


Highlights of Chinese Power Industry in 2004

2004 was a year of most strained power supply in China since 1990s. Facing this serious power shortage situation, power industry, under the guidance of scientific development ideology, has conscientiously implemented macro- economic regulation, pushed forward actively the power institutional reform and achieved remarkable results in power construction, operation and management, made great contributions to meet the ever increasing national economy and people's living standards.

● Power construction made great progress

In 2004, the newly-commissioned power installed capacity of China exceeded 50 GW, created once again a new historically highest record. By the end of 2004, the national total installed capacity hit 442.39 GW, or 13.02% over 2003, it was a year of fastest growth of power in recent ten years. In this year, two historical breakthroughs were realized on installed capacity in China. One was national total capacity breaking 400 GW marked by the commissioning of Unit 7 of the Three Gorges Hydropower Station on April 29, the other was hydropower capacity breaking 100 GW marked by the commissioning of Unit 1 of Gongboxia Hydropower Station on the Yellow River on September 26.

The technical level of power equipment was further promoted by a batch of advanced power equipment put into successive operation, such as the 900-MW super critical coal-fired unit in Waigaoqiao Power Plant of Shanghai, the 300-MW direct air-cooling power generator of Zhangshan Power Generating Company and the autonomous designed and manufactured Unit 3 of vertical shaft impulse type in Yunnan Ajiutian Hydropower Station. The first roof-top solar power station in China commissioned in Beijing in September. In addition, the first autonomously developed and constructed embedded gas power plant was put into commercial operation in October in Wuxi, Jiangsu Province.

The total transmission lines on 220 kV and above voltage newly commissioned in 2004 amounted to 25,080 km and the substation capacity of 114.97 GVA. By the end of 2004, the national total length of transmission lines on 220 kV and above was mounted to 229,000 km and the substation capacity of 714.88 GVA, they were 10.5% and 17.9% increased respectively over the previous year. Of which, the 500 kV EHV transmission lines totaled 54,000 km in length and the substation capacity of 206.71 GVA, or 22.3% and 27.9% increased respectively.

The "power transmission from west to east" and national power grid interconnection projects achieved remarkable progress. The "power transmission from west to east" project was completed with eight bulk power channels, simplified as "five AC and three DC", with a total transmission capability of 11.5 GW, the target of sending additional 10 GW power to Guangdong Province defined by the State Council realized one year ahead. By the end of 2004, the interconnections between Northeast and North China, North China and Central China, Central China and East China, as well as between Central China and South China power grids were realized, which covered 430 GW in capacity, and the AC synchronized power grids interconnected reached to a scale of 200 GW, a national power grid interconnection has been initially formed.

● Serious shortage of power supply still existed

Notwithstanding the total electricity generation hit 2194.4 TWh in 2004, it was 15.18% over 2003, or a historical net increase of 289.2 TWh, yet the power shortage situation had still been unchanged. With further extending power shortage scope and heavier power shortage scale in 2004, it was the year of most strained power supply situation since 1990s. There were 24 provincial power grids experienced power curtailments in succession, 25 provinces (municipalities, autonomous regions) were involved, of which power grids suffering most prominent and persisting power shortage situations including West Inner Mongolia, Shanxi, Southern Grid of Hebei, Zhejiang, Jiangsu, Yunnan, Guizhou, Guangdong and Guangxi provinces (autonomous regions).

To alleviate this tense power supply situation, the Administrative Office under the State Council issued the *Notice on Fully Meeting Summer Power Peaks* which asked for all governmental departments, power enterprises to implement the spirit of National Economic Working Conference and policies concerning macroscopic regulations, to enhance leadership and coordination and take strong measures for meeting the summer peaks. Through joint efforts, the nationwide power systems had achieved safe and stable operation without significant influence on people's livelihood, economic and social development.

A celebration ceremony was held for national installed capacity hitting 400 GW and Unit 7 of Three Gorges Hydropower Station put into commercial operation

● Macroscopic regulations promoted healthy development of power industry

Due to rapid growth of power supply and demand and the influence of tense power shortage situation in recent years, the disordered and rule-breaching power constructions had arisen in some regions. To avoid waste of resources and sharp rise-and-fall of power development, the National Development and Reform Commission (abbreviated to NDRC) issued *Notice on Strengthening Power Construction Management* to promote orderly and healthy development of power industry, in which any project violating construction approval procedures is required to be straightened out, those constructed or under construction projects conforming with industrial policies and power development programs, fulfilling environmental protection requirements and enabling comprehensive balance shall be supplemented with examining and approval procedures. Any unapproved project shall be unauthorized to receive any bank loans, have equipment supplies and connect to power grid and fuel supply and transportation will have no guarantee. The State Council has placed high emphasis on the problem of disordered and rule-breaching power construction, an urgent *Notice on Firmly Prohibit Disordered Power Project Constructions* was released and conveyed to the NDRC on November 24.

To guide reasonable power consumption and promote industrial structure regulation, the State related department had used price leverage for macroscopic regulation. In June, the State Electricity Regulatory Commission (abbreviated to SERC) issued a notice asking for clearing up and consolidating power consumption in calcium carbide, ferroalloy and coking industries, working out a name list of enterprises which shall be ruled out from power supply or be limited in their power consumption with increased electric tariff. In July, the NDRC decided to execute power tariff discriminating policy and raised the retail price by an average of 0.022 Yuan/kWh. Based on this average raise, those industries belonging to the kind of products limitation or elimination according to the national industrial policy were imposed with additional 0.02 and 0.05 Yuan/kWh charges respectively. The SERC and the NDRC jointly carried out electric tariff inspections, checked up unreasonable favorable price and surcharge by enterprises. Any of those breaching the state electric tariff policy, increasing or decreasing electric price to grid and retail price, and imposing surcharges without authorization would be penalized.

● Reforms on power investment and tariff pricing systems realized new breakthroughs

In July, the State Council issued *Decision on Investment System Reform*, in which, the authorization of review and approval for investment in power projects was stipulated as follows: hydropower projects of 250 MW and higher capacity sited on main rivers shall be approved by competent authority under the State Council, other hydropower projects shall be approved by investment competent department under local government; pumped-storage hydropower projects shall be approved by the competent authority under the State Council; thermal power projects shall be approved by investment competent authority under the State Council, coal-fired co-generation power projects shall be approved by investment competent authority under the State Council, other projects shall be approved by investment competent department under local government; wind power projects with a total generating capacity of 50 MW and above shall be approved by investment competent authority under the State Council, other projects shall be approved by investment competent department under local government; and nuclear power projects shall be approved by the State Council; power grid projects on 330 kV and higher voltage grade shall be approved by investment competent authority under the State Council, other projects shall be approved by investment competent department under local government.

In November, the NDRC issued *Scheme for Interlinking Between Coal and Power Prices*. This interlink, basing on a coal and power price transformation mechanism, shall set up a formula expressing interlinking between power price to grid and coal price; taking the synthetic mine-mouth price of power coal at the end of september 2003 as basis, to exercise interlinking between coal and power prices; power enterprises shall digest 30% of coal price escalation; when power price to grid for coal-fired power plants adjusted, power price to grid for hydropower stations shall be appropriately adjusted, other power enterprises shall not adjust their price to grid along with coal price adjustment. Among different categories of power customers, the retail price for residence, agriculture, medium and small fertilizer factories shall be kept relatively stable, adjusted once in a year at most; except residential tariff, the retail price for all other customer categories shall be correspondingly adjusted in line with the change of electric price to grid.

● Regulatory system enhanced gradually and trade associations improved progressively

With the approval of the State Commission Office for Public Sector Reform, the SERC has established North China, Northeast, Northwest, East China, Central China and South China six regional electricity regulatory bureaus, and set up commissioner's offices in each related cities. Pursuant to the authorization, the main functions of regional electricity regulatory bureaus include to supervise power market operation, normalize power market performance and maintain fair competition; to supervise power enterprises and power dispatching and trading agencies within respective regions; to be responsible for related legal affairs such as power administrative legal execution, administrative penalty and legal proceedings within the region; to supervise power security and reliability; to release power market statistics and information; to manage electric power business permits; to investigate and penalize enterprises' illegal behaviors by law within the region. As of the end of 2004, the regional regulatory bureaus in Northeast, East China, Central China and South China as well as Chengdu Regulatory Office had been established and started to perform regulatory responsibility.

Being the national professional self-disciplinary organization, China Electricity Council held the 4th National Delegation Assembly in Beijing on 15-16 December 2004, on which the 4th Board of Directors was elected. China Electricity Council currently has 1440 group members, affiliates 12 branch associations and 9 special committees, constitutes basically a network of complete functioning, dividing responsibility and cooperation, mutual supplement, orderly normalized service coverage all over the industry. In addition, entrusted by the State-Owned Assets Supervision and Administration Commission of the State Council, China Electricity Council has managed six national specialized associations on its behalf. By the end of 2004, 30 provinces (municipalities, autonomous regions) established provincial associations except Tibet.

● Power market construction made new progress

Being the first regional power market in China, the Northeast Regional Power Market had initiated simulative operation successfully since January 15, 2004. The East China regional power market had formally entered into simulative operation stage since May 19. The *Scheme of Power Market Construction in South China* was formally issued at the end of the year. The case studies for Central China and Northwest China power markets were completed, while the preparation for North China power market was started.

In April, the SERC jointly with the NDRC issued the *Tentative Management on Power Consumers Purchasing Power Directly from Power Generating Enterprises*. In September, the demonstrative scheme of Jilin Carbide Company Ltd purchasing power directly from Longhua Co-generation Company was approved, became the first demonstration project on direct power purchasing.

● Safe production gained great concern

Pursuant to the practical situation after the new round power institutional reform, China has fundamentally established a new management and working system supported by the public over power safety issues with comprehensive management by government responsible body, supervision by power regulatory agency according to regulations and respective responsibilities taken by power enterprises.

There set up a called Security Supervision Bureau directly under SERC and two committees were also established named National Electric Power Security Committee and National Electric Power Security Expert Committee respectively. SERC had issued in time the *Regulations on Supervising Electric Power Safe Production*, *Tentative Stipulations on Submission of Electric Power Safe Production Information*, revised *Regulations on Report of Power Industry Fault Investigations* and *Hydropower Dam Security Supervision Management*, as well as the *Emergency Scheme for Large Area Blackout in Power Grid* required by the State Council.

Power Sources Construction and Operation

■ Hydropower

● General

By the end of 2004, the national total hydropower installed capacity had broken 100,000 MW, reaching 105,240 MW. It accounted for 23.8% of nation's total installed capacity of 442,390 MW, or 10.9% increased over the total hydropower installed capacity of 94,900 MW in 2003. The total hydro-electricity generation amounted to 331.0 TWh, accounting for 15.1% of nation's total electricity generation of 2194.4 TWh, or 17.7% increased over 281.3 TWh of hydro-electricity generation in 2003. Until then, the exploitation rate of hydropower resources counted on capacity basis had reached 27.8%; both hydropower installed capacity and yearly hydro-electricity generation of China had been ranked first in the world.

The hydropower capacity mix of 40-MW and above units as of the end of 2004 is shown in Fig. 1; and

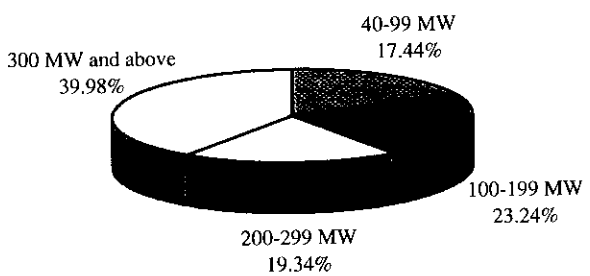


Fig. 1 Hydropower capacity mix on unit capacity basis

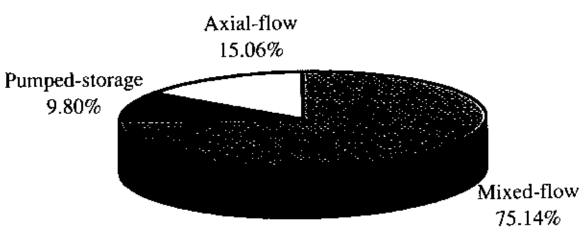


Fig. 2 Hydropower units mix on hydraulic turbine type basis

the type mix is shown in Fig. 2. The share of 200-MW and above units accounted for 59.32%, or 0.76 percentage points lower than that of 33.82% in 2003.

As of the end of 2004, there were 19 conventional hydropower stations of 1000 MW and above under operation in China, with a total installed capacity of 34,527.5 MW. Presently, the largest hydropower station constructed in China is the Three Gorges Hydropower Station, located in Hubei Province, with an installed capacity of 7700 MW. The conventional hydropower stations each with a capacity of 1000 MW and above are listed in Table 1.

Along with incessant development of power grids, the construction of pumped storage hydropower stations have achieved remarkable breakthrough. By the end of 2004, pumped storage hydropower stations, including Guangzhou Station (2400 MW), Tianhuangping Station (1800 MW), Ming Tomb Station (800 MW), Panjiakou Station (150 + 280 MW), Xianghongdian Station (80 MW), Xikou Station (80 MW), etc. had been successively constructed and put into operation, besides Yangzhuoyong Lake Pumped Storage Station constructed in Xizang (Tibet) Plateau with a water head of 840 m and an installed capacity of 112.5 MW. Presently, the largest pumped storage station in China is Guangzhou Pumped Storage Station with an installed capacity of 2400 MW. Table 2 lists out the 300-MW and above pumped storage stations under operation.

● Hydropower construction

Since entering 21st Century, hydropower construc-

Table 1 Conventional hydropower stations of 1000 MW and above under operation by the end of 2004

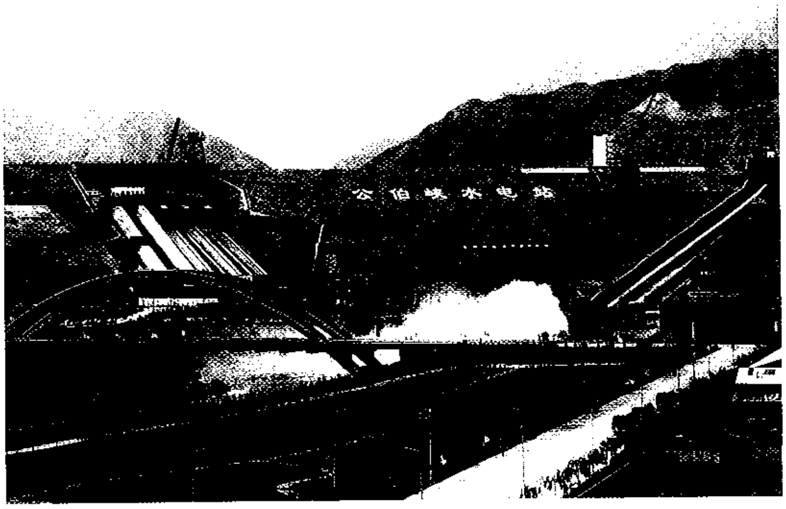
No.	Station	River	Location	Installed capacity (MW)	Capacity mix (number x MW)	Dam type	Dam height (m)	Storage capacity (billion m^3)
1	Three Gorges	Yangtze	Yichang, Hubei	7,700	11 x 700	CGD	175	39.30
2	Ertan	Yalong	Panzhihua, Sichuan	3,300	6 x 550	CDCAD	240	5.80
3	Gezhouba	Yangtze	Yichang, Hubei	2,715	19 x 125+2 x 170	GD	47	1.58
4	Xiaolangdi	Yellow	Jiyuan, Henan	1,800	6 x 300	ECRD	154	12.65
5	Lijiaxia	Yellow	Jianzha and Hualong, Qinghai	1,600	4 x 400	CDCAD	165	1.65
6	Baishan	Songhua	Huadian, Jilin	1,500	5 x 300	CGAD	150	6.43
7	Shuikou	Minjiang	Minqing, Fujian	1,400	7 x 200	CGD	101	2.60
8	Dachaoshan	Lancang	Yunxian, Yunnan	1,350	6 x 225	RCCD	111	0.94
9	Tianshengqiao Cascade II	Nanpan	Longlin, Guangxi and Anlong, Guizhou	1,320	6 x 220	RCCD	61	0.12
10	Liujiaxia	Yellow	Yongjing, Gansu	1,290	2 x 225+2 x 260 x 1 x 320	CGD	147	5.70
11	Longyangxia	Yellow	Gonghe and Guinan, Qinghai	1,280	4 x 320	CGAD	178	24.70
12	Manwan	Lancang	Yunxian and Jingdong, Yunnan	1,250	5 x 250	CGD	132	1.06
13	Yantan	Hongshui	Dahua, Guangxi	1,210	4 x 302.5	CGD	110	2.61
14	Geheyan	Qingjiang	Changyang, Hubei	1,200	4 x 300	CGAD	151	3.40
15	Wuqiangxi	Yuanshui	Yuanling, Hunan	1,200	5 x 240	CGD	86	4.35
16	Tianshengqiao Cascade I	Nanpan	Longlin, Guangxi and Anlong, Guizhou	1,200	4 x 300	CFRD	178	10.26
17	Wujiangdu	Wujiang	Zunyi, Guizhou	1,130	3 x 210+2 x 250	CGAD	165	2.14
18	Wanjiazhai	Yellow	Pianguan, Shanxi	1,080	6 x 180	CGD	105	0.90
19	Fengman	Songhua	Jilin, Jilin	1,002.5	1 x 60+2 x 65+5 x 72.5+2 x 85+2 x 140	CGD	91	10.80

Note: CGD—concrete gravity dam; CDCAD—concrete double curvature arch dam; GD—gate dam; ECRD—earth core rock-fill dam; CGAD—concrete gravity arch dam; RCCD—roller compacted concrete dam; CFRD—concrete face rock-fill dam

Table 2 Pumped storage stations of 300 MW and above under operation by the end of 2004

No.	Station	River	Location	Installed capacity (MW)	Capacity mix (number x MW)	Dam type	Dam height (m)	Storage capacity (million m^3)
1	Guangzhou	Liuxi	Conghua, Guangdong	2,400	8 x 300	U /RCFRD D/RCCD	68.2 43.0	25.75 28.32
2	Tianhuangping	Daxi	Anji, Zhejiang	1,800	6 x 300	U/ACCERD D/RCFRD	73.0 92.0	8.85 8.77
3	Ming tomb	Wenyu	Changping, Beijing	800	4 x 200	U/ACCERD D/MD	70.0 29.0	4.01 81.00

Note: U—upper reservoir; D—down stream reservoir; RCFRD—reinforced concrete face rock-fill dam; RCCD—roller compacted concrete dam; ACCERD—asphalt concrete core earth and rock fill dam; MD—monozone dam tion in China has been highly accelerated. In 2004, the newly added hydropower installed capacity reached 11,990 MW, accounting for 22.53% of nation's total newly added installed capacity of 53,230 MW, of which, units of 300 MW and higher in capacity totaled 4400 MW.


Gongboxia Hydropower Station, Qinghai Province

Conventional hydropower stations

As shown in Table 3, there were 13 large-sized conventional hydropower units of 200 MW and above newly commissioned in 2004, with a total installed capacity of 5400 MW. As of the end of 2004, the projects with planned capacity of 1000 MW and above under construction included mainly: the Three Gorges (22,400 MW), Longtan (6300 MW), Xiaowan (4200 MW), Pubugou (3300 MW), Goupitan (3000 MW), Gongboxia (1500 MW), Sanbanxi (1000 MW), Manwan Phase II (300 MW), Laxiwa (4200 MW) and Shuibuya (1600 MW), etc.

Among the projects under construction, some super large conventional hydropower projects represented by the Three Gorges Hydropower Station and Longtan Hydropower Station feature not only large-sized in capacity and electricity generation, and highly beneficial in flood control, power generation and navigation, but also world-advanced in many technologies.

The 11 out of 14 of 700 MW units in Three Gorges Hydropower Left Bank Station were commissioned by the end of 2004; the remaining three units will be commissioned in May, July and December of 2005 respectively. The 12 units of 700 MW in Three Gorges Right Bank Station are now under construction in full swing; it is planned to commission 6 units in 2007 and another 6 in 2008. In addition, 6 more units of 700 MW will be installed in Right Bank Underground Station. Until then the Three Gorges Hydropower Station will have 32 units of 700 MW, totaling 22,400 MW in capacity.

Longtan Hydropower Station, situated in Tian'e County of Guangxi Province, is a key and controlling project in the cascade exploitation of Hongshui River.

Table 3 Large-sized conventional hydropower projects commissioned in 2004
(unit capacity 200 MW and above)

No.	Station	Location	Capacity commissioned (MW)	Capacity mix (number x MW)	Month of commissioning
1	Three Gorges Left Bank	Yichang, Hubei	3,500	5 x 700	4, 4, 7, 8, 11
2	Gongboxia	Hualong, Qinghai	600	2 x 300	9, 10
3	Hongjiadu	Qianxi, Guizhou	600	3 x 200	7, 11, 12
4	Fengtan	Yuanling, Hunan	400	2 x 200	5, 12
5	Jiangkou	Wulong, Chongqing	300	1 x 300	12

It is also one of the ten symbolic projects in development of western region and a strategic project of "power transmission from west to east." The total installed capacity amounts to 6300 MW (9 x 700 MW), and yearly electricity generation amounts to 18.7 TWh. The total storage capacity amounts to 27.3 billion m^3, and flood control capacity 7.0 billion m^3. The phase I project will be installed with 7 x 700 MW units. The Longtan Hydropower Project will create three world records, i.e., the highest roller compacted concrete dam, the largest underground machine house and the highest rising of ship lifts.

Pumped storage stations

Due to the necessity of peak regulation in recent years, China has intensified construction of pumped storage stations. By the end of 2004, pumped storage projects, namely, Guangdong Huizhou (2400 MW), Zhejiang Tongbai (1200 MW), Shanxi Xilongchi (1200 MW), Henan Baoquan (1200 MW), Jiangsu Yixing (1000 MW), Shandong Tai'an (1000 MW), Hebei Zhanghewan (1000 MW), Anhui Langyashan (600 MW) and Jilin Baishan (300 MW) pumped storage stations had started to construct in succession. It is expected that the first unit of Baishan Station will be commissioned in 2005; the first units of Tongbai Station, Tai'an Station and Langyashan Station will be commissioned in 2006; and the first units of Zhanghewan, Yixing and Huizhou stations will be commissioned in 2008.

The Huizhou Pumped Storage Station is the largest pumped storage station under construction in China. It is situated by the Mount Xiangtou, 16 km north of Boluo County, Huizhou City of Guangdong Province, and 120 km from Guangzhou Municipality. Its designed water head is 532 m; total capacity is 2400 MW; designed yearly pumping electricity consumption is 6.003 TWh; and yearly electricity generation is 4.563 TWh. It is another world-level large-sized pumped storage station after Guangzhou Pumped Storage Station. Its main-body engineering started in October 2004 and the whole project is expected to complete in 2011.

Hydropower operation

By strengthening management, in 2004, the nationwide hydroelectric generating enterprises achieved new progress in safe and economic operation (refer to Table 4 for detail).

From Table 4 it can be seen that the average utilization hours of hydropower units of 6000 kW and above changed little from 2000 to 2004. The five years' average of 3275 hours seems to be too low; the main reason is less water inflow and less hydropower stations with storage reservoirs especially long-period storage reservoirs. The house service rates are relatively stable.

Table 4 Operational economic indexes for hydropower units of 6000 kW and above in recent five years

Year	Average utilization hours (h/unit year)	House service rate (%)
2000	3,258	0.49
2001	3,129	0.46
2002	3,289	0.49
2003	3,239	0.55
2004	3,462	0.47

The operational reliability indexes of conventional hydropower stations of 40 MW and above are shown in Table 5. It can be seen from the table that the service factors declined year by year, especially in 2004. The equivalent availabilities, though fluctuated, remained on a high level. The equivalent forced outage rates and unplanned outage times were gradually declined.

The variation trend of operational reliability indexes of pumped storage hydropower units in recent five years is shown in Table 6.

Table 5 Operational reliability indexes for hydropower units of 40 MW and above in recent five years

Year	2000	2001	2002	2003	2004
Number of units counted	291	314	325	346	361
Average capacity (MW/unit)	137.73	137.29	134.94	139.34	148.99
SF (%)	57.37	56.19	55.16	51.31	54.61
EAF (%)	90.30	92.44	92.99	92.37	93.16
EFOR (%)	1.36	0.97	0.26	0.18	0.36
UOT (times/unit · year)	3.12	2.14	1.89	1.52	1.17

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

Table 6 Reliability indexes of pumped storage units in recent five years

Year	2000	2001	2002	2003	2004
Number of units counted	18	21	21	21	21
SF (%)	30.17	25.09	28.19	29.62	31.90
EAF (%)	80.73	89.32	91.87	89.42	92.42
EFOR (%)	16.64	10.38	2.01	0.86	0.49
UOT (times/unit · year)	24.49	9.10	4.43	4.33	3.75

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

■ Thermal power

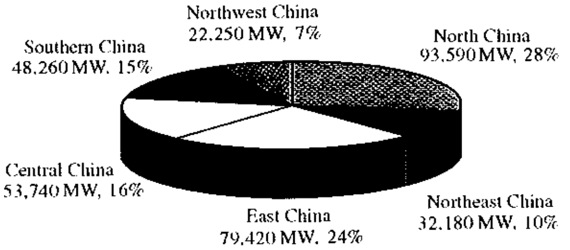
● General

Because of stern power supply situation, the thermal power installed capacity and electricity generation has persistently increased in recent years. The newly commissioned thermal power capacity in 2004 amounted to 40,260 MW, accounting for 75.65% of the total newly commissioned capacity in the year. The national total thermal installed capacity reached 329,483 MW by the end of 2004, or 13.70% increased over the previous year, accounting for 74.48% of national total installed capacity. The thermal electricity generation amounted to 1810.38 TWh, representing 82.50% of nation's total electricity generation, or 14.66% increased over the previous year. The thermal power capacity, electricity generation, the share in nation's total and the growth rate in recent years are shown in Table 7.

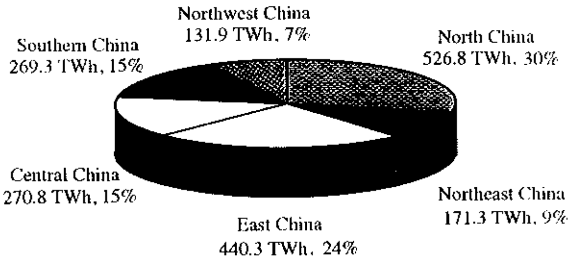
The regional distribution of thermal installed capacity and electricity generation are shown in Fig. 3. The capacity mix of thermal power units is shown in Fig. 4.

The share of 200-MW and above thermal power units reached 59.83%, 0.86 percentage points higher than 58.97% in the previous year; 6-49 MW units accounted for 15.41%, or 0.6 percentage points lower than 15.74% in 2003. The largest thermal unit by capacity was the 900-MW unit installed in Waigaoqiao No. 2 Power Plant in Shanghai. Supercritical parameter units representing higher level of thermal power generation had found application in China. There were 16 supercritical units with a total capacity of 8480 MW as of the end of 2004.

By the end of 2004, the thermal power plants



a. Installed capacity



b. Electricity generation

Fig.3 Regional distribution of thermal installed capacity and electricity generation

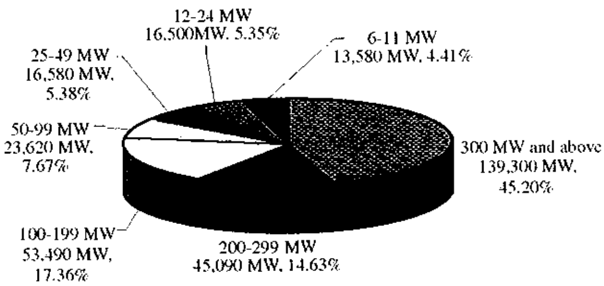


Fig. 4 Capacity mix of thermal power units

each with a capacity of 1000 MW and above amounted to 92, with a total capacity of 125,330 MW (see Table 8), in which the largest one is Houshi Power Plant of Fujian Province.

Houshi Power Plant is situated in Longhai City, Zhangzhou Prefecture of Fujian Province, owned by Huayang Power Company Ltd. The plant is equipped with 6×600 MW supercritical units, of which, the first four boilers and turbo-generator units are made by Mitsubishi Heavy Industry of Japan, the other two boilers are made by ABB-CE of USA, and turbo-generators are also from Mitsubishi of Japan. As of July 2004, all the six units of Houshi Power Plant had been commissioned with a net coal consumption of around 340 g/kWh. Based on the principle of "environment first," the plant employed world advanced desulfuration and deNOx installations, electrostatic precipitators and waste water treatment equipment as well as totally enclosed circular coal bins and totally enclosed coal conveyers. The sulfur dioxide, NOx and flue dust emissions from the plant are lower than the national standards.

● Thermal power construction

The newly commissioned thermal power capacity amounted to 40,260 MW in 2004, making it a year with most newly commissioned capacity in recent years. Among the newly commissioned 6-MW and

Table 7 Thermal installed capacity and electricity generation in recent years

Year	**2000**	**2001**	**2002**	**2003**	**2004**
Installed capacity (MW)	237,540	253,012	265,547	289,771	329,483
Proportion in the total capacity (%)	74.39	74.75	74.47	74.03	74.48
Growth rate on a year-on-year basis (%)	6.31	6.51	4.95	9.12	13.70
Electricity generation (TWh)	1,107.94	1,204.48	1,352.20	1,578.97	1,810.38
Proportion in the total electricity generation (%)	80.96	81.17	81.75	82.88	82.50
Growth rate on a year-on-year basis (%)	10.27	8.71	12.26	16.77	14.66

Table 8 Fossil-fired power plants in operation (1000 MW and above)
(as of December 31, 2004)

No.	Power plant	Location	Plant capacity (MW)	Capacity mix (number x MW)
1	Houshi	Fujian	3,600	6 x 600
2	Dezhou	Shandong	2,520	4 x 300+2 x 660
3	Shalingzi	Hebei	2,400	8 x 300
4	Zouxian	Shandong	2,400	4 x 300+2 x 600
5	Tokto	Inner Mongolia	2,400	4 x 600
6	Yangcheng	Shanxi	2,100	6 x 350
7	Dalate	Inner Mongolia	1,980	6 x 330
8	Shajiao C	Guangdong	1,980	3 x 660
9	Jianbi	Jiangsu	1,830	3 x 100+4 x 300+1 x 330
10	Waigaoqiao No. 2	Shanghai	1,800	2 x 900
11	Beilun	Zhejiang	1,800	3 x 600
12	Jiaxing	Zhejiang	1,800	3 x 600
13	Mawan	Guangdong	1,800	3 x 600
14	Suizhong	Liaoning	1,600	2 x 800
15	Harbin No. 3	Heilongjiang	1,600	2 x 200+2 x 600
16	Douhe	Hebei	1,550	2 x 125+4 x 200+2 x 250
17	Yuanbaoshan	Inner Mongolia	1,500	1 x 300+2 x 600
18	Shentou No. 2	Shanxi	1,500	3 x 500
19	Luohuang	Chongqing	1,440	4 x 360
20	Taizhou	Zhejiang	1,410	6 x 125+2 x 330
21	Dalian	Liaoning	1,400	4 x 350
22	Ligang	Jiangsu	1,400	4 x 350
23	Nantong	Jiangsu	1,400	4 x 350
24	Fuzhou	Fujian	1,400	4 x 350
25	Zhuhai	Guangdong	1,400	2 x 700
26	Jiujiang	Jiangxi	1,350	2 x 125+2 x 200+2 x 350
27	Huangpu	Guangdong	1,350	6 x 125+2 x 300
28	Pucheng	Shaanxi	1,320	4 x 330
29	Shizuishan	Ningxia	1,320	4 x 330
30	Shang'an	Hebei	1,300	2 x 350+2 x 300

Table 8 Fossil-fired power plants in operation (1000 MW and above) as of December 31, 2004

(Continued)

No.	Power plant	Location	Plant capacity (MW)	Capacity mix (number x MW)
31	Shentou No. 1	Shanxi	1,300	2 x 500+6 x 200
32	Xuzhou	Jiangsu	1,300	4 x 125+4 x 200
33	Weihe	Shaanxi	1,300	4 x 300+2 x 500
34	Dagang	Tianjin	1,280	4 x 320
35	Shiliquan	Shandong	1,270	2 x 125+3 x 140+2 x 300
36	Xingtai	Hebei	1,220	1 x 220+5 x 200
37	Dingzhou	Hebei	1,200	2 x 600
38	Xibaipo	Hebei	1,200	4 x 300
39	Taiyuan No. 1 Cogeneration	Shanxi	1,200	4 x 300
40	Datong No. 2	Shanxi	1,200	6 x 200
41	Yangquan No. 2	Shanxi	1,200	4 x 300
42	Fengzhen	Inner Mongolia	1,200	6 x 200
43	Datang Panshan	Tianjin	1,200	2 x 600
44	Liaocheng	Shandong	1,200	2 x 600
45	Shiheng	Shandong	1,200	4 x 300
46	Laicheng	Shandong	1,200	4 x 300
47	Tieling	Liaoning	1,200	4 x 300
48	Jinzhou	Liaoning	1,200	6 x 200
49	Qinghe	Liaoning	1,200	4 x 100+4 x 200
50	Shuangliao	Jilin	1,200	4 x 300
51	Fularji No. 2	Heilongjiang	1,200	6 x 200
52	Yangzhou No. 2	Jiangsu	1,200	2 x 600
53	Wangting	Jiangsu	1,200	4 x 300
54	Pengcheng	Jiangsu	1,200	4 x 300
55	Changshu	Jiangsu	1,200	4 x 300
56	Beilun No. 1	Zhejiang	1,200	2 x 600
57	Pingwei	Anhui	1,200	2 x 600
58	Luohe	Anhui	1,200	4 x 300
59	Shidongkou No. 2	Shanghai	1,200	2 x 600
60	Wujing No. 2	Shanghai	1,200	2 x 600
61	Shidongkou	Shanghai	1,200	4 x 300

Table 8 Fossil-fired power plants in operation (1000 MW and above) as of December 31, 2004

(Continued)

No.	Power plant	Location	Plant capacity (MW)	Capacity mix (number x MW)
62	Waigaoqiao	Shanghai	1,200	4 x 300
63	Qinbei	Henan	1,200	2 x 600
64	Yaomeng	Henan	1,200	4 x 300
65	Jiaozuo	Henan	1,200	6 x 200
66	Hanchuan	Hubei	1,200	4 x 300
67	Yangluo	Hubei	1,200	4 x 300
68	Xiangfan	Hubei	1,200	4 x 300
69	Fengcheng	Jiangxi	1,200	4 x 300
70	Baoji No. 2	Shaanxi	1,200	4 x 300
71	Pingliang	Gansu	1,200	4 x 300
72	Daba	Ningxia	1,200	4 x 300
73	Zhanjiang	Guangdong	1,200	4 x 300
74	Zhujiang	Guangdong	1,200	4 x 300
75	Shajiao A	Guangdong	1,200	3 x 200+2 x 300
76	Qianbei	Guizhou	1,200	4 x 300
77	Anshun	Guizhou	1,200	4 x 300
78	Nayong	Guizhou	1,200	4 x 300
79	Qujing	Yunnan	1,200	4 x 300
80	Xuanwei	Yunnan	1,200	4 x 300
81	Zhenhai	Zhejiang	1,050	2 x 125+4 x 200
82	Baoshan Steel	Shanghai	1,050	3 x 350
83	Qinling	Shaanxi	1,050	2 x 125+4 x 200
84	Zhangze	Shanxi	1,040	2 x 100+4 x 210
85	Mudanjiang No. 2	Heilongjiang	1,020	4 x 100+2 x 210+1 x 200
86	Qinhuangdao Cogeneration	Hebei	1,000	2 x 200+2 x 300
87	Guohua Panshan	Tianjin	1,000	2 x 500
88	Junliangcheng	Tianjin	1,000	4 x 50+4 x 200
89	Yimin	Inner Mongolia	1,000	2 x 500
90	Shouyangshan	Henan	1,000	2 x 200+2 x 300
91	Panxian	Guizhou	1,000	5 x 200
92	Longkou	Shandong	1,000	2 x 100+4 x 200

above units, large-sized units of 300 MW and above amounted to 23,020 MW, accounting for 56.72%; units of 200-299 MW amounted to 1010 MW, accounting for 2.5%; units of 100-199 MW amounted to 8350 MW, accounting for 20.57%; and units of 50-99 MW amounted to 1090 MW, accounting for 2.68%; units of 25-49 MW amounted to 530 MW, accounting for 1.3%, and units below 25 MW amounted to 10,310 MW, accounting for 25.4%. Therefore, the adjustment of power capacity mix needs to be further stressed. Table 9 shows the projects newly commissioned in 2004 with unit capacity of 200 MW and above.

From the newly commissioned power projects in 2004, it can be seen that the thermal power construction in China was experiencing a technical upgrading process. After the commissioning of 800-MW supercritical units in Suizhong Power Plant of Liaoning Province, two 900-MW supercritical units were subsequently commissioned in Waigaoqiao No. 2 Power Plant of Shanghai in April and September 2004 respectively. Two supercritical units in Qinbei Power Plant of Henan Province, being a backing project for localization, were commissioned in 2004. The Fuyang Power Plant in Anhui Province and Wangqu Power Plant in Shanxi Province also planned to adopt the localized technologies. In addition, the State has decided to launch a pilot project for ultra-supercritical generation technologies in Yuhuan Power Plant of Zhejiang Province. In the meantime, the 1000-MW ultra-supercritical unit of Zouxian Power Plant in Shandong Province was approved as a backing project for localization of the technology and listed in the national "863" scientific and technical key program.

In line with development of high parameters and large-sized power units, resources conservation and environmental protection has become more and more important concern in thermal power construction. For example, in areas abundant in coal reserves but lack of water resources, large-sized air cooling generating equipment shall be constructed, and the development of clean coal combustion technology and flue gas treatment equipment shall be speeded up. In September 2004, the first 300-MW air cooling generating unit was commissioned in Zhangze Power Plant of Shanxi Province. In addition, the Jiawang Power Plant of Jiangsu Province being a demonstrative project of PFBC technology and Yantai Power Plant of Shandong Province being a demonstrative project of IGCC technology at a level of 300-400 MW were under verification.

In 2004, thermal power projects newly started to construct at a scale of 1000 MW and above included Huizhou Power Plant (LNG, 1170 MW), Huaneng Yuhuan Power Plant (1200 MW), Huaneng Yangluo Power Plant Phase III (1200 MW), Qianxi Power Plant (1200 MW), Dafang Power Plant (1200 MW), the electricity-coal integrated project of Shaanxi Shenmu

Table 9 Large-sized fossil-fired projects newly commissioned in 2004 (unit capacity 200 MW and above)

No.	Power plant	Location	Capacity commissioned (MW)	Capacity mix (number x MW)	Month of commissioning
1	Waigaoqiao No. 2	Shanghai	1,800	2 x 900	5, 9
2	Dingzhou	Dingzhou, Hebei	1,200	2 x 600	9
3	Qinbei	Jiyuan, Henan	1,200	2 x 600	11, 12
4	Tokto	Hohhot, Inner Mongolia	1,200	2 x 600	7, 9
5	Jiaxing	Jiaxing, Zhejiang	1,200	2 x 600	7, 12
6	Houshi	Houshi, Fujian	1,200	2 x 600	1, 7

Table 9 Large-sized fossil-fired projects newly commissioned in 2004 (unit capacity 200 MW and above)

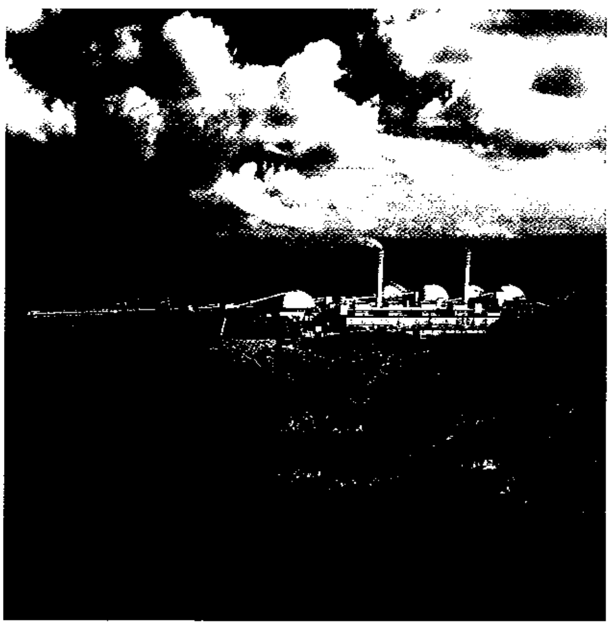
(Continued)

No.	Power plant	Location	Capacity commissioned (MW)	Capacity mix (number x MW)	Month of commissioning
7	Taicanggang	Taicang, Jiangsu	900	3 x 300	5, 7, 11
8	Dalate	Dalate, Inner Mongolia	660	2 x 330	8, 10
9	Xisaishan	Huangshi, Hubei	660	2 x 330	7, 12
10	Heshan	Heshan, Guangxi	660	2 x 330	9, 12
11	Zhangze	Changzhi, Shanxi	600	1 x 600	12
12	Hequ	Hequ, Shanxi	600	1 x 600	11
13	Taishan	Taishan, Guangdong	600	1 x 600	4
14	Tangshan	Tangshan, Hebei	600	2 x 300	1, 9
15	Dengfeng (Huarong)	Dengfeng, Henan	600	2 x 300	7, 9
16	Zhangshan	Changzhi, Shanxi	600	2 x 300	9, 10
17	Yushe	Yushe, Shanxi	600	2 x 300	10, 11
18	Puqi (Huarun)	Chibi, Hubei	600	2 x 300	7
19	Pengcheng	Pengcheng, Jiangsu	600	2 x 300	6, 9
20	Xuzhou (Huarun)	Xuzhou, Jiangsu	600	2 x 300	6
21	Guang'an	Guang'an, Sichuan	600	2 x 300	7, 10
22	Qianbei	Jinsha, Guizhou	600	2 x 300	2, 9
23	Nayong	Nayong, Guizhou	600	2 x 300	3, 9
24	Shentou No. 2	Shuozhou, Shanxi	500	1 x 500	12
25	Pucheng	Pucheng, Shaanxi	330	1 x 330	12
26	Shizuishan No. 2	Shizuishan, Ningxia	330	1 x 330	6
27	Xiagang	Xiagang, Jiangsu	330	1 x 330	12
28	Jianbi	Zhenjiang, Jiangsu	330	1 x 330	9
29	Hengshui	Hengshui, Hebei	300	1 x 300	12
30	Yudong (Yongcheng)	Shangqiu, Henan	300	1 x 300	8
31	Liancheng	Yongdeng, Gansu	300	1 x 300	12
32	Leiyang	Leiyang, Hunan	300	1 x 300	6
33	Maoming Cogeneration	Maoming, Guangdong	300	1 x 300	
34	Shenzhen West	Shenzhen, Guangdong	300	1 x 300	
35	Baihe	Kaixian, Chongqing	300	1 x 300	6
36	Qujing	Qujing, Yunnan	300	1 x 300	5
37	Xuanwei	Xuanwei, Yunnan	300	1 x 300	6
38	Wanjiang	Anqing, Anhui	300	1 x 300	12

Power Plant and Jinjie Coalmine (Phase I, 1200 MW), Huaneng Luohuang Power Plant (Phase III, 1200 MW), Shuangyashan Power Plant (Phase III, 1200 MW), Shenzhen East Power Plant (1170 MW), Shanwei Power Plant (Unit 1 and Unit 2, 1200 MW), Zhuhai Power Plant (Unit 3 and Unit 4 , 1200 MW), Jinzhushan Power Plant (extension, 1200 MW) and Zhejiang Banshan Gas Turbine Power Plant (1170 MW) etc.

● Thermal power operation

The nationwide thermal power operational level had been continuously improved, both the gross coal consumption and net coal consumption rates had somewhat decreased, but due to the ratio of small units had been increased instead of decreased, the decrease of gross coal consumption tended to be slowed down. Because of tense power supply situation plus insufficient water inflow to hydropower stations in recent years, thermal power plants had to increase generation, thus the house service rate and utilization hours were persistently high. Table 10 lists out the trend of net coal consumption, house service rate and utilization hours in recent years.



Houshi Power Plant, the largest thermal power plant in operation

Table 10 Operational economic indexes for thermal power units of 6 MW and above

Year	2000	2001	2002	2003	2004
Net coal consumption (gce/kWh)	392	385	383	380	376
House service rate (%)	7.31	7.25	7.10	6.93	5.95
Utilization hours (h/unit·year)	4,848	4,900	5,272	5,767	5,991

Table 11 Operational reliability indexes for thermal power units of 100 MW and above

Year	2000	2001	2002	2003	2004
Number of units counted	711	754	792	824	888
EAF (%)	90.30	90.64	91.06	91.15	91.70
EFOR (%)	1.99	1.74	1.30	1.37	1.14
UOT (times/unit·year)	2.88	2.81	2.57	2.39	2.10
MTBF (h/unit·year)	3,637	3,686	3,957	4,043	4,574
UTH (h/unit·year)	5,086	5,186	5,530	6,080	7,548

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

The operational reliability indexes and their changing tendency of 100 MW and above thermal power units is shown in Table 11.

■ Nuclear Power

● General situation

Under the situations of serious power shortage in recent years and ever-unveiling constraints of limited primary energy resources and its supply as well as environment pollution to the national economy, the nuclear power industry, being a kind of safe, clean, continuous and bulk power source, has attracted more and more concerns from high-level leaderships and economic departments of China. After stagnation for several years, the State Council held the "National Nuclear Power

Working Conference" in October 2003 on which the guiding ideology for nuclear power development was adjusted as "to vigorously push forward nuclear power development" instead of the previous "to moderately develop nuclear power", and the nuclear power development program was incorporated into the State's medium and long-term development program on electric power for the first time. Since 2004, the nuclear power in China had entered a new historical era of accelerating development. Nuclear power, together with thermal and hydropower, will become three mainstays of power industry in China.

As of the end of 2004, China had five nuclear power plants with nine nuclear units in operation (refer to Table 12), totaling 6836 MW in capacity (actual output around 7000 MW). It was 10.51% increased over the previous year and accounted for 1.55% in the national total capacity. The nuclear electricity generation amounted to 50.5 TWh, or 15.1 % increased over the previous year. It represented 2.3% in the national total generation of 2194.4 TWh.

● Nuclear power construction

The nuclear power projects under construction by the end of 2004 included the Tianwan Project (2x1000 MW), sited in Lianyungang, Jiangsu Province, the Guangdong Ling'ao Phase II Project (2x1000 MW), Qinshan No. 2 Plant Phase II Project (2x650 MW), Zhejiang Sanmen Project (2x1000 MW or 2x1500 MW), and Guangdong Yangjiang Project (2x1000 MW or 2x1500 MW). The first unit of Tianwan Project is expected to commission in June 2005; the units of Ling'ao Phase II and Qinshan No. 2 Plant Phase II will all be put into operation in 2011; and the units of Zhejiang Sanmen and Guangdong Yangjiang will all be put into operation in 2013.

Both the Ling'ao Phase II Project and the Qinshan No. 2 Plant Phase II Project are expansion ones based on the phase I projects by copying and upgrading. Through these projects, the target of independent and domestic design, manufacturing, construction and operation for PWR nuclear power plants can be approached, which will lay foundations for the localization of third-generation nuclear technologies.

The Sanmen Phase I Project sited in Sanmen County, Taizhou City, Zhejiang Province and the Yangjiang Phase I Project sited in Yangjiang, Guangdong Province are two new projects. They are the backing projects for localization of the advanced third-generation PWR technologies of 1000-MW level.

● Operation in nuclear power plants

Qinshan No. 1 Plant is the first domestically designed, constructed, debugged and operated 300-MW nuclear power plant. In the assessment sponsored by WANO in 2004, it entered medium level in eight indexes, among which, five indexes including capacity factor,

Table 12 Nuclear power plants in operation by the end of 2004

No.	Power plant	Location	Plant capacity (MW)	Capacity mix (number X MW)	Reactor type
1	Qinshan No. 1	Haiyan, Zhejiang	300	1x300	PWR, domestic
2	Qinshan No. 2	Haiyan, Zhejiang	1,300	2x650	PWR, domestic
3	Qinshan No. 3	Haiyan, Zhejiang	1,456	2x728	HWR, Canadian
4	Daya Bay	Shenzhen, Guangdong	1,800	2x900	PWR, French
5	Ling'ao	Shenzhen, Guangdong	1,800	2x900	PWR, French

unplanned loss of capacity factor, combined radioactive dose etc. entered top 1/4 level. The capacity factor of the unit reached 99.81% and the times of automatic unplanned reactor shutdown equaled to zero in 2004, creating the historically best record of continuous operation for 448 days.

In Qinshan No. 2 Plant, the capacity factor of Unit 1 reached 80.18% in 2004, both the reactors of Unit 1 and Unit 2 experienced unplanned outage once. Three indexes of Unit 1 and five indexes of Unit 2 exceeded the medium level of WANO.

In Qinshan No. 3 Plant, the capacity factors of units 1 and 2 reached 76.16% and 92.85% respectively, the unplanned reactor shutdown was zero. Five indexes reached medium level of WANO, in which, three indexes including capacity factor, times of unplanned reactor shutdown and radioactive dose entered top 1/4 level.

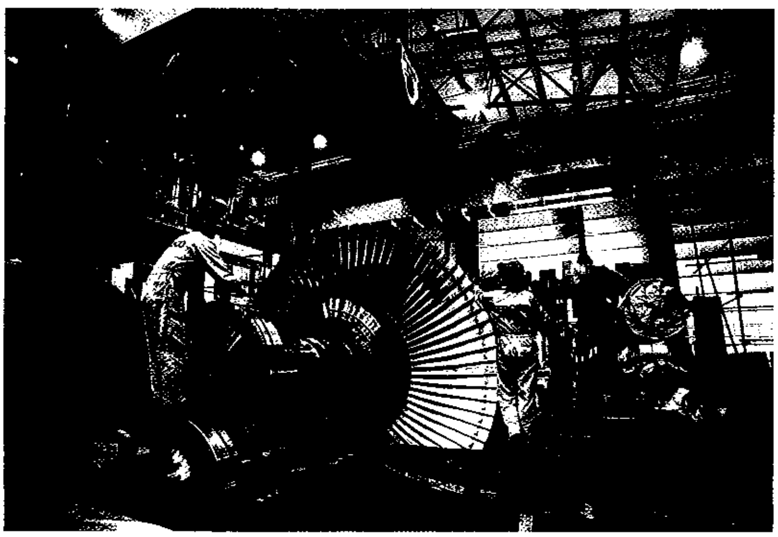
The Daya Bay Nuclear Power Plant had operated safely and stably for ten years. Among WANO's eight critical indexes assessment in 2004, its five indexes exceeded the world medium level, of which the forced loss of capacity and chemical index reached top 1/4 level. The capacity factors of units 1 and 2 reached 87.77% and 73.91% respectively; the times of automatic unplanned reactor shutdown was zero for Unit 1 and once for Unit 2. These two units continuously operated for 411 days and 404 days respectively, creating a new record of longest continuous and safe operating days of Daya Bay Nuclear Power Plant.

The capacity factors of units 1 and 2 of Ling'ao Phase I Project were 88.5% and 80.43% respectively in 2004. Its five indexes exceeded the medium level and three indexes reached top 1/4 level in the assessment of WANO in 2004.

■ Renewable energy and new energy power generation

● General

China has abundant renewable energy resources with huge exploitation potential. Chinese government has been attaching importance to renewable energy development and utilization, and has adopted some incentive policies to support renewable energy development, such as favorable tax rates, favorable price, investment subsidy, appropriation for scientific research and construction of demonstrative projects, etc. By the end of 2004, the capacity of small hydropower reached 38,655 MW, wind power installed capacity reached 764 MW, solar power capacity reached about 65 MW and biomass power capacity reached around 2000 MW. The yearly utilization of renewable energy is around 130



Low-pressure cylinder hoisting, Ling'ao Nuclear Power Plant during construction million tons of standard coal, corresponding to 7% of the nation's total primary energy consumption.

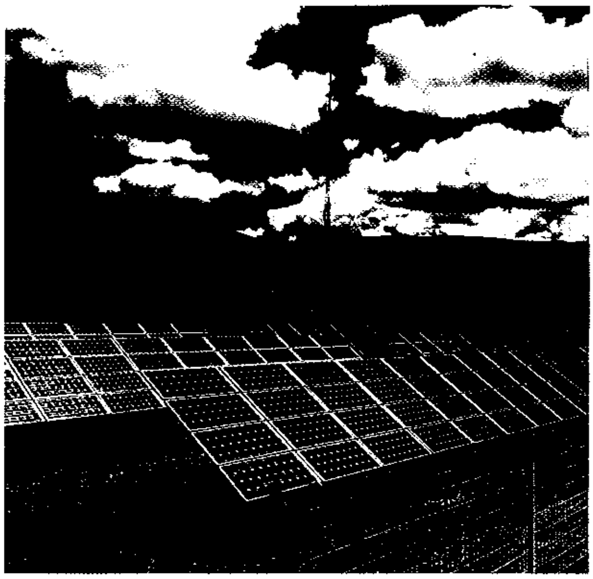
● Regulations and policies for renewable and new energy

To speed up development of renewable and new energy, the State has accelerated to set up associated regulations and policies. In December 2004, the Environment & Resources Committee under the National People's Congress completed the draft of *Law on Renewable Energy* and submitted to the Standing Committee of National People's Congress for preliminary review and approval. The law was expected to be approved in 2005. Some active regulations on energy and environment have certain stipulations in principles when involving renewable energy. These laws and regulations include mainly *Law on Electricity*, *Law Concerning Energy Conservation* and some local regulations and rules.

The State has exercised certain market protection policies for renewable energy, in particular for wind power, solar power and biomass power currently under initial developing stages. Presently, the State implements strong market protection policy for wind power, for example, adopting concession bidding for wind farm development and construction, asking power companies to take the responsibility of constructing electricity send-out projects and buying up the electricity supplied by the concession projects at bidding prices. Recently, the departments concerned are studying policies about quota system, funds and fixed purchase prices involved in renewable energy projects.

Besides, the State has also implemented incentive policies for renewable energy projects, including favorable tax duty, favorable price or price subsidy as well as discount loans.

Favorable tax duty Currently, spare parts of wind power and photovoltaic equipment have been granted favorable customs duties. The value-added tax for marsh



A photovoltaic power station in Yajiang County, Sichuan Province

gas is levied on 13%, small hydropower levied on 6%, wind power levied on half tariff, and for the value-added tax for ethanol fuel production (only for pilot projects) and refuse power generation, a system of levy and reimbursement is implemented. Furthermore, the business tax for ethanol fuel production shall be exempted.

Favorable price Power grid enterprises shall buy up electricity generated from renewable energy at a price defined on the basis of repayment of principal and interest plus reasonable profits.

Incentive policies on investment and financing Policy-related measures implemented include mainly to set up special loans, discount loans and interest subsidy for investment. The State executes special economic policies on rural electric power construction, such as direct investment and investment subsidy, of which, the renewable energy development and utilization is one of the main aspects.

● Resources exploitation and construction

Small hydropower

China has abundant natural resources for construction of small hydropower with unit capacity below 50

MW and above 100 kW. The technically exploitable potential amounts to 128 GW with yearly generation 450 TWh, which spreads widely over thirty provinces (municipalities, autonomous regions) and more than 1600 counties (cities). The provincial distribution of technically exploitable small hydropower resources is shown in Fig. 5.

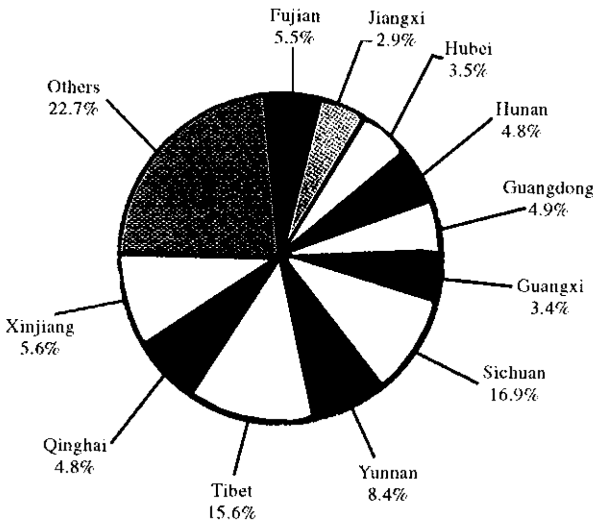


Fig. 5. Distribution of technically exploitable small hydropower resources in main provinces

As of the end of 2004, small hydropower stations constructed in more than 1500 counties (cities) of nationwide thirty provinces (municipalities, autonomous regions) amounted to more than 42,000. The total installed capacity reached 38,655 MW and yearly generation reached 110.46 TWh, accounting for 36.7% of nation's total hydropower capacity of 105,240 MW and 33.4% of total hydro-electricity generation of 331.0 TWh, respectively (refer to Table 13 for detail).

To speed up small hydropower exploitation and construction, demonstrative projects of substituting small hydropower for fuels are now under way in 26 counties of five provinces as part of the ecological protection engineering. According to the State's program, these projects will solve the problems with living fuel for 104 million people through newly constructing small hydropower stations of 24 GW to the year 2020. Upon completion, deforestation can be reduced by 149 million m^3, areas of forest can be protected by 226,667 km^2, and emissions of carbon dioxide can be reduced by 41 million tons, thus, the ecological benefits will be remarkable.

Wind power

The exploitable wind energy resources amount to 253 GW onshore and 750 GW offshore, totaling 1000 GW. The wind energy resources distribute widely in China, mainly in southeast coastal areas and islands, northwest China, northeast China, north China and Qinghai-Tibet Plateau.

By the end of 2004, fourteen provinces (municipalities, autonomous regions) had exploited wind energy. 43 wind farms were constructed, and 1291 wind power units were installed in these provinces with a total capacity of 764 MW (refer to Table 14 for detail). As compared with the total wind power installed capacity of 567 MW in 2003, the wind power capacity increased by 34.7% in 2004. As of the end of 2004, the number of wind farms of 10 MW and above amounted to 22, with a total installed capacity of 663.02 MW (refer to Table 15 for detail). Among fourteen provinces having already exploited wind energy, the three top provinces are Inner Mongolia (135 MW), Xinjiang (124 MW) and Liaoning (113 MW).

There were 3 wind farms and 250 wind power units

Xinjiang Dabancheng Wind Farm

Table 13 Rural hydropower installed capacity and electricity generation in 2004

No.	Administrative division	Installed capacity (kW)	(%)	Electricity generation (GWh)	(%)
1	Total	38,655,048	100.00	110,455.27	100.00
2	Beijing	42,920	0.11	28.97	0.03
3	Tianjin	5,000	0.01	0.42	0.00
4	Hebei	331,910	0.86	371.74	0.34
5	Shanxi	150,930	0.39	344.60	0.31
6	Inner Mongolia	52,730	0.14	83.17	0.08
7	Liaoning	343,549	0.89	852.41	0.77
8	Jilin	364,248	0.94	977.40	0.88
9	Heilongjiang	210,095	0.54	528.67	0.48
10	Jiangsu	59,786	0.15	82.57	0.06
11	Zhejiang	2,550,304	6.60	3,894.90	3.53
12	Anhui	591,058	1.33	1,201.06	1.09
13	Fujian	4,682,908	12.11	10,362.55	9.38
14	Jiangxi	1,629,506	4.22	3,181.87	2.88
15	Shandong	68,228	0.18	113.18	0.10
16	Henan	330,638	0.86	796.74	0.72
17	Hubei	2,443,425	6.32	6,805.26	6.16
18	Hunan	3,221,418	8.33	9,899.77	8.96
19	Guangdong	5,190,862	13.43	10,964.26	9.93
20	Guangxi	2,457,987	6.36	7,586.82	6.87
21	Hainan	240,243	0.62	655.65	0.59
22	Chongqing	1,196,524	3.10	4,760.86	4.31
23	Sichuan	5,203,675	13.46	21,437.66	19.41
24	Guizhou	1,128,397	2.92	4,569.80	4.14
25	Yunnan	3,313,801	8.57	12,366.03	11.20
26	Tibet	422,440	1.09		
27	Shaanxi	560,330	1.45	1,715.01	1.55
28	Gansu	647,525	1.68	2,357.61	2.13
29	Qinghai	304,325	0.79	1,383.61	1.25
30	Ningxia	61,200	0.16	99.45	0.09
31	Xinjiang	588,839	1.52	1,994.18	1.81
32	Xinjiang Corps	153,647	0.40	607.54	0.55
33	Ministry of Water Resources	106,600	0.28	451.47	0.41

newly added in 2004, with a total installed capacity of 200.1 MW. As compared with the newly-added capacity of 98 MW in 2003, the growth rate of newly added wind power capacity reached 104% in 2004. The accumulated and newly added wind power capacities in recent years are shown in Fig. 6.

In 2004, China has 19 wind farms under construction with a total generating capacity of 517.8 MW. Among them, 13 wind farms are of 10 MW and above capacity, including Rudong (100.0 MW), Huilai (100.0 MW), Taobei (50.0 MW), Zhangbei Manjing (45.0 MW), Shangyi Manjing (34.5 MW), Saihanba (30.0 MW), Liu'ao (30.0 MW), Helan Phase II Project (25.0 MW), Shanwei Phase II Project (20.0 MW), Nanhui (16.5 MW), Jiugongshan (13.6 MW), Yumen (11.9 MW) and Helan Expansion Project (10.2 MW). Among these projects, the Rudong, Huilai and Nanhui are newly started to construct.

Solar power

China has rich solar energy resources, according to estimation, land surface receiving solar radiation amounts to 5×10^{22} Joules, equivalent to 1700 billion tons of standard coal. Presently solar energy utilization in China is mainly through photovoltaic cells for household use in remote and bordering areas. By the end of 2003, the photovoltaic cells installed in China amounted to 50 MW in total capacity. In the meantime, the roof top photovoltaic system linked to power network had started test and demonstrative project. This lays a foundation for large-scale utilization of solar photovoltaic power. The first roof top solar power generating station has been completed and put into operation in September in Beijing. This solar power generating system, with a total installed capacity of 140 kW, can supply electricity in modes of either isolated from the network or integrated into the network. The demonstrative project of solar energy panel is completed through cooperation between the NDRC and Japan New Energy Industrial Agency.

Table 14 Wind power capacity in fourteen provinces (municipalities, autonomous regions) by the end of 2004

No.	Province (municipality, autonomous region)	Number of units	Installed capacity (kW)
1	Total	1,292	764,370
2	Inner Mongolia	224	135,140
3	Liaoning	202	126,460
4	Xinjiang	224	113,050
5	Guangdong	177	86,390
6	Ningxia	65	55,250
7	Gansu	74	52,200
8	Heilongjiang	47	36,300
9	Hebei	66	35,050
10	Zhejiang	69	34,450
11	Shandong	47	33,565
12	Jilin	49	30,060
13	Fujian	24	12,800
14	Hainan	19	8,755
15	Shanghai	5	4,900

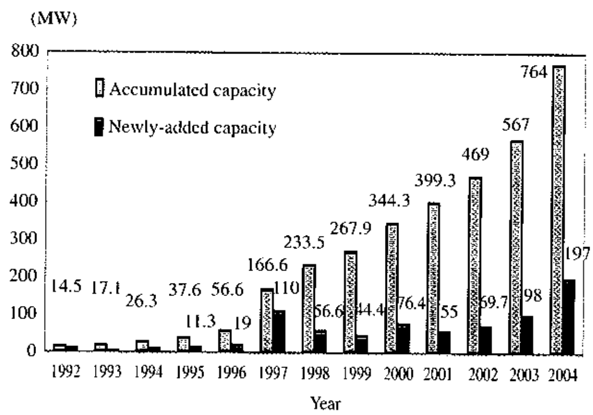


Fig. 6 The accumulated and newly-added wind power capacity in recent years

Biomass energy power

China has also abundant biomass energy resources. The generating capacity of biomass energy amounts to 2000 MW, in which, the generating capacity from bagasse amounts to 1700 MW, the remaining are from agricultural wastes, such as rice chaffs, straws, etc, forest product residuals and municipal wastes.

Table 15 Wind farms of 10 MW and above by the end of 2004

No.	Wind farm	Location	Number of units	Installed capacity (kW)
1	Total		1,065	663,020
2	Dabancheng No. 2	Dabancheng, Xinjiang	157	82,800
3	Huitengxile	Huitengxile, Inner Mongolia	94	68,500
4	Nan'ao	Shantou, Guangdong	130	56,690
5	Helan	Helan, Ningxia	65	55,250
6	Yumen	Yumen, Gansu	74	52,200
7	Dali	Chifeng, Inner Mongolia	73	51,360
8	Xianrendao	Yingkou, Liaoning	47	31,660
9	Tongyu	Tongyu, Jilin	49	30,060
10	Dabancheng No. 1	Dabancheng, Xinjiang	58	28,000
11	Fujin	Fujin, Heilongjiang	27	24,300
12	Chengde	Chengde, Hebei	40	24,000
13	Donggang	Donggang, Liaoning	38	22,450
14	Haiyanghong	Dandong, Liaoning	28	21,000
15	Kuocangshan	Kuocangshan, Zhejiang	33	19,800
16	Shanwei	Shanwei, Guangdong	25	16,500
17	Jimo	Jimo, Shandong	15	16,400
18	Hedingshan	Hedingshan, Zhejiang	26	14,350
19	Huilai	Huilai, Guangdong	22	13,200
20	Changdao	Changdao, Shandong	20	12,300
21	Mulan	Mulan, Heilongjiang	20	12,000
22	Kangping	Kangping, Liaoning	12	10,200
23	Zhangwu	Zhangwu, Liaoning	12	10,200

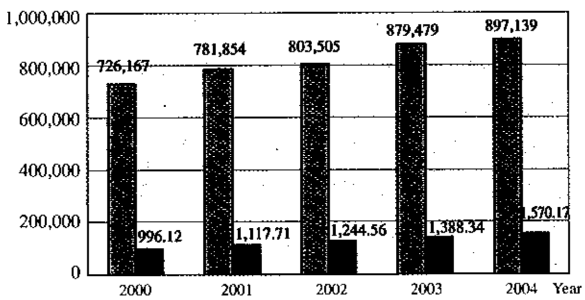
The first refuse incineration power plant of China was commissioned in 1987 in Shenzhen; the first landfill gas power generating unit was commissioned in 1997 in Hangzhou; and a 1250-kW landfill gas power plant (with a total designed capacity of 5000 kW) has been constructed in Nanjing. Presently, a batch of landfill gas power plants are being constructed in Shanghai, Beijing etc, each with a planned capacity of around 10 MW and around 100 MW in total. Wuxi Landfill Gas Power Plant, the first landfill gas power plant developed and constructed domestically, was formally put into operation and linked to power grid in October 2004. This project is a part of the Program of the State's Action on Landfill Gas Collection and Use in China jointly pushed forward by China and UNDP. Currently it is installed with two power units with yearly electricity generation under full load operation reaching 15,300 MWh.

Power Grid Construction and Operation

■ General

Pushed forward by incessant growth of power demand, power sources construction in China has expanded with unprecedented scale and power grid construction has been accordingly booming. As of the end of 2004, the nation's total length of transmission lines on 35 kV and above voltage reached 897,139 km, or 2% increased over the previous year; the total substation capacity of 35 kV and above reached 1,570,171 MVA, or 13.1% increased over the previous year.

The growth of transmission lines and substation capacity of 35 kV and above in recent years are shown in Fig. 1.



	2000	2001	2002	2003	2004
Length (km)	726.167	781,854	803,505	879,479	897,139
Capacity (GVA)	996.12	1,117.71	1,244.56	1,388.34	1,570.17

Fig. 1. Transmission lines and substation capacity of 35 kV and above from 2000 to 2004

Power grids in China mainland are all operated and managed by the State Grid Corporation (abbreviated to SG) and China Southern Power Grid Corporation Ltd. (abbreviated to CSG). Under the management of the SG, there are the Northeast, Northwest, North China, East China and Central China five large regional power grids and three isolated regional power grids (Xinjiang, Tibet and Inner Mongolia). The CSG takes the responsibility for operating and managing Guangdong, Guangxi, Yunnan, Guizhou and Hainan five provincial (regional) power grids. The basic conditions of regional power grids by the end of 2004 are as follows.

Northeast Power Grid

Northeast Power Grid, covering Liaoning, Jilin and Heilongjiang provinces, has transmission lines of 99,261 km and a substation capacity of 144,665 MVA on 35 kV and above voltage. The 500-kV trunk power network extends longitudinally north from Heilongjiang south to Liaoning, all linked by three or four circuits of 500-kV lines between Liaoning and Jinlin as well as between Jilin and Heilongjiang to ensure bulk power transmission between north and south. The east grid of Inner Mongolia is closely linked with Northeast Power Grid through 500-kV double-circuit lines to connect Yuanbaoshan and Yimin power plants with the main grid.

North China Power Grid

North China Power Grid covers Beijing and Tianjin municipalities and Shanxi, Hebei and Shandong provinces and western part of Inner Mongolia. Within this power grid, the total length of transmission lines on 35 kV and above amounted to 169,189 km, and the substation capacity of 364,036 MVA. The voltage level of trunk network is on 500 kV, on which, the Beijing-Tianjin-Tangshan Power Grid (including north grid of Hebei) receives bulk power from coal bases in Shanxi and western part of Inner Mongolia through multiple 500-kV AC circuits. The northern part of North China Power Grid has been connected with Northeast Power Grid (from Suizhong Power Plant) through 500-kV tie-line. The interconnection between North China Power Grid and East China Power Grid is in a manner of "point to grid" connection, i.e., from Yangcheng Power Plant of Shanxi Province sending power through 500-kV AC double-circuit lines directly to East China Power Grid. This 500-kV power grid has also extended from south part of Hebei directly to Shandong Provincial Power Grid forming the main trunk network in "Y" shape.

Northwest Power Grid

The Northwest Power Grid is a power grid having largest coverage in China. Its service area occupies one-third the China territory, including Shaanxi, Gansu, Qinghai, Ningxia and Xinjiang five provinces (autonomous regions). Except the Xinjiang Power Grid located in remote bordering region and isolated from the main grid having its trunk voltage level temporarily on 220 kV, all the remaining four provincial power grids have their trunk network voltage level on 330 kV, or the unique inter-provincial power grid having its highest voltage level on 330 kV in China. The total length of transmission lines on 35 kV and above reached 104,871 km and total capacity of transformers on different levels amounted to 101,089 MVA.

East China Power Grid

East China Power Grid covers the most economically developed areas in China. There are Shanghai, Jiangsu, Zhejiang, Anhui and Fujian provinces. This power grid has a total transmission line length of 151,540 km and a total substation capacity of 409,316 MVA on 35 kV and above voltage level. Its 500-kV trunk network extends from north to south through multiple double-circuit lines with Shanghai, Jiangsu and Zhejinag as its center, forming a strong trunk network.

Central China Power Grid

Central China Power Grid covers Hubei, Henan, Hunan, Jiangxi, Sichuan provinces and Chongqing Municipality. The grid has a total length of transmission lines of 205,753 km on 35 kV and above voltage level, it is the largest power grid in China, the corresponding total substation capacity reached 263,771 MVA, its service area covers 1,298,000 km^2, and a service population of 382 million, it is thus a regional power grid providing power service for the largest population and with the first 500-kV trunk network constructed in China. The Central China Power Grid is also a center of typical "power from west to east, and power complementation between north and south" projects. A batch of famous hydropower stations, such as the Three Gorges Station, Gezhouba Station, Ertan Station, etc. constructed along the Yangtze River forms an interconnected power grid west from Ertan Station of Sichuan extending eastward to East China Power Grid through three ± 500-kV DC lines. Meanwhile, from Henan passing Hubei through Hunan forms a longitudinal channel for mutual compensation between thermal power and hydropower.

South China Power Grid

South China Power Grid covers Guangdong, Guangxi, Yunnan, Guizhou and Hainan provinces (autonomous region). Presently, the Hainan Provincial Power Grid has not yet been connected with the main grid (the cross-strait transmission line is now under construction). This grid has a total transmission length of 156,329 km on 35 kV and above voltage and a substation capacity of 273,997 MVA. The trunk network of the grid is a 500-kV AC/ ± 500-kV DC hybrid system. Power is transmitted from Tianshenqiao Hydropower Station of Guangxi through one ±500-kV DC line and three 500-kV AC lines to Guangdong, from Guizhou through one ± 500-kV DC circuit and 500-kV AC double-circuit to Guangdong, and from the Three Gorges Station to Huizhou of Guangdong through one ± 500-kV DC circuit. All the receiving ends are at Zhujiang River Delta. (The Hainan Provincial Power Grid is currently an isolated 220-kV AC system).

Tables 1, 2 and 3 give out transmission line length, number of substations and substation capacities of all regional power grids on different voltage levels and 500-kV DC transmission length and converter capacities in 2004. Fig. 2 shows a schematic diagram of inter-regional power grids in China.

Table 1 Transmission line length by grid by the end of 2004

(in km)

Grid	Total	500 kV	330 kV	220 kV	110 kV	35 (66) kV
Northeast Power Grid	99,261	5,778		25,095	6,080	62,310
North China Power Grid	169,189	11,301		35,030	50,135	72,721
Northwest Power Grid	104,871		10,722	6,801	39,118	48,229
East China Power Grid	151,540	11,332		31,489	43,031	65,678
Central China Power Grid	205,753	11,760	50	32,816	67,037	88,690
South China Power Grid	156,329	7,172		27,005	56,081	66,071
Tibet Power Grid	3,088				1,512	1,577

Table 2 Substation capacities by grid by the end of 2004

(in MVA)

Grid	Total	500 kV	330 kV	220 kV	110 kV	35 (66) kV
Northeast Power Grid	144,665	23,061		48,889	8,886	63,849
North China Power Grid	364,036	40,424		117,092	137,367	69,153
Northwest Power Grid	101,089		20,640	13,446	49,058	17,946
East China Power Grid	409,316	62,991		131,695	132,291	82,419
Central China Power Grid	263,771	26,318		83,088	116,237	38,128
South China Power Grid	273,997	45,750		89,176	117,587	21,484
Tibet Power Grid	901				432	469

Table 3 500-kV DC transmission line length and converter capacity by the end of 2004

Items	SG	CSG
Line length (km)	3,827 (3,856)	2,132 (1,842)
Converter transformer capacity (MVA)	11,400 (14,400)	12,600 (9,600)

Note: Figures in ( ) indicate different ownerships.

■ Power grid construction

Power grid construction was prosperous in 2004. The investment in power grid construction of different kinds totaled more than 130 billion Yuan, of which the SG alone invested 74.5 billion Yuan in large- and medium-sized transmission and substation projects; the CSG invested 16.7 billion Yuan. The transimission line length and substation capacity commissioned on 110 kV and above voltage level in 2004 are shown in Table 4.

Power grid construction featured in several characteristics. 1) The "power transmission from west to east," "power transmission from north to south" and power grid interconnection projects are prominently emphasized. 2) The trunk network construction of all regional and provincial power grids, in particular the receiving-end power grid construction are strengthened.

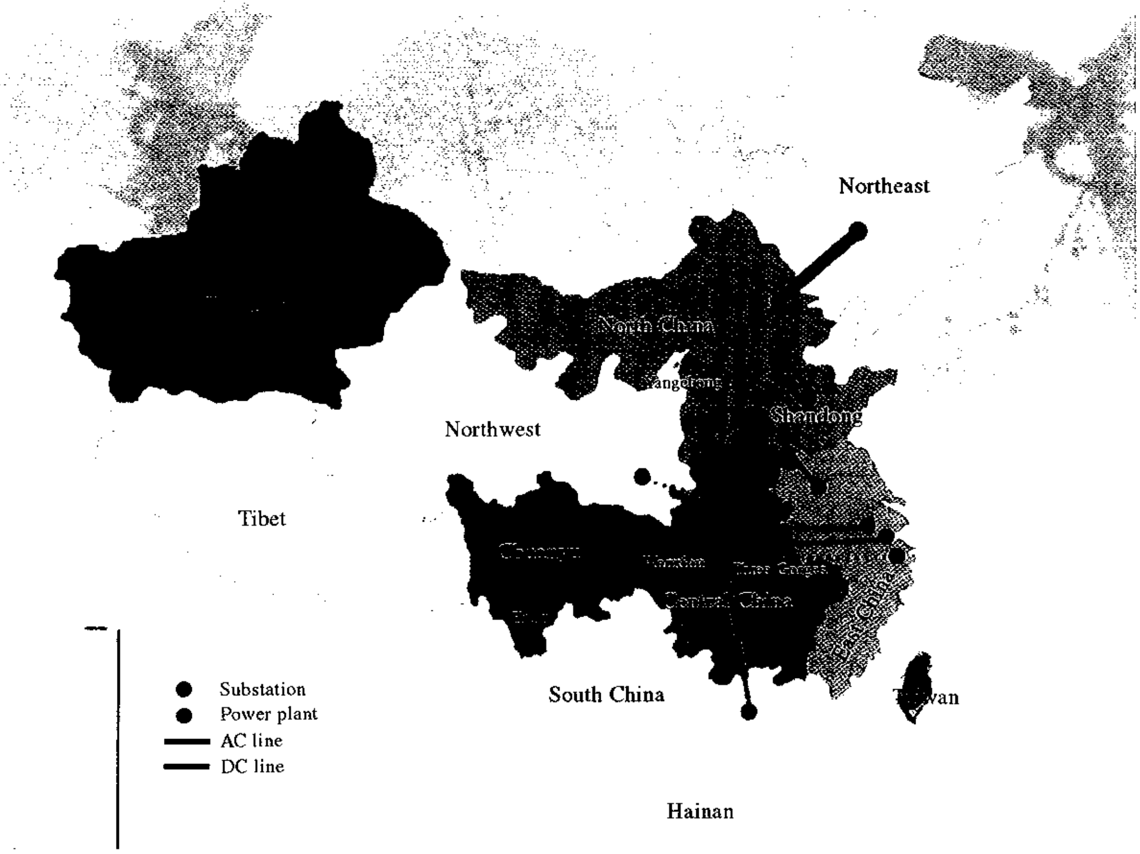


Fig. 2 Schematic diagram of inter-regional power grid connections in China

Table 4 Transmission line length and substation capacity commissioned in 2004 (110 kV and above)

Voltage (kV)	500*	330	220	110
Line length (km)	11,149	547	14,033	28,594
Substation capacity (MVA)	51,000	1,830	60,250	122,820

* Including DC lines

3) Transmission projects for completing large-sized, newly-built power sources are going on smoothly. 4) Power grid projects proceeded appropriately in advance.

Some main transmission projects are described as follows.

Three Gorges transmission phase II project

The Three Gorges transmission phase II project includes mainly the outlet project of right bank station, the 500-kV AC line and substation project (from Central China Power Grid to East China Power Grid) and ± 500-kV DC line and converter station project (from the Three Gorges to Guangdong). The DC transmission project from the Three Gorges to Guangdong was fully constructed and commissioned in May 2004, its domestication rate of main equipment reached around 50%. Besides, other ten circuits of 500-kV AC transmission lines and six 500-kV AC substation projects had been constructed (expanded) and commissioned. The ± 500-kV DC transmission project from the Three Gorges' right bank to Shanghai (T-S project for short) with a transmission capacity of 3000 MW and a total transmission distance of 1075 km started to construct in 2004; in addition, four circuits of 500-kV AC transmission lines and eight 500-kV AC substations had newly started to construct, among which, the "T-S" DC transmission is the key project with domestication rate of 70%.

Lingbao DC "back to back" project

The Lingbao DC "back to back" project for interconnection between Central China Power Grid and Northwest Power Grid is the first constructed DC "back to back" demonstrative project in China to realize asynchronous connection between two large regional power grids. The project employed +120-kV unit connection scheme, the transmission capability reached 360 MW, the valve current 3000 A. All equipment made on trial in China has now been basically installed. It is predicted to be commissioned early in 2005.

Jiangyin 500-kV long cross-over project

To expand power transmission capability from Jiangsu to Shanghai, the East China Power Grid constructed Jiangyin 500-kV double-circuit long cross-over (Yangtze River) project from Yangzhong to Doushan. The span of this long crossing is as long as 2303 m, it ranks the third in the world; the height of tower on both sides is 346.5 m, it is the world highest tower, even 25.8 m higher than the famous Eiffel Tower in Paris. The weight of single tower is 4192 tons, also the heaviest in the world. This project was completed and put into operation in November 2004, the maximum transmission capability reached around 6500 MW.

Northwest 750-kV transmission demonstrative project

This domestic constructed above 500-kV voltage level transmission project first in China starts from 750-kV Guanting Substation in Qinghai Province and ends at 750-kV East Lanzhou Substation in Gansu Province, with a transformer capacity of 1500 MVA and a transmission distance of 153 km. This project, situated at northwest plateau with an altitude between 1830-2880 m, imposes special requirements on insulation, anti-pollution and reducing corona losses, etc. Through a series of scientific research, the technical indexes or measures and technical specifications for main equipment regarding to system stability control, over-voltage protection and insulation coordination, electro-magnetic environment, corona study, etc. have been put forward. This project is expected to be completed in August 2005.

■ Power grid operation

The feature of power grid operation in 2004 was booming of power demand. The influence of atmospheric temperature on power supply balance tended to be even more significant and the effect of inter-regional power exchanges and complementation between surplus and deficit on power supply balance became more and more prominent. In addition, under the condition of large-scope bulk power transmission and highly increased power demand, there had no system instability and large-area blackout emergency occurred on main power grids in the year.

Along with gradual improvement of power grid construction and operational management, the rate of line losses decreased to 7.55%, of which, the SG was 6.95%, and that of the CSG was 7.43%. The variation of line losses from 1995 to 2004 is shown in Fig. 3.

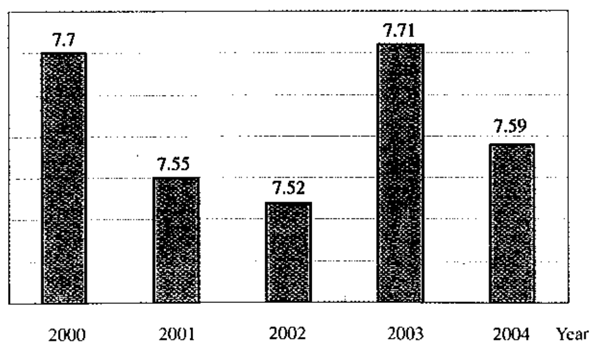


Fig. 3 Trend of line losses from 2000 to 2004

● Power exchange

The gradual formation of interconnected power grid had created fundamental material basis for rational allocation of power energy resources in large scope.

Power exchange included the exchange between regional power grids under the SG, the exchange between provincial power grids under regional power grids and the exchange between the SG and the CSG.

Inter-regional power exchange

Table 5 lists out electricity exchanges and their growth rates between regional power grids.

Inter-provincial power exchange under regional power grids

Table 6 lists out power exchanges and their growth rates between provincial power grids.

Electricity transmitted from the Three Gorges to regional power grids

From tables, 5, 6 and 7, it can be seen that: 1) the electricity generation of the Three Gorges Station has grown very fast, it was 353.59% over 2003; 2) the electricity exchanges between regional power grids have increased, as compared with that in 2003 (including the electricity transmitted from the Three Gorges), the growth reached 83.78%; 3) the electricity exchanges between provincial power grids under regional power grids tended to increase, as compared with that in 2003, the growth reached 33.87%. These data indicate that along with setting up power market mechanism and gradual improvement, the power exchange between power grids will tend to increase.

● Power supply reliability

Power supply reliability indexes of 10-kV customers

10-kV customers' data from nationwide 316 power supply enterprises are collected and summarized in Table 8.

The power service reliability index (RS1) is calculated from power outages of all customers, it truly reflects the power supply capability of the power system. The RS3 is the power service reliability after deducting the issues of power curtailments, which reflects directly the present condition of urban power grids and the comprehensive management level of power supply enterprises.

Table 9 shows the variation of power service reliability indexes of these enterprises since 1995. From the table it can be seen that the power service reliability index had always been ascending and reached the highest in 2002, but somewhat descended in subsequent two years. It is attributable to power shortage, and is impressive from RS3 data.

Reliability indexes of HVDC transmission system

There were five HV DC systems in 2004 in China, among which, Ge-Nan (from Gezhouba of Hubei to Nanqiao of Shanghai), Long-Zheng (from Longquan of

Table 5 Electricity exchanges between regional power grids

Direction of power transmission	Electricity transmitted (TWh)		
	2003	2004	Growth rate (%)
Central China to East China	14.183	26.934	89.90
East China to Central China	0.000	0.427	
Northeast to North China	4.272	4.552	6.55
SG to CSG	1.779	14.708	726.76
CSG to SG	1.019	1.430	40.33
Yangcheng Power Plant to Jiangsu Power Grid	10.402	11.336	8.98

Table 6 Electricity exchanges and their growth rates between provincial grids

Grid	Direction of power transmission	Electricity transmitted (GWh)		
		2003	2004	Growth rate (%)
North China Power Grid	West Inner Mongolia to Jing-Jin-Tang	8,993.32	8,015.55	-10.87
	Shanxi to Jing-Jin-Tang	2,100.45	2,982.00	41.97
	Hebei to Jing-Jin-Tang	13.56	1,878.67	13,754.50
	Jing-Jin-Tang to Hebei	2,951.38	3,148.92	6.69
	Shanxi to Hebei	2,030.91	2,050.26	0.95
Northeast Power Grid	Northeast China Grid Company to Liaoning	7,997.84	9,091.93	13.68
	Northeast China Grid Company to Jilin	5,142.57	7,053.02	37.15
	Northeast China Grid Company to Heilongjiang	4,803.73	5,315.13	10.65
	Liaoning to Northeast China Grid Company	107.68	77.72	-27.82
	Liaoning to Jilin	62.86	6.45	-89.74
	Jilin to Northeast China Grid Company	1,082.35	1,127.74	4.19
	Jilin to Liaoning	6,138.40	10,919.01	77.88
	Jilin to Heilongjiang	211.39	110.36	-47.79
	Heilongjiang to Northeast China Grid Company	11.50	35.86	212.09
	Heilongjiang to Jilin	5,437.15	7,898.48	45.27
Northwest Power Grid	Shaanxi to Gansu	4,392.13	4,083.62	-7.02
	Gansu to Shaanxi	47.14	221.19	369.23
	Qinghai to Gansu	659.74	771.01	16.87
	Gansu to Qinghai	2,217.55	2,570.32	15.91
	Ningxia to Gansu	409.29	725.40	77.24
	Gansu to Ningxia	2,654.85	3,275.70	23.39
East China Power Grid	Jiangsu to Shanghai	4,737.33	5,983.13	26.30
	Shanghai to Jiangsu	48.33	97.62	101.99
	Jiangsu to Anhui	0.55	27.43	4,887.27
	Anhui to Jiangsu	5,358.64	3,894.47	-27.32
	Jiangsu to Zhejiang	8,209.67	10,243.33	24.77
	Zhejiang to Jiangsu	65.65	7.21	-89.02
	Anhui to Zhejiang	5,815.15	5,668.65	-2.52
	Zhejiang to Anhui	2.33	2.55	9.44
	Shanghai to Zhejiang	1,823.57	2,976.89	63.25
	Zhejiang to Shanghai	3,283.55	2,297.70	-30.02

Table 6 Electricity exchanges and their growth rates between provincial grids

(Continued)

Grid	Direction of power transmission	Electricity transmitted (GWh)		
		2003	2004	Growth rate (%)
East China Power Grid	Zhejiang to Fujian	677.15	921.60	36.10
	Fujian to Zhejiang	3,103.45	412.24	-86.72
Central China Power Grid	Hubei to Henan	3,542.93	3,256.28	-8.09
	Hubei to Hunan	2,175.65	3,694.34	69.80
	Hubei to Jiangxi	15.40	536.94	3,386.67
	Hubei to Chongqing	0.00	1,374.80	
	Henan to Hubei	349.52	529.44	51.48
	Hunan to Hubei	407.31	348.00	-14.56
	Jiangxi to Hubei	2,156.30	395.73	-81.65
	Chongqing to Hubei	0.00	1,207.00	
	Sichuan to Chongqing	8,161.41	9,057.87	10.98
	Chongqing to Sichuan	1,262.37	1,483.99	17.56
South China Power Grid	Yunnan to Guangxi	3,648.64	3,707.05	16.00
	Guizhou to Guangxi	1,711.92	2,397.15	40.00
	Yunnan to Guangdong	8,873.77	12,731.14	43.47
	Guizhou to Guangdong	5,333.95	8,408.85	57.65
	Guangxi to Guangdong	245.38	302.50	23.28
	Guangdong to Guangxi	82.82	590.04	612.44
	Guangdong to Hong Kong and Macao	10,566.34	9,958.54	-5.75
	Hong Kong to Guangdong	3,006.62	3,086.26	2.65

Table 7 Electricity transmitted from the Three Gorges to regional power grids

Direction of power transmission	Electricity transmitted (GWh)		
	2003	2004	Growth rate (%)
Three Gorges to East China Grid	3,450	19,790	473.62
Three Gorges to Central China Grid	5,156	11,000	113.34
Three Gorges to South China Grid	0	8,246	

Hubei to Zhengping of Jiangsu), Tian-Guang (from Tianshengqiao of Guangxi to Guangzhou of Guangdong) and Jiang-Cheng (from Jiangling of Hubei to Guangdong) are now under operation, another Gui-Guang (from Guizhou to Guangdong) DC system was commissioned in October 2004 and due to less operating time, it is not included in the statistics. The comparison of main indexes of the four DC systems participated in statistics are listed in Table 10.

From the index comparison, it can be seen that the Jiang-Cheng system had though operated only for

Table 8 Reliability indexes of 316 power supply enterprises for 10-kV customers

Total number of customers	768,389
Total length of overhead lines (km)	168,041
Total length of cable lines (km)	65,501
Total number of distribution transformers	925,037
Total capacity of distribution transformers (MVA)	335,338
RS1 (%)	99.820
Customers' yearly average outage (h)	15.806
RS3 (%)	99.927

Table 9 Variation of nationwide 10-kV power service reliability indexes from 2000 to 2004

Year	Suppliers counted	RS1 (%)	RS3 (%)
2000	286	99.889	99.893
2001	310	99.897	99.898
2002	312	99.907	99.916
2003	312	99.866	99.929
2004	316	99.820	99.927

about half a year, its operating conditions were good, two operational indexes were better than other systems. The energy utilization factor and system total electricity transmitted by Long-Zheng system ranked top among the four systems, hence this Long-Zheng system plays an important role in the Three Gorges' power output.

From statistic data it can be seen that some features of the DC systems under operation arising are as follows.

1) Along with power grid development, DC transmission plays a very important role, the superiority of DC system with its high voltage and large transmission capacity has been revealed day by day. The electricity transmitted in each power grid basically increased in 2004, particularly the electricity transmitted by Long-Zheng DC system reached 20.588 TWh, the energy utilization factor reached 78.13%, entered into advance level in the world.

2) Viewing from the factors affecting system energy availability, system overhauling is still the main reason for the decrease of energy availability, therefore, carefully organizing to shorten the overhauling time and promote system operational reliability index shall be stressed.

3) Double-pole outage is the most sever fault in DC system, it causes directly system shutdown. The most sever event is the bi-pole unplanned outage fault.

Table 10 Comparison of reliability indexes of DC systems in 2004

No.	Index	Ge-Nan	Long-Zheng	Tian-Guang	Jiang-Cheng
1	Energy availability (%)	82.55	92.85	89.23	96.60
2	Energy unavailability (%)	17.45	7.15	10.77	3.40
3	Planned energy unavailability (%)	16.98	6.22	6.09	1.40
4	Unplanned energy unavailability (%)	0.46	0.92	4.68	2.00
5	System service factor (%)	83.19	96.98	95.71	99.25
6	Planned outage times on bi-pole operation (times)	2	0	2	0
7	Planned outage hours on bi-pole operation (h)	1,468.39	0.00	361.29	0.00
8	Unplanned outage times on bi-pole operation (times)	1	0	0	1
9	Unplanned outage hours on bi-pole operation (h)	7.25	0.00	0.00	13.97
10	Energy utilization factor (%)	59.58	78.13	31.80	58.73
11	Total electricity transmitted by the system (TWh)	6.345	20.588	5.028	9.011

Electricity Supply and Consumption

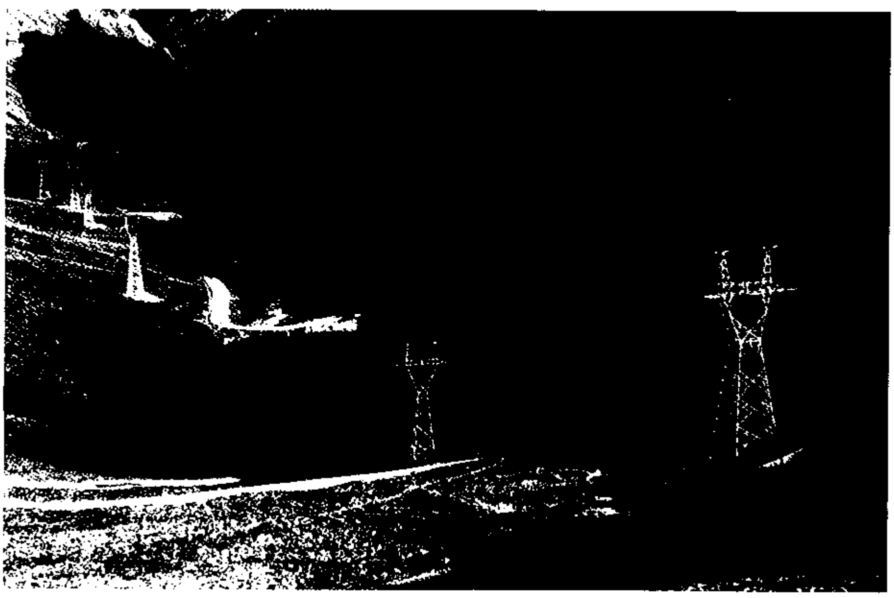
■ Electricity supply

In 2004, the total yearly electricity generation amounted to 2194.4 TWh, it was 15.18% over the previous year and a net increase of 289.2 TWh. Of which, hydro-electricity amounted to 331 TWh, or 17.65% increased, thermal electricity amounted to 1810.4 TWh, or 14.66% increased over the previous year, which accounted for 82.50% of the nation's total. The nuclear electricity generation grew steadily and the yearly generation amounted to 50.5 TWh, or 15.08% increased over the previous year.

In 2004, the water inflow to all reservoirs was a little better than that in 2003, but still lower than the normal year's average and appeared uneven yearly distributed as "prior wet and later dry" in southern areas, while "prior dry then later normal" in northern areas, only except northeast region and Sichuan province had higher rainfall than the normal year.

In 2004, the nation's total hydro-electricity generation increased by 49.6 TWh, or 17.65% increased over the previous year. With five additional units commissioned, the Three Gorges Hydropower Station generated 39.2 TWh of electricity, or increased by 32.3 TWh over the previous year, accounted for around 70% of the newly added hydro-electricity generation this year. If deduct the electricity newly added of the Three Gorges Station, the nation's hydro-electricity generation increased by 17.3 TWh, or 5.2% increased over the previous year.

The yearly accumulated average utilization hours of power generating equipment were 5455 hours, or 210 hours more than that in 2003. Of which, thermal power utilization hour reached 5991 hours, or 224 hours more than that in the previous year. The averaged thermal power utilization hour in Hebei, Shanxi, Inner Mongolia, Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Guangdong, Guangxi, Guizhou, Yunnan, Shaanxi, Gansu, Qinghai and Ningxia all exceeded 6000 hours, in particular



A transmmision line stretching into western China

Guizhou, Qinghai and Ningxia even exceeded 7000 hours.

The inter-regional electricity exchange (including trading electricity) reached 66.033 TWh, or 121% over planned figure and exceeded 11.5 TWh of contracted electricity exchange, or 94% increased over the previous year.

The Three Gorges Station sent out 39.0 TWh of electricity to East China, Central China and Guangdong Province respectively, or 304% increased over the previous year, these have effectively alleviated power shortage situation in respective regions.

The inter-provincial electricity exchange within the region amounted to 153.48 TWh in 2004, or 14.93% over the previous year. The inter-regional and inter-provincial electricity exchange optimized disposition of resources, which became one of the important measures to alleviate power shortage situation.

Considering investments in recent years, the power grid construction was not in pace with and lagged much behind the power sources construction. In 2003, the investments in power sources and power grid construction amounted to 187.1 and 126.5 billion Yuan respectively, the share of investment in power grid construction realized accounted for 40.3%. While in 2004, investment in these two realized 331.4 and 128.1 billion Yuan respectively, the share of investment in power grid dropped to 27.9%, on which bottlenecks on power grids would duly arise to further deepen power shortage situation. In some regions, the long lasting high temperature in summer caused long overloading on lines and transformers, led to more emergency blackouts, the safety reserve margin of power supply decreased, plus obsolescent transmission equipment, foreign damage and natural disasters, the transmission safe and stable operation had been greatly affected.

The main control room of Yuanbaoshan Power Plant in Chifeng, Inner Mongolia

■ Electricity consumption

Due to strong traction of persisting rapid growth of national economy, the national social electricity consumption broke 2000 TWh record, hit 2176.1 TWh, or 15.18% increased over 2003, it was the second year of high-speed growth following 2003 since implemented reform and open policy. The electricity consumption of primary industry amounted to 60.3 TWh, or 1.29% increased; that of secondary industry amounted to 1627.5 TWh, or 16.58 % increased, the tertiary industry consumed 242.8 TWh, or 15.18% increased and the urban and rural residential consumption amounted to 245.6 TWh, or 10.12% increased. As compared with the same period of 2003, the growth rate of primary and tertiary industries had a little increased, while that of the secondary industry kept basically unchanged, the growth rate of residential consumption decreased by 1.7 percentage points, of which, urban consumption increased 9.28%, but 6.8 percentage points lower than the growth rate in 2003; the rural residential consumption increased 11.41%, it was 5.6 percentage points higher than that in 2003. The industrial electric consumption amounted to 1605.3 TWh, or 16.57% increased over the previous year, the share of industrial consumption further escalated to 73.77%, in which, the booming of high electricity consuming industries such as ferrous metallurgy, non-ferrous metallurgy, construction materials, chemical industry, an increase of 18.17%, was the main reasons attributed to the rapid growth of industrial electric consumption.

The social electricity consumption growth reached a peak in February in 2004, the growth rate was 16.19% from January to February (refer to Fig. 1) and 16.1% from January to April, of which, 2.92% growth in primary industry, 18.25% growth in secondary industry, and 12.98% growth in tertiary industry. From Fig. 1 we can see, after the state macroscopic regulation policy put forward, the rise rate of social electricity consumption in the month of the same period tended to decline since May, in which, the secondary industry increased by 16.44% and the tertiary industry increased by 16.01%, which demonstrated the government macroscopic regulation achieved preliminary effects, the growth of industrial consumption tended to be slowed down and the tertiary industry tended to be speeded up, this indicated the industrial structure developed toward expectancy.

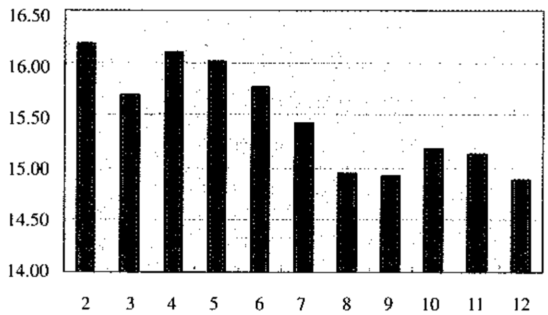


Fig. 1 Monthly growth rate of electricity consumption in the whole society

However, the growth of electricity consumption had a back spring in October, it reached 15.17% from January to October, but fell back to 14.88% in the whole year.

Along with the per capita GDP exceeded US$1000 and the progress of constructing the grand project of well-off society, the electricity consumption has grown persistently higher than economic growth, the specific

Table 1 Power demand intensity by industry and trade in 2004

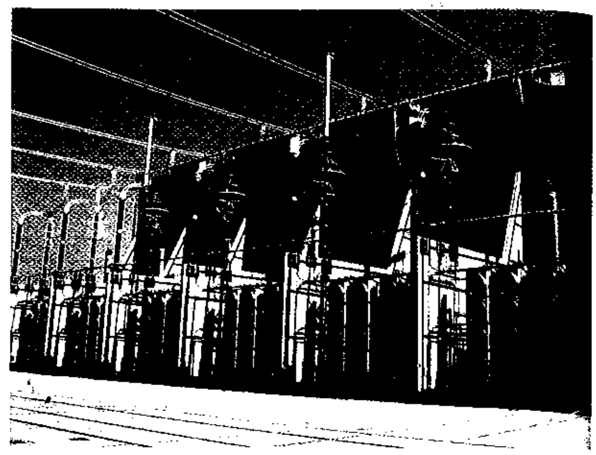
Period in month	Secondary industry	Tertiary industry	Heavy industry	Light industry	Ferro. industry	Constr. material	Nonferro industry	Chemi. industry	Urban resid.	Rural resid.
1-2	1.116	0.843	1.140	1.044	1.743	1.781	1.505	0.813	0.369	1.202
1-3	1.120	0.825	1.187	0.887	1.856	1.318	1.393	0.759	0.627	0.744
1-4	1.134	0.806	1.188	0.934	1.830	1.242	1.294	0.756	0.604	0.511
1-5	1.122	0.898	1.163	0.963	1.798	1.215	1.397	0.711	0.671	0.420
1-6	1.103	0.990	1.143	0.951	1.665	1.256	1.130	0.840	0.646	0.495
1-7	1.078	1.083	1.097	0.997	1.568	1.220	1.316	0.798	0.688	0.602
1-8	1.099	1.072	1.139	0.946	1.697	1.145	1.258	0.781	0.567	0.577
1-9	1.102	1.073	1.151	0.919	1.694	1.114	1.194	0.827	0.575	0.657
1-10	1.106	0.997	1.169	0.879	1.728	1.085	1.162	0.914	0.576	0.593
1-11	1.092	1.013	1.145	0.897	1.703	1.109	1.125	0.997	0.592	0.693
1-12	1.103	1.024	1.147	0.927	1.686	1.079	1.172	0.881	0.503	0.621
Policy effects	-0.031	0.218	-0.041	-0.007	-0.144	-0.163	-0.122	0.125	-0.101	0.110

Note: Power demand intensity is the ratio of electricity consumption growth rate of a trade to that of the whole society. If the power demand intensity of any trade is greater than 1, it means this trade has developed quicker than others.

consumption per GDP was continuously upward. In 2004, the specific consumption per GDP was 174.6 kWh/thousand Yuan (on 2000 constant money), it was 8.6 kWh/thousand Yuan higher than that in 2003, which led to more than 100 TWh of electricity additionally consumed; the electric elasticity coefficient was 1.57, and greater than 1 in five successive years. The specific consumption per unit GDP in 2004 was 16% increased over 2000.

Table 1 shows that the power demand intensity of secondary industry increased from 1.1155 at the beginning of 2004 to 1.13354 between January and April, the growth amplitude was 0.01804. Since the state macroscopic regulation policies have been put forward in succession since April 2004, the power demand intensity fall back to 1.07847, the decrease amplitude was 0.05507. From this can be seen that in initial period of implementing the state macroscopic regulation policy, the effect was significant. It had a little leap upward since August, it was 1.10613 from January to October, with a growth amplitude of 0.02766, appeared a strong back leaping. The currency policy of the People's Bank of China to increase interest by 0.027% on October 29, it induced the power demand intensity of secondary industry fell back to 1.103 at the end of 2004. The influence of the state macroscopic regulation policy to power demand intensity of secondary industry was - 0.031 (as compared with that in April 2004, the same below), the effect was significant. It can be also seen that under a series of macroscopic regulation policies, the power demand intensity of secondary industry was never lowered than 1, this means that the implicit power was significant, the problem of structural system still remained prominent.

From January to December of 2004, the power demand intensity of heavy industry arose significantly under the influence of state macroscopic regulation policies. It increased from 1.14 at the beginning of 2004 to 1.188 from January to April, with a rising amplitude of 0.048, far bigger than that of secondary industry and the rising tendency was strong. Different macroscopic regulation policies made it fall to 1.097, with a falling amplitude of 0.091 from January to July, which greatly suppressed the rising tendency, and the effect of macroscopic regulation was significant. The demand intensity was upward again since August to 1.169 from January to October, with a rising amplitude of 0.072, the rising tendency was quite strong, but fell back to 1.147 by the end of 2004. The influence of macroscopic regulation policy to power demand intensity of heavy industry was effective to a certain extent.



A converter station of 500-kV HVDC transmission system

The power demand intensity of light industry was relatively weak and appeared a basic downward tendency. In addition to 1.044 was greater than 1 at the year beginning of 2004, all other months were smaller than 1, being 0.927 by the end of 2004.

The power demand intensity of tertiary industry was weak at the year beginning, only 0.84 and appeared a falling tendency, fell to 0.81, far below 1 from January to April. It started to rise back in May, breaking 1, reached 1.024 by the end of 2004, with a rising amplitude of 0.218, this meant the development of tertiary industry appearing a favorable tendency.

Viewing from power consuming characteristics of industries, the ferrous metal, construction materials, non-ferrous metals and chemical industry four large energy consuming industries accounted for 30% of electricity consumption. The state macroscopic regulation policy had higher effects on first three industries.

The power demand intensity of ferrous metal industry fall from 1.83 in January-April to 1.568 in January-July, which showed the influence of macroscopic regulation policies (mainly by administrative measures) to power demand intensity of ferrous metal was -0.262. Due to escalation of steel price in the world, some steel enterprises couldn't help breaking through the administrative measures, to increase steel production for profits, thus the power demand intensity of ferrous metallurgy industry rised to 1.728 from January to October.

The power demand intensity of construction materials industry was 1.781 at the year beginning, and fell to 1.2 from January to July, then through small fluctuations fell to 1.079 by the end of 2004.

The power demand intensity of non-ferrous metal industry was 1.781 at the year beginning, and fell to 1.2 from January to July, then through small fluctuations fell to 1.172 by the end of 2004. The influence of different macroscopic regulation policies to power demand intensity of non-ferrous industry was -0.122, it was also one of the industries sensitive to macroscopic regulation policies.

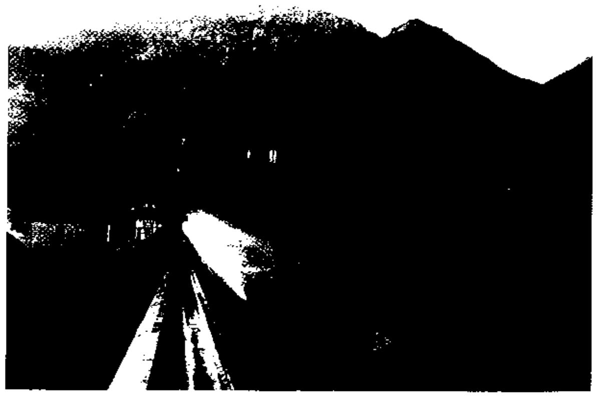
The power demand intensity of chemical industry was always smaller than 1 and fluctuated around 0.8, it didn't belong to overheated development industries. The variation of its power demand intensity appeared in U shaped, it meant a trend of first high, then low, then return to high, to reach 0.881 by the year end, belonged to a virtuous growth.

Table 1 shows the power demand intensity of urban residence decreased by 0.101 as compares with that in April 2004, it was related with prices in urban areas. Fortunately, the power demand intensity of rural residence was as high as 1.2 in January-February. Since May, the rural residence power consumption appeared a rising tendency as compared with the previous year. Since August, the power demand intensity of rural residence began to be higher than urban residence level to reach 0.62 at year-end, or 0.12 higher than that of urban residence.

■ Analysis on power supply and demand situation

Due to persistent high speed growth of national economy, insufficient installation of power sources, lack of fuel and water inflow, etc., the situation of power supply and demand in China became stern in 2004, there are 24 provincial power grids experienced power curtailment, the biggest power deficit occurred in summer around 30.0 GW. The provincial power grids suffered from power curtailment included: Beijing-Tianjin-Tangshan, south part of Hebei, west part of Inner Mongolia, Shanxi, Shandong, Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Henan, Hubei, Hunan, Jiangxi, Sichuan, Chongqing, Shaanxi, Gansu, Qinghai, Hainan, Ningxia and Guangdong, Guangxi, Guizhou, Yunnan of Southern Power Grid.

The power coal supply was even more serious in



A morning of the coalyard in Chaoyang Power Plant, Liaoning Province

2004, the power coal problem became one of the key factors hampering power supply capability. Regions seriously lack of coal supply included Central China, North China, Northeast China and Yunan, Guizhou of south China, these regions all happened power units shut down or output decrease due to lack of coal supply.

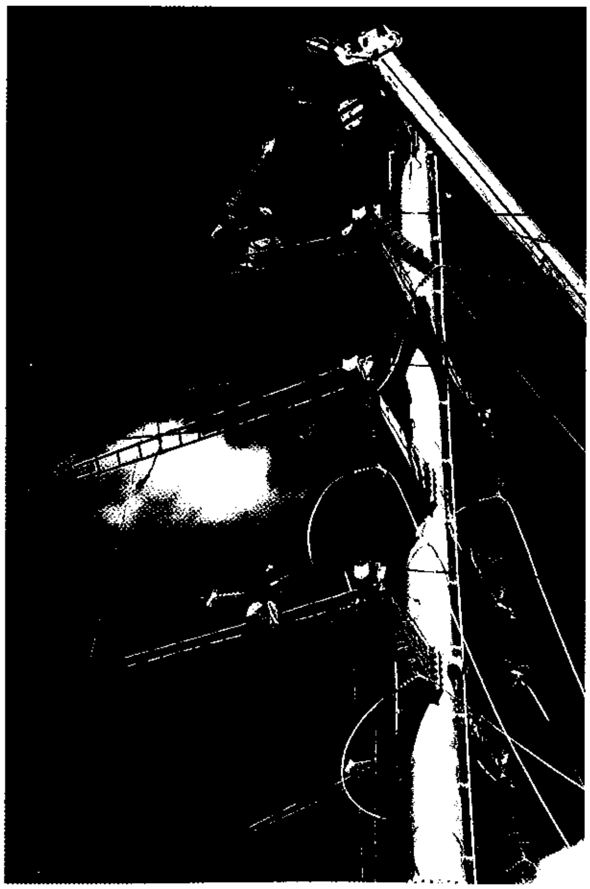
Facing this stern power supply situation, from Central Committee of CCP (Chinese Communist Party) and the State Council to local governments, power grid companies and power generating enterprises highly stressed power security production and supply problems. Leaders from Central Government investigated power enterprises for several times, the State Council issued specific documents to instruct power productions, power grid enterprises strived to optimize power grid dispatching, strengthen coordination between power plants and power grids, power generating enterprises spent no efforts to strengthen operation and maintenance, to guarantee fully tapping power supply capability to the greatest extent.

■ Demand side management

Under the serious power shortage situation and by strong supports from governments on different levels, power enterprises based on discriminating principle and incorporated with actual conditions, worked out demand side management (DSM) schemes, to introduce vigorously rational use of and saving electric power by multiple measures, such as electric tariff regulation, peak interrupting and shifting and load control, thus effectively alleviated tense power shortage situation and safeguarded social production and livelihood.

Particularly on July 23, under the condition of power deficit as high as 30 GW in the SG system, the measure of DSM was employed to shift load for 21.86 GW, accounting for 70% of total power deficit, in which, load shifted for 9.54 GW, load avoided for 9.51 GW, load controlled and limited for 2.81 GW. The amount of load shifted and limited by DSM measures were much higher than load curtailment of 7.97 GW, the effect of DSM was remarkable, the loss of power deficit was minimized. The CSG increased load factor by 1.6 percentage points by employing DSM measure, relieved pressure on power shortage.

Power demand side management could fully mobilize initiatives of power grid operational enterprises, power customers and energy intermediate agents, made them commonly participate and share benefits. Under present imperfection of corresponding incentive mechanism, all participating parties, in particular power grid operational enterprises, being the main body of implementing energy saving, shall assist actively the government to work out DSM regulations, standards, programs and policies. All works concerning power DSM shall be fixed in power system planning, production and operational management, to devote contributions to relieve power supply and demand contradictions.



Environment Protection & Resources Conservation

■ Legal and policy environment & trade management

In 2004, the State has continuously emphasized legal construction for strengthening environmental protection and resources conservation, compiled or revised related laws, standards, regulations and documents, in the meantime, some standards previously issued have put into force in 2004. Those closely related with power industry include: The *Law of People's Republic of China on Prevention and Control of Environment Pollution from Solid Wastes* was adopted by the Standing Committee of the National People's Congress on December 29, 2004 and put into force on April 1st, 2005; the national compulsive standard of *Emission Standard of Air Pollutants for Thermal Power Plants* (GB13223-2003) jointly issued by the State Environmental Protection Administration of China and the General Administration of Quality Supervision, Inspection and Quarantine has put into force on January 1st, 2004.

Among standards, the *Emission Standard of Air Pollutants for Thermal Power Plants* is the most important regulafive requirement on power industry, it was reissued after revision of this standard which was formerly issued in 1996. In comparison with the 1996 edition, the concentration limit for atmospheric pollutant has been mainly adjusted; the way of determining emission concentration limit based on different type of precipitators, ash and sulfur contents of coal shall be eliminated; a time limit for power boilers to meet the stricter emission limit has been further stipulated and the calculation of equivalent excess air factor for atmospheric pollutant emission concentration of thermal power has been adjusted. The standards for concentration control of flue dust, SO_2 and NOx are shown in tables 1, 2 and 3.

The *Notice of Requirements on Coal-Fired Power Project Planning and Construction* issued by the NDRC has great influence on newly-built power plants, except Tibet, Xinjiang and Hainan, etc. The notice calls for all other regions to plan and construct high parameters, large capacity, high efficient, water saving and environmental friendly coal-fired power plants, in power unit selection, the unit capacity shall be 600 MW

Table 1 Maximum permissible emission limit to flue dust for utility boilers

	Maximum permissible concentration (mg/m³)					**Blackness limitation (Ringelmann blackness degree)**
Time section	Section I		Section II		Section III	
Date of enforcement	2005.01.01	2010.01.01	2005.01.01	2010.01.01	2004.01.01	2004. 01. 01
Coal-fired boilers	300 600	200	200 500	50 100 200	50 100 200	1.0
Oil-fired boilers	200	100	100	50	50	1.0

Table 2 Maximum permissible emission concentration of SO_2 for utility boilers

(in mg/m³)

Time section	Section I		Section II		Section III
Date of enforcement	2005.01.01	2010.01.01	2005.01.01	2010.01.01	2004.01.01
Coal-fired and oil-fired boilers	2,100	1,200	2,100 1,200	400 1,200	400 800 1,200

Table 3 Maximum permissible emission concentration of NOx for utility boilers and gas turbine units

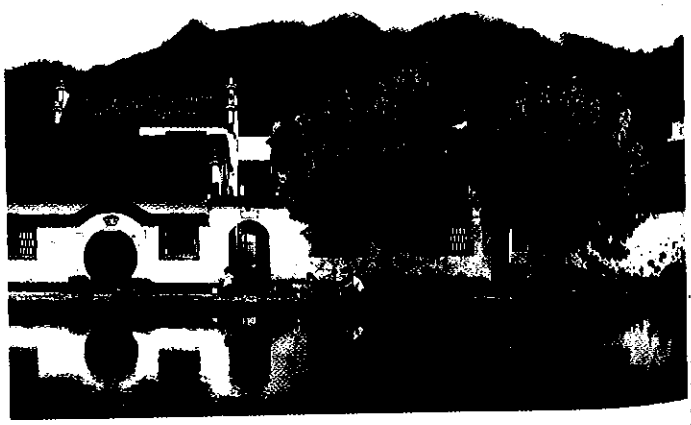
(in mg/m³)

Time section	Section I	Section II	Section III
Date of enforcement	2005.01.01	2005.01.01	2004.01.01
Coal-fired boilers, V_{daf}<10%	1,500	1,300	1,100
Coal-fired boilers, 10%≤V_{daf}≤20%	1,100	650	650
Coal-fired boilers, V_{daf}>20%	1,100	650	450
Oil-fired boilers	650	400	200
Gas turbine, oil-fired			150
Gas turbine, gas-fired			80

and above in principle, the specific coal consumption for electricity generation shall be controlled below 286 gce/kWh. The eastern coastal areas where short of coal reserves shall plan to construct with priority coal-fired power plants with specific coal consumption below 275 gce/kWh. In coal reserve abundant areas, in planning to construct mine-mouth power plant, the specific coal consumption of units shall be controlled below 298 gce/kWh, (for air-cooled thermal units, the specific coal consumption shall be controlled below 305 gce/kWh). In northern areas where lack of water resources, the newly built or expansion projects are prohibited to extract and use underground water, strictly controlled to use ground surface water and shall be encouraged to use intermediate water from urban sewage treatment plants or other waste water. In principle, the large air-cooled units to be constructed shall have water consumption rate be controlled below 0.38 m³/sec·GW.

The NDRC also set forth a series of policies to solve contradictions in electric tariff, of which, for the newly built desulfuration equipment in most regions, the electric price to grid has increased by 0.015 Yuan/kWh, this stimulated the enthusiasm to build desulfuration equipment.

According to the national stipulations on charging sewage discharge, since July 1st, 2005, the charge for



national cooperation, trial and demonstrative projects for flue gas desulfuration of thermal power plants have been organized and implemented, these projects are aimed at laying foundations for equipment localization. Presently viewing quantitatively only, the design and contracting capability on wet limestone-gypsum FGD method can meet basically the market demand in China. Through importing matured and advanced desulfuration technologies represented by wet limestone-gypsum FGD method and applying in large sized thermal power plants and under the instruction of technology suppliers, we are now able to design, construct, debug and operate large sized thermal power desulfuration systems. The construction cost of large sized coal-fired unit desulfuration projects was decreased to about 300 Yuan/kW.

thermal power SO_2 emission would be escalated from 0.42 Yuan/kg to 0.63 Yuan/kg and since July 1st, 2004, the charge for NOx emission would begin to be levied on 0.63 Yuan/kg.

In 2004, power environmental protection and resources conservation have achieved new progress. China Electricity Council compiled and issued *Statistical Indexes and Interpretations for Environmental Protection and Resources Conservation* and *Analytical Report on Main Pollutants Discharge and Control of Thermal Power Plants in 2003* etc.

■ Pollutant control and waste utilization

The control of sulfur dioxide emission from thermal power plants started to enter into the era of large scaled desulfuration, by the end of 2003, about 10 GW units installed with flue gas desulfuration equipment, to the end of 2004, it was doubled, about 20 GW units installed with FGD equipment; the desulfuration equipment under construction amounted to about 90 GW.

The industrialization of desulfuration equipment has been further developed, and the construction cost has been further decreased. Since 1990s, through international cooperation, trial and demonstrative projects for flue gas desulfuration of thermal power plants have been organized and implemented, these projects are aimed at laying foundations for equipment localization. Presently viewing quantitatively only, the design and contracting capability on wet limestone-gypsum FGD method can meet basically the market demand in China. Through importing matured and advanced desulfuration technologies represented by wet limestone-gypsum FGD method and applying in large sized thermal power plants and under the instruction of technology suppliers, we are now able to design, construct, debug and operate large sized thermal power desulfuration systems. The construction cost of large sized coal-fired unit desulfuration projects was decreased to about 300 Yuan/kW.

As for the control of NOx emission, under the condition of continuous application of mainly low NOx combustion technology, due to the local atmospheric control standard of NOx pollutant discharge in Beijing is stricter than the national standard, some power plants in Beijing have started to employ flue gas deNOx scheme to control NOx emission.

The comprehensive utilization rate of pulverized coal ash was continuously kept around 60% in 2004.

In prevention from and control of electro-magnetic radiation and radioactive interference in the course of transmission and substation construction and operation which affect environment, power construction, in particular hydropower construction strengthened ecological environment protection and water and soil conservation works in 2004.

Science & Technology Development and Information Technology

General situation

In 2004, power enterprises, in particular the State Grid Corporation, China Southern Power Grid Corporation. Ltd., China Huaneng Group, China Datang Corporation, China Huadian Corporation, China Guodian Corporation and China Power Investment Corporation, as well as other large-sized power generation groups, together with research institutions, universities, engineering consultants and professional associations had endeavored to rely upon scientific and technical progress, set up, improve and perfect scientific and technical management system, intensify technical upgrading, strengthen research and development of critical and common practicable technologies, speed up exchanges and popularizations for technical results, employ new and high technologies presented by information technologies to promote the technical level of power industry, and had achieved new progress. According to incomplete statistics, power industry had invested more than 1 billion Yuan in a batch of research and development projects, obtained remarkable results, of which some projects have autonomous intellectual property rights and some reached domestic or even international advanced level. China electric power advancement prize for citing outstanding science and technical achievement appraised 5 first-class prizes, 22 second-class prizes and 47 third-class prizes. Those projects awarded with first-class prizes include the "Study on Bulk Power Transmission Technologies for the Three Gorges 500-kV Transmission and Substation Project", "Study and Implementation of Security Protection Systems for National Power Secondary System", "Study and Demonstration of 100-MW CFB Boiler with Autonomous Intellectual Property Rights", "Research of Construction and Completion Technology for Sand-Based Roller Compact Concrete Dam", "Study on Large-Sized Thermal Power Plant Machine Hall Earthquake-Resisting Design Technologies", etc.

Main scientific research and development projects

- Study on Ultra-Supercritical Coal-Fired Thermal Power Generation Technologies. This is a theme of "863" plan in the 10th Five-Year Plan period. It includes 5 sub-themes, of which the "Study on Type Selection for Ultra-Supercritical Power Generation Techniques" passed acceptance by the Ministry of Science and Technology in 2004.

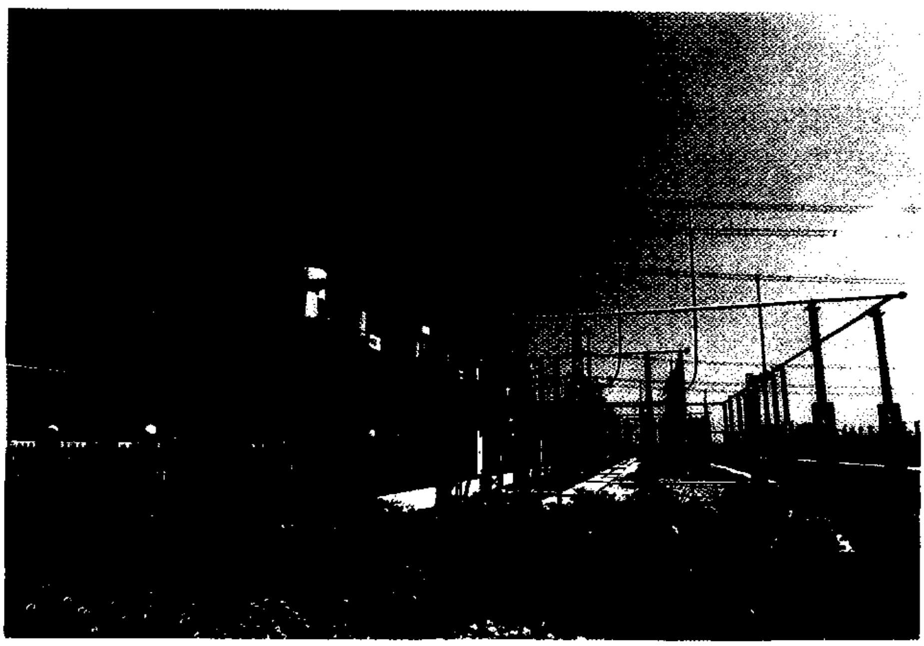
- Study on Practicable Type Super Conductive Cables. This is one of "863" state key research program in the field of new materials in the 10th Five-Year Plan period. The practicable type super conductance cable developed in this project was the first group in China and the third group in the world. It has now been put into operation in Puji Substation of Yunnan Province and passed acceptance by the Ministry of Science and Technology.

- Fundamental Study of Coal-Pyrogeneration, Gasification and High-Temperature Purification Process. It is a sub-theme of "973" development project of the state key fundamental research program which passed acceptance of the Ministry of Science and Technology in November 2004. This project set forth and verified the concept of electrostatic promoting high-temperature precipitation in moving bed, the concept of particle layer and surface filtering composite bed, and the concept of integration of desulfuration and precipitation. All these reached international comparable research level. By setting forth the preparation of desulfuration agent, an international difficulty of high-temperature absorbent crystal pulverizing has been resolved. These dechlorination agent and dealkalization metal agent prepared reached international advanced level and has been already used in industrial production.

● Demonstrative Project for Power System Information Security Applications. This is a sub-item of "State Information Security Application Demonstration Project". It had been carried out demonstrative practice in Jiangsu Electric Power Company and passed acceptance of the Ministry of Science and Technology in 2004. This project has systematically and comprehensively set forth the overall structure, security strategy, security assessment system, technical and managerial system for electric power information system. This advanced and practicable theoretical system and its total technology reached domestic leading position and international advanced level.

● Research and Development for Domestication of 220-kV Controllable Series Compensation Equipment. The first domesticated 220-kV controllable series compensation project from Bikou to Chengxian in Gansu Province was successfully commissioned in December 2004. This project ranked 7th and the largest as well as the first conventional and controllable hybrid type series compensation project in the world. The commissioning of this project indicates that the high/extra-high voltage FACT technologies with autonomous intellectual property rights have stepped into engineering practicable stage.

● Study on Domestication of Static VAr Compensation (SVC) Equipment. The domesticated SVC equipment was smoothly commissioned in 220-kV Hongyi Substation in Anshan of Liaoning Province in 2004. This equipment, being applied first time in China, can substitute for synchronous condensers, and is a kind of compensation mode considering dynamic and static in combination. Thus it can promote power grid voltage stability and voltage regulation by ± 10% in distribution system and effectively improve electric energy



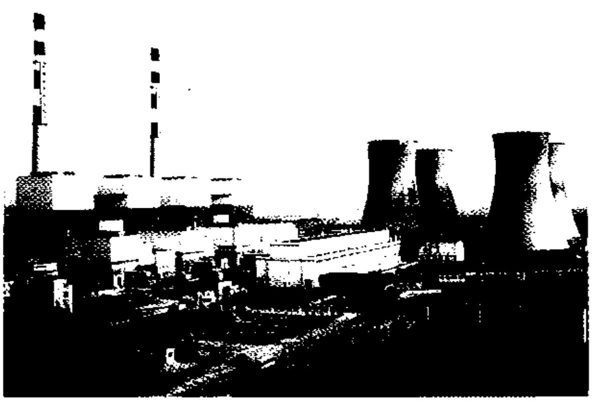
The TCSC Station on 500-kV Da-Fang Transmission Line quality in 66-kV distribution systems.

- Study on Key Technologies for Northwest 750-kV Transmission and Substation Project, Study on Key Technologies for Northwest 750-kV Substation and Study on Technologies for Northwest 750-kV Transmission and Substation Construction and Operation. These three research projects all passed experts' acceptance in 2004.

- Study and Demonstration of 100-MW Circulating Fluidized Bed (CFB) Boiler Technologies. The R&D and demonstrative project for 100-MW CFB boiler with autonomous intellectual property rights had been completed and passed experts' acceptance successfully in 2004. On this basis, the self-developed 200-MW CFB boiler demonstrative project was also started in 2004. The success of this project will lay a foundation to push forward self-development of CFB boilers of even larger capacity.

- Study on ± 500-kV DC Multiple Tappings Technologies. This project had achieved stage results in 2004.

- Study on Plasma Ignition and Stable Combustion Technologies for Pulverized Coal -Fired Boilers. This project has been successfully applied on more than 130 units in large-sized coal-fired thermal power plants, and achieved second-class National Science and Technical Progression Prize.



Shizuishan Power Plant, a demonstrative project for design mode of coal-fired power plants

- Study on Large-Sized Thermal Power Plant Machine Hall Earthquake-Resisting Design Technologies. This project will solve the difficulties earnestly in engineering practice, provide reliable basis for compiling regulations for large-sized thermal power plant machine hall design. The overall techniques approached international advance level, and passed acceptance in 2004.

- Study on EYE Unix Station Monitoring and Control System. This system is applicable to 220-750 kV substations and station network control system, its total performance reached international advance level.

- Study on Power System Stabilizer of Input Signal Power Accelerating Type (PSS-1 Type Power System Stabilizer) and Expert System for Generator Stator Water-Cooling Monitoring and Fault Diagnosis. This project passed experts' acceptance and reached international advanced level. The results can be applied widely in power systems.

■ Information technology upgrades power industrial level

After the institutional reform of power industry, the two large power grid corporations and all power generation group companies have focused on information constructions, established and consolidated information leadership group, worked out group companies' (enterprises) information development program, and issued a series of regulations and documents on information construction. The two large power grid corporations and most of power generating companies had set up wide-area network covering all their affiliated enterprises, built up preliminarily different management information systems from power production management system, assets management system, production process control system to power marketing management system (including customer's calling system), the ERP system in some power enterprises had been on-line operating.

The 500-kV compacted transmission line from Changping to Fangshan

As of the end of 2004, the SG had built up a trunk communication network consisting of optical fiber, digital microwave, satellite etc. various communication measures covering the entire system and the Beijing optic fiber loop network, forming an optical trunk line connecting Beijing with Northeast, North China, East China and Central China regional companies and with the provincial companies in these regions. The State Power Dispatching Data Network (SPDnet) built up with digital communication equipment had significantly promoted the operational indexes of real-time data-transmission in dispatching systems, which ensured the commissioning of the Three Gorges Transmission System and nationwide interconnection successfully. The SPDnet has covered all provincial dispatching sectors only except that in Tibet.

As for the problem of information network security, in addition to continuously execute power information security demonstrative project, the construction for network security had been strengthened by multiple layers from network layer, system layer, application layer, data layer to customer layer. The power information network had been emphatically strengthened by network identity authentication, anti-viruses and prevention from attack. These measures effectively protected the network from world-wide computer viruses attacks for several times, guaranteed safe operation of the State Grid Information Network, and promoted the management and reliability level of the information network significantly.

Application of information technology in whatever power planning, design, construction, production, and scientific research fields or in power generation, power system dispatching and control, transmission and distribution, power supply and marketing, power consumption and enterprises management, etc. had become an imperative measure to promote power industry development, improve managerial efficiency, reduce cost and raise technical level.

On the basis of widespread use of distributed control system (DCS), the plant monitoring system had been combined with power plant management information system (MIS), realized power plant information management. The substation monitoring system based on field bus lines had been widely applied. The SCADA/EMS systems constructed in power grid dispatching centers on different levels in the early 1990s had been renewed or upgraded, realized data exchange with MIS system, thus promoted the technical level of dispatching automatic system. The power market technical supporting systems in Northeast and East China etc. had been put into operation, these had provided technical support for power market reform. The power plant simulation training system and dispatchers' simulation training system (DTS) had also been widely applied.

Organizational System and Main Enterprises

■ Organizational system

As said in the *Power Institutional Reform Scheme* issued by the State Council in March 2002: assets managed by the former State Power Corporation would be divided according to different business into power generation and power grid, thus power plants would be separated from power grids. The State Electricity Regulatory Commission would be established directly under the auspices of the State Council, to execute administrative and legal functions and to perform nationwide electric power supervising functions pursuant to laws and regulations; China Electricity Council and other associations would be consolidated and made perfect. Two power grid corporations (the State Grid Corporation of China and China Southern Power Grid Corporation), five power generating group corporations (China Huaneng Group, China Datang Corporation, China HuaDian Corporation, China GuoDian Corporation and China Power Investment Corporation) and four supplementary business corporations (China Power Engineering Consulting Group Corporation, China Hydropower Engineering Consulting Group Corporation, Sinohydro Corporation and China Gezhouba Group Corporation) were formally established on Dec. 29, 2002. Through this round of reform, the organizational structure has been greatly changed, a new managing pattern of "government exerts macroscopic administration, regulatory agencies regulate by law, enterprises operate autonomously and associations serve the industry by self-discipline" had been preliminarily formed.

Fig. 1, 2 and 3 are schematic charts showing organizational structure of power enterprises, electric power regulatory and power professional associations respectively after power institutional reform in China.

■ Main power enterprises

State Grid Corporation of China

State Grid Corporation of China (SG) is a super large state-owned power grid corporation established pursuant to national electric power institutional reform scheme on the basis of part of enterprises and institutions in original State Power Corporation. It takes responsibilities for construction, development and operational management of northeast China, north China, northwest China, east China and central China regional power grids, as well as construction and development of regional and inter-regional power grids interconnec-tions. In 2004, SG has set forth the development target of building up a modernized company with strong power grid, excellent assets, services and performance. The electricity exchange among inter-regional and inter-provincial power grids under the SG amounted to 179.8 TWh in 2004, or 30.1% increased over the previous year; the electricity sold amounted to 1283.8 TWh, or 14.5% increased over the previous year. The development program of SG, in particular the ultra-high voltage project has been defined. A batch of inter-regional or inter-provincial transmission projects have been started to construct, such as the 750 kV demonstrative project in northwest region was under construction smoothly, the Three Gorges to Guangdong DC transmission project passed acceptance, the Three Gorges to Shanghai DC transmission project started to construct, etc. In line with strengthened regional and provincial power grids and speeded up urban and rural power grid constructions,

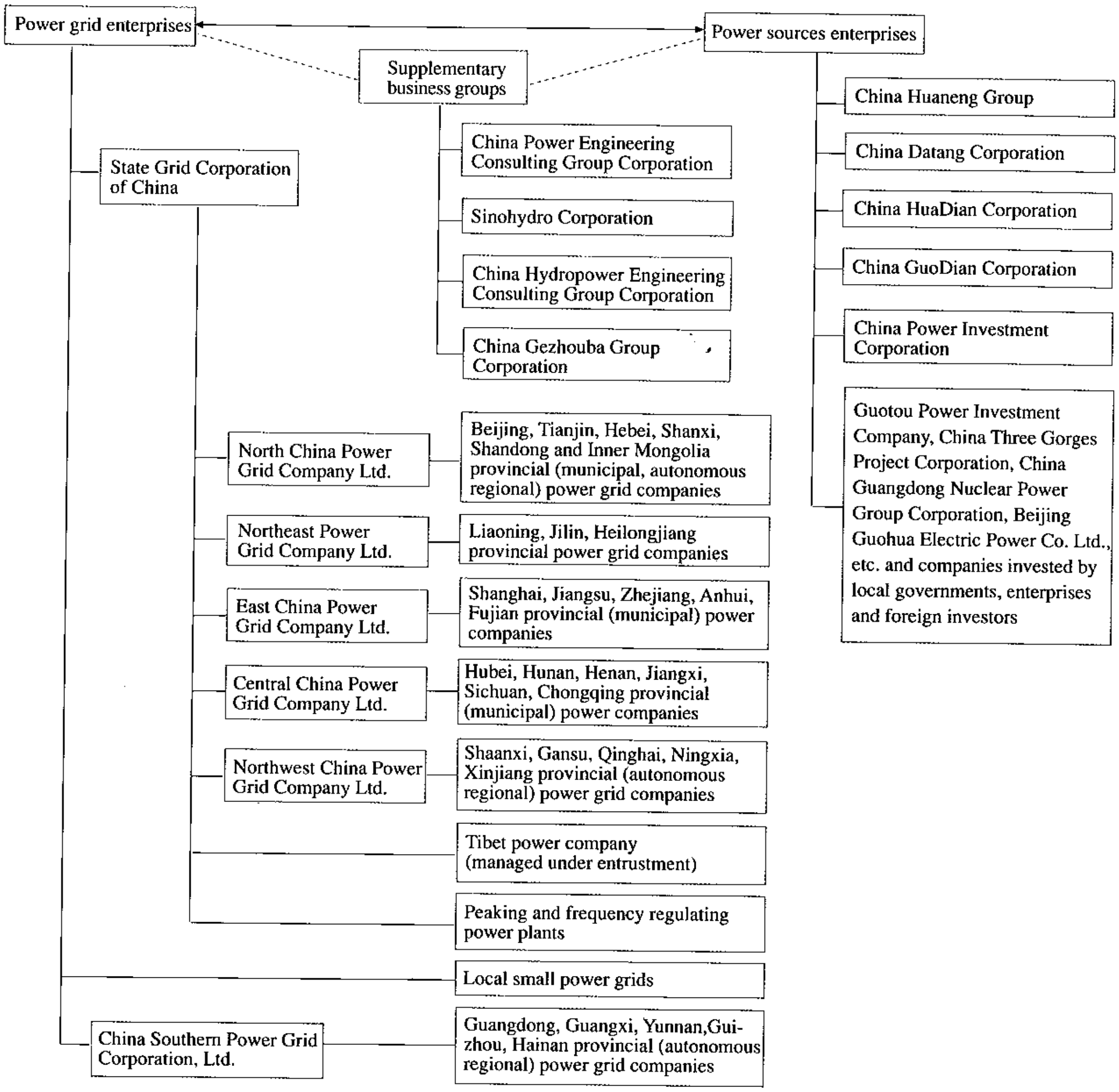


Fig. 1. Schematic chart of main power enterprises after power institutional reform in China

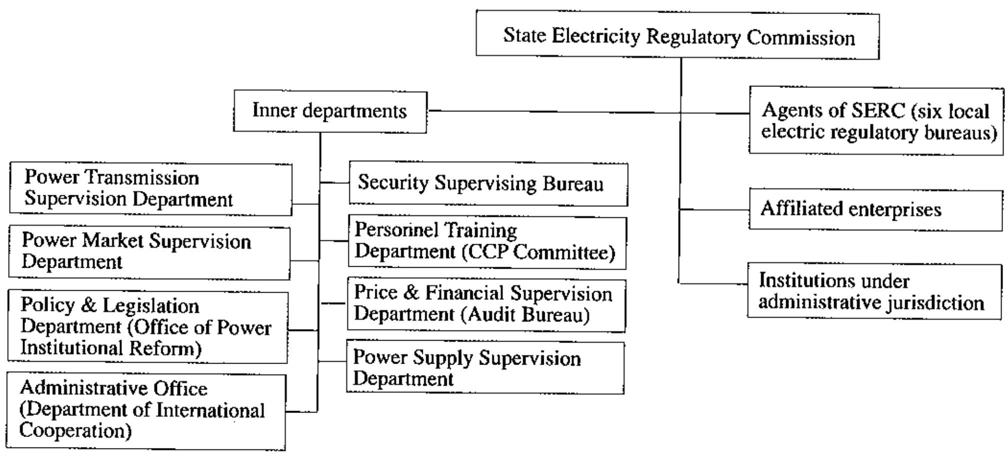


Fig. 2. The electricity regulatory system of the State

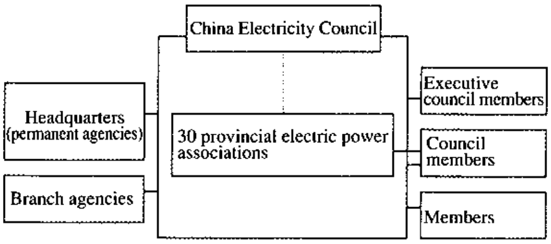


Fig. 3. Schematic diagram of organizational structure of electric power industry associations

the investment in power fixed assets amounted to 92.5 billion Yuan, in which 82.5 billion Yuan in power grids, or 12.7% increased over the previous year.

China Southern Power Grid Corporation, Ltd.

China Southern Power Grid Corporation, Ltd. (CSG) is a super large state-owned power grid enterprise established after power institutional reform, with a registered capital of 60 billion Yuan, its business scope covering Guangdong, Guangxi, Yunnan, Guizhou and Hainan provinces and autonomous region. In 2004, the electricity sales realized within the company's system amounted to 308.2 TWh, 19.7% increased over the previous year; the electricity transmitted from west to east amounted to 41.84 TWh, or 57.0% increased; the electricity generated by emergency peaking power plant amounted to 11.7 TWh. The combined line loss rate was 7.43%; the investment in fixed assets realized 33.1 billion Yuan, in which 28.2 billion Yuan in power grid construction; transmission lines on 220 kV and above have been newly commissioned 4953 km in length, 18.85 GVA in substation capacity and 3000 MW in converter capacity. The frequency qualification rate reached 99.99%, voltage qualification rate 98.61%, urban power supply reliability reached 99.77% and rural power supply reliability reached 98.06% in this power grid.

China Huaneng Group

China Huaneng Group (CHNG) is one of the five power generating groups established after power institutional reform, with a registered capital of 20 billion Yuan and the installed capacity under its control amounted to 33.566,6 GW, the total assets amounted to 151.0 billion Yuan. The newly commissioned installed capacity amounted to 1933 MW, electricity generated 194.78 TWh in 2004, or 11.7% increased over the previous year; the combined sales revenue realized 52.3 billion Yuan, or 16% increased over 2003.

China Datang Corporation

China Datang Corporation (CDT) is one of the five power generating corporations established after power institutional reform, with its registered capital of 12.0 billion Yuan. By the end of 2004, it owned controllable installed capacity of 33.53 GW. In 2004, the Corporation realized investment in medium and large sized capital construction of 29.13 billion Yuan and newly commissioned 3845 MW in capacity; the yearly electricity generation amounted to 173.37 TWh, or 21.17% increased over the previous year; the net coal consumption was 363.41 gce/kWh, or 4.78 gce/kWh lowered than the previous year.

China HuaDian Corporation

China HuaDian Corporation (CHD) is one of the five power generating corporations established after power institutional reform, with a total registered capital of 12.0 billion Yuan. By the end of 2004, it owned controllable installed capacity of 30.79 GW and total assets of 119.7 billion Yuan. In 2004, the newly commissioned installed capacity reached 2111 MW, electricity generation realized 138.4 TWh, or 10.88% increased; the sales revenue realized 35.6 billion Yuan, or 18.7% increased; the total profits realized 1.2 billion Yuan, or 22.0% increased; and the net profit realized 67.8 million Yuan, or 2.5 times over the previous year.

China GuoDian Corporation

China GuoDian Corporation (CGDC) is one of the five power generating corporations established after power institutional reform, with a total registered capital of 12.0 billion Yuan. By the end of 2004, it owned controllable installed capacity of 29.30 GW. In 2004, the newly commissioned installed capacity reached 3960 MW, electricity generation realized 168.0 TWh, or 22% increased; the net coal consumption was 365.7 gce/kWh, or 5.6 gce/kWh lower than that in 2003.

China Power Investment Corporation

China Power Investment Corporation (CPI) is one of the five power generating corporations established after power institutional reform, with a total registered capital of 12.0 billion Yuan. By the end of 2004, it owned the controllable installed capacity of 27.95 GW. In 2004, the newly commissioned installed capacity reached 1140 MW, electricity generation realized 130.635 TWh, or 6.59% increased; the sales revenue realized 29.0 billion Yuan, or 15% increased; the profit realized 1.465 billion Yuan, or 6.0% increased and the net profit rate of return increased 0.67 % over the previous year.

China Hydropower Engineering Consulting Group Corporation

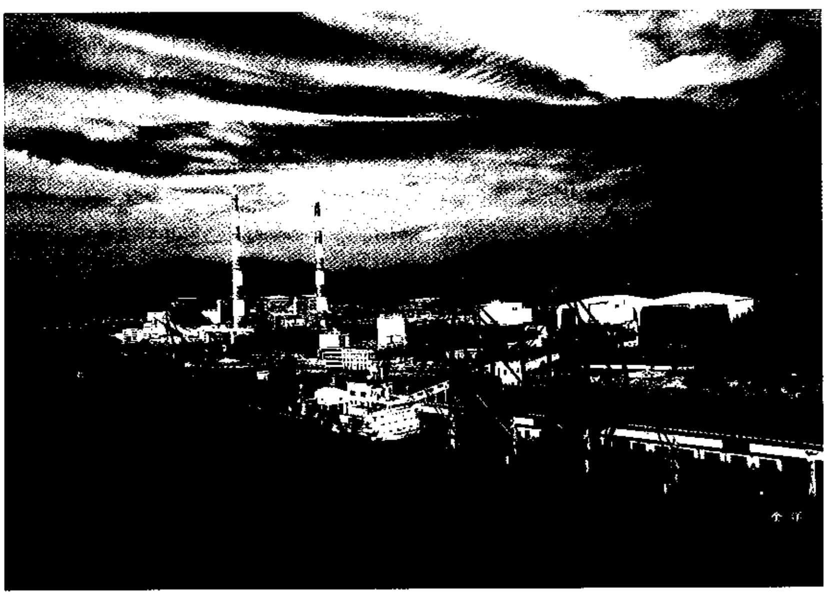
China Hydropower Engineering Consulting Group Corporation is one of the four supplementary business groups established after power institutional reform. It faces both domestic and foreign markets, it is an intermediary agency to provide service for planning, survey, design, consultation, managing, security verification, engineering contracting, research and development, project financing and construction management. In 2004, a total of 6.5 billion Yuan worth contracts were signed, it was 130% of 5.0 billion Yuan worth contracts signed in 2003, the main business income totaled 3.205 billion Yuan, and the profit totaled 77 million Yuan.

China Power Engineering Consulting Group Corporation

China Power Engineering Consulting Group Corporation is one of the four supplementary business groups established after power institutional reform. It affiliates seven solely-owned enterprises and one institutional unit, namely: Northeast China, East China, Mid-South China, Northwest China, Southwest China electric power design institutes, North China Electric Power Design Institute Engineering Company Ltd, China Electric Power Construction Consulting Company and General Institute of Electric Power Planning & Design. In 2004, a total of 9.46 billion Yuan worth contracts were signed, or 106.8% increased over the previous year; a production value of 3.95 billion Yuan was realized, or 36.6% increased over the previous year.

Sinohydro Corporation

Sinohydro Corporation is one of the four large supplementary business groups established after power institutional reform. It is the largest and strongest water resources and hydropower construction enterprise of China, it owned installed capacity on capital equity about 1140 MW. In 2004, the Group Corporation constructed 57 large and medium-sized hydropower units, with a total capacity of 5565.5 MW; realized the production value of 24.45 billion Yuan, or 31.5% increased



Huaneng Fuzhou Power Plant along Minjiang River over the previous year. The total amout of contracts signed in 2004 was 16.6% increased over the previous year.

China Gezhouba Group Corporation

China Gezhouba Group Corporation is one of the four large supplementary business groups established after power institutional reform. It is mainly engaged in total contracting for water resources and hydropower construction projects and provides survey, design, construction contracting services in the field of power, transportation, municipal engineering, industrial and civil constructions, airport projects, etc. In 2004, the total production value of this enterprise increased by 34 percentage points over the previous year, created a historical best record.

China Three Gorges Project Corporation

China Three Gorges Project Corporation (CTGPC) was established in 1993, it has taken full responsibilities for organizing, implementing, fund rising, fund using and reimbursing for the Three Gorges construction project. Being an investment agency authorized by the state in 2002, the corporation realized a total profit of 5.254 billion Yuan in 2004; and a rate of return on net assets was 3.57%; the electricity generation reached 56.17 TWh, or 21.4% exceeded the target value.

In 2002, China Three Gorges Project Corporation being the main sponsorship incorporated with Huaneng International Power Company Ltd., China Nuclear Industrial Group Corporation, China Petroleum & Natural Gas Group Corporation, China Gezhouba Water Resources & Hydropower Engineering Group Corporation and Yangtze River Water Resources Survey and Design Institute to organize the China Yangtze Power Co., Ltd. (abbreviated as CYPC). As of the end of 2004, CYPC had total assets of 33.134 billion Yuan, net assets of 21.905 billion Yuan, total installed capacity of 5515 MW and the yearly electricity generation of 35.758 TWh, main business revenue of 6.174 billion Yuan, total profit realized 4.535 billion Yuan and net profit of 3.039 billion Yuan.

China Guangdong Nuclear Power Group Corporation

China Guangdong Nuclear Power Group Corporation is a large enterprise group established in 1994, taking China Guangdong Nuclear Power Group Corporation as its core enterprise. The Group Corporation owned Daya Bay Nuclear Power Station, Ling'ao Nuclear Power Station (Phase I), with a total installed nuclear power capacity of 4000 MW and the yearly electricity generation capability of 30 TWh; it also owned pumped storage stations and conventional thermal power stations with total equity capacity of 1000 MW and a yearly generation of 3.0 TWh. As of the end of December 2004, the Group Corporation owned the total assets of 57.6 billion Yuan, net assets of 20.5 billion Yuan, the accumulated nuclear electricity fed into the grid amounted to 172.071 TWh, of which, 95.198 TWh sent to Hong Kong, which contributed greatly to Hong Kong's economic and social development.

Guotou Power Investment Company

The Guotou Power Investment Company is a solely-owned subsidiary company under the State Development & Investment Company, with a registered capital of 3.0 billion Yuan. It undertakes mainly on power project investment, construction and operation business, and pursuant to the model of stock control company to carry out operational management on stock holding or participating investment projects. In 2004, the newly commissioned power capacity reached 740 MW to a total installed capacity of 16.71 GW by the end of 2004, and a yearly electricity generation of 44.3 TWh, realized a profit of 800 million Yuan.

Guangdong Yudean Group Co. Ltd.

Guangdong Yudean Group Co. Ltd. established on August 8th, 2001, is a provincial state-owned large enterprise and also the largest power enterprise in

Guangdong Province. It realized a yearly electricity generation of 66.524 TWh, 6.83% increased over 2003 and a sales revenue of 27.384 billion Yuan in 2004. By the end of 2004, the Company's total assets reached 88.915 billion Yuan and the net assets of 38.613 billion Yuan.

Zhejiang Provincial Energy Group Company Ltd.

Zhejiang Provincial Energy Group Company Ltd. (ZPEGC) is a provincial state-owned assets running agency in the field of energy established in 2001. This Company has been engaged mainly in power sources investment, construction and production, coal circulation operation and natural gas exploitation and utilization, etc. within the province. As of the end of June, 2004, the company's total assets reached 41.2 billion Yuan, the net assets of 18.2 billion Yuan and the stock controlled and participated power installed capacity totaled 14.50 GW. 55.504 TWh electricity was generated by the stock controlled plants in 2004.

Beijing Energy Investment Holding Co. Ltd. (Beijing International Power Development & Investment Corporation)

Beijing Energy Investment Co. Ltd., formerly named Beijing International Power Development & Investment Corporation, was established in1993, with a registered capital of one billion Yuan, is a large-sized state solely-owned company directly under the auspices of Beijing municipal government. Its investment and operational scope covered four main businesses including: power & energy, real estate, science & technical industries and financial & securities, with total assets of 28.0 billion Yuan and net assets of 10.7 billion Yuan. By the end of 2004, the company owned installed capacity of 4424 MW on capital equity and a controlled capacity of 5345 MW, with a yearly electricity generation of 7.476 TWh in 2004.

Beijing Guohua Electric Power Co. Ltd.

Beijing Guohua Electric Power Co. Ltd. is a solely owned subsidiary company under the Shenhua Group Corporation, established in 1999. Through several years efforts, the company has grown up as a national power generating enterprise with certain scale. In 2004, 1800 MW installed capacity was newly commissioned, and 40.208 TWh of electricity generation was realized, it was 47.90 % increased over the previous year; the district heat supply reached 9488 thousand GJ, or 5.37% increased; the sales revenue realized 10.5 billion Yuan and a total profit of 2.5 billion Yuan, the net profit of 800 million Yuan, increased by 320 million Yuan. By the end of 2004, the Corporation's total installed capacity reached 6960 MW.

Shenergy (Group) Company Ltd.

The Shenergy (Group) Company Ltd. was established in 1996, had its main business involving in power and natural gas investment and operation, forming an industrial pattern of equal stressing on power and gas. In 2004, the company realized the main business income of 5.734 billion Yuan, or 54.55% increased over the previous year; realized a net profit of 1.160 billion Yuan, or 2.2% increased over the previous year. As of the end of 2004, the company's total assets amounted to 17.952 billion Yuan, or 17.8% increased; the net assets amounted to 8.970 billion Yuan, or 7.4% increased over the previous year.

China Anneng Construction General Company

China Anneng Construction General Company is a large-sized multi-industry capital construction enterprise with strong technical personnel and perfect equipment. It has been authenticated as a special qualified water resources and hydropower project contractor by the Ministry of Construction from Jun. 28, 2003. It has undertaken more than 50 large-sized water resources and hydropower projects in succession, constructed water reservoirs with the total storage volume of 35 billion m^3, and a total installed capacity of 4000 MW. As many as 31 projects were awarded through bidding, with a total contracted worth of 3.22 billion Yuan in the year.

Data on National Electric Power Production (as of December 31, 2004)

Index		Unit	2003	2004
Installed capacity	Total	MW	391,407.8	442,387.3
	Hydro	MW	94,896.2	105,241.6
	Thermal	MW	289,770.9	329,483.0
	Nuclear	MW	6,186.0	6,836.0
	Others	MW	554.7	819.7
Electricity generation	Total	GWh	1,905,208	2,194,352
	Hydro	GWh	281,330	330,990
	Thermal	GWh	1,578,966	1,810,380
	Nuclear	GWh	43,854	50,469
	Others	GWh	1,058	2,513
Average generating capacity for units with single capacity of 6000 kW and above	Total	MW	55.1	56.8
	Hydro	MW	47.8	48.4
	Thermal	MW	56.2	58.2
	Nuclear	MW	773.3	759.6
Utilization hours for plants with total capacity of 6000 kW and above	Total	h	5,245	5,455
	Hydro	h	3,239	3,462
	Thermal	h	5,767	5,991
Fuel consumed for plants with total capacity of 6000 kW and above	Coal for electricity	10^4t	76,543.12	89,512.27
	Oil for electricity	10^4t	1,321.99	1,386.50
	Gas for electricity	10^4m^3	3,165,713	8,068,090
	Coal for heat	10^4t	8,549.94	9,878.08
	Oil for heat	10^4t	132.62	101.09
	Gas for heat	10^4m^3	1,028,817	2,896,909
Standard coal consumption for plants with total capacity of 6000 kW and above	Gross	g/kWh	355	349
	Net	g/kWh	380	376

Data on National Power Supply and Consumption (as of December 31, 2004)

Index	Unit	2003	2004
Electricity supply	GWh	1,635,116	1,880,528
Electricity sales	GWh	1,509,048	1,738,468
Line loss	GWh	126,068	142,060
Line loss rate	%	7.71	7.55

Data on National Power Supply and Consumption (as of December 31, 2004)

(Continued)

Index		Unit	2003	2004
Electricity consumption of the whole society	Total	GWh	1,889,371	2,176,130
	Primary industry	GWh	59,507	60,274
	Secondary industry	GWh	1,396,057	1,627,479
	Tertiary industry	GWh	210,781	242,778
	Residential	GWh	223,025	245,599
Transmission line length of 110 kV and above	Total	km	460,381	491,864
	500 kV	km	44,364	54,252
	330 kV	km	10,389	10,773
	220 kV	km	152,400	163,835
	110 kV	km	253,228	263,004
Substation capacity of 110 kV and above	Total	MVA	1,109,290	1,276,720
	500 kV	MVA	161,660	206,710
	330 kV	MVA	18,990	20,640
	220 kV	MVA	425,880	487,530
	110 kV	MVA	502,760	561,840

Data on National Capital Investment Accomplishment on Fixed Assets (as of December 31, 2004)

Index		Unit	2004
Newly-commissioned generating equipment	Total	MW	53,225
	Hydro	MW	11,501
	Thermal	MW	40,265
	Nuclear	MW	650
	Others	MW	810
Newly-commissioned transmission lines of 110 kV and above	Total	km	41,158
	500 kV	km	10,182
	330 kV	km	1,067
	220 kV	km	13,830
	110 kV	km	16,078
Newly-commissioned substations of 110 kV and above	Total	MVA	150,109
	500 kV	MVA	54,030
	330 kV	MVA	1,862
	220 kV	MVA	59,077
	110 kV	MVA	35,140

National installed capacity and electricity generation by province (as of December 31, 2004)

Province (municipality, autonomous region)	Installed capacity (MW)					Electricity generation (GWh)				
	Total	Hydro	Thermal	Nuclear	Others	Total	Hydro	Thermal	Nuclear	Other
Nationwide total	442,387.3	105,241.6	329,483.0	6,836.0	819.7	2,194,352	330,990	1,810,380	50,469	2,513
Beijing	4,514.4	1,055.9	3,458.5			18,926	347	18,579		
Tianjin	6,013.5	5.0	6,008.5			33,952	0	33,952		
Hebei	20,730.0	783.8	19,932.7		13.5	125,535	525	124,970		40
Shanxi	18,480.5	787.3	17,693.3			106,958	2,032	104,926		
Inner Mongolia	14,321.2	567.9	13,641.5		111.7	81,458	813	80,427		218
Liaoning	16,506.4	1,404.1	14,960.3		142.0	88,754	3,947	84,543		264
Jilin	9,595.9	3,601.2	5,958.7		36.1	39,470	6,147	33,242		81
Heilongjiang	12,143.0	844.6	11,259.1		39.3	54,866	1,338	53,482		46
Shanghai	12,018.3	0.0	12,014.9		3.4	71,134	0	71,127		7
Jiangsu	28,433.6	126.5	28,289.5		17.5	163,901	327	163,545		29
Zhejiang	30,953.9	6,418.4	21,439.8	3,056.0	39.7	125,883	8,545	95,255	21,988	95
Anhui	10,057.3	692.8	9,364.5			61,102	1,227	59,875		
Fujian	15,507.5	7,180.1	8,315.4		12.0	65,966	15,457	50,490		19
Jiangxi	8,045.9	2,549.9	5,496.0			34,017	3,890	30,127		
Shandong	32,923.6	50.8	32,860.4		12.3	163,975	41	163,918		16
Henan	24,226.5	2,438.0	21,788.5			116,236	6,884	109,352		
Hubei	24,624.4	15,115.1	9,509.3			112,546	69,512	43,034		
Hunan	14,227.8	7,448.2	6,779.5			61,423	24,236	37,186		
Guangdong	42,621.0	8,584.6	30,172.9	3,780.0	83.4	212,133	14,114	169,389	28,481	149
Guangxi	9,418.5	5,040.4	4,378.1			37,372	17,229	20,143		
Hainan	2,170.4	562.2	1,599.5		8.7	6,874	1,177	5,687		10
Chongqing	4,679.0	1,407.9	3,271.1			22,914	5,670	16,520		725
Sichuan	20,283.2	13,382.9	6,900.3			93,529	58,902	34,627		
Guizhou	14,698.3	6,896.5	7,801.8			73,100	23,379	49,720		
Yunnan	11,365.5	7,058.6	4,306.9			53,672	29,350	24,322		
Tibet	469.2	403.5	34.6		24.2	1,206	1,088	6		112
Shaanxi	9,516.9	1,876.5	7,640.4			51,481	7,043	44,439		
Gansu	8,679.9	3,566.1	4,975.6		138.2	45,726	12,047	33,242		438
Qinghai	4,943.2	4,053.4	889.8			17,278	11,071	6,208		
Ningxia	4,190.7	366.2	3,782.0		42.5	26,327	984	25,298		46
Xinjiang	6,028.0	973.0	4,959.7		95.3	26,641	3,668	22,752		221

Techno-economic indexes for electricity generation in 2004

Province (municipality, autonomous region)	Average utilization hours (h)			House service rate (%)			Coal consumption (gce/kWh)	
	Total	Hydro	Thermal	Total	Hydro	Thermal	Gross	Net
Nationwide total	5,455	3,462	5,991	5.95	0.47	6.85	349	376
Beijing	5,379	330	7,322	7.84	1.93	7.94	317	348
Tianjin	5,656		5,656	6.35		6.35	323	344
Hebei	6,086	444	6,350	6.49	2.70	6.50	350	375
Shanxi	6,450	2,667	6,622	7.57	0.42	7.70	361	391
Inner Mongolia	6,436	3,939	6,712	7.08	0.91	7.17	336	369
Liaoning	5,460	2,931	5,715	6.94	1.33	7.21	349	376
Jilin	4,147	1,655	5,633	6.64	0.75	7.68	362	392
Heilongjiang	4,612	1,528	4,837	7.69	1.27	7.84	376	408
Shanghai	6,243		6,243	5.22		5.22	329	347
Jiangsu	6,385	2,242	6,402	5.92	1.03	5.93	346	368
Zhejiang	5,701	1,284	6,923	5.69	0.62	5.68	340	361
Anhui	6,155	1,684	6,450	5.94	0.23	6.03	341	369
Fujian	4,768	2,093	6,469	5.09	0.30	6.07	334	359
Jiangxi	4,637	1,506	5,634	6.58	1.20	7.04	353	380
Shandong	5,145		5,148	7.32		7.32	337	364
Henan	5,487	2,862	5,819	7.72	0.43	8.19	411	377
Hubei	5,228	5,407	4,968	2.51	0.12	6.58	345	376
Hunan	4,761	3,620	5,778	4.98	0.51	7.47	362	391
Guangdong	5,503	2,026	5,908	5.00	0.60	5.42	336	358
Guangxi	4,894	3,914	6,104	4.53	0.43	8.33	361	394
Hainan	3,623	1,887	4,155	5.62	1.06	6.24	334	358
Chongqing	5,065	4,909	5,123	8.70	2.09	11.06	386	434
Sichuan	4,946	4,671	5,412	4.05	0.39	9.41	407	455
Guizhou	5,403	3,419	6,970	5.17	0.30	7.06	339	370
Yunnan	5,153	4,428	6,238	3.82	0.30	7.56	368	398
Tibet	2,908	3,034		4.91	2.52	22.57		
Shaanxi	5,515	2,607	6,087	7.01	0.60	7.50	358	387
Gansu	5,520	3,449	7,126	4.73	0.70	6.21	348	368
Qinghai	3,804	3,109	6,124	3.61	1.05	7.96	396	430
Ningxia	7,276	3,211	7,732	5.25	0.41	5.45	336	358
Xinjiang	4,420	3,772	4,588	8.03	1.50	9.07	416	460

Operational reliability indexes of thermal power units of 100 MW and above in 2004

Unit capacity	Sort of unit	Number of units	Unit year	UTH (h)	SH (h)	RH (h)	EAF (%)	EFOR (%)
100 MW		131	130.92	6,551.87	7,476.04	679.62	92.98	0.67
	Coal-fired	129	129.25	6,550.17	7,478.01	684.28	93.06	0.64
	Coal-fired, domestic	119	119.23	6,591.63	7,491.63	714.08	93.59	0.67
	Coal-fired, imported	10	10.03	6,057.23	7,316.09	329.91	86.78	0.27
	Oil-fired, domestic	2	1.67	6,683.14	7,323.61	319.13	87.25	2.95
110 MW	Coal-fired	8	7.89	5,802.12	7,431.08	664.18	92.40	0.29
	Coal-fired, domestic	6	5.88	6,250.15	7,555.77	563.45	92.67	0.38
	Coal-fired, imported	2	2.01	4,488.02	7,065.38	959.64	91.59	0.00
112.11 MW	Coal-fired, imported	2	2.01	7,367.82	7,862.50	319.55	93.40	0.04
115 MW	Coal-fired, domestic	1	1.00	4,890.21	6,108.36	1,724.18	89.41	0.00
120 MW	Coal-fired, imported	2	2.01	6,999.58	8,054.68	419.04	96.70	1.04
125 MW		142	142.11	6,439.79	7,450.43	642.20	92.16	1.22
	Coal-fired	136	136.09	6,502.03	7,512.06	595.82	92.33	1.23
	Coal-fired, domestic	133	133.08	6,531.02	7,525.51	588.60	92.40	1.16
	Coal-fired, imported	3	3.01	5,219.36	6,916.95	915.46	89.36	4.57
	Oil-fired, domestic	6	6.02	5,032.05	6,056.42	1,691.38	88.37	0.91
130 MW	Coal-fired, domestic	1	1.00	7,632.92	8,416.07	11.07	95.83	1.01
135 MW	Coal-fired, domestic	38	38.10	6,174.51	7,282.52	855.45	92.69	1.69
137.5 MW	Coal-fired, domestic	1	1.00	7,169.45	8,374.63	176.27	97.49	0.02
140 MW	Coal-fired, domestic	8	8.02	5,830.00	7,562.90	692.02	94.23	0.01
142 MW	Coal-fired, imported	2	2.01	6,433.07	7,524.75	670.48	93.49	0.13
145 MW	Coal-fired, domestic	5	5.01	5,676.52	8,057.58	297.18	95.37	0.45
165 MW	Coal-fired, imported	4	4.01	6,243.30	7,991.48	193.97	92.91	0.67
100-199 MW		345	345.09	6,405.20	7,468.66	666.25	92.69	1.00
	Coal-fired	337	337.41	6,430.11	7,496.09	648.25	92.80	0.99
	Coal-fired, domestic	312	312.34	6,458.33	7,494.46	663.92	92.97	1.00
	Coal-fired, imported	25	25.07	6,087.25	7,515.86	457.84	90.72	0.89
	Oil-fired, domestic	8	7.69	5,332.38	6,286.92	1,441.78	88.17	1.35
200 MW		180	180.17	6,312.18	7,338.55	622.80	90.59	1.78
	Coal-fired	179	179.16	6,347.51	7,379.61	577.28	90.54	1.78
	Coal-fired, domestic	166	166.13	6,322.01	7,366.40	604.60	90.71	1.80
	Coal-fired, imported	13	13.04	6,672.41	7,547.86	229.08	88.37	1.61
	Oil-fired, domestic	1	1.00	0.37	3.62	8,756.38	100.00	0.00
210 MW	Coal-fired, imported	10	10.03	6,131.26	6,968.95	1,245.03	93.74	0.73

Operational reliability indexes of thermal power units of 100 MW and above in 2004

(Continued)

Unit capacity	Sort of unit	Number of units	Unit year	UTH (h)	SH (h)	RH (h)	EAF (%)	EFOR (%)
220 MW	Coal-fired	16	16.04	6,495.17	8,095.98	174.93	94.29	0.51
	Coal-fired, domestic	14	14.04	6,506.08	8,057.88	188.20	94.06	0.50
	Coal-fired, imported	2	2.01	6,418.81	8,362.67	82.05	95.87	0.54
225 MW	Coal-fired, domestic	2	2.01	5,410.84	7,555.73	520.69	92.11	0.16
250 MW	Coal-fired, imported	2	2.01	7,275.66	8,386.42	45.49	96.25	0.01
200-299 MW		210	210.25	6,320.19	7,397.65	608.58	91.14	1.58
	Coal-fired	209	209.25	6,350.07	7,432.60	570.06	91.09	1.58
	Coal-fired, domestic	182	182.17	6,326.29	7,426.82	568.59	91.01	1.66
	Coal-fired, imported	27	27.07	6,504.61	7,470.22	579.62	91.65	1.05
	Oil-fired, domestic	1	1.00	0.37	3.62	8,756.38	100.00	0.00
300 MW		197	197.43	6,272.70	7,530.54	491.15	91.42	1.17
	Coal-fired	196	196.42	6,278.11	7,531.12	489.41	91.41	1.17
	Coal-fired, domestic	183	183.49	6,290.59	7,525.03	487.32	91.31	1.11
	Coal-fired, imported	13	12.93	6,101.00	7,617.53	519.00	92.75	1.96
	Oil-fired, domestic	1	1.00	5,212.57	7,417.51	832.70	94.18	1.03
310 MW	Coal-fired	2	2.01	5,351.70	6,838.78	1,162.74	91.09	0.48
320 MW	Coal-fired	10	9.85	7,016.93	8,031.52	96.68	92.69	0.34
	Coal-fired, domestic	4	3.84	7,017.31	8,049.28	40.59	92.12	0.45
	Coal-fired, imported	6	6.02	7,016.68	8,020.20	132.45	93.05	0.27
330 MW	Coal-fired	21	21.06	6,780.62	7,680.40	275.73	90.65	2.41
	Coal-fired, domestic	17	17.05	6,971.63	7,734.32	184.12	91.19	2.38
	Coal-fired, imported	4	4.01	5,968.84	7,451.26	665.07	92.65	2.55
335 MW	Coal-fired, domestic	3	3.01	3,862.46	5,478.58	2,642.68	92.54	0.01
350 MW	Coal-fired	45	45.12	6,468.99	7,979.98	203.71	93.30	0.43
	Coal-fired, domestic	8	8.02	5,970.33	7,382.27	761.32	92.70	0.74
	Coal-fired, imported	37	37.10	6,576.81	8,109.22	83.14	93.43	0.37
352 MW	Coal-fired, imported	2	2.01	6,404.12	7,840.40	154.94	91.27	2.12
360 MW	Coal-fired, imported	4	4.01	5,648.78	7,372.99	572.98	90.71	0.59
362.50 MW	Coal-fired, imported	2	2.01	6,298.86	7,619.55	230.39	89.25	0.21
300-399 MW		286	286.50	6,330.55	7,611.73	435.33	91.72	1.08
	Coal-fired	285	285.49	6,334.32	7,612.38	433.99	91.71	1.08
	Coal-fired, domestic	217	217.41	6,302.55	7,508.92	504.01	91.31	1.18
	Coal-fired, imported	68	68.08	6,425.99	7,910.95	231.94	92.87	0.80
	Oil-fired, domestic	1	1.00	5,212.57	7,417.51	832.70	94.18	1.03

Operational reliability indexes of thermal power units of 100 MW and above in 2004

(Continued)

Unit capacity	Sort of unit	Number of units	Unit year	UTH (h)	SH (h)	RH (h)	EAF (%)	EFOR (%)
500 MW	Coal-fired, imported	6	6.02	6,367.80	7,369.78	515.82	90.01	0.46
600 MW	Coal-fired	30	30.08	6,342.10	7,667.03	339.07	91.07	1.10
	Coal-fired, domestic	12	12.03	6,091.91	7,467.27	551.85	90.96	1.27
	Coal-fired, imported	18	18.05	6,508.89	7,800.20	197.22	91.15	0.99
660 MW	Coal-fired, imported	7	7.02	6,614.88	8,016.30	256.07	94.21	0.59
700 MW	Coal-fired, imported	2	2.01	6,628.83	8,163.24	6.02	92.18	1.08
800 MW	Coal-fired, imported	2	2.01	6,001.38	7,100.00	261.91	83.75	0.35
500-800 MW	Coal-fired	47	47.13	6,383.80	7,684.83	323.60	91.11	0.91
	Coal-fired, domestic	12	12.03	6,091.91	7,467.27	551.85	90.96	1.27
	Coal-fired, imported	35	35.10	6,481.92	7,757.95	246.87	91.16	0.79
100-800 MW		888	888.97	6,350.96	7,548.08	502.50	91.70	1.14
	Coal-fired	878	879.27	6,363.72	7,561.64	489.42	91.71	1.14
	Coal-fired, domestic	723	723.96	6,336.93	7,482.72	562.35	91.63	1.26
	Coal-fired, imported	155	155.32	6,437.77	7,779.80	287.78	91.93	0.83
	Oil-fired, domestic	10	9.69	4,554.30	5,639.32	2,345.39	91.11	1.26
Gas turbine		11	11.03	3,680.08	5,032.45	2,764.89	88.86	0.76

Note: UTH—utilization hours; SH—service hours; RH—reserve hours; EAF—equivalent available factor; EFOR—equivalent forced outage rate

Operational reliability indexes of hydropower units of 40 MW and above in 2004

Unit capacity	Number of units	Unit year	Average capacity (MW/unit)	UTH (h)	SH (h)	RH (h)	EAF (%)	EFOR (%)
Total	361	358.59	148.99	3,539.74	4,784.21	3,377.03	93.16	0.36
Axial-flow	84	83.52	96.42	4,221.63	5,119.43	2,931.64	91.91	0.02
40-99 MW	44	43.41	57.47	3,193.01	4,006.66	3,970.85	91.07	0.02
100-199 MW	33	33.09	126.39	5,470.99	6,211.44	1,865.84	92.21	0.03
200-299 MW	7	7.02	200.00	2,327.16	3,843.27	4,260.45	92.51	0.00
Mixed-flow	256	254.00	157.87	3,533.48	4,978.59	3,213.35	93.52	0.43
40-99 MW	115	114.35	57.20	2,669.81	4,129.80	4,075.22	93.66	0.33
100-199 MW	62	61.22	134.27	2,599.81	4,021.88	4,184.89	93.68	0.16
200-299 MW	36	35.32	228.06	4,179.36	5,296.46	2,985.96	94.55	0.07
300 MW and above	43	43.12	402.37	4,000.07	5,603.04	2,534.88	92.90	0.70
Pumped-storage	21	21.06	250.95	2,544.65	2,794.41	5,302.00	92.42	0.49
40-99 MW	3	3.01	90.00	165.34	273.86	8,091.23	95.49	0.00
200-299 MW	4	4.01	200.00	920.18	1,177.80	7,460.46	98.61	0.00
300 MW and above	14	14.04	300.00	3,007.03	3,264.38	4,711.55	91.05	0.53

Note: UTH—utilization hours; SH—service hours; RH—reserve hours; EAF—equivalent available factor; EFOR—equivalent forced outage rate

Transmission line length and substation capacity on 35 kV and above (as of December 31, 2004)

Province (municipality, autonomous region)	Transmission line (km)					Substation capacity (MVA)				
	Total	500 kV	330 kV	220 kV	110 kV	Total	500 kV	330 kV	220 kV	110 kV
Nationwide total	897,139	54,252	10,773	163,835	263,004	1,570,171	206,714	20,640	487,533	561,837
Beijing	7,194	985		1,727	2,353	45,562	10,056		15,940	16,814
Tianjin	6,961	466		1,661	1,792	26,814	3,903		8,711	6,356
Hebei	46,743	3,412		8,003	14,400	93,573	8,301		29,130	38,776
Shanxi	31,332	2,613		6,103	9,727	51,489	4,250		16,530	21,594
Inner Mongolia	31,928	1,646		8,483	7,695	30,718	3,750		13,871	8,770
Liaoning	33,406	2,787		9,090		73,107	10,250		25,407	
Jilin	22,343	1,045		6,732		26,904	4,318		9,005	
Heilongjiang	34,616	1,945		7,688	5,970	39,350	5,073		12,777	8,866
Shanghai	6,852	552		2,020	737	72,879	13,758		25,185	7,083
Jiangsu	52,490	5,046		10,967	14,902	146,668	19,000		48,407	53,999
Zhejiang	34,997	2,999		7,998	10,611	104,158	20,750		30,433	36,184
Anhui	30,552	1,384		5,736	7,945	42,020	3,603		13,260	16,335
Fujian	26,648	1,351		4,768	8,846	43,591	5,800		14,410	18,691
Jiangxi	25,438	830		4,803	7,558	21,421			7,620	9,896
Shandong	53,926	2,180		10,639	14,279	121,186	13,584		34,610	45,057
Henan	41,933	2,037	50	8,211	13,669	69,737	6,000		22,059	29,592
Hubei	39,527	3,884		6,955	13,128	54,671	8,068		17,351	24,130
Hunan	42,542	1,230		7,964	14,017	45,928	5,500		15,326	19,900
Guangdong	46,429	3,570		10,418	20,535	168,988	30,500		57,869	76,851
Guangxi	37,716	644		5,818	8,807	31,371	3,500		9,887	11,684
Hainan	5,422			1,145	2,021	5,699			1,760	3,088
Chongqing	14,292	1,175		2,485	4,243	23,110	3,000		7,200	10,083
Sichuan	42,021	2,604		7,797	14,423	48,904	3,750		13,532	22,636
Guizhou	21,937	1,389		4,662	8,965	32,071	5,250		8,492	14,696
Yunnan	44,826	1,569		4,962	15,753	35,868	6,500		11,168	11,268
Tibet	3,088				1,512	900				432
Shaanxi	25,858		3,292	815	11,477	31,979		8,700	990	17,895
Gansu	31,347		4,577	1,188	10,336	29,164		7,560	3,803	12,183
Qinghai	8,564		2,083		3,718	9,859		3,240		5,249
Ningxia	8,079		770	1,748	2,963	15,028		1,140	5,654	6,412
Xinjiang	31,023			3,050	10,624	15,061			2,999	7,319
Inter-region	7,109	6,909		200		12,396	8,250		4,146	

Electricity supply, sales and line loss (as of December 31, 2004)

Province (municipality, autonomous region)	Electricity supply (GWh)	Electricity sales (GWh)	Line loss (GWh)	Line loss rate (%)
Nationwide total	1,880,528	1,738,468	142,060	7.55
Beijing	47,284	43,607	3,677	7.78
Tianjin	30,019	27,985	2,034	6.78
Hebei	116,667	109,721	6,946	5.95
Shanxi	66,703	60,573	6,130	9.19
Inner Mongolia	51,703	49,170	2,552	5.04
Liaoning	83,842	77,858	5,983	7.14
Jilin	30,081	28,586	1,494	4.97
Heilongjiang	40,009	36,755	3,254	8.13
Shanghai	67,123	62,694	4,430	6.60
Jiangsu	158,712	143,613	15,100	9.51
Zhejiang	122,208	113,427	8,781	7.19
Anhui	43,617	40,825	2,791	6.40
Fujian	54,056	51,298	2,758	5.10
Jiangxi	28,656	26,746	1,910	6.67
Shandong	131,831	122,954	8,877	6.73
Henan	83,107	77,981	5,126	6.17
Hubei	56,083	51,497	4,586	8.18
Hunan	55,584	50,276	5,308	9.55
Guangdong	215,163	199,368	15,795	7.34
Guangxi	42,860	39,405	3,455	8.06
Hainan	6,294	5,527	766	12.18
Chongqing	27,908	25,415	2,493	8.93
Sichuan	90,918	82,393	8,525	9.38
Guizhou	40,697	38,201	2,496	6.13
Yunnan	49,771	45,348	4,423	8.89
Tibet	891	795	96	10.82
Shaanxi	38,297	35,762	2,535	6.62
Gansu	38,722	36,078	2,644	6.83
Qinghai	16,396	15,454	943	5.75
Ningxia	25,798	24,157	1,641	6.36
Xinjiang	16,606	14,998	1,608	9.68
Inter-regional line loss	2,922		2,922	100.00

Reliability indexes of power supply in municipalities and provincial capitals in 2004

No.	City	Power supply reliability (%)		Average outage time (h/consumer)		Total transformer capacity (kVA)
		RS1	RS3	AIHC-1	AIHC-3	
1	Beijing	99.981	99.981	1.644	1.644	20,329,452
2	Shijiazhuang	99.972	99.972	2.452	2.448	3,244,730
3	Taiyuan	99.958	99.980	3.730	1.747	2,107,914
4	Hohhot	99.886	99.909	9.979	7.965	1,092,921
5	Tianjin	99.931	99.949	6.052	4.462	7,781,636
6	Shenyang	99.927	99.927	6.355	6.355	5,328,428
7	Changchun	99.901	99.901	8.656	8.656	3,925,703
8	Harbin	99.915	99.915	7.465	7.465	4,616,216
9	Nanjing	99.973	99.973	2.383	2.383	7,609,632
10	Hangzhou	99.309	99.992	60.708	0.718	5,950,863
11	Hefei	99.972	99.972	2.493	2.440	2,834,079
12	Shanghai	99.979	99.979	1.810	1.810	21,134,547
13	Zhengzhou	99.941	99.954	5.205	4.017	4,539,570
14	Wuhan	99.688	99.941	27.457	5.196	5,984,593
15	Changsha	99.169	99.732	72.966	23.550	4,191,669
16	Nanchang	99.893	99.893	9.372	9.372	1,226,924
17	Chengdu	99.916	99.918	7.375	7.234	3,031,998
18	Guiyang	99.921	99.922	6.929	6.810	1,731,584
19	Kunming	99.897	99.942	9.070	5.080	2,996,253
20	Chongqing	99.895	99.959	9.248	3.599	6,675,662
21	Xi'an	99.937	99.938	5.540	5.426	5,817,120
22	Lanzhou	99.900	99.900	8.817	8.817	2,250,713
23	Xining	99.775	99.787	19.716	18.716	1,202,871
24	Yinchuan	99.961	99.961	3.428	3.428	949,242
25	Urumqi	99.954	99.954	4.068	4.068	1,228,228
26	Fuzhou	99.723	99.782	24.324	19.151	2,808,615
27	Jinan	99.975	99.975	2.170	2.170	3,009,396
28	Guangzhou	99.961	99.962	3.389	3.358	18,003,146
29	Nanning	98.773	99.868	107.735	11.557	1,828,600
30	Haikou	99.614	99.619	33.903	33.505	1,018,559

Note: RS—service reliability; AIHC—average interruption hours per customer

Per capita electric indexes in 2004

Province (municipality, autonomous region)	Installed capacity (kW per capita)	Electricity consumption (kWh per capita)	Livelihood electricity consumption (kWh per capita)
Nationwide total	0.340	1,674.10	188.94
Beijing	0.302	3,437.24	537.21
Tianjin	0.587	3,320.70	326.69
Hebei	0.304	1,896.61	189.11
Shanxi	0.554	2,497.78	116.84
Inner Mongolia	0.601	2,224.96	138.71
Liaoning	0.391	2,418.26	279.37
Jilin	0.354	1,372.43	210.77
Heilongjiang	0.318	1,376.66	209.38
Shanghai	0.690	4,715.52	520.32
Jiangsu	0.383	2,448.66	230.08
Zhejiang	0.656	2,931.54	306.80
Anhui	0.156	798.16	112.26
Fujian	0.442	1,892.22	313.65
Jiangxi	0.188	783.25	109.40
Shandong	0.359	1,786.41	187.50
Henan	0.249	1,225.72	123.99
Hubei	0.409	1,163.91	157.28
Hunan	0.212	920.87	127.86
Guangdong	0.513	2,874.68	346.05
Guangxi	0.193	934.47	122.87
Hainan	0.265	819.19	124.17
Chongqing	0.150	969.17	171.59
Sichuan	0.232	982.26	166.74
Guizhou	0.376	1,174.92	109.03
Yunnan	0.257	1,029.47	133.58
Tibet	0.171	315.93	97.84
Shaanxi	0.257	1,287.52	128.73
Gansu	0.331	1,724.85	104.67
Qinghai	0.917	3,520.66	158.01
Ningxia	0.713	4,592.07	155.05
Xinjiang	0.307	1,357.16	123.56

China Electric Power Information Center

No.1 Lane 2, Baiguang Road, Beijing, China 100761
Tel: 86-10-63416475
E-mail: leiye@sgcc.com.cn