cent greater.[3]

3. *Production*

Electricity production showed the second highest energy growth rate following

[3] Calculated from the data derived from various sources including information aired by Zhejiang Broadcasting Station on September 28, 1980, and by Shanxi Broadcasting Station on January 14, 1980; also [22, 1981 edition, p. 252].

TABLE IX

ELECTRICITY PRODUCTION AND CAPACITY, 1949–81

	Production (Gwh)		Installed Capacity (Mw)			
	Total	Of Which Hydropower	Total	Thermal Power	Hydropower	Of Which Small-Scale Hydropower
1949	4,300	700	1,840	1,680	160	
1952	7,300	1,300	2,170	1,830	340	
1957	19,300	4,800	4,310	3,340	970	
1965	67,600	10,400				
1970	115,600	20,500				
1975	159,800	47,600				
1978	256,600	44,600	57,120	39,844	12,272	5,380
1979	282,000	50,100				6,330
1980	300,600	60,300	62,940	39,140	23,800	6,930
1981	309,300	65,550	67,817	46,704		

Sources: Compiled from [23] and Chinese official data.

oil. While both coal and oil production are faced with negative growth during the readjustment period, electricity production continues to grow every year even though the growth rate may be small (see Table IX).

Over three-quarters of the electricity produced in 1980 was produced by thermal power. Although hydropower accounts for more than one-third of installed capacity, hydropower represents less than a quarter of actual production. Thus it can be said that China's electricity production pattern is dominated by thermal electricity with hydropower subordinate.

4. *Power transmission lines*

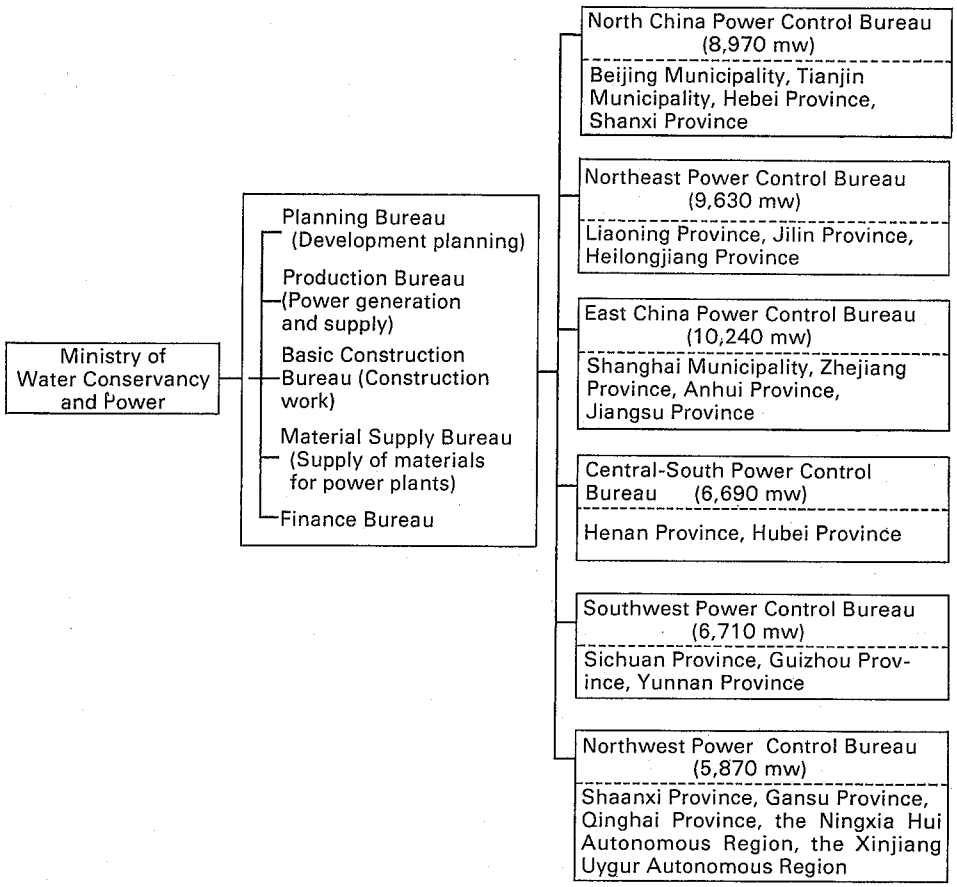
China has six electric control bureaus under the Ministry of Water Conservancy and Power which handle the supply of electricity in sixteen provinces, three municipalities, and two autonomous regions (see Figure 3). It appears that the remaining nine provinces and three autonomous regions manage electricity supply for themselves.

For the past several years, much emphasis has been placed upon the improvement and extension of power transmission lines. Such work has involved, for example, change from 110 kv (kilovolt) to 220 kv cables as well as the installation of new transmission lines of 220 kv and 500 kv.

As of 1979, there were thirty-two power grids handling more than 100 mw, of which twelve were over 1,000 mw. There were 61,000 km of 110 kv transmission line, 25,000 km of 220 kv, and 81 km of 330 kv. A 500 kv transmission line has subsequently been completed between Pingdingshan and Wuhan (600 km). There are 1,900,000 kva (kilovolt-ampere) worth of 330,000 v transformers, 63,000,000 kva worth of 220,000 v transformers, and 72,320,000 kva worth of 110,000 v transformers. China can now produce such large-scale transformers domestically.

Much emphasis has been placed upon the formation and expansion of power grids in the past year or two. The Northeast power grid was linked with the

Fig. 3. Organization Structure of the Power Industry



Source: [5].

Notes: 1. The figures for power generating capacity managed by each control bureau are for the end of 1980.

2. Provinces and autonomous regions not listed under the various control bureaus have their own electric power administrations.

Daqing grid (820 mw) to bring total capacity of 8,800 mw. A new power grid of 8,820 mw was created by linking Jinjintang and Shihan (6,400 mw combined) with Shanxi and a large-scale grid of 7,120 mw is on the way to completion linking the three provinces of Sichuan, Guizhou, and Yunnan. The objective behind this present trend is to increase the ability to transmit surplus electricity from favored regions to regions with an electricity shortage since production capacity cannot be increased abruptly. This is expected to provide an interim solution to electricity shortage in some regions.

B. *Consumption*

In the case of electricity, production more or less equals consumption. Table VII shows electricity consumption in China by sector. Industrial consumption, which amounts to 73 per cent, is overwhelmingly predominant (43 per cent in Japan). The electricity consumed by agriculture and for nonproductive purposes is low, amounting to less than 9 per cent and about 8 per cent, respectively. The loss of over 8 per cent is quite great.

The chemical industry uses the most electricity in industry with 17 per cent of the total industrial consumption. The major part of this is consumed by the chemical fertilizer plants and the soda industry which are of the high electricity consumption type. The chemical industry is followed by the metallurgy industry which consumes about 16 per cent, light industry with less than 13 per cent, and the machinery industry with 7 per cent. Because of obsolete facilities, efficiency is low on the whole, and thus it can be said that prospects for further energy conservation exist. Moreover, loss is also quite substantial. In fact, it seems that the 8 per cent figure only accounts for transmission loss, and it is said that were other losses to be included, loss would amount to over 15 per cent.

Consumption for nonproductive purposes is 23,200 gwh, which works out to a per capita consumption of 25 kw—less than one-thirtieth that of Japan. However, in view of the recent sudden increase in the production of household electric appliances such as television sets, washing machines, and refrigerators, which consume relatively large quantities of electricity, it may happen that these appliances alone will take up a large portion of the annual increase in electricity production as they become more prevalent.

C. *Development*

Of all China's energy problems, the electricity shortage is a particularly serious one as can be seen from various reports. For example, one article complains that "at present, 20 per cent of industrial production capacity is idle due to lack of electricity" [15, p. 14] and another says "there is a shortage in power generating capacity of nearly 10 gw" [13, May 9, 1981, p. 2].

In an attempt to remedy this situation, priority has been given to the power sector, the related capital construction expenditures amounting to 5,000 million yuan in 1978 and 5,100 million yuan in 1979, or 39 per cent and 42 per cent of all expenditures on energy (see Table IV). These expenditures exceeded those on coal and oil.

The bulk of these power sector expenditures have gone for the improvement and extension of hydropower facilities and transmission lines. The 1981 investment in transmission lines was boosted to 28.1 per cent from 22.3 per cent in 1980 and the investment in hydropower was raised from 48 per cent to 50 per cent, the investment in thermal power being decreased proportionately [13, Jan. 20, 1981, p. 1].

As far as installation growth is concerned, since it is reported that an invest-

ment of about 1,400 yuan is required to add 1 kw of hydropower generating capacity [13, May 3, 1982, p. 2], calculation shows that there was a potential annual buildup of 1,710 mw of hydropower generating capacity on the basis of the 1980 investment of 2,400 million yuan. As for thermal power, it is estimated that an investment of something over 600 yuan is required to add 1 kw of capacity [13, Nov. 16, 1981, p. 2], and consequently, an investment in thermal power generation of 1,500 million yuan should give an annual buildup of something under 2,500 mw, for a combined annual total (hydro plus thermal) of approximately 4,000 mw.

Since there is a limit to state investment capabilities, the Ministry of Water Conservancy and Power has requested that provinces with capital but lacking sufficient electricity invest in the construction of power plants. The ministry has already concluded deals with the provinces of Jiangsu, Hebei, Shandong, and Heilongjiang and with Shanghai Municipality for the installation of fourteen large-scale power generators (involving both new construction and enlargement). It has been reported that the capital accumulated in the various provinces for this purpose reached 875 million yuan [13, May 10, 1982, p. 2]. Indeed, in order to increase the power production as quickly as possible, all available measures, including the seeking of foreign cooperation, are to be applied.

D. *Demand Prospects*

Although the quickest solution to the present electricity shortage would be to invest intensively in the construction of thermal power plants with their cheap construction costs and short construction period, investment priority has been given to hydropower and the improvement of transmission lines. This is because the government hopes that the shortage can be managed through increased efficiency during the readjustment period. Priority is given to hydropower, even though it may be a somewhat roundabout way, because of the rewards that will accrue in the future. In the short-run, however, it appears likely that conditions will be especially severe in the near future.

As of the spring of 1981, large-scale power plants under construction induced about 10,000 mw worth of thermal generating capacity and about 9,400 mw worth of hydropower capacity [13, Feb. 27, 1981, p. 1]. Included among the thermal power plants are the Second Datong Power Plant (1,200 mw), the Hebei Qinghe Power Plant (800 mw), and the Henan Yaomeng Power Plant (an additional 600 mw to bring overall capacity to 1,200 mw). Most of these plants are being constructed near coal mines. Included among the hydropower installations are the Hubei Gezhouba Power Plant (of 2,715 mw, 340 mw to be completed by the end of 1981) and the Qinghai Longyangxia Power Plant (1,400 mw). It is estimated that over 8,000 mw worth of additional thermal power facilities and 4,000–6,000 mw of additional hydropower facilities will be completed by 1985. Moreover, since small- and medium-scale power plants are also being newly constructed and expanded, the total installed capacity may be in the vicinity of 75,000–80,000 mw at that time.

During this period, however, while some facilities may be renovated, others

TABLE X

DEMAND AND SUPPLY PROSPECTS BY ENERGY TYPE, 1985

	1979		1985 (Author's Estimate)	
	Production	Consumption	Production	Consumption
Coal (1,000 tons)	635,300	594,370	670,000–680,000	700,000
Oil (1,000 tons)	106,150	84,160	100,000	90,000–100,000
Natural gas (million m^3)	14,500	14,500	13,000–15,000	15,000 and over
Electricity (gwh)	282,000	282,000	370,000–380,000	
Total (1,000 tons of standard coal equivalent)	645,940	586,000	6,700,000–6,800,000	6,700,000–6,800,000

Source: From Chinese official data for 1979.

may cease to operate. All in all, although it is estimated that the production in 1985 may reach 380 gwh (70–80 gwh higher than 1980 production), this does not mean that the problem of electricity shortage will be solved.

V. OVERALL ENERGY PROSPECTS

The estimates of energy demand and supply for 1985 which have been discussed in the earlier sections by energy type are summarized in Table X. For energy production as a whole, it is estimated that there will be a production of 670–80 million tons of standard coal equivalent in 1985, which is no more than a 4–6 per cent increase over the figure for 1981. This low production forecast is in line with the government's intention to limit energy production as much as possible.

What, then, about demand? Three methods of estimation are being applied. One is to estimate demand based on macroeconomic relations. As for the correlation between energy and economic development, it has been reported that the elasticity of energy consumption with regard to gross domestic product for the period 1953 to 1978 was 1.22 [13, Aug. 17, 1981, p. 5], while with regard to gross industrial and agricultural production for the same period it was 1.33 [2, Dec. 7, 1979, p. 3]. Thus the growth rate of energy consumption exceeded that of economic development. In the past few years, however, the elasticity has been less than unity: while the growth rate of gross industrial and agricultural production was 8.5 per cent in 1979, 7.2 per cent in 1980, and 4.5 per cent in 1981, that of energy production was 3.0 per cent, −1.0 per cent, and −1.0 per cent, respectively. Hence, it is considered that the elasticities calculated on the basis of long-run macro data cannot be applied in forecasting.

Another method, which is also based on the macroeconomic relations, is to use the rate of energy consumption per unit of industrial and agricultural production. The growth target during the readjustment period appears to be set at 4–5 per cent, and should gross industrial and agricultural production increase

TABLE XI
ENERGY CONSUMPTION PROSPECTS BY SECTOR

	Coal (1,000 Tons)		Oil (1,000 Tons)		Natural Gas (Million m³)		Electricity (Gwh)	
	1979	1985	1979	1985	1979	1985	1979	1985
Industry	446,150		59,020		12,000		204,700	
Electricity	118,930	over 170,000	18,180	10,000	3,000	3,000	19,400	
Steel	70,000	70,000–80,000	5,170		1,200		46,300	
Chemicals	38,990	35,000–40,000	8,670	10,000	4,400	over 6,000	48,300	
Light industry	40,950	60,000	6,830	9,000–10,000	700		35,400	
Communications and transportation	26,090	30,000	8,430	10,000–11,000			1,300	
Agriculture	3,510	4,000	9,690	over 10,000			24,400	
Nonproductive purposes	106,000	130,000–150,000	4,090		2,200	3,000	23,200	
Loss	25,050	20,000	5,330	4,000	300		23,300	
Total (including loss)	619,420	700,000	89,490		14,500	over 15,000	282,000	370,000–380,000

Source: From Chinese official data for 1979.

at this rate, it would amount to 805.0 to 836.5 billion yuan in 1985 at 1970 prices. Energy consumption per one billion yuan of gross industrial and agricultural production was 1.0 million tons in 1978, 0.95 million tons in 1979, and 0.89 million tons in 1980 [22, 1981 edition, p. 249]. Assuming that this rate would be reduced to 0.85 million tons by 1985, overall energy demand would come to about 684–710 million tons at that time, a figure which would considerably exceed the production when the additional demand for nonproductive purposes and loss is taken into account. This does not necessarily mean, however, that the desired growth target is unattainable due to the big energy gap, since various energy conservation measures are being reinforced. In 1979, conserved energy amounted to 15 million tons of standard coal equivalent [13, Feb. 23, 1982, p. 1], in 1980, the figure rose to 35 million tons [13, Jan. 30, 1981, p. 1], and it was 24 million tons in 1981 [13, Feb. 23, 1982, p. 1].

The third method of estimation, which is more primitive than the former two, is to sum up the estimates for each energy type by sector, taking into consideration the various policies and measures for energy conservation (see Table XI). The estimate of consumption thus obtained is more or less balanced with the production estimate. This assumes that priority will continue to be given to light industry during the forecast period, as light industry consumes less than one-fifth of the energy required by heavy industry [13, Aug. 17, 1981, p. 5]. A fairly severe crisis would come, however, if heavy industry were again given priority: some energy industries could not achieve the predicted production level,

fuel conversion from oil to coal would end in failure, and industrial energy consumption could not be curtailed in order to improve the people's living standards. By way of conclusion, it can be said that the future energy situation depends to a very great extent upon how much more coal can be produced and utilized efficiently.

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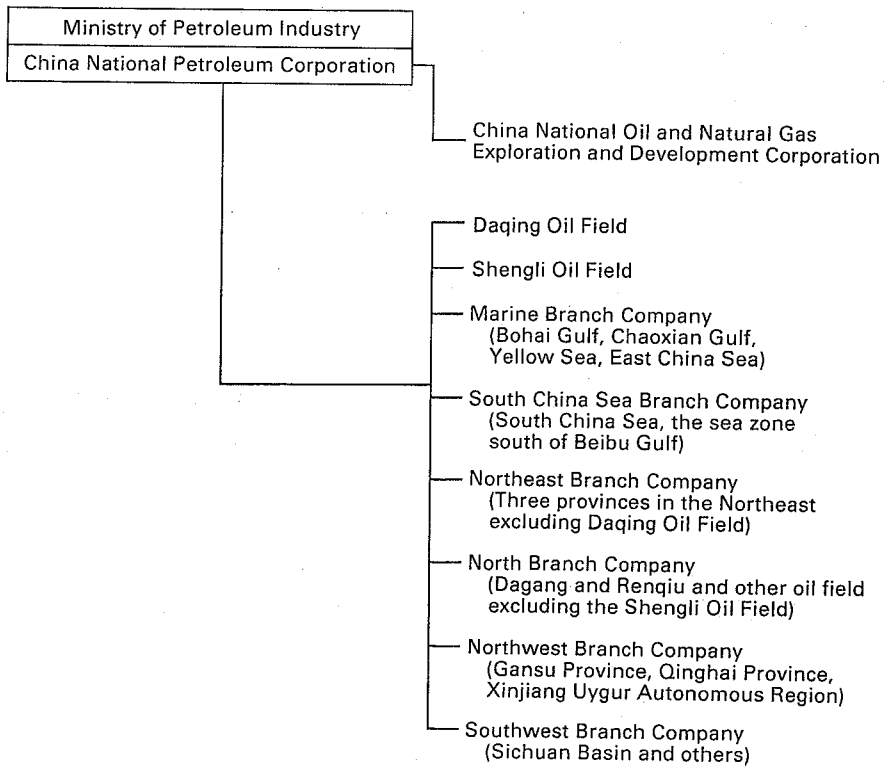
APPENDIX

Petroleum-Related Organizations



Source: [14].