

**Reform of the Chinese Electric Power  
Market: Economics and Institutions**

Chi Zhang and Thomas C. Heller

Working Paper #3 (Revised)

January 2004

The Program on Energy and Sustainable Development at Stanford University is an interdisciplinary research program focused on the economic and environmental consequences of global energy consumption. Its studies examine the development of global natural gas markets, reform of electric power markets, and how the availability of modern energy services, such as electricity, can affect the process of economic growth in the world's poorest regions. The Program also works on legal and regulatory issues surrounding the development of an effective international regime to address the dangers of global climate change.

The Program, established in September 2001, includes a global network of scholars—based at centers of excellence on six continents—in law, political science, economics and engineering. The Program is part of the Center for Environmental Science and Policy, at the Stanford Institute for International Studies.

**Program on Energy and Sustainable Development**

At the Center for Environmental Science and Policy

Stanford Institute for International Studies

Encina Hall East, Room 415

Stanford University

Stanford, CA 94305-6055

<http://pesd.stanford.edu>

[pesd-admin@lists.stanford.edu](mailto:pesd-admin@lists.stanford.edu)

## **About the Authors**

**Thomas C. Heller** is the Lewis Talbot and Nadine Hearn Shelton Professor of International Legal Studies at Stanford Law School in California. His research interests include international law and political economy, legal theory and environmental law. In addition to publishing widely on these topics he has consulted for several international organizations, including the Intergovernmental Panel of Climate Change, the Electric Power Research Institute and the World Business Council for Sustainable Development. Prof. Heller holds a Bachelor's degree from Princeton University and a LLB from Yale Law School.

**Chi Zhang** is a Research Fellow at the Program on Energy and Sustainable Development and the Center for International Security and Cooperation, both at Stanford University in California. His research interests include market reform, the dynamics of energy supply decision processes and carbon emissions trading policies. Dr. Zhang holds a Ph.D. in economics from Johns Hopkins University and has worked at the Institute for International Economics in Washington, DC, the Monterey Institute of International Studies and the Institute of World Economics and Politics at the Chinese Academy of Social Sciences in Beijing, China.

## **About the Political Economy of Power Market Reform Study**

Early in 2002, the Program initiated a study to compare the experiences with power market restructuring in five critical developing countries—Brazil, China, India, Mexico and South Africa. Each individual country study examines the interaction of the political, legal, and economic forces that affect how countries restructure their electricity systems away from state domination and towards greater use of markets.

This paper presents results from one of the countries studied. For other individual country studies, synthesis of results, and in-country events on electricity markets, please see the Program website at <http://pesd.stanford.edu>.



# **Reform of the Chinese Electric Power Market: Economics and Institutions**

*Chi Zhang and Thomas C. Heller*

## **1. Introduction**

When the People's Republic was founded in 1949, the Chinese electricity industry, with only 1.85 GW installed capacity, was primitive. It has since grown into the second largest in the world, with installed capacity rising to 353 GW in 2002. The number of people who have no access to electricity has been reduced to less than 2 percent of a population of 1.26 billion. On a per capita basis, installed capacity has edged up to one half of the world's average. Development has been particularly impressive since the 1980s thanks to increased investment in the sector. According to industry accounts, an estimated RMB 1,107 billion (\$US 134 billion) was invested between 1981 and 2001 in new generation and delivery capacity. Additional investment was also made in retrofitting and upgrading the system, reaching over RMB 100 billion (\$12 – 15 billion) per annum in the past seven years. Three quarters of this sectoral capital came from domestic sources, with foreign investment making up the rest. This remarkable power sector growth and financing have been achieved through an ongoing, unsystematic process of electricity industry reforms initiated in the mid 1980s. Further system expansion, projected at about 25 GW per year for the next two decades, challenges the Chinese government to continue and deepen this reform process.

After the founding of the People's Republic of China in 1949, the new government adopted an economic organization modeled upon Soviet style hierarchical comprehensive administration. The government nationalized all industries, including electric power, and instituted five-year central planning to promote industrialization. The reorganized electricity sector was characterized by structures commonly associated with the utility industries of many countries. The system was publicly owned, vertically integrated, and operated through state enterprises (SOEs). Moreover, consistent with the demands of central planning, ownership and control were concentrated almost exclusively at the national level. The central government planned the scale and location of all power projects, provided the investment funds for infrastructure expansion, operated the system and set the priorities according to which end-users were allocated electrical service. It collected all operating revenues and balanced all financial accounts. Under this organization, sub-national governments did no more than implement centrally dictated plans. Nor were SOEs autonomous firms so much as administrative mechanisms for executing plans, without independent corporate status or claims to financial returns. The industry managed to grow

at an average rate of 14 percent per year under central planning because electricity was given strategic importance in China's industrialization, and therefore was allocated significant amounts from central government budgets. Despite the growth, the industry was afflicted by the unavoidable flaws of central planning – economic inefficiency and chronic shortage of supply.

In 1979, the central government, in order to introduce market mechanisms into the economy, began sweeping reforms which spread, albeit relatively slowly, into the electricity sector. Subsequently, rapid income growth and burgeoning demands for power in response to the economic reforms further challenged the electricity industry to take more specific measures to increase output. The central government initiated the first stage of specific electricity industry reforms in 1986, partially decentralizing investment authority in the generation sub-sector. Local governments, state owned industrial enterprises and even private, sometimes foreign, investors, were invited to build new power plants to supplement the state power system in meeting the surging demand. To make incremental investment attractive, the central government adopted a “cost plus” tariff for new plants that allowed accelerated capital recovery and promised a competitive rate of return. In addition, various electric power construction and user fees were added to most end-user tariffs to fund both central and provincial electricity infrastructure expansions at a rate faster than permitted by previous commitments of budgetary capital grants alone. The first electricity law was promulgated in 1995 to protect formally the interests of new investors.

This initial phase of reform successfully broadened sources of investment and raised badly needed capital for the electricity sector. Moreover, the reform changed the landscape of the electricity industry. An industry exclusively owned and controlled by the central government evolved into a dual system, with a dominant state planning system at the core and a decentralized generation system, owned by investors associated with more diverse levels of government, industrial entities and private ventures at the periphery. While the central government, the core of the system, still maintained dominance, the system began to experience conflicting interests and political complications in both capacity development and power dispatch.

A second stage of electricity industry reform began in 1997, in conjunction with a broader campaign for economy-wide transformation toward a market economy. The focus of this new second wave of reform was to separate government administration from business operations, which had been indistinguishable under central planning. In the electricity industry, the State Power Corporation (SPC) was created in 1997 to manage the state electricity system. The once encompassing Ministry of Electric Power Industry (MEPI) was eliminated in 1998, with its business functions transferred to the SPC and its administrative functions assigned to other government agencies. The SPC was later corporatized to fashion a western style holding company, owning generation and transmissions assets across China that were routinely operated by the SPC's provincial

subsidiaries<sup>1</sup>. With the political consent of central government planning authorities, in 1999 the SPC initiated a limited experiment of wholesale market competition in six provinces. This experiment was partially prompted by the unexpected turn of the market from chronic shortage to surplus following the Asian financial crisis. The SPC hoped that market competition could help resolve political fights among diverse investors about whose power would be dispatched and also increase sales by lowering tariffs. However, the experiment was soon halted because the quick return to a tighter power market in 2001 absorbed excess capacity and alleviated any immediate pressure for competition. At the same time, economic inefficiencies, exposed during the slack market, arising from the political operation of a system combining central and decentralized ownership, made it clear that the partially reformed industry organization needed further revamping.

Following intensive internal debate and international advice, the central government formally started the still unfolding third stage of electricity sector reform in December 2002. In theory, the reform conforms to the global trend of utility de-integration and market competition. The vertically integrated SPC was broken up into two government-owned grid companies and five state generation companies, created through the transfer of SPC assets. An autonomous government regulatory commission has also been established. Although legal de-integration between generation and transmission has taken place, the government is still contemplating the wholesale market design, the scope of power and responsibility of the regulatory commission, the possible continuing roles of central planning (including retail tariff setting), as well as industry structure and other issues associated with a functioning electricity market.

This chapter investigates the reforms that have been going on in the Chinese electricity sector. It offers an overview of industry development in Section 2. Section 3, following a brief description of the vertically integrated structure and characteristics of central planning in the industry before the reforms, carefully examines the three successive stages of utility reforms in the broader context of macroeconomic reforms. It argues that the first stage of reform in 1986 was initiated specifically to raise capital to expand electricity system capacity, and suggests that its great success was due to the central government's preference and ongoing economic and political control that furnished the utility industry both selective access to capital and the ability to pass on the cost of sectoral expansion to end-users. In contrast, the second stage of electricity reforms was motivated less by concerns internal to the energy sector than by a systematic push across the Chinese economy to separate government administration and business operation. Its particular implementation and effects, however, were more influenced by the dynamics of an unexpected slack in the power market. We conclude that the reform was unsuccessful

---

<sup>1</sup> The Province of Guangdong is one exception in this respect. While its assets belong to the State Council, the provincial government and its power company were granted operating controls of the assets since the early days of reform and have been operating the system independent of SPC.



because the central government never relinquished its structural control over management or policy despite all sorts of nameplate changes.

In spite of the limited impacts of the first two stages of reforms on the core sectoral organization of China's electricity system, the changes in industry landscape that they stimulated have complicated the politics of future utility reforms. The current third stage reform program announces a reinvigorated effort by the central government to rekindle rapid infrastructure expansion and improve production efficiency through an alternative industry and government organization modeled on utility de-integration and competitive markets. As the reform unfolds, there is great uncertainty about its outcome. Among other uncertainties, a serious challenge would be for truly independent power producers to raise enough capital in the incompletely liberalized Chinese financial markets to build 25 GW capacity per year in the context of a competitive wholesale power market. Section 4 summarizes the study.

## **2. Electricity Industry Development**

### Brief history

The Chinese electricity industry was born in the 1880s, and went through three major periods of development. The original establishment of the industry was characterized by various private and government investors operating in scattered local systems. The first power plant was built by a British company in Shanghai in 1882. In 1888, the Guangdong provincial government of the Qing Dynasty installed an imported generator in the city of Guangzhou and became the first Chinese power producer. These early power plants used local coal to generate electricity to light city streets. The proliferation of the use of electricity among rich urban households in the following decade prompted the first wave of power industry investment. Both domestic and foreign private companies, as well as successive Chinese governments, built local electric power systems to serve large cities such as Shanghai, Tianjin, Beijing, Chongjiang, Wuhan, etc.<sup>2</sup> For over sixty years these local systems grew slowly as the country went through numerous wars and regime changes.

The founding of People's Republic of China in 1949 brought about a significant change in the organization and rate of growth of the electricity industry. The new government, led by the communist party, believed that public ownership of the means of production and central planning of the national economy would overcome the inequality and cyclical recessions that plagued capitalist market economies. Guided by this ideology, the new

---

<sup>2</sup> During this period, foreign power producers often held a dominant share over relatively weaker domestic companies. For example, in 1911, foreign companies owned 1.5 MW of the 2.7 MW total national capacity. In 1936, foreign companies owned 79% of 2.66 MW capacity in Shanghai, and accounted for 85% of power generation in the city. See, A Bright Cause: In Memory of the 120<sup>th</sup> Anniversary of the Chinese Electricity Industry, China Electric Power News, July 31, 2002.

regime nationalized the electricity industry, as well as all other significant economic assets, and implemented the first five-year plan in 1953. The central government became the exclusive investor and operator of the electric power system for the next three decades.

The small electric power system the new regime inherited in 1949 had 1.85 GW installed capacity. Building up the electricity infrastructure became a core, long-term national priority to support the massive industrialization strategy the Chinese government adopted to develop the economy.<sup>3</sup> The electricity industry received strong financial and material supports from the central government and expanded steadily. Generation capacity increased from 2,000 MW to 80,000 MW between 1949 and 1978 (see Figure 1 below). Meanwhile, a national system of five inter-connected regional and several provincial level grids gradually evolved. However, despite its rapid increase, electricity supply constantly lagged behind the growth of demand for power under central planning. By the mid 1970s, the national shortage of capacity was estimated at about 5,000 MW, or 12 percent of installed capacity.<sup>4</sup>

General economic difficulties associated with comprehensive central command induced the government to begin market reforms in 1979. These initial reforms, implemented across the economy, only gradually and selectively penetrated into the electricity sector. For example, general reforms have motivated continuous efforts since the early 1980s to change production units from centrally planned to commercially autonomous enterprises. At different times, they have included replacing the repatriation of SOE net revenues to the responsible state supervisory department with a tax system, enacting a corporate responsibility system with incentives for capital retention at the enterprise level, and introducing an accounting for capital as well as other production costs to guide the behavior of enterprises (World Bank, 1994). The currents of economic reforms, already implemented in other sectors, were introduced in the electricity industry in 1986 when the national government partially decentralized investment decision-making and finance in the generation sub-sector in an effort to increase system capacity to meet rising demand. During the reform period since 1986, provincial and local governments, non-government enterprises and foreign power producers have been permitted to supplement central government-planned projects to add to power infrastructure. The combined share of capacity owned by these new investors rose from zero to over 50 percent of the national total in a matter of 15 years, although the central government continued to be the single largest provider of power generation (as well as the sole operator of all long distance transmission and most local distribution systems). This more decentralized capacity development, reinforced by the establishment of some market incentives favoring new capital investment, led to an unprecedented expansion of the electricity industry. The

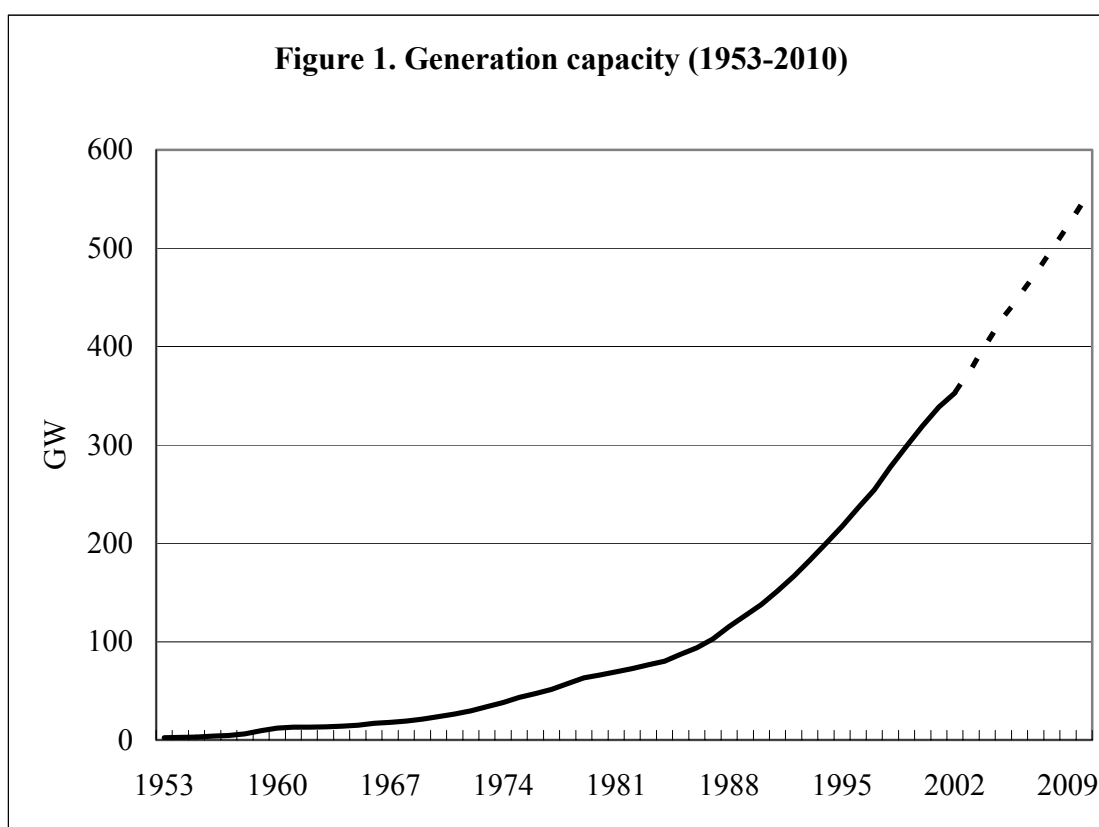
---

<sup>3</sup> The government followed the Soviet strategy to demonstrate the believed superiority of communism.

<sup>4</sup> See the State Council 1975 circular “Speeding up the development of the electric power industry”.

growth effectively eliminated the nationwide chronic power shortage by the late 1990s and created the second largest electric power system in the world.<sup>5</sup>

As Figure 1 shows, generation capacity increased from 2.3 GW in 1953 to 319 GW in 2000. The rate of growth was particularly significant in the second half of 1980s and 1990s because of the surging demand for electricity and the continuing prospective investment associated with market economic reform. 15 GW capacity was added each year on average. This recent expansion makes Chinese electricity generation a world scale industry, but one of comparatively recent and qualitatively varied vintage (Figure 2).

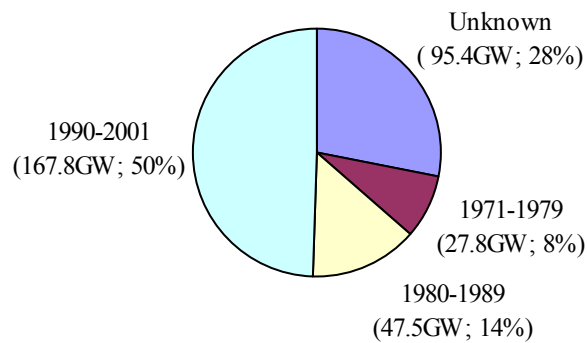


Note: The projection for 2003 to 2005 is based on 7 percent growth rate to reach the government 10<sup>th</sup> Five-year plan target which was revised upward in March 2003. Five percent growth rate is assumed for the second half of the decade.

Source: China Energy Yearbook, various years.

<sup>5</sup> The turn of the power market from chronic shortage to surplus in the late 1990s was to some extent also associated with the unexpected slowdown of demand increase. The Asian financial crisis of 1997 and tight domestic monetary policy to control inflation slowed income growth and demand for electricity.

**Figure 2. 2001 Capacity by commission date**

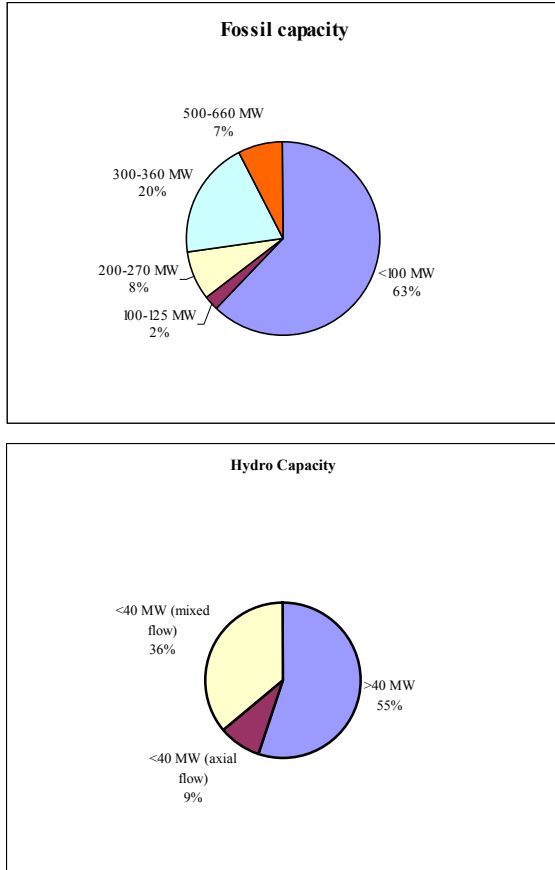


Note: “Unknown” includes capacity in 2001 that did not have a commission year. The 95.43 GW size is larger than the total national capacity in 1970, indicating they were not all old units built before the 1970s. Calculation assumes capacity commissioned during the 1970s was still in service in 2001. Source: China Electric Power Yearbook, various years.

Although many increasingly large units have been built throughout the reform period, smaller less efficient units (less than 100 MW) still account for more than half of the total installed capacity (Figure 3). Two major factors, the pattern of politically available foreign assistance and limited domestic technological capacity, have influenced the choice of generation technologies. During the Cold War embargo, China received technical assistance mainly from the former Soviet Union and Eastern Europe. After China broke its diplomatic ties with the Soviet Union in 1960, its domestic development of Eastern European technology was slowed and interrupted by intermittent internal political chaos (Xu, 2002). In this period, power plants built under central planning were typically small in size and basic in technology. Many of these out-of-date plants have been operating beyond their intended lifetime due to the long-term capacity shortage. Subsequently, the involvement of government entities other than the central government in power generation has also contributed to the growth of outdated technology and small power plants. During the first wave of electricity industry reform of the mid 1980s, discussed in more detail below, local governments and non-government enterprises, encouraged to invest in power generation, favored small power plants that were easy to approve, required low financing,

needed short construction times, and supplied small franchised areas (Zhang, et al. 2001). In comparison, as Chinese technical expertise gradually improved in the 1990s contemporary projects developed by the central government became better planned to meet demand increases through large grids. They conformed to the larger size requirement (currently 300 MW) and higher technology standards set by the plan, and received favorable financing from state policy banks and, at times, international lending agencies. As a result, both large modern capacity and small backward capacity have simultaneously characterized the structure of China's electricity build out since the 1980s.

**Figure 3. Capacity by unit size (2000)**



Source: State Power Corporation (2002)

## Fuel Structure

The Chinese electricity industry started with small-scale plants fired by local coal. A limited number of hydropower stations were developed earlier in the 20<sup>th</sup> century. After 1949, several factors reinforced this industry fuel structure. First, China's long-term energy policy has emphasized energy security and promoted indigenous energy resources, mainly coal and hydropower. While China's coal resources are abundant, quality coal for power generation is concentrated in the north, far from the load centers in the eastern and southeastern coastal areas. Moving coal or transmitting electricity generated at mine mouths put a serious strain on the inadequate transport infrastructure.<sup>6</sup> To mitigate these problems, coal production, transportation, and supply to power plants were, and still are to some extent, integrated and coordinated by the national five-year economic plans. In addition, coal price subsidies and fuel import controls were implemented as part of national energy policy. As a result of the gradual establishment of a national economy increasingly dependent on domestic coal, the institutional and productive organization of China's electricity industry is for the most part adapted to coal-based technologies, and coal-fired capacity now accounts for 70 percent of total installed capacity (Figure 4).

Among non-fossil fuels, hydro and nuclear are the predominant sources of power. While China's hydro resources are abundant, their distribution is predominantly in the west, again widely removed from the coastal demand centers. Development of hydropower has been slow due to lack of funding and inadequate technologies for large hydropower stations and long-distance transmission systems.<sup>7</sup> Almost 80% of exploitable hydro capacity remains undeveloped.<sup>8</sup> China began developing nuclear power in the 1980s. The first nuclear power plant, the 300 MW Qinshan (Phase One) in Zhejiang Province, was commissioned in 1992. By 2000, nuclear stations accounted for about 1% of installed capacity.

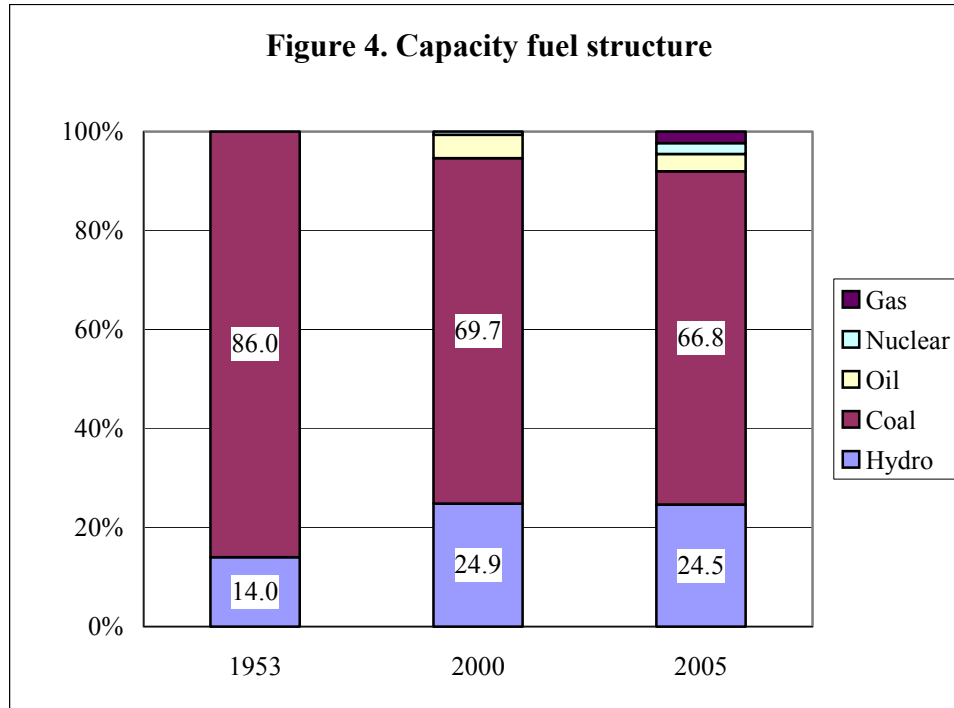
More recent Chinese energy policy has begun to look toward greater diversification of energy resources because heavy coal use has had an adverse impact on the environment. Developing hydroelectricity is assuming a new policy importance, which also serves the government strategy of investing in the poorer western regions. Moreover, the government now proposes to expand the use of natural gas as a fuel for power generation. Close to 10 GW of natural gas fired generation capacity is planned for the 10<sup>th</sup> five-year plan period (2001-2005), including 2.0 GW in Guangdong Province using LNG shipped in from Australia, and 7.93 GW in eastern China using piped gas from Xinjiang. The construction of the 4200km West-East gas pipeline between Xinjiang and Shanghai began in 2002, and will start supplying natural gas by the end of 2003. Its 12 billion cubic meters of gas will replace the equivalent of nine million tons of standard coal per year in East China.

---

<sup>6</sup> Coal accounts for 40 percent of annual railroad and one third of annual river and sea freight transportation.

<sup>7</sup> The failure of the first large hydropower project in the 1950s, San Men Xia Hydro Station, and the withdrawal of the Soviet technical assistance in 1960 also adversely affected hydropower development.

<sup>8</sup> China's exploitable hydropower resources are estimated at 378.5 GW. LBNL China Energy Data Book.



Note: Numbers for 2005 are calculated on the basis of government planned development.

Source: China Statistical Yearbook; 10<sup>th</sup> Five-year plan; Study of 2002 Electricity Industry Development (January 16, 2003) (<http://www.drcnet.com.cn>).

### Transmission

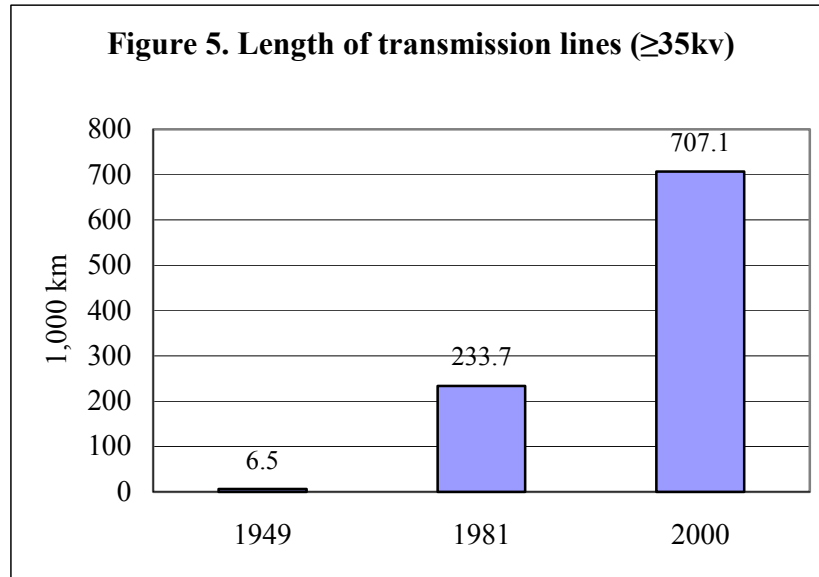
The transmission and distribution systems have been accorded high development priority under Chinese central planning. In 1949, the new government of the People's Republic inherited a weak electrical infrastructure with 6500 kilometers of transmission lines (35kv and above). It has multiplied by more than a hundred times since then. The fastest growth was achieved during the years of reform after 1981 (Figure 5). In particular, the transmission system is characterized by late installation of high-voltage transmission lines and continuing fragmentation of transmission networks.<sup>9</sup> China constructed the first 330kv transmission line (534km) in 1972. The first 500kv AC line was not installed until 1981. Although regional and provincial grids have been adopting these high-voltage lines as their trunk networks in recent years, in 2000 330kv and 500kv lines accounted for only 5 percent of national transmission lines (Table 1).

As in many other fast-growing electricity systems, the expansion of China's power delivery network continually lagged behind the concurrent development of generation capacity, which is easier seen as a more immediate solution to chronic localized power shortages. For many years, inadequate transmission systems limited the installation of hydro and coal-fired power generation in resource abundant western China to satisfy the needs of load centers in the east. As economic development and concomitant power sector growth among different regions and provinces has diverged in recent years, weak power delivery systems have created bottlenecks in inter and intra-provincial power exchanges. The weakness of both transmission and distribution

<sup>9</sup> See Xu (2002) for details.



became further apparent when power suppliers were not able to reach a large number of rural end-users even as a power surplus emerged in more economically advanced markets toward the end of the 1990s.



Source: State Power Corporation (2002 and <http://www.sp.com.cn/zgdl/dwfb/default.htm>).

**Table 1. 2000 Transmission capacity (35kv and above)**

	km	percent
Total	707,142	100
500kv	25,910	3.7
330kv	8,524	1.2
220kv	122,597	17.3
110kv	195,001	27.6
66kv	46,054	6.5
35kv	309,056	43.7

Source: State Power Corporation (2002).

Since 1998, in an effort to break the bottleneck, the central government has begun to increase investment in the grid and distribution systems. Between 1998 and 2000, the State Power Corporation, which controlled all transmission and most distribution networks before it was eliminated in 2002, invested \$18.4 billion--\$7.1 billion in urban systems and 11.3 in rural areas--to upgrade distribution facilities. An additional \$23 billion investment in transmission and distribution is planned for the 10<sup>th</sup> five-year plan period (2001 – 2005).<sup>10</sup> Large western hydro,

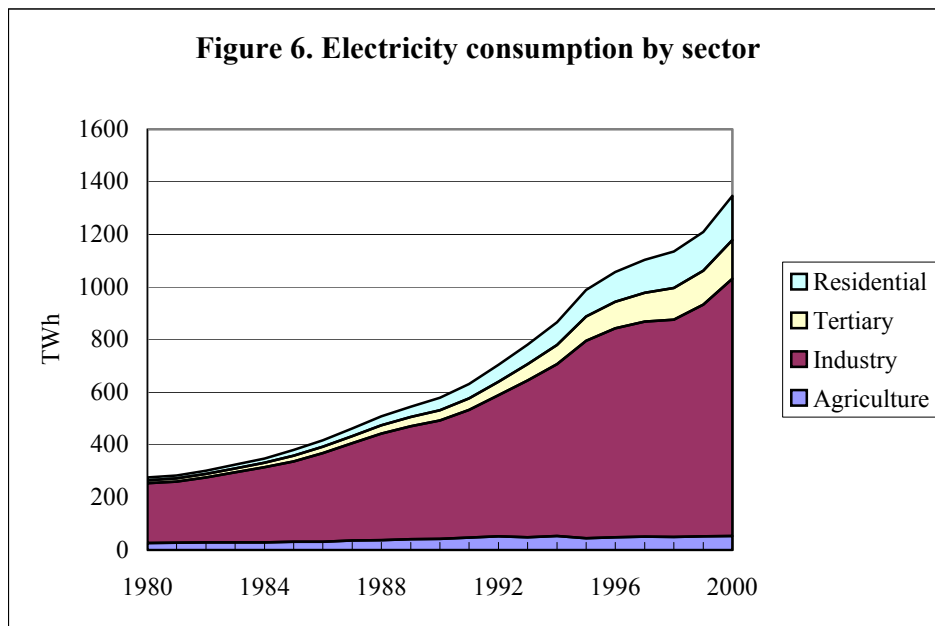
<sup>10</sup> Xinhua News Agency, <http://www.sp.com.cn/html/gndt/c2.htm>, <http://www.sp.com.cn/html/yaowen/y0429.htm>

including Three Gorges Station, and coal mine-mouth power plants planned for this period will provide further impetus for the development of long distance high-voltage transmission lines and integration of the national grid system.

### Electricity end uses

Consistently since 1949, the Chinese government has skewed its strategy for economic development toward industrialization, particularly the concentrated growth of infrastructure and heavy manufacturing sectors providing producer goods. Given limited financial and other resources, consumer goods manufacturing and services industries were forced to give way in resource planning, and consumers were asked to sacrifice for faster future growth. The structure of the country's electricity consumption fully reflected these development priorities. Figure 6 illustrates that the industrial (manufacturing) sector accounted for over 80 percent of national power consumption in 1980 after thirty years of development under central planning. It continued to be the largest user in 2000, although economic reform in the past twenty years has led to expanded development of the tertiary (service) industry and higher residential power consumption.

Another atypical feature of the Chinese electricity development is that, unlike some other leading developing countries such as India, power consumption in agricultural production has constituted a very small portion of aggregate electricity use over time. In particular, as economic growth sped up in the 1980s and 1990s, the share of agricultural power consumption slid from 10 percent to only 4 percent of the country's total power consumption.



Source: China Energy Statistical Yearbook

## Rural Electrification

Rural electrification has long lagged behind the pace of national electricity development in general due to central planning that favored the manufacturing sectors. In China's first phase of growth, the national government's near exclusive focus on expanding electricity infrastructure to support industrial policy did not leave enough capital or technical capability to promote capacity growth for rural electric power development. Even though in the late 1950s and 1960s the central government set up rural power administration and exchange institutions, stressed support by the national and provincial electric power systems for irrigation in grain production, and initiated a few pilot rural electrification projects, urban power shortages of the 1970s rendered these efforts short lived and inconsequential.<sup>11</sup> As large rural areas were left no option except to follow the government maxim of "self-construction, self-management, and self-consumption", many analysts have concluded that "rural electrification was entirely ignored before 1980" (Xu, 2002 p.74).

With little support from the central government, country communes and villages slowly developed small, mostly hydro, local power stations during the 1960s and 1970s. By 1979, about 90,000 small hydropower stations had been built, with a total capacity of 6.33 GW (Smil, 1988, p.64). These facilities averaged only 70.3 KW capacity, were unreliable due to seasonality, had no connection to major grids, and suffered high inefficiency with line losses as high as 25 – 30 percent.<sup>12</sup>

Because of this slow development of rural electric power and lack of support from the national system, before the 1980s rural power consumption was historically low. In 1978, rural areas, which contained seventy percent of the country's population, consumed only 13.3 percent of the national power, or 27.5 TWh. Thirty-one percent of the rural population, or 245 million people, had no access to electricity in 1979.

Rural electrification has improved significantly since economic reforms began in 1979. Available data indicate that both installed capacity and power generation have increased rapidly (Table 2). Rural power consumption has increased accordingly. In particular, consumption by agricultural production rose from 27 TWh in 1980 to 50 TWh in 1998. Per capita rural residential consumption of electricity rose to 64.13 KWh in 1998, which was still only one-eighths that of their urban counterpart. 12 million people gained access to electricity every year between 1992 and 2001.

Several factors have contributed to accelerated rural electrification in the past twenty years. First, development of township and village enterprises (TVEs) increased the demand for electricity, especially from coal and diesel power, which are more reliable than run-of-the-river hydro stations.<sup>13</sup> Table 2 indicates that the share of fossil powered electricity increased significantly in

---

<sup>11</sup> See, for example, Yang (2003).

<sup>12</sup> Rural small hydro power is an evolving definition. In the 1950s, hydro stations with a capacity of 500 KW or smaller were considered small hydro. In the 1960s, small hydro power referred to stations with unit size of 500 KW or smaller and total capacity up to 3 MW. By the 1990s, the definition of a small hydro station increased to 50 MW.

<sup>13</sup> Market reforms of the early 1970s greatly increased agricultural productivity and made a large labor force redundant in the rural area. To prevent large scale migration and problems associated with urbanization, the central government encouraged the farmers to remain in their towns and counties and set up manufacturing enterprises with

rural areas. Second, the central government introduced several programs to increase rural electrification during the 1990s, with campaigns like “400 Rural Electrification Counties”, “Sending Electricity to Villages” and “Replacing Firewood with Electricity”.<sup>14</sup> Some of these programs served the multiple purposes of promoting rural development, energy conservation and environmental protection. Third, the development of the overall electricity system has played a positive role. Especially since 1998 when a power surplus developed at the national level, the central government has stepped up efforts to send electricity to the rural areas at lower costs. As a result, more rural electricity is now provided by large national and provincial grids than by small local systems (Wu, 2003).

**Table 2. Rural Electricity Development 1987 – 1994**

	1987		1994		1998
Rural capacity	MW	%	MW	%	MW
Total	15930	100.0	32090	100.0	44150
Small hydro	10660	66.9	15770	49.1	n.a.
Small thermal	2330	14.6	8180	25.5	n.a.
Diesel	2900	18.2	8060	25.1	n.a.
Renewable	40	0.3	80	0.2	n.a.
Rural generation	TWh	%	TWh	%	TWh
Total	39.9	100.0	98.9	100.0	132.1
Small hydro	27.7	69.4	54.3	54.9	n.a.
Small thermal	10	25.1	38	38.4	n.a.
Diesel	2.1	5.3	6.5	6.6	n.a.
Renewable	0.1	0.3	0.1	0.1	n.a.

Source: Ministry of Electric Power Industry, 1996, p.46; Wu, 2003.

### Environmental Consequences

Rapid expansion of predominantly coal based capacity and power generation has had serious environmental impact and has caused economic damages. By 1998, the power sector used 450 million tons of coal (25 percent of national coal consumption), emitted 6.97 million tons of SO<sub>2</sub> (30 percent of the national total), and 228.5 million tons of CO<sub>2</sub> (25 percent of the national total).<sup>15</sup> It was also responsible for 80 percent of national NO<sub>x</sub> emissions.<sup>16</sup>

Pollution emissions from power generation have caused huge environmental damages and social economic costs. SO<sub>2</sub> is the most harmful source because of lax emission controls, total quantities released and the regional concentration of damages induced. Studies conducted by the Chinese

---

the help of the local government. Development of TVEs greatly increased demand for power in the rural areas. TVEs have met with some economic hardships in recent years. There is an extensive literature on the TVE model of economic reform.

<sup>14</sup> See Wu (2003), and Yang (2003).

<sup>15</sup> Zhu, et al. (1999).

<sup>16</sup> DRC (2002), p.71.

government estimate that SO<sub>2</sub> emissions caused the country between \$7 and \$13 billion in the mid 1990s.<sup>17</sup> As a consequence, environmental protection has become a growing challenge to sustainable electricity development in China.

Chinese policy makers have enacted a number of environmental protection laws and regulations to address the problems associated with power production and to improve efficient uses of power consumed.<sup>18</sup> While enforcement of many laws that directly address environmental problems has been problematic, substantial gains have been registered due to shifting energy policies with ancillary environmental benefits. For example, increased prices for electricity use in industry and de-emphasis of heavy industrial growth have lowered energy intensity (Sinton and Fridley, 2000). In addition, the recent long-term policy shift to diversify fuel sources has assumed growing importance in controlling environmental pollution from power generation. More large hydropower, long distance lines to transmit it, and nuclear and gas-fired power plants have been planned. Renewable energy, especially wind power, has been encouraged. Finally, the central government's effort to shut down small old thermal power plants initiated in the late 1990s to alleviate the economic effects of the unforeseen power surplus (see below) has also contributed to environmental protection. According to State Power Corporation (SPC) data, a total of 10 GW of small thermal capacity was eliminated between 1996 and 2000. New power plants with better technology are scheduled to replace an additional 14.2 GW during the 10<sup>th</sup> five-year period (SPC, 2002).

### Future Development

The electricity industry requires further expansion in the next decade to meet growing demand. China's economy is projected to grow 7 - 8 percent per year between 2001 and 2010. Accordingly, the State Development Planning Commission (SDPC) has planned to build 110 GW new generation capacity for the 10<sup>th</sup> five-year plan (2001 – 2005), and an additional 100 GW for the second half of the decade.<sup>19</sup> This translates into an addition of 20 GW to the system every year till 2010, which presents serious financial, organizational and environmental challenges to industry and government (see Figure 1 above).

Moreover, as rapidly as the Chinese electricity industry has been expanding, it still remains at a low level of development. The per capita installed capacity is only 0.25 KW, and per capita annual electricity consumption is barely over 1,000 KWh. Both numbers stand at about 50% of average world levels. By SPC's estimate, there were still about 23 million rural residents who had no access to electricity in 2000.<sup>20</sup> Over the long term, simply raising these levels to the world average demand unremitting, massive expansion of the power infrastructure.

---

<sup>17</sup> See DRC (2002) Chapter 3 for the source of literature. See also McElroy (1997), World Bank (1997).

<sup>18</sup> China's Air Pollution Control Law was promulgated in 1987. It has since been amended several times to tighten the control. The Electric Power Law of 1995 also provided for environmental protection in electricity development.

<sup>19</sup> The 110 GW capacity for 2001 – 2005 represents a recent 30 GW upward revision of the 10<sup>th</sup> Five-year plan which was adopted in 2001. Drafted during slack market years, the original plan anticipated a 4 – 6 percent annual increase in power demand. However, fueled by GDP growth, demand for power rose 9 and 11.7 percent in 2001 and 2002 respectively. See, <http://www.sp.com.cn/dlyw/rdxx/200304010009.htm>.

<sup>20</sup> Estimates of people without access to electricity range from 17.6 million (studies cited in IEA, 2002), to over 20 million (Yang, 2003), 23 million (Zhao, 2002). The discrepancy amounts to 10.4 million people, or 0.8 percent of the Chinese population. The number used in the text is the median estimate.

### **3. Electricity Industry Reforms**

#### Industry organization before reforms

Although the Chinese electricity industry before the initiation of reforms resembled in basic form that of many countries in its key economic and institutional structures, the degree of its politicization was extensive compared even to other national state electric monopolies. First, it was government owned. The Chinese government, led by the Communist Party, nationalized the country's electricity system soon after it assumed power 1949. It took over the assets owned by the defeated nationalist government, and issued coupon bonds to private owners for their plants - a move consistent with the revolutionary ideology and necessary for command-and-control economic planning. The newly nationalized electricity industry had a very simple ownership structure. In theory, all assets belonged to the whole people.<sup>21</sup> In practice, however, the central government exercised full ownership rights. The government directed the management of all sector assets, allocating the revenues they generated in the best interest of the nation, as the general government budgets dictated. The nationalized assets were assigned to and operated by various state owned enterprises (SOEs) which combined generation, transmission and distribution activities with exclusive franchises in designated, usually province-wide, geographical service areas. These vertically integrated utility SOEs were placed under the administrative supervision of the Ministry of Electric Power Industry (MEPI).<sup>22</sup>

Second, the entire industry was organized as a hierarchically unified national system. MEPI controlled the system in every important dimension. The central administration's planning process determined policy and practice in from the heights of national long term energy strategy, through technological research and development, investment funding, power plant siting, design and construction, and even down to operating rules, complex tariff schedules, and the allocations of daily dispatch and end-user quotas. Utility sector SOEs were never independent firms with management responsibility, the ability to allocate assets, or to command residual earnings. They were administrative units that effectively implemented government direction.

Third, not only were the SOEs government production units, but they also served to assure social welfare for their workers. Under the Chinese economic system, it was SOEs, or "Work Units" in Chinese terms, that built housing, schools, and hospitals for their workers and provided job security, life insurance, retirement benefits and other services. An accounting scheme was designed by the central government to facilitate these services. In general, the government budgeted SOE revenues sufficient to cover a low wage adequate for workers to meet daily living

---

<sup>21</sup> There were two basic forms of public ownership in China: assets owned by the whole people and assets owned collectively by the people directly associated with the assets (such as workers in an enterprise). The former were usually operated by the central government and the latter by provincial or lower level governments depending on the size of the assets. Such being the case, assets in the electricity industry as well as other important infrastructure industries predominantly took the form of the former.

<sup>22</sup> That the central government set up a ministry to operate an industry was not unique to the electric power sector. In fact there were many ministries under the Chinese State Council running industries, ranging from textiles to aerospace.

expenses, and to ensure SOEs could provide comprehensive social welfare services free of charge.<sup>23</sup>

Within this typical form of Chinese industrial organization, electric utilities were governed under the broader principles of central planning. First, the formal relationship between government and SOEs was that of a bureaucratic hierarchy. SOEs accepted all externally allocated inputs, executed production decisions, and collected proceeds for repatriation to the ministry. They enjoyed no financial independence and had no economic incentives to perform. Consequently, the management of utility SOEs basically combined politics and technique. While nearly all electricity managers had an engineering background that encouraged attention to technological more than economic concerns, SOEs and their leaders also had governmental ranks. For example, the director of a large power plant could at the same time be a bureau chief level cadre answering to the deputy minister of MEPI. This arrangement secured the government's control over SOEs. In this organizational design, government and business, economic and political objectives, were never clearly separated.

Second, the relationship between the central government and the provinces wherein regionally distinct SOEs were nominally established, was originally characterized by highly centralized control. Provincial governments were politically subordinate to the central government. They had no constitutional power to legislate. Legally, what they might exercise was any degree of discretion, variably granted by the central government, in implementing national rules and policies.

More practically, the central-provincial relationship was faced with a constant tension between economic controls and economic potential. On the one hand, the central government always wanted to maintain tight control over the national economy. However, this control left provincial governments with little incentive to adapt central directives to local conditions or surpass expected production levels. On the other hand, giving provincial governments more freedom could improve economic performance, but at the same time cause economic "chaos" or loss of uniform order. There was, and still is, a regular pattern of control and relaxation between centralization and decentralization in the Chinese utility industry (as well as in the still heavily planned sectors of the economy as a whole).<sup>24</sup>

Finally, under central planning MEPI had extensive collaborative operational relationships with other central government ministries and agencies. It worked with the State Development Planning Commission (SDPC), the chief economic planning and tariff-setting agency, in projecting demand for power, planning new projects to meet the demand, and setting tariffs for new plants. It also interacted with various ministries and state banks to arrange the financing, construction, fuel supply and staffing for the new projects. When the new plants were built,

---

<sup>23</sup> It should be noted that it often looked like these services were free when in fact they were rewards in kind to compensate for low pecuniary wages under central planning. Changing compensation schemes and shifting social welfare services from SOEs to the market is one of the difficulties in reforming inefficient SOEs in China. Relieving them of their social responsibilities requires funded outside social programs to take over SOEs' accumulated liabilities in the form of employees' housing, health insurance, pension, etc. Foreign investors who buy into these SOEs often have not expected these liabilities.

<sup>24</sup> See Zhu (2003) for an account in the utility industry, and Wu (1999) for an comprehensive discussion of the general problem.

MEPI coordinated its operations with the State Economic and Trade Commission, which was in charge of production and supply of the entire economy, in allocating and dispatching generation quotas and delivering power to end-users according to plans.<sup>25</sup> In essence, all the demand and supply relationships in the entire chain of electricity supply were planned allocations among government branches, rather than market choices by business firms. This resulted in a system of differentiated and particular arrangements within the electricity sector and an absence of either general regulations or equilibrated prices.

Given the financial and material constraints, development strategy for electric power was always derived mainly from national industrial priorities. Equitable regional development was a secondary, though important long-term goal. Consequently, provinces that hosted strategic industries such as steel and heavy machinery manufacturing would enjoy preferential treatment in the siting of new power projects. Equity and geographic balance would then be considered for the rest of the capital budget. This balancing and allocation process, followed subsequently by bargaining over investment and operational details, required extensive and incessant negotiations between different levels of government. But, the central state, whose views might reflect the personal preferences of party leaders, always retained ultimate authority in as much as cadres, from power plant leaders to ministers and governors, were political appointees with incentives and careers controlled by the Party.

Although the SDPC set both wholesale and retail prices throughout the economy, it did not act only as a balancing mechanism between supply and demand. Prices were “symbols of government policy priorities” (Xu, 2002, p.204), and highly irrational from the market economic point of view (DRC, 2002, p. 52). The SDPC set power tariffs with little reference to the true cost of supplying electricity. For example, in order to give priority to electricity development in service of China’s industrialization, the central government, in addition to granting to the industry large amounts of unpriced capital, set a low coal charge for the power sector that allocated artificial tariffs for generators on the basis of administered low operating costs. In addition, because the entire system was under unified ownership and integrated under the same ministry, there was no independent cost accounting for transmission and distribution, and, therefore, no corresponding pricing of these services. Finally, favorable low end-user tariffs were ordained for priority industries, with higher prices for less important sectors such as services. This price differentiation among end-users only accidentally related to their relative costs of supply.

These organizational relationships governed the development of the Chinese utility industry, as they did much of the national economy, between the 1950s and 1970s. The general inefficiency of organization by central command caused the government to begin ambitious reform in 1979 in order to transform a planned to a more marketized economy. As an integral part of the overall economy, the utility sector reform has both been influenced by the general reform approach and tackled difficulties associated specifically with utility industry development.

---

<sup>25</sup> Detailed discussions of the institutional arrangement of central planning may be found in Lieberthal and Oskenberg (1988). See also, Lieberthal (1997), and Zhang, et al. (2001).



### Reform to raise capital (1986 – 1996)

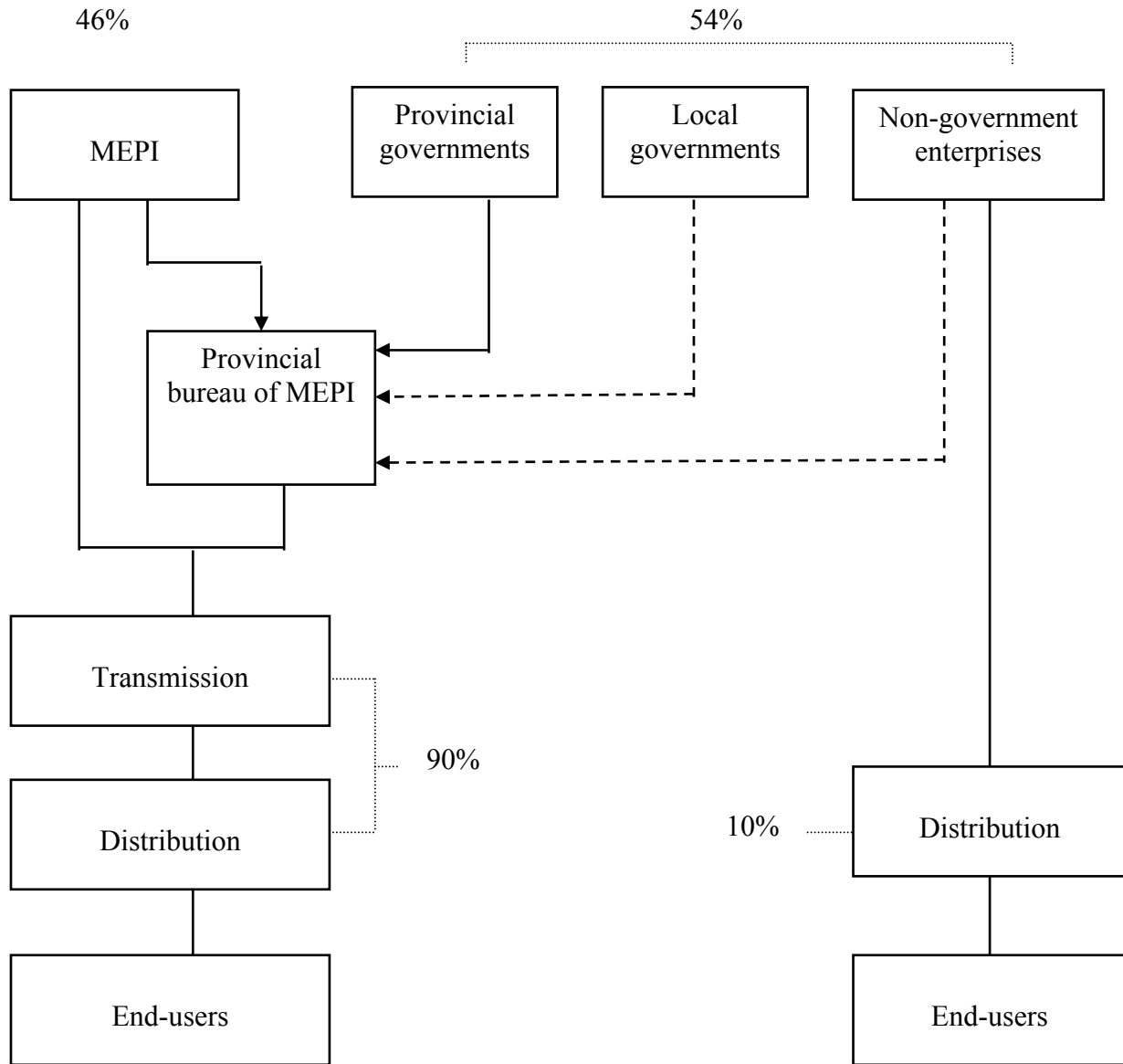
Since the central planning years the Chinese electricity industry has faced a long-term need for large-scale system expansion. For decades, it has required a significant amount of annual capital investment by the central government, which was until 1986 the only source of energy investment financing. However, from the beginning of the 1980s, as economic reforms, initially implemented in other sectors, gave rise to almost double-digit income growth, the gap widened between electricity supply and demand. According to government estimates, in 1979 electricity shortfall amounted to 10 GW of capacity and 40 TWh of generation. By 1986, it had grown to about 15 GW and 700 TWh, equal to 17 percent of the annual power consumption. The shortage was especially severe in fast growing Guangdong Province. According to Guangdong Energy Techno-economic Research Center(1999), many factories were often forced to shut down four days out of every week due to lack of electricity. The urgent need to meet the surging demand for electricity increasingly dwarfed the inadequate financial and administrative capabilities of the institutions of the central government. Raising capital incremental to traditional state capital funding became the driver of the initial reforms of the electricity industry.

The first important policy shifts in the electricity industry started in 1986 with the explicit objective of securing investment for industry expansion from organizations previously barred from power sector development. The reform included several measures to broaden sources of financing and to increase electricity prices, which would in turn attract investors. First, the central government surrendered its long-term exclusive right to invest in electricity infrastructure and allowed sub-national governments, state-owned enterprises and foreign companies to build and own generation facilities. The SDPC also decentralized the project approval process. While it still maintained the authority to approve large projects and all projects involving foreign investors, projects of 50 MW (\$30 million) or smaller would only require the approval of provincial governments. Three variants of new independent power producers (IPPs) emerged around entities owned by provincial governments, local governments, and non-government enterprises.<sup>26</sup> By the end of the 1990s, the non-central government power producers grew to control 54 percent of the national total installed capacity (Figure 8).

---

<sup>26</sup> It should be noted that when a Chinese enterprise is classified as an IPP it may not mean IPP as it is generally understood. For example, Huaneng International is the most well-known IPP in China. But, Huaneng and the State Power Corporation (SPC), the successor of MEPI, belonged to the same owner, i.e. the State Council, Huaneng is listed as the subsidiary of SPC in the latter's corporate organization chart, and Huaneng's Chairman is one of the CEOs of SPC. Even after SPC was de-integrated into the national grid company and five generation companies, Huaneng being one of the five, in December of 2002, Huaneng's Chairman was still the deputy general manager of the national grid company.

**Figure 8. Electricity System After Early Reforms**  
**Generation**



Notes: 1. MEPI and its provincial bureaus were replaced by SPC and its provincial subsidiaries. 2. Solid arrows indicate that the generating capacity was trusted to the Provincial bureau of the Ministry to operate, while the broken arrows indicate power generated from self-operated capacity was sold into the grid through the Provincial bureau of the Ministry. 3. Percentages represent shares of assets.

Second, to encourage investment the central government established a special tariff paid to all newly developed generators. For older power plants built before 1985 with state grants covering the costs of equipment and construction, the generation price was set by the SDPC in an orthodox way that covered only the operating cost of power plants and T&D. The reformed policy created two-track pricing for old and new generation capacity that fixed a tariff formula for new power based on a cost plus basis which guaranteed a 12-15% rate of return and offered an accelerated capital repayment schedule, usually over only ten years for plants with a much

longer lifetime . The reform acknowledged that electricity produced by new capacity would be more costly than that from the older, nationally financed plants because the latter had incurred no or subsidized capital costs and often benefited from cheaper fuel supplies under central planning. In effect, the new policy allowed wholesale prices to be set individually on the basis of the approved cost of a power plant or even of an individual generating unit. For new plants, nearly as many generation prices were adopted as there were new plants or units. Table 2 demonstrates the cost-tariff relationship of one representative power plant in Guangdong Province in the first period of policy reforms.<sup>27</sup> Table 3 contains the national averages of these two tracks of generation prices.

---

<sup>27</sup> Our interview investigation of 25 thermal power plants in Liaoning Province revealed similar relationship.

**Table 2. “Cost Plus” Tariff of a Representative Power Producer  
In Guangdong Province (1999)**

<b>Capital cost</b>		
capital cost by capacity	Yuan/KW	6000
interest rate	Percent	10
payback period	Year	12
annual capital cost	Yuan/KW	880
operating hours	Hour	5000
<b>Unit capital cost</b>	<b>Yuan/KWh</b>	<b>0.176</b>
<b>Fuel cost</b>		
Coal	Yuan/ton	300
Coal consumption	gram/KWh	475
<b>Unit coal cost</b>	<b>Yuan/KWh</b>	<b>0.143</b>
<b>O&amp;M cost</b>	<b>Yuan/KWh</b>	<b>0.002</b>
<b>Total cost</b>	<b>Yuan(\$)/KWh</b>	<b>0.321(0.039)</b>
Misc.	Yuan/KWh	0.018
Tax & Profit	Yuan/KWh	0.10
<b>Tariff</b>	<b>Yuan(\$)/KWh</b>	<b>0.439(0.053)</b>

Source: GETRC (1999)

**Table 3. 2002 National Average Prices paid to Power Generators**

	\$/KWh
Industry average	0.035
Capacity built before 1985	0.029
Capacity built after 1985	0.040
Vintage 1997 (62 plants)	0.050
Vintage 1999-2000 (70 plants)	0.043

Source: DRC (2002), p.46

Third, a fee of RMB .02 (0.24 US cent) per KWh was added to the end-user prices nationwide to raise capital for an electricity construction fund. The central government allocated half of the collections to the state power system under MEPI and, after 1997, SPC (including its provincial subsidiaries) to expand the generation and T&D capacity of the state system and returned the other half to provincial governments to set up power companies and build IPPs of their own.<sup>28</sup> In addition, a wide range of special fees and charges were collected by both the central and local governments to finance specific projects such as the Three Gorges hydro project construction.<sup>29</sup> Table 4 shows the tariffs charged to different end-users in the urban area of Guangdong

<sup>28</sup> For example, the Shanghai Municipal Government used its share of the collection to create Shenneng Corporation to invest in and operate power plants alongside the Shanghai Electric Power Company, a subsidiary of the SPC and therefore part of the state system.

<sup>29</sup> This part of pricing is often subject to local government abuses. As SPC (2001) points out, a huge pricing problem is that provincial and local governments often change the electricity pricing and form their own pricing policy within their controlled areas, without permission, after the SDPC set the price for them (p.111).

Province.<sup>30</sup> While Guangdong's prices are among the highest in the nation, it should be noted that, considering relative income levels, Chinese electricity tariffs in general are not low in comparison to many other developing, or even developed, nations.

**Table 4. 1999 Guangdong Urban Area End-user Prices**

End-users	\$/MWh					
	Grid selling price	Power Construction Fee	Three Gorges Fund	Extra Local Fuel Fees	City Fees	Total
Large manufacturing	65.46	2.42	0.85	13.77	1.69	84.18
Other manufacturing	79.35	2.42	0.85	14.37	1.69	98.67
Commercial	110.87	2.42	0.85	15.10	1.69	130.92
Residential	72.46	2.42	0.85	3.62	0.00	79.35
Agricultural irrigation	37.44	2.42	0.85	0.00	0.00	40.70

Source: GETRC (1999)

Fourth, in 1995, China passed the first national electricity law which gave the new investors formal legal recognition and protection.

During the same period in which the central government began to encourage new investors in the electricity sector, it was also gradually reforming the broader financial system. It experimented throughout the 1980s and early 1990s with various mechanisms to allow SOEs to retain part of their operating earnings in order to increase autonomy and incentives. In addition, Beijing gradually abandoned its practice of budgetary capital allocations to state enterprises in favor of investment financing through state bank loans. At the margins, the central government even relaxed its repression of non-bank capital markets, permitting politically selected state firms to raise funds through securities markets. For example, Huaneng International was founded by the central government in 1985 to access international equity markets to build power plants. The creation of domestic equity markets in 1992 further liberalized the sources of financing for those electricity utilities and generators granted state permission to list. More than thirty utilities collectively have raised about \$1.8 billion in new equity funds (around 3% of total investment) according to some estimates. Finally, the former MEPI and its successor, SPC, twice issued bonds to domestic investors in 1997 and 1998.<sup>31</sup>

As the first stage of reform significantly changed electricity industry investment from exclusive reliance on planned budgetary allocations to a policy that favored multiple power developers using more diversified financial sources (Table 5), it aggregated capital supplies to support the construction of 226 GW of new capacity between 1986 and 2000 (two and half times the total installation in 1986 of 96 GW). According to the SPC, \$20 billion per year was invested in the

<sup>30</sup> See also Wang, et al. (2001), DRC (2002) and Xu (2002) for end-user price data for other provinces.

<sup>31</sup> The \$129.5 million and \$350.2 million issues carried a three-year term and at 11% and 8% annual interest rate respectively. The first issue was paid back, and the second issue was first allowed to be traded on Shanghai security exchange in May of 1999.

electricity industry between 1996 and 2000 alone -- 85 percent from domestic sources and the balance from foreign investors in offshore China and beyond (Wang, X. and Chai, G., 2001).

**Table 5. Capital Construction Financing (1996 - 2000)**

	\$ billion	%
<b>By Source</b>		
Total Capital construction	70.4	100.0
Central government sources	31.4	44.6
Local government sources	13.6	19.4
Enterprise internal funds	9.2	13.1
Foreign investment	12.2	17.4
Other sources	4.0	5.6
<b>By Type</b>		
Total Capital construction	70.4	100.0
Bank loans	29.5	42.0
Government special funds	9.6	13.7
Enterprise raised funds	9.2	13.1
Debt	0.8	1.1
Foreign investment	12.2	17.4
Unclassified source	9.1	12.9

Source: Wang, X., Chai, G. (2001)

In as much as the financing of new capital infrastructure is a serious difficulty in most developing countries, the Chinese reforms in the power sector should be credited as an unmatched success. Facing in the late 1980s a consistently growing demand for electricity and preoccupied with macroeconomic problems associated with uncontrolled monetary growth from undisciplined state bank lending, China announced the first stage of electricity reform to respond to both real and financial sector constraints. But the success of the policy changes in releasing new capital for power development never really signaled either a comprehensive restructuring of the electricity industry or a deep liberalization in financial markets. Political management of both the power sector and the allocation of China's extraordinary national savings rate of more than 40% of GDP remained at all times the dominant characteristics of the initial reform period. The largest part of new electricity infrastructure was invested within the existing state utilities by means of loans from state banks where China's huge household savings were locked up because of the absence of alternative savings instruments. Although for many SOEs the shift from capital grants to soft loans was practically inconsequential except as a bookkeeping change, most electric utilities, having good income flows, did keep current on their loans. However, in general, it remained true that state banks possessed no real autonomy to reject government approved projects and did not monitor borrower performance during the reform period. Four-fifths of total bank lending in recent years still has gone to SOEs which destroy more economic value than they create (Economist 2/6/03).

In the state power sector additional investment funds were mobilized by national decisions to raise administered tariff schedules and extra-tariff fees and by giving state-controlled utilities early selective access to new and oversubscribed securities markets. However, again these reforms reproduced the familiar pattern of state control. On one hand, the state was able to

increase end-user tariffs with minimal resistance because state-owned enterprises and other forms of public companies often operating with soft budgets constituted a major percentage of large end-users.<sup>32</sup> State political control has also allowed utility enterprises, predominantly government-owned, to easily pass on the cost of expanding electric system capacity to non-industrial end-users. Unlike in Brazil, India, Mexico and South Africa, consumers were not allowed to organize as interest groups to influence government policy making. In some cases, such as Three Gorges Hydropower, the government can even ask all consumers to pay in advance for the electricity that many of them do not even use. On the other hand, as is often pointed out by Chinese researchers, “(E)xcept for their form, [Chinese markets] have nothing essential in common with western stock markets” (Yi, 2003 <http://www.drcnet.com.cn>). The initial purpose and design of the Chinese stock markets was principally to tap a novel means of raising capital to prolong the life of financially distressed SOEs, without any real intent to change their corporate governance or operations. Access to Chinese equity capital became a new form of SOE privilege that has particularly benefited favored enterprises in the electric sector (The Economist, February 6 2003). Similarly, the Chinese bond market remains relatively undeveloped. Outstanding bonds account for about 10% of total financial assets. As with stocks, the central government strictly limits corporate bond placement to selected SOEs. By restricting supply, the central government has been able to allow bonds to issue at comfortable interest rates as low as 3 percent, creating an implicit subsidy for favored enterprises. In short, although China has installed all the formal elements of a financial market, these new markets do not serve to allocate capital efficiently across a broad portfolio of competing investments.<sup>33</sup>

The potentially more radical shift in the state policy that occurred in the first stage reform was the admission of new actors as capital suppliers. This opening operated to reduce credit expansion (and inflation), as well as to contribute to the effort to reform the practice of soft loan financing by state banks, by channeling the industrial earnings of local governments into infrastructure investments. Foreign investors, both off-shore Chinese joint ventures with local governments and international independent power producers attracted by carefully crafted power purchase agreements (PPAs) with state utilities, further multiplied the organizational and legal diversity available in the power sector. But again, it is important to note that these new entrants did not fundamentally change the structure of China’s electricity industry. They fitted into the existing pattern of operations. Without formal PPAs, local governments negotiated on a recurring basis with provincial power utilities the dispatch and tariff conditions of their generation units in what might be termed a political merchant market. The IPPs as well soon found that their legal guarantees were less credible than they had hoped and were equally reduced to adapting to the ongoing political re-determination of their off-take and returns. In no important way did the first stage reforms shift the underlying operations, market rules, corporate governance or regulatory/environmental performance of the power sector. In retrospect, it remains unclear whether any reform beyond meeting capital constraints in the context of a more constrained macro-economic policy was ever intended. This situation left the electricity far behind most industries in the transition away from central planning.

---

<sup>32</sup> To the extent problematic state-owned enterprises could not afford higher electricity cost, they were able to let payments lapse without being cut off by the power companies, or eventually have the government bail them out.

<sup>33</sup> See Chen et al. (2000) for a general discussion of the continued government dominance in the evolving financial sector.



Nevertheless, the initial reforms of China's electricity were more than just formalities. They introduced new actors and new dynamics into the system, mitigating the near-exclusive influence of the central government. The limited financial and political capacity of the central government to keep up with growth in electricity demand during the period of high economic expansion has led to a partial relaxation of central planning and the emergence of more decentralized energy development to meet residual demand not satisfied by the national power system. In effect, Chinese electricity development after the first reforms may be understood as a dual system, with a strong core of centrally planned and integrated utilities and a periphery of more varied, usually smaller, operators. This peripheral system has generally been built, financed and managed by local levels of government, sometimes as co-investors with offshore Chinese or foreign IPPs. The relative size of the core and periphery elements of the electricity system has been determined by the rate of income growth (and power demand), by shifting national macroeconomic and capital market policies that determine the volume and sources of investment financing, and by the uncertain central-provincial/local relationships that play out as an unending theme of Chinese governance. In general, when economic growth is high, macroeconomic policy restrictive, and central authority weaker, the relative importance of decentralized investment on the periphery will be more likely to grow.<sup>34</sup>

#### Reform to change the role of government (1997 – 2001)

As discussed at the beginning of this section, before reform, the boundaries between government and business in the Chinese electricity industry and other strategic sectors were wholly diffuse. The central government commanded all major economic activities through state finance, production quotas and use allocations. Both social welfare functions and the implementation of economic policies were directly carried out as performance obligations of productive organizations. However, since 1979 the government has increasingly recognized that the command economy gave SOEs no material incentives to efficient production and has implemented reforms to transform SOEs into more commercially oriented enterprises. The reforms included, among other things, contracts with SOEs to eliminate the transfer of all net revenues from business firms to the state and the later creation of a tax system which would allow them to retain residual profits.<sup>35</sup> Nevertheless, as late as the 1990s, core sector SOEs continued to be subject to massive government controls over their commercial decisions even as they acquired greater financial autonomy. Continuing losses in many state enterprises and lack of innovation in business practice led the central government to launch a second stage of economy-wide reform in 1997 to separate government administration from business operations.

In the electricity industry, the second stage of reform began with the same objective at the same time. The central government implemented three major reform measures. First, in 1998 it eliminated the Ministry of Electric Power Industry, which had managed both policy planning and commercial direction for the electricity sector.<sup>36</sup> The Ministry's entire stock of productive assets, as well as its business responsibilities, were taken over by the SPC – a new entity created one year before. The Ministry's administrative and policy making functions were transferred to the newly-established Electric Power Department of the State Economic and Trade Commission. A

---

<sup>34</sup> See Zhang, et al. (2003).

<sup>35</sup> See, for example, World Bank (1994) for discussion of these reforms in the electric power industry.

<sup>36</sup> A dozen other industrial ministries were also abolished in the same year.

parallel separation was carried out in the organization and regulation of the electricity industry at each level of government -- from provinces to counties and municipalities.

Second, the SPC itself was reorganized from an administrative department into a corporation. The SPC was not a private corporation with shareholders or any stock exchange listing, but did have a modern corporate board, along with state appointed executives and a state supervisory body. The government also created provincial subsidiaries within the SPC and attempted to give them more discretion in making business decisions and to provide additional economic incentives in their operations – all with the aim of transforming the enterprise into a more efficient business operator.

As a third measure, in 1999 the SPC began to experiment with wholesale market competition between generators on a very limited basis in six provinces. The experiment was associated with the unexpected turn around of the power market from chronic shortage to a wide-spread surplus, occasioned mainly by slack demand after the Asian financial crisis. This macro-economic reversal caused serious conflicts among different power producers and highlighted the inability of the long-standing Chinese practice of dispatching electric generators by political allocations instead of relative economic costs to create appropriate signals for efficient operations and tariff reductions. Under the administrative principle, characteristic of central planning, power dispatch had followed a rule by which each generator was dispatched proportionally to its capacity, irrespective of the economic merit. When demand fell short of capacity in 1997, the system simply cut all power producers' generation quotas proportionally (though actual quotas were subject to regional preferences and under-the-table deals). A more efficient mechanism was clearly needed to deal with the economic downturns.

Six provinces (Liaoning, Jilin, Heilongjing, Zhejiang, Shanghai and Shandong) were selected to experiment with market competition to lower cost and increase sales.<sup>37</sup> The experiment followed a very crude English power pool model. Typically, each province selected a certain number of power producers to participate in a limited competition that served only a small fraction of market demand. The bulk of demand continued to be met by the plan allocated dispatch, with reductions in dispatch caused by oversupply again allocated to all power producers in proportion to their existing generation. Even power companies with PPAs were forced to reduce their contracted off-take hours. In the small designated competitive sectors, different plans were adopted. For example, Liaoning Province designed a "1 + n" model, that is, one grid and n generators. The province decided that certain power plants – including co-gen plants, hydropower, and a single unit with capacity less than 10 megawatts - would not participate in the experiment. Essentially, the power generators forced to participate were the twelve largest IPPs (SOEs that had recently been spun off from the integrated provincial utility). For each, the total power capacity was divided into a contractual amount and a smaller (typically 10 percent) that was forced to compete. The contractual amount was dispatched as usual every day at the politically set price. The 10 percent beyond the contractual amount was bid into the grid at

---

<sup>37</sup> Electricity surplus was serious in these provinces. Some provinces also had more diversified ownership structure in the generation sub-sector. For example, the average operating hours of all power plants in Liaoning province dropped to below 4500 hours from more than 5500 during the shortage years. By the province's account, there were 85 power plants which were not owned or controlled by the provincial power company.

market price. The IPPs were free to make their own decisions whether to compete or not on a daily basis.

Simulation of the competition began in July 2000, with no actual financial settlements. The experiments in all six provinces were suspended after two years for various reasons including unfair competition, an upturn in the market that reduced excess capacity, and the announcement of prospective government policy initiatives that presaged still newer reform models (discussed below). The experiment of wholesale market competition was generally inconsequential because its scope was extremely limited and the experiment was halted as soon as the power market became tighter in 2001, alleviating the pressure on power producers to lower prices or compete for dispatch on the grid.

More generally, the second stage reforms aimed at reducing the role of government in business and introducing market incentives were less effective than the earlier reforms aimed principally at raising capital for expanding capacity. The ineffectiveness stems from the fact that the central government never really committed to relinquishing its role as the economic planner and decision maker. As discussed at the beginning of this section, the Chinese state began the reform process as the sole decision maker, investor, financier and operator of the economy. Through the reforms since the 1980s, it has partially released SOEs from its administration and created multiple public and private financial intermediaries to replace capital grants from the state budgets as investment funding. But, the central government has always been especially cautious about losing control of electricity which it views as a strategic lynchpin of both security and development.

Although Beijing no longer aims to control how many restaurants will emerge in the next five years, it does see a need to continue to plan and decide how many power plants to build, where to site them, what fuel they should tap and what prices they will charge.<sup>38</sup> As a result, instead of partially withdrawing from business, the government merely switched its role from directly controlling the power industry via repatriation of all revenues and direction by ministerial fiat to indirectly controlling utility SOEs' access to financial markets and project approval.<sup>39</sup> SOEs in the power sector are not substantially more independent than they were before the reform in terms of power project development. This ongoing politicization of the energy sector explains why now corporatized SOEs still calculate financial viability and risks of their investments so differently than do organizations constrained and motivated by competitive commercial and financial markets.<sup>40</sup>

---

<sup>38</sup> That the government now trusts markets to run many businesses except for energy and a few other vital sectors is not all unjustified because of public good or natural monopolistic natures of these industries. The question to the government is whether the five year planning is really better than a regulated "Invisible Hand".

<sup>39</sup> In addition, the government continues to maintain the political control of the utility SOEs through political appointment of corporate leadership. Following the central government's policy and order is a must for someone to be appointed. In the case a utility SOE becomes listed, the government always has majority interests, and the Chinese stock markets with "socialist characteristics" rarely give minority owners any voice.

<sup>40</sup> For example, the Chinese oil industry SOEs would not hesitate to start to construct the long-distance West-east natural gas pipeline when neither future gas price nor offtake was understood. Similarly, state generation companies would not hesitate either to import expensive gas turbines when they knew the regulated gas price and power market condition would make gas power non-competitive. Their risks were insured politically by the government.

While the second stage of electricity reforms, like its predecessor, did not fundamentally restructure the power sector or effectively separate its management from pervasive political direction, added organizational changes of variable motivation and consequences were introduced. Consistent with reforms making faster process in other economic sectors, corporatization and even private minority interests ownership were advanced in the core or state dominated power sector. Formal ministerial administration receded and the newly chartered SPC pursued policies to improve operational incentives through decentralization. A prospective drive for efficiency was suggested by the marginal competition experiments. However, in the end, the second stage of reform may better be interpreted more as reaction to, than enhancement of, real change.

With the unexpected growth of a power surplus in the economic downturn after 1997, the dual organizational model of core and periphery that emerged from the first stage reform became problematic for the central government. Provincial utilities, having been given more autonomy by the SPC once it replaced MEPI in 1998, acted to preserve their political accords with generators owned by local governments and to increase provincial protectionism. The utilities maintained political balance by reducing dispatch proportionally from both core and peripheral plants, leaving both newer state owned and foreign IPPs with idle capacity. The central government reacted by initiating a campaign to close smaller and environmentally lower quality peripheral plants and threatening merit dispatch in competitive markets. Nevertheless, the immediate impacts of these reactions were limited in the face of local autonomy. In the short run, the political tensions manifest in the partially reformed electricity markets during the second stage of reform were mitigated by the return to faster growth around 2000 and the consequent increase in capacity use. In the longer run, the central government retained an impetus to reform the power system further through both an expansive macroeconomic policy that cut the need for non-state capacity financing and more far-reaching structural reforms.

#### Market reform to introduce competition (2002 - )

In December 2002, China adopted a different approach to electricity reform, announcing its intent to implement the standard global model of deregulation toward competitive utility markets. This apparent rejection of the orthodox Chinese approach to energy had been heatedly debated among domestic policy makers since 2000 and was strongly recommended by international experts on the utility industry.<sup>41</sup> Reinforced by the disenchantment with the experience of more decentralized political control of the electricity sector in the late 90s, the de-integration and the competitive market model embraced the most plausible alternative for more comprehensive reform, which at the same time fit the country's general effort to replace central planning with markets.<sup>42</sup>

---

<sup>41</sup> International advice has been available to the Chinese government to design the reform. See, Berrah, et al. (2001), The Development Research Center (2002).

<sup>42</sup> The dispatching difficulty of Ertan Hydropower station due to the SPC monopoly made the State Council finally determined to break up SPC and de-integrate the system. Ertan is the largest hydropower station in China. It was built in the late 1990s to supply power to Sichuan province. However, since its commission, it was only able to sell two thirds of the contracted power and at a very low tariff of just above two cents. The reason was partly because the Provincial subsidiary of SPC which owns transmission and distribution in Sichuan favored its own power plants in a weak market. This created great financial stress for Ertan Hydropower Station. See, People's Daily July 10, 2000 for the detail.

The structural focal points, as well as the principal drivers, of the reform are eliminating integrated utilities with monopolies in geographic areas and curtailing economic regionalism. To this end, the central government eliminated the SPC at the end of the year 2002 and reallocated its corporate assets. Five state-owned independent generation (holding) companies were created to take over SPC's generation assets. Although these companies are called independent power producers, and though in some cases they hold the controlling stock interests in listed companies set up as IPPs in the 90s, all are legal dependencies of higher government organizations. SPC's main transmissions and distribution (T&D) assets were transferred to a new State Grid Company which would be the state grid operator across northern China. Its T&D assets in the three southern provinces (Guangxi, Yunnan and Guizhou) were merged with the formerly independent Guangdong Provincial and Hainan Island grids to form the new China Southern Grid Company, a jointly held company between the central government and Guangdong Province, the majority holder. The same separation and asset reshuffling encompasses the assets nominally held by the SPC's former provincial subsidiaries. The generation assets of the subsidiaries are to be transferred into the five national state generation companies; their T&D facilities are to be relabeled as provincial subsidiaries of the State Grid Company in the north, and minority partners of the China Southern Grid Company in the south. After the reorganization, the Chinese electricity industry will be composed of two regional grid companies, one wholly state-owned and one jointly held, and five state-owned generation companies which will operate and compete against each other nationwide. Public and private independent power producers previously outside the SPC system will continue to operate and compete with the five state generation companies.

In addition, in March 2003, The State Electric Power Regulatory Commission (SERC) was created as an independent regulatory agency under the State Council. SERC currently is just starting the process to define its local structure, functions, responsibilities, and authority. Among its primary duties will be the establishment of the rules to frame competitive electricity markets and the technical standards of electricity quality. Beyond these, the scope and nature of its policy reach are not yet clear.

Chinese advocates of comprehensive electricity restructuring hope to achieve multiple ends. As laid out in the government reform plan, the objectives of the reform include: (a) to create a fair and competitive power market, with at least a wholesale market as the first stage, independent regulation and a new electricity pricing system; (b) to improve efficiency and lower costs; (c) to optimize resource allocation and promote development and national grid interconnections; (d) to incorporate into the pricing mechanism environmental charges and incentives for renewable energy; and (e) to continue the rural electricity structural reforms.<sup>43</sup> Although it is too early to see how the details will be designed and implemented, or how much the reform will be able to accomplish, it presents a daunting task, confronting multiple obstacles occasioned in good part by its interactions with the simultaneous reforms in China of financial, industrial, and social policies.

First, China faces a tremendous task of long-term, large scale generation and delivery capacity expansion and financing. Past experience suggests that, when there is a need to increase capacity by 25 to 30 GW a year to meet demand, the urgency of raising capital to build new plants

---

<sup>43</sup> See <http://www.sp.com.cn/newsp/ggzl/gjwj/xgxx07231.htm>.

outweighs any economic reforms that may disturb stable production in pursuit of other system goals. Chinese reform planners time and again stress that lack of capacity makes China a significantly different case than developed countries engaged in electricity reform, where sufficient capacity focuses attention mainly on the value of competition to lower costs. The primary objective of electricity policy in China is still development financing. If the classical object of deregulation, efficiency, remains subordinate, the pace of its implementation will be sporadic.

Given these priorities, the direction of energy reform is directly tied to the reforms of financial markets. The earlier discussion pointed out that the government met the financing challenge of the last two decades by expanding its core sector through state bank loans, a small opening to securities markets and a tariff policy that allowed new capital costs to be passed through in part to end-users. It supplemented these state allocated resources by allowing a growing periphery financed by local governments and private capital to emerge. Looking forward, as macroeconomic and utility market reforms proceed, the government now envisages a new financing model. In theory, independent generation companies will face competitive wholesale power markets and have to raise capital by themselves in financial markets on commercial terms.

In practice, pervasive uncertainties cloud this posture. First, financial markets in China remain politically influenced. Core state-controlled holding companies, like the new gencos and gridcos, have selective access to both state bank credit and securities listings. At the same time, Chinese macro-economic policy has been expansive since 2000. This expansion allows core electricity groups adequate finance for new capacity without recourse to local governments, foreign investors or the discipline of competitive capital markets. Next, the availability of foreign investors has been adversely affected by the government's repudiation and renegotiation of power purchase agreements in the context of late 90s surplus electricity supply. Finally, efficient investment financing requires some mitigation of the regulatory and commercial risks associated with emerging markets. Neither the market rules, discussed below, in the energy sector, nor the independent capacity of the legal system to enforce contracts, nor the prospective market power of the new state-controlled actors is yet apparent. The aggregate effect of these uncertainties and instabilities, both structural and macroeconomic, is to make highly problematic the depoliticizing of financing imagined in the ideal version of electricity reform.

Second, around the world, utility market reforms have proven more complicated than economic textbooks would suggest. In most countries that have implemented such reforms, political and institutional factors have confounded efforts to create well-functioning markets for electricity. Such factors are likely to have a large impact on how market reforms unfold in China given the transitional nature of its economy and institutions. As discussed earlier, the central government's residual controls "die hard" because, even as it experiments with markets, the central government continues to exercise extensive investment planning and social policy intervention in the strategic energy sector. It retains its control of firms, bureaucratic appointment of industry leadership and a politically dominated legal system to ensure the implementation of its objectives. Creating a fair and competitive power market demands that the linked central and provincial governments relinquish their traditional role as primary resources allocators and their administrative capacity to manage power supply and consumption.

Nevertheless, the plan to reform the government in this respect is weak. Indeed, even the market reform designer, the SDPC, has not indicated whether it will give up control over tariffs and administrative authority over power project approval.<sup>44</sup> This has led to worries among researchers that the new State Electric Power Regulatory Commission would never become independent of traditional political functions and will wind up another “decoration” under continued government control.<sup>45</sup> The continuing exercise of political authority would be favored by at least three pressures on the reform process. First, the government is not anxious to raise tariffs for industrial users, especially beleaguered SOEs. Second, there is no current discussion of market rules that would establish spot or day-ahead markets for more than a minor percentage of future competitive power markets. This implies most power will be supplied after reform by contract in potentially reformed markets where a small number of dominant generating firms with residual political influence will wield substantial market power. In this regard, it is important to recall that, even with the break up of the SPC, the five national generation holding companies created by the reform to inherit the SPC assets are all wholly controlled by state interests. Given the market power these “independent gencos” are likely to possess, it is difficult to say in advance that the effective power of the central government over industry development necessarily will wane.

Third, Chinese electricity reform must account for the social welfare objectives of regional development, environmental protection and rural electrification. However, these objectives do not necessarily push policy in the same direction and deregulated market competition may at times work against them. Outcomes depend on the overall portfolio of government policies that is subject to ongoing political contest both within the central government and between it and more decentralized interests. In its next five year plans, the central government has planned investments in a number of large hydro, natural gas, nuclear power, and transmission and distribution development and upgrade projects. These projects all serve the purpose of environmental protection, but only some promote the economic development of poor western regions of China that are abundant in certain types of primary energy resources. For example, a policy that gave the highest priorities to Western growth would emphasize hydro and coal development, along with T&D investments to create an integrated grid to move this cheap power to load centers further east. The effects would be of mixed environmental quality. Nuclear and natural gas, especially from imported LNG sources, could have higher environmental value than coal fired development and be more satisfactory to coastal interests who prefer more local energy self-sufficiency and the economic value of local industrial development, even at the cost of higher electricity tariffs.

Existing studies show that nuclear power, generation and renewable energy will not be commercially competitive against coal, even if desulfurization is mandated. Similarly, the competitiveness of gas power will depend critically on the price of gas, peak load power tariffs and the credible quantity of offtake (Zhou, 2000; GTRDC, 2003). Upgrading of the rural distribution system in many cases is actually loss making for the utility companies that have been

---

<sup>44</sup> In fact, government planning is such an entrenched fixing in the Chinese economy that even reform experts believe that pricing, project and financing should continue to be authorized by the SDPC to maintain stability, and the function of the regulatory commission should mainly be designing rules of the game, and supervising the implementation of SDPC authorized projects. See, for example, International Financial News October 28, 2002.

<sup>45</sup> Liu Jipeng, China Economic Daily, September 16, 2002.

directed to do it. Investing in these unprofitable or loss-making projects posed no problem for a state utility company under central planning because the government would always cross-subsidize prices or bail out losses. However, to promote these projects in more competitive markets, the government will either have to require offtake contracts or mandate portfolio standards, thus limiting market competition, or impose market rules that set relative energy prices or dispatch order so as to reflect the social values of these projects. In either case, there is as yet no indication as to whether market rules will be designed to promote these projects in the context of a competitive power market, or even whether such choices will be subject to central or provincial determination.

In short, given the expected evolution of all factors that influence the economic and institutional transition from central planning to a market economy in the electric power sector in the next decade, central government control over the electricity system will remain undiminished. However, the bimodal development of the organizationally reformed government controlled state system at the core and a supplementary decentralized system in the periphery will also continue for some time. In these circumstances as noted above, the relative sizes of the core and periphery is likely to be determined primarily by the rate of economic growth, national macroeconomic and financial market policies, and the political ability of regional and local governments to protect their economies.

Projecting from the first two stages of reform, the incipient third stage may be characterized by countervailing influences associated with periods of substantial economic growth. In the shorter term, rising demand will induce capacity expansion primarily in the national or core power sector. This expansion will be financed heavily by state credit and securities issues by the new national generating companies under the broad guidelines of central investment planning. The additional core sector infrastructure will be primarily coal fired, large-scale (600 MW), domestically manufactured plants, although more expensive gas-fired and nuclear capacity will be supported at the political margins for regional industrial policy and energy security reasons. In addition, the development of the west to east power transfers will result in continuing hydro expansion and mandated offtake, often through dedicated transmission lines. However, incipient competition in partially reformed electricity markets will be more likely manifest in political contests between the new gencos seeking favorable plant siting, financing, and control allocations than in the institution of open merchant operations. Key questions about the scale and structure of the core sector will also depend on policy that sets the rate of T&D investment and the corporate choices of the two national grid companies about how far and fast to integrate what have until now been fragmented power networks. Although better integration would increase the potential for effective inter-regional competition, the substantial market and political power of new state generating companies are still more likely to influence the emerging shape of the market reforms than will the conduct of independent regulators in setting market rules shape corporate business strategies.

The counter-thrust to the development of the centrally planned core sector will arise in the medium term from the combined effects of high and variable regional growth and the decentralization motivated by earlier stages of reforms. Demand projections made by fast growing provinces will differ from the central plan in quantity and (peaking/environmental) quality. The push to supplement centrally approved investments with local production will



expand with the pace of growth. How much a revival of dualism in the sector is tolerated will be partly a function of whether market rules are detailed and mandatory, or are left open to local interpretation and optional implementation. Delay in integrating the national grid system through relatively lower T&D investment and Beijing's uncertain ability to sustain an expansionary macroeconomic policy in the face of an already incipient signs of economic overheating will also help determine the relative scope of peripheral variation. As in past periods of reform, innovation in power sector fuel composition, finance and organization is more likely to accelerate if diversity on the margins perturbs the slower evolving orthodoxy of the core.

#### **4. Summary**

The Chinese electricity industry has faced the long-term challenge of large scale system expansion since the 1950s. To power national development, the government organized electricity production and distribution as a state-owned vertically integrated utility, structured and operated under central planning. Electricity was supplied on the basis of political priority instead of cost, and the single party authority ensured that national economic, technical and social policies were implemented by managers at all levels of the industry.

Since the mid 1980s, the Chinese government has experimented with sequential reforms that relaxed elements of the traditional industry organization to encourage more investment. In particular, it has replaced its once exclusive control of capital investment through budgetary grants to allow other actors to raise money and build power plants. It increasingly recognized the value of more accurately reflecting cost, price and profit in electricity development and implemented a tariff policy that promised a competitive rate of return for investors in the utility sector. Moreover, it has more recently tried to sever the administrative identity of government and business and de-integrate generation and transmission in order to encourage competition. Without a doubt, the result of even these limited reforms is remarkable. Electricity supply has grown at unmatched rates and a far larger percentage of people have access to the grid in China than anywhere else in the developing world.

While many Chinese researchers attribute the success of capacity growth and access to a national commitment to market reform, foreign researchers are less persuaded. This study has reached two conclusions. First, the capacity growth in the past twenty years was achieved predominantly through continuing economic and political control by the central government. Where the central government ran up against inefficient state bank lending and macroeconomic limits on state credit expansion, it allowed local governments and some foreign investors to develop a more diverse and somewhat decentralized periphery of new plants to supplement the state core. However, after the past decade of reform and against a background discussion of sectoral deregulation in favor of competitive markets, what had principally changed were the sources and forms of financing. The periphery was given a place at the table of politically negotiated wholesale tariffs and off-take quotas, while little occurred in the reform of operations, dispatch, corporate governance, environment or end-user pricing. In the national core of the energy system, the government maintained its control over the nation's banks and emerging securities markets, its administrative approval of all important projects and even, as the reforms advanced into the reorganization of state enterprises, its control of the new corporatized firms. This does not suggest that the changes introduced in diversifying financing or introducing economic

incentives or formally dividing business and government were not real improvements relative to the pre-reform power system. The point is that the resulting new organization remains more a political than an economic market.

Second, gains were achieved through the medium of an authoritarian governmental system. This system ensured that provincial/local governments and government owned utility companies did not go too far astray while exercising the discretion granted by the central government to develop their power generation capacity. Moreover, although raising end-user electricity tariffs has proven a most sensitive problem in pluralist political systems, the Chinese central government has not been constrained by popular grievances in selectively increasing tariffs to support capacity growth.

As much as the central government dominated system has up to now been flexible enough to cope with the needs of high growth, still tougher reform challenges lie ahead. While demand for electric power will continue to increase at unprecedented absolute levels in the future, the reforms announced in 2002 to institute competitive markets are beset with uncertainties. Providing electricity in even developed country electricity markets has proven economically and politically difficult because of concentrated market power among generators, transmission and distribution bottlenecks, and weak incentives for capacity enhancement. China would face each of these problems given the state ownership and market dominance of its national generators and its lack of well functioning financial markets, legal institutions, and independent sectoral regulators. Moreover, potential electricity competitors would face policy instabilities over regional development, environmental quality, and power market rules that increase commercial risk. In these circumstances, there is a high likelihood that the government will opt to defer reform in order to balance system growth and stability. In the short term, this balance can be achieved by assuring state financial credit to the limited group of national producers that have succeeded to the assets of the state power system. In the longer run, more uncertainties may arise associated with macroeconomic problems of rapid credit expansion, unresolved tensions between the central government and fast growing regions over their economic autonomy, and the increase in the number of firms and consumers seeking greater voice under the pressures of competitive markets and political liberalization. China's electricity system has moved well away from its pre-reform command structure. But its transition away from a deeply political market foretells a yet lengthy process.

## Reference

Berrah, N., Lamech, R., and Zhao, J., 2001. Fostering Competition in China's Power Markets. World Bank Discussion Paper No. 416.

Brennan, T., Palmer, K., Martinez, S., 2002. Alternating Currents: Electricity Markets and Public Policy. Resources for the Future, Washington, D.C.

Chen, Baizhu, J. Kimball Dietrich and Yi Fang ed. Financial Market Reform in China: Progress, Problems and Prospects. Westview Press, Boulder Colorado. P.5.

Development Research Center, 2002. Strategies for China's Electricity Reform and Renewable Development (White Paper). Prepared for China Sustainable Energy Program, The Energy Foundation.

Fridley David eds. LBNL: China Energy Databook v. 5.0, May 2001, LBNL-47832

Gupta, J., Vlasblom, J. and C. Kroeze, 2001. An Asian Dilemma: Modernizing the electricity sector in China and India in the context of rapid economic growth and the concern for climate change. Vrije Universiteit, Amsterdam, Report number E-01/04.

IEA, 2002. World Energy Outlook.

Lieberthal, K., 1997. China's Governing System And Its Impact on Environmental Policy Implementation. China Environment Series, Issue 1. Woodrow Wilson Center, Washington, D.C.

Lieberthal, K. and Oksenberg, M., 1988. Policy Making In China – Leaders, Structures, and Processes. Princeton University Press, Princeton, New Jersey.

May, M., Heller, T. and Zhang, C., 2002. Electricity Industry Development and Global Warming Impact: Case Studies of Three Chinese Provinces. Prepared for EPRI, Stanford University, November 2002.

Shao, S., Lu, Z., Berrah, N., Tenenbaum, B., Zhao, J., 1997. China: Power Sector Regulation in a Socialist Market Economy. World Bank, Washington, D.C.

Sinton, Jonathan E. and Fridley, David, 2000. Growth in China's Energy Consumption. Energy Policy, 28, 671-687.

Smil, V., 1988. Energy in China's Modernization: Advances and Limitations. M.E. Sharpe, New York, New York.

State Power Corporation, 2002. Report on Electric Power Industry during the Ninth Five-year Plan. China Electric Power Press, Beijing, China.

State Statistical Bureau of China. China Statistical Yearbook, various years. China Statistical Publishing House, Beijing, China.

World Bank, 1994. China Power Sector Reform: Toward Competition and Improved Performance. World Bank, Washington, D.C.

World Bank, 1997. Clear Water, Blue Skies: China's Environment in the New Century. Washington, D.C.

McElroy, M., 1997. Industrial Growth, Air Pollution, and Environmental Damage. In Energizing China: Reconciling Environmental Protection and Economic Growth. Harvard University Press, Cambridge, MA.

Xu, Yi-chong, 2002. Powering China: Reforming the Electric Power Industry in China. Ashgate Publishing Company, Burlington, VT.

Yang, Ming, 2003. China's rural electrification and poverty reduction. Energy Policy 31, 283-295.

Zhang, C., May, M. and Heller, T., 2001. Impact on global warming of development and structural changes in the electricity sector of Guangdong Province, China. Energy Policy 29, 179-203.

Zhang, C. Heller, T., May, M., 2003. Carbon intensity of power generation and CDM baseline: case studies of three Chinese Provinces. Forthcoming Energy Policy.

Zhou, D., Guo, Y., Shi, Y., Logan, J., 2000. Electric Power Options in China. Prepared for the Pew Center on Global Climate Change, May 2000.

Zhu, C., Li, W., Yang, F., Ogden, D., 1999. Overview of Institutional and Market Reforms and Future Prospective in China's Utility Sector. Report of Lawrence Berkeley National Laboratory submitted to China Sustainable Energy Program, The Energy Foundation.

### **References in Chinese**

China Statistical Yearbook, China Energy Yearbook.

Development Research Center of State Council, 2000. Strategic Study of Chinese Electric Power Structure Reform and Sustainable Development. Report submitted to the Energy Foundation and W. Alton Jones Foundation, October.

Guangdong Energy Techno-economic Research Center, 1999. Guangdong Electric Power Development and Future Trend. Paper presented at the Forth China Energy Project Workshop of CISAC, Stanford University, November 1999.

GTRDC, 2003. Guangdong Provincial Electric Power Market Reform and Future Development, Working Paper, PESD, Stanford University.

Jiang, S., Ouyang, C., 2002. Strategic Structural Adjustment of the Electric Power Industry during the 9<sup>th</sup> Five-year Plan Period. In SPC (Comp.), Summary of the Electricity Industry Performance during the 9<sup>th</sup> Five-year Plan. China Electric Power Press, Beijing, pp.218 – 232.

Ministry of Electric Power Industry, 1996. Electric Power Industry in China, China Electric Power Press, Beijing.

Planning Division of the Ministry of Electric Power, 1996. Report on Electricity Supply and Demand in China, in Planning Division of the Ministry of Electric Power, ed., Reform and Planning in the Power Industry, Beijing: China Electric Power Press (1996).

Shao, H., 1998. A Critique of Electricity Grid Price Reform. China Energy No. 1, 33-39.

SPC, 2001. Main Report. In SPC (Comp.), Summary of the Electricity Industry Performance during the 9<sup>th</sup> Five-year Plan. China Electric Power Press, Beijing, pp.29 - 174.

Wang, Tiesheng, Zuo, Yongkun, Zeng, Dongning, Tang, Li and Zhang, Jinzhu, 2001. Liaoning Electric Power Industry Development and Greenhouse Gas Emissions Abatement Policy, Report submitted to China Energy Project, Institute for International Studies, Stanford University, Stanford, CA.

Wang, Xin, Ni, Xiaoting, and Feng, Ailing, 1998. Evolution of the Chinese Investment Financing System: Problems and Reform Directions, in Guo Shuqing eds. Investment Financing System Moving toward Market Economy. Reform Press, Beijing. P.53.

Wu, Guihui, 2003. Retrospect and Perspective of Rural Electrification in China. [http://www.drcnet.com.cn/html\\_document/guoyan/inoth/2003-01-24](http://www.drcnet.com.cn/html_document/guoyan/inoth/2003-01-24).

Wang, X., Chai, G., 2001. Review of Economic Policy in the Electricity Industry During the 9<sup>th</sup> Five-year Plan and Future Prospect. In SPC (Comp.), Summary of the Electricity Industry Performance during the 9<sup>th</sup> Five-year Plan. China Electric Power Press, Beijing, pp. 266 – 277.

Wu, J., 1999. Contemporary Chinese Economic Reforms. Far East Press, Shanghai. (Dang Dai Zhong Guo Jing Ji Gai Ge.)

Zeng, L, Chen, L, Su, B., 1999. Guangdong Electric Power Development and Future Trend. Paper presented at the Forth China Energy and Global Environment Workshop of CISAC, Stanford University, November 1999.

Zhu, Chengzhang, 2003. Fifty years of structural reform in the Chinese electric power industry. National Electric Power Information Net. <http://www>.