ELECTRIC POWER IN CHINA 2004

CHINA ELECTRIC POWER INFORMATION CENTER

Contents

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Writers

Jiang Shaojun, Wang Zhixuan

Hu Zhaoguang, Liu Chunsheng

Wang Changhai, Xu Jintao

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Survey on Power Industry

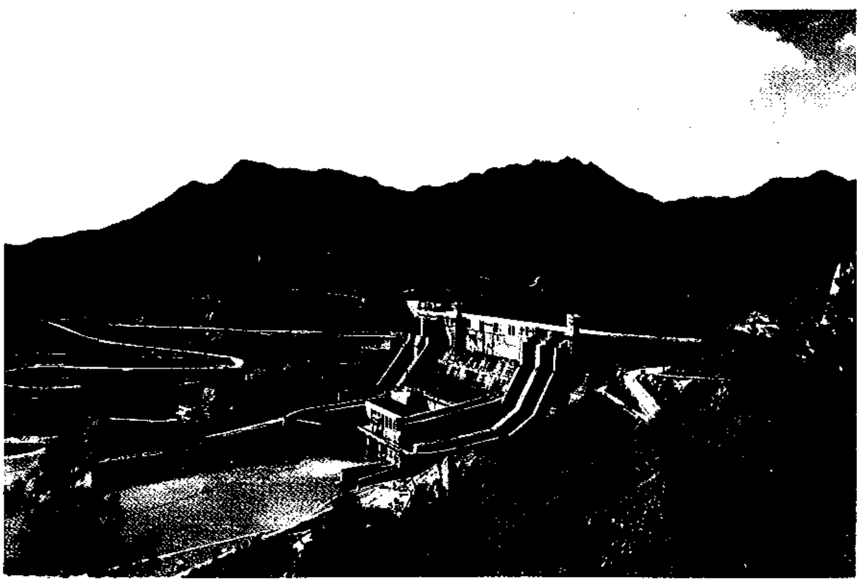
2003 was the first year after implementing the *Program of Power Institutional Reform* put forth by the State Council, with the separation of power plants from power grids and reorganization of the state-owned power assets basically completed. Under the correct leadership of CPC Central Government and the State Council, the power institutional reform progressed smoothly and power systems operated stably.

■ Power institutional reform

The State Electricity Regulatory Commission (SERC), being an institutional unit affiliated under the State Council, was formally established and started to perform functions since March 20, 2003. In the meantime, the Office of State Power Institutional Reform was transferred from the former State Development Planning Commission to SERC, and the latter has taken over the responsibility for the routine of power institutional reform.

Along with the establishment of North China Grid Company Ltd. on November 8, 2003, five regional grid companies affiliated to the State Grid Corporation had all been organized, which included North China, Northeast China, East China, Central China and Northwest China. The main responsibilities of the regional grid companies are to operate and manage power grid in respective region and power sources kept by the grid companies for peak and frequency regulation and emergency power reserves, to ensure power security, to make grid development planning in the region, to cultivate regional power market, to optimize regional power resources disposition, to manage regional power dispatching and trade center, and to dispatch regional power grid as a whole. In 2003, about five hundred power plants affiliated to the former State Power Corporation were assigned respectively to relevant power generation groups. With the separation of power plants from power grids basically completed, it had laid a sound foundation for further deepening the reform of bidding for access to grid.

The successful separation of the central power



Baozhusi Hydropower Station (700 MW), Sichuan Province enterprise's main business from side business had opened good prospects of further transformation of power operational mechanism. The North China Electric Power University originally affiliated to the former State Power Corporation had been transferred to the Ministry of Education and jointly financially supported by the newly established two large power grid corporations and five power generation groups.

Power market development

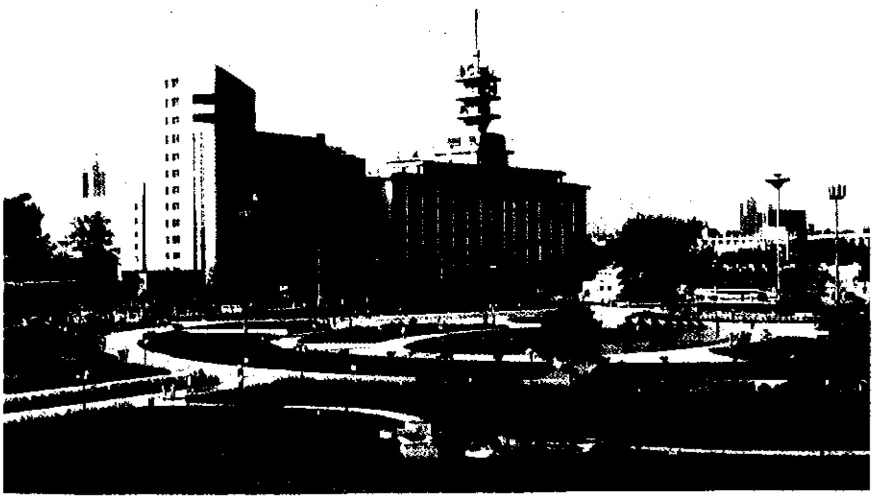
To normalize and ensure a unified, open, competitive and orderly power market, SERC worked out and issued *Regulation over Power Market (Tentative)* and *Basic Rules on Power Market Operation (Tentative)* and other regulations. SERC also put forth the *Instruction on Establishing Northeast China Regional Power Market* and *Notice on Launching East China Power Market Demonstrative Project*. The demonstrative projects for these two regional power markets had all been initiated.

Power tariff reform

In July 2003, the State Council issued *Power Tariff Reform Program* (GBF[2003] Document No. 62), on which a basic ideology of power tariff reform for setting up a clear and hierarchical power tariff system and corresponding pricing mechanism was put forward on the basis of steady progress of power institutional and market reform, in the meantime, the normalized, transparent and efficient power tariff supervision system would be built up. The Program involves five aspects, namely price separation for power plant and power grid, electricity price to grid, transmission and distribution prices, retail price and power tariff managing system. Along with implementation of bidding for access to grid, the newly built and existing nuclear power having appropriate conditions will also participate in market competition, besides conventional hydro and thermal power. The wind power, geothermal power and other new energy and renewable energy enterprises will temporarily be free from market competition, but their electricity generated shall be purchased prior by the power grids on government quoted price or bidding price. Competitive market for new energy and renewable energy will be set up when conditions matured. An independent transmission and distribution pricing system adaptable to the business will also be set up. The reform of retail price shall aim at enabling all consumers having rights to freely select their power suppliers and the price to be regulated by market.

Power security

The vast areas blackout fault happened in the United States and Canada in August 2003 have alerted



Henan Electric Power Test and Research Institute us to keep power system secure in China. In addition, the separation of power plants from power grids has brought about new hidden worriment. The CPC Central Government and the State Council have highly stressed power security and set forth successively a series of important instructions. For example, the State Council Administrative Office issued the *Notice on Strengthening Power Security* on December 5, 2003, to call for consolidating power security. The State Administration of Safe Production Supervision was authorized to take the responsibility for comprehensive management of power security operation and SERC was assigned to be responsible specifically for supervision management of power safety operation, while power enterprises shall act as the main competent body for safety operation.

Pursuant to the requirement of the State Council, SERC held meetings to discuss specifically the problems of power security supervision and issued notice to put forward specific requirements on power security. China Electricity Council held successfully the "China Power Forum 2003" in Shanghai in September, to discuss emphatically problems of ensuring power security, building up power grid contingent mechanism and safeguarding power supply. Under closely coordinated between power enterprises and public security departments, fighting actively against theft and destroying power equipment and electricity stealing had achieved remarkable progress.

Power supply management

In 2003, power reliability management was built even harder towards systematization and standardization, and played an important role in ensuring safe and stable operation of power grids and improving power supply quality.

The nationwide power shortage situation became even severe in 2003. Facing this stern power supply/demand situation, the State Council Administrative

Office issued the *Notice of Strengthening Earnestly Power Supply Management* on April 21, which called for all departments under the State Council, local governments and power enterprises to strengthen leaderships, make concerted efforts, take effective measures to alleviate power supply shortage, and ensure passing safely through the peak demand period. The government related departments had pushed forward actively the demand side management (DSM), strongly advocated electricity saving ideology, and insisted on the way of new type industrialization with low energy consumption and high output.

Power production and construction

Driven by sustained rapid growth of national economy, both electricity generation and consumption in China had the tendency of parallel rapid increase in 2003, a year with fastest growth rate since open and reform policy. In this year, the national electricity generation amounted to 1905.2 TWh, or 15.17% higher than the previous year; and the electricity consumption of the whole society amounted to 1889.1 TWh, or 15.29%

higher than the previous year. The nationwide power shortage situation, however, became more and more severe, twenty-two provinces (autonomous regions, municipalities) suffered from load curtailments, in which, the most severe regions included Zhejiang, Jiangsu, Shanghai, Yunnan, Guizhou, Hebei (southern area), Shanxi, Inner Mongolia (western area), etc. Dealing with this rigorous power supply situation, under the unified disposal of the State Council, all related units had made concerted efforts and taken effective measures to alleviate power shortage situation and safeguard safe and stable operation of the power system.

In line with accelerated power constructions, a batch of key power projects proceeded smoothly. By the end of 2003, the national total power installed capacity hit 391.4 GW, or 9.77% increase over 2002. The world renowned Three Gorges Project duly realized the three tremendous targets — water storage, navigation and power generation. There were six units put into operation in succession by the end 2003, which made the total installed capacity to 4200 MW and an accumulated electricity generation of 8.607 TWh, created a world record of installation and commissioning for hydropower units. The projects of power transmitting from west to east, mutual complementary between north and south and national power grid interconnection, including a batch of key projects such as the DC transmission project from the Three Gorges to Changzhou, the Three Gorges AC transmission and substation phase II project, the DC transmission project from the Three Gorges to Guangzhou, the interconnection project between Central China and North China power grids, the interconnection project of the second circuit between Fujian and East China power grids, the Tokto power send-out phase I project, the 500 kV AC transmission and substation project from Guizhou to Guangdong, etc. all were successfully commissioned.

In 2003, the power environmental protection and resources conservation were further enhanced. The State started a new pollution charging system, and revised and issued the *Emission Standards of Air Pollutants for Thermal Power Plants*. The related governmental departments issued new requirements on SO_2 control for coal-fired power plants. The electric power industry and power enterprises placed higher priority on environmental protection and resources conservation; the power capacity newly equipped with flue gas desulfuration equipment broke through 10 GW, which opened the prelude of equipping flue gas desulfuration equipment on a large scale.

Night view of Huaneng Nantong Power Plant

Power Sources Construction and Operation

In 2003 the power sources construction speeded up its progressive pace. In respect of hydropower the cascade rolled development of great river valleys was launched with unprecedented steps. Specially, the magnificent Yangtze Three Gorges project successfully accomplished three major missions, that is, first filling, shiplock navigation and electricity generation. In respect of thermal power, China was making steady progresses towards vigorously developing large generating units, large power plants, environmental protection equipment and clean coal combustion technologies, etc. In respect of nuclear power and wind power, a solid foundation was laid for a further expansion. To put it briefly, gigantic achievements of world interest were made in the year 2003.

As shown in Table 1, in recent ten years, the installed capacity and annual electricity generation all over the country were grown constantly. As of the end of 2003, the installed capacity in China reached 391,408 MW, of which hydropower reached 94,896 MW (accounting for 24.24 per cent of the nationwide total), thermal power reached 289,771 MW (74.03 per cent) and nuclear power 6186 MW (1.58%). Over the period of 2003 the net newly-added installed capacity came up to 34,837 MW, resulting in a total capacity increase of 9.77 per cent in 2003 over 2002, of which hydropower shared 8822 MW, thermal power 24,224 MW, nuclear power 1718 MW, bringing about total capacity increases of 10.25 per cent, 9.12 per cent, and 38.45 per cent in each category respectively. In 2003 the total annual electricity generation stood at 1905.21 TWh, an increase of 15.18 per cent over that of the previous year, of which hydropower amounted to 281.33 TWh, representing

Table 1 Installed capacity and annual electricity generation in China

Year	Installed capacity (MW)				Electricity generation (TWh)			
	Total	Hydro	Thermal	Nuclear	Total	Hydro	Thermal	Nuclear
1994	199,897	49,061	148,736	2,100	927.88	166.79	747.05	14.04
1995	217,224	52,184	162,940	2,100	1,006.95	186.77	807.34	12.83
1996	236,542	55,578	178,864	2,100	1,079.36	186.92	878.10	14.34
1997	254,238	59,730	192,408	2,100	1,134.20	194.57	924.95	14.42
1998	277,289	65,065	210,124	2,100	1,157.70	204.30	938.81	14.10
1999	298,768	72,971	223,434	2,100	1,233.14	212.93	1,004.74	14.83
2000	319,321	79,352	237,540	2,100	1,368.48	243.13	1,107.94	16.74
2001	338,487	83,006	253,012	2,100	1,483.86	261.11	1,204.48	17.47
2002	356,571	86,075	265,547	4,468	1,654.16	274.57	1,352.20	26.49
2003	391,408	94,896	289,771	6,186	1,905.21	281.33	1,578.97	43.85

14.77 per cent of the nationwide total, thermal power 1578.97 TWh, 82.88 per cent, and nuclear power 43.85 TWh, 2.30 per cent. Besides, the installed capacity of wind power of in-network type amounted to 567 MW in the whole country, and the annual electricity generation reached 1.20 TWh.

Thanks to the power industry to devote major efforts to expand high-efficient large generating units and power plants, retrofit old units, and shut down small-thermal power units and strictly control their construction, main techno-economic indexes of power production were improved in recent years all along.

■ Hydropower

■ General

Up to the end of the year 2003, the hydropower installed capacity amounted to 94,896 MW, 10.25 per cent up as compared with the previous year. The annual electricity generation reached 281.33 TWh, 2.46 per cent up as compared with the previous year (Table 2). So far, the development and utilization rate of water resources in China reached 24.40 per cent. The hydropower installed capacity and electricity generation came out at the top in the world.

With the advent of the 21st century, China steps into a fast track of hydropower development. In 2003 there were twenty-seven 40 MW and above hydropower units put into operation, among them ten units had single capacity over 200 MW. They were Nos.5 and 6 units in Dachaoshan Power station (250 MW each), Nos.4 and 5 units in Wujiangdu Power Station (224 MW each) and Nos.1 ~ 6 units on the left bank in Three Gorges Power Station (700 MW each) (see Table 3). Up to the end of 2003, China had more than two hundred and twenty 250 MW or above hydropower stations built up or under construction. Among these, 1000 MW or above hydropower stations in operation are listed in Table 4.

In recent years, China saw a quicker increase of 40 MW and above hydropower units, adding up 311 units in 1999 (42,095 MW) and 388 units (55,696 MW) in 2003. Their installed capacity accounted for 57.69 per cent and 58.69 per cent of the hydropower total in the indicated years respectively (Table 5).

Table 2 Hydropower installed capacity and electricity generation in recent years

Year	1999	2000	2001	2002	2003
Installed capacity (MW)	72,971	79,352	83,006	86,075	94,896
Proportion in the total installed capacity (%)	24.42	24.85	24.52	24.14	24.24
Net newly-added capacity (MW)	7,906	6,381	3,654	3,069	8,822
Growth rate on a year-on-year basis (%)	12.15	8.74	4.60	3.70	10.25
Electricity generation (TWh)	212.93	243.13	261.11	274.57	281.33
Proportion in the total electricity generation (%)	17.27	17.76	17.60	16.60	14.77
Growth rate on a year-on-year basis (%)	4.22	14.18	7.40	5.15	2.46

Yantan Hydropower Station with an installed capacity of 1210 MW, Guangxi Province

Table 3 Ten hydropower units (over 200 MW) put into operation in 2003

Name of station	Serial unit number	Unit capacity (MW)	Date of commission
Dachaoshan	No.5	225	13.06.03
	No.6	225	23.10.03
Wujiangdu	No.4	250	26.08.03
	No.5	250	09.12.03
Three Gorges (left bank)	No.1	700	22.11.03
	No.2	700	10.07.03
	No.3	700	18.08.03
	No.4	700	28.10.03
	No.5	700	16.07.03
	No.6	700	29.08.03

■ Three Gorges hydropower project reached the prearranged target for 2003

The year 2003 was the tenth of Three Gorges project construction. In this year, the Three Gorges project successfully achieved its fixed goals of reservoir filling up to the initial water level of 135 m (on June 10th), trial navigation of the twin five-flight shiplock (on June 16th) and commissioning of first generating units. It marked the completion of the Three Gorges No.2 phase project and the beginning of No.3 phase project. The Three Gorges project commenced transiting from single construction to simultaneous promotion of construction and management.

Over ten years of construction of the Three Gorges project, science and technology ran through the entire proceeding of planning, demonstration, design, construction, operation and management. Scientific research and practice in regard to the project involved diverse disciplines and specialties, namely sediment and navigation, hydrology, geology, hydraulic engineering, building materials, metal structure, electromechanical equipment and ecological environment, etc. From 1994 to 2003, some dozens of scientific and technological achievements came up to a leading level in China or in the world. Large quantities of achievements were awarded the first or second prizes at the national or provincial (ministerial) level. Successfully damming the Yangtze River in the Three Gorges project enabled the Chinese river closure technique to rank among the world's most advanced. Technologies for rapid dam construction made a new breakthrough. Key technologies of excavation and support of high slope for the twin five-flight shiplock were splendidly developed.

■ Pumped-storage power

Along with uninterrupted expansion of the scope

Table 4 Large hydropower stations (1000 MW and above) in operation as of Dec.31, 2003

No.	Name	River	Location	Installed capacity	Capacity mix (No. x MW)	Dam type	Dam height (m)	Total storage capacity (Gm³)
1	Three Gorges	Yangtze River	Yichang, Hubei	4,200	6x700	G	175	39.3
2	Ertan	Yalong	Panzhihua, Sichuan	3,300	6x550	DCAD	240	5.8
3	Gezhouba	Yangtze River	Yichang, Hubei	2,715	19x125+ 2x170	G.D.	47	1.58
4	Guangzhou Pumped-Storage	Liuxi	Conghua, Guangdong	2,400	8x300	CFRD/RC-CD(U/D)	68/43.5	0.02575
5	Tianhuangping Pumped-Storage	Daxi	Anji, Zhejiang	1,800	6x300	ER/CFRD (U/D)	70/92	0.02832
6	Xiaolangdi	Yellow River	Jiyuan, Henan	1,800	6x300	R	154	12.65
7	Lijiaxia	Yellow River	Jianzha and Hualong, Qinghai	1,600	4x400	DCAD	155	1.65
8	Baishan	Songhua	Huadian, Jilin	1,500	5x300	AG	149.5	6.431
9	Shuikou	Minjiang	Minqing, Fujian	1,400	7x200	G	101	2.6
10	Manwan	Lancang	Yunxian, Yunnan	1,355	5x250+ 1x105	G	132	0.92
11	Liujiaxia	Yellow River	Yongjing, Gansu	1,350	2x225+ 2x260+ 1x320	G	147	5.7
12	Dachaoshan	Lancang	Yunxian, Yunnan	1,350	6x225	G	111	0.94
13	Tianshengqiao II	Nanpan	Longlin, Guangxi and Anlong, Guizhou	1,320	6x220	G	60.7	0.11569
14	Longyangxia	Yangtze River	Gonghe and Guinan, Qinghai	1,280	4x320	AG	178	24.7
15	Yantan	Yalong	Dahua, Guangxi	1,210	4x302.5	G	110	3.38
16	Geheyan	Yangtze River	Changyang, Hubei	1,200	4x300	AG	151	3.4
17	Wuqiangxi	Liuxi	Yuanling, Hunan	1,200	5x240	G	85.5	4.35
18	Tianshengqiao I	Daxi	Longlin, Guangxi and Anlong, Guizhou	1,200	4x300	CFRD	178	10.26
19	Wujiangdu	Yellow River	Zunyi, Guizhou	1,130	3x210+ 2x250	AG	165	2.14
20	Wanjiazhai	Yellow River	Pianguan, Shanxi	1,080	6x180	G	105	0.896
21	Fengman	Songhua	Jilin City, Jilin	1,002.5	1x60+2x65 +5x72.5+2x 85+2x140	G	91	10.8

Notes: G—gravity dam; DCAD—double curvature arch dam; G.D.—gates dam; CFRD—concrete face rockfill dam; RCCD—roller compacted concrete dam; R—rockfill dam; U/D—upper reservoir/downstream reservoir; AG—arch-gravity dam.

of power networks, the construction of pumped-storage power stations were also being accelerated. In 2003 there was a batch of pumped-storage stations under construction: Zhejiang Tongbai (1200 MW), Shanxi Xilongchi (1200 MW), Henan Baoquan (1200 MW), Shandong Tai'an (1000 MW), Hebei Zhanghewan (1000 MW), Jiangsu Yixing (1000 MW), Anhui Langyashan (600 MW), Jilin Baishan (300 MW), and Henan Huilong (120 MW). These projects were quickening their construction steps. It is expected that the first unit of Baishan will be commissioned in 2005, the first units of Tongbai, Tai'an and Langyashan will be in 2006, and the first units of Zhanghewan, Yixing and Xilongchi in 2008.

Table 5 Proportion of large hydropower units (40 MW and above) in total hydropower capacity

Year	Number of units	Capacity (MW)	Shares in total capacity (%)
1999	311	42,095	57.69
2000	337	46,230	58.26
2001	355	48,487	58.41
2002	361	49,417	57.41
2003	388	55,696	58.69

■ Rural hydropower

Up to 1980s, more than half of villages in the country depended chiefly on the supply of rural hydropower. Presently, more than 8 hundred counties rely still on rural hydropower supply. Through development of rural hydropower on a big scale, the problem of power utilization for more than 500 million populations without electricity supply has been solved. By the end of 2003 there were over 1500 counties (cities) which had exploited rural hydropower and built up 48,000 small hydropower stations. In 2003 , the newly built rural hydropower capacity was 2700 MW. Thus, China's rural hydropower capacity reached 34,140 MW and annual generation reached 110 TWh, both represented 40 per cent or so of the nationwide total.

■ Main reliability indexes of hydropower units (40 MW and above)

In recent five years the trend of main reliability indexes of 40 MW and above hydropower generating units (including pumped-storage power units) can be seen in Table 6.

It is shown that over the period of 1999~2003, the service factor came down year after year, especially, in 2003 decreased by a bigger margin; the equivalent availability factor maintained a higher level all along; the equivalent forced outage rate and the unplanned outage times tended downwards.

Table 6 Main reliability indexes of hydropower generating units (40 MW and above)

Year	Number of units in operation	Number of units counted	Average value of indexes			
			SF (%)	EAF (%)	EFOR (%)	UOT (time/unit · year)
1999	311	279	57.36	92.53	1.25	1.87
2000	337	291	57.37	90.30	1.36	3.12
2001	355	314	56.19	92.44	0.97	2.14
2002	361	325	55.16	92.99	0.26	1.89
2003	388	346	51.31	92.37	0.18	1.52

Notes: SF—service factor; EAF-equivalent availability factor; EFOR—equivalent forced outage rate; UOT—unplanned outage times.

Thermal Power

General situation

As of the end of 2003, China hit 289,771 MW and 1578.97 TWh in the thermal power installed capacity and the annual electricity generation, representing 74.03 per cent and 82.88 per cent of the nationwide respectively. In 2003 the newly-added installed capacity throughout the country reached 24,224 MW, which increased the total capacity by 9.12 per cent compared with that in 2002. It was a year with the most newly-added capacity in recent years (Table 7).

Major efforts have been made to build large thermal power units with high parameters

In 2003, the proportion of large thermal power generating units with high parameter was getting higher and higher. In the year China built up and commissioned 37 thermal power units (with a single unit capacity of 200 MW and above), their total capacity was 11,460 MW (Table 8).

Since early 1990s, the thermal power construction has entered the times to mainly employ subcritical pressure 300-MW and 600-MW-class units to build large power plants. In recent years, except for thermal power plants in remote provinces (regions) and cogeneration power plants, the 200 MW and below thermal power units have no longer been employed basically. In the past five years, the proportion of 300 MW and above units in the total thermal power capacity has increased from 35.98 per cent of 1999 to 41.39 per cent of 2003 (Table 9).

Also, large thermal power plants (1000 MW and above) increased in quantity rapidly. In 2002 there were 76 plants, and by the end of 2003 there were already 83 plants (see Table 10), of which Huaneng Dezhou Power Plant (Shandong Province) is the biggest with an installed capacity of 2520 MW. Moreover, there was a batch of 1000 MW and above thermal power plants under construction, of which Waigaoqiao Power Plant (Shanghai) is the largest. The plant has originally 4 × 300 MW generating units and its phase II project is expected to install 2 × 900 MW supercritical pressure units, one of the two units successfully started to generate electricity on December 20, 2003, forty-two days ahead of schedule and planned to go into commercial operation in May 2004.

Table 7 Thermal power installed capacity and annual electricity generation in 1999~2003

Year	1999	2000	2001	2002	2003
Installed capacity (MW)	223,434	237,540	253,012	265,547	289,771
Proportion in the total installed capacity (%)	74.78	74.39	74.75	74.47	74.03
Net newly-added capacity (MW)	13,551	14,106	15,472	12,535	24,224
Growth rate on a year-on-year basis (%)	6.46	6.31	6.51	4.95	9.12
Electricity generation (TWh)	1,004.74	1,107.94	1,204.48	1,352.20	1,578.97
Proportion in the total electricity generation (%)	81.48	80.96	81.17	81.75	82.88
Growth rate on a year-on-year basis (%)	7.02	10.27	8.71	12.26	16.77

Table 8 200 MW and above newly-built thermal power units in 2003

Name of project	Location	Number of units	Capacity commissioned (MW)	Date of commission
Tokto P.P. Phase I	Inner Mongolia	2	1,200	09.06.03; 29.07.03
Liaocheng P.P. unit 2	Shandong	1	600	11.09.03
Laicheng P.P. unit 4	Shandong	1	300	06.05.03
Shengli Oil Field P.P. unit 3	Shandong	1	300	12.11.03
Changxing P.P. Phase IV	Zhejiang	1	300	22.05.03
Liyujiang P.P. extension project	Hunan	2	600	01.07.03; 10.09.03
Zhuzhou P.P. modification project	Hunan	2	620	29.08.03; 27.12.03
Laiyang P.P. Phase II	Hunan	1	300	26.12.03
Jiujiang P.P.	Jiangxi	1	350	29.05.03
Pucheng P.P. Phase II	Shaanxi	1	330	31.12.03
Pingliang P.P.	Gansu	2	600	20.08.03; 20.12.03
Shizuishan No.2 P.P.	Ningxia	2	660	14.07.03; 06.12.03
Taiyuan No.2 P.P. Phase V	Shanxi	1	200	01.05.03
Pingwang P.P.	Shanxi	2	400	11.11.03; 13.12.03
Huahai P.P.	Inner Mongolia	2	400	10.01.03; 18.01.03
Hebei Cogeneration P.P.	Hebei	2	400	24.06.03; 26.06.03
Hongyanchi No.2 P.P.	Xinjiang	2	400	31.08.03; 26.12.03
Taishan P.P.	Guangdong	1	600	12.03
Shenzhen West P.P.	Guangdong	1	300	07.03
Maoming P.P.	Guangdong	1	200	04.03
Qianbei P.P.	Guizhou	2	600	04.03; 08.03
Nayong P.P.	Guizhou	2	600	04.03; 09.03
Anshun P.P.	Guizhou	2	600	03.03; 08.03
Qujing P.P. Phase II	Yunnan	1	300	11.03
Xuanwei P.P. Phase VI	Yunnan	1	300	02.03

Note: P.P.—Power Plant

Table 9 Capacity proportion of thermal power units

Year		1999	2000	2001	2002	2003
200 MW and above	Number of units	433	455	496	518	556
	Installed capacity (MW)	119,609	129,705	143,615	152,603	164,219
	Proportion in total thermal power (%)	53.53	54.60	56.76	59.48	56.67
300 MW and above	Number of units	238	262	295	313	339
	Installed capacity (MW)	80,379	90,875	103,185	110,753	119,943
	Proportion in total thermal power (%)	35.97	38.26	40.78	43.17	41.39

Table 10 Principal fossil power plants in operation (1000 MW and above) as of December 31, 2003

No.	Name of power plant	Location	Plant capacity (MW)	Capacity mix (No. x MW)
1	Huaneng Dezhou	Shandong	2,520	4x300+2x660
2	Shalingzi	Hebei	2,400	8x300
3	Zouxian	Shandong	2,400	4x300+2x600
4	Houshi	Fujian	2,400	4x600
5	Yangcheng	Shanxi	2,100	6x350
6	Shajiao C	Guangdong	1,980	3x660
7	Beilun	Zhejiang	1,800	3x600
8	Mawan General	Guangdong	1,800	6x300
9	Suizhong	Liaoning	1,600	2x800
10	Harbin No.3	Heilongjiang	1,600	2x200+2x600
11	Jianbi	Jiangsu	1,600	2x50+3x100+4x300
12	Douhe	Hebei	1,550	2x125+4x200+2x250
13	Yuanbaoshan	Inner Mongolia	1,500	1x300+2x600
14	Huaneng Luohuang	Chongqing	1,440	4x360
15	Taizhou	Zhejiang	1,410	6x125+2x330
16	Huaneng Dalian	Liaoning	1,400	4x350
17	Ligang	Jiangsu	1,400	4x350
18	Huaneng Nantong	Jiangsu	1,400	4x350
19	Huaneng Fuzhou	Fujian	1,400	4x350
20	Zhuhai	Guangdong	1,400	2x700
21	Jiujiang	Jiangxi	1,350	2x125+2x200+2x350
22	Huangpu	Guangdong	1,350	6x125+2x300
23	Hanfeng	Hebei	1,320	2x660
24	Dalate	Inner Mongolia	1,320	4x330
25	Pucheng	Shaanxi	1,320	4x330
26	Huaneng Shang'an	Hebei	1,300	2x350+2x300
27	Shentou	Shanxi	1,300	2x50+6x200
28	Xuzhou	Jiangsu	1,300	4x125+4x200
29	Weihe	Shaanxi	1,300	4x300+2x50
30	Dagang	Tianjin	1,280	4x320
31	Shiliquan	Shandong	1,270	2x125+3x140+2x300
32	Xingtai	Hebei	1,200	6x200
33	Xibaipo	Hebei	1,200	4x300
34	Taiyuan No.1 Cogeneration	Shanxi	1,200	4x300
35	Datong No.2	Shanxi	1,200	6x200
36	Yangquan No.2	Shanxi	1,200	4x300

Table 10 Principal fossil power plants in operation (1000 MW and above) as of December 31, 2003 (continued)

No.	Name of power plant	Location	Plant capacity (MW)	Capacity mix (No. x MW)
37	Fengzhen	Inner Mongolia	1,200	6x200
38	Tokto	Inner Mongolia	1,200	2x600
39	Datang Panshan	Tianjin	1,200	2x600
40	Shiheng	Shandong	1,200	4x300
41	Laicheng	Shandong	1,200	4x300
42	Liaocheng	Shandong	1,200	2x600
43	Qinghe	Liaoning	1,200	4x100+4x200
44	Jinzhou	Liaoning	1,200	6x200
45	Tieling	Liaoning	1,200	4x300
46	Shuangliao	Jilin	1,200	4x300
47	Fularji No.2	Heilongjiang	1,200	6x200
48	Wangting	Jiangsu	1,200	4x300
49	Yangzhou No.2	Jiangsu	1,200	2x600
50	Changshu	Jiangsu	1,200	4x300
51	Beilun No.1	Zhejiang	1,200	2x600
52	Luohe	Anhui	1,200	4x300
53	Pingwei	Anhui	1,200	2x600
54	Shidongkou	Shanghai	1,200	4x300
55	Waigaoqiao	Shanghai	1,200	4x300
56	Shidongkou No.2	Shanghai	1,200	2x600
57	Wujing No.2	Shanghai	1,200	2x600
58	Yaomeng	Henan	1,200	4x300
59	Jiaozuo	Henan	1,200	6x200
60	Hanchuan	Hubei	1,200	4x300
61	Yangluo	Hubei	1,200	4x300
62	Xiangfan	Hubei	1,200	4x300
63	Fengcheng	Jiangxi	1,200	4x300
64	Baoji No.2	Shaanxi	1,200	4x300
65	Pingliang	Gansu	1,200	4x300
66	Daba	Ningxia	1,200	4x300
67	Zhanjiang	Guangdong	1,200	4x300
68	Shajiao A	Guangdong	1,200	3x200+2x300
69	Zhujiang	Guangdong	1,200	4x300
70	Anshun	Guizhou	1,200	4x300
71	Zhenhai	Zhejiang	1,050*	2x125+4x200
72	Baogang Industrial	Shanghai	1,050*	3x350

Table 10 Principal fossil power plants in operation (1000 MW and above) as of December 31, 2003 (continued)

No.	Name of power plant	Location	Plant capacity (MW)	Capacity mix (No. x MW)
73	Qinling	Shaanxi	1,050	2x125+4x200
74	Zhangze	Shanxi	1,040	2x100+4x210
75	Mudanjiang No.2	Heilongjiang	1,020	4x100+2x210+1x200
76	Qinhuangdao Cogeneration	Hebei	1,000	2x200+2x300
77	Shentou No.2	Shanxi	1,000	2x500
78	Junliangcheng	Tianjin	1,000	4x50+4x200
79	Guohua Panshan	Tianjin	1,000	2x500
80	Yimin	Inner Mongolia	1,000	2x500
81	Shouyangshan	Henan	1,000	2x200+2x300
82	Panxian	Liaoning	1,000	5x200
83	Longkou	Shandong	1,000	2x100+4x200

Note: Capacities of gas-steam combined cycle units are not included in data with *.

In recent years China has successively introduced a batch of 300 MW, 500 MW 600 MW and 800 MW supercritical pressure units. Through debugging and improvement these units have been operating smoothly with higher availability and efficiency gained. It has laid a certain foundation for China to develop home-made supercritical pressure generating units.

Over the past ten-odd years, through introducing technology, jointly tackling, cooperatively producing, incessantly innovating and optimizing, China has successfully realized the research, development and domestication of subcritical pressure 300-MW and 600- MW-class generating units in a comparatively short term. The optimized 300 MW and 600 MW units have basically come up to advanced world standards.

In order to speed up the domestication course of supercritical pressure units, as the backing project of domestication, Qinbei Power Plant in Jiyuan City of Henan Province was started to construct in October 2002, with two supercritical pressure 600 MW units to be installed in the first phase, planned to put into operation in 2005, the ultimate scale will reach 3600 MW. The domestication rate of the first phase project is planned to be 70%, with net coal consumption of 300 gce/kWh. Besides, Anhui Fuyang Power Plant with two supercritical pressure 600 MW units to be installed has been approved to start construction, and the feasibility study report on Shanxi Wangqu Power Plant with two supercritical pressure 600 MW units to be installed has been approved too.

To adopt ultra supercritical pressure parameter may further raise the efficiency of thermal power unit, save the energy and reduce the pollution to our environment. The State has approved the project proposals on jointly building two ultra supercritical pressure units of 1000-MW-class each with known foreign firms separately in Yuhuan City, Zhejiang, and Zouxian City, Shandong.

Shanxi and West Inner Mongolia are abundant in coal reserves, but are serious in water shortage. In 1990s a lot of air cooling coal-fired power plants had been built up (such as Datong No.2 Power Plant 2 × 200 MW, Fengzhen Power Plant 4 × 200 MW, Taiyuan No. 1 Power Plant 2 × 300 MW etc.). Currently, two direct air cooling 600 MW generating units in Datong No.2 Power Plant are being under construction, there are still a lot of large air cooling coal-fired units planned to build in the near future in West Inner Mongolia.

■ Availability and coal consumption of thermal power units

Since the implementation of the policy to adopt large generating units with high parameters, to build large power plants, to shut down small thermal power, and to retrofit old generating units, the reliability of thermal power units has been improving ceaselessly and the coal consumption of thermal power units decreasing year by year (Table 11 and Table 12).

■ To develop gas-steam combined cycle generation techniques along with the implementation of pipelining gas from west to east

Since 1980s, along with the rapid growth of national economy in China, a considerable quantity of gas turbine power plants have been built up. As of the end of 2003, the total installed capacity of gas turbine units and combined cycle units reached 5106.54 MW (single unit, simple cycle 35 MW and above, combined cycle 50 MW and above), mainly distributed in the eastern coastal regions. For further development of combined cycle techniques China has signed the contracts on purchasing 18 sets and 10 sets of 390-MW-class combined cycle units with US based GE Corporation and Japan based Mitsubishi Corporation separately in 2003, of which, the single gas turbine unit capacity being

Table 11 Main reliability indexes of thermal power units (100 MW and above)

Year	Number of units in operation	Number of units counted	Average value of indexes				
			EAF (%)	EFOR (%)	UOT (times/unit · year)	MTBF (hours/unit · year)	UTH (hours/unit · year)
1999	749	657	89.86	2.09	2.94	3,638	4,992
2000	791	711	90.30	1.99	2.88	3,637	5,086
2001	842	754	90.64	1.74	2.81	3,686	5,186
2002	880	792	91.06	1.30	2.57	3,957	5,530
2003	966	824	91.15	1.37	2.39	4,043	6,080

Notes: EAF—equivalent availability factor; EFOR—equivalent forced outage rate; UOT—unplanned outage times; MTBF—mean time between failures; UTH-utilization hours

Table 12 Service power rate and coal consumption for thermal power plants of 6 MW and above units

Year	1999	2000	2001	2002	2003
Service power rate (%)	7.51	7.31	7.25	7.10	6.93
Net coal consumption (gce/kWh)	399	392	385	383	380

A 600 MW generating unit in Beilun Power Plant, Zhejiang Province

250~270 MW. For the domestication degree of combined cycle units will be raised in the future, as a result, they will certainly become an important constituent of Chinese power industry.

■ Gratifying achievements in desulphurization and clean coal combustion technologies

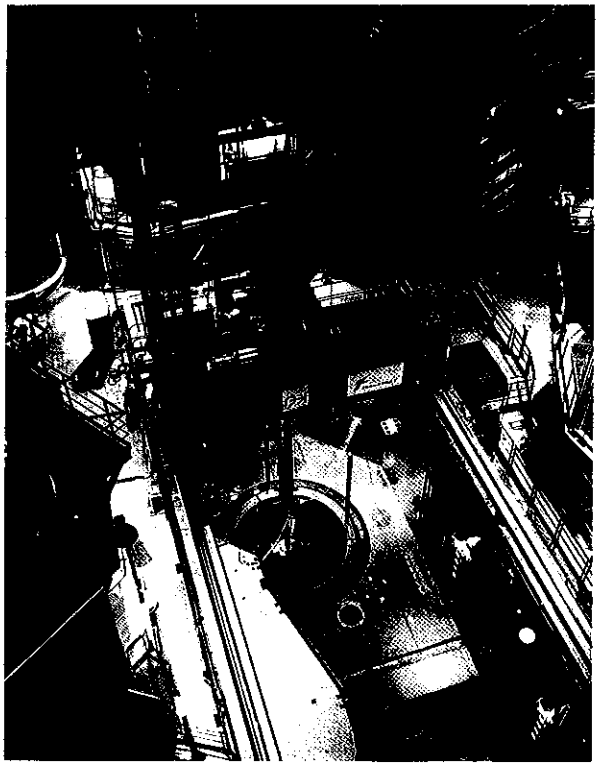
In February 2003 the dry FGD project of 210 MW generating unit in Guangzhou Hengyun Power Plant, the biggest project in Asia, smoothly passed the acceptance of Guangzhou City Environmental Protection Bureau. All emission indexes met the requirements stipulated in the national environmental protection rules of China. Its desulphurization efficiency was more than 90 per cent and particulate emission was controlled below 100 mg/Nm^3.

Sichuan Baima Demonstration Power Plant, the biggest circulating fluidized bed project in the world was approved by the State and placed into the national construction plan in March 1999. Its negotiations for contracts on technology introduction and equipment procurement were completed in August 2002. The boiler foundation started excavation in August 2003. The project is expected to commission as of the end of 2005. It is of great significance for localization of generation technology and equipment manufacture of large circulating fluidized bed boiler.

■ Nuclear Power

Early in 1990s, China built up Qinshan (Zhejiang) and Daya Bay (Guangdong) nuclear power stations, as a result, a history without nuclear power was concluded. From that time on, the projects of Qinshan No.2, Qinshan No.3, as well as Ling'ao, Tianwan stations have successively begun construction according to the State's policy of appropriately expanding nuclear power. This is a forceful move to speed up the restructure of power sources. According to statistics, as of the end of 2003, the nuclear power capacity in Chinese mainland reached 6186 MW, and the annual electricity generation reached 43.85 TWh, accounting for 1.58 per cent and 2.30 per cent of the total amounts respectively. The nuclear power plants in operation by the end of 2003 are shown in Table 13.

The second phase project of Qinshan, China's first nuclear power station with independent design, building, management and operation is equipped with two 600 MW PWR units. No.1 generating unit went into commercial operation early in February 2002. Its share of Chinese-made equipment is 55 per cent, and the construction cost is US$1330/kW, being lower than generating units of the same kind in the world. The No.2 unit in this station is planned to put into commercial operation in late April of the year 2004.



Refueling in Daya Bay Nuclear Power Plant

The third phase of Qinshan nuclear power project is China's first commercial HWR station, adopting Canadian CANDU 6 technology, and is equipped with two 728 MW generating units. No.1 unit was connected to power grid in November 2002. No.2 unit went into commercial operation in July 2003, 112 days ahead of schedule. It has created a record of shortest construction cycle of HWR nuclear power stations in the world.

Daya Bay Nuclear Power Station installed with two 900 MW PWR units has always been in safe and stable operation for ten years, since it was commissioned in 1994.

Ling'ao Nuclear Power Station also has two 900 MW PWR units. Nos. 1 and 2 units were put into commercial operation in May 2002 and January 2003 respectively. Most of their technical-indexes have come up to the IAEA safety standards.

Tianwan Nuclear Power Station is a Sino-Russian cooperative project taking Chinese side as the dominant factor. Four 1000-MW-Class units are planned to install in its station area, and a space is reserved for additional two to four generating units. The first phase project of the station is constructing two 1060 MW AES-91 PWR units. Their designed lifetime is 40 years, and yearly electricity generation will be 14 GWh. It was

Table 13 Nuclear power plants in operation as of December 31, 2003

No.	Name of Power Plant	Location	Plant capacity (MW)	Capacity mix (No. x MW)	Date of commission
1	Ling'ao	Guangdong	1,980	2 x 990	05.2002, 01.2003
2	Daya Bay	Guangdong	1,968	2 x 984	02.1994, 05.1994
3	Qinshan Phase Ⅲ	Zhejiang	1,456	2 x 728	12.2002, 07.2003
4	Qinshan Phase Ⅱ	Zhejiang	650	1 x 650	04.2002
5	Qinshan	Zhejiang	300	1 x 300	12.1991

Table 14 Main reliability indexes of nuclear power units

Year	Number of units counted	Average capacity of units (MW)	Average value of indexes			
			SF(%)	EAF(%)	EFOR(%)	UOT (times/unit · year)
1999	2	984	87.01	86.70	0.03	0.00
2000	2	984	88.18	87.22	1.20	1.00
2001	3	759	90.80	90.59	0.68	1.67
2002	3	759	84.10	84.06	7.08	1.00
2003	6	774	86.56	86.39	3.17	1.33

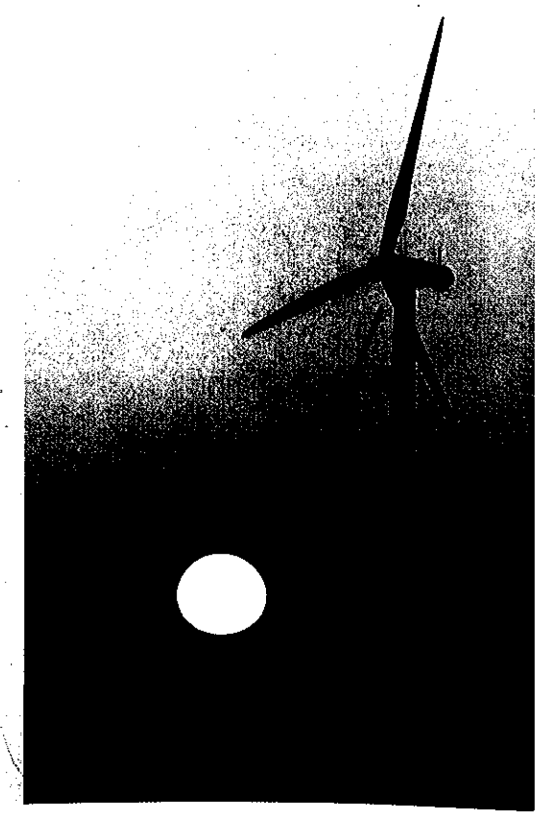
Notes: SF-service factor; EAF-equivalent availability factor; EFOR-equivalent forced outage rate; UOT-unplanned outage times

expected that No.1 unit would be commissioned in May 2004 and No.2 unit would be put into commercial operation before the end of 2005. Lingdong Nuclear Power Station with two 1000-MW-class PWR units is under construction at present.

As viewed from the changing reliability of nuclear power nuclear units in recent five years (Table 14), they were in safe and stable operation, though the nuclear power industry in China was in the initial stage of development.

■ Wind Power

China is rich in wind energy resources. By estimates of China Meteorology Research Institute the exploitable wind energy on the nationwide land totals around 253 GW, and the offshore wind energy is about 750 GW. Both of them add up to about 1000 GW. And the wind energy is widely distributed throughout the country, as seen in Figure 1. It is shown that China is provided with adequate conditions to develop wind power industry.



China started to develop wind power very late. It stepped into the stage of commercialized development and scale-construction only in 1990s. As of the end of 2003, there were 40 wind power farms which were equipped with 1042 generating units. Their generating capacity amounted to 567 MW, accounting for 0.14 per cent of the nationwide total. Accumulated and newly-added installed generating capacity over the years is seen

Fig.1 Distribution of wind energy in China

Table 15 Wind power farms (over 10 MW) as of the end of 2003

No.	Name	Unit capacity (kW)	Number of units	Installed capacity (kW)
1	Xinjiang Dabancheng II	300, 500, 600, 750	157	82,800
2	Guangdong Nan'ao	130-300, 350-750	130	56,690
3	Inner Mongolia Huitengxile	550, 600	72	42,700
4	Liaoning Yingkou Xianrendao	600, 660, 1300	47	31,660
5	Inner Mongolia Chifeng Keshiketeng	600, 660, 750	45	30,360
6	Jilin Tongyu	600, 660	49	30,060
7	Liaoning Donggang	300, 550, 750	38	22,450
8	Gansu Yumen	300, 600	38	21,600
9	Liaoning Dandong	750	28	21,000
10	Zhejiang Kuocangshan	600	33	19,800
11	Xinjiang Dabancheng I	100, 150, 450, 600, 750	42	18,400
12	Guangdong Shanwei	660	25	16,500
13	Shandong Jimo	250, 300, 1300	15	16,400
14	Zhejiang Hedingshan	250, 500, 600	23	13,250
15	Guangdong Huilai	600	22	13,200
16	Liaoning Kangping	850	12	10,200
17	Liaoning Zhangwu	850	12	10,200
18	Ningxia Helan	850	12	10,200

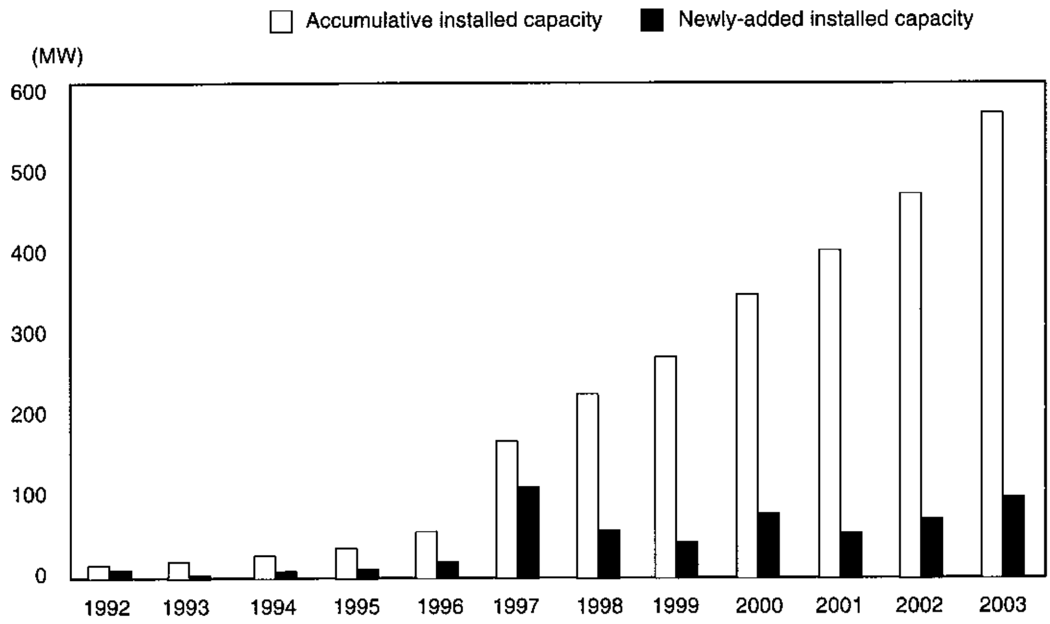


Fig. 2 Accumulative and newly-added installed capacity of wind power

in Figure 2. These units are distributed in 14 provinces (regions, cities), of which 126.5 MW in Liaoning, 103.5 MW in Xinjiang, 88.3 MW in Inner Mongolia, and 86.4 MW in Guangdong. The wind power farms which had capacities over 10 MW as of the end of 2003 are shown in Table 15. The single-unit capacity increased from 100 kW, 200 kW, and 300 kW to 600 kW, 750 kW, and 1300 kW step by step.

China has made great strides forward in the manufacturing technology of wind power equipment and has a basic manufacturing capability of 700 kW and below wind power units. At the same time , the operating departments have mastered management techniques in wind power farms to a certain extent, and a batch of qualified personnel in the field of design and construction has been trained.

For the sake of promoting wind power construction, the Chinese government has issued a *Circular on Questions Concerning Advancement of Renewable Energy Resources* in 1999, in which the preferential policy of renewable energy, in particular, wind power projects was set forward that bank-loaned projects would be given a fiscal subsidiary of 2 per cent and wind power projects putting Chinese-made equipment to use would be given a preferential treatment of 5 per cent on return rate of investment, etc.

The new scheme of power industry restructuring made by the State Council points out clearly a discount standard for emission from electricity generation, thus helping accelerate the development of renewable energy resources, such as wind power. The latest scheme of restructuring electricity pricing puts forward that enterprises of new energy and renewable energy generation don't participate in the competitive market temporarily and power network enterprises should give priority to buy their electricity generation at government-instructed price or bidding price.

Power Networks Construction and Operation

General situations

According to Power Institutional Reform Program, power grid in China has been divided into the State Grid and the Southern Power Grid two large parts since 2003, managed respectively by the State Grid Corporation of China and China Southern Power Grid Co., Ltd. Under the auspices of the State Grid, there are Northeast China, North China, East China, Central China and Northwest China five regional power grids, managed respectively by corresponding power grid corporations. The State Grid Corporation is the sponsor of the five power grid corporations, while China Southern Power Grid Co., Ltd is a state-owned enterprise organized on the basis of Guangdong and Hainan power grid assets together with those power grid assets in Guangxi, Guizhou and Yunnan belonged to the State Power Grid Corporation. The China Southern Power Grid Co., Ltd is directly managed by the Central Government. All above mentioned power grid corporations were organized in 2003. Under the management of the State Grid Corporation and China Southern Power Grid Co., Ltd, the power grid reform and management in China have now stepped into a normal operational mechanism.

By the end of 2003, the national total length of transmission lines on 35 kV and above was 879,479 km, or 9.46% longer than the previous year. The substation capacity on 35 kV and above amounted to 1388.34 GVA, or 11.53 % higher than the previous year. This growth rate was the highest in history, and the growth of substation capacity was higher than that of power sources.

The transmission line and substation capacity by voltage levels are shown in tables 1 and 2; the DC transmission line and converter capacity are shown in Table

Table 1 Length of transmission line on 35 kV and above by the end of 2003

Unit: km

	Total	500 kV	330 kV	220 kV	110 kV	35 (66) kV
Circuit length	879,479	44,364*	10,389	152,400	253,228	419,098

Note: *Including DC transmission lines

Table 2 Substation capacity on 35 kV and above by the end of 2003

	Total	500 kV	330 kV	220 kV	110 kV	35 (66) kV
Number of substations	40,524	133	54	1,788	9,113	29,436
Number of transformers	74,466	414*	91	3,272	16,041	54,648
Transformer capacity (MVA)	1,388,340	161,660	18,990	425,880	502,760	279,060

Note: *Including DC converter capacity

3; and the installed capacity and electricity generation in different regions are shown in Table 4.

The total length of transmission lines and substation capacity in all regions are shown in tables 5 and 6.

■ Power network construction

In 2003, the two large power grids invested 73.6 billion yuan in power network construction, of which, the State Corporation commissioned 5004 km transmission lines on 330 kV and above, substation capacity of 15,330 MVA, DC converter transformer capacity of 3000 MVA. The Southern Power Grid Co., Ltd commissioned 5616 km transmission lines and substation capacity of 19,340 MVA on 220 kV and above in this year.

The "power transmission from west to east" projects achieved remarkable progress in 2003. In south power channel, the AC transmission line from Guizhou to Guangdong, the double circuit of Lu–Tian line and Ping–Guo series capacitive compensation and completion project, which has promoted transmission capacity from west to Guangdong in the east by 1500 MW, were commissioned. The electricity transmitted from west to east accumulated to 26.6 TWh in the whole year, or 31.5% higher than the previous year. In central power channel, the San–Wan line and DC San–Chang line were put into operation, realized power from Sichuan through the Three Gorges Station to East China Power Grid with a transmitting capacity of 3000 MW added.

Table 3 DC line length and converter transformer capacity by the end of 2003

	Below 500 kV	500 kV
Length of transmission line (km)	-	3,760
Converter transformer capacity (MVA)	-	18,544

Table 4 Installed capacity and electricity generation in regions by the end of 2003

	Installed capacity (MW)				Electricity generation (TWh)			
	Total	Hydro power	Thermal power	Nuclear & others	Total	Hydro power	Thermal power	Nuclear & others
North China	87,362.6	3,266.0	84,006.6	90.1	461.653	3.798	457.675	0.181
Shandong	30,545.2	50.8	30,494.4	0	139.565	0.019	139.546	0
Northeast China	37,647.6	5,816.6	31,663.4	167.6	165.817	7.568	157.983	0.266
East China	81,096.5	13,603.4	65,036.5	2,457.7	429.127	31.982	382.112	15.033
Central China	83,450.5	36,557.0	46,893.2	0	367.289	126.448	240.839	0
South China	71,476.4	25,960.7	41,643.6	3,872.1	341.082	84.722	227.259	29.101
Hainan	1,759.6	551.4	1,199.5	8.7	5.942	1.451	4.479	0.012
Northwest China	29,998.0	9,382.0	20,492.7	122.9	139.235	25.899	113.093	0.242
Xinjiang	5,495.0	989.8	4,413.5	91.3	23.610	3.569	19.834	0.208
Xizang	376.2	311.4	34.6	30.2	1.005	0.913	0.005	0.088

Note: Actual results in 2003 shown in Table 4 ~ 6 indicate that Shandong Power Grid has joined into North China Power Grid, but not yet interconnected; Xinjiang Power Grid has joined into Northwest Power Grid, also not yet interconnected; Xizang still remained isolated and managed temporarily by the State Grid Corporation; Hainan Power Grid has joined into Southern Power Grid, and not yet interconnected.

Table 5 Transmission lines on 35 kV and above in regions by the end of 2003

Unit: km

	Total	500 kV	330 kV	220 kV	110 kV
North China	166,499	8,267	0	32,397	47,324
Shandong	50,122	1,718	0	10,019	13,040
Northeast China	88,148	5,031	0	23,241	5,996
East China	142,634	9,995	0	28,845	39,876
Central China	217,601	9,112	0	36,707	67,896
Southern China	162,177	11,960	0	24,308	53,850
Hainan	4,981	0	0	748	2,023
Northwest China	100,541	0	10,389	6,902	37,171
Xinjiang	29,690	0	0	3,087	10,164
Xizang	1,878	0	0	0	1,116

Note: Figures in this table are in circuit length. DC lines are included.

Table 6 Substation capacity on 35 kV and above by the end of 2003

Unit: MVA

	Total	500 kV	330 kV	220 kV	110 kV
North China	315,406	30,260	0	104,192	115,968
Shandong	95,385	6,500	0	29,840	35,332
Northeast China	129,726	18,251	0	42,977	8,780
East China	344,158	42,240	0	111,921	112,493
Central China	245,012	22,068	0	75,494	108,555
Southern China	257,184	48,837	0	79,520	107,697
Hainan	4,586	0	0	1,410	2,380
Northwest China	96,695	0	18,990	11,786	49,180
Xinjiang	17,914	0	0	2,539	11,173
Xizang	162	0	0	0	85

Note: DC converter stations are included.

In north power channel, a newly built transmission line from Inner Mongolia to North China load centers was put into operation. Thus "power transmitting from west to east" has been shaped to a certain scale.

Along with the commissioning of San–Guang project (from Jingzhou in Hubei to Huizhou in Guangdong), San–Wan project, the DC back-to-back project connecting Northwest to Central China and Central China to North China power grids and strengthening the interconnections between Northeast China and North China as well as between East China and Fujian power grids, a prelude of national interconnection in China has now been opened. Also along with the progress of transmission projects, an initial shape of national interconnection covering Northeast–North China–East China–Southern China has been preliminarily realized.

Three Gorges Transmission Phase II Project

The Three Gorges transmission and substation phase II project consists mainly of outlets from the Three Gorges Left Bank Station, DC lines from Central China to East China, AC lines from Central China to Sichuan/Chongqing power grid, regional completion project and secondary systems and communication projects, etc., which include 20 AC transmission lines on 500 kV with a total length of 2562 km, eleven substations on 500 kV with a total capacity of 7000 MVA, a DC transmission line with 860 km long and two converter stations with 6000 MW in capacity. The total investment amounted to 14 billion yuan and all were completed in 2003, which have met the requirements of power output from the Three Gorges Station and improved power grid configurations. The San–Chang DC transmission project is featured as the world largest in capacity, short in construction period and large in single converter bridge capacity, with the longest transmission distance and the highest technological contents. This project was accepted by the state in 2003.

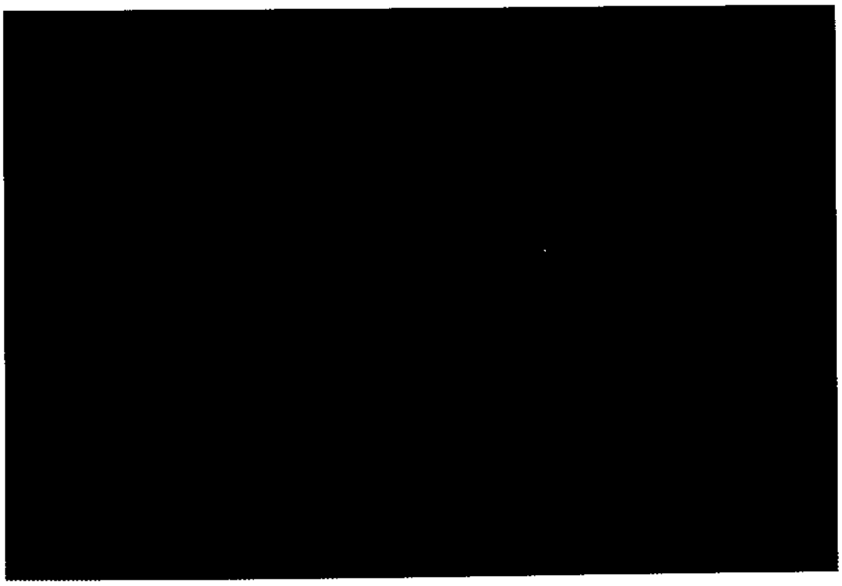
San–Guang DC transmission project

This project, being an important part of power transmitting from west to east, consists of DC transmission line from Jingzhou in Hubei to Huizhou in Guangdong with a distance of 975 km and converter capacity of 2 × 3000 MW, the construction period was stingy, the whole line was completed in 2003 and in single pole operation after adjustment test. Its construction period was shortened by nine months.

Interconnection and power transmission projects

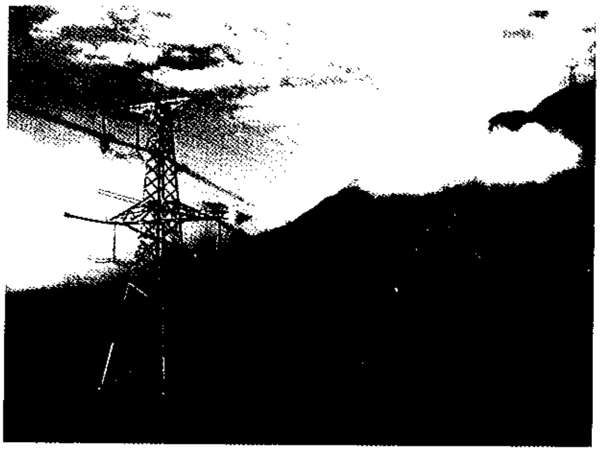
For implementing the strategy of "power transmitting from west to east, mutual complementary between north and south and national interconnection," the pace of power grid interconnection was accelerated. The projects mainly include the following.

Two circuits interconnecting Fujian to East China power grid were completed and put into operation, in the meantime, two circuits connecting Northeast and North China started construction. The Xin–Jia line connecting Central and North China power grids made these two power grids successfully operated in parallel. Till then, an interconnection covering Northeast, North China and Central China (including Sichuan/Chongqing Grid) 3 large regions, a territory across 14 provinces (autonomous regions, municipali-ties), a distance of 4600 km from north to south and a total installed capacity of 140 GW has been formed.



Datong 500 kV transrnission line

In North China Power Grid,



Zigong No.1 500 kV transmission line

the AC 500 kV Tuo–An transmission line finished construction and put into operation, being the first circuit for sending power from west to east newly built in the north power channel. Since then, there are four circuits sending power from west to east in the north power channel.

The AC transmission project of 1300 km long and the DC transmission project from Guizhou to Guangdong were constructed and put into operation in Southern Power Grid.

The Guanting–Lanzhou 750 kV transmission and substation project in Northwest Power Grid was formally started construction in September. It is another leap forward in power transmission history and has important significance in power network construction in China.

Rural power grid construction and upgrading projects determined by the National Development and Reform Commission started since 2003 with a total investment of 33.4 billion yuan. Through concerted efforts, an investment of 17.75 billion yuan were realized, in which, the Southern Power Grid realized an investment of 3.6 billion yuan. The State Grid Corporation also put forth opinions on further deepening rural power grid reform, to push forward steadily the corportization reform on county basis.

■ Power network operation

● Safety operation

In December 2003, the State Council issued a *Notice on strengthening power security operation*, in which SERC is authorized to take the responsibility for power supervision and management, the State Grid Corporation and China Southern Power Grid Co., Ltd are clarified to take the responsibility for operational security in respective power grids. These two large power grids have in turn issued separately No.1 instructions, which call for "enhancing dispatching management, safeguarding power grid safe and stable operation".

Power grids in China achieved excellent performance that still maintained neither vast area blackout nor system collapse fault happened in 2003.

● Power demand and exchange in power grids

Power demand nationwide appeared still vigorous in 2003, both power generation and supply tended consistently to be high with higher increase rates. The national electricity supplied amounted to 1719 TWh and electricity sold amounted to 1509 TWh, the line losses accounted for 7.71%, a little higher than the previous year. The change of line losses is shown in Fig.1.

Power exchange between large regional power grids, regions and provinces accumulated to 163.6 TWh in 2003, in which, electricity exchanged 33.7 TWh between large regional grids and 134 TWh across provines, or autonomous regions power grids. In Southern Power Grid, 19.5 TWh electricity were sent from west to Guangdong and 5.36 TWh were sent to Guangxi power grid in 2003.

The power output and consumption load in power grids in 2003 are shown in Table 7. The yearly load characteristics are shown in Fig. 2.

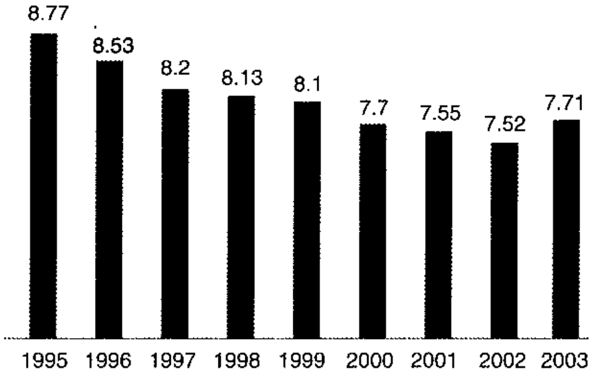


Fig.1 Line loss trends in recent years

Facing power severe situation, the Administrative Office under the State Council issued a notice to call for well managing power supply, for which, the main measures include strengthening coordination among coal, power, oil and transportation, creating good external environment for power production, enhancing equipment maintenance and unified dispatching of power grids, so as to promote stable and reliable power supply. The demand side management, peak shifting and time of day electric tariff as an economic lever should also be implemented to regulate demand. The construction of a batch of fast effective power source projects should be speeded up.

● Operational reliability

The reliability indexes of 13 categories transmission and substation equipment nationwide in 2003 were basically equal to those in 2002, and maintained on a higher level, all availability factors were kept above 99%. The national average power supply reliability (RS1) was 99.866%, a little lower than the previous year, but after deducting the factor of electricity quota due to power shortage, the supply reliability (RS3) still maintained an increasing trend, reached a record of 99.929%.

By the end of 2003, power grids in China hadn't occurred serious fault such as power system instability or collapse in successive 7 years, the power system frequency qualification rate in main power grids reached above 99.99%.

Table 7 The power output and consumption load by grids by the end of 2003

Grids	Maximum power output		Maximum consumption load		[illegible]	
	Figure (MW)	Growth (%)	Figure (MW)	Growth (%)	[illegible]	[illegible]
North China	39,540	10.02	40,080	9.69	267.56	16.28
Northeast China	27,440	7.19	26,730	7.01	170.97	10.00
East China	51,780	4.71	56,890	11.00	348.07	20.56
Central China	35,950	14.31	34,450	11.89	192.69	16.01
Sichuan/Chongqing	12,250	13.11	14,250	18.65	72.48	15.15
South China	40,550	25.46	39,530	27.19	235.97	19.69
Northwest China	16,090	17.53	16,090	17.88	102.82	19.06
Shandong	17,600	8.57	17,600	8.57	105.43	8.51
Fujian	10,300	21.75	9,230	21.13	57.64	16.46
Xinjiang	2,040	14.61	1,810	12.42	12.21	11.90
Hainan	930	5.68	930	5.68	5.24	10.88
Xizang	180	28.57	180	38.46	0.71	30.29

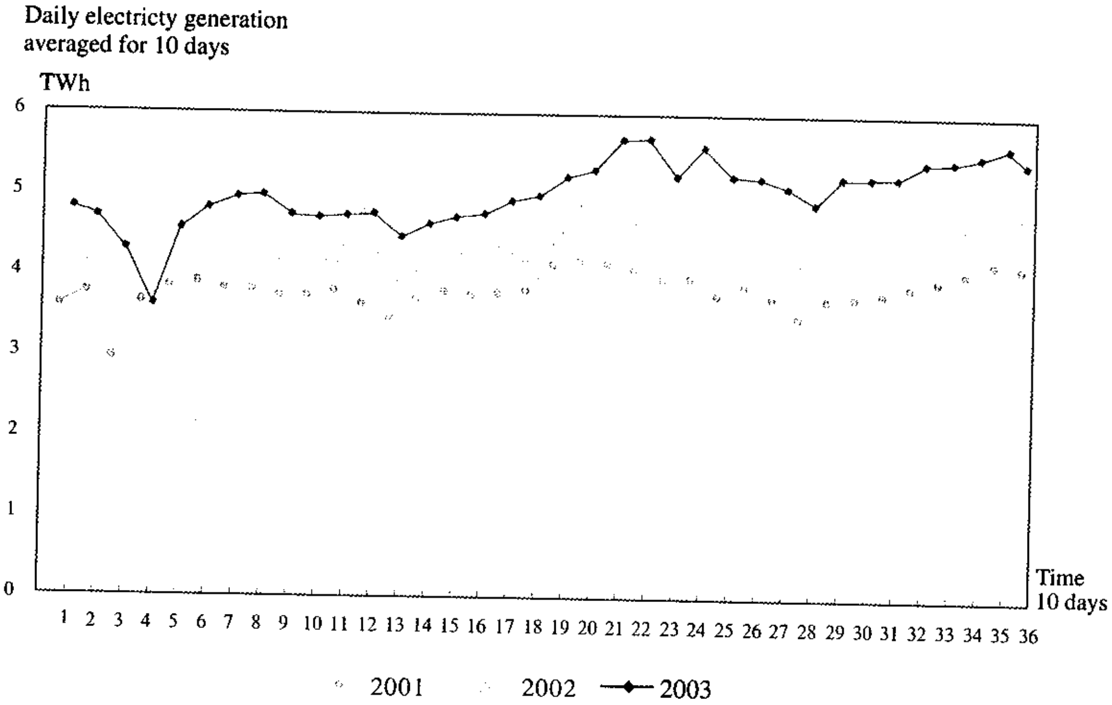


Fig.2 The national load characteristics in 2001 ~ 2003

● Scientific and technical development

The power grid scientific and technical development in 2003 reached a new level, the indications are:

※ The power electronic technology started application in ultra high voltage power grids, particularly in series compensation to promote transmission capability.

※ The localization of 500 kV DC transmission technology achieved great breakthrough. Several domestic large manufacturers have been engaged in and supplied key DC transmission technical products, including complete converter valve components, converter transformers, wave smoothing reactors, AC/DC filters, etc. and laid foundations for further localization.

※ The power grid safety control and automatic level was further improved.

The power scientific and technical progress in China achieved remarkable results in 2003, of which, six projects are among the important technical achievements:

※ The Yixing–Zhensgping double circuit 500 kV compact tower transmission line outgoing from the Three Gorges Station.

※ The demonstration project for application of power system information security technology.

※ Research on promoting 500 kV transmission capability.

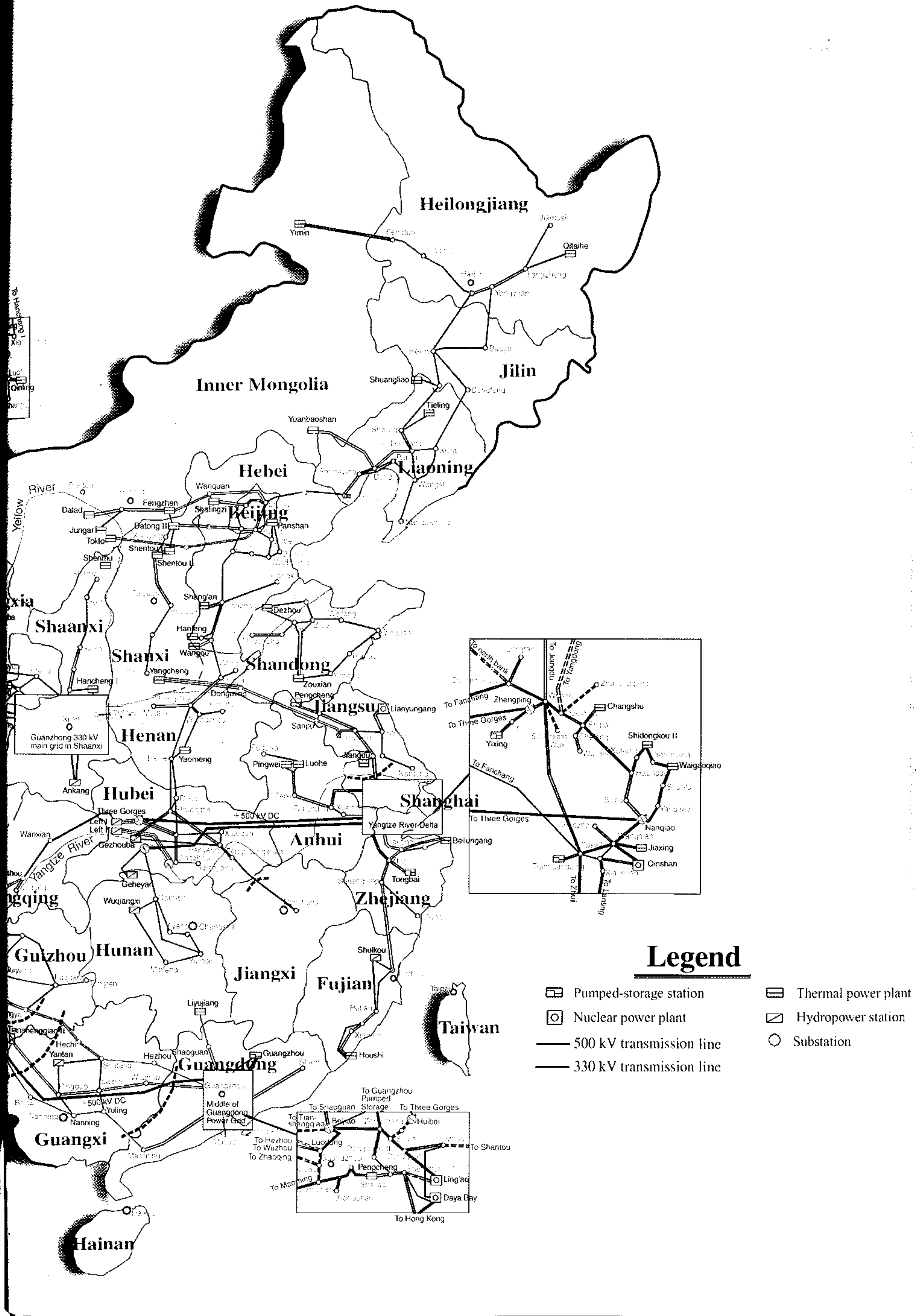
※ Power system analytical software and large scaled AC/DC power grid simulator system.

※ OPS-1 emergent control on-line pre-decision system.

※ Study on 500 kV double circuit transmission line protection and fault locater.

In addition, some practicable and innovative technologies closely have been achieved remarkable results. For example, the study of DC transmission technology, the key technology for 750 kV transmission and substation project, the controllable series compensation technology, power grid dynamic reactive power compensation (SVC) and static Var compensation (STATCOM), power grid automation, communication and information technologies, transmission and substation construction and testing technologies, etc.

Sketch map of national power networks



Heilongjiang
Yimin
Qitaihe
Jilin
Inner Mongolia
Shuangliao
Tieling
Yuanbaoshan
Liaoning
Hebei
Beijing
Wanquan
Fengzhen
Shalingzi
Panshan
Dalad
Jungar
Tokto
Datong II
Shentou
Shentou II
Shenmu
Yellow River
Shaanxi
Shanxi
Shang'an
Hanfeng
Wangqu
Dezhou
Shandong
Yangcheng
Hancheng I
Dongming
Zouxian
Pengcheng
Jiangsu
Lianyungang
Sanpu
Henan
Guanzhong 330 kV main grid in Shaanxi
Yaomeng
Pingwei
Luohe
Jiangdu
Ankang
Hubei
Three Gorges
Left I
Left II
Gezhouba
Wanxian
Yangtze River
+ 500 kV DC
Shanghai
Yangtze River Delta
Anhui
Beilungang
Geheyan
Tongbai
Zhejiang
Wuqiangxi
Hunan
Guizhou
Jiangxi
Shuikou
Fujian
Taiwan
Liyujiang
Hezhou
Shaoguan
Guangzhou
Guangdong
Houshi
Hechi
Yantan
+ 500 kV DC
Yuling
Nanning
Guangxi
Middle of Guangdong Power Grid
Hainan
To North bank
To Jiangdu
To Yangdong
To Fanchang
Zhengping
Changshu
To Three Gorges
Yixing
Shidongkou II
Waigaoqiao
To Fanchang
To Three Gorges
Nanqiao
Jiaxing
Qinshan
To Zhuji
To Lanxing
To Guangzhou Pumped Storage
To Shaoguan
To Three Gorges
Huibei
To Tianshengqiao
To Hezhou
To Wuzhou
To Zhaoqing
Luodong
To Shantou
Pengcheng
To Maoming
Ling'ao
Daya Bay
To Hong Kong
Legend
Pumped-storage station
Nuclear power plant
500 kV transmission line
330 kV transmission line
Thermal power plant
Hydropower station
Substation

Electric Power Supply and Consumption

National economy

China is a developing country with people more than 1.29 billion. China has achieved remarkable success in economic progress since the beginning of reforms on opening her doors to the outside world in 1978. Its average annual economic growth rate during 1980~2000 was 9.7 percent. Trends of energy intensity and share of electricity consumption since 1980 are shown in Table 1.

With the economic development transferred from the way of planned economy to market economy, a goal has been made for China's gross domestic product (GDP) in 2020, which will be four times that of 2000. It will reach 7.2% of annual growth from 2000 to 2020 through the strategy of sustainable development. With the high economic growth, it is predicted that electricity demand will increase by 6.1% annually, to be 4500 TWh and the generation capacity will be around 950 GW in 2020.

China's GDP in 2003 was around 11,689.8 billion yuan, increasing 9.1% than that of 2002. The growth rates were 2.5% for the first industry, 12.5% for the secondary industry and 6.8% for the tertiary industry. Since the economic progress was so fast that there was not enough power supply to meet the demand, more than 21 provinces in China were suffering power shortage in 2003. The government was promoting to use Demand Side Management to lower the power demand, and remarkable achievements had been got.

Power supply

The major data of power supply in 2003 is shown in Table 2. Comparing with 2002, the electricity generation increased by 15.17% and the utilization hours were 5245 h, growing 385 h. The utilization hours for thermal power units were 5767 h, 495 h higher than that of 2002. While those of hydro power units were 3239 h, 50 h lower than that of

The main control room in Huaneng Dandong Power Plant

Table 1 Trends of energy intensity and share of electricity consumption

Year	GDP (1) (billion yuan RMB) (indexed at 1980)	Primary energy consumption (2) (Mtce)	Share of electricity consumption (%)	Energy intensity (2)/(1) (kgce/yuan)	Growth index		
					GDP	Primary energy	Electricity
1980	451.78	602.75	20.60	1.33	100	100	100
1985	751.31	766.82	21.32	1.02	166	127	137
1990	1,096.92	987.03	24.68	0.90	243	163	207
1995	1,927.75	1,311.76	29.58	0.68	427	218	335
1996	2,114.74	1,389.48	30.76	0.66	468	231	357
1997	2,305.43	1,377.98	32.76	0.60	510	229	377
1998	2,484.79	1,322.14	34.69	0.53	550	219	385
1999	2,665.50	1,301.19	40.07	0.49	590	216	410
2000	2,877.84	1,302.97	41.72	0.45	637	216	455
2001	3,094.69	1,349.14	42.90	0.44	685	224	494
2002	3,347.69	1,482.22	43.56	0.44	741	246	550
2003	3,654.90	1,678.00	43.80	0.46	809	278	634

Table 2 Data on power supply side

Items	2002	2003	Growth
Electricity generation	1,654.16 TWh	1,905.21 TWh	15.17%
Hydropower	274.57 TWh	281.33 TWh	2.46%
Thermal power	1,352.20 TWh	1,578.97 TWh	16.77%
Nuclear power	26.49 TWh	43.85 TWh	65.29%
Net coal consumption for thermal units of 6 MW and above	383 g/kWh	380 g/kWh	-3 g/kWh
Service power rate	6.15%	6.07%	-0.08%
Hydropower	0.49%	0.55%	0.06%
Thermal power	7.10%	6.93%	-0.17%
Utilization hours of generating units	4860 h	5245 h	385 h
Hydropower	3,289 h	3,239 h	-50 h
Thermal power	5,272 h	5,767 h	495 h
Electricity supplied	1,403.23 TWh	1,635.12 TWh	16.53%
Electricity sales	1,297.69 TWh	1,509.05 TWh	16.29%
Line loss	7.52%	7.71%	0.19%

2002 since there were few rains in the most areas in 2003.

Electric power consumption

The electricity consumption of the whole society in the past decade has been increased higher. In 1991, it was 669.70 TWh as shown in Fig.1, while in 2003 it was 1889.12 TWh, which increased by 15.29% than that of 2002 (Table 3). Since the investment increased fast, the electricity consumption in heavy industry such as chemical industry, manufacture of building materials, ferrous and non-ferrous metal smelting and processing increased fast. There was 163.03 TWh used by chemical industry, growing 12.53%; 164.14 TWh used by ferrous metal smelting and processing, growing 24%; 103.09 TWh used by manufacture of building materials and other non-metal fossil product, growing 17.42%; and 107.17 TWh used by non-ferrous metal smelting and

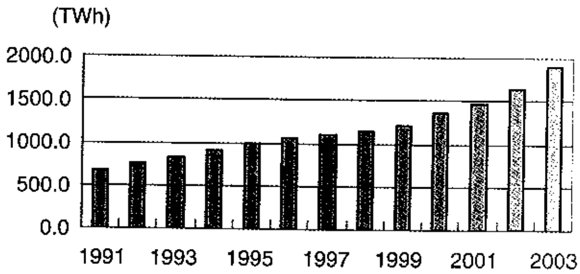
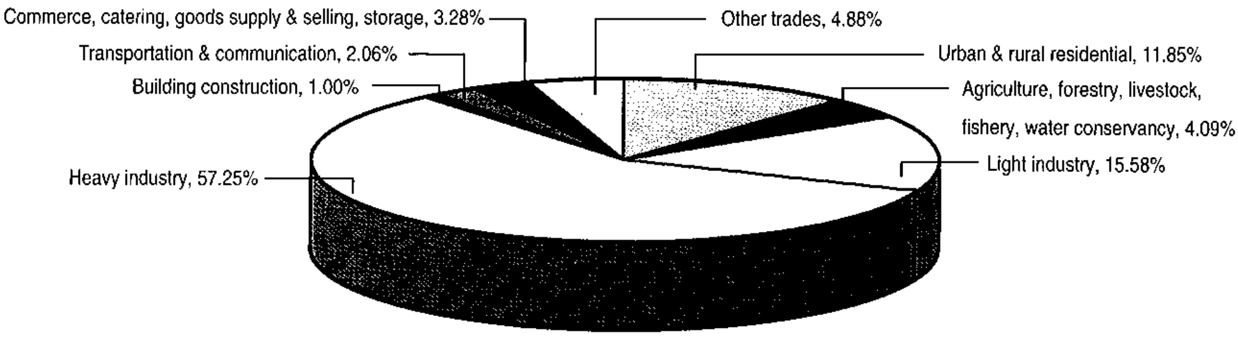


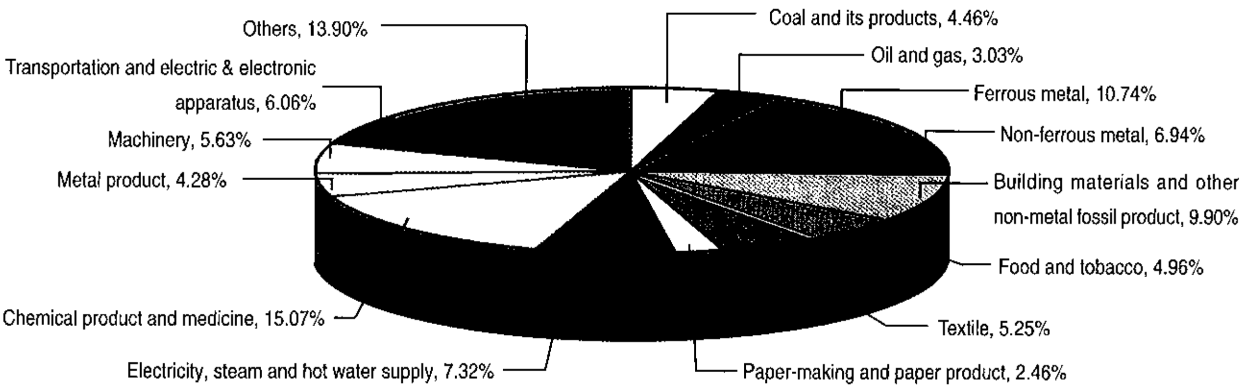
Fig.1 Historic electricity consumption

Table 3 Electricity consumption in 2003

Items	Power utilization capacity (MW)			Electricity consumption (TWh)		
	2002	2003	Growth (%)	2002	2003	Growth (%)
Total of whole society	**957,324**	**1,004,696**	**4.95**	**1,638.63**	**1,889.12**	**15.29**
Category by industries						
Primary industry	72,102	65,915	-8.58	59.02	59.58	0.95
Secondary industry	443,462	460,496	3.84	1,195.73	1,394.85	16.65
Tertiary industry	172,819	196,777	13.86	183.73	210.88	14.78
Urban & rural residential	268,941	281,508	4.67	200.14	223.80	11.82
Urban residential	160,506	170,122	5.99	116.89	135.74	16.12
Rural residential	108,435	111,386	2.72	83.25	88.07	5.79
Total of whole trades	**688,383**	**723,188**	**5.06**	**1,438.48**	**1,665.32**	**15.77**
Category by trade						
Agriculture, forestry, livestock, fishery, water conservancy	89,776	83,967	-6.47	77.62	77.32	-0.40
Industries	426,888	441,076	3.32	1,179.32	1,375.87	16.67
Light industry	129,384	131,699	1.79	254.87	294.31	15.48
Heavy industry	297,504	309,376	3.99	924.45	1,081.56	17.00
Building construction	16,574	19,420	17.17	16.41	18.98	15.62
Transportation & communication	28,343	32,006	12.92	33.19	38.97	17.44
Commerce, catering, goods supply & selling, storage	50,753	54,611	7.60	53.64	61.98	15.54
Other trades	76,051	92,108	21.11	78.30	92.19	17.74



a. Share of various sectors in total consumption



b. Share of various industrial sectors in tolal industry consumption

Fig. 2 Electricity consumption structure in 2003

processing, growing 25.3%. The electricity consumption in the four sectors increased by 19%, with a share around 29% in the total electricity consumption in China. Fig. 2 shows the electricity consumption structure in 2003.

The electricity consumption of the whole society in each province is uneven. Guangdong Province had the highest electricity consumption of 203.13 TWh and a higher growth rate of 20.35%. In spite of the lowest electricity consumption of 0.69 TWh, Xizang had the highest growth rate over 2002, up to 88.20%. Inner Mongolia had a secondary higher growth rate of 29.96% and electricity consumption of 41.64 TWh. Zhejiang, Jiangxi and Jiangsu had higher growth rates of 21.95%, 21.48% and 20.88%, and electricity consumptions of 123.25 TWh, 29.95 TWh and 150.51 TWh, respectively.

The peak load increased fast since the weather was too hot in many provinces in 2003. For example, it increased by 27.19% in South China Power Grid, 17.88% in Northwest Power Grid, 11.89% in Central China Power Grid and 11.00% in East China Power Grid. The load factor was higher than that of 2002 for each grids since the power shortage limited the peak load growth.

It is clear that the power supply did not meet the demand in 2003 in China. The index of power supply and demand can show the balance between them. If it is higher than 1, then the power supply can not meet the demand. If it is lower than 1, there is enough generation

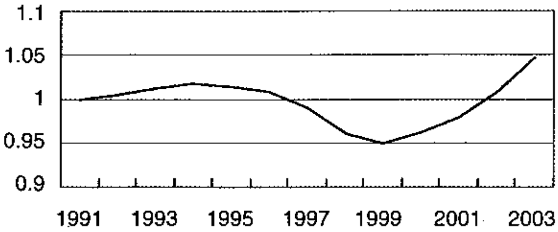


Fig. 3 Historic index of power supply and demand

capacity to meet the demand. The historic index of power supply and demand is shown in Fig.3 which shows the index is 1.046 for 2003. If there were another 30 GW as extra generation capacity, the index would be 1, which means that the supply and demand would be in balance. There were more than 21 provinces with power shortage in China in 2003. The central and local governments were promoting demand side management to reduce the peak load and electricity consumption.

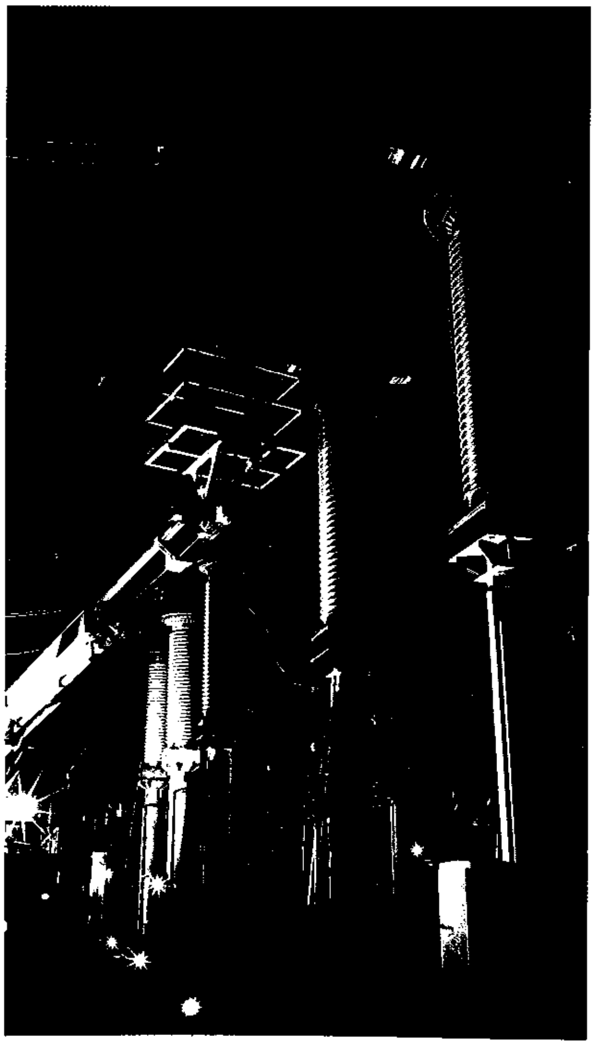
■ Demand side management

Demand Side Management (DSM) is a much cheaper, faster, cleaner, more reliable and more secure way existing to fuel China's growing economy, utilizing saved electricity or "megawatts." Rather than focusing primarily on the development of conventional energy supplies, a more cost-effective approach would evaluate all resource options, both supply-side and demand-side, and choose the cheapest mix of ways to reduce demand or increase supply. There are many great achievements from US, Canada, Japan, France, Germany, China and other countries in the world in the past two decades. So, DSM will be a powerful measure for the challenge.

Over the past decade, China has conducted several pilot DSM studies, all of which found tremendous electricity savings potential and environmental benefits.

Since the demand of electric power was very high in 2003, the government was promoting DSM to save electric power as the main measures on power shortage. Time of use and interrupted load made great contributions to the power shortage in 2003. With the incentive policies on promoting DSM, it has contributed about 30% on power shortage in 2003.

The electricity selling prices of some provinces in 2003 are shown in Table 4~9.



A night view of substation construction site

Table 4 Electricity selling price of Beijing Power Grid

Consumer category	Electricity charge (yuan/kWh)					Capacity charge	
	Below 1 kV	10 kV & below	Below 110 kV	Below 220 kV	220 kV& above	Per maximum demand (yuan/kW · month)	Per transformer capacity (yuan/kVA · month)
Residential household	0.470	0.460	0.460				
Non-residential lighting	0.683	0.673	0.673				
Commercial	0.688	0.678	0.678				
Non-industry	0.598	0.588	0.578				
Ordinary industry	0.615	0.605	0.595				
Large industrial		0.478	0.463	0.453	0.448	22.50	15.00
Calcium carbide, caustic soda, phosphor		0.468	0.453	0.443	0.438	22.50	15.00
Medium & small fertilizer industry		0.290	0.282	0.276	0.271	18.00	12.00
Agricultural production	0.489	0.479	0.469				

Table 5 Electricity selling price of Shanghai Power Grid

Consumer category			400 V & below	10 kV	35 kV	110 kV & above
One part system (yuan/kWh)	Residential household		0.610	0.605		
	Middle & primary school lighting		0.679	0.664		
	Ordinary lighting		0.814	0.799		
	Non- & ordinary industry		0.706	0.691	0.676	
	Power for sewer		0.506	0.491	0.476	
	Power for agricultural & sideline production		0.299	0.297	0.294	
	Irrigation power		0.244	0.242	0.239	
Two parts system	Electricity charge (yuan/kWh)	Ordinary industry	0.584	0.569	0.554	0.539
		Ferroalloy, calcium carbide, caustic soda		0.414	0.399	0.384
		Synthetic ammonia		0.228	0.213	0.198
		Gas		0.554	0.539	0.524
		Lighting	0.764	0.749	0.734	
	Capacity charge	Per maximum demand	30.00 yuan/kW · month			
		Per transformer capacity	20.00 yuan/kVA · month			

Table 6 Electricity selling price of Liaoning Power Grid

Consumer category	Electricity charge (yuan/kWh)					Capacity charge	
	Below 1 kV	10 kV & below	Below 110 kV	110 kV	220 kV & above	Per maximum demand (yuan/kW · month)	Per transformer capacity (yuan/kVA · month)
Residential household	0.450	0.440	0.440				
Non-residential lighting	0.699	0.689	0.689				
Commercial	0.795	0.775	0.775				
Non- & ordinary industry	0.661	0.651	0.641				
Medium & small fertilizer industry	0.560	0.550	0.540				
Large industry		0.432	0.419	0.406	0.396	22.00	15.00
Calcium carbide, caustic soda, synthetic ammonia, phospher		0.422	0.409	0.396	0. 386	22.00	15.00
Medium & small fertilizer industry		0.343	0.330	0.317		22.00	15.00
Agricultural production	0.400	0.390	0.380				

Table 7 Electricity selling price of Jiangsu Power Grid

Consumer category	Electricity charge (yuan/kWh)					Capacity charge	
	Below 1 kV	10 kV & below	Below 110 kV	110 kV	220 kV & above	Per maximum demand (yuan/kW · month)	Per transformer capacity (yuan/kVA · month)
Urban residential household	0.520	0.510					
Rural residential household		0.393					
Commercial lighting	0.899	0.884	0.869				
Other lightings	0.825	0.810	0.795				
Non- & ordinary industry	0.698	0.683	0.668				
Provincial owned medium & small fertilizer industry	0.342	0.327	0.312				
Large industry		0.507	0.492	0.477	0.462	30.00	20.00
Calcium carbide, caustic soda, synthetic ammonia, phosphor		0.497	0.482	0.467	0. 452	30.00	20.00
Provincial owned medium & small fertilizer industry		0.214	0.199	0.184		27.00	18.00
Agricultural production	0.421	0.411	0.396				
Agricultural irrigation in poor county	0.275	0.273	0.269				

Table 8 Electricity selling price of Hubei Power Grid

Consumer category	Electricity charge (yuan/kWh)					Capacity charge	
	Below 1 kV	10 kV & below	Below 110 kV	110 kV	220 kV & above	Per maximum demand (yuan/kW · month)	Per transformer capacity (yuan/kVA · month)
Residential household	0.520	0.510	0.510				
Non-residential lighting	0.813	0.798	0.783				
Commercial	0.905	0.890	0.875				
Non- & ordinary industry	0.643	0.628	0.613				
Medium & small fertilizer industry	0.413	0.403	0.393				
Large industry		0.450	0.435	0.420	0.405	30.00	20.00
Medium & small fertilizer industry		0.293	0.273	0.263	0.258	25.00	19.00
Agricultural production	0.455	0.445	0.435				
Agricultural irrigation in poor county	0.220	0.215	0.210				

Table 9 Electricity selling price of Shaanxi Power Grid

Consumer category	Electricity charge (yuan/kWh)					Capacity charge	
	Below 1 kV	10 kV & below	35 kV	110 kV	220 kV & above	Per maximum demand (yuan/kW · month)	Per transformer capacity (yuan/kVA · month)
Residential household	0.490	0.490	0.490				
Non-residential lighting	0.691	0.682	0.682				
Commercial	0.821	0.812	0.802				
Non- & ordinary industry	0.559	0.552	0.543				
Medium & small fertilizer industry	0.348	0.344	0.340				
Large industry		0.394	0. 374	0.354	0.349	30.00	20.00
Ferroalloy, caustic soda, synthetic ammonia, phosphatic fertilizer, phosphor		0.384	0. 364	0.344	0.339	30.00	20.00
Calcium carbide		0.374	0. 354	0.334	0.329	30.00	20.00
Medium & small fertilizer industry		0.231	0. 216	0.206	0.201	24.00	16.00
Agricultural production	0.419	0.411	0. 401				
Agricultural irrigation	0.201	0.199	0.196				
Deep well high rise irrigation	50~100 m	100~300 m	>300 m				
	0.181	0.171	0.161				

Environment Protection and Resources Conservation

■ Legal construction

In 2003, the State further intensified legal construction on environment protection and resources conservation, and issued and executed a series of rules and regulations. They are mainly *Law of People's Republic of China on Clean Production Promotion* (promulgated on June 29, 2002, put in force on January 1, 2003), *Law of People's Republic of China Concerning Environmental Influence Evaluation* (promulgated on October 28, 2002, put in force on September 1, 2003), *Law of People's Republic of China Concerning Radiative Pollution Prevention and Control* (promulgated on June 28, 2003, put in force on October 1, 2003), *Rules of People's Republic of China on Levying and Using Pollutant Discharge Fees* (Adopted by the State Council on January 30, 2002, promulgated on January 2, 2003, executed since July 1, 2003). Based on the *Rules of Levying and Using Pollutant Discharge Fees*, the State Development Planning Commission, the Ministry of Finance, the General Administration of Environment Protection and the State Economic and Trade Commission jointly enacted the *Procedures for Levying Standards of Pollutant Discharge Fees* (Executed since July 1, 2003) and the Ministry of Finance and the General Administration of Environment Protection made the *Procedures for Levying and Using Pollutant Discharge Fees* (Executed since July 1, 2003). For consolidating execution of the Law on Clean Production Promotion, the National Development and Reform Commission (NDRC), the Ministry of Education, Ministry of Science and Technology, Ministry of Finance, Ministry of Land and Resources, Ministry of Construction, Ministry of Water Resources, Ministry of Agriculture, General

A seaside coal yard

Administration of Taxation, General Administration of Quality Supervision, General Administration of Environment Protection set forth *Instruction on Speeding Up Implementation of Clean Production*, which was consented by the State Council on October 20, 2003, and conveyed nationwide for execution. The national compulsory standard — the *Emission Standards of Air Pollutants for Thermal Power Plants* (GB13223-2003) was jointly promulgated by the General Administration of Environment Protection and the General Administration of Quality Supervision and Examination on December 30, 2003 and executed since January 1, 2004. In January 2003, the State Economic and Trade Commission and National Standardization Committee jointly issued six national standards on water extraction quota for industrial enterprise, which include *Water Extraction Quota: Part I: Thermal Power Plant* (GB/T18916.2-2003), to be executed after January 1, 2005.

Laboratorial test for wastewater reuse

All the above laws, regulations, standards and administrative rules will impose important and long lasting influence on environment protection, resources saving and economic efficiency in power industry, particularly in thermal power plants.

■ Industrial management

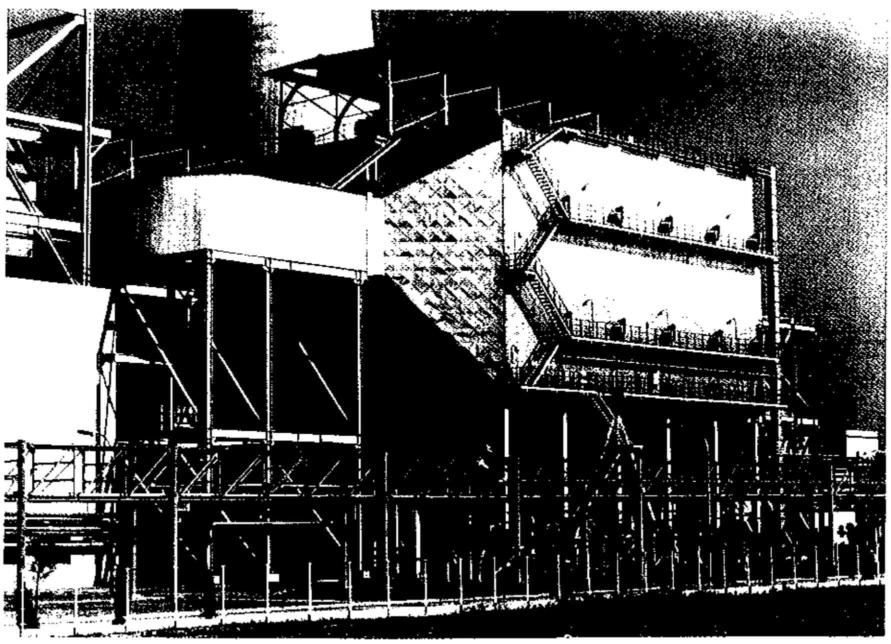
Since implementing power industry institutional reform in 2003, in order to enforce management of environment protection and conservation of resources, promote power industry sustainable development, the responsibility for industrial management and service of power environment protection has been transferred to China Electricity Council. In March 2003, China Electricity Council integrated environment protection with energy saving, water saving, oil saving and comprehensive utilization in conformity with conservation of resources, established a new functional department — the Department of Environment Protection and Resources Conservation under China Electricity Council. Its main functions are to study, and participate in constituting relative laws, codes, policies and standards of the State; to constitute regulations and stipulations of electric power industry on environment protection and resources conservation and supervise the execution; to launch statistic analysis and release related information; undertake planning and consultation service, open up international cooperation; organize publicity, education and training relating to power industry. Under the State's unified disposal, power industry has launched study on basic ideology of medium and long term planning for oil saving and substitution, planning ideology of water saving in power industry, planning ideology of pollutant prevention and control in power industry, SO_2 emission control of national coal-fired power plants in the 11th Five-Year Plan and long-term target to 2020, flue gas desulfurization industrialization program for national thermal power plants, as well as study on clean production index system for power industry. For launching study on industrial regulations and rules for environment protection and conservation of resources, constitution and revision of Stipulations of Power Industry on Environment Monitoring Management and Interpretation of Statistics Indexes on Environment Protection of Thermal Power Plants were initiated. For actively participating in constitution (or revision) of environment protection regulations, policies and standards, the power system environment protection workshop was held, which was the first meeting on environment protection for the entire electric power sector since 1996. In the meantime of pioneering the new situation of environment protection and conservation of resources in power industry, the newly established electric power group corporations have also placed highly emphasis on environment protection and conservation of resources.

■ Achievements

Over twenty-two years from 1980 to 2002, even though the thermal power installed capacity had increased from 46.5 GW to 265.6 GW, or a growth of 4.7 times, the flue dust emission was basically remained on equal level, and has obviously decreased since 1998. The flue dust emission amounted to 3990 thousand tons in 1980, 3000 thousand tons in 2000 and 2700 thousand tons in 2002. In 2003, the flue dust emission amounted to about 2800 thousand tons. The demonstrative project for localization of bag type precipitator was completed and successfully put into operation.

The SO_2 emission in China is mainly due to coal-fired thermal power. Coal consumed for power generation shares 50% of the total production. According to the report on environmental conditions in 2003, the nation-wide total SO_2 emission amounted to 221.587 million tons, in which 17.914 million tons came from industrial sources.

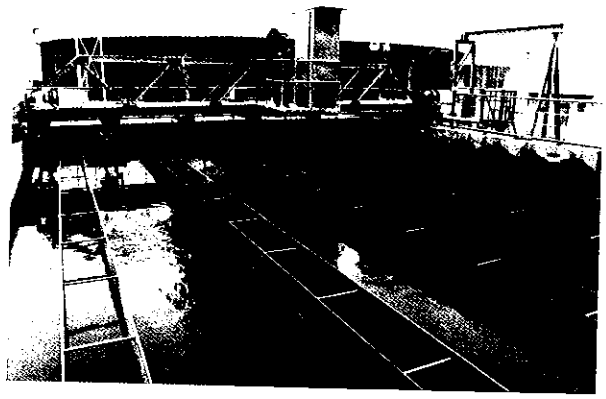
For control of SO_2 emission, comprehensive measures were adopted continuously, including burning low sulfur content coal, promoting energy efficiency, SO_X reduction during combustion and flue gas desulfuration. Flue gas desulfuration became gradually the main measure for control of SO_2 emission. In 2003,



The domestic static precipitator of five electric fields reduces flue dust to 81 mg/Nm³ the flue gas desulfuration techniques operating in China included limestone-gypsum scrubbing FGD process, rotary sprayed dry FGD process, circulating fluidized bed FGD process, electron beam ammonia FGD process, seawater scrubbing FGD process, and LIFAC, etc. Based on technical import, China has now basically mastered the main desulfuration technologies, and is capable of designing, constructing and operating flue gas desulfuration project independently. The demonstrative project for localization of limestone-gypsum scrubbing FGD process on 300 MW coal-fired thermal power unit has been completed and put into operation. By the end of 2003, the installed capacity with desulfuration equipment constructed and under construction amounted to 20 GW and the power capacity equipped with desulfuration under operation has reached 8000 MW (excluding CFBC units) in China. Thanks to these measures, SO_2 emission per unit kW decreased incessantly, about 20% drop in 2003 as compared with that in mid 1990s. However, because of tense supply/demand situation of coal, electricity and transportation, which worsened the coal quality for power plants, plus less flue gas desulfuration equipment in operation, the total amount of SO_2 emission was higher in 2003 than in 2002.

In the aspect of conservation of resources, from 1980 to 2003, the net coal consumption rate decreased from 448 gce/kWh to 380 gce/kWh; the service power rate decreased from 6.44% to 6.07% and the line losses decreased from 8.93% to 7.71%. As compared with 1980, coal equivalent saving reached 120 million tons in 2003.

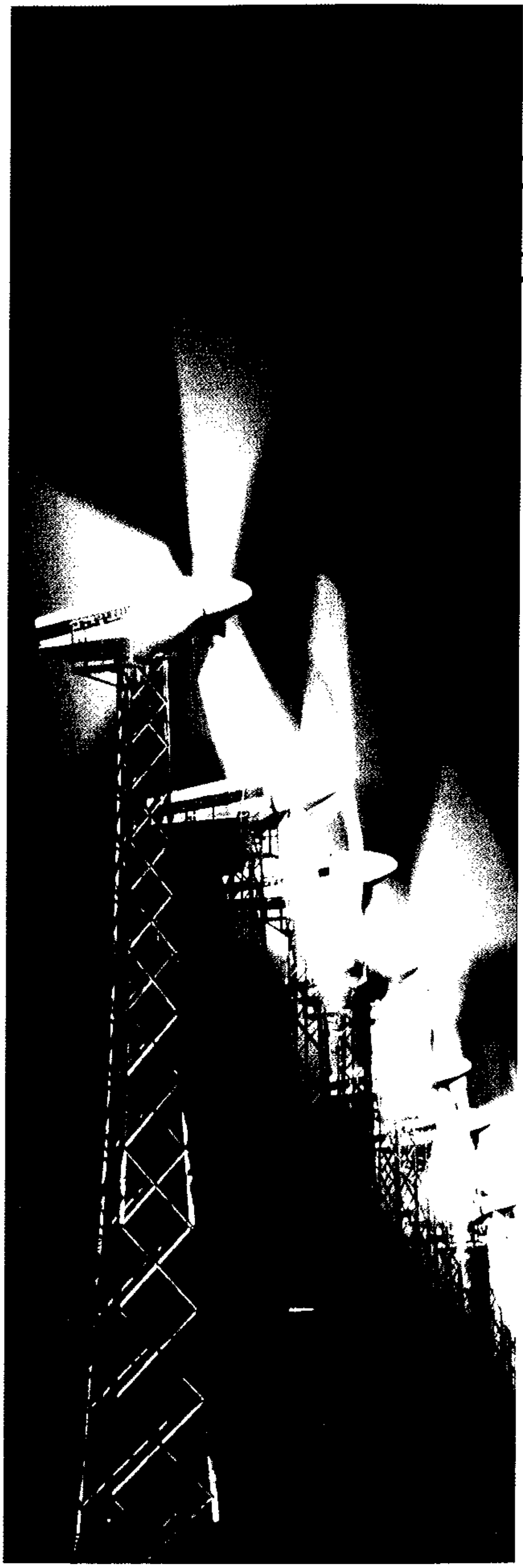
Water consumption per unit electricity generation is an important index in measuring the utilization level of water resources in power generation. In 2002, water consumption of thermal power plant reached 3.54 kg/kWh, or the average water consumption rate of installed capacity was 0.98 $m^3/s \cdot GW$, it was about 1/3 lower than the averaged water consumption rate of 1.42 ~ 1.56 $m^3/s \cdot GW$ in 1980s. The yearly water saving by thermal power amounted to 1.03 billion m^3, and the industrial water reuse rate reached 69%.



The sedimentation tank for ash water treatment and reuse is in operation

The dry ash separation, pulverized coal ash used in construction materials production, road paving and dam construction, and the gypsum from desulfuration used in production of construction materials such as cement and plaster slabs, all these had become the important means for power enterprises to change the waste materials into the precious ones. The comprehensive utilization rate of pulverized coal ash has been continuously kept above 60% in 2003.

In 2003, preventing and eliminating electromagnetic interference on environment in the course of power transmission and substation construction and operation were further strengthened; and the influence to ecological environment and conservation of water and soil in the course of power construction, in particular, the hydropower construction were also improved.



tion of China
y Council

With the approval of the State Council and founded in 1988 when the former Ministry of Energy was just set up following the government organization restructuring, China Electricity Council (CEC) is a consolidated organization of all Chinese power enterprises and institutions. It is also a non-profit social and economic organization. Three boards of council members have been set up since its founding. During the first and the second boards in power, CEC was under the jurisdiction of the former Ministry of Energy and the former Ministry of Electric Power respectively. Currently CEC is under the jurisdiction of the State Electricity Regulatory Commission (SERC).

In October 1998, CEC held its National Assembly. A historical transform was completed, which was from running industrial organizations by the government to legitimately running in joint efforts by power enterprises and institutions; from serving the enterprises and institutions which directly under the central government to facing the society and serving the whole power sector; from being a state-approved institution to an aggregate corporation registered at the Ministry of Civil Affairs

At present the council has 1274 members, with 189 council members and 32 executive council members. There are 13 departments in the Head Office.

The missions of CEC are:

* To study the issues concerning the power sector, put forward suggestions on policies and legislation; to make industrial statistic and analysis and participate in formulating development plans for the industry; to be in charge of the management of legal consulting for the industry and enterprises;

* To undertake industry management on environment protection evaluation, professional safety and health, qualification and certification of institutions for utility boiler's pressure vessel testing;

* To participate in the formulating of the operation rules and the building up of the power market, to coordinate with SERC to implement the supervision, inspecting and other work entrusted by the Commission;

* To participate in relevant hearings organized by the government, which are related to the rights and interests of the power industry; to organize or representing the industry and enterprises to deal with and coordinate some disputes and issues of difference from international trade affairs;

* To formulate and supervise implementing of industrial rules and regulations; to establish industry self-regulating system and normalize the behaviors of enterprises; to safeguard the legal rights and interests of the industry and enterprises;

* To formulate industrial standards, service standards, quality standards and power construction cost control; carry out power reliability management and qualification examination of operation of related enterprises and quality certification in power industry;

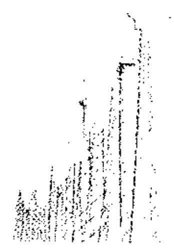
* To organize and carry out the work of professional skill identification, education and training; to organize the assessment, examination, identification and popularizing of scientific and technical results in power sector and provide various forms of consulting and service;

* To carry out Non-governmental international exchange and cooperation, to join the related international organizations on behalf of the power sector and enterprises; to organize, coordinate and host exhibitions, fairs, and carry out activities for introducing investment and promoting the selling of products;

* To develop industrial and social public welfare establishment, and participate in the management and guiding of the key newspapers and periodicals for power industry; to take management of related industrial associations and organize the book compiling of historic records in power industry;

* To undertake other work entrusted by the government and provide services on request of the members and the society;

*To be on behalf of Chinese power industry, China Electricity Council has been elected as the President for the Association of the Electricity Supply Industry of East Asia and the West Pacific (AESIEAP) and is responsible for hosting the 15th Conference on the Electric Power Supply Industry (CEPSI 2004, Shanghai).



Executive Council Members of China Electricity Council

(Arranged in Alphabetic order)

Beijing Guohua Power Company Ltd.
Central China Grid Company Ltd.
China Anneng Construction Company
China Datang Corporation
China Electricity Council Head Office
China Gezhouba Water & Power (Group) Co., Ltd.
China Guangdong Nuclear Power Holding Co., Ltd.
China GuoDian Corporation
China HuaDian Corporation
China Huaneng Group
China Hydropower Engineering Consulting Group Co.
China Power Engineering Consulting Group Co.
China Power International Company Ltd.
China Power Investment Corporation
China Southern Power Grid Co., Ltd.
China Three Gorges Project Corporation
China Yangtze Power Co., Ltd.
East China Grid Company Ltd.
Ertan Hydropower Development Company Ltd.
Hanjiang Water Resources & Hydropower Group Co., Ltd.
Inner Mongolia Power Group Company Ltd.
North China Grid Company Ltd.
Northeast China Grid Company Ltd.
Northwest China Grid Company Ltd.
Shandong Electric Power Corporation
Shandong Zhonghua Power Company
Shenneng (Group) Company Ltd.
Shenzhen Energy Group Company Ltd.
Sinohydro Corporation
State Development & Investment Corporation
State Grid Corporation of China
Sunburst Energy Development Inc.

China Electric Power Information Center

No.1 Lane 2, Baiguang Road, Beijing, China 100761
Tel: 86-10-63416480
E-mail: xiliangwang@sgcc.com.cn