

### **III. CHINESE FIVE IGCC EXPERTS DISCUSSION**

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## **1. Current Status and Prospects of China's Energy and Electricity Industry**

**Professor Zhou Fengqi, Director  
Energy Research Institute of PRC State Planning Commission  
Chinese Academy of Sciences  
Beijing, China**

### ***Energy Resources and Energy Production***

China has rich coal and hydropower resources.

Proved resources of coal in China amount to about 1 trillion tons, which accounts for more than 90 percent of the available conventional energy. Of this, 75 percent is bituminous, 12 percent is anthracite, and the balance, 13 percent, is lignite. 80 percent of Chinese coal lies in north and northwest China.

China has 379 gigawatts (GW) of exploitable hydropower resources, which ranks the first in the world, and most of this is in southwest, northwest and central China.

According to major reviews completed in 1993, China has 94 billion tons of total oil resources, and total natural gas resources of 38 trillion (T) cubic meters. Exploration for oil and gas in China is still at the beginning stage. Proven reserves are only a small part of the total, most of which are concentrated in the eastern region north of the Yangtze River.

The major biomass resources of China include three parts: Crop stalk which can be used as fuel; Firewood from the logical felling of different kinds of trees; human and animal manure and organic waste water. At present, the annual consumption of biomass resources is about 300 million tons of standard coal equivalent (Mtce).

In summary, China has abundant energy resources of comprehensive types, but it is unevenly distributed, and because of the large population, available energy per capita is small, and its use should be frugal.

Energy production in China has developed rapidly. During the period from 1949 to 1993, the output of raw coal increased from 32 million tons (Mt) to 1,149.7 Mt; that of crude oil increased from 120 thousand tons (Kt) to 145.2 Mt; natural gas grew from 7 million cubic meters to

16.95 billion (G) cubic meters; and electricity rose from 4.3 trillion watt-hours (TWh) to 839.5 TWh, of which hydropower rose from 0.7 TWh to 151.8 TWh. The total output of primary energy reached 1,112.63 Mtce, ranking the third in the world.

Chinese energy production for different years is shown in table 1. According to the data in the table, we can calculate the annual average growth rate of energy production, to be 9.1 percent.

### *The Current Status and Characteristics of Energy Consumption*

Table 2 shows China's total energy consumption, by type, for some selected years.

The table indicates that, from 1949, along with the increase of energy consumption, the primary energy consumption structure changed significantly, which changed from coal alone to a multi-energy structure comprising coal, oil, gas, hydropower, and etc. But we can predict that it is difficult to change the coal-dominated energy structure within a short period of time.

Table 3 shows the primary energy consumption and mix by sector in China. The table shows that industry is the major energy consumer. Since the 1980s, the fraction of energy consumption by industrial production hasn't decreased. On the contrary, it has continuously increased. Energy consumption by industrial production accounts for 70 percent in 1992. Within the industrial sector, energy consumption of chemistry, metallurgy and building material accounts for 45.8 percent.

Energy produced in China mainly supplies domestic consumption. Coal exports in 1993 were less than 2 percent of this year's output. Where China once exported great quantities of crude oil, it became a net oil importer in 1993.

Table 4 shows China's energy imports and exports from 1980 to 1993. The proportion of coal converted into secondary energy is small. In 1992, 1140 Mt of coal was consumed in China altogether, of which 43 percent was converted into secondary energy including 29.3 percent for electricity. The remaining 57 percent was used in industrial boilers, kilns, and residential cooking and heating. The huge amount of direct coal combustion led to serious air pollution.

People make use of biomass as their major residential energy in rural areas. 70 percent of residential energy in rural areas of China was derived from biomass in 1992, but during the 12 year period from 1980-1992, the annual growth rate of commercial energy was larger than 10

percent on average. Commercial energy consumption exceeded that of biomass in 1992.

### ***Future Energy Demand Forecast of China***

The method for energy demand forecast: LEAP (Long-Range Energy Alternatives Planning) model is used to help the energy demand forecast. 1990 is taken as the base year, and 2000, 2010, and 2020 are the planned target years. Six major sectors with 17 subsectors and 11 kinds of end use energy types are taken into consideration.

### **Assumptions for the Planned Indicators**

**Economic development:** It is projected that the GDP growth rate from 1990 to 2000 will average 9 percent per annum; from 2000 to 2010, 7.5 percent; and 6 percent per year for 2010 to 2020. The economic growth rate of the first, second and third industry and sectors are shown in table 5.

**Population:** It is projected that the annual average population growth rate will be 12.5 percent, 7.2 percent, and 4.2 percent during the periods of 1990-2000, 2000-2010, and 2010-2020, respectively. According to the projection, the population will be 1.294, 1.39 and 1.45 billion, respectively. Table 6 shows the details.

**Energy conservation rate:** It is assumed that the nationwide annual average energy conservation rate will be 4.49 percent, 4.42 percent, and 3.35 percent during the periods of 1990-2000, 2000-2010, and 2010-2020, respectively.

### **Results of the Energy Demand Forecast**

According to the end energy consumption and the assumptions outlined above, the LEAP model is used for energy demand forecasts of the target years. The results are presented in table 7. Table 8 shows the increase rate of China's end energy demand of China in target years. Tables 9 through 12 present the end use energy demand of China in target years by sector. From the results of energy demand forecasts we can conclude:

(1) The share of coal in end use will decrease from 33 percent in 1990 to about 20 percent in 2020;

(2) Electricity demand will rapidly increase. The share of electricity in end use will rise from 17.7

percent in 1990 to 35.5 percent in 2020;

(3) The demand for oil and gas will also increase considerably. The share of oil and gas will increase from 13 percent in 1990 to 22.4 percent in 2020.

### ***Forecast for Future Electricity Production of China***

The total installed capacity of electric power of China was 137.89 GW in 1990, of which hydro power was 36.05 GW, accounting for 26.1 percent; Electricity generation reached 621.62 TWh, of which hydro power amounted to 126.47 TWh, accounting for 20.34 percent.

In 1990, the fuel consumption for thermal power stations was 202.18 Mtce, of which, 94.4 percent came from coal, and only 5.65 percent came from fuel oil and gas. The average energy consumption for electricity generation was 392 gram standard coal equivalent/kilowatt-hour (gce/kWh), while generation gross efficiency was 31.4 percent. The average unit consumption for thermal power stations was 427 gce/kWh at the consumer's end, and electricity supply net efficiency was 28.8 percent. The main reasons for high unit consumption are: most of the existing thermal power plants are fueled by coal, while most of these coal-fired plants utilize technologies and equipment typical of the 1950s and 1960s. Only a few of these plants utilize modern, highly efficient technologies. At the end of 1990, the Chinese generating plants of greater than 125 MW capacity that operated at higher pressures and efficiencies constituted only 47 percent of the total installed thermal generating capacity. At present, operating small capacity units of medium and low pressure account for 26 percent of the installed thermal power capacity. The larger Chinese thermal power generation plants are less efficient than those in more advanced countries by an average of 10 percent and normally cannot reach their nominal design output in terms of electricity production. Generally, auxiliary equipment efficiency also is lower and thus the internal electricity consumption is higher, at 8.22 percent in 1990, than more advanced plants by 30-50 percent.

According to experts' forecasts, tables 13 and 14 present the development trend of China's electric power industry. What should be indicated is that this forecast is based on a low rate of increase. During the 30 years' period of 1990-2020, the annual average rate of increase in installed capacity for thermal power generation will be 5.55 percent, while during the 1990s, it will be 8 percent.

### ***Forecast for Primary Energy Supply***

According to the forecast results of end use energy demand, and considering the consumption arising from energy production, transportation and distribution, the primary energy demand can be derived. After considering domestic output and import, we can get the scenarios for primary energy supply, which are shown in table 15.

Table 15 shows that the primary commercial energy demand in 2000, 2010, and 2020 will be about 1.5, 2.0, and 2.5 billion tons of standard coal equivalent (Gtce) respectively; Coal demand will be 1.5, 2.0, and 2.5 Gt respectively; Crude oil demand will be 0.2, 0.28, and 0.35 Gt; and Natural gas demand will be 30, 60, and 120 billion (G) cubic meters. The share of coal in primary energy will decrease by 10 percent during the 30 year period, and the share of natural gas, hydro power, and nuclear power will increase gradually.

### ***Challenges in China Energy Development***

China's modernization faces huge pressure in terms of population, available resources and the environment. Energy is closely related to the three restricting factors.

At first, population is too high. As of February 1995, China's population had reached 1.2 billion. More than half of the population's education level was limited to primary school or even lower. Excess population and low educational levels are the long term and most important restricting factor in resolving China's energy problems. At present, China's primary energy consumption has ranked second in the world, but the per-capita figure is very low. The per-capita commercial energy consumption was 1,024 kilograms of standard coal equivalent (kgce) in 1994, which was only 50 percent of the world average. Household per-capita electricity consumption was 73 kWh, only equivalent to 2.2 percent of the American figure. Moreover, up to now, there are still 100 million people in China who have no access to electricity

Second, per-capita energy resources are insufficient. China has an abundance of many kinds of energy resources, but, on a per-capita basis, this is relatively insufficient. The total coal resources amount to 4,000 Gt in the 1,500 meter depth range, but under the current technological and economic conditions, the recoverable reserves only amount to 114.5 Gt. The per-capita figure is only equivalent to half of the world average. According to data from "1995 World Energy Statistic Review," which was completed by British Petroleum Corporation, by the end of 1994 the undeveloped demonstrated reserves of petroleum amounted to 3.3 Gt, making the per-capita

amount only 2.75 tons, equivalent to only 11 percent of the world average. Relatively insufficient per-capita energy resources, especially petroleum, is an important restricting factor for society and economic development of China.

Third, the ecological environment is deteriorating. The major energy and environment problems of China are atmospheric pollution in the cities, caused by great quantities of coal combustion and ecological damage caused by over consumption of biomass in rural areas.

China is one of few countries in which coal plays so large a role in the energy mix. It is also the largest coal consumer in the world. China's coal consumption in 1994 amounted to 26.6 percent of the world's coal consumption. Nationwide (not including town and village enterprises), SO<sub>2</sub> emissions amounted to 18.25 Mt and total suspended particulates (TSP) emissions amounted to 14.14 Mt. Compared to 1990, this represents increases of 12.2 percent and 6.8 percent respectively. Of this, it was estimated that 90 percent and 70 percent, respectively, was due to coal combustion. Because the controls on SO<sub>2</sub> emissions lack strength at present, it is estimated by experts that acid rain happens in one third area of China's national land area. The economic damages which are caused by SO<sub>2</sub> and acid rain pollution from 1 ton of coal combustion in some cities reaches 50-70 yuan RMB.

Additionally, as greenhouse gas emissions from China have been ranked third in the world, it is also necessary to adopt some measures for controlling the rapid increase of CO<sub>2</sub> emissions.

### *Energy Policies for Sustainable Development*

#### **Integrated Energy Planning and Management**

To establish an energy supply system and consumption model which can adapt to economic development and environmental requirements, it is necessary to undertake integrated planning for energy, environment and economic development, which can be used as the proof of planning, policy, measures and management. It is advantageous to comprehensively analyze, study and solve the cross-problems in the fields of energy, the environment and the economy, to coordinate correlations, so as to realize the comprehensive coordination and balance among energy, the environment and economic development.

The goal of integrated energy planning and management is to establish a set of methods for integrated planning in the areas of energy, the environment and the economy which can be

appropriate to China's situation and the requirements of the socialist market economic mechanism, disseminate and apply it to different levels of energy management departments. National and local energy, the environment, and economic integrated planning and corresponding implementation scenarios will be developed before 2000.

Before the end of this century, China's strategies and policies can be summarized as follows: Equal focusing given to energy exploitation and conservation, and give priority to energy conservation; improvement of energy mix and distribution; As for energy industrial development, taking electric power as the center, taking coal as the base, energetically developing hydro power, positively exploiting petroleum and natural gas, moderately developing nuclear power, suiting measures to localities, developing new energy and renewable energy, depending on scientific and technological improvement, raising energy efficiency, reasonably using energy resources, and reducing environmental pollution.

### **Raising Energy Efficiency and Energy Conservation**

Along with the rapid economic development and population increase, the contradiction that the energy supply is unable to meet the demand will exist in a long term, the gap between high quality energy supply and demand will enlarge day by day, so Chinese economic development pattern should change from extensive operation to intensive operation, and begin to focus on efficiency. On the other hand, energy conservation is also an economic and efficient measure for preventing pollution, and limiting the production of so-called greenhouse gases.

Currently, energy consumption per unit production value in China is equivalent to 3-4 times that of developed countries, the energy consumption per unit production of major products is higher than that in developed countries by 40 percent on average. China's average energy utilization rate is only about 30 percent, compared with more than 40 percent in developed industrial countries. Therefore, China has great direct energy conservation potential.

Not all of the industrial structure of China is reasonable. The percentage of the service industry which has low energy consumption is small, while the share with intensive energy consumption is large, which accounts for 51.8 percent, there is only a small number of enterprises of moderate scale. Along with the adjustment and optimization of industrial structure, product structure and energy mix, energy distribution will become sound. The potential for indirect energy conservation is larger than that for direct energy conservation. The objective for energy saving is that the energy conservation rate should be higher than 4 percent before the year 2000. The energy



consumption elasticity coefficient should be less than 0.5, i.e., more than half of an energy demand increase will be met by energy conservation. To achieve the targets mentioned above, it is necessary to include the work of energy conservation in national economic and society development planning, institute and implement an "Energy Conservation Law," gradually cancel the unreasonable financial subsidy for energy, and further rationalize energy pricing.

### **Dissemination of Clean Coal Technology**

Deployment of clean coal technology is a component of the strategy for accelerating the change of the coal-dominated energy system to a sustainable model with no environmental damage. The Chinese government is planning to prepare a clean coal technology development plan, and put it into national economic and society development planning. Meanwhile, China will promote clean coal utilization by instituting a series of policies, laws, regulations and economic strategies.

Study cleaning, separation and desulfurization technologies for high sulfur coal, dry separation technologies, increase the percentage of raw coal to be washed. Increase the production of residential and industrial briquettes, increase the share of quality coal for power plants, study and develop biomass briquetting which has high efficiency and little pollution, develop or introduce large scale circulating fluidized bed (CFB) combustion technologies, develop or introduce coal/water slurry combustion technologies, develop or introduce coal gasification and integrated (coal) gasification combined-cycle (IGCC) electricity generation technologies, study and develop high efficiency combustion, and technologies to utilize peat, anthracite and lignite.

The aim will be to raise the share of coal which is converted into clean secondary energy such as electricity, heat and coal gas etc., and reduce the end use of coal which is directly or separately burned.

Develop and introduce advanced and high efficiency flue gas clean technologies, focused upon development of technologies and equipment for flue gas dust removal, desulfurization, denitration and waste reuse which are suitable to China's national situation.

### **Development and Utilization of New Energy and Renewable Energy**

Renewable energy doesn't produce, or produces little pollution. Therefore, renewable energy is the base of the future sustainable energy mix.

China has rich renewable energy resources, and there is great potential for further development and utilization. By the year 1993, the exploited hydro power was only 11.8 percent of the total, the exploited wind power is 0.002 percent, and the exploited geothermal power is 0.01 percent. Solar energy and biomass energy resources utilization also have a good prospects.

To increase the use of renewable energy and make it able to compete with fossil fuel, it is necessary to increase investment and policy support, develop technologies, and reduce cost. The target is that the total utilization of renewable energy should amount to 298 Mtce and 390 Mtce by the years 2000 and 2010, respectively.

Table 1. Energy Production in China 1949-1993

Year	Total (Mtce)	Coal (Mt)	Oil (Mt)	Natural Gas (Gm <sup>3</sup> )	Electricity Generation (TWh)	
					Total	Hydropower
1949	23.71	32.0	0.12	0.007	4.3	0.7
1952	48.71	66.0	0.44	0.008	7.3	1.3
1957	98.61	131.0	1.46	0.07	19.3	4.8
1962	171.85	220.0	5.75	1.21	45.8	9.0
1965	188.24	232.0	11.31	1.10	67.6	10.4
1970	309.90	354.0	30.65	2.87	115.9	20.5
1975	487.54	482.0	77.06	8.85	195.8	47.6
1980	637.35	620.0	105.95	14.27	300.6	58.2
1985	855.46	872.0	124.90	12.93	410.7	92.4
1990	1039.22	1080.0	138.31	15.30	621.2	126.7
1993	1112.63	1149.7	145.20	16.95	839.5	151.8

Source: China Statistic Yearbook 1994

Table 2. Primary Energy Consumption Mix in China 1953-1993

Year	Total (Mtce)	Energy Consumption Mix (%)			
		Coal	Oil	Natural Gas	Hydropower
1953	54.11	94.33	3.81	0.02	1.84
1957	96.11	92.32	4.59	0.08	3.01
1962	165.40	89.23	6.61	0.93	3.23
1965	189.01	86.45	10.27	0.63	2.65
1970	292.91	80.89	14.67	0.92	3.52
1975	454.25	71.85	21.07	2.51	4.57
1980	602.75	72.15	20.76	3.10	3.99
1985	770.20	75.92	17.02	2.23	4.83
1990	987.03	76.20	16.60	2.10	5.10
1993	1117.68	72.80	19.60	2.00	5.60

Source: China Statistic Yearbook 1994

Table 3. Primary Energy Consumption by Sector and Mix

	1980		1990		1992	
	Mtce	%	Mtce	%	Mtce	%
Total End Energy Consumption	602.75	100	987.03	100	1,091.70	100
1. Production Sectors	480.55	79.7	794.30	80.47	891.73	81.68
A. Agriculture	46.92	7.8	48.52	4.92	50.20	4.60
B. Industry	389.86	64.7	675.78	68.47	762.79	69.87
a. Heavy Industry	322.14	53.4	538.60	54.57	606.28	55.53
b. Light Industry	67.72	11.2	137.19	13.90	156.51	14.34
C. Construction	9.57	1.6	12.13	1.23	13.92	1.28
D. Transportation & Communication	29.02	4.8	45.41	4.60	50.58	4.63
E. Commercial	5.18	0.9	12.47	1.26	14.24	1.30
2. Non-Production Sectors	12.05	2.0	34.73	3.52	43.61	4.00
3. Household	110.15	18.3	158.00	16.01	156.36	14.32

Source: China Statistic Yearbook 1994, 1991

Table 4. Energy Export and Import in China 1980-1993

Unit: Mt

		1980	1985	1990	1991	1992	1993
Crude Oil	Export	13.31	30.03	23.99	22.60	21.51	19.43
	Import	0.37		2.92	5.97	11.36	15.65
Oil Products	Export	4.20	6.21	6.33	6.82	5.98	4.56
	Import	0.46	0.90	3.94	5.91	7.78	17.54
Coal	Export	6.32	7.77	17.29	20.10	20.19	19.81
	Import	1.99	2.31	2.00	1.37	2.00	

Source: China Energy Annual Review 1994

Table 5. China Economic Development Scenarios by Sector

Unit: Output: 100 million yuan; Share: %; Growth rate: %

	1990		2000			2010			2020		
	Output	Share	Output	Share	Growth Rate	Output	Share	Growth Rate	Output	Share	Growth Rate
Nationwide	17,676	100	41,846	100	9	86,246	100	7.5	154,453	100	6
The first industry	5,024	28.4	7,700	18.4	4.36	10,522	12.2	3.17	13,437	8.70	2.48
The second industry	7,829	44.3	18,878	45.16	9.2	37,394	43.36	7.07	63,324	41.0	5.41
The third industry	4,818	27.3	15,170	36.3	12.15	38,385	44.44	9.73	77,711	50.3	7.31
Agriculture	5,024	28.4	7,700	18.4	4.6	10,522	12.20	3.17	13,437	8.70	2.48
Industry	6,981	39.5	16,679	39.90	9.10	32,859	38.10	7.0	55,140	35.70	5.3
Construction	848	4.80	2,199	5.26	10.00	4,534	5.26	7.5	8,124	5.26	6.0
Transportation	956	5.41	2,480	5.93	10.00	5,114	5.93	7.5	9,174	5.94	6.0
Commercial	944	5.34	2,958	7.07	12.10	7,596	8.81	10	15,560	10.10	7.4
Non-material	2,918	16.5	9,732	23.30	12.80	25,678	29.80	10	52,977	34.30	7.5

Table 6. China Population Increase Scenarios

Unit: Population: 100 million; Share: %; Growth rate: %

	1990		2000			2010			2020		
	Popula- tion	Share	Popula- tion	Share	Growth Rate	Popula- tion	Share	Growth Rate	Popula- tion	Share	Growth Rate
Nationwide	11.43	100.0	12.94	100.0	12.5	13.90	100.0	7.2	14.5	100.0	4.2
City	3.02	26.4	4.06	31.4		5.20	37.4		6.5	44.8	
Rural	8.41	73.6	8.88	68.6		8.70	62.6		8.0	55.2	
Persons/ Household	4.20		3.86			3.61			3.37		

Table 7. Forecast Results: Final Energy Demand and Mix

Type	Unit	1990		2000		2010		2020	
		Demand	Share (%)	Demand	Share (%)	Demand	Share (%)	Demand	Share (%)
Coal	Mt	530.98	33.04	632.76	27.85	771.59	24.00	715.71	19.97
Crude Oil	Mt	3.87	0.48	2.32	0.20	2.81	0.19	3.09	0.17
Natural Gas	100 Mm <sup>3</sup>	147.89	1.71	268.20	2.20	537.74	3.38	995.19	5.17
Electricity	100 GWh	5182.40	17.70	11232.50	24.92	19413.94	30.26	28246.88	35.30
Oil Products	Mt	88.11	11.29	157.16	14.25	229.67	15.95	299.84	17.23
Biomass	Mtce	264.97	23.08	264.40	16.29	254.32	12.01	220.76	8.62
Others	Mtce	145.74	12.70	231.64	14.28	300.72	14.20	346.51	13.53
Total	Mtce	1147.98	100.00	1622.63	100.00	2117.46	100.00	2560.36	100.00

Table 8. Annual Increase Rate of End-Energy Demand

Unit: %

	1990-2000	2000-2010	2010-2020
Coal	1.77	1.18	0.06
Crude Oil	-4.97	1.93	0.95
Natural Gas	6.13	7.20	6.35
Electricity	7.13	4.71	3.50
Oil Products	5.96	3.87	2.70
Biomass	-0.02	-0.38	-1.40
Others	4.74	2.64	1.43
Total	3.52	2.70	1.92

Table 9. End-Energy Consumption and Mix by Sector in China 1990

	Household		Agriculture		Industry		Transportation		Construction		Service		Total	
	Mtce	%	Mtce	%	Mtce	%	Mtce	%	Mtce	%	Mtce	%	Mtce	%
Coal	93.13	24.56	14.93	3.94	237.35	62.58	10.01	2.64	3.40	0.90	20.45	5.39	379.27	100
Crude Oil	0	0	0	0	4.75	86.00	0	0	0.77	14.00	0	0	5.53	100
Natural Gas	2.47	12.58	0	0	15.63	79.45	0	0	1.41	7.16	0.16	0.81	19.67	100
Electricity	18.87	9.29	16.68	8.21	152.33	74.98	2.09	1.03	2.26	1.11	10.92	5.38	203.15	100
Oil Products	4.26	3.28	11.83	9.12	59.78	46.11	49.36	38.07	1.96	1.51	2.47	1.91	129.65	100
Biomass	264.97	100	0	0	0	0	0	0	0	0	0	0	264.97	100
Others	32.51	22.31	0	0	111.69	76.64	0	0	0	0	1.54	1.06	145.74	100
Total	416.21	36.26	43.44	3.78	581.53	50.66	61.46	5.35	9.80	0.85	35.54	3.10	1147.98	100

Table 10. Forecast on End-Energy Consumption and Mix by Sector 2000

	Household		Agriculture		Industry		Transportation		Construction		Service		Total	
	Mtce	%	Mtce	%	Mtce	%	Mtce	%	Mtce	%	Mtce	%	Mtce	%
Coal	89.28	19.75	16.29	3.61	308.29	68.21	7.28	1.61	3.54	0.78	27.29	6.04	451.9	100
Crude Oil	0	0	0	0	3.32	100	0	0	0	0	0	0	3.32	100
Natural Gas	9.45	26.49	0	0	24.0	67.27	0	0	1.64	4.59	0.59	1.65	35.67	100
Electricity	50.45	12.48	20.68	5.11	288.62	71.38	5.71	1.41	5.07	1.25	33.83	8.37	404.37	100
Oil Products	9.40	4.07	14.42	6.24	98.53	42.61	99.69	43.11	3.04	1.31	6.18	2.67	231.25	100
Biomass	264.40	100	0	0	0	0	0	0	0	0	0	0	264.40	100
Others	64.89	28.01	0	0	162.50	70.15	0	0	0	0	4.25	1.83	231.64	100
Total	487.88	30.07	51.39	3.17	885.26	54.56	112.68	6.94	13.29	0.82	72.13	4.45	1622.63	100

Table 11. Forecast on End-Energy Consumption and Mix by Sector 2010

	Household		Agriculture		Industry		Transportation		Construction		Service		Total	
	Mtce	%	Mtce	%	Mtce	%	Mtce	%	Mtce	%	Mtce	%	Mtce	%
Coal	93.27	18.35	17.27	3.40	351.85	69.22	4.15	0.82	4.03	0.79	37.72	7.42	508.28	100
Crude Oil	0	0	0	0	4.02	100	0	0	0	0	0	0	4.02	100
Natural Gas	32.15	44.96	0	0	35.11	49.09	0	0	2.58	3.60	1.68	2.35	71.52	100
Electricity	90.55	14.13	25.41	3.97	421.36	65.77	11.69	1.82	8.84	1.38	82.81	12.93	640.66	100
Oil Products	13.91	4.12	19.80	5.86	117.78	34.85	172.87	51.15	3.75	1.11	9.83	2.91	337.94	100
Biomass	254.32	100	0	0	0	0	0	0	0	0	0	0	254.32	100
Others	87.09	28.96	0	0	203.99	67.84	0	0	0	0	9.63	3.20	300.72	100
Total	571.30	26.98	62.49	2.95	1134.11	53.56	188.71	8.91	19.19	0.91	141.67	6.69	2117.46	100

Table 12. Forecast on End-Energy Consumption and Mix by Sector 2020

	Household		Agriculture		Industry		Transportation		Construction		Service		Total	
	Mtce	%	Mtce	%	Mtce	%	Mtce	%	Mtce	%	Mtce	%	Mtce	%
Coal	99.82	19.53	18.07	3.53	336.91	65.90	0	0	4.13	0.81	52.31	10.23	511.22	100
Crude Oil	0	0	0	0	4.42	100	0	0	0	0	0	0	4.42	100
Natural Gas	84.38	63.75	0	0	40.48	30.58	0	0	3.85	2.91	3.66	2.76	132.36	100
Electricity	128.74	14.24	31.61	3.50	543.35	60.11	21.83	2.42	13.73	1.52	164.64	18.21	903.90	100
Oil Products	18.72	4.24	24.54	5.56	123.91	28.09	255.21	57.85	3.84	0.87	14.95	3.39	441.18	100
Biomass	220.76	100	0	0	0	0	0	0	0	0	0	0	220.76	100
Others	108.79	31.40	0	0	222.65	64.25	0	0	0	0	15.07	4.35	346.51	100
Total	661.21	25.83	74.22	2.90	1271.72	49.67	277.05	10.82	25.54	1.00	250.62	9.79	2560.36	100

Table 13. The Development Trend of Installed Capacity of China Electric Power Industry

Electricity Generation Mode	1990		2000		2010		2020	
	MW	%	MW	%	MW	%	MW	%
Thermal power	101820	73.86	220200	75.79	374650	76.39	514850	73.55
Hydro power	36040	26.14	66500	22.89	100000	20.39	138000	19.71
Nuclear energy	0	-	2700	0.93	10700	2.18	32000	4.57
Wind energy	10	-	1000	0.34	4000	0.82	10000	1.43
Geothermal energy	21	-	60	0.02	100	0.02	150	0.02
Solar energy	0.26	-	80	0.03	1000	0.20	5000	0.71
Total	137891	100.00	290540	100.00	490450	100.00	70000	100.00

Table 14. Forecast on Electricity Generation of China Electric Power Industry

Electricity Generation Mode	1990		2000		2010		2020	
	TWh	%	TWh	%	TWh	%	TWh	%
Thermal power	495.05	79.64	1044.53	78.48	1788.72	78.81	2447.56	75.51
Hydro power	126.47	20.34	266.36	20.01	400.54	17.65	552.75	17.05
Nuclear energy	-	-	17.56	1.32	69.59	3.07	208.11	6.42
Wind energy	-	-	2.00	0.15	7.99	0.35	19.98	0.62
Geothermal energy	0.1	0.02	0.23	0.02	0.38	0.02	0.56	0.02
Solar energy	-	-	0.20	0.02	2.50	0.10	12.49	0.38
Total	621.62	100.00	1330.88	100.00	2269.72	100.00	3241.45	100.00



Table 15. Primary Energy Supply (1990 – 2020)

	Unit	1990		2000		2010		2020	
		Supply amount	Share %	Supply amount	Share %	Supply amount	Share %	Supply amount	Share %
Commercial Energy	Mtce	1041.92	79.54	1505.45	84.79	2045.58	88.62	2544.86	91.61
Coal	100 Mt Mtce	10.83 773.58	74.25	15.00 1072.45	71.23	19.63 1401.84	68.53	22.77 1626.23	63.91
Petroleum	Output	100 Mt Mtce	1.38 197.69		1.65 235.79		2.00 285.80		2.21 314.38
	Import	100 Mt Mtce	0 0		0.38 54.14		0.84 119.47		1.34 191.59
	Supply	100 Mt Mtce	1.38 197.69	18.97	2.03 289.93	19.26	2.84 405.27	19.81	3.55 505.97
Natural gas	Output	100 Mm <sup>3</sup> Mtce	157.74 20.98		300.15 39.92		499.25 66.40		798.80 106.24
	Import	100 Mm <sup>3</sup> Mtce	0 0		0 0		99.55 13.24		393.76 52.37
	Supply	100 Mm <sup>3</sup> Mtce	157.74 20.98	2.01	300.15 39.92	2.65	598.80 79.64	3.89	1192.56 158.61
Hydro power	100 GWh Mtce	1266.00 49.63	4.76	2665.28 95.95	6.37	4007.88 132.26	6.47	5525.63 176.82	6.95
Nuclear Power	100 GWh Mtce	0 0		175.83 6.33	0.42	696.36 22.98	1.12	2080.31 66.57	2.61
Wind, geothermal & solar energy	100 GWh Mtce	1.02 0.04		24.17 0.87	0.06	108.79 3.59	0.18	330.31 10.57	0.42
Sum	Mtce	1041.92	100.00	1505.45	100.00	2045.58	100.00	2544.86	100.00
Non-commercial energy (biomass)	Mtce	268.07	20.46	270.09	15.21	262.57	11.38	233.01	8.39
Total	Mtce	1309.99	100.00	1775.54	100.00	2308.15	100.00	2777.87	100.00