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China Power Sector Reform: Toward Competition and Improved Performance

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\$1.00 = Y 8.50

FISCAL YEAR

January 1 to December 31

WEIGHTS AND MEASURES

km	Kilometer (= 0.62 miles)
kWh	Kilowatt hour (= 860.42 kcals)
GWh	Gigawatt hour (1,000,000 kilowatt hours)
TWh	Terawatt hour (1,000,000,000 kilowatt hours)
kW	Kilowatt (1,000 watts)
MW	Megawatt (1,000 kilowatts)
GW	Gigawatt (1 million kilowatts)
kV	Kilovolt-ampere (1,000 volt-amperes)
kVA	Kilovolt-ampere (1,000 kilovolt-amperes)
MVA	Megavolt-ampere (1,000 kilovolt-amperes)
mg	Milligram
m ³	Cubic meter
tce	tons of standard coal equivalent

ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank
CDC	Capital Development Corporation
CITIC	China International Trust and Investment Corporation
CRISPP	China Reform Institutional Support and Preinvestment Project
ECO	Expanded Cofinancing Operation
EDF	Electricité de France
ESMAP	Energy Sector Management Assistance Program
GDP	Gross Domestic Product
GNP	Gross National Product
HIPDC	Huaneng International Power Development Corporation
ICB	International Competitive Bidding
IDF	Institutional Development Fund
IPP	Independent Power Producer
LRMC	Long-Run Marginal Cost
MOEP	Ministry of Electric Power
MOF	Ministry of Finance
PCBC	People Construction Bank of China
PPDF	Private Power Development Fund
PPP	Public-Private Partnership
SDB	State Development Bank
SEIC	State Energy Investment Corporation
SIC	State Investment Corporation
SOE	State-Owned Enterprise
SPC	State Planning Commission
TVE	Township and Village Enterprise

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PREFACE

In early 1993, the Chinese Government requested Bank assistance to assess its power sector reform progress and provide guidance on the direction and implementation of further reforms. This assistance was provided in two phases. In phase one, the Bank funded, through its Institutional Development Fund (IDF), technical assistance to improve common understanding on key restructuring concepts, review successful international experiences, discuss strategic options for power sector reform in China and build a consensus among agencies involved in the restructuring process on a strategic vision of what might be the most appropriate ownership/organization/legal and regulatory structure of the industry over the medium term. The assistance focused on building local capacities to sustain the gradual and difficult sector restructuring process. A summary of the activity is provided in Annex 1.

In the second phase, two missions were fielded by the Bank in November 1993: the first to review recent development in power sector reform, identify key remaining issues and discuss with the Chinese counterparts future priorities of the reform; the second to discuss present and planned institutional arrangements in China for the power sector financing and recommend new institutional measures to improve resource mobilization both domestic and foreign.

Building upon the lessons learned from past projects and the work carried out this report focuses on two major sets of issues that, if not adequately addressed, could jeopardize the future of China's very fast growing power sector. The first set of issues is related to *the structural organization* of the sector: ownership, structure of the industry and legal and regulatory framework. The second set of issues is related to *performance of the sector*: pricing, diversification of the financing of the sector, and the environmental impacts of the development of the sector essentially based on coal and big hydro-projects. The report makes suggestions on ways the Chinese Government could accelerate implementation of power sector reform. Annex 2 of the report outlines a future Bank assistance program to provide support for implementation of power sector reforms.

The task was completed by N. Berrah (task manager and principal author of the report) and R. Taylor (energy economics). This paper and its annexes are based on the finding of a mission to China in October/November 1993. The mission team comprised S. Hunt (pricing and sector structure), R. Fitzgibbons (legal and regulatory framework), R. Lamech (corporatization and sector structure); Z. Khan, P. Cordukes (financial issues), Y. S. Wang (research assistance). A. Hussain also contributed substantially to the corporatization section. A key foundation of this report was the work of four Chinese working groups coordinated by Shao Shiwei and chaired by Zhou Fengqi (organization and structure of the sector), Zhou Zhongnan (legal and regulatory framework), Ye Rongsi

(separation of government and power utilities), and Zhu Chengzhang (financing sources). The members of the study team would especially like to acknowledge the support of the Ministry of Finance and the Ministry of Electric Power, Jiangsu Provincial Electric Power Company, Zhejiang Provincial Electric Power Company, and the wide variety of agencies and institutes, without which this study would not have been possible. The report was reviewed by D. Anderson (IENDR), D. Craig (ECEIV) and W. Hay (IENPD). The Division Chief is Richard S. Newfarmer, and Department Director is Nicholas C. Hope.

EXECUTIVE SUMMARY

A. AN OVERVIEW

- i. **China's power system grew at a high pace of more than 8 percent per annum from 1980 to 1993 to become the fourth largest generating system in the world. Installed capacity increased from 66 GW to 183 GW and power generation increased from 300 TWh to 836 TWh. However, in spite of this dramatic growth, the sector is still plagued by acute shortages and still fails to provide adequate supply to the economy.**
- ii. **To cope with the surging demand, the industry has gone through a series of incremental changes to decentralize decision-making and give further autonomy to power enterprises, to increase and rationalize power tariffs and finally to diversify ownership and attract enough funds to sustain the expansion. The power industry is in a state of rapid transition.**

The Reforms of the 1980s

- iii. **At the beginning of the 1980s, China's power industry was one large government department with provincial bureaus operating as local representatives of central and regional administrations. Managers needed to refer virtually all decisions to the top. Prices were low and totally controlled. The industry was fully vertically integrated and run as an administration rather than a commercial business.**
- iv. **Faced with tightening budget constraints, in the early 1980s, the central government changed the funding of large power generation and transmission projects from state budget allocations to low interest loans through government policy banks or specialized financial institutions. It also provided provincial power entities increased autonomy and more important roles in the operation and day-to-day management of the systems and mobilization of investment funds. These limited changes fell short of meeting the increasing investment needs and the sector was, by the mid-1980s, facing a major capital crisis, which triggered a second wave of reforms.**
- v. **To increase the volume of the investment, the Government took two major steps in reforming the sector. In 1985, the "Provisional Regulations on Encouraging Fund-Raising for Power Construction and Introducing Multi-Rate Power Tariff" put an end to the monopoly of the central government as the sole supplier of investment funds in the industry and started the process of diversification of ownership with far-reaching effects on the structure of the industry and the pricing system. It allowed entrants at the generation level to charge prices based on debt repayment and the power companies to pass**

on the higher costs of "new electricity" to final consumers through a multi-tier pricing system. In 1988, the initiation of the "Responsibility Contract System" gave the provincial power companies a greater responsibility for administration of labor and wages and allowed them to retain part of their operating surplus. This measure increased the business orientation of the industry, and provincial power bureaus were renamed power companies in many provinces.

vi. The results have been impressive. Annual added capacity to the system increased from 4-6 GW in the early 1980s to 10-12 GW by the end of the decade. Various levels of government (e.g., provincial, prefecture and county) dramatically increased their participation in financing new power investments through so-called "joint-investment projects," which accounted in 1993 for about half the installed capacity in several provinces. The Government created two independent public power sector producers to attract more foreign funds to the sector and improve the technology transfer. Finally, the Hopewell Group (Hong Kong) built one of the first BOTs in a developing country, opening the sector to private investors.

The Need for Further Reform

vii. The reforms of the 1980s went a long way to loosen the centralized management of the power sector, mobilize and diversify financial sources and improve cost recovery through higher tariffs. However, they yielded mixed results: power supply has dramatically increased but still fails to cope with the surging demand and the ad hoc approach to reform has not yet established a coherent and transparent framework for sustained development of the sector. The sustained rapid economic growth will put even more pressure on China's power industry. Yearly capacity additions will average about 15 to 16 GW from 1994 to 1997 and about 17 to 20 GW from 1992 to 2000, compared to the average yearly increase of 12 GW from 1987 to 1993. This annual increment is equivalent to the total installed capacity in Indonesia or Belgium.

viii. Many of the leading officials recognize that coping with this tremendous growth requires an urgent and wholesale reform agenda to improve efficiency at all levels of the industry (investment, production and consumption) through introduction of market-based policies, further opening of the sector to domestic and foreign investors, and sound environmental policy to minimize adverse impacts of large coal-fired and hydro power plants.

ix. To achieve these objectives, the Chinese Government initiated in the early 1990s a comprehensive and coordinated reform agenda. The efforts will focus on promoting an *industry structure* that ensures that enterprises are run as efficient businesses and reduces (and ultimately removes) barriers to entry to spur competition at the generation level; and a *legal and regulatory framework* that supports further progress towards market economy and ensures proper regulation of the monopolistic segments of the industry. The Government intends also to put in place *performance incentives* to improve the economic efficiency of the system through adequate pricing at all the industry levels to guarantee that investors earn an appropriate return and customers pay enough to cover the costs of the

new investments; attract private (domestic and foreign) investment funds; and increase the environmental awareness of power enterprises.

B. POLICY OPTIONS TO IMPROVE THE MARKET ORIENTATION OF THE SECTOR

x. Several new policies and reforms, summarized below, could achieve the above objectives and provide the policy environment to alleviate power shortages and hasten the transition towards more open and market-driven power sector. The first set of policies relate to the ownership, structural organization of the industry and the legal and regulatory framework. The second set of policies relate to more adequate pricing system, further diversification of the financing of the sector, and finally improved mitigation of the environmental impacts of the fast expanding generating system. This report suggests an acceleration of the reform program to address structural weaknesses of the industry and its performance shortcomings.

Corporatization

xi. Because of China's 40-year history of central planning, power companies are still not run as businesses that respond to market signals (commercialization), and still do not have clear ownership, governance and internationally accepted accounting principles and standards (corporatization). They are combined with a network of supervisory government organizations and carry social and other activities not related to their core business. Finally, management is still not fully responsible for enterprise performance and do not focus on their corporate objectives.

xii. The policy initiatives over the last two years clearly indicate the Government's resolve to achieve full corporatization of China's power industry. An adequate policy and legislative framework has been put in place through the enactment of three major regulations and laws: the "Regulations on Transforming the Management Mechanism of State-Owned Enterprises" (July 1992), the "Regulations on Adoption of New Accounting System" (July 1993), and more importantly, the "Company Law" (December 1993). However, implementation is slow.

xiii. *The Bank therefore recommends that Government put in place incentives/penalties that encourage the transformation of the sector companies to enterprises that are run as efficient commercially oriented businesses, sheltered from government interference in micro-management, and therefore fully accountable for their profits and losses, through a two pronged approach. First, all new entrants, in all segments of the industry, should be established as corporations, with clear status under the new Company Law, autonomous management and clear procedures to ensure proper accountability. Second, existing power enterprises should be required to prepare time-bound plans to implement the existing laws and regulations relating to enterprise commercialization and corporatization, in cooperation with the various organizations involved in the sector. These implementation plans should focus on the following priority actions: (a) Separation of Government and Enterprise Functions. Detailed arrangement should be prepared and agreed upon by relevant authorities to separate power bureaus from*

power companies. (b) *Management Autonomy and Accountability.* The transitional regulations issued by MOEP on the implementation of the "14 rights" are very restrictive and should be reviewed to provide the sector enterprises more autonomy. Rights that are incompatible with the monopolistic powers of the companies should be reviewed and adapted to the sector specific characteristics. Proper procedures should be designed and implemented to ensure proper accountability of the enterprises. (c) *Adequate Implementation of New Accounting and Reporting Systems.* Power sector enterprises should focus on adequate implementation of the MOF new financial regulations based on international accounting principles and standards, together with the design of improved internal management and financial reporting systems, based on responsibility concepts. (d) *Revised Charters.* Power enterprises should be required to prepare new charters that clarify their objectives, authorities, responsibilities, legal powers, governance and corporate structure. The new charters should be based on the new Company Law and reflect other laws related to the management of SOEs (see also Chapter 5).

Industry Structure

xiv. The ad hoc structural changes did not provide a clear direction on stable environment conducive to efficiency. The roles of the different entities are still not clearly defined, and suitable policies and trading relationships are still not in place. However, the current structure emerging trends and size of market have the potential for competition in generation. *China should now focus on capturing the higher efficiency which competition can provide, through easier entry at the generation level and further development of a framework and incentives, especially competitive prices, to attract independent power producers.*

xv. Involvement of a wide variety of producers should be encouraged, including domestic joint-investment projects, foreign/domestic joint ventures, and wholly foreign-owned companies. The Government should promote the Purchasing Agency Model as the basic structure for provincial systems, so as to foster increased competition at the generation level and ease entry of new producers. Under different variations of this model, the provincial power company acts as the sole bulk purchase and sales agent of power within a franchised retail service industry. Further progress, depending on the specific conditions of each system, will require expansion of the role of IPPs, including the reformulation of joint-investment plants into true IPPs, and the development and implementation of improved contractual arrangements for power exchanges based on principles of greater transparency and equal treatment of all operators.

xvi. In most cases, it is expected that the purchasing agency will continue also to be a power producer and/or distributor. It is therefore critical that sector regulation be fully separate from the provincial power company, to avoid potential conflicts of interest and abuse of market power. In the more advanced provinces, a number of more sophisticated variations of this model could be tried. Generation could be fully separated from the provincial power companies, and place with one or more state generation companies, competing against IPPs and separate joint-investment plants. Greater independence among distribution entities also can be promoted, through further creation

of autonomous distribution companies, or at least proper definition of distribution sub-entities as profit centers.

Legal and Regulatory Framework

xvii. China's legal tradition is short. The power sector is still governed by a complex array of laws, provisions, administrative rules, regulations and policy circulars. Most of these laws and regulations, enacted under the command and control economy, fail to support structural changes and, sometimes, hinder the smooth functioning of the emerging market economy and further involvement of private investors in the sector.

xviii. The Government has initiated a major overhaul of the legal and regulatory framework to support the power sector reform, to reconcile the current contradictory requirements on the power sector and define the rights and responsibilities of power enterprises and supervisory government organizations.

xix. To complement these efforts, *the Government should put more focus on the design and implementation of a legal and regulatory framework that ensures the above objectives, reduces barriers to the introduction of market forces and encourages private investment in power sector.* China's legal and regulatory reform will obviously take time, however, priority actions include (a) *Finalization of the Electricity Law.* The final law, and associated regulations, should clearly define the rules of entry at the generation level, including private investors rights, to encourage private investment in new power projects. (b) *Promotion of Contractual Arrangements.* The Government, especially Ministry of Electric Power (MOEP) should encourage the expanded use of proper contractual arrangements to define and clarify commercial relationships for power exchanges at all levels. Technical assistance might be sought to help identify contractual arrangements likely to be required by the power sector, to develop model contracts, to provide education as to the content of such contracts, and finally to support the power enterprises in negotiations with potential power developers.

Electricity Pricing

xx. China has made considerable progress in increasing power tariffs to reflect costs and rationalizing tariff structure to reduce cross-subsidies and improve electricity consumption. However, the pricing system remains cumbersome and problematic. Some of the issues which need to be addressed include (a) the time structure of current debt repayment pricing at the generation level; (b) the structure of prices in power purchase contracts; (c) unification of multiple-track consumer tariffs; (d) the structure of consumer prices; and, (e) the quota allocation process.

xxi. *The Government should consolidate and accelerate the reform process developed in 1985 to continue evolving towards economic pricing and to ensure that customers pay enough to cover the costs of new investment.* At this juncture, it is important to undertake an objective assessment of the existing options for the future, followed by the definition of a pricing system (or pricing systems) most appropriate for the

country's long-term needs and a medium-term strategy for putting this in place. Careful thought needs to be given to how to balance different needs in the development of pricing for new generation facilities, and how to provide adequately for transmission and distribution investment as the structure of the power industry changes. Past experience has shown that adoption of various incremental changes, largely in response to short term needs, can provide useful results, but this approach also can lead to the entrenchment of new (and perhaps unintended) problems. It is therefore recommended that MOEP, as the key agency for government oversight of the sector, organize and lead a major effort to clearly define the specific objectives and implementation strategy for the electricity price reform over the medium term. International technical assistance could be provided where required.

xxii. In addition, several actions can be undertaken immediately or in the near future, at national or provincial levels, to improve the pricing system. These include actions to (a) improve the price structures in IPP power purchasing agreements to properly reflect the cost of supply and the value to the system, providing improved incentives for economic dispatch; (b) collapse the existing provincial and local government power investment into the overall provincial power company tariff, as emerging conditions permit; (c) unify multiple-track consumer tariffs at local levels into a single tariff; (d) increase voltage differentiation and the ratio of demand to energy charges in the consumer tariff, limit cross-subsidies, introduce lifeline rates for small consumers, and above lifeline rates based on cost of supply for other residential consumers; and (e) review options for the quota allocation system more transparent and market-driven, followed perhaps by pilot implementation schemes.

Financing the Expansion

xxiii. Despite strong expansion and gains in productivity, China's power sector still fails to generate enough internal capital for investment. Moreover, domestic banking/capital markets are underdeveloped and currently unable to efficiently intermediate domestic and foreign savings.

xxiv. In 1986, the Government introduced major reforms to mobilize funds from the combined resources of central, provincial and municipal governments, increase foreign borrowing and open the sector to para-public and foreign independent power producers. These measures succeeded in expanding and diversifying sources of finance. Contributions from the State Budget dropped from 60 percent in 1986 to about 6 percent in 1993. Provincial and municipal funds accounted for 47 percent of total investment in 1993 and private investors are increasingly involved in developing power projects through BOT (Shajiao B and C) or joint ventures (Daya Bay nuclear power plant). However, these measures seem to have reached their limits and giving the scale of China's present development requirements, the power sector may face another capital crisis if further reforms are not introduced.

xxv. *The Government should take further steps to improve mobilization of funds.* First, existing power enterprises should be allowed to charge tariffs sufficient to earn

adequate returns on their assets, and to retain profits to increase their self-financing capability. Second, financing mechanisms should be diversified through encouragement of domestic and foreign equity investments and improve intermediation of financial sector. Further reforms to improve the intermediation of the financial sector through increased competition, market-based interest rates, increased freedom for corporatized enterprises to issue financial instruments, minimization of directed credit, and easier availability of foreign exchange. These policies and instruments might be supplemented by development of new institution(s) to channel more domestic and/or foreign saving to the power (infrastructure) sector.

xxvi. *To encourage independent power producers (IPPs), the Government should formulate a basic policy framework that would provide for competition at entry, mitigate investor concerns on foreign exchange convertibility and other policy-based risks, and adequately assign commercial risks to prospective investors.* Encouraging competition at entry on the basis of the price of power--before memoranda of understandings are signed--will discipline rates of return on equity, and will bring down the cost of power and foreign investment over time. This would allow the market to replace costly and time-intensive bilateral negotiation between power utilities and prospective IPPs, and obviate the subsequent lengthy review process at the center. During some transitional phase, limited guarantees on exchange availability, selected policy-related risks, and/or contract performance risks might be warranted; as the policy gains credibility, the policy strategy should be to phase out these guarantees.

Energy Efficiency and Environmental Protection

xxvii. China has a sound energy conservation record among developing countries, even though electricity consumption is expanding, its growth rate is lower than the growth of overall economic output. Per capita electricity use in China remains low - slightly more than one third of the world per capita consumption and less than one tenth of OECD countries per capita consumption. However, because of the size of the country's power sector, future growth brings major environmental challenges, not only for China, but for the region and the world as a whole. Reliance on coal and large hydro projects could have damaging impacts if environmental issues are not adequately addressed.

xxviii. Aware of this, the Government has shown its resolve to continue improving electricity efficiency through national, provincial and local conservation programs. It also initiated a vast reform program to put in place legal and regulatory instruments to mitigate damaging impacts on the environment. *Conservation efforts should be strengthened to develop an industry that pollutes less and is more environmentally sustainable.* This could be achieved, first, through increased conservation, and stricter enforcement of existing and possibly improved environmental standards, and promotion and gradual introduction of market-based energy efficiency and pollution control incentives. The latter include economic pricing, better information of energy users, and a system of input or output environmental taxes as a first step of internalization of environmental costs.

xxix. This important policy shift should be complemented in the short/medium term by actions to rationalize and reduce electricity consumption and mitigate the environmental impacts of the sector development: (a) electricity conservation should be provided through more rigorous equipment standards and equipment labelling especially for high electricity consumption, including motors, transformers, and cooling equipment; (b) staffing of institutions involved in electricity conservation should be improved; and (c) more direct incentives for reducing power system losses and transparent accountability should be put in place through development of profit-center accounting and financial reporting for generation, transmission and distribution entities.

xxx. To reduce pollution, increases in plant scale are critical for improved efficiencies in thermal power generation and consequential reductions in pollutant emissions. Although national policy emphasizes development of 300 MW and 600 MW units, investment by local governments in new small-scale plants continues, under the pressure of local power shortages. One means to resolve this problem is to improve the efficiency of capital mobilization and investment approval procedures for large projects, including legal and contractual improvements to increase local participation and confidence in joint-investment projects. In addition, environmental protection regulations must be applied to new small plant projects in a much more stringent and forceful way. All new small-scale units must be required to meet comparable emissions criteria as new large plants, regardless of ownership. *Stricter regulation and enforcement are needed both in the issuance of construction and production permits, and in monitoring to ensure proper operating practices. China could possibly lead and begin the transition to more market-oriented strategies, especially by using available taxation instruments.*

xxxi. For new, larger, plants, one priority is to continue efforts to apply high efficiency electrostatic precipitators on a larger scale. In areas where power station emissions result in ambient levels of sulfur dioxide which are a serious health concern, additional measures to control sulfur dioxide emissions on power plants must be adopted in order to reduce ambient levels within limits acceptable to human health. Particularly in areas where high-sulfur coals dominate, the power industry must be prepared to incur substantial investment costs for improved control of SO₂ emissions. Concerning regional impacts of SO₂ emissions (e.g., acid rain), there is a need for a national level review of China's response to growing concerns, followed by the development of a least-cost abatement strategy.

xxxii. *China's sound legal, administrative and institutional framework for reservoir resettlement can be further improved through standardization of the quality of resettlement planning and implementation, improvements in costing and budgeting, and a tightening of the monitoring of local implementation programs.* For both resettlement and environmental protection in hydro projects, further domestic capacity building should be achieved through domestic and international interchange in environmental assessment methods and procedures, and additional training of Chinese staff. Environmental panels should be set up for all major projects, and training centers focusing on resettlement and environmental issues should be further developed.

C. CONCLUSIONS

xxxiii. The Chinese Government has made impressive progress in reforming and restructuring the power sector. These efforts brought a sustained high growth during the last decade and more openness of the sector to nonutility (mostly public but also private) producers. However, the sector is still plagued by severe shortages because of barriers to entry and absence of a legal and regulatory framework to support introduction of competition and market mechanisms. The recommendations of this report, together with an agreed time frame for implementation, are summarized below. Both the Bank and the Government recognize that the magnitude of the reform agenda and its close interdependence with reforms (proceeding at a lower pace) in other areas might require slight adjustments of the agenda schedule, especially in less advanced provinces. The next three to five years will be critical for consolidating and accelerating the reform process and increasing its market-orientation to cope with the momentous expansion of the 1990s. Nonetheless, the Government has shown full commitment to aggressively pursue the reform course.

SUMMARY OF RECOMMENDATIONS

Item	Current status of the reform	Recommendations	Timeframe
Corporatization	<p>Major progress was achieved in the late 1980s and early 1990s through enactment of different regulations and laws especially:</p> <ul style="list-style-type: none"> ● the "Regulations on Transforming the Management Mechanism of State-Owned Industrial Enterprises"—July 1992 ● Regulations on adoption of new accounting system—July 1993 ● the "Company Law"—Dec 1993 	● Initiation of separation of Government and enterprise functions (abrogation of the "one entity with two name plates" policy)	1-2 years
		● Achievement of management autonomy and accountability of sector enterprises, including revised Charters and implementation of new accounting and financial management systems	2-3 years
		● Full corporatization of existing enterprises	4-5 years
		● All new enterprises established according to the "Company Law"	Immediate
Industry Structure	<ul style="list-style-type: none"> ● Progress in decentralization ● Promotion of nonutility producers (about 50% of the installed capacity in some provinces) ● First private investment in the power sector (1987) and listing of some power companies on foreign financial markets (1994) 	● Remove major obstacles to entry of independent power producers to promote competition where feasible	1-2 years
		● Framework to encourage competitive bidding for new independent power projects rather than negotiated rate of return	1-2 years
		● Improvement of contractual arrangements to achieve greater efficiency	2-3 years
		● Unbundle the accounts of the generation, transmission and distribution businesses of the Power companies.	2-3 years
Legal and Regulatory Framework	<ul style="list-style-type: none"> ● Draft electricity law is under discussion at senior level. 	● Finalization of the Electricity Law to support reform efforts	1 year
		● Overhaul of the legal and regulatory framework:	
		● First stage: Definition of a conceptual approach, objectives and priorities; definition and allocation of regulatory responsibilities	18 months
		● Second stage: Design and implementation of regulatory institutional framework mechanisms, development of regulatory procedures, etc.	4-5 years
		● Development of model contracts especially for the transitional period.	1 year-18 months

Item	Current status of the reform	Recommendations	Timeframes
Price Reform	<ul style="list-style-type: none"> ● Introduction of multiple track pricing system (1985) ● Reform of catalogue prices in 1993/94 ● Experimentation of unified consumer tariffs in some areas 	<ul style="list-style-type: none"> ● Comprehensive Study: assessment of existing system, definition of principles and objectives, review of options for future pricing policy and regulation ● Improvement of the price structures (increased capacity charges, introduction of a lifeline tariff, improved reflection of cost of service for each consumer category) ● Unification: elimination of the multiple-track consumer pricing system. 	<p>18 months</p> <p>2 to 3 years</p> <p>4-5 years</p>
Financing the Expansion	<ul style="list-style-type: none"> ● Ongoing reform of the financial sector ● Listing of some power companies on foreign financial markets ● Experimental infrastructure development fund 	<ul style="list-style-type: none"> ● Improvement in the intermediation of the financial sector (market-based interest rates, increased competition, minimization of direct credit, etc.) ● Freedom of corporatized enterprises to issue different financial instruments ● Novel financing schemes to mobilize foreign and domestic private funds. 	<p>5 years or more</p> <p>1-2 years</p> <p>2-3 years</p>
Energy Conservation and Environmental Protection	<ul style="list-style-type: none"> ● Good institutional framework for electricity conservation ● Gradual improvement in consumer incentives ● Good record in population resettlement 	<ul style="list-style-type: none"> ● Institutional strengthening of institutions involved in electricity conservation ● Improvement of information of users/equipment labelling ● Introduction of market-based incentives for electricity conservation and standards for high electricity consumption equipment ● Enforcement of environmental standards for small polluting power plants ● Emission tax for pollution control (very important but not specific to the power sector) <ul style="list-style-type: none"> - Experimentation - Design and implementation 	<p>1-2 years</p> <p>1-3 years</p> <p>2-3 years</p> <p>Immediate</p> <p>(1-2 years)</p> <p>(3-5 years)</p>

(): Schedules suggested by the Bank and not discussed with concerned Chinese authorities.

1. INTRODUCTION

1.1 In step with the nation's overall economic reform, important changes have taken place in China's power sector since the early 1980s. Previous policies based on central planning and control are being progressively replaced by policies reflecting the two main concepts underlying the development of China's socialist market economy: first, state-owned enterprises operate as independent actors, and second, they relate to each other through market-based mechanisms. Remarkable progress has been achieved in reforming the sector enterprises and giving them greater managerial autonomy, opening the sector to investors other than the central government (including private producers), and increasing and rationalizing electricity prices. However, the reform of the industry has proceeded on a piecemeal basis. China's power sector has only begun putting in place a new industry structure and proper incentives to ensure adequate and efficient supply to alleviate shortages and meet the fast growing demand.

Overview of China's Power Sector

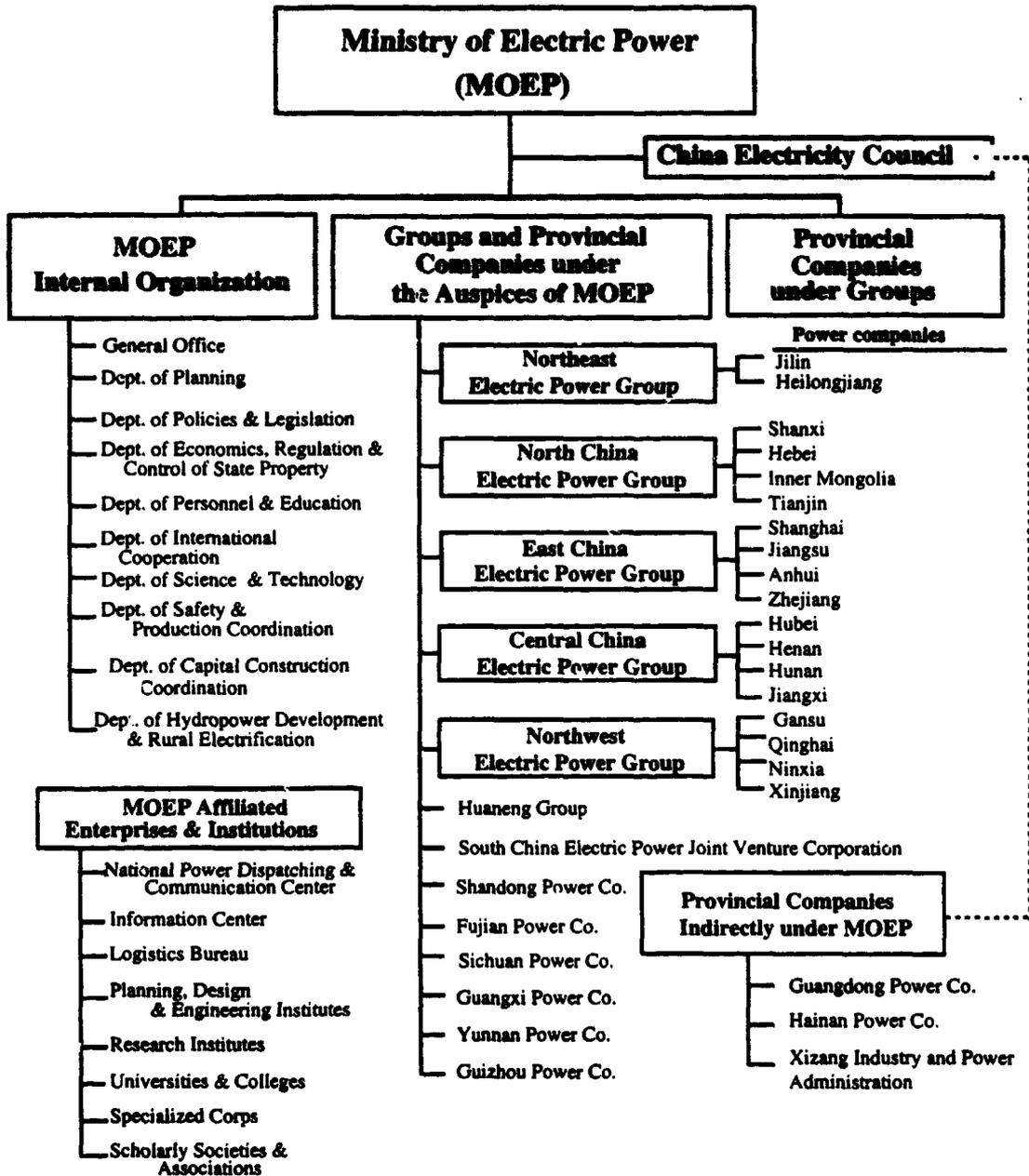
1.2 **Organization and Recent Trends.** China does not have a unified electric power system. It has 13 power networks with capacities of 1 GW or more. This includes five regional power grids which coordinate the systems of several interconnected provincial grids, and eight major separate provincial grids (See Figure 1.1).

1.3 The power industry consists of several different types of enterprises:

- (a) **Regional Power Bureaus/Groups/Corporations.** These entities cover groups of provinces and are responsible for regional power projects, coordination of grid operations and interprovincial transmission.
- (b) **Provincial Power Companies/Bureaus.^{1/}** These core utilities are engaged in construction activities, power generation, intraprovincial transmission, and distribution (mostly in urban areas). They are responsible for economic dispatch within the boundaries of the provinces. Their role in generation is decreasing and in some provinces, they supplied less than 50 percent of the total generation in 1993.
- (c) **Independent (nonutility) Power Producers.** This category includes entities which build and operate power generation plants but do not engage in

^{1/} This also includes companies of Municipalities (Beijing, Tianjin and Shanghai) and Autonomous Regions of provincial-level rank.

Figure 1.1: CHINA—ORGANIZATION CHART OF POWER SECTOR



transmission and distribution. Included are power plants owned by public groups such as Huaneng International Power Development Company (HIPDC) of the Huaneng Group, Xinli (Sunburst) Power Company of the China Investment and Trade International Corporation (CITIC), and private power companies such as the Hopewell Power Company. HIPDC operates several power plants in different provinces with a total capacity of 6,000 MW and the Hopewell Power Company built one of the first BOTs in a developing country, the 700 MW coal-fired Shajiao "B" power plant.

- (d) **Associated Power Producers (Joint-Investment Power Plants).** These are power plants that are jointly owned by various central, provincial and local government entities. Most of them are managed by the provincial companies under management contracts, but some are managed independently. All of them are dispatched with the provincial system.
- (e) **Local (prefecture, county) Power Companies/Bureaus.** These are mainly independent distribution companies even if some may engage in power generation in their localities. There is more than 1,500 companies of this type; approximately 800 of them rely mainly on small hydro power plants and are under the supervision of the Ministry of Water Resources (MWR).^{2/}
- (f) **Service Companies.** These national or provincial companies are engaged mainly in engineering and construction of power projects.

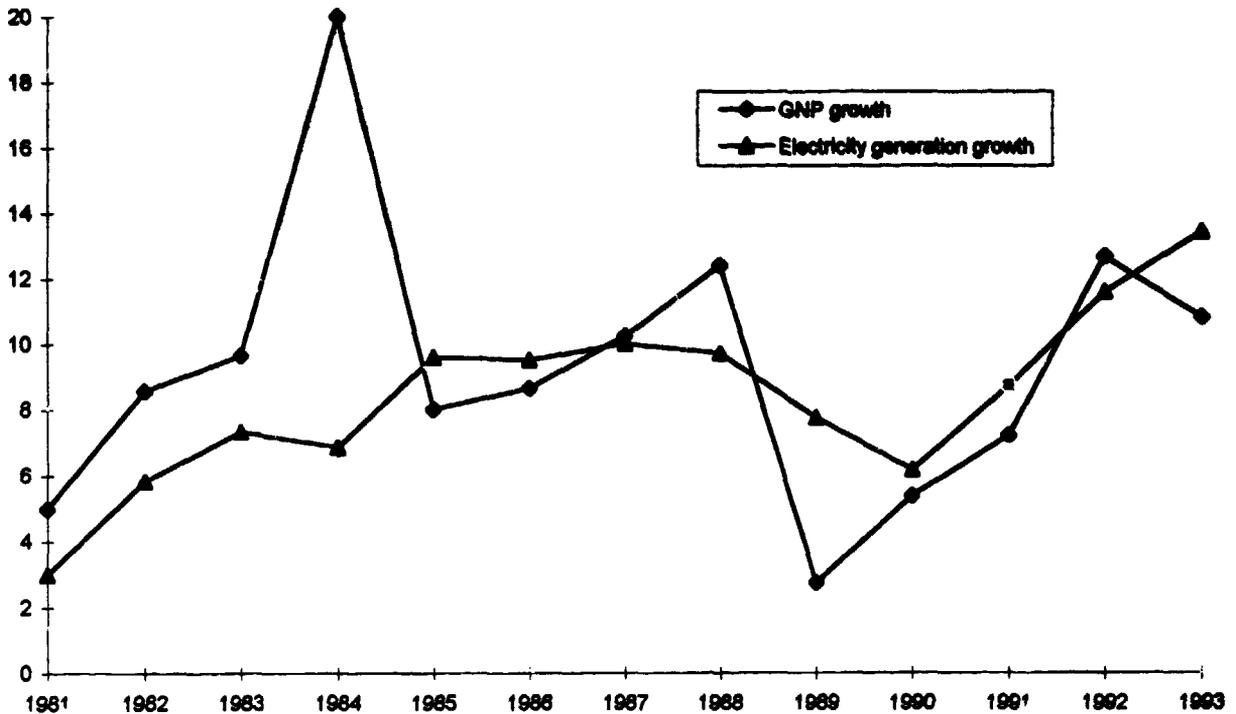
1.4 Total installed capacity in China increased from 66 GW in 1980 to about 183 GW in 1993, an average growth of about 8 percent per year. With 183 GW installed in 1993, China has the fourth largest generating system in the world. However, compared to developed countries the power sector in China is still underdeveloped. Considering electricity needs of 1 kW per person would mean a capacity of 1100 GW or seven times as much as in China at present.

1.5 Total power generation in China increased from 390 TWh in 1980 to 836 TWh in 1993, an average growth of 8 percent per year over 12 years, with a higher growth of more than 10 percent during the last two years. In 1993, the per capita electricity consumption was about 630 kWh and 120 million people still do not have access to electricity. The elasticity of electricity generation growth over GDP growth during 1980-93 was 0.86—an exceptionally low elasticity for any country over a sustained period, and particularly for an industrializing country such as China (see Figure 1.2).

1.6 The fuel mix in China is more and more dominated by coal. About 80 percent of the 100 GW of new generating capacity added to the system from 1980 to 1993

^{2/} The Energy Sector Management Assistance Program (ESMAP) has been very active in providing technical assistance to these decentralized power companies to improve their efficiency and increase their business and market orientation.

Figure 1.2: A COMPARISON OF GNP AND ELECTRICITY GENERATION ANNUAL GROWTH



consisted of coal-fired units. During the same period, the share of electricity generated by coal-fired power plants increased from 60 to 75 percent, in part because of strict government policies to limit generation of oil-fired units. The share of hydroelectric power accounted for about 17 percent in 1992, 2 percent less than 1980 (see Table 1.1 and Figure 1.3).

1.7 China's recent power development program has emphasized the addition of progressively larger generation units (e.g., 200, 300 and 600 MW coal-fired units) to take advantage of economies of scale. This objective is being achieved through a combination of modernization and expansion of domestic manufacturing capabilities to produce 300 MW units, the development of new capabilities to produce 600 MW units, and imports of state-of-the-art generating equipment, in part with multilateral or bilateral foreign loans. The share of imported generation units in meeting the new added capacity is estimated at 25 to 30 percent by the Ministry of Electric Power (MOEP). Despite the progress achieved, however, over one half of the installed thermal capacity is still inefficient units of 125 MW and below. Very few old and inefficient units are being decommissioned because of the persistent power shortages.

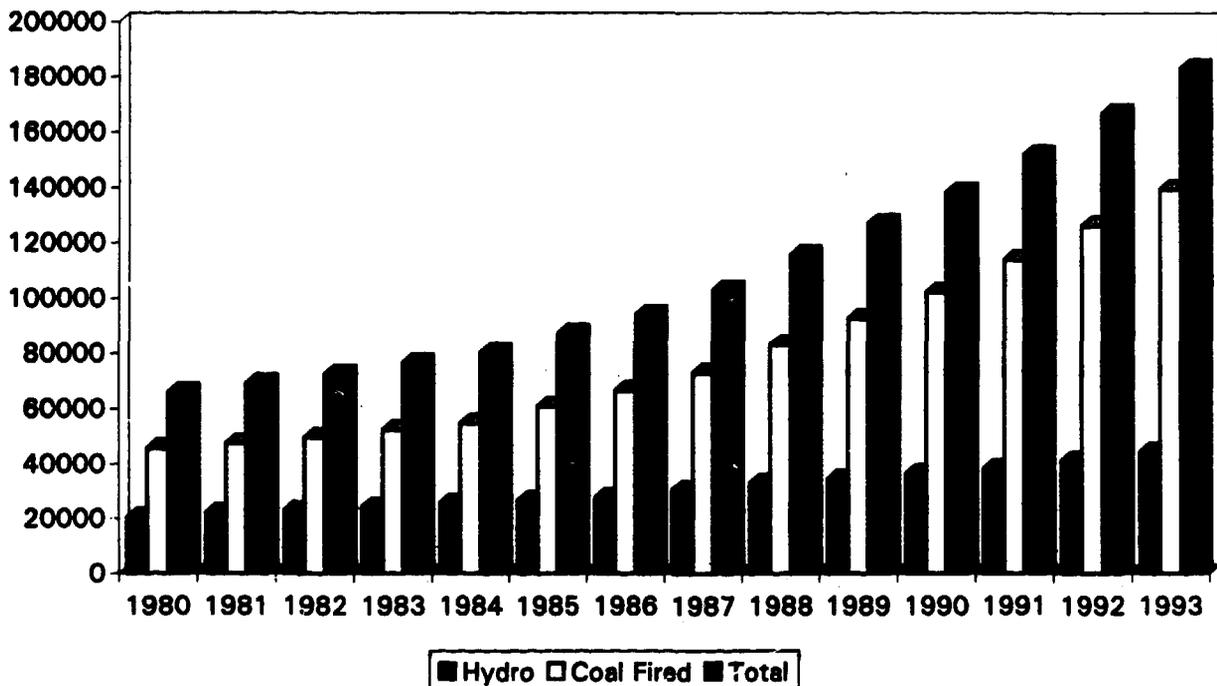
1.8 China has a long tradition in the design and construction of small- and medium-size hydropower plants and is making progress in improving their design and

Table 1.1: POWER GENERATION IN CHINA, 1980-93

	1980	1985	1991	1992	1993
Total Capacity (GW)	65.9	87.1	151.5	166.5	182.9
% Hydro	30.7	30.0	25.1	24.4	24.0
% Thermal	69.3	69.3	74.9	75.6	76.0
Total Generation (TWh)	301.0	411.0	678.0	754.2	836.0
% Hydro	19.4	22.5	18.5	17.4	18.0
% Coal	59.3	64.6	73.8	82.6	82.0
% Hydrocarbons	21.3	12.0	7.8		
Capacity Factors (%)	52.1	53.8	51.1	51.7	52.1
Hydro	22.0	40.0	38.0	36.8	39.0
Thermal	61.0	60.0	56.0	54.7	56.3
Thermal Power Conversion Efficiency (%) (Gross efficiency units over 6 MW)	29.8	30.0	31.5	31.8	-

Source: Ministry of Electric Power—Electric Power Industry in China (1992/93).

Figure 1.3: CHINA—INSTALLED CAPACITY IN MW



modernizing their manufacturing capabilities. However it has limited capability to build large hydropower plants. Technology and know-how transfer is needed for large hydro projects which will account for more than three quarters of the new added hydro capacity. Technical assistance is sought for projects funded through multilateral or bilateral channels particularly in connection with general project layout, the design of sophisticated structures and large underground work, the selection of equipment and efficient construction management. More than 20 GW of such projects are currently under construction or are being negotiated.

1.9 China used a cautious approach to nuclear power development during the 1980s. China's first nuclear power plant (300 MW) is in operation at Qinshan, Zhejiang Province, and planned generation is 1.5 TWh per year. The construction of a second nuclear plant (2x900 MW) at Guangdong Province has been completed and it was commissioned in 1994.

1.10 The opening of the power sector to the outside helped, during the 1980s, to increase awareness of the environmental impact of power sector development. Major progress has been achieved in carrying out thorough environmental assessments for major projects, minimizing TSP emissions in coal-fired plants, minimizing adverse environmental impacts of hydroelectric projects, and, in most cases, successfully resettling displaced populations.

1.11 **Future Demand Growth.** Prepared in the late 1980s, China's Ten-Year Development Program for the 1990s envisioned an average economic growth of 6 percent per year and a growth in electricity demand of 6.5-7.0 percent per year. However, with the acceleration of the economic growth in 1992 and 1993, the targets of the Ten-Year Development Program were readjusted up to 8-9 percent for GDP. Electricity demand is expected to grow according to a electricity demand/GDP growth elasticity of about 1.0, even with aggressive conservation efforts. Chinese authorities estimate the yearly capacity additions at 15 to 16 GW from 1994 to 1997 and to 17 to 20 GW from 1998 to 2000, compared to an average yearly increase of 12 GW from 1987 to 1993. Even so, it is estimated that the revised supply targets would only reduce existing electric power shortages from 10 to 5 percent of the total demand, and would not alleviate them completely.

1.12 This sustained rapid growth will put tremendous pressure not only on China's electric power industry, but also on the coal mining industry and railway infrastructure.^{3/}

^{3/} For further discussion of problems related to coal use in the power industry and to coal transportation, see "China—Efficiency and Environment Impact of Coal Use" (World Bank Report #8915-CHA, 1991), and the forthcoming World Bank Report on "China—Coal Transportation Study."

Table 1.2: ELECTRICITY FORECAST (1990-2000)

Year	1990	1995	2000
Electricity demand (TWh)	621	965	1,560
Installed capacity (GW)	138	200	300
Average additional capacity per year (GW)		12.5	20

Source: Ministry of Electric Power (1993).

Power Sector Reform In the 1980s

1.13 Until the early 1980s, all profits and provisions for amortization were transferred by the power enterprises/entities to government financial/planning departments, which, in turn, allocated all investment funding on a grant basis and made provisions for any operating losses. One of the first steps of the reform was to change investment allocations to loans, with repayment requirements at low interest rates. This change, coupled with high demand growth, led to a capital crisis in the sector and provided much of the impetus for reform. During the middle and late 1980s, reforms focused primarily on decentralization in sector management, initial attempts to commercialize power entities, and development of alternative financing schemes and related new pricing mechanisms.

1.14 **Decentralization.** In 1980, the power sector was highly centralized, and fully controlled and managed by a hierarchy of government departments, with strong vertical command from central through regional, provincial and local levels. Over the decade, however, provincial power entities gained increasing autonomy and gradually became the core utilities in the industry, playing a more important role in the mobilization of investment funds, and managing the day-to-day affairs of the provincial power systems ^{4/} (see Figure 1.1). The role of the five regional power groups, whose operations correspond with China's five interprovincial regional grids, changed to more of an oversight role, focussing more on grid coordination and dispatch, and less on vertical management of what were once considered provincial subsidiaries.

1.15 **Commercialization.** Efforts were initiated in 1988 to create power companies, at most regional and provincial levels, separate from the government power bureaus. The power companies were charged with responsibility for management of power systems, according to commercial business principles, while the power bureaus were to

^{4/} Although their franchisees are defined at the provincial level, provincial power companies continue to be considered central-government-owned enterprises, however.

play a government regulatory role. This reform, however, was not implemented in functional terms—while separate names existed, government and utility functions and staff were not separated, in a situation known in China as "one organization with two name plates." Indeed, in some aspects, the government involvement in utility operations increased, as provincial and local governments, in addition to the central government, became more involved.

1.16 Alternative Financing Schemes. By the middle 1980s, the central government was less and less able to cope with increasing power investment needs. In response were two practical-minded reforms which have since proven to have had far-reaching significance:

- (a) Substantial price increases through introduction of multiple-tier pricing. A series of cumbersome and complicated systems were devised to mobilize more funds for investment, especially from local governments and major power consumers, including higher "out-of-plan prices" for power from many new plants, certain other "above quota" prices, the levy of a 2-fen per kWh surcharge for power development collected by provincial governments, and the sale to enterprises of supply quotas for additional power.
- (b) Joint-investment projects (jizibandian). These are new generating projects which are jointly financed by "loans" from various levels of government (e.g. central, provincial, prefecture and county), and sometimes other companies, such as the state-owned Huaneng Group and its affiliates, or the Sunburst Power Company, affiliate of CITIC. By the turn of the decade, the majority of new generation projects were these joint-investment projects. This development is the most important from the structural point of view, because it implicitly opened entry to the sector at the generation level to other investors, and broke the monopoly of the provincial power companies.

The Need For Future Reform

1.17 The reform of the 1980s, outlined in the above section and further discussed in the following chapters, achieved impressive progress in loosening the centralized management of the power sector and mobilizing financial resources through improved cost recovery and diversification of funding sources. However, despite the strong growth in electricity output, the sector still fails to provide adequate supply to the economy and most areas of China continue to suffer severe shortages. Power is allocated through administrative procedures and market mechanisms are only just being introduced in the industry.

1.18 There is an increased awareness among the Chinese authorities and all entities involved in power sector operation that the sector's inability to effectively cope with a fast growing demand and its performance failures should be traced to structural and institutional issues. As discussed in detail in the following chapters, a new, broader and

deeper reform program was initiated in 1992, dealing more fundamentally with the core issues involved in restructuring the sector to meet the needs of the new market economy. Momentum behind the package of reforms is increasing, especially since late 1993. This report concludes that the best guarantees for improving efficiency at all levels of the industry (investment, production and consumption), and to alleviate power shortages, is through the implementation of a reform program, focused on the development of:

- (a) enterprises that are run as efficient commercially oriented businesses, sheltered from government interference in micro-management, and therefore fully accountable for their profits and losses (Chapter 2);
- (b) a power sector structure conducive to efficiency, ensuring both that incentives are in place to promote the most efficient construction and operation of power plants, and that the industry takes advantage of economies of scale and scope, such as the economies of fuel created by economic (or merit order) dispatch (Chapter 3);
- (c) a legal and regulatory framework that ensures the above objectives reduces barriers to the introduction of market forces and encourages private investment in power sector (Chapter 4);
- (d) a pricing system that continues to evolve toward economic pricing and to ensure that customers pay enough to cover the costs of new investment (Chapter 5);
- (e) more and diversified financing mechanisms that ensure mobilization of funds primarily through self financing by existing enterprises and domestic savings, and foreign investments, particularly during the transition period before full corporatization of power sector enterprises and development of the domestic financial market (Chapter 6); and
- (f) an industry that pollutes less and is environmentally sustainable, mainly through increased conservation, promotion of market-based incentives for pollution control, and stricter enforcement of existing and possibly improved environmental standards (Chapter 7).

2. COMMERCIALIZATION AND CORPORATIZATION

2.1 Until quite recently, the hand of central government was pervasive in China's power industry. Basically organized as one large government department, with regional, provincial and local representatives, managers within the system needed to refer virtually all decisions to the top. Investments decisions, allocation of raw materials, production quotas, rationing to customers and price control were all managed through a centralized hierarchy. The industry was run as an administration rather than a commercial business. But this is changing rapidly.

2.2 This chapter first presents a brief review of current status of power industry enterprise reform and the problems impeding corporatization of power enterprises. Three essential requirements for full corporatization of China's power enterprises are then analyzed: separation of government and enterprise functions, increased responsiveness of enterprise to market signals, and finally clarification of enterprise legal status.

The Current Status of Power Enterprise Reform

2.3 **Recent SOE Reforms.** In line with overall reform effort for state-owned enterprises (SOEs), a series of changes were introduced during the 1980s to give power enterprises more financial autonomy. These included the regulations on the establishment of an "Enterprise Fund" and "Profit Retention," and first and second-stage reforms for "Replacement of Profit Repatriation with Tax." In 1988, power enterprises adopted the "contract responsibility system," which allows them to retain their operating surplus after paying the prescribed profits to the Government, completing defined technical renovation tasks, and achieving electricity sale targets, material consumption and the payroll. This first round of reforms yielded mixed results. It gave enterprise management greater autonomy and an economic incentive to improve efficiency, but it did not establish a clear link between performance and rewards. It also did not provide enterprises with full financial autonomy.

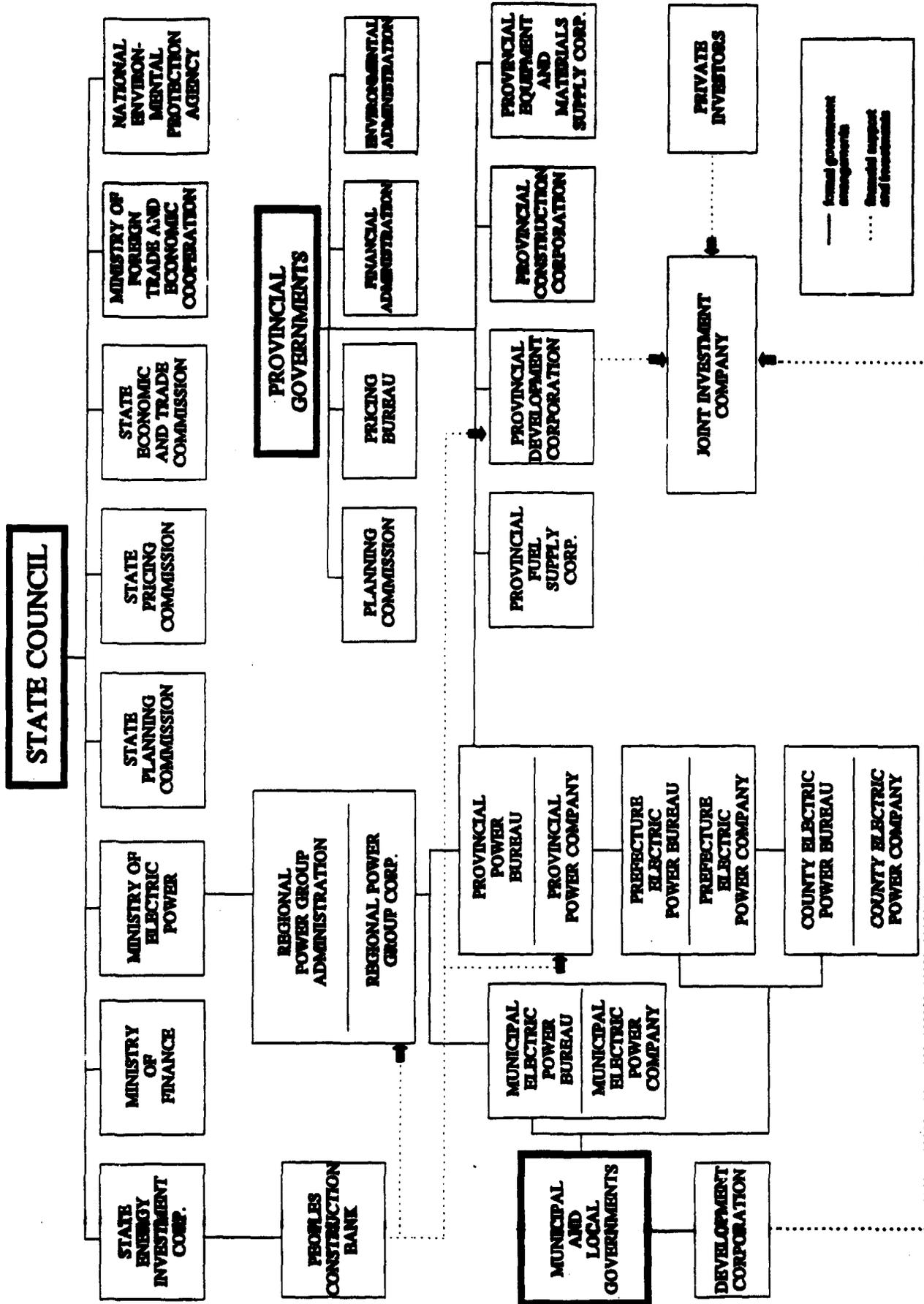
2.4 An ambitious second wave of reforms to speed the corporatization of SOEs was begun in 1992. Major initiatives setting the stage for the reform include the "Guidelines for the Transformation of the Management Mechanisms of SOEs" (1992) (often referred to as the "Fourteen Rights"), the "General Rules on Enterprise Finance and Accounting" (1993), and the "Company Law of the People's Republic of China" (1993). The Fourteen Rights provide enterprises with greater responsibilities and autonomy in managing their own operations, including personnel and wage issues. However, detailed directives for the implementation of the Fourteen Rights among power enterprises were issued only in late 1993. Efforts to implement a full reform of the accounting system of power enterprises, to better conform with international practices, were begun in July 1993,

in line with the "General Rules on Enterprise Finance and Accounting." A "Company Law" was enacted in late December 1993 and will provide the needed legal basis for further progress towards corporatization of the sector enterprises.

2.5 Current Issues. Power industry enterprises still face major impediments towards full corporatization:

- (a) **Insufficient Managerial Autonomy.** The reforms of the 1980s introduced the concept of state-owned enterprises, as opposed to state-controlled enterprises, to reduce government interference in day-to-day management. However, due to China's long history of central planning and slow change in enterprise practices, power enterprises are still run as government agencies. They still are combined with a network of supervisory government organizations—the power bureaus. Different government levels still allocate raw materials and investment, impose (rather than regulate) prices and allocate output through administrative directives. These arrangements subject power enterprise to government control, and management is not fully responsible for enterprise performance (see Figure 2.1).
- (b) **Inadequate Internal Control of Enterprise Operations.** The internal structure of power enterprises is not geared toward maximization of profits and minimization of operation costs. This stems (i) from the state-controlled enterprise approach, where there is no distinction between enterprise profits, taxation and dividends; and (ii) the overlap of commercial activities and social welfare duties. Internal accounts, information systems and monitoring processes are underdeveloped and/or inadequate to ensure proper accountability. In fact, monitoring procedures and systems are designed to facilitate supervision and control by the various state and local agencies.
- (c) **Unclear Ownership.** The diversification of the sources of finance has increased the volume of investment but also has created ambiguity about the ownership of various fixed assets and enterprises. This militates against a clear delineation of the rights and responsibilities of the management and owners and has adverse implications for attracting new sources of capital. Three systemic factors contribute to this problem: (i) the old accounting system was based on sources and users of central government funds and did not have a definition of equity, which makes the transition to clear ownership difficult; (ii) claims by various levels of government that their grants/earlier loans represent equity interests; (iii) the existing governance structure with different levels of supervision by central, provincial and local authorities makes the distinction between administrative/regulatory oversight and ownership control difficult. This arrangement dilutes the corporate objectives of the enterprises and reinforces their identification with government interests.

FIGURE 2.1: POWER GROUP STRUCTURE AND RELATED SUPERVISORY GOVERNMENT ORGANIZATIONS



- (d) **Absence of Consistent and Comprehensive Legislation and Regulations on Electricity.** There is no comprehensive national electricity law. The power sector is subject to multiple levels of government directives that are not well coordinated and are often contradictory. These requirements have low legislative rank and cannot be effectively enforced.
- (e) **Lack of Focus on Core Business.** The reforms to date have created an increasing conflict between operation of power enterprises on commercial principles and achievement of social and wider economic objectives. Currently power enterprises carry out numerous activities which are not directly connected with the generation, transmission and distribution of power. As with most SOEs, they have welfare responsibilities for their labor forces, such as provision of housing and running hospitals and clinics.
- (f) **Nonuniform Taxation Regime.** The power industry is subject to a nonuniform taxation regime. The main issues are (i) separate tax treatment of state-owned power companies, domestic joint-investment power plants, and joint ventures, (ii) no clear separation of taxes from dividends to the government as owner; (iii) special preferences that may not be consistent with a sustainable capital structure for commercial operation; and (iv) insufficient incentives for domestic enterprises to create internal surpluses through improved efficiency on environmental protection.

2.6 The Foundation for Further Reform. The years, 1994 and 1995, promise to be critical years in the effort to corporatize China's power enterprises. The issuance in late 1993 of MOEP's directive on the implementation of the Fourteen Rights in the power sector, together with the enactment of the "Company Law," provide the legal basis to achieve corporatization—that is, the creation of separate legal entities with clearly defined ownership. Major steps that are required to achieve these objectives in the power sector include, first, separation of the government and enterprises functions; second, increased autonomy and accountability of the sector enterprises; and third, clarification and specification of the rights of owners.

Separation of Government and Enterprises Functions

2.7 In the Chinese context, separation of government and enterprise functions means a clear definition and separation of the three roles which have traditionally been played by China's government: enterprise ownership, enterprise operation and management, and sector regulation. It implies more focus by the enterprises on economic objectives, a gradual transfer of activities designed for social objectives to the Government and a shift from government direct involvement in management to supervision and regulation.

2.8 The separation of government and enterprise functions is a prerequisite for the structural reform of the industry, and it involves three essential components:

- (a) **A clear, urgently needed decision to entrust the Government's ownership interest (shareholder rights) to an entity separate from the entity charged with operation, and the definition of a process to implement this reform;**
- (b) **Separation of government regulatory functions from the enterprise management functions, and the elimination of "one organization with multiple nameplates." More specifically the power enterprises (power group corporations, provincial and local power companies) must be separated, as soon as possible, from the power bureaus at regional, provincial and local levels. This initial step does not imply that the bureau will be entrusted the regulatory functions; it should be considered as a transition to a more stable and legally defined regulatory structure.**
- (c) **Increased focus of power companies on their core business through a spinning off of service and construction activities, followed by clear identification of social responsibilities carried out on behalf of the Government, and gradual transfer of these responsibilities to competent government agencies or commercialization in synchronization with the reforms of social sectors (housing, health insurance, etc.).**

2.9 Progress is being made on this agenda in China, especially since mid-1993. Commitment to reform of the situation of "one organization with multiple nameplates" is increasing. Noticeable progress has been achieved in separating core and noncore business in some provincial power companies. Jiangsu Provincial Electric Power Company, for example, intends to spin-off around 20 percent of its original personnel in three years. This effort will then be spread over 60 operating subsidiaries, involving 50 percent of the staff of the company.

Increased Autonomy and Accountability

2.10 A major step in the reform is to transform power industry enterprises into market and efficiency-oriented firms, which respond to market signals (especially prices) and focus on commercial and economic objectives—to increase profitability and the efficiency of use of assets. This process is closely related to the separation of government and enterprise functions, but also will require adoption of internationally accepted accounting practices; a strengthening of entire internal management systems, especially for financial management; and a change in enterprise management outlook to better conform with a market economy.

2.11 **Implementation of the New Accounting System.** Power enterprises in market economies use internal cost accounting and internationally accepted accounting practices both to assess and monitor the performance of their constituent departments, and to provide adequate financial disclosure to commercial creditors and potential investors. Implementation of the directives of the Ministry of Finance on the new accounting system is therefore an essential and urgent step to improve the market orientation of the power enterprises. It must be noted that these new accounting principles introduce new key

concepts to China, such as ownership, equity, valuation of assets, etc. Assistance from international experts may therefore be required to ensure speedy and effective implementation.

2.12 Strengthening of Internal Management. In parallel with implementation of the new accounting system, there are urgent needs to (a) decentralize decision-making within power companies, and give managerial responsibility to subunits organized as profit centers; and (b) develop new internal management and budgeting systems to improve budgetary discipline, increase cost awareness among managers and ensure proper accountability. Proper cost control and improved efficiency within power companies cannot be achieved without these reforms.

2.13 Implementation of internal management reform is far from trivial, as it must involve a wholesale revamping of many time-honored and entrenched procedures and practices. Properly pursued, this reform requires careful and detailed design efforts, followed by a *sustained commitment to implementation*. Given the required conversion in the accounting system, the current period presents an excellent opportunity for implementing management and accounting reform as part of a combined package. Timely and well-targeted technical assistance and training would be very useful to carry out this important task.

2.14 Establishment of a New Relationship between Enterprises and Government. Commercialization will require that existing administrative directives be replaced by explicit contracts between the government and power enterprises. The contracts should recognize the autonomy of the enterprise management and specify performance targets (including quality standards) and the social responsibilities which are expected of enterprises. Although it may be difficult for the government to compensate power enterprises from the budget in the near future, it is highly recommended that, at a minimum, the cost of meeting these specified social responsibilities and their impact on the finances of power enterprises be calculated and clearly delineated.

2.15 Contracts between the government and enterprise management already are widespread in China, and they will continue to play an important role until the design and implementation of a comprehensive regulatory system. However they need to be extended to cover all aspects of the relationship between the government and management, and brought more in line with international practice and the requirements of a market economy. Performance contracts should not include taxation provisions and the power sector should be treated the same way as other industries for enterprise taxation. This principle is already accepted by the government and the existing Contract Responsibility System should be revised accordingly to focus on efficiency, quality of service and profit targets.

2.16 Change of Enterprise Behavior. The completion of the above tasks is important for the implementation of an autonomous management system. However, complete and successful commercialization requires a fundamental change in the behavior of enterprises and the outlook and perspective of enterprise managers. Power companies

should focus on their corporate objectives and interests and avoid identification with government or the interests of other agencies.

Clarification and Specification of the Rights of Owners

2.17 A further step in the reform involves the transformation of power enterprises into corporations under the Company Law, with clear specification of the rights of the parties with a stake in the profits earned on the assets (i.e., shareholders claims). This step will enhance investor confidence and provide access to domestic and/or foreign capital market lending, resulting in both increased investment and financial discipline in power enterprises through capital markets pressures.

2.18 Corporatization will require a clear vision about the institutional restructuring of the industry because it will create ownership interests and could make further structural reforms difficult. The transformation of power enterprises into true companies will involve a number of strategic decisions on the desired future structure of the industry. These include the following:

- (a) At what level should corporatization take place? Should the corporation be a provincial-level company, and should it involve a group of enterprises?
- (b) What should be the extent of vertical integration of these companies?
- (c) What should be the size of the companies and their geographical coverage?

These should be addressed in conjunction with issues concerning operational efficiency and investment mobilization (see Chapter 3).

2.19 Corporatization will involve several steps, some of which are likely to take some time. It will require Articles of Association specifying the company's main areas of activity, objectives, the procedures for the appointment of senior managers, and the rights and responsibilities of owners and management. But more importantly and probably most difficult, it will require a clarification of ownership claims on the assets and profits of the company. The assets of existing power enterprises have been financed by grants and loans from various government agencies and banks. Clarification of ownership claims will have to be based on an agreed valuation of assets and the establishment of a clear link between the past contributions to investment by various agencies and their ownership stake in the company. There is no simple procedure for settling such competing claims, and the settlement will have to be based on pragmatic considerations. It may involve some financial restructuring of the enterprise whereby some loans or grants are written off. The process of valuation has already been initiated but the settlement of claims may take considerable time. In such cases, it will be important to agree on transitional arrangements for continued progress towards full corporatization of existing enterprises (on legal issues, see also para. 4.7).

Conclusions and Recommendations

2.20 The Chinese Government has stated that the long-term objective is to achieve full corporatization of China's power industry enterprises. The corporatization of well-established power enterprises is likely to take some time because of the complicated valuation of assets and vested interests of various parties, but the process may be relatively quick in the case of new enterprises or Sino-foreign joint ventures. Thus the speed to commercialization and corporatization is likely to vary from enterprise to enterprise and locality to locality.

2.21 The policy and legislative framework for corporatization is now largely in place, but implementation is proceeding on a piecemeal basis and in some instances, is inadequate and very slow. Thus for some time there are likely to be commercialized and corporatized power enterprises existing side-by-side with enterprises which are yet to be commercialized and corporatized. It will be important to consider special policies during the transitional period that commercialized and corporatized enterprises are not at a disadvantage relative to the rest. For example, in the recent past enterprises who have adopted the new accounting system had to pay higher taxes than those who did not implement the new accounting procedures. The Government should put in place incentives/penalties that encourage the sector enterprises to make the transition as quickly as possible.

2.22 Corporatization is a prerequisite for the success of the ongoing power sector reforms. Implementation of existing laws and regulations should be considered as the first priority, achieved through a two pronged approach. First, all new entrants, at all segments of the industry, should be established as corporations, with clear status under the new Company Law, autonomous management and clear procedures to ensure proper accountability. Second, existing power enterprises should be required to prepare time-bound plans to implement the existing laws and regulations relating to enterprise commercialization, in cooperation with the various organizations involved in the sector. These implementation plans should focus on the following priority actions:

- (a) Separation of Government and Enterprise Functions.** Detailed arrangement should be prepared and agreed upon by relevant authorities to separate power bureaus from power companies;
- (b) Revised Charters.** Power enterprises should be required to prepare new charters that clarify the enterprise's objectives, authorities, responsibilities, legal powers, governance and corporate structure. The new charters should be based on the new Company Law and reflect other laws related to the management of SOEs (see also Chapter 5).
- (c) Board of Directors.** The Charters and associated by-laws must require the Board of Directors for power enterprises to supervise management in order to maximize the enterprises' efficiency and profitability. The Boards'

operation and relationships with enterprise management must be defined in corporate documents.

- (d) **Management Autonomy and Accountability.** The transitional regulations issued by MOEP on the implementation of the "14 rights" are very restrictive and should be reviewed to provide the sector enterprises more autonomy. Rights that are incompatible with the monopolistic rights of some of the sector operators should be reviewed and adapted to the sector specific characteristics. Proper procedures should be designed and implemented to ensure proper accountability of the enterprises.
- (e) **Adequate Implementation of New Accounting and Reporting Systems.** Power sector enterprises should focus on adequate implementation of the new accounting system based on international accounting principles and standards, together with the design of improved internal management and financial reporting systems, based on responsibility concepts.

3. STRUCTURE OF THE INDUSTRY

3.1 The power sector is undergoing reform worldwide. In the early 1980s, most electricity utilities were vertically integrated entities, owning generation, transmission and distribution and selling only to captive customers. They also were frequently owned by the government. The trend now is towards more competition, more market-based transactions between separate enterprises, more autonomy for managers, and less government control of enterprises.^{1/}

3.2 In China, major structural changes have taken place in the power industry over the last decade, and the industry structure of 1993 differs in many ways from the previous monolithic and centralized structure. This chapter outlines the main characteristics of the current "mixed" structure of the Chinese power sector, and discusses structural reforms to introduce competition, especially at the generation level, and the prospects for the further involvement of nonutility and private independent power producers.

Characteristics of the Current Structure: A Mixed Model

3.3 In line with the country's economic reforms based on gradualism (e.g., "crossing the river by feeling the stones"), the structure of China's power sector today resulted from a series of incremental changes, adopted to rectify pressing problems as they arose rather than a comprehensive program of reforms, adopted according to a long-term plan. The current structure is referred to as a "mixed model" because there are considerable variations in the organizational structures adopted by different provinces, according to their specific circumstances.

3.4 According to the conventional grouping of activities into generation, transmission and distribution, China's power industry can be generally characterized as follows:

- (a) **Multiple Generation Entities.** Provincial companies lost total monopoly over generation with the promotion of "joint-investment" power plants, the creation of the Huaneng Group and its subsidiary, HIFDC, and the introduction of the first BOT projects. However, they continue to play a major role in generation because they are entrusted with control of generating capacity financed by the central government (referred hereafter to as "state plants"). In coastal provinces, generation by state plants

^{1/} These issues, and solutions adopted elsewhere, were reviewed at a conceptual level in the workshop on "Options for Power Sector Reform in China" (Beijing-July 1993). The relevant chapter of the proceedings of that report, referring to international experience, is attached in Annex 2.

accounted for roughly one half of total power generation in 1993. The remaining one half is generated mainly by joint-investment power plants, followed by Huaneng, and finally private generators, whose role remains marginal but is likely to increase in the future.

- (b) **Provincial Monopolies of Transmission.** Transmission activities and despatch within the provinces are carried out by the provincial power companies. The provincial companies have a de facto monopsony power at the provincial level. The companies are also entrusted the operation and management of the state power plants, i.e., plants owned by central government. Interprovincial transmission and power exchanges are undertaken by the regional power bureaus/groups in the five interprovincial systems.
- (c) **Diversity at the Distribution Level.** There is considerable variation in the organization of distribution activities. In many cases, including many rural areas but also a significant number of more suburban or urban localities, distribution is carried out by local county or city-level power companies. They purchase power, and sometimes build their own power plants, to meet local demand. There are about 1,500 of such decentralized power companies. In other cases, distribution is fully vertically integrated with transmission and state generation. In addition, maintenance and operation of rural distribution systems are undertaken by local communities—townships. The townships purchase power from distribution companies in bulk at the 10 kV level and are responsible for the operation of low voltage systems, and billing and collection activities in their areas. Responsibilities are given to local township or village administration staff, or, more often, to a private party (e.g., the township electrician) on a contractual basis.

3.5 The reforms of the 1980s achieved considerable success in changing the structure of the industry by increasing the role of nonstate power generators and loosening the vertical integration of the industry. But, they fell short of changing the trading relationships between the different business entities, or introducing market mechanisms and competition in the industry to stimulate efficiency and environmental protection.

Toward Competition in Generation

3.6 **Alternative Models.** Discussions at the Workshop on Options for Power Sector Reform in China focused on four generic models, which differ by the amount of competition they envisage (see Annex 2):

- **Model 1.** Vertically integrated monopoly. There are no competing generators in a given area. Customers buy from a generator who has the monopoly over generation, transmission and distribution (the EDF model in France, the US model prior to 1978, and many other countries);

- **Model 2.** Vertically integrated generation and transmission monopoly with independent local distribution monopolies. The only difference with model 1 is that distributors are separate from the vertically integrated generation/distribution. This is still a full monopoly model, but it might be considered a first step toward competition (the UK, prior to 1990, and many other countries);
- **Model 3.** Competition in generation with generators selling to the transmission monopoly (The "Purchasing Agency Model"). The Purchasing Agency Model introduces competition in generation but all sales must be to a designated purchasing agency. The Purchasing Agency then sells to retailers or to its own customers who have no choice of supplier (most of the US since 1978, Spain); and
- **Model 4.** Full competition—competition in generation, with customers or retailers having a choice of supplier (the UK, Norway).

3.7 Efficiency can be achieved through any of these models if the companies are autonomous and business oriented, and suitable policies and trading relationships are put in place. Table 3.1 provides an outline of the policies and instruments needed to stimulate efficiency within the power sector under the different models. However, the experience of the last two decades in most developing countries has shown that lack of enterprise autonomy and policy failures have resulted in inefficiencies and major capital crises that have impeded power sector development.

3.8 **Transition to a Purchasing Agency Model.** The discussions of the workshop and following Bank/Government dialogue led to the conclusion that gradual introduction of competition and promotion of nonstate and private investment, especially in generation, through a gradual transition to a "Purchasing Agency Model," along the lines of Model 3 above, would improve efficiency at the investment and operational levels. Different levels of vertical integration could exist, depending of the specific characteristics of different provinces.

3.9 The Chinese Government is committed to the introduction of competition and market mechanisms in the power industry and the promotion of private investment. However, free entry and full competition, as envisaged in Model 4, are regarded as possibilities only for the long term because they require open access to the transmission system, an electric power spot market, and complex legal structures. These have been attempted to date in only a few advanced countries. Implementation in China would be jeopardized by the current scarcity of skilled personnel and the weak management resources of the sector.

3.10 The Purchasing Agency Model is rightly perceived as the most suitable to a transition from central planning and introduction of fundamental market-oriented reforms without disruption. During the transition period, some elements of central control can be retained through the provincial companies (purchasing agencies), which will continue to

Table 3.1: POLICIES NEEDED UNDER STRUCTURAL ALTERNATIVES

Objective	1 & 2 Monopoly at all levels	3 Competition in generation	Full competition
Efficient Production	Performance con- tracts, targets Economic Despatch	Adequate con- tractual arrangement to achieve economic despatch	Spot market
Efficient consump- tion	LRMC tariffs (Quotas if shortage exists)	LRMC tariffs (Tradeable quo- tas/auction of quo- tas in shortages)	Market prices
Efficient investment:			
Generation	Planning and possi- ble competitive bids for plant construc- tion	Competitive bidding for new capacity	Forward market for power
Transmission	Planning	Purchasing Agency Pool	Transmission con- tracts
Mobilize investment funds:	Auto-financing Loans	IPP contracts	IPP contracts
Sufficient revenues	Tariff policy	Tariff policy	No guarantee
Optimum size of enterprise	Decentralization	Separation of distri- bution	Competition law ^{/a}
		Break up generation	Mergers and acquisitions
Control of monopoly power (consumer policy)	Economic Regula- tion	Economic Regula- tion	Competition law
		Continuous bidding	Freedom of entry
Ability to subsidize or control	High	Medium	Low

^{/a} Anti-trust law.

meet public service obligations such as rural electrification, and to restrain wholesale prices to the cost of production, through competitive bidding and/or adequate contractual arrangements, thus preventing market prices from rising too high in a time of shortages. In addition, given China's high growth, introduction of competition in generation—the primary focus of this model—will contribute most to improving the efficiency of investment and will gradually increase the pressure on power companies to reduce future operation and fuel costs.

3.11 The structure of two sample provincial power systems, in Zhejiang and Jiangsu, is such that both provinces could move easily to a Purchasing Agency Model through gradual structural changes. Despite minor structural differences, the following features are common to both provinces:

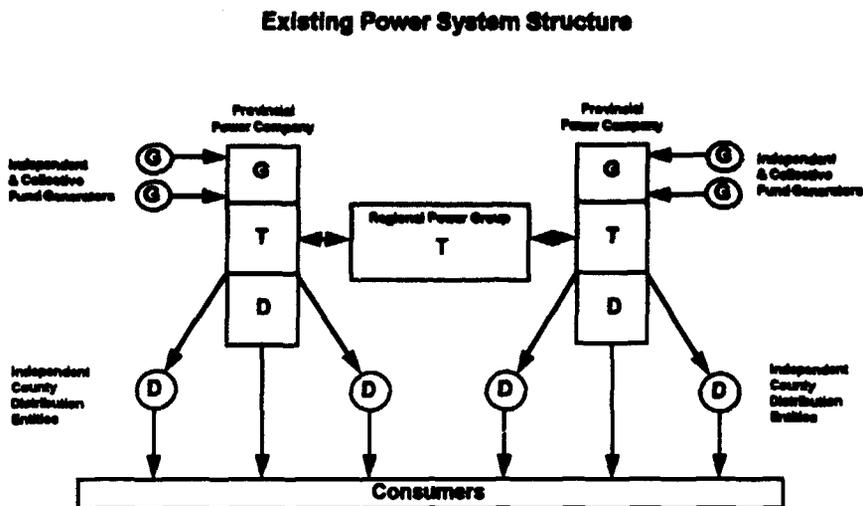
- (a) The power companies no longer have a generation monopoly. Autonomous power plants generate power and sell it to the company. In Zhejiang, however, all these power plants are operated by the provincial power company under management contracts, while in Jiangsu, some of them, such as the Nantong Huaneng Plant, are completely independent.
- (b) The power companies in both provinces are de facto purchasing agencies because they control the transmission network and are the only bulk power purchasers/sellers.
- (c) In Jiangsu, distribution is vertically integrated with transmission and part of the generation, while in Zhejiang, only five of the county distribution companies/bureaus are controlled by the provincial power company—the others are under local government control with no direct management link with the provincial power company.

3.12 Transition to the Purchasing Agency Model could be gradually achieved by clearly defining the rights and duties of the provincial power companies as purchasing agencies and increasing the role, on a competitive basis, of IPPs in generation. Further steps for increasing competition over the medium term might include (a) the creation of one or more independent generation companies, with a number of plants, which could sell to the provincial power companies in competition with other supply sources; (b) the creation/expansion of autonomous distribution companies, in charge of retail sales, who purchase in bulk from the provincial power companies (see Figure 3.1); and/or (c) limited access to the transmission system to permit direct sales from generators to distribution companies at unregulated prices.

Priority Actions

3.13 Introduction of competition at the generation level and smooth transition toward a purchasing agency model requires that the following issues be clarified and addressed, at the national level, as soon as possible: (a) the role of the regional power

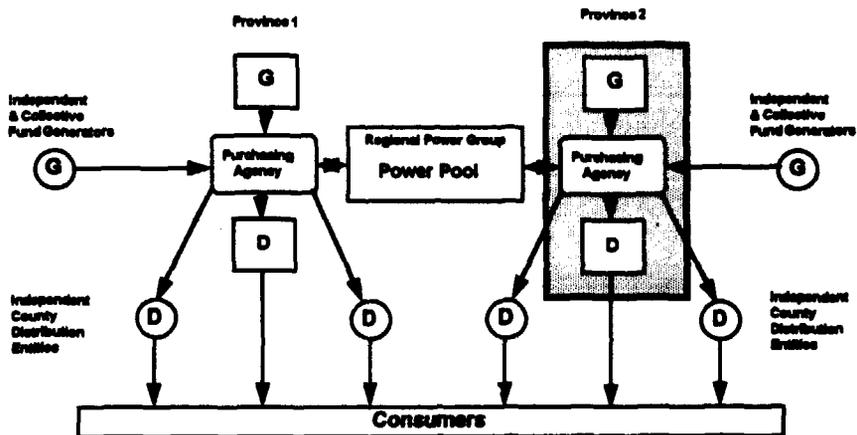
FIGURE 3.1: EVOLUTION OF POWER SECTOR STRUCTURE IN CHINA



Features

- Limited and imposed coordination of transmission planning and system operation
- Provincial Power Company as the sole purchaser has monopoly power

Potential Purchasing Agency Model for China



Features

- Improved system planning and improved system efficiency through Power Pooling
- Increased competition by permitting grid access for generators
- Transaction costs between entities may be higher

groups, (b) responsibilities for transmission, and (c) the policies on the entry of Independent Power Producers (IPPs).

3.14 The Role of the Regional Power Groups. Even though the provincial power companies are considered the backbone of the power industry in China, their structural relationship with the five regional power groups, in the cases where provincial power companies are part of regional, interprovincial grids (see para. 1.3 and Figure 1.1), has still not been clarified. Options under discussions include mainly:

- (a) Constitution of the regional power groups as asset holding companies, vested with the responsibility of managing the state ownership stake in the provincial power companies (the group will act as principals); and,
- (b) Broadening the scope of responsibility of regional power groups holding companies to include supervision of planning, operation and management.

3.15 The second holding company option with broader responsibilities could prevent a full transfer of autonomy to provincial power companies and hinder their ability to act as purchasing agencies. It also could introduce another layer of control and approval based on command and jeopardize the progress achieved through decentralization since 1986. To achieve the objective of operational coordination and efficiency, it is preferable to establish cooperative interprovincial power pools. Based on the willingness of more business and profit-oriented provincial power companies to reduce their operation costs, interprovincial power pools could provide for increased reliability of supply and also take advantage of possible economies of scale and scope to increase efficiency, especially large scale regional hydropower projects and minemouth thermal power plants.

3.16 Transmission Responsibility. Under the Purchasing Agency Model, generators sell all the power to the purchasing agency who is responsible for the transmission, wholesale sales and eventually retail sales. In China, currently, provincial power companies are fully responsible for the transmission systems within the provinces. However, in this area as well, ambiguity remains regarding the role and functions of the regional power groups. An urgent confirmation of the responsibility of provincial power companies over the expansion of the transmission is needed because most of them are already involved in negotiations with IPPs. It is important for project developers that the responsibilities of their counterparts are clearly defined and that their access to power markets is assured. Ambiguity can only result in investment delays.

3.17 Less crucial, but also important, is early attention to issues concerning the vertical integration of the transmission systems with part of the generation and/or the distribution. Implementation of the Purchasing Agency Model requires the awarding of joint-investment power plants (or at least the important ones), Huaneng, and other generators more autonomy and allowing them to compete. A further step would be the separation of transmission from generation and distribution currently carried out by the provincial power companies, and if necessary the breaking generation into several generation companies. In most cases, however, this is not envisaged in the near future for

generation, or even for distribution in some provinces. In most provinces, provincial power companies acting as purchasing agents would still remain substantially involved in power generation and distribution, at least over the short term. Therefore, care must be taken that the roles of the provincial power companies, as generator, transmitter and/or distributor, do not conflict and that independent generators are not disadvantaged. To avoid conflict of interest, the provincial power company (purchasing agency) cannot retain regulatory responsibilities and decide on disputes arising out of contracts or provision of transmission services (see also Chapters 2 and 4).

3.18 A first step toward clarification of transmission responsibility and possible separation of transmission from generation and distribution is to organize and manage subsidiaries of provincial power companies involved in generation and particularly distribution as profit centers. This both provides the additional clarity in operations needed for effective and equitable implementation of the Purchasing Agency Model, and helps to improve the efficiency of these operations.

3.19 **Entry of Independent Producers.** To spur competition and increase efficiency, the Purchasing Agency Model requires that independent investors (including private investors, whether domestic or foreign) can construct power plants and sell their output to the provincial power companies. Entry of would-be generators should be made as easy as possible. Rules should be clarified and publicized to increase the confidence of investors and create an adequate environment for competition.

3.20 Competitive bids for the right to build power plants is a preferred alternative to individual negotiations with IPPs with prices based on repayment of loans or return on equity. Auctions should be sought, where possible, for additional or replacement capacity to maximize the efficiency of the transactions and minimize generation costs. If competitive bidding is difficult to implement in the short term, generators, including Huaneng and important joint-investment projects, should be paid prices for capacity and energy on the basis of standard costs which also can be used in economic dispatch. This will address a major deficiency in the form of contracts now in place in China, which have only an energy price with take or pay provisions that lead to uneconomic dispatch (see para. 5.28).

3.21 Power sector transactions are multidimensional deals; bidding and contractual processes can be very difficult and complex, as proven by experience in the U.S. and some BOT projects in developing countries. Good contractual arrangements are essential to guarantee a market and a corresponding revenue stream for the power producers, provide the protection and incentives for performance sought by the purchaser, and allocate risks associated with a power project. In China, contractual arrangements and processes are weak and underdeveloped. It is essential that the central government assist the provincial power companies in developing sound contractual arrangements and; if needed, standard power purchase contracts to ensure fair competition and minimize negotiation time. Review of selected international competitive bidding experiences and

development of standard contractual arrangements could be carried out and completed in a very short time with adequate technical assistance.^{2/}

Conclusions and Recommendations

3.22 The current industry structure, as it has evolved over the last decade, is conducive to development of competition in power generation. China can now capture the higher efficiency which competition can provide, through further development of a framework and incentives which allow for expanded entry of IPPs. Involvement of a wide variety of producers should be encouraged, including domestic joint-investment projects, foreign/domestic joint ventures, and wholly foreign-owned companies.

3.23 The Government should promote the Purchasing Agency Model as the basic structure for provincial power systems, as the best means to foster increased competition at the generation level. Under the different variations of this model, the provincial power company acts as the sole bulk purchase and sales agent of power within a totally or partially franchised retail service industry. Further progress, depending on the specific conditions of each system, will require expansion of the role of IPPs, including the reformulation of joint-investment plants into true IPPs, and the development and implementation of improved contractual arrangements for power transactions and exchanges based on principles of greater transparency and equal treatment of all players. In most cases, it is expected that the purchasing agency will continue also to be a power producer and/or distributor. In these cases, it is critical that sector regulation be fully separate from the provincial power company, to avoid potential conflicts of interest and abuse of market power.

3.24 In the more advanced provinces, a number of more sophisticated variations of this model could be tried. Generation could be fully separated from the provincial power companies, and placed with one or more state generation companies, competing against IPPs and separate joint-investment plants. Greater independence among distribution entities also can be promoted, through further creation of autonomous distribution companies, or at least proper definition of distribution subentities as profit centers.

^{2/} See *"Power Purchase Agreement and other Requisite for a Successful Power Project"* by R. Fitzgibbons, Jr. This paper was presented and discussed with Chinese officials during the mission in November 1993.

4. LEGAL AND REGULATORY REFORM

4.1 The power sector remains governed by over five hundred laws, provisions, administrative rules, regulations and policy circulars. Most of them were enacted prior to the acceleration of power sector reform, reflecting the command and control approach. They are not consistent with or supportive of the movement toward market-oriented operations in the sector. This chapter evaluates the legal and regulatory framework for the power sector and concludes that it is inadequate to support the reform contemplated for the power sector. New legislation and regulations, and their effective implementation, are needed to make further progress to establish a new type of transaction between public and private sectors, to introduce competition and the operation of market forces, and to ensure proper regulation of the monopolistic segments of the industry.

The Context of Legal and Regulatory Reform

4.2 The legal and regulatory framework for the power sector is in a state of transition. Existing legal and institutional arrangements are largely based upon government ownership within a command and control economy. The existing system consists primarily of a wide range of government directives, controlled virtually all aspects of the power sector's operations, in tune with the previous organization of the sector as essentially a hierarchy of government departments.

4.3 The shift to a market orientation in the power sector, and the efforts to commercialize and corporatize power enterprises (Chapter 2) and reform the structure of the industry (Chapter 3), requires a comprehensive reform in the legal and regulatory framework for the sector. Separation of government ownership and regulatory functions from enterprise operation and management functions is an absolutely essential prerequisite for realizing increased market orientation, commercialization and corporatization, and the efficiency gains which will accompany these shifts (see paras. 2.8-2.10). This separation, then, must become the foundation of a restructured legal and regulatory framework for the sector, focussing on clear definition of (a) the ownership, rights and responsibilities of power enterprises, operating as business-oriented entities; (b) the relationships between power enterprises operating in the sector, and the rules and contractual arrangements governing their economic relationships; (c) the role and processes of government regulation of sector enterprises; and (d) the relationship between government regulatory bodies and enterprises, on one hand, and between public utilities and new private contracts, on the other hand.

4.4 Reforms to gear the power sector to market principles also will increase the importance of legal clarity, documentation, and mechanisms for enforcement and addressing grievances. Overall, China's legal tradition is relatively recent, and the overhaul of the legal system that will be required for the smooth functioning of a market economy is in some ways just beginning. The shift towards greater reliance upon the legal system for establishment and arbitration of the rules governing sector operations, therefore, will take time.

Legal Basis for Power Enterprise Corporatization

4.5 The "charters" issued to power enterprises may refer to the terms "company," "corporation" and "limited liability," but these terms did not have legal meaning under Chinese law until the recent enactment of the Company Law. They generally do not clarify the enterprise objectives, authorities, responsibilities, legal powers, governance and corporate structure, in other than the broadest of terms. They also do not reflect recent reforms which award more autonomy to the sector enterprises such as, the Fourteen Rights afforded to state-owned enterprises (see para. 2.5). In late December 1993, China enacted a Company Law that will serve as the basis for commercial ventures and should provide the needed legal basis for corporatizing enterprises within the power sector. The Company Law should help to better define the structure and regulations of power enterprises.

4.6 Nothing in the law, regulations or the charters of power enterprises defines the ownership interest of the central, provincial and local governments in the various power enterprises. As a result, the state, provincial and local governments exercise their ownership interest indirectly through the network of government supervisory organizations, and the identity of the power enterprises as independent economic entities is blurred. The ownership, rights and responsibilities of power enterprises must be more clearly defined.

4.7 Adequate implementation of the Company law and other SOE reforms to develop Chinese power enterprises into corporations requires:

- (a) Revision of power enterprise charters to clearly specify the enterprise corporate objectives, authority, responsibilities, legal powers, corporate structure and governance, including a Board of Directors.
- (b) Establishment of a Board of Directors for each of the power enterprises.
- (c) Development of Articles of Association (by-laws) that will specify the relationship between the Board of Directors of the enterprise and management. The by-laws should reflect the extent to which the Fourteen Rights have been extended to the power sector.
- (d) Formalization of government ownership of the power enterprises through definition of clear corporate structures and the issuance of shares consistent with the requirement of the new Company Law and the objectives of the

power sector reform. Shareholding will reinforce the separation of government ownership from management.

Contractual Arrangements

4.8 The relationships between power enterprises can be clarified to some extent through corporate charters and other measures defining responsibilities, such as the issuance of licenses to power producers or distribution franchises. In addition, however, the introduction of market mechanisms requires that government directives relating to the relationship between enterprises must be replaced by commercial relationship governed by contractual arrangements.

4.9 The reforms introduced to decentralize decision making and promote joint investments have already resulted in the growth of contracts. These documents, however, are often vague and incomplete, and their legal standing unclear. In addition, many aspects of power sector continue to operate without contractual arrangements, relying instead on mechanisms based on central planning. Failure to accelerate reliance on contracts, to improve their clarity, completeness and standing, and to develop relevant expertise will seriously handicap the introduction of market mechanisms. Government supervision of sector operations will be more difficult. Efforts to encourage private investment in new power plants will be undermined. The efficient construction and operation of power facilities will be impeded.

4.10 Following practices in other countries that have introduced competition in power sectors, all commercial and operating arrangements should be formalized in contracts. Model contracts and agreements should be developed for use by the various elements of the power industry. Model contracts will shorten the period necessary to negotiate commercial transactions, minimize transaction costs, and provide education as to the topics that need to be addressed in such contracts. Model agreements should be developed for (a) power pool agreements; (b) interconnection agreements (coordination and capacity contracts); (c) power purchase agreements for independent power projects (and related contractual agreements); and, especially, (d) wholesale tariffs (for power sales to distribution entities).

Regulatory Framework

4.11 China's framework for regulation of the power sector needs to be overhauled, to better conform with the needs of a more market-driven system and the redefinition of the industry structure and relationships between the government and power enterprises.

4.12 An efficient power sector capable of attracting investment requires a stable, predictable, transparent, effective and efficient regulatory framework. Investors, managers, and consumers must have a clear understanding and certainty as to the "rules" that govern the operation of the power sector.

4.13 The regulatory framework must also be capable of disciplining the monopolistic elements of the power sector. Power enterprises cannot operate as autonomous, commercially oriented businesses without of safeguards to ensure fair and predictable prices, prudent planning, efficient operation, and quality service. Until this discipline can be imposed through competition, effective regulation is a prerequisite for meaningful reform of the power sector.

4.14 China's current regulatory framework does not satisfy the foregoing requirements. The current system for government oversight is complicated and diffuses regulatory responsibility among multiple government organizations (see Annex 4 for additional details). Government responsibilities are not clearly defined. On the one hand, continued pervasive government involvement in operations and uncertainties as to requirements and procedures for investment approval are key impediments to the autonomy of power enterprises and to the growth of private and foreign investment in the industry. On the other hand, certain minimum regulatory functions are not being performed, including specification and enforcement of service obligations, service quality standards and control of operating costs.

4.15 The main components of a reform program that need to be further studied to establish a viable regulatory framework adapted to the specific characteristics of China's power sector include:

- (a) Enactment of legislation to establish a comprehensive regulatory regime. The legislation should: (i) define, clarify and delineate the responsibilities of all government supervisory organizations; (ii) define the relationship between government supervisory organizations and power enterprises; (iii) define the rights of the power enterprises, private investors, and consumers, and (iv) simplify the approval process for power projects.
- (b) Information requirements and control of potential abuse of market power by monopolistic entities. Although precise definitions of regulatory responsibilities will depend upon the details of sector institutional structure reform, the main government regulatory functions are expected to include: (i) review and approval of tariffs; (ii) issuance of service franchises and licenses; (iii) ensuring quantity and quality of electric service, and (iv) cost control (review and approval of investment plans, power projects, and power purchases from other power producers). (see Box 4.1).
- (c) Promotion of competition in the power sector. This function could be carried out by an existing or a new organization, which would monitor corporate reorganizations of (but not necessarily limited to the power sector) to prevent growth of monopoly power within the generation sector. The organization would also be given the authority to order divestiture and other corporate activities as necessary to promote a competitive industry structure.

Box 4.1: POWER SECTOR REGULATION

Regulation, i.e., direct or indirect supervision, of the power sector activities is needed to (a) protect consumers against abuse of monopoly power by the sector enterprises and ensure availability and quality of supply (consumer protection function); (b) encourage entry into the sector and prevent direct or indirect expropriation of entrants (investor protection function); and (c) prevent government and political interference in operation and investment decision of power companies (buffer function). Power sector regulation should be considered as a specialized government oversight function that is an integral part of laws, rules and administrative procedures that protect consumers, investors and national economic interests. It should rely on legal and commercial framework already in place.

In practice, some or all regulatory functions, are exercised by controlling the sector structure, monitoring the conduct of sector entities and setting performance requirements or some combination of the three.

The scope of regulation depends mainly on the structure of the industry. For example, (a) the investor protection function might not be needed if the structure is based on vertical integration and national/regional monopoly(ies), but it is crucial if the structure is based on competition in generation and promotion of IPPs; (b) price regulation is only needed in the monopolistic segments of the industry and generation prices do not need to be regulated if generators are allowed to compete.

Approach to regulation in China should be careful, flexible and evolutive to meet the changing needs of a sector in state of transition. Regulatory mechanisms should be simple, precise and workable. Some of the urgent issues to be addressed are scope of regulation and jurisdiction of the regulatory agency(ies), entities to be regulated, distribution of regulatory rules in primary legislation, secondary legislation, licenses, franchises, mechanisms for controlling performance, etc.

- (d) Rational division of regulatory responsibilities between the different levels of government. One division of responsibilities that is recommended for consideration is for the central government to focus on national policy, interprovincial projects, pooling arrangements among provincial power entities, regulation of holding companies that transcend provincial boundaries and appeals from provincial regulatory decisions; while provincial governments could review and approve bulk power and retail tariffs, issue franchises and licenses consistent with desired industry structure, monitor cost, and establish and enforce performance standards (see Box 4.2).**
- (e) Within each level of government, economic regulation of the power sector should be consolidated within one government organization. Possible options for exploration are (i) the consolidation of all economic regulation at the provincial level within the provincial power bureau (after power bureaus have been truly separated from the provincial power companies); (ii) extension of the responsibilities of the existing economic regulatory commissions, at the provincial level, to include the regulatory functions.**

Box 4.2: POTENTIAL REGULATORY TASKS

Regulatory functions and their division between the central and provincial levels of government were discussed at length by the Chinese task forces after the workshop on "Options for Power Restructuring in China". The following division of responsibility was proposed by the task forces for consideration by the Chinese authorities:

Central Government	Provincial Governments
Establish principles/methodology for tariff determinations	Review and approve tariffs
Review and approve technical and performance standards	Enforce technical and performance standards
Develop model franchises and licenses	Issue franchises and licenses to power enterprises
Develop national energy policy and sector plan	Review enterprise investment plan for consistency with national energy policy
Review and approve interprovincial projects and power pooling arrangements	Review and approve intraprovincial projects
Establish rules and requirements competitive power solicitations and develop model transaction documents	Review implementation and results of competitive power solicitations
Determine appeals of provincial regulatory decisions	Resolve disputes between power enterprises

The latter option, however, involve a greater risk to perpetuate the former command and control approach of the economic regulations.

- (f) Extended independence of regulatory bodies and transparency of the regulation processes. Although establishment of regulatory entities "independent" from existing government authorities is not realistic at this time, a regulatory structure and process needs to be developed to make regulatory decisions transparent and sheltered, as much as possible, from political influence.

The Proposed New "Electricity Law"

4.16 Currently, China has no consistent and comprehensive set of legislation and regulations governing the power sector. The sector is subject to multiple levels of

government directives that are not well coordinated and are often contradictory. These requirements have low legislative rank and do not contain penalties, and thus cannot be effectively enforced. Recently, a consensus has been reached on the need for an electricity law to address these problems.

4.17 Following this major development, MOEP has proposed a new comprehensive electricity law for the power sector, which currently is under review by the State Council and National People's Congress Legal Commissions. Among other things, the law will attempt to reconcile current contradictory requirements on the power sector and define the rights and responsibilities of power enterprises and supervisory government organizations. Following Chinese practice, the law will represent an umbrella set of principles, of high legal rank, under which a series of new or revamped regulations can then be promulgated and implemented.

4.18 It is expected that the electricity law would be approved in 1995. Promulgation of the law will be a major step towards restructuring the legal and regulatory system to better meet the needs outlined in previous paragraphs. A brief summary of the highlights of the proposed legislation is contained in Annex 3. According to a presentation made by MOEP during the November mission, the legislation is intended to:

- (a) Provide for the separation of power enterprises from the power bureaus at all levels of operation (e.g., complete separation of government administration from power enterprise management). The power bureaus would report to and be supervised by MOEP. MOEP would be able to supervise the regional power group corporations directly, in which case the regulatory functions of the regional power group administrations would be eliminated.
- (b) Define the functions, rights and obligations of power enterprises. Management would have full autonomy to manage the power enterprises subject to regulatory approval, including the ability to propose prices, incur debt, issue bonds, plan investments and responds to market signals.
- (c) Specify general pricing principles. MOEP and the State Pricing Bureau/SPC would establish pricing policies based on the principles set forth in the law. Tariffs will be based on cost plus tax, plus profit and proposed for approval to provincial and central governments. The existing multi-track system will be progressively eliminated.
- (d) Clearly state that private participation in the power sector is permissible.
- (e) Specify the project approval process. Planning would be done by MOEP subject to review and approval by SPC. Once approved by SPC, power enterprises would be responsible for plan implementation. Power projects would not need to be approved by SPC if the projects are consistent with SPC approved plans.

- (f) **Require a franchise license to engage in distribution service. The franchise would be issued by either the central or provincial government, as appropriate. A license would not be required for generation and transmission activities.**
- (g) **Clarify the rules governing the creation, merger and bankruptcy of power companies.**
- (h) **Establish the electricity as commodity rather than a public service, with the elimination of the existing system of allocations.**

4.19 The text of the draft law has not been thoroughly reviewed by the mission, however, based on the presentation and preliminary discussions with MOEP, the following suggestions are proposed:

- (a) **The draft law focuses on the responsibilities of MOEP and the provincial power bureaus. The legislation should also clarify the authority and responsibilities of every government institution involved with the power sector.**
- (b) **The draft law would establish MOEP as the supervisory organization for the power sector, with the power bureaus reporting directly to MOEP. The division of responsibilities between the power bureaus and MOEP and other government institutions must be precisely defined. The need for government supervisory organizations below the provincial level should be evaluated.**
- (c) **The draft legislation should specify all management decisions and power enterprise actions that will require government approval. The process for obtaining government approvals and appealing decisions of supervisory government organizations must be clarified.**
- (d) **The draft law would vest responsibility for power sector planning with government institutions, notably MOEP and SPC. Consideration should be given to shifting responsibility for planning to the power enterprises and regional power groups and pools subject to regulatory review and approval as part of the licensing process.**
- (e) **Eliminating SPC review of individual projects whenever such projects are consistent with SPC-approved power sector plans is a positive development. Government review of projects, to the extent deemed necessary, should be consolidated in one government institution, such as SPC, MOEP or the provincial power bureaus.**
- (f) **The draft law includes pricing principles that may be too restrictive. The principles focus on the "costs" of providing service. The principles could**

Box 4.3: OPTIONS FOR TARIFF REGULATION

1. Rate of Return (Cost plus)

- Tariffs established to allow enterprise to recover all reasonable costs and sufficient "return" on equity to attract capital
- Regulator reviews costs to determine expenses that enterprise will be allowed to recover

2. Indexation

- Tariff ceiling established based on projected costs and rate of return
- Tariffs are fixed for defined period (five years), but subject to automatic adjustment (inflation minus productivity factor)
- Savings are retained by enterprise and not translated into tariff reductions
- "Return" on equity is not regulated

3. Avoided Cost

- Tariff for power generators established by focusing on costs of purchasing utility and not power generator
- Tariff equals purchaser's cost of acquiring power from alternative sources (self-generation or third party)
- Power generator's costs and "return" on equity are not regulated
- Regulator approves "avoided cost"

4. Competitive Solicitations

- Tariffs established by prices bid by power generators
- Rules of solicitation are established to promote competition and objective evaluation of proposals
- Regulator reviews competitiveness of solicitation
- Regulator would review terms of power contract

be interpreted as requiring prices to be established strictly on the basis of costs. Other price regulation method could be considered, especially the electricity law should not preclude prices being established by competition, without reference to cost, such as through competitive bidding programs for new power plants (see Box 4.3).

- (g) It is notable that the need for distribution franchises has been recognized. The draft legislation would not, however, require licenses for power production or the provision of transmission services. It may be advisable to issue licenses for power production and transmission as a means to establish and enforce performance standards and to ensure proper provision of transmission service.
- (h) The draft law indicates that regulation will be used to control prices and the quality of service. It is not clear how regulation will be used to encourage efficiency and cost control. This topic should be addressed in the legislation through requirements for information disclosure by the sector operators.
- (i) The draft law introduces a major change in stressing that power enterprises will be subject to the rules that apply to all commercial ventures and not to specific rules adapted to the power sector.
- (j) The draft law would strengthen the role of the regional power group corporations (and provincial power companies not located within a regional power group). These organizations would become the conduit for tariff and financial proposals for all power entities located within such organizations' geographic territory. This intermediate layer of administrative authority could reduce the autonomy of principal power companies and reintroduce tight control, as performed by the former regional power administrations.

Conclusions and Recommendations

4.20 The legal and regulatory framework for the power sector must be overhauled to support the reforms initiated by the Government to make the sector's enterprises more autonomous, attract private financing and introduce competition at the generation level. The detailed regulation to implement the new laws will obviously take time, however.

4.21 The preparation of the electricity law is a major step forward for the necessary overhaul of the legal and regulatory framework. The draft law has many positive features. However, it appears that it does not include any provisions to introduce sufficient competition and market forces into the power sector. The final law, and associated regulations, should address these issues and clearly define the rules of entry at the generation level, including private investors rights, to encourage private investment in new power projects.

4.22 The new legislation should also include provisions that would promote the operation of market forces, such as encouraging competitive bidding for new power plants; authorizing appropriate supervisory government organizations to take actions to foster competitor. (e.g., review and approve new industry organization structures, mergers and disposition of assets, and power marketing and pooling arrangements); and establishing an effective mechanism to ensure enforceability of contracts and the timely resolution of disputes.

4.23 The Government, especially MOEP, should continue to encourage the expanded use of proper contractual arrangements to define and clarify commercial relationships for power exchanges at all levels. Technical assistance is needed to help identify contractual arrangements likely to be required by the power sector, to develop model contracts, to provide education as to the content of such contracts, and finally to support the power enterprises in negotiations with potential power developers.

4.24 Current initiatives to separate regulatory and commercial functions, together with the principles presented in the proposed electricity law, lay important groundwork for the development of a regulatory regime for the power sector which is in tune with evolving needs. The Government's efforts to design and implement a new regulatory framework require a comprehensive approach which would clarify the objectives of the envisaged regulatory system, its long term structure and the priority issues to be advised during the transition period. This effort should include the definition and allocation of regulatory responsibilities, the design of regulatory organizations and mechanisms, and the development of regulatory procedures. The new regulatory framework should precisely define and clarify the responsibilities of all government supervisory organizations, the relationship of government organizations and power sector enterprises, and the rights and responsibilities of power sector enterprise, private investors and consumers. It should also be flexible to ensure quick adaptation to evolving policy and market conditions. Technical assistance is necessary to accelerate the design and implementation of this framework, taking full benefit of international experience.

5. ELECTRICITY PRICING

5.1 China has gone a long way in reforming its power pricing system. Average consumer prices have increased dramatically over the last decade, and in 1993 they compared reasonably well with the long-run marginal cost (LRMC) of supply, especially in provinces where generation is mostly based on coal and/or where nonutility capacity is important. Mobilization of investment resources and cost recovery also have sharply improved during the late 1980s and early 1990s. However, price reform is confronted to new challenges due to surging inflation and changes in the exchange rate. Future price adjustment must properly address these issues to avoid power prices erosion in real term.

5.2 The current system is the result of a number of incremental changes, made in response to events and to various relatively immediate needs, instead of a well-constructed long-term price reform program. The current pricing system remains too complex and cumbersome in spite of the major reforms initiated in 1993. Important distortions and major inequities continue to exist. Major efforts are still required to rationalize the power pricing system so that it can better meet the needs of the emerging market economy and changing macroeconomic conditions.

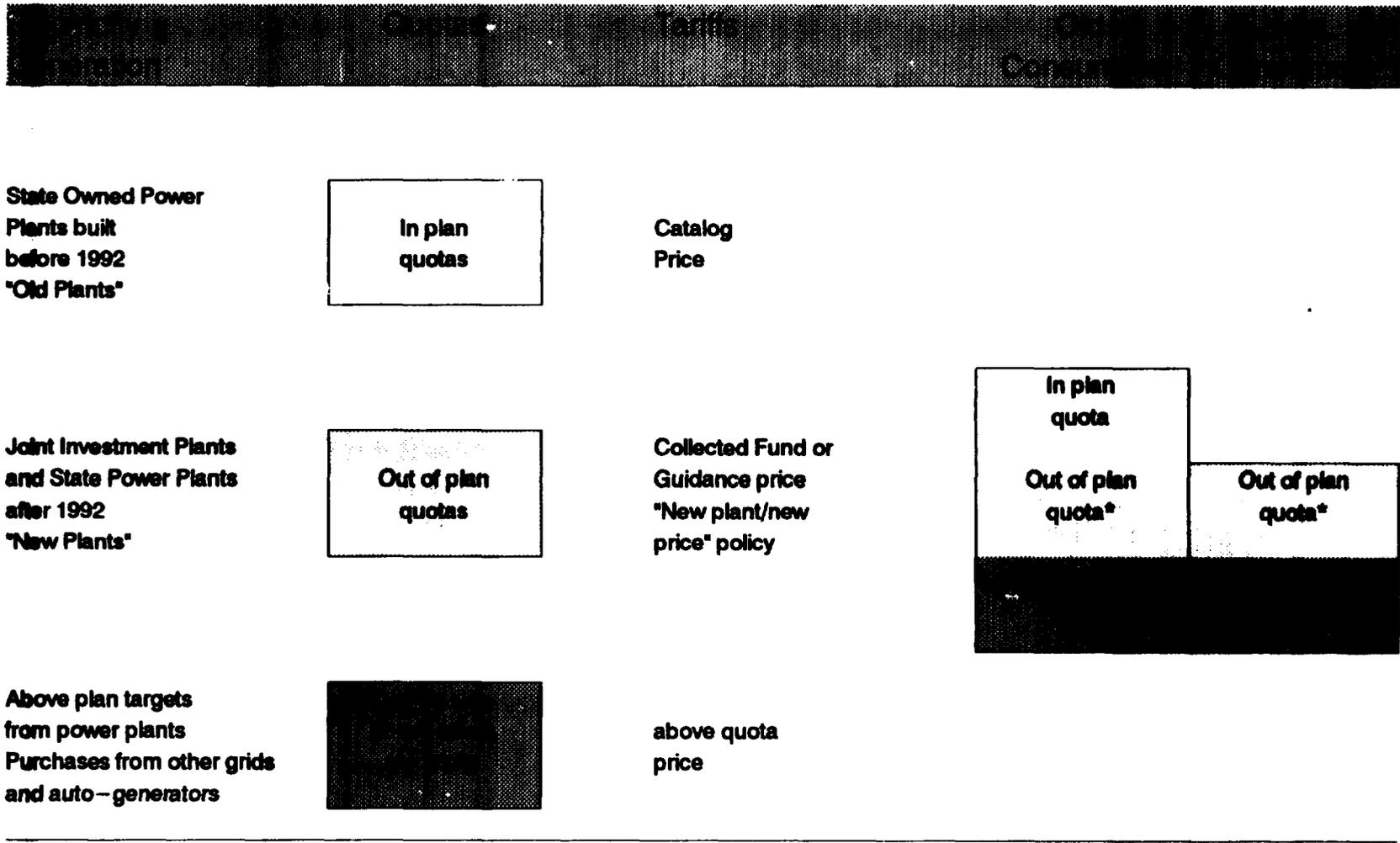
5.3 This chapter reviews the principles of power pricing in China; it describes how electricity prices are set, the recent reform of the catalogue (state) prices and the "new plant-new price policy." It then stresses the need for further improvements to avoid distortions and achieve economic efficiency.

How The Customer Tariffs Are Set

5.4 **Quotas.** Because of pervasive shortages, electricity has to be rationed by quotas or allocations. These are part of the pricing system. The quota allocation system is very complex. Basically, it involves a theoretical matching of power produced from different types or categories of plants to different consumers or categories of consumption. The principles of the current multiple-quota/price-tier system were established in the mid-1980s. It was decided that power produced from plants existing in 1985 would be allocated to enterprises and retailers according to "in-plan" quotas, based on their consumption level in 1985, but that power produced from new plants would be allocated to enterprises and retailers in "out-of-plan" quotas. Since then, the system has further evolved, with a number of local variations and adjustments, including the addition of other types of quotas provided to certain consumers, again tied to specific supply sources. The basic rule is that state enterprises which were well-established by 1985 retain in-plan supply quotas in most provinces, and they also may have other, out-of-plan quotas for consumption over 1985 levels. Most state enterprises established after 1985, or township

Figure 5.1: QUOTAS AND TARIFFS

Quotas and Tariffs



and village enterprises (TVEs), however, have only out-of-plan quotas (although they may have several types) (see Figure 5.1).

5.5 The electric power allocation system is managed by the economic commissions of provincial governments, in coordination with the provincial power bureaus. Many details, however, are administered by the economic commissions of prefectural/municipal or county governments, and the local power supply bureaus. Quotas are allocated on a monthly basis. With the introduction of multiple sources for funding new plants, the investors in the plants are associated in allocating power from new plants. For a given joint-investment plant, the central, provincial, and local governments each reserve the right to determine the final allocation of a share of the plant's output equal to the share each provided in the total plant investment.

5.6 Power shortages constitute a major impediment to increased market orientation of the sector and emergence of business-oriented relationships among operators. Because of the shortages of electric power, and the fact that power supplied under different quotas carries different prices, there are a variety of vested interests and political interference through exceptions to the basic rules in the current system at provincial, and especially local, levels.

5.7 **Consumer Prices.** There are three basic tiers of prices, which apply to different consumption quotas. A first tier is the *"catalogue" or "state base" tariff*. This tariff is applied to electricity generated by all large plants constructed before 1985 and financed by the central government, and generally supplied to consumers under in-plan quotas. A second tier is a system of *"joint-investment" or "new plants" prices*. This is applied to the output of post-1985 plants built with noncentral government funds, supplied to consumers under out-of-plan quotas. A third tier may be categorized as *above-quotas (in-plan and out-of-plan quotas) prices*, applied to various additional sources of supply and allocated under out-of-plan quotas. Consumers pay according to one or more of these tariffs, depending upon the types of quotas retained. The names of different types of quotas and price tiers vary, and provincial and local governments combine or divide them in different ways. In Jiangsu Province, for example, all above-quota power supply (e.g., the second and third tiers described above) is combined into a *guidance price*, averaged at local levels. In Fujian Province, a *Huaneng tariff* is specifically separated out from the second tier (new plant/new price) mentioned above.

5.8 Consumers also pay a variety of investment surcharges, fees and taxes (paras. 5.19-5.20). Again, the nature of these additional fees, and the types of consumers which are required to pay them, varies from locality to locality.

5.9 Data on the final power prices actually paid by Chinese consumers is not routinely collected, and can, at this point, be obtained only through surveys. Variations between areas and between different consumers are substantial, due to variations in the complex blend of price components that make up consumer prices. To try to simplify the administration of the system, many local governments calculate local averages of different

sources of supply, quotas, and special fees, and apply them to various blocks of consumers, but these practices are not at all uniform.

The Catalogue Price

5.10 Until the mid-1980s, China's electricity price system was based on one price catalogue established in 1976. The catalogue price consisted of a per-kWh price, differentiated by voltage level, and a demand charge for large industrial consumers. "Motive power" prices were differentiated for three customer groups—small industry and commerce, large industry, agriculture—and there was one price for lighting, for all customers. The lighting rate differed by province; the other rates were the same (except for Northeast China), and averaged about 7 fen/kWh. Table 5.1 shows the standard 1976 tariff.

Table 5.1: CHINA—THE 1976 CATALOGUE TARIFF

Lighting	Below 1 kV	0.150 Y/kWh
	1 kV and above	0.145 Y/kWh
Small industry & commercial	Below 1 kV	0.085 Y/kWh
	1 to 10 kV	0.083 Y/kWh
	35 kV and above	0.080 Y/kWh
Large industry demand charge	Transformer capacity	4.00 Y/kVA/month
	Maximum Demand	6.00 Y/kVA/month
	1 to 10 kV	0.058 Y/kVA/month
	35 kV and above	0.055 Y/kVA/month
Fertilizer and chemical products	1 to 10 kV	0.048 Y/kWh
	35 kV and above	0.045 Y/kWh
Agriculture	below 1 kV	0.060 Y/kWh
	1 to 10 kV	0.058 Y/kWh
	35 kV and above	0.055 Y/kWh

5.11 The 1976 price remained basically unchanged at about 7 fen/kWh until 1985. After that year, coal prices began to increase sharply. The rising cost of coal was passed on as a variable surcharge, and the simple tariff structure became more and more complicated. A raft of surcharges for coal, transport, and various items were added. The average price in 1992 ranged from 15 to 20 fen/kWh, depending on the province. The differentials for voltage and demand charges had seriously eroded, and it was widely acknowledged that the catalogue tariff was in need of repair.

5.12 The 1993 reforms simplified the catalogue tariff back to something like the original structure, by consolidating all the surcharges, and raising the basic price from around 15-20 fen/kWh to around 18-25 fen/kWh. The catalogue nonresidential prices were increased, in 1994, by 7 to 10 percent on average to 20-27 fen/kWh for large industry and 28-37 fen/kWh for small industry and commercial uses. The revised, 1993 catalogue tariff for Zhejiang Province is presented in Table 5.2. The average price applied to consumers in Zhejiang in this "first tier" tariff was 25.0 fen/kWh. The tariff structure is the same across China, and catalogue price levels are higher in provinces where generation is mostly based on coal because price increases during the late 1980s and early 1990s were made essentially to cover higher operating costs (coal delivery). In provinces where generation is mainly based on hydro, such as Sichuan and Fujian, and in poorer provinces, catalogue prices tend to be lower than in the coastal provinces.

Table 5.2: ZHEJIANG PROVINCE—THE NEW CATALOG PRICES FOR 1994

Category	Energy price (Y/kWh)			Demand charge	
	Below 1 kV	1 - 10 kV	35 kV & above	Peak demand /a	Transformer capacity /b
Residential	0.250	0.245	-	-	-
Commercial	0.367	0.354	-	-	-
Regular industry	-	0.330	0.319	-	-
Large industry	-	0.240	0.227	15.00	10.00
Chemical products	-	0.230	0.217	15.00	10.00
Agriculture	0.277	0.268	0.254	-	-
Fertilizer in-plan production	0.267	0.174	0.164	15.00	15.00
out-of-plan production	-	0.261	0.252	-	-

/a Peak demand in Y/kW/month.

/b Transformer capacity in Y/kVA/month.

5.13 The new tariff provides for more simplified annual reviews to incorporate fuel price or other changes. The new system also provides that, for the first time, the output of capacity financed with central government funds since 1985 can be priced at higher "debt-repayment" prices (see para. 5.14), under the new plant/new price policy.

5.14 The catalogue tariff is applied to the output of all state plants (capacity financed by central government). As provincial power companies generally control only these assets, the catalogue tariff therefore provides the basis for the revenue of the provincial power companies. The 1993/94 catalog price increases had significant positive financial ramifications for these companies, due to the overall increase in price levels, the

more timely and simplified mechanisms for fuel cost adjustments, and particularly the introduction of debt-repayment prices for new plants.

Joint-Investment and "New Plant/New Price" Prices

5.15 During the mid-1980s, the state utility monopoly in power generation was broken, and new entrants were allowed to pool funds and engage in power generation development (see para. 1.5). In some provinces, such as Zhejiang and Jiangsu, these new power plants currently represent 50 to 60 percent of the total installed capacity. The main incentive for the new entrants to invest is the "new plant-new price" principle adopted by the government in 1985.^{1/} Under this principle, power from the "new plants" is sold to provincial power companies at "debt-repayment prices." Calculated and paid on a plant-by-plant basis, the debt-repayment prices are designed to provide sufficient revenue for the "repayment of loan capital with interest," generally within ten years. The formula, determined by central government regulations, is complicated. In order to maintain the new prices at a reasonable level, the formula includes lower-than-market interest rates for local loans and tax breaks to the producers.^{2/}

5.16 The new power plants built under joint-investment projects are required to pay for connection to the grid, which is to be expected, but they also may be required to pay charges amounting to some 20 percent of total project costs, in some areas, as a contribution for transmission expansion.^{3/} They then are allowed use of the transmission system without a specific charge. In other cases, a specific charge of 2 fen/kWh is made for transmission as an add-on to the joint-investment independent producer tariff.

5.17 The joint-investment power plants sell their production to the provincial power companies at different prices (referred to as "network tariffs") based on their debt recovery schedules. In Zhejiang, the average price paid to producers under this network tariff ranged from 18 fen/kWh to more than 30 fen/kWh for the recent power plants and the average price was 23.0 fen/kWh in 1993. The provincial power companies then adjust these network prices to cover other supply costs, mainly transmission and line loss costs, and average them into the "joint-investment" tariff for consumers/retailers. In Zhejiang

1/ The Provincial Regulations on Encouraging Joint-Investment Power Development and Implementation of Multiple Power Prices were approved by the State Council in May 1985.

2/ Otherwise prices would be far over the life-cycle economic cost of supply. See also paras. 5.23 and 5.24.

3/ Although it is traditional in western countries to separate the costs of transmission, and charge them back to users of the system, some analysts are now recommending that generators and distributors should buy rights to use the transmission system, and that the charges for rights should be based on the costs of expanding the entire system to take the additional power, not just the cost of the immediate connection. In one sense, this is what China already does. However, following disputes over the ownership of transmission lines, the Government decided that participation of non-utility or independent producers to financing transmission development will be considered as loans and paid back by provincial power companies. The ownership and future development of transmission systems should be analyzed and explicitly addressed before reforming this aspect of the Chinese system.

in 1993, this "second tier" price averaged 30.5 fen/kWh, or 22 percent higher than the average "first tier," catalogue price. The extra revenues from these sales are retained by the provincial power companies. Network tariffs for Zhejiang Province in 1993 are given in Annex 6.

Additional Above-Quota Prices

5.18 Additional sources of supply may be arranged, especially by local governments, and provided to enterprises under above quota allocations. One common supply source is "*processed electricity*"—power provided by plants over and above their state-determined production quota levels, usually in exchange for coal and a "processing fee." Another common source is surplus power provided from industrial self-generation facilities. In Zhejiang, the average price for such "third tier," above-quota (in-plan and out-of-plan quotas) supply was about 38 fen/kWh in 1993, or 50 percent more than the average catalogue price. Electricity allocated under this category and sold at this price amounted to about 20 percent of total sales in Zhejiang. The extra revenues are generally managed by the "three electricity offices," which allocate quota, supervise security and manage electricity conservation programs.

Investment Surcharges, Fees and Taxes

5.19 Consumers also are required to pay a large number of surcharges, fees and taxes, which are added on to the consumer tariffs at national, provincial and local levels. The largest sums consist of investment surcharges. These include the *2-fen surcharge*, initiated in 1988, which is levied nationwide and accrues to provincial governments. Funds from the 2-fen surcharge are collected in Local Power Development Funds, and used by Provincial Energy Investment Corporations for provincial government investment in joint-investment plants. In the fast-growing, power-starved coastal provinces, local government also often levy similar, additional investment surcharges of 3-4 fen/kWh, and use the funds for their participation in joint-investment schemes. Beginning in 1993, a national surcharge of 0.3 (increased to 0.4 in 1994) fen/kWh also was introduced to mobilize funds for the Three Gorges project.

5.20 Additional, primarily local, add-ons often include street-lighting fees and transmission or distribution levies. Some charges, for example, for urban development or education, are really local taxes, which have nothing to do with power development. The final consumer prices in some localities of Zhejiang Province are given in Annex 6.

Final Consumer Prices and Costs of Supply

5.21 Comparisons of final consumer prices with supply costs are quite difficult for the following reasons: (a) statistics on final consumer prices are not available and data collection requires surveys at prefecture/county level; (b) supply costs vary widely depending on the province, and sometimes even on the specific condition of prefectures or counties; and (c) previous tariff studies carried out under Bank loans now require revisions to assess the impact of recent changes in macroeconomic conditions, i.e., higher

Box 5.1: APPLES AND ORANGES

International electricity price comparisons are always tricky and difficult. In the case of China, they can be very misleading, leaving Chinese "tariffs" apparently low by comparison with other countries; but this is not necessarily the case.

First, construction and basic operation costs (coal, labor, etc.) can be different. Several surveys show that economic construction costs power kW installed (with appropriate shadow prices) in China are low compared to other countries, even developing ones with comparable environmental standards.

Second, the mix of generation may be different. China's generation mix is dominated by coal and hydro, which are generally cheaper than other generation technologies (e.g., oil or natural gas fired units, etc.), especially when, as in China, cheap coal and adequate site are available.

Third, the "average" prices are affected by the demand structure. In China, a far higher percentage (about 70 percent or more) of electricity is used by industry and taken at higher voltage level (35, 110 and 220 kV). Households, which generally pay the highest prices, account only for 7 to 8 percent in most parts of China (compared to 35 to 45 percent in developed countries, more than 25 percent in India and 21 percent in Brazil).

Fourth, the published prices in China (catalogue prices) are not final consumer prices. Specific surcharges, and sometimes local taxes, are added to these prices to cover part of the transmission/distribution costs at the provincial and county levels. Comparison with full costs in other countries are therefore incomplete. (The surcharges earmarked for distribution network development could be considered as unrecorded capitalized prepayments of tariffs.).

Fifth, most importantly, the quality of service is not taken into account. The Chinese customers are submitted to frequent "brownouts" and to drastic limitations in making use of the capacity at their disposal. (Frequently, industries are not allowed to operate at more than half of their full capacity during 12 to 16 hours.) Therefore, load factor in most Chinese systems are higher than 70 percent and can reach 80 and even 90 percent, compared to 55 to 65 percent elsewhere. (It would be more relevant to compare Chinese industry prices to interruptible tariffs in more advanced countries.)

investments and operating costs due to surging inflation, price deregulation for coal, and new exchange rate.

5.22 However, based on analyses carried out during the latest preparation and supervision missions, the following preliminary conclusions can be drawn:

- (a) Prior to the surge of inflation and recent change in exchange rate, final consumer prices compared reasonably well with computed LRM in most provinces where the generation mix is dominated by coal-fired power plants. LRMCs (or in some cases AICs) were estimated in early 1993 in the range of 25-30 fen/kWh and average consumer prices surveyed during the same period in Shanghai, Jiangsu, Zhejiang, Henan, Hainan, Shandong were in

the range of 25-30 fen/kWh (including taxes), with higher prices in the coastal provinces, such as Jiangsu and Zhejiang.

- (b) Subsequent consumer price increases in 1993 and 1994 covered the supply cost escalations in most of these provinces. In 1994, revised estimates of LRMCs/AICs in the same provinces were in the range of 35-43 fen/kWh and surveyed final consumer prices were in the range of 32-45 fen/kWh. Consumer prices are equal or higher to LRMC in provinces where nonutility generation is important such as Jiangsu and Zhejiang and slightly lower in provinces where utility generation is dominant, such as Shandong province.
- (c) Available information suggests that consumer prices in provinces where generation is mostly based on hydro fully cover financial costs but are lower than LRMCs/AICs. In Sichuan and Fujian for example, consumer prices are in the range of 25-30 fen/kWh, whereas marginal production costs for new important hydro projects are estimated at roughly 35-40 fen/kWh or more. However, this conclusion need to be confirmed by more in depth analyses, which are being carried out with the Bank assistance in both provinces.

5.23 In conclusion, consumer prices compare reasonably well with LRMC in many provinces. However, there is a need for price increases in some provinces, especially those where generation is mostly based on hydro to meet LRMCs, and for continued periodic price adjustments in catalogue prices to rising supply costs due to inflationary pressures.

Directions for Further Reform

5.24 The new 1993 catalogue reforms go a long way to correcting the deficiencies in the catalogue tariffs that had developed over the previous 16 years. They contain simpler provisions for annual escalation with coal prices; and the overall 1994 catalogue price level is 30 to 40 percent higher than 1992 levels. Even though the catalogue tariff does not include time or seasonal differentials, some provinces also are beginning to introduce time of day and seasonal tariffs.

5.25 The pricing system as a whole, however, remains cumbersome and problematic in a number of respects. Further rationalization is necessary to induce efficient use of the present resources and attract new investment in the power sector. Some of the issues which need to be addressed include (a) the time structure of current debt repayment pricing; (b) the structure of prices in power purchase contracts; (c) streamlining of investment mobilization through the tariff; (d) unification of multiple-track consumer tariffs; (e) the structure of consumer prices; and (f) the quota allocation process.

5.26 **Debt-Repayment Prices.** Use of these pricing principles for power supplied by nonutility and independent producers ensures that producers are fully remunerated for

costs (para. 5.15). However, as these prices are calculated to ensure repayment of all loan principal and interest over just 10 years, application of this principle to new plants at market rates and new taxation rules will result in very high consumer prices, in contradiction with economic power pricing principles, as such prices would be far above life-cycle economic costs. Currently, this problem is only mitigated by the provision of local loans at rates lower than market rates and various tax breaks. In addition, there will be enormous confusion as to who owns the new plants and how the electricity will be priced when the various 10-year periods are over and the debts repaid.

5.27 An evaluation of the whole new-plant pricing issue is beyond the scope of this paper, but needs to be done as a matter of urgency, in order to design a policy which would attract investors without imposing excessive prices on Chinese consumers. Such a review would consider, among other things appropriate plant depreciation schedules and their relation to technical progress; and the inherent conflict of traditional lending policies and repayment schedules with rational, economic pricing policies.

5.28 **The Structure of IPP Prices.** Current contracts between independent power producers and purchasing agencies are based on a single kWh price and take-or-pay provisions. This results in uneconomic dispatching because the purchasing agency has no incentives to buy more power after meeting its contractual obligations and prefers to run its own plants, even if they are less efficient, rather than pay the relatively high contracted kWh price. Before more plants of this type are commissioned, the pricing agreements in the purchasing contracts with the new plants should be improved, or the contracts will run into conflict with the efficient operation of the overall system.

5.29 Contract prices that provide for different prices for sales during periods of different system load characteristics should be investigated. Improved price structures based on the marginal cost of supply and the value to the system should be reviewed and adapted to future contracts to give the plants incentives to be available when they are needed most. The structure of the kW and kWh prices and availability penalties need to be thought out carefully so as to both maintain efficient dispatch and avoid overpayment for plant availability. Technical assistance to develop model contracts would help in achieving these objectives in the short term.

5.30 **Streamlining Mobilization of Investment Funds.** The investment surcharges—e.g., the provincial government two-fen surcharge and local government investment surcharges, where applicable (para. 5.19)—have played a role in increasing the mobilization of investment resources for building new power plants. This indirect method of raising funds for power development is, however, inefficient and cumbersome. As in other countries, it would be more efficient and transparent for these surcharges to be collapsed into the overall tariff collected by provincial power companies, and used by the company for power development. It is recognized, however, that progress on this reform is in some ways linked to power enterprise corporatization (and the definition of equity positions in provincial power companies), and to progress in moving away from the current quota allocation system.

5.31 Unification of Multiple-Tier Consumer Prices. The multiple-tier system means that consumers in the same service area retain different types of power allocation quotas, carrying different prices. Two customers with exactly the same consumption characteristics can easily be paying different average prices, because of different mixes in quota allocations. For example, new industries are paying higher prices than old industries by 30 to 40 percent in Zhejiang and by about 80 to 100 percent in Henan.

5.32 The multiple-tier price system may have been useful for phasing in higher prices to consumers, but it has now become a major impediment for progress toward economic pricing and results in distorted consumption behavior. It has outlived any usefulness that it once may have had and should be eliminated in favor of a unified consumer tariff. Consumers receiving the low prices have insufficient incentive to conserve energy, and these consumers tend to be precisely the old industries which most need to modernize and use energy more efficiently. Allocations of cheap power have, in effect, become subsidies to protected industries (fertilizers are a case in point in China), and the potential for political influence is pervasive. As the system allows different prices to be paid by similar consumers for purely administrative reasons, it also is blatantly unfair.

5.33 *Unification of the consumer tariff* means that one tariff should apply to all consumers in a given service area, with no exceptions. A single tariff would continue to provide for different prices for different consumer categories, and variations based on voltage, time-of-day, etc., as service costs vary. In absence of competition, consumers with the same service characteristics, however, should pay the same price. Where there are different service costs in different service areas, it may be useful to adopt different unified tariffs; in such cases there is no economic rationale for unifying tariffs across wide regions, such as provinces.

5.34 Unification of the consumer tariff is supported under existing state policy, but implementation at local levels has been slow. Implementation efforts need to be strengthened, and speeded up where at all possible.

5.35 Consumer Tariff Structure. Much progress has been made in many ways to simplify the tariff, and bring it into line with costs. However, some aspects still require attention, particularly the following:

- (a) Voltage differentials have been increased, reducing subsidization of residential uses by industrial consumers, but the differential still reflects only about one half of the computed cost differential. International experience shows that if the voltage differential is too low it immediately results in customers requesting supply at lower voltages, which simply shifts the costs of transformers to the other customers.
- (b) The demand charge for large industrial consumers has been raised from Y 6 to Y 15/kW/month, increasing marginally the ratio of demand to energy charges for large users. The demand charge is still too low, however,

representing only about one third of LRMC-based levels, estimated at 50 yuan/kW/month in some provinces. For those customers with demand meters, the application of a cost-based demand charge is important.

- (c) Cross subsidies which remain in the new tariffs should be gradually removed. The 1993 catalogue tariffs retain special prices for irrigation in poor counties, chemical fertilizer producers, and a few other types of consumers. Subsidies, when necessary, should be provided in a transparent way without the involvement of the power industry.
- (d) The adoption of differential block rates for residential consumers should be strongly considered. Under such a scheme, households would pay full service costs for consumption over a basic "lifeline" level. Lifeline tariffs are intended for low income households and applied for a monthly consumption of about 40 to 50 kWh/month.

5.36 Market-based Power Allocation. The system of allocating power supply by administrative quotas will continue to make it difficult to fully implement an economically rational electricity pricing system. Since severe power shortages and power rationing through some type of quotas will continue to exist, consideration should be given to methods to make the quota allocation process more transparent and market-driven at least on the margin. One possibility would be to introduce consumer bidding for incremental power supply, in excess of existing quotas. Auctions could be held by the power company and regulated by provincial authorities, providing small blocks of incremental power supply to the highest bidders, who value it most. It is preferable that power companies could retain the additional revenues.

Conclusions and Recommendations

5.37 Despite the substantial progress achieved in recent years, the reform of China's electric power pricing system to a fully economically rational system remains incomplete. At this juncture, it is important to undertake an objective assessment of the existing system and review of options for the future, followed by the definition of a pricing system (or pricing systems) most appropriate for the country's long-term needs and a medium-term strategy for putting this in place. Careful thought needs to be given to how to balance different needs in the development of pricing for new generation facilities, and how to provide adequately for transmission and distribution investment as the structure of the power industry changes. Past experience has shown that adoption of various incremental changes, largely in response to short term needs, can provide useful results, but this approach also can lead to the entrenchment of new (and perhaps unintended) problems. It is therefore recommended that MOEP, as the key agency for government oversight of the sector, organize and lead a major effort to clearly define the specific objectives and implementation strategy for the electricity price reform over the medium term. International technical assistance could be provided where required.

5.38 In addition, there are a number of actions which can be undertaken now or in the near future, at national or provincial levels, to improve the pricing system. Summarizing from previous sections, these include actions to (a) improve the price structures in IPP power purchasing agreements to properly reflect the cost of supply and the value to the system, providing improved incentives for economic dispatching; (b) collapse the existing provincial and local government power investment surcharges into the overall power company tariffs, as emerging conditions permit; (c) unify multiple-track consumer tariffs at local levels into a single tariff; (d) improve the structure of existing tariffs by increasing voltage differentiation and the ratio of demand to energy charges in the consumer tariff, gradually eliminating cross-subsidies, and introducing different lifeline rates for small consumers and above-lifeline rates based on cost of supply for other residential consumers; and (e) review options for making the quota allocation system more transparent and market-driven, followed perhaps by experimentation in advanced provinces of market-based power allocation mechanisms.

6. FINANCING THE EXPANSION

6.1 The power sector in China is faced with an investment requirement that could range from \$15-20 billion per year until the year 2000 and more thereafter. This chapter reviews the changes introduced by the Government to mobilize funds to meet these important needs, discusses the limits of past reforms, and proposes, for consideration by the Government, various options to mobilize domestic and foreign capital.

Past Developments

6.2 Prior to the 1980s, all large power generation and transmission projects were financed through allocations from the State Budget. Distribution expansion and rural electrification were financed from state provincial and local government sources and partly by local communities (townships and villages). Profits and especially depreciation funds, remitted to the central government, were not fully reinvested in the sector since, in aggregate they exceeded direct government allocations. The effective result was a deficit of financial flows into the sector and a major capital crisis in the early 1980s.^{1/}

6.3 Faced with this critical situation, the government initiated the reform of the sector financing by:

- (a) **Changing the pattern of financing of the power sector.** All state budget allocations were henceforth provided through the Peoples Construction Bank of China (PCBC) as loans. However, the available amount of these loans, subject to low interest rates of 2.4 percent per year in the early 1980s and 3.6 percent later, and repayment term of 15 years, fell far short of meeting the increasing financial needs of the sector.
- (b) **Increasing foreign borrowing.** Initiated in 1983 with the Bank's first power loan for the Lubuge project, foreign borrowing has become an increasingly important source of finance for the power sector. World Bank loans were the main source of foreign financing until the early 1990s. Other bilateral sources and concessional funds, mainly OECF, funded several power projects in the 1980s. The Asian Development Bank (ADB) has also begun lending to China's power sector in 1993. Foreign finance has been almost all based on sovereign borrowing, with only a few exception of limited recourse project financing.

^{1/} A presentation of options for power sector financing is provided in EA2IE paper: Mobilizing Domestic and Private Savings: Options for the Power Sector (World Bank Mission report—June 1994).

In 1994, a first cofinancing operation, through the Bank's Expanded Cofinancing Operations (ECO), was successfully initiated to meet the foreign exchange needs of the Yangzhou Power Project and, promote China's power sector access to international financial markets.

6.4 A second, and most important step, for further diversification and expansion of sources of funds was taken in 1985 by authorizing local governments (provincial, municipal and county) to participate in financing of new plants and allowing them to set power prices based on loan repayment (New Plant-New Price Policy). In 1988, provincial governments were authorized to levy a 2-fen per kWh surcharge on electricity consumption (except for agricultural and residential users). The 2-fen surcharge became the major source of local financing but sales of power rights to industrial consumers, issuance of power construction bonds, and numerous other financing schemes contributed in increasing investments in the sector.

6.5 A third step consisted of promoting public (Huaneng, Xinli) and private (Hopewell Power Limited) independent power producers to build and operate power plants and sell their output to the provincial power companies. Huaneng, created in 1985, operates now more than 6,000 MW and Hopewell financed one of the first BOTs to be constructed in a developing country, the 700-MW coal-fired Shajiao B powerplants. Other projects are under construction by the same operators and a large number of other projects also are under consideration by additional developers.

6.6 These measures have been successful in increasing the mobilization of funds and diversifying sources of finance. The capacity added to the system increased dramatically from 4-5 GW in the early 1980s to about 12-13 GW in the early 1990s, and dependence on direct government allocations fell from more than 66 percent in 1980 to less than 6 percent in 1993 (see Figure 6.1 and Table 6.1). However the established measures seem to have reached their limits and the sector is in danger of facing another capital crisis, given China's present expansion needs.

Issues in Project Financing

6.7 The main issues and inadequacies in sector financing are as follows:

- (a) Despite strong expansion and gains in productivity, power enterprises have failed to generate sufficient internal capital for investment because most depreciation funds and the 2 fen per kWh power construction surcharge are still remitted respectively to the Central and provincial governments. Even if power enterprises are now allowed to retain a larger proportion of depreciation funds than previously, the problem of adequate capitalization is yet to be resolved, since the sector is expected to service as debt an excessive proportion of its market finance which ought to be more properly treated as equity.

Figure 6.1: CAPACITY ADDITIONS TO THE SYSTEM (GW)

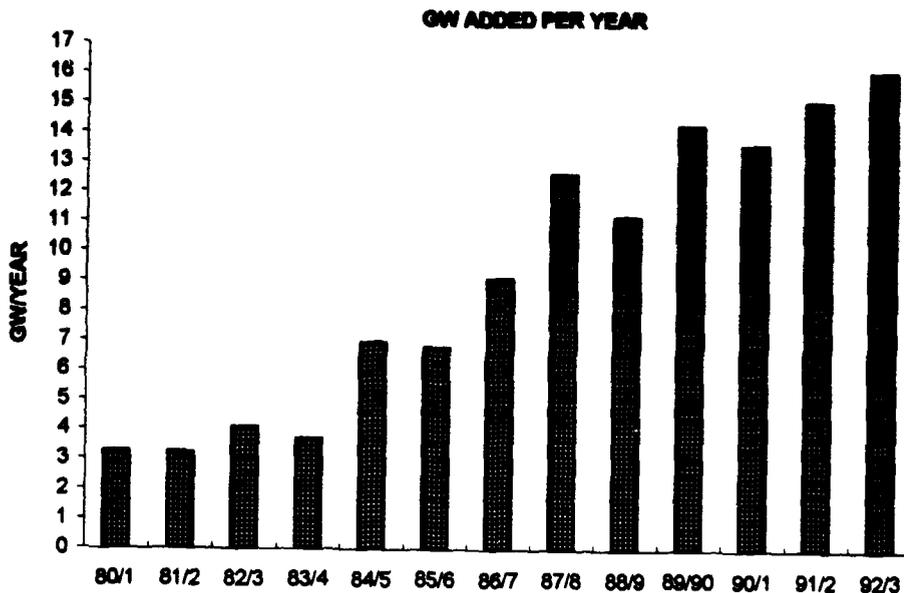


Table 6.1: FINANCING FOR THE POWER SECTOR

Source	1980		1992		1993	
	Y bln	%	Y bln	%	Y bln	%
1. State Budget	2.7	66.0	2.0	5.5	2.1	3.8
2. PCBC and Other Specialized banks	1.0	24.0	11.0	30.5	18.5	33.2
3. SEIC	-	-	6.0	17.0	7.4	13.3
4. Bilateral and multi- lateral institutions	-	-	3.0	8.0	3.4	6.1
5. Local Government/funds	0.4	10.0	14.0	39.0	24.4	43.6
Total	4.1	100.0	39.0	100.0	55.8	100.0

Source: Ministry of Electric Power.

- (b) A significant portion of funding is debt with maturity period shorter than the economic/technical life of the equipment. This poses term mismatch problems for the sector.
- (c) China's domestic financial markets are underdeveloped and currently unable to efficiently intermediate domestic and foreign savings, mainly because of excessive government controls on interest rates, security issues, and the direction of credit. Moreover, funds raised through bond issues are all of medium-term (three to five years) nature and most importantly, are normally issued on a residual basis, after the annual sale of treasure bonds is completed.
- (d) As pointed out in Chapters 3 and 4, the institutional environment is not yet fully conducive to significant private sector involvement in the power sector. At present, China lacks appropriate policies, market mechanisms and institutional arrangements necessary to tap the vast pool of foreign capital on a limited recourse basis. The success stories of the Shajiao projects are due to specific conditions and cannot be regarded as reliable precedents for further private, especially foreign, investments in the power sector.

6.8 Overcoming these problems to ensure sustained financial flows to meet the large needs of the power sector requires, first, an increase in funds generated by existing power companies and improving their access to domestic and financial markets; second, encouragement of foreign equity investment on a commercial (not subsidized) basis, in both wholly foreign owned projects and in joint ventures; and third, improvement of the intermediation ability of the financial sector through, particularly, novel financing schemes.

Increased Financing by Power Utilities

6.9 Adequate self-financing of new investments is vital for the sustained development of the industry. This means the companies require a market-determined rate of return on assets (usually 8-12 percent on revalued assets). Increased power sector self financing requires further pricing reforms based on full recovery of supply cost and more autonomy to power enterprises on how these funds can be reinvested as discussed in Chapter 5 on price reform and in Chapter 2 on Corporatization of power enterprises. These measures will be essential if power companies are to become financially viable entities, able to access funds from capital markets on commercial terms based on their own financial performance and the strength of their balance sheets.

Financial Sector Reform and Novel Financing Schemes

6.10 The largest potential share of finance outside the sector is the enormous pool of domestic savings of Chinese households. The Government launched major financial sector reforms last year that would move the financial system away from reliance on directed credit and toward allocations through markets. Nonetheless, these reforms have not yet included full liberalization of domestic interest rates and full convertibility of

Renminbi. These reforms are ultimately necessary to attract an adequate supply of domestic and foreign resources into the power sector. Unless power companies can issue bonds and equity into the financial markets, they will be dependent on the budget, Government guarantees (implicit or explicit), or foreign financial markets. The absence of foreign exchange convertibility also impedes full access to foreign markets. Therefore, rapid financial sector reforms, interest rate liberalization and full convertibility are prerequisites for fully tapping the potential resources available.

6.11 A second prerequisite for effective mobilization of domestic savings fully is the acceleration of Government's ongoing reforms on corporatization of power enterprises, implementation of international accounting, introduction of competition and promotion of a sound legal and regulatory framework. The Government has shown, in the early 1990s, strong commitment to pursue this course.

6.12 Assuming that the government would accelerate policy reforms to develop an appropriate policy, regulatory, and institutional framework that will encourage investors to participate in long-term private power development in China, the next priority will be to introduce new and innovative financial instruments. This would include postconstruction refinancing, policy and currency convertibility risk guarantees, bond rollover guarantees, and mezzanine financing through an Independent Power Development Fund (IPDF). Financial institutions would invest normally in marketable bond and equity instruments of provincial or regional power companies that have been corporatized and are in the process of reform. During the initial phases, they might offer limited guaranteed/assurances as to the contractual performance of projects and foreign exchange availability for debt-service and repatriation purposes.

6.13 Finally, there are no institutional vehicles to intermediate domestic savings into the power sector or other infrastructure. Funds now only come to the sector through state budget allocations, subsidies or with implicit government guarantees. The government should consider restructuring of existing institutions and/or creating new independent investment corporations for the financing of infrastructure projects, including those in power sector. The institutions should follow certain norms of ownership, management, fund mobilization and operations. They should be established as profit-oriented companies managed independently of government direction, mobilize funds on market terms without guarantee, and reinvest them in marketable instruments of commercially viable companies. They should be financial consortia owned jointly by the government, multinational financial institutions, and other potential project sponsors, offering a range of financing products, or facilities, designed specifically to address key issues to foreign investment in infrastructure projects. Their joint state and nonstate ownership would enable them to effectively isolate, evaluate, and address the relative risks associated with each phase. This would make them more effective in raising cheaper financing for the different phases of the project. They could access the domestic and, eventually, the international capital markets to achieve an appropriate mix of local and foreign exchange funds. In order to have a maximum impact on the domestic capital market, they would issue different types of bonds; for examples, bonds with equity warrants, convertible bonds, income participating bonds, etc. They should invest in sound

and commercially viable projects. Furthermore, they should operate in an open and competitive environment.

Encouragement of Foreign Financing

6.14 Recognizing the limitations of domestic financing sources, the Chinese Government has opened the sector and is encouraging private investors to play a role in its development, including foreign/local joint ventures and wholly owned foreign firms, operating on BOT, BOO, lease financing or any other rational basis. The Government is seeking about \$25 billion in foreign financing between 1994 and 2000, i.e., about 20 to 25 percent of sector investment. Financing schemes being explored and tested by the Government include:

- (a) Promotion of joint-venture and fully foreign-financed Independent Power Producers.
- (b) Issuance of stocks on overseas stock exchange markets to create shareholding companies, around one or more existing power plants. Some energy investment companies of the special economic zones have also been authorized to raise equity capital. Following its gradual approach, the government designated Shandong province and Shanghai Municipality as pilot cases to test these new financial schemes in the near future (1994 and 1995). In addition, HIPDC has been authorized to list some of its power plants on foreign financial markets.
- (c) Establishment of a power development fund based in Hong Kong, which would float bonds in international capital markets or engage in commercial syndicated loans.

6.15 However, the results achieved so far are limited. Listing companies overseas to attract private capital is proceeding relatively well, and it can be accelerated through implementing the corporatization reforms. However, the policy framework is biased in favor of foreign investors; it is easier to attract portfolio foreign investment than domestic investment because of the ceilings on rates of return to domestic financial instruments.

6.16 The results of efforts to attract foreign direct investment or domestic Chinese entrants into power production have been less satisfactory. Despite the attractiveness of the Chinese market and the palpable interest of foreign power producers—more than 100 Memoranda of Understandings have reportedly been signed—the number of actual IPP deals that have actually begun construction is insignificant. The reason is that the Government has not yet formulated a comprehensive framework that is transparent, competitive, and clearly formulated in regulations and law. As a result, provincial authorities have consummated Memoranda of Understanding through bilateral negotiations rather than competition, and the central government authorities, unsure about market rates of return on equity, appear reluctant to ratify agreements. At the same time, authorities

have signalled producers that they wished to maintain ownership control, have Chinese contractors as turnkey constructors, and vetoed rates of return higher than 15-17 percent. Restrictions on foreign exchange convertibility, inadequate fuel supply and power sales agreements, and difficulties in enforcing contracts have compounded the disincentives into entering the Chinese market.

6.17 Investors, therefore, have negotiated with the objectives of shifting legitimate commercial risks—construction and project risks—back to the Government, and have demanded a higher risk premiums to operate in China. This means requiring relatively high rates of return on investment compared to risks actually borne in the project. The absence of agreement on the policy framework is thus delaying numerous projects, raising the cost of power to Chinese consumers, and raising the cost of foreign investment to the society.

6.18 To address these problems and encourage IPPs, the Government should formulate a basic policy framework that would provide for competition at entry on the price of power supplied, mitigate investor concerns on foreign exchange convertibility and other policy-based risks, and adequately assign commercial risks to perspective investors. Encouraging completion at entry on the basis of the price of power—before memoranda of understandings are signed—will discipline rates of return on equity, and will bring down the cost of power and foreign investment over time. This would allow the market to replace costly and time-intensive bilateral negotiation between power utilities and prospective IPPs, and the subsequent lengthy review process at the center. During some transitional phase, limited guarantees on exchange availability, selected policy-related risks, and/or contract performance risks might be warranted; as the policy gains credibility, these guarantees should be phased out.

Conclusions and Recommendations

6.19 In 1986, the Government introduced major reforms to mobilize funds from the combined resources of central, provincial and municipal governments, increase foreign borrowing and open the sector to para-public and foreign independent power producers. These measures succeeded in expanding and diversifying sources of finance. Contributions from the State Budget dropped from 60 percent in 1986 to about 6 percent in 1993. Provincial and municipal funds accounted for 47 percent of total investment in 1993 and private investors are increasingly involved in developing power projects through BOT (Shajiao B and C) or joint ventures (Daya Bay nuclear power plant). However, these measures seem to have reached their limits and given the scale of China's present development requirements, the power sector may face another capital crisis if further reforms are not introduced.

6.20 The Government should deepen and hasten the reform in the power sector, remove the major distortions and constraints in the financial sector, and introduce new and innovative instruments to attract more private (domestic and foreign) investors. The following major steps could be considered:

- (a) Power sector reform, especially the corporatization of power enterprises, the rationalization of electricity tariff (especially power sales/exchange prices to ensure adequate return to investors) and the development of an adequate legal and regulatory framework to support further introduction of market-oriented mechanisms, are required to increase self-financing of power utilities, improve their financial vitality, and improve their access to domestic and foreign financial markets, and second, to attract more private investors and independent power producers.**
- (b) To encourage IPPs, the Government should formulate a basic policy framework that would provide for competition at entry on the price of power supplied, mitigate investor concerns on policy-based risks, and adequately assign commercial risks to prospective investors.**
- (c) At the same time, the financial intermediation to the power sector could be improved through development of proper policies and instruments to channel more domestic savings and/or foreign investments to the power (infrastructure) sector. The Government should also encourage the entry of new intermediaries into infrastructure financing.**

7. ENERGY EFFICIENCY AND ENVIRONMENTAL PROTECTION

7.1 Per capita electricity use in China remains low—about one-twentieth of that in the US. Further rapid increases in power output will be required to sustain major increases in per capita income levels. Because of China's size, however, future growth brings major environmental challenges, not only for China, but for the region and world as a whole. This chapter explores the intertwined issues of energy efficiency and environmental protection in the power sector, with focus on improving the efficiency of electricity use and coal use in thermal power plants, reducing air pollution from thermal power plants, reducing potential adverse environmental impacts of hydroelectric development, and improving resettlement schemes.^{1/}

Improving the Efficiency of Electricity Delivery and Use

7.2 China's ability to further improve the efficiency of electricity use will continue to depend upon developments in the Chinese industrial sector, as in the past. Although electricity use in the residential and commercial sectors will most likely continue to grow more rapidly, industry's current position as the consumer of over three quarters of final electricity supply means that the industrial sector will continue to dominate total incremental demand growth well into the next century.

7.3 Changes in macroeconomic and industrial structure have been the most important cause of the relatively low elasticity of electricity demand growth relative to growth in GDP over the last decade. Expected further structural changes should continue to yield strong downward pressures on the electricity intensity of the economy. Key factors include changes in the shares of the industrial and service sectors in output, patterns of trade in energy-intensive commodities, and changes in the mix of products produced by Chinese industry. The future role of these structural factors—which are central to the level of economic output derived per unit of electricity—are closely tied to China's progress on economic system reform as a whole, including the related issues of increasing the role of the market and competition, and enterprise autonomy and accountability.^{2/}

7.4 Direct measures to conserve electricity include efforts to reduce losses within the power production, transmission and distribution system and efforts to conserve

^{1/} Additional analysis also is presented in the following recent Bank sector reports: (a) *China: Efficiency and Environmental Impact of Coal Use* (1991), (b) *China: Environmental Strategy Paper* (1992), and (c) *China: Energy Conservation Study* (1993).

^{2/} See *China: Energy Conservation Study* (1993), Chapter 2.

electricity by final consumers. Market-based incentives should be promoted to realize the integration of financial, economic and environmental decision-making at the enterprise level.

7.5 Reducing Power System Losses. Some 16-20 percent of China's power generation is lost in the transmission and distribution system, compared to losses of 10-12 percent in most developed country systems. Losses in rural areas are reported at a very high 33 percent. The main cause of high losses is the prevalence of old, out-of-date equipment and increases in system load well over the carrying capacity that they were originally designed for. In the countryside, high-loss transformer models still dominate in most areas, system power factors reportedly average only some 0.7, and substation capacities, line cross-sections and line lengths typically do not match current loads.

7.6 The share of transmission and distribution investment in total sector investments must increase above current levels in order to avoid further increases in losses, let alone provide for significant loss reduction. Whereas transmission and distribution investment accounted for 22.5 percent of power sector capital construction investment in 1985, this share declined to only 17.7 percent by the end of the decade. Given the rapidly rising load that the system needs to carry, efficiency will deteriorate rapidly without major investments in network expansion and renovation, improvements in grid configurations, transformer replacements and other substation overhauls, and further addition of capacitance where required.

7.7 Currently, power (and especially) distribution bureaus and companies are allowed to pass all power loss costs to consumers. Future price regulation should promote incentives for operational efficiency and avoid to exclusively relate the company's prices to its own cost of service. Consumers prices should be indexed on operational efficiency (productivity improvement) or based on best performing systems (yard stick regulation).

7.8 Increasing the Efficiency of Electricity End-use. Achievement of much of the potential for improving the efficiency of electricity use is tied to the overall process of industrial modernization. In many subsectors, the greatest gains can be achieved through improvements in process technology or better capture of scale economies, where major improvements in productivity translate into declines in the intensity of use of a variety of inputs, including electricity. In addition, advances can be made through the production and adoption of more efficient electric equipment that meet minimum technical standards, equipment labelling, better information of electricity users, and more importantly economic pricing.

7.9 China has over ten years of experience in the active promotion of electricity conservation, with a solid record of achievement. The strength of its program lies in the well developed institutional framework that has been gradually built up. Electricity conservation is handled by the network of "Three Electricity Offices," with offices at central, provincial, prefectural and county levels throughout the country. These offices are under the leadership of local Economic Commissions, and coordinate their work with provincial power companies. They monitor electricity intensity and use patterns in all

major enterprises, promote adoption of conservation technologies and electricity management improvements, and assist, at times, in organizing funding for efficiency improvements. However, the three electricity offices need to adapt their action to the emerging market conditions and growing nonstate sector. Future actions should rely more on economic pricing and user information and education rather than power allocations and administrative or coercive measures.

7.10 Although price reforms have brought average consumer electricity prices to levels approaching LPMC in most major load centers and introduced incentives for optimal use of installed capacity especially through time-of-the-day tariffs, certain consumers still receive preferential prices which undermine conservation efforts (paras. 5.29 and 5.32). Problems include low, in-plan prices still provided in many areas to older (and often inefficient) state-owned enterprises, and specific subsidies for certain chemical producers, most notably producers of nitrogen fertilizers. During the transitional period to an adequate pricing system for electrical equipment, the government should consider adoption of minimum energy efficiency standards, applied only to a few types of key equipment, to encourage technological renovation. These should be applied much more rigorously than other types of standards common in China today. Electric motors and air conditioners would be good candidates for application of well-designed electricity efficiency standards because they account for more than three quarters of electricity consumption in the country.

Improving the Efficiency of Coal Use in Power Plants

7.11 Thermal power production currently accounts for only about one quarter of China's coal consumption, but this share is expected to gradually increase. In 1992, the average net heat rate for plants over 6 MW was 420 grams of coal equivalent (gCE) per kWh. Excluding station uses of power, this is equivalent to a gross conversion rate of 31.6 percent, only a modest improvement over the average rate in 1980, which was 29.7 percent. Further, more substantial, improvements can be made, which would not only alleviate pressure on the coal production and transportation system, but also have a major impact on particulate, and sulfur dioxide and carbon dioxide emissions. Although some gains can be made through renovation of existing plants, particularly to economize on power use for fans, pumps, or pulverizing equipment, the issue of overriding importance is the better achievement of scale economies through expanded development of large generating units.

7.12 As Table 7.1 shows, only about 15 percent of China's thermal power capacity is in unit sizes of 250 MW or more, while 32 percent is 50 MW or less. The differences in coal consumption rates between these categories is large. In Jiangsu Province, net heat rates for units of 50 MW or less average about 500 gCE/kWh, compared to about 310 gCE/kWh in a state-of-the-art, imported 600-MW unit.

7.13 National policy emphasizes the addition of 300 MW and 600 MW units in the system, and construction of even larger units is being studied. These plants are both most efficient and most economic. However, new projects have lagged behind demand,

Table 7.1: COAL CONSUMPTION AND ECONOMIES OF SCALE IN THERMAL POWER PRODUCTION IN CHINA IN 1990

Plant size	Share of total thermal power capacity, 1990	Net heat rate (gCE/kwh)	
		Design	Actual Average, 1990
6-50 MW, low pressure	22.6	n.a.	n.a.
6-50 MW, High pressure	9.8	n.a.	n.a.
Cogeneration systems	9.1	n.a.	n.a.
100-120 MW'	11.5	388-390	418
125 MW	8.6	355-358	392
200-210 MW	23.0	345-360	394
250-350 MW	14.2	338-344	362
500-600 MW	1.2	320	358
Total	100.0		420

Source: MOEP and SPC.

largely due to difficulties in mobilizing the necessary large investment resources. A disturbing consequence is that some local governments, pressed by acute shortages of electricity, are continuing to invest in large numbers of new small coal-fired plants, in unit sizes of 50 MW or less. In Jiangsu Province, for example, 35 percent of the incremental thermal power produced during 1985-92 came from such small plants. Compared with a state-of-the-art, 600-MW plant, these plants consume over 60 percent more coal per unit of electricity produced. This also results in at least 60 percent higher sulfur dioxide emissions (depending upon the coal used), and roughly 60 percent greater emissions of carbon dioxide. Particulate emissions from the small plants are proportionally even higher, due to use of inefficient particulate control technology. If a sufficient pipeline of large scale projects cannot be brought on stream in a timely fashion through enhanced regional cooperation to promote minemouth power plant where economically justified and enforcement of environmental standard on small polluting power plants, there is little doubt that this problem will worsen.

Reducing Air Pollution from Thermal Power Plants

7.14 Aside from improvements in the efficiency of coal use, additional measures clearly are required to mitigate the environmental impacts of thermal power production. However, given the multiplicity of impacts and the fact that the power sector, accounting for only a quarter of coal use, is only one among many pollution sources, the following need to be considered to determine appropriate investments:

- (a) Pollution mitigation measures should be formulated with the objective of reducing or eliminating reasonably well-identified priority environmental impacts and their associated sources. Geographic definition of impacts (e.g., local, regional or global) also provides clarity as to who is harmed by pollution and who benefits from pollution abatement.
- (b) The contribution of specific thermal power generation facilities to the specific priority environmental impacts should then be defined as clearly as possible.
- (c) Investments or changes in operations to achieve the least-cost alternatives among available mitigation options should be promoted through a market-based approach and profit-based incentives. China has already the legal structure and tax instruments to introduce such innovative approaches (see Box 7.1).

7.15 **Changes in Fuel Mix.** Coal currently accounts for over 90 percent of thermal power production in China, and its share is unlikely to decline in the foreseeable future. Due primarily to the distance of much of China's remaining hydropower resources from load centers, the share of hydroelectric power in total power generation is not expected to increase significantly. The role of nuclear power may increase modestly, but while this poses advantages in terms of acid rain and global warming, it poses other environmental disadvantages. The principle alternative fuels for thermal power production—natural gas and petroleum—are not likely to play a significant role over the medium term. Additional, domestic or imported supplies of these fuels will continue to be consumed primarily in other sectors, for both economic and environmental reasons. Unlike any of the developed countries, three quarters of China's coal consumption is used outside of the power sector, mostly for direct combustion in industrial boilers and kilns; in stoves and boilers in households, shops and offices; in rail locomotives and ships, etc. Coal use in these sectors is inefficient. From both technical and institutional perspectives, emissions control is more problematic among these predominantly small-scale consumers than in large-scale power production. As in more developed countries which once relied heavily on coal throughout their economies, China's power sector is likely to be among the last targets for substituting cleaner fuels for coal.

7.16 **Particulate Emissions.** Particulate emissions from coal combustion is one of the most serious airborne pollutants in China in terms of impacts on local health. High particulate concentrations cause or contribute to chronic asthma and other respiratory

Box 7.1: APPLYING MARKET-BASED INCENTIVE INSTRUMENTS FOR ENVIRONMENTAL PROTECTION

Market-based pollution control strategies have emerged due to the realization that traditional command-and-control regulatory approaches are inefficient for most pollution abatement, and difficult to enforce in practice. For example, in the power sector with an extremely wide variance in the size, sophistication and vintage of thermal units, the cost of installing and operating mandated pollution control equipment can vary widely both as a percentage of total investment and O&M costs. Through a market-based approach to achieve the most efficient (least cost) reduction in pollution, plants with the lowest abatement costs should reduce their level of pollution with due compensation from plants with the highest abatement cost. In theory there are two ways this efficiency can be achieved:

1. A sophisticated system of tradable allowances may be used where each plant is given an initial baseline emission limit, a portion of which can be sold to other plants if the cost of reducing emission below the baseline limit is less than the market price of the allowance—i.e., the allowance seller installs the control equipment and sells his unused baseline allowance to another plant whose cost of reduction exceeds the market price of the allowance.
2. A system of input or output taxes may be used—wherein the tax is set to a level that equals the external cost of each unit of pollutant. Plants that can reduce each pollutant unit at a cost less than the tax will do so and others whose costs exceed the tax will choose to pay the tax.

The first option requires a sophisticated trading or market-making system, as well as environmental impact analysis that can define the geographical demarcations of a trading block and the baseline allocations of allowable emissions. It is generally accepted that these systems are applied best in countries that have a good historical database of average plant emissions and ambient pollutant levels. A trading system that can reduce transactions cost to an acceptable level is also a prerequisite.

The second option has greater scope for introduction over the medium term in China. There are three factors that favor this approach: (a) the framework of tax and environmental legislation is already in place; (b) the proposed policy instruments do not induce distortions; and (c) the scheme will increase fiscal revenues, or at least be revenue-neutral.

To achieve a workable system the following considerations and actions are required:

- **Determine the Damage or External Cost of Each Unit of Pollutant.** This is usually proportional to concentration and may not be directly proportional to each unit of emission. As estimating the full external costs accurately may be difficult owing to the scope of influence (local versus regional); temporal impacts that depend on pollutant accumulation, etc.; it is easier and often a good first step to set the charges based on ambient standards. This can be accomplished in two stages. First, technical experts describe the consequences of different levels of ambient quality, for example, human health at different levels of ambient sulphur dioxide. Then, a target level of ambient quality is chosen and a charge for emissions is set at the level necessary to achieve the target. This is done by estimating the relationship between different charge levels and the emissions from different sources based on the average marginal costs of these sources.
- **Define the Tax Base.** The task here is essentially one of determining whether the input (e.g. coal) or an output (i.e., SO₂, SPM) should be taxed. This choice has important implications for effective administration and enforcement. An input tax base is similar to a standard sales or excise tax—consequently, easier to administer. Defining a base for environmental taxes on outputs (i.e., emissions) raises various measurement and monitoring issues. The major distinction is that effluents have no intrinsic value that is being taxed. These substances leave no trace of recorded monetary transactions and provide no incentive for storage. Further physical constraints eliminate the storage option. Consequently, measurement needs to be conducted on a flow basis. More importantly, there is only a single time and event (taxable transaction) that can be used for determining the tax. In this case, it is the moment the effluent or air polluting emission is discharged.
- **Selection of Competent Authority.** The most critical determinant of an effective tax is that a competent authority legislate, implement, monitor and enforce the tax. Although these functions may be conducted by more than one agency, it is necessary that the final authority be vested in a single entity. The competent authority is required to ensure the following: (a) it should facilitate a fair dispute resolution procedure. This is important to ensure public acceptance of the tax, and (b) it should allow for uniform base definitions and rates of taxation across the geographical boundary in question. Distortions in trade and competition are thereby avoided. It is not possible to define an ideal competent authority framework because circumstances vary based on national constitution, size of nation, existing structure of administrative law, etc.

In summary, China can possibly lead and begin a transition from a standards based or regulatory approach to environmental protection to one that is market (and specially tax) based. The power sector with its large installed base and known production characteristics would be a useful sector to experiment with a market-based approach. However, care must be taken to see that the power sector is treated neutrally with other polluting activities. Otherwise, the objectives of environmental protection may not be fully realized in a framework that distorts sectoral production decisions and cost functions.

problems. Health damage from fine and ultrafine particulates is particularly severe. Ambient concentrations of total suspended particles (TSP) are generally highest in northern Chinese cities. The chief sources of the problem are low-level emissions from coal smoke from cooking and heating stoves, and industrial or heating boilers. Although the contribution of thermal power production to street-level pollution is certainly substantially lower than its 25 percent share in coal consumption, power production does contribute to the problem, especially production in small-size plants, located in or near urban centers.

7.17 **Electrostatic precipitators (ESPs)**, with dust collection efficiencies of 98 percent or more, are now installed on new large power plants (e.g., 100 MW and above), and this, together with higher stack heights, greatly reduces the contribution of the larger plants to ambient TSP levels. However, older and smaller plants continue to be a problem in many cities. Stack heights often remain low, and control technology typically is limited to cyclones or water screens. The ultimate solution lies in the phasing of these plants out of production, but phasing out will only be achieved gradually. Speedier conversion could be achieved through easier entry for independent power producers and stricter enforcement of environmental standards on the small and more polluting power plants. Over the shorter term, some improvement can be achieved through increases in stack height and installation of ESPs or well-designed fabric filters to meet the country TSP standards. Improved fabric filters need to be developed and produced in China, largely through technology transfer from abroad, for both power generation and industrial boilers.

7.18 **Sulfur Dioxide Emissions.** Sulfur dioxide emissions from all sources in China vary from 15 to 16 tons per year according to official sources and could be as high as 20 million tons per year, an amount similar to that in the US according to some experts. The power sector currently emits about 5 million tons of sulfur dioxide per year, or 25 percent of the total.

7.19 China is blessed with ample reserves of low-sulfur coal, but distribution of low-sulfur reserves is uneven. The average sulfur content of coal produced in China in 1990 was 1.2 percent. About two thirds of total coal production has a sulfur content of 1 percent or lower. The share of low sulfur coals in total consumption will definitely increase in the future, as China's program to expand coal production concentrates on exploitation of the vast reserves of North China (e.g., Shanxi, Inner Mongolia and Shaanxi), in mining centers where sulfur contents are well under 1 percent. In certain other parts of the country, however, sulfur contents are high, reaching averages of 3-4 percent in large parts of the southwestern provinces of Sichuan and Guizhou. Due to this geographic variation of coal quality, and regional variations in climatic conditions, problems relating to sulfur dioxide emissions in China vary substantially.

7.20 At the local level, high ambient air concentrations of sulfur dioxide adversely affect public health (especially respiratory problems among the young, aged and infirm), certain crop species and natural vegetation. They also cause premature corrosion damage to most exposed surfaces, including buildings, bridges, equipment, etc. In China, ambient concentrations are highest in southwestern cities, such as Chongqing or Guiyang,

where average annual ambient sulfur dioxide levels reach 300-500 micrograms/cubic meter, or some five times the level of most cities in eastern China. (WHO considers 60-80 micrograms per cubic meter to be the limit for adequate protection of human health.) Concentration in some northern cities also are relatively high (e.g., Taiyuan or Shenyang), especially during winter, in large part due to very high street-level emissions of coal smoke.

7.21 The principal contribution of the power sector to local sulfur dioxide problems is emissions from old or small plants with short stacks in downtown areas, areas with limited atmospheric dispersion capability, and/or areas where prevailing wind patterns consistently expose a sensitive sector of the human or biological environment (e.g., hospitals, schools, or protected ecological areas "downwind of the plume"). These problems are particularly severe in areas which rely on high-sulfur coals.

7.22 At the regional level, sulfur dioxide emissions in China clearly contribute to major acid rain problems in southwestern China, and may also contribute to problems in other countries in the region. Potential acid rain problems stemming from massive coal use in northern China are tempered by high dust concentrations in the air, which reduces acid rain formation. In Chongqing, Sichuan Province, average rain pH levels are about 4.3, and rains with pH levels below 3.0 have been recorded.

7.23 The power sector undoubtedly is a significant contributor to acid rain formation, especially where high stacks are involved. Determination of which power plants are sources of the most ecologically damaging acid rain problems, however, requires further study both to track sources of acid rain formation and to analyze where acid rain occurrences coincide with low ecological buffering capacity, producing the most serious impacts.

7.24 Definition of appropriate sulfur dioxide control measures for the power industry requires clarity as to which problems are high priority. To reduce current or potential human health damage from high ambient sulfur dioxide concentrations, regulatory measures or market-based incentives could be promoted to incite power producers to minimize sulfur dioxide emissions, through a combination of proper location, use of high stacks, and attention to coal quality. Regulations now require that these measures be adopted for new, large or medium-scale thermal power plants. At this point, problems focus primarily on the older and/or smaller plants. For existing plants, the principal mitigation measures include closure or relocation, construction of taller stacks, and ensuring supply of low-sulfur coal. In certain areas where high-sulfur coal dominates supply, additional, more costly, measures may also be required.

7.25 In connection with major investments specifically to reduce acid rain, there is a need to assess the relative priority of investments in this area, compared to investments to mitigate other China's many pressing environmental problems. This should include identification of which acid rain problems arising from Chinese emissions have the most severe environmental/ecological impacts, where these problems are, and who bears the cost. For determination of appropriate investments in the power industry, it is then

necessary to determine which thermal power plant locations are most responsible for the most severe acid rain impacts, and to define the most cost-effective measures to reduce the relevant sulfur dioxide emissions.^{3/} If the considered acid rain problems are beyond China's borders, China could seek the cooperation of the countries involved in mitigation strategies and investment.

7.26 For China, the principal measures to mitigate the potential role of power plants in acid rain formation include (a) adjustments in coal quality, (b) alternative combustion techniques, including use of fluidized bed technologies or limestone injection into burners, and (c) flue-gas quality control, including use of wet or dry flue gas desulfurization (FGD) systems, or possible limestone injection into flue ducts. Due to its high additional cost, FGD systems currently are installed in only a few units in southwestern China.

7.27 **Emissions of Nitrogen Oxides.** Of the various nitrogen oxides, nitrogen oxide (NO) is the leading type emitted from fuel combustion. In the atmosphere, it gradually reacts to form NO₂. In the presence of sunlight, nitrogen oxides can act as a precursor to the formation of photochemical oxidants (commonly known as smog) from unburned hydrocarbons (present in automobile exhaust) released into the atmosphere. Smog can seriously aggravate asthma or other respiratory diseases. In addition, emitted nitrogen oxides also absorb water and form acid rain.

7.28 China is now introducing NO_x emissions standards for new power plant approved after August 1996. For new plants, relatively inexpensive mitigation options include limitation of excess air firing, low-NO_x burners, staged combustion, and gas recirculation.

7.29 **Greenhouse Gas Emissions.** Over the short and medium term, China's efforts to mitigate growth in greenhouse gases (GHG), such as carbon dioxide, should focus on the vast potential for energy-efficiency improvements and other measures which yield both major reductions in GHG emissions and sound economic returns. In the power sector, key areas for focus include improvements in the efficiency of electricity delivery and use, and reductions in coal consumption rates per unit of electricity production. Investment in the research, development and pilot demonstration of alternative, nonfossil fuel power generation technologies, including wind, solar and nuclear power, is worthwhile, especially from the long term perspective. Large-scale deployment of technologies which are not economically attractive in order to reduce GHG emissions, however, is not recommended at this stage.^{4/}

^{3/} Current studies relating to these topics being undertaken with Bank support are discussed in Annex 2, paras. 2.2 and 2.3.

^{4/} An in-depth strategy for control of greenhouse gas emissions in China will be presented in the final report for the major GEF-sponsored, UNDP/World Bank/Chinese Government study, *China: Issues and Options for Greenhouse Gas Emissions Control* (forthcoming in 1994).

Hydropower Plants and Resettlement

7.30 **Resettlement.** As expressed in two recent Bank reviews of resettlement in China,^{5/} China has demonstrated a high degree of commitment to successful resettlement. The Chinese approach emphasizes resettlement as a process requiring sustained attention, rather than as an event, such as payment of compensation. Institutional support and organizational capacity are relatively strong. Although the objective may be achieved gradually, improving or at least maintaining the standards of living of affected people is clearly accepted as a key objective of resettlement. China is the only country in the Region in which attempts are consistently made to provide land to affected persons. Pilot resettlement schemes have been particularly productive, where authorities and the affected population can see actual results and judge the appropriateness of resettlement program designs and implementation. "Where the standard of maintaining real income is followed, as it is for Bank-funded projects in China, resettlement experts with broad international experience consistently rate Chinese reservoir resettlement performance among the best in a difficult business."^{6/}

7.31 One issue which needs to be continuously addressed is a tendency to underestimate resettlement costs, especially the impact of price escalation. While problems of underfunding have been quickly remedied in the case of Bank projects, once the problems has been raised, solutions in other cases may not be as timely.

7.32 Another issue is a need for improved supervision and monitoring of local efforts. Local governments are the focal point of implementation of resettlement plans, and capabilities and dedication vary. The flow of timely information from the field also can be a constraint. Monitoring by project authorities or government ministries needs to be systematic and consistent. The involvement of international resettlement experts should be encouraged for all large hydro projects.

7.33 **Environmental Aspects.** Environmental issues common to most hydropower projects include possible health impacts from possible increases in certain diseases, changes in land use patterns, sedimentation, changes in water quality, impacts on fish and wildlife, and the downstream effects of changes in water flow. Government attention to these issues, and measures to address them as part of project selection and design, have increased over the last decade. Further improvements require reinforcement of the environmental assessment process (particularly for non-Bank projects), improved monitoring capabilities, and the further development of the capacity of Chinese institutions and staff in these areas, in part through greater international exchange.

^{5/} Asia Technical Department, "East Asia Region: Report on Resettlement for the Bank-wide Resettlement Review" (November 1993); China and Mongolia Department, "China: Involuntary Resettlement" (June 1993).

^{6/} cf., "China: Involuntary Resettlement."

Conclusions and Recommendations

7.34 Electricity Conservation. Efforts to further strengthen China's programs to improve the efficiency of electricity use must continue to be a cornerstone in the country's power sector development strategy for the 1990s. Electricity efficiency improvements serve the interests of both economic efficiency and environmental protection. In the broad sense of reducing electricity use per unit of economic output, the most important factors are (a) further changes in macroeconomic and industrial structure, attained through economic system reform; and (b) industrial modernization, including, in particular, proliferation of more efficient industrial process technology and better achievement of scale economies in energy-intensive industries. More direct electricity conservation efforts remain important, including promotion of selected technical renovation projects and improvements in electricity management in industrial enterprises. Greater emphasis should be placed on the production and adoption of more efficient electric equipment, particularly electric motors and associated equipment for industrial use.

7.35 The Government should further promote and gradually introduce market-based conservation incentives especially through economic pricing, improved information of energy users and a system of input or output environmental taxes as a first step for internalizing environmental costs. This important strategic shift should be completed in the short term by the following actions:

- (a) **Equipment Standards.** More rigorous electricity consumption standards should be developed and more effectively enforced for the production and sale of certain key types of electrical equipment, including motors, transformers and cooling equipment.
- (b) **Institutional Strengthening.** The current network of Three Electricity Offices provides a good framework for promotion of electricity conservation, but available resources and well-trained staff need to be increased.
- (c) **Incentives for System Loss Reduction.** The need for more direct incentives for reducing power system losses increases the urgency of recommended reforms to develop profit-center accounting and financial reporting for generation, transmission and distribution entities (paras. 2.13-2.14).

7.36 Pollution Control in Thermal Power Plants. Increases in plant scale are critical for improved efficiencies in thermal power generation and consequential reductions in pollutant emissions. Coal consumption rates, and particulate and sulfur dioxide emissions, in modern large plants are dramatically lower than in the units of 50 MW or less which comprise about one third of China's thermal power capacity. Although national policy emphasizes development of 300-MW and 600-MW units, investment by local governments in new small-scale plants continues, under the pressure of local power shortages. One means to resolve this problem is to improve the efficiency of capital

mobilization and investment approval procedures for large projects, including legal and contractual improvements to increase local participation and confidence in joint-investment projects. In addition, environmental protection regulations must be applied to new small plant projects in a much more stringent and forceful way. All new small-scale units must be required to meet comparable emissions criteria as new large plants, regardless of ownership. This could be achieved through stricter regulation, enforcement both in the issuance of construction and production permits, and in monitoring to ensure proper operating practices and, finally, by using tax instruments already in place to begin the transition to more market-based pollution control strategies.

7.37 In many urban centers, older, relatively backward, thermal power plants remain one of the key sources of air pollution. Accelerated retirement is one option to alleviate this problem, but this often proves difficult in practice due to current capacity shortages. Where continued operation is proven to be critical to local power supply, it is recommended that regulators allow, as a transitional measure, operators to recover pollution control (technical renovation and/or expensive but less polluting coal) costs, through plant-specific price surcharges added to the state catalogue power price.

7.38 For new, larger plants, one priority is to continue efforts to apply high efficiency ESPs on a larger scale. In areas where power station emissions result in ambient levels of sulfur dioxide which are a serious health concern, additional measures to control sulfur dioxide emissions on power plants must be adopted in order to reduce ambient levels within limits acceptable to human health. Particularly in areas where high-sulfur coals dominate, the Government should invite, through economic/fiscal and regulatory means, the power industry to incur substantial investment costs for improved control of SO₂ emissions. Concerning regional impacts of SO₂ emissions (e.g., acid rain), there is a need for a national-level review of China's response to growing concerns, followed by the development of a least-cost abatement strategy.

7.39 **Hydropower.** China's sound legal, administrative and institutional framework for reservoir resettlement can be further improved through standardization of the quality of resettlement planning and implementation, improvements in costing and budgeting, and a tightening of the monitoring of local implementation programs. For both resettlement and environmental protection in hydro projects, further domestic capacity building should be achieved through domestic and international interchange in environmental assessment methods and procedures, and additional training of Chinese staff. Environmental panels should be set up for all major projects, and training centers focusing on resettlement and environmental issues should be further developed.

ANNEXES

INSTITUTIONAL DEVELOPMENT FUND STUDY

1. In February 1993, the World Bank's Institutional Development Fund provided the Chinese Government with technical assistance grant funds to initiate a series of activities to evaluate reforms in the power sector. These activities were *process* driven and directed at expanding the dialogue on power sector reform in China. The tasks that were identified, and which have been largely completed are as follows:

- (a) Creation of a high-level "Steering Committee" to supervise and coordinate the entire effort. All agencies that had a substantial involvement in the Chinese reform process as a whole and the power sector in particular, were represented in the Committee: the Ministry of Finance; the State Planning Commission/Energy Research Institute of the State Planning Commission; System Reform Commission; State Energy Investment Corporation; Economic and Trade Office of the State Council, etc. The Steering Committee was established in February 1993.
- (b) Definition of the thematic areas for studying and understanding the implications of power sector reform. Four areas were delineated: (i) sector Structure and Organization; (ii) legal and Regulatory Framework; (iii) power Enterprise Reform; and (iv) financing for the Power Sector.
- (c) Constitution of four task forces of Chinese experts who were to focus on a single thematic area each. The composition of these task forces was to ensure that the various actors in the sectors were represented. Each task force included representatives from central government agencies and regional/provincial power companies.
- (d) Selection of international experts to work closely with the task force members and assist each task force in preparing a preliminary discussion report that outlined the principal issues and options for reform. This joint effort was carried out in April-May 1993.
- (e) Organization of a Workshop in China which would bring together senior power sector officials, executives and international experts to discuss the preliminary discussion papers. The Workshop was to facilitate a free exchange of ideas and views amongst Chinese participants and an international team that could share the lessons of power reform experience in their own countries. This Workshop was held in July 1993.

- (f) **Revision of the preliminary discussion notes prepared by the task forces based on the substantive issues, principles and directions for reform, that were raised and debated during the Workshop.**
- (g) **Organization of a study tour for the task force members to various countries whose experience was highlighted during the Workshop. The purpose was to allow task force members to evaluate, on a first-hand basis, lessons that could be relevant to China. Three teams visited UK and France in November 1993, USA in November 1993, and Australia and New Zealand in March 1994.**
- (h) **Preparation of a final report by the Chinese task force that would be widely circulated for discussion within China, and which would be a key document in charting the reform program in the country. The first of a five volume report, including a translation of the new Bank policy, was issued in March 1994.**

2. The most important existing outputs of the above exercise has been a clear articulation of the objectives of power sector reform in China and consensus on the direction for reform:

- (a) **Reform should be driven by provincial realities and strengths. Regions and provinces are diverse in terms of levels of development, sophistication of power systems, and degree of decentralization in decision-making.**
- (b) **Competition should be gradually introduced—where possible and specifically in generation to facilitate efficient decision-making and economic decentralization.**
- (c) **Commercialization and corporatization of power companies is necessary to attract the large volumes of required investment capital from domestic, as well as foreign sources. Legal instruments are in-place to achieve these objectives.**

3. The reform strategies are expected to focus on the following steps that required coordination at the provincial and national level:

- (a) **Commercialization of companies at the regional and provincial level. This will involve financial and organizational restructuring to make progress on the following fronts: (i) establish transparency in cost structures in order to rationalize tariff setting mechanisms that provide a reasonable return; (ii) establish standards of performance that can serve as a basis to clearly separate government functions from the productive activity of companies; and (iii) implementation of the new accounting standards.**

- (b) **Corporatization of the power companies.** Incorporation of commercialized power companies as joint-stock limited liability entities that will enable them to take advantage of reforms in the financial sector and national capital markets. These reforms should reflect reforms in Chinese company law as required. Once corporatized power companies could access domestic and foreign sources of finance by (i) floating equity; (ii) issuing bonds; and (iii) contracting commercial debt.

- (c) **Reorganization of the industry structure based on the provincial realities.** Tentative first steps could include (i) encouraging transparency in prices between the generation, transmission and distribution segments, either through contracts or publication of prices by competent provincial and national authorities; (ii) making power allocation procedures more transparent to allow for development of market mechanisms, where possible; (iii) encouraging the entry of independent (nonutility) producers to spur competition at the generation level; and (iv) promoting contractual arrangements to achieve greater operational efficiency and economic dispatch.

- (d) **Establishing a legal and institutional framework for the power sector that will result in defined service obligations and effective regulation.** The procedures and systems for decision making that need to be articulated include (i) establishing regulatory functions with the appropriate provincial and national competent authorities to control monopolistic enterprises (tariffs, quality and availability of service) and conserve coordinated planning, and operation of power sector; (ii) establishing norms for efficient bulk power transfer between provinces, through the development of systems and procedures for the pricing and operation of transmission services; and (iii) establishing guidelines for the entry of independent power producers.

PROPOSED BANK ASSISTANCE FOR IMPLEMENTATION OF POWER SECTOR REFORM IN CHINA

1. The profound change in the course of power sector development in China and the redefinition of the World Bank's role in this sector worldwide underline the need for adjustments in the present assistance strategy. This chapter discusses the Bank's past assistance in increasing power generation capacity in China and in increasing technical efficiency through technological and management improvements in construction and system operation. It then outlines a future assistance program which will provide support for power sector development through greater emphasis on sector reform and market-supportive institutions. This will favor the emergence of a sector environment and policy conducive to higher prospects for improved performance at the sector and project levels.

Past Bank Participation in the Power Sector

2. The Bank has supported the Government's effort to foster efficient, sustainable and environmentally sound development of the power sector through a strong lending program to reduce power shortages and introduce much needed, state-of-the-art technologies; a policy dialogue and technical assistance program to identify and implement sector policy changes synchronized with macro and industrial reforms to achieve economic pricing and greater power enterprise autonomy; and support to increase environmental awareness and mitigate the environmental impacts of power generation.

3. Since 1981, the Bank has helped to finance 13 power projects: 5 thermal power plants totalling 3,600 MW, 7 hydropower projects totalling 7,890 MW, and one transmission project. One of the hydro projects was the Bank's first pumped storage power project to improve load management. Total volume of the power lending in China amounted to about \$2.5 billion during the last decade.

4. Through these operations, the Bank has assisted power companies to improve project preparation through comprehensive planning, detailed feasibility studies, and environmental assessments, carried out by Chinese teams supported by foreign experts. Efficiency gains also have been achieved through the introduction of international competitive bidding (ICB) for procurement of major equipment and construction works. The Bank has promoted expanded utilization of efficient and advanced technologies by funding high efficiency and state-of-the-art 300- and 600-MW coal-fired generation units, the transfer of know-how related to design and construction of large hydropower projects, and the means to increase operational efficiency through improved technical and financial management.

5. During the 1980s, policy dialogue and technical assistance focused on improving system planning, especially at the generation level, and on price reform and improved cost recovery. Technical assistance was provided to strengthen the capabilities of the Beijing Economic Research Institute for Water Resources and Electric Power in least-cost generation planning techniques and in tariff studies (East China and Sichuan loans). The Institute is disseminating these techniques by providing a wide range of technical assistance and consulting services to provincial power companies. This effort has contributed to impressive progress in improving the planning and economic evaluation of power projects, and important reforms of the pricing system that have improved the tariff structure and resulted in average consumer price levels roughly on par with LRMC in most provinces, in 1993.

6. Additional, recent technical assistance efforts have included (a) a collaborative technical assistance activity, supported from the Bank's Institutional Development Fund (IDF), on Strategic Options in Power Sector Reform, which provided much of the basis for this report; (b) a review of innovative options for financing power projects (ongoing); and (c) a workshop on promotion of IPPs, sponsored by the UNDP/World Bank Aid Energy Sector Management Assistance Program (ESMAP).

A Strategy for Transition

7. Continued strong support to China's power sector is critical during this transitional phase. Building upon the strong relationships developed over the past decade, carefully targeted Bank financial support and advice on regulatory, institutional, pricing and financial issues can play a key role in assisting China to overcome electricity shortages which jeopardize economic growth and to complete the country's ambitious reforms in the power sector. The Bank can help reduce sector inefficiencies and speed the reform program, helping China to avoid the mistakes experienced in some countries during the transition from command and control to market-oriented economies.

8. Despite the piecemeal approach of the reform process, the progress achieved by the Chinese Government in transforming the power sector, breaking the state-owned monopoly (especially in generation), and involving private operators in sector development, are among the most successful experiences in the developing countries. Achievements include the completion of a first BOT scheme in 1987, and development of innovative schemes, including the floating of bonds in domestic and international markets, to finance expansion. Recent experience, discussed in previous chapters, clearly indicates the Government's commitment to deepen and hasten the sectoral reform in a direction consistent with the Bank's new policy for electric power sector. The dialogue at the national and provincial level is becoming increasingly robust and more focused on implementation issues. The collaborative process initiated by the IDF study has helped in reaching a common understanding of restructuring concepts, in the definition and assessment of the most promising reform options, and more importantly, in building consensus on priority implementation actions. The Bank can support the government's reform efforts and to assist the power companies in managing the difficult transition toward

autonomy and market orientation. Continued cooperation between the Bank and the Government will greatly improve the prospects for successful future power projects.

9. Future Bank involvement in the power sector will be focused on the following six major points.

- (a) Clarification of ownership and further progress toward corporatization of power enterprises. Key goals are to delineate the ownership and regulation functions of the government, and clearly separate them from enterprise management. Corporatization also will protect the autonomy and commercialized operation of power enterprises.
- (b) Promotion of competition at the generation level and contractual arrangements to promote market-type mechanisms in the sector, and proper regulation of the monopolistic segments of the industry.
- (c) Further rationalization of electricity pricing, focusing in the short term on progressive elimination of the dual quota system (unification), on equal treatment of power consumers and on gradual reduction of cross-subsidies especially in the dominant industrial sector.
- (d) Promotion of new sources of financing and further involvement of domestic and foreign equity investment in both wholly foreign-owned projects and joint ventures.
- (e) Improved investment planning and technical efficiency, taking further advantage of potential economies of scale and means to reduce losses in the power system.
- (f) Reduction of the environmental/ecological impacts of power sector through promotion of modern technologies, electricity conservation and support for the adoption of cost-effective techniques of the pollution control.

10. Achievement of these objectives will require establishing a stronger legal and regulatory framework for the power sector. The Bank will therefore continue assistance efforts on several fronts, but will especially strengthen the ongoing, more integrated dialogue on legal and regulatory reform issues with central authorities, and support the Government's efforts to introduce the Electricity Law and design and implement detailed regulatory procedures.

11. **Ownership and Corporatization.** Following continued dialogue between the Bank and Chinese authorities at the central and provincial level, the "Regulations on Transforming the Management Mechanisms of SOEs" has lately been extended to the enterprises/companies operating in the power sector. The promulgation in December 1993 of the "People's Republic of China Company Law" also has created the proper conditions for further progress toward corporatization. Future power operations will therefore focus

on the difficult process of the actual implementation of these regulation which provide concrete definition of the rights of power sector enterprises and management autonomy over major business decisions.

12. **Establishing clear ownership and management rights are essential for mobilizing domestic and foreign private investment, whether via portfolio or BOT-type investments. They also enable managers to have the clearest incentive to operate companies in the most economically efficient manner. Clearly defined rules also will help unleash the entrepreneurial potential of the sector's operators.**

13. **Specifically, through the lending program, the Bank will support:**

- (a) **Abrogation of the "one-entity/two-name plates" policy by encouraging the separation, at provincial and regional levels, of power bureaus (regulatory bodies) from power companies (business-oriented entities).**
- (b) **Revision, when needed, of the charters of the power companies to clearly specify power companies corporate objectives, authority, rights, responsibilities, legal powers, corporate structure and governance, including a Board of Directors.**
- (c) **Adequate implementation of international accounting standards to set up new accounting systems in line with the corporate objectives of the power companies. Selected future loans will include training programs and technical assistance components to define proper accounting procedures, assist in addressing complicated issues such as equity ownership and valuation of assets.**
- (d) **Design and formulation of budgeting and financial management systems to increase cost awareness among managers and ensure proper accountability.**

14. **In addition to the above objectives, the Bank will support the ongoing efforts of power utilities to spin-off noncore businesses, to carry out training programs to enhance the managerial and technical skill of the staff, and to develop personnel transfer programs to meet the manpower needs posed by dramatic growth with only very selective outside recruitment.**

15. **Promotion of Competition and Market-based Mechanisms. The Bank will support government efforts to reduce barriers to entry for new generators and gradually introduce real competition at the generation level. It will seek to introduce competition in generation and promote an industry structure where investors, whether domestic or foreign, can construct power plants, preferably through competitive bidding, and sell the output to provincial companies, according to the "Purchasing Agency Model" (the current U.S. model). Within this model, it will seek to promote competitive bidding for new capacity to enable purchasing agents to chose the most cost-effective sources of power and the development of proper contractual arrangements for power purchases and**

sales to achieve economic despatch and operational efficiency. This might require development of model agreements for use by power enterprises to replace the existing inadequate arrangements and reduce future transaction costs.

16. **Economic Pricing.** Improved allocative efficiency will be sought through further progress toward economic pricing and improved power purchasing contracts. The Bank will continue to provide action-oriented assistance and advice on the details of implementing price reform, through supervision of the six ongoing power price reform programs at provincial and regional levels associated with current lending operations. In addition, future Bank operations will put increased focus on (a) promotion of power purchase pricing and contractual arrangements which are more conducive to economic despatch and efficient operation of existing capacity; and (b) unification of the tariff at the consumer level, to reduce distortionary cross subsidies within and between different consumer categories, and, when and if necessary, further increases of consumer tariffs to ensure full cost recovery.

17. As part of the overall dialogue on power price reform, the Bank also will support technical assistance, as needed and requested, on the broader issues associated with the development, and implementation over the medium term, of adequate power pricing principles and methods which meet the needs of the evolving structure of the Chinese power industry. Two main areas require immediate attention: the producer pricing system and means to introduce competition at the generation level and the pricing of the transmission services.

18. **Promotion of Alternative Sources of Financing.** To keep pace with economic growth, power sector investments in China need to reach a level of \$15-20 billion per year during 1993-2000, compared to an average of \$10-12 billion during the last five years. Meeting this demand will require increased mobilization of private sector funds. The Bank will continue to support the government's efforts to improve the policy and institutional framework to facilitate mobilization of funds from domestic and foreign private sources and take advantage of the great appeal of China's fast growing power sector to outside investors. It will continue to participate in power sector development through its own resources and Expanded Cofinancing Operations (ECO) and explore innovative ways for mobilizing further financial resources and/or strengthening domestic financial markets based on international best practice.

19. **Investment and Technical Efficiency.** Past efforts in power system planning focused on strengthening the capabilities of the design and economic institutes at the central and regional levels. Following the partial decentralization of investment decision-making, provincial power companies are now more involved in the planning process than previously. Where needed, the Bank will continue to support technical assistance to strengthen the planning capabilities of the power companies, especially for transmission and distribution, by introducing state-of-the-art planning methodologies and computerized planning aids. Stronger support is also required to enhance the capabilities of power companies to efficiently manage the construction of large thermal and hydropower projects, and to reduce construction time.

20. Building upon the efforts made and progress achieved through past and ongoing power projects, the Bank will continue to support the Government's efforts to develop large size coal-fired units to meet new capacity needs and to gradually replace the inefficient and environmentally damaging small units. The Bank also will continue to support economically and environmentally sound hydropower projects to ensure a balanced and least-cost development of the sector. Support will include efforts to further improve local capabilities in equipment manufacture, efficient construction, and consulting services.

21. Future projects will put more emphasis on increasing the availability of power plants and reducing power losses through (a) introduction of Computer-aided Energy Management Systems in thermal power plants to ensure efficient operation; (b) design and implementation of maintenance procedures and introduction, where feasible, of advanced maintenance practices (predictive maintenance); and (c) increased focus on the efficient expansion of transmission and distribution systems and gradual replacement of high-loss transformers, to minimize power losses.

22. Environmental Protection and Energy Conservation. The overall sector assistance strategy discussed above, and especially support for further improvements in technical efficiency, are geared toward mitigation of the environmental impact of the power sector development in China. Additional Bank efforts over the medium term will include:

- (a) Further strengthening of local capacity for environmental assessments and resettlement programming. Supported with the provision of international expertise, where needed, efforts should include further institutional capacity building; efforts to improve standardization of the quality of resettlement planning, implementation and budgeting; and review of domestic manpower and skills requirements, methodologies/models used to carry out environmental assessments, and identification and implementation of training programs and updated methodologies to ensure high quality outputs.**
- (b) Establishment and implementation of reliable monitoring procedures to ensure the enforcement of environmental policies.**
- (c) Strengthening of the Bank/Government dialogue on sectorwide environmental issues, strategies and policies, especially concerning air pollution from thermal power plants. In cooperation with government agencies at both national and provincial levels, the Bank will expand technical assistance and strategic policy review efforts on the local and regional impacts of air pollution from thermal power plants, and mitigation measures to reduce these impacts. Efforts will focus in particular on areas utilizing high-sulfur coals, such as Southwest China. Review of acid rain issues will be coordinated with the ongoing RAINS-ASIA program, supported by the Bank in Asia as a whole.**

23. The Bank will continue to support the efforts of the Government to improve the efficiency of electricity use. Through GEF investment operations, selected technical

assistance, and the policy dialogue associated with lending operations, the Bank will seek to support (a) development and implementation of policies, regulatory instruments and market-based incentives to improve electricity end-use efficiency; (b) further strengthening of the capabilities of the network of Three Electricity Offices which promote electricity conservation; and (c) efforts to improve incentives for system loss reduction, especially in the distribution network.

The Future Bank Assistance Program

24. The Bank will continue a broad program of strong support in the electric power sector in China, including both lending and technical assistance. The central objective of the program will be to assist the Government in the implementation of the power sector reform agenda, focussing on six points as discussed in para. 8.9. Demonstrated progress of this agenda will be closely monitored and is important for continued strong Bank support; in the context of specific operations, the Bank will seek agreements to time-bound action plans and assurances on specific policy-related actions. However, because of uneven progress in different provinces on the various aspects of the reform, provincial action plans will be tailored to the specific conditions and needs of each province.

25. **The Lending Program.** Bank lending in the electric power sector during the next five to eight years will continue to be in the range of \$600-800 million per year. During a first phase of three to five years, the program will continue to emphasize direct support to regional and provincial power companies to assist them with the difficult transition to autonomous and business-oriented entities in a new competitive environment. In close cooperation with the Government, the Bank also will explore innovative ways for mobilizing financial resources and strengthening domestic financial markets based on international best practice. This may lead to a second phase in the lending program, with a gradual shift from project-related lending to wholesale lending through suitable financial intermediaries.

26. In the near term, continued strong involvement with the provincial power companies is critical, as successful reform at this level is an essential prerequisite for further progress in achieving a more market-oriented industry. The primary objective of direct lending operations during the first phase of the lending program will be to develop and execute detailed and practical reform implementation programs at the provincial level, while addressing needs to increase power supply, reduce shortages, improve efficiency, reduce losses, and strengthen environmental management. In support of reform implementation, special focus will be given to the separation of government from company management, increased power enterprise autonomy, improvement in enterprise management, and introduction of more efficient contractual arrangements in tune with the evolving market economy. For the best results, however, reform initiatives must be sharply focused and detailed, and the projects must not be burdened with too many objectives at once.

27. Direct lending operations will involve a gradual shift away from the more advanced coastal provinces toward the inland, less developed provinces. As the reforms proceed, the power industry in the most advanced provinces will be in the best position to increase reliance on their own resources, on private investors and on developing financial markets. To help address growing regional disparities and to support the extension of reform to less-advanced areas, however, direct Bank support and project-oriented lending must continue to play a role in the inland provinces.

28. The Bank also will initiate discussions with the Government on the transition from direct support through its own resources to leveraged mobilization of private funds through further use of Expanded Cofinancing Operations (ECO), assistance in developing one or two private power projects, and further exploration of wholesale lending operations. The Bank will also begin discussion on wholesale lending through financial intermediaries, beginning with efforts to stimulate private sector but the pace of progression in this activity cannot be predicted because it is closely related to the difficult process of setting up an adequate legal and regulatory framework.

29. **Project Supervision.** China's power sector portfolio is among the highest-ranked in the Bank. The increasing focus on sector reform means that project supervision work in general, and Bank staff supervision input in particular, will need to increase during the coming years, especially supervision relating to the implementation of reform programs and associated capacity building and technical assistance.

30. **Technical Assistance.** Technical assistance activities must continue to play a key role in the Bank's program to address specific sector reform issues and provide the needed training to improve planning operation and management skills. As at present, technical assistance should be provided through a wide range of mechanisms, both connected with lending operations or independent. Technical assistance activities should be carefully interwoven with the overall assistance program, and may be financed by the beneficiaries of power loans, through CRISPP, through the Bank's own resources (including IDF), through ESMAP, and through various bilateral or multilateral grant arrangements.

31. **Project-related technical assistance**, associated with lending operations, is expected to focus on (a) specific power pricing issues; (b) design and implementation of power company corporatization programs; (c) reform of financial reporting and accounting in power companies; (d) design of programs to improve environmental protection and resettlement schemes associated with power development, especially at the provincial level; (e) development of model power purchasing contracts, and improvement in the framework for IPP development and operation; (f) institutional capacity building for electricity conservation activities, including development of efficiency standards for electrical equipment; and (g) improved transmission and distribution planning, including power loss reduction studies.

32. **Priority areas for free-standing technical assistance** are presented in Table 1. Implementation is contingent upon securing funding. The recommended program

Table 1: TECHNICAL ASSISTANCE PROGRAM

Activity	Description	Possible funding
Power Sector Reform		
<ul style="list-style-type: none"> ● Legal and Regulatory Framework 	Ad hoc assistance to the Chinese Government in definition and allocation of regulatory responsibilities, the design of regulatory organization and mechanisms, and development of regulatory procedures.	IDF Bilateral
<ul style="list-style-type: none"> ● Development of Regional Power Markets/Pooling 	Assessment of the economic viability of coordinated operation of provincial systems, evaluation of different means and ways to take advantage of political economies of scale and scope, review of successful international experiences in operation of interconnected power systems and power pool operations.	ESMAP
<ul style="list-style-type: none"> ● Model Power Purchase Contracts 	Preparation of standard/model contracts to be used for independent projects and technical training on the various contractual arrangements likely to be required by the power sector.	ESMAP CRISPP
Pricing		
<ul style="list-style-type: none"> ● Future Directions for Power Price Reform 	Assistance to the Ministry of Power to critically review the current pricing policy, define long-term goals for power price reform and an implementation program to achieve them.	Bilateral
Corporation of Decentralized Power Companies		
<ul style="list-style-type: none"> ● Commercialization of Decentralized Power Companies (DPCs) 	Assist DPCs to enhance their operational efficiency and self financing capacity by initiating changes in organizational and management practices, helping them in modifying accounting and financial management practices, etc. (Phase 1: Diagnostic if funded and Phase 2: Proposed to potential donors)	ESMAP
Environmental Production		
<ul style="list-style-type: none"> ● Air Pollution Control in Thermal Power Plant 	Assistance will include: Completion of a country case study for the ASIA-RAINS acid rain analysis program, in cooperation with ASTEN, focussing on thermal power production in Southwest China.	Bilateral
Renewable Energy		
<ul style="list-style-type: none"> ● Renewable Energy Assessment 	Review of the status of new and renewable status of energy (NRSE) development in China, including the institutional framework for NRSE RSD and commercialization efforts. Development of a sound strategy for the development of China's renewable energy sector.	IENPD ASTAB

includes key topics related to legal and regulatory reforms, development of regional power pools, assistance in preparing model power purchasing contracts, further directions for electricity pricing reform, commercialization of small power companies, and air pollution control in thermal power plants. IDF support will be sought for urgent capacity building activities not amenable to financing from other sources.

AN INTERNATIONAL EXPERIENCE OF POWER SECTOR REFORM

1. **There are so many variations in the experience of different countries, and so many ways to describe an industry, that it is necessary to develop some conceptual basis for making comparisons. This section distills some of the international experience described at the conference under four headings:**

- **ownership and management,**
- **vertical integration of activities,**
- **fragmentation or concentration and cooperation, and**
- **degree of monopoly/competition.**

These dimensions are not the only things which distinguish one country from another: countries also have different laws and regulations, different fuels, different growth rates and so on. These four dimensions (which we later reduce to two), are those that are the most economically and commercially important.

Modes of Ownership and Management

2. **A primary distinction, especially for China, appears between modes of ownership. Owners are defined as those "who are entitled to the profits of the industry"; owners appoint managers to ensure that the enterprise is run efficiently, give them authority to do so, and hold them accountable for the results. The three most common forms of ownership/management are:**

- **Direct Government Ownership.** The government both owns and has direct managerial control over the industry, as in China at present (and as was formerly the case in many countries). The same people are owners and managers, although sometimes they have different "nameplates" in their different roles.
- **A Government-owned Corporation.** The government owns a corporation which manages the industry so that government is one step removed from day to day control. The Board sets the goals, and appoints different people, the management, to achieve those goals. This is the case with EDF in France, and used to be the case in the UK under the CEBG.

- **A Privately Owned Corporation.** A third form of ownership is private ownership of the corporation and its assets, as in the US and now the UK. These companies (joint-stock companies ^{1/}) are listed on the stock exchanges and are expected to make profits for their shareholders. The managers are accountable to the Board, which represents the shareholders.

3. However, the steps to be taken to separate ownership and management are: (a) **Commercialization** happens when the government relinquishes detailed control and the company is run as a business. This is happening in all industries in China, but it is a change in behavior rather than organization; (b) **Corporatization** is the formal and legal move from direct government control to a legal corporation with separate management. This may be a government-owned corporation; (c) The move from government corporation to a privately held corporation is called "privatization."

4. International experience suggests that incentives for efficiency are greater if management is separate from government, since government by its nature always has many objectives and may force the enterprise to meet so many objectives that it loses focus in its main task. If the government sets broad objectives for a separate corporation, and holds managers accountable, the efficiency of the enterprise increase. Incentives for efficiency are considered even greater if management is subject to the disciplines of stock market valuation of the company, when the enterprise is privatized.

5. Most countries with government-controlled power sectors are moving to corporatization and commercialization: examples are New Zealand, Australia, Korea, Jordan and Malaysia. There is also evidence that government ownership itself is not a bar to efficiency: (a) the recent UK experience of restructuring introduced competition along with privatization. The whole exercise had induced very large efficiency gains. However, Nuclear Electric, which remains a government-owned corporation, had also shown large efficiency gains, suggesting that **competition rather than private ownership was the determining factor in the UK**; (b) in France, EDF, a government-owned company manages to create incentives for efficiency. The management of EDF agrees written and specific goals with the government each year, in a process known as "le Contrat Plan" or the [Planning Contract]. The management then have to meet these goals.

6. Finally, it was noted that privatizing too early creates vested interests which may make subsequent moves difficult. In the US, where most of the power industry is private, reform is slower than the other countries; one regulator noted that "reforming a regulatory system was more difficult than reforming a power sector." This suggests that getting other aspects of the structure right may be more important than immediate private ownership, but that it is important to separate management from government.

^{1/} A joint-stock company (a limited liability company whose shares are quoted on a stock exchange) may be a completely private company, or the government may own enough shares to control the company. One way of gradually privatizing an enterprise is to form a joint-stock company with only a minority of shares held privately.

Vertical Integration of Activities

7. Another dimension in the choice of a structure for the sector is in terms of the activities of Generation, Transmission, Distribution, and retail sales, and whether these activities are managed separately or together: (a) if they are managed together they are called **vertically integrated**; (b) if the activities are managed separately, they are **vertically disintegrated or separated**. The relevant consideration is whether the costs of making contracts between the separated companies ^{2/} is greater than the benefits of greater accountability of a smaller scale enterprise.

8. Before enterprises are corporatized, a decision will have to be taken as to the scope of the activities of the enterprise, and whether existing enterprises should be separated or consolidated. In China, there is already some vertical separation between distribution enterprises and generation/transmission enterprises.

9. **Separation of distribution from generation and transmission.** The relevant consideration for separating distribution from generation/transmission is whether the costs are greater than the benefits. The costs are costs of metering, and of developing prices for the sale of power from generator to distribution company. The benefits are two-fold: greater accountability of a smaller scale enterprise, and the possibility of eventually permitting local distribution companies to choose their suppliers. There seems to be no intrinsic difficulty in making this separation, since it is found in so many countries. The systems in France and in the US are vertically integrated (generation, transmission and distribution are all managed by the same company); in Brazil they are partially integrated, while in the UK they are fully separated. In the UK, the distribution companies were separate before privatization. However, EDF in France has established decentralized management of distribution and retailing and decentralized distribution operations might almost be considered separate companies. China currently has a large number of some separated distribution systems and some vertically integrated systems.

10. **Separation of generation from transmission.** Separating generation from transmission is much more complicated, because of the technical need to coordinate operations between generators to ensure the stability of the transmission system. If transmission and generation are controlled by the same company, the coordination is established by command. But if the transmission and generation are owned by separate companies, more complicated arrangements have to be made to ensure that things continue to work efficiently. It is not easy to make the separation, because of the difficulties of making the contracts between the generators and the transmission company for access to the transmission system. The UK, and also New Zealand, Sweden, Norway and Finland, have separated transmission from generation. This has only been attempted within the last decade. Such separation is usually adopted in order to achieve fully competitive markets in the power sector, and to allow competing generators access to customers.

^{2/} The costs of making and enforcing contracts is known to economists as transactions costs.

11. The steps which need to be taken to separate distribution are metering and a pricing policy for wholesale power. The steps which need to be taken to separate transmission are contracts for access to the transmission system.

Concentration or Fragmentation, and Level of Coordination

12. The industry can also be described in terms of how many enterprises conduct the same activity within a geographic or administrative area. This is of course a relative concept, but where there are many small enterprises, relative to the size of the industry in an area, the industry is called **fragmented**. Where there are few enterprises the industry is called **concentrated**.

13. China will need to decide at what level the enterprises need to be corporatized: should it be at a single plant level, or at the provincial bureau level or something in between? The relevant consideration is **economies of scale and scope**: the enterprise should be large enough to exhaust the economies of scale. The more fragmented the industry, the more coordination is required for building transmission, for power transfers and optimal investment in generation.

14. International experience suggests that most existing industries obtained their present concentrated or fragmented form long ago, and many different examples can be found at the generation level. However most companies own more than a single plant: in most market economies, multi-plant firms are the norm in most industries.

- in the US the industry is fragmented into many relatively small companies, some of less than 1 GW, some of 20 GW,
- in France, one company with 100 GW serves the entire country.
- In the UK there are three large generating companies, of 10-25 GW, so it is fairly concentrated.
- Northern Ireland may be the extreme case, where each plant is separately owned.
- In Brazil, where there is fragmentation, the lack of transmission made much of the generating plant unable to operate at full output.

In distribution, sizes range from very small (a single town) to very large (the whole of France). There is no good evidence about the optimal scale of generation companies or of distribution companies, although the international evidence points to viability at a relatively small scale.

Competition and Monopoly

15. A fourth useful distinction, arising from the reforms of recent years, has been the extent of competition and monopoly in the industry. The generation sector has become more competitive; many countries have encouraged competing generation, including the US and the UK, but they have done it quite differently. (Transmission and distribution to small customers remain a monopoly in all countries).

16. Most countries start out with monopolies, sometimes one monopoly for the whole country, sometimes local monopolies. These enterprises are required to serve everyone, and in return they get exclusive rights. This has enabled development of transmission systems, it has permitted subsidies for rural or poor areas, and has enabled introduction of larger plants. But now, countries are wondering whether central control of generation has been inefficient, and are thinking about competition.

17. There are two basic ways to introduce competition into generation. The question is, to whom may a competitive/independent power producer (IPP) sell his output? Sometimes, as in the US, the IPP generator has only one choice, namely, to sell to the company which has the local monopoly over final customers. We call this a **Purchasing Agency Model**, because there is only one purchaser for each area, and all customers in that area have to buy from the Purchasing Agency. Sometimes, as in the UK, the IPP generator has the choice of selling direct to final customers, or to distribution companies, or into a short term or "spot" market. We call this the **full competition model**.

18. The difference between these alternatives is extremely important. First, they imply different commercial arrangements: (a) the Central Purchasing Agency model requires contracts for the sale of power from the IPP to the purchasing agency. It is often associated with **bidding systems** to choose the cheapest source of power; (b) the full competition model requires a **market mechanism** such as a spot market, and **open access to the transmission system**. These are difficult to put in place. IPPs then make their own contracts with customers.

19. Second, the two alternatives have different implications for central control over prices to final customers: (a) the Purchasing Agency, which retains a monopoly over customers, **allows prices to be set at regulated levels**; this can include the cost of subsidies, or past mistakes; (b) in the full competition model, **the price of power is determined by market forces**. In the UK case, market forces have increased efficiency in existing plant and also changed the choice of fuel from coal and nuclear to gas. The cost of generation has fallen. The US, which has been running on the Purchasing Agency model since 1978 when PURPA ^{3/} was passed; each local utility has become a purchasing agency, taking bids for new power plants and paying for the power under

^{3/} The Public Utilities Regulatory Policy Act of 1978.

contract. Now, the pressure for full competition has become intense, and utilities are worried about their ability to maintain prices high enough to cover their costs.

20. The fundamental concept here is the degree of monopoly. Monopoly means customers have no choice. If they have no choice the price can be set to whatever level the government, or the regulator chooses, and the profitability of enterprises can be more or less guaranteed. If not, prices will be determined by a market. The benefits are asserted to be increases in efficiency, through the effects of competition.

Structural Models

21. From this discussion, we can conceptualize four models of alternative levels of competition. These are only broad concepts, although they are labelled with the names of countries that most nearly approximate the concept. The boxes are drawn around the monopolies, which can determine their own prices.

- **Option 1: No competition at all** (Figure 1a). There are no competing generators in an area. Customers buy from a generator who has a monopoly over them. (The EDF model, the US prior to 1978, and many other countries)
- **Option 2.** A small variation on this (Figure 1b) is that the distributors are separate. But the distributor in turn has no choice over which generator to buy from. This is still a full monopoly model, but it might be considered a step toward full competition. (The UK, prior to 1990, and many other countries)
- **Option 3: The Purchasing Agency model** (Figure 1c). There is competition to generate, but all sales must be to a designated purchasing agency. The Purchasing Agency then sells to retailers or to its own customers who have no choice of supplier. (Most of the US, since 1978; Spain)
- **Option 4: Full Competition** (Figure 1d). Competition to generate, with customers or retailers having a choice of supplier. (UK, Norway)

Conclusions from International Experience

22. There are many dimensions to the choice of industry structure, and many different variations exist and work reasonably well. We have discussed four dimensions in the preceding text. At the workshop, the two most important dimensions seemed to be the question of ownership, and the question of competition. The workshop was shown a chart which integrated the four structural models (monopoly/competition) and the three ownership models. This chart, which proved extremely useful in promoting discussion, is reproduced as Figure 2.

Figure 1: GENERIC STRUCTURAL MODELS OF POWER SECTOR

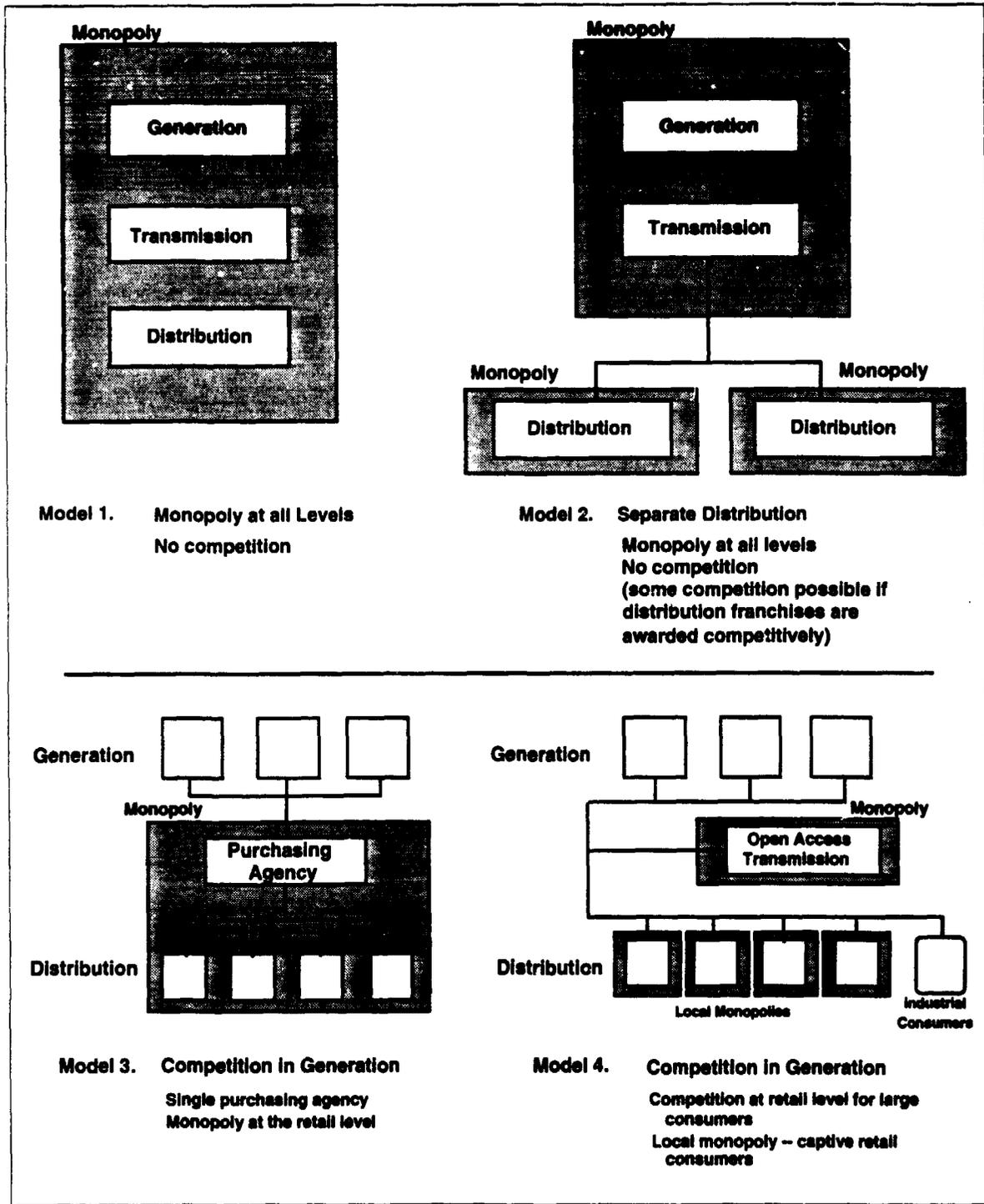


FIGURE 2: THE FEATURES OF TRANSITION

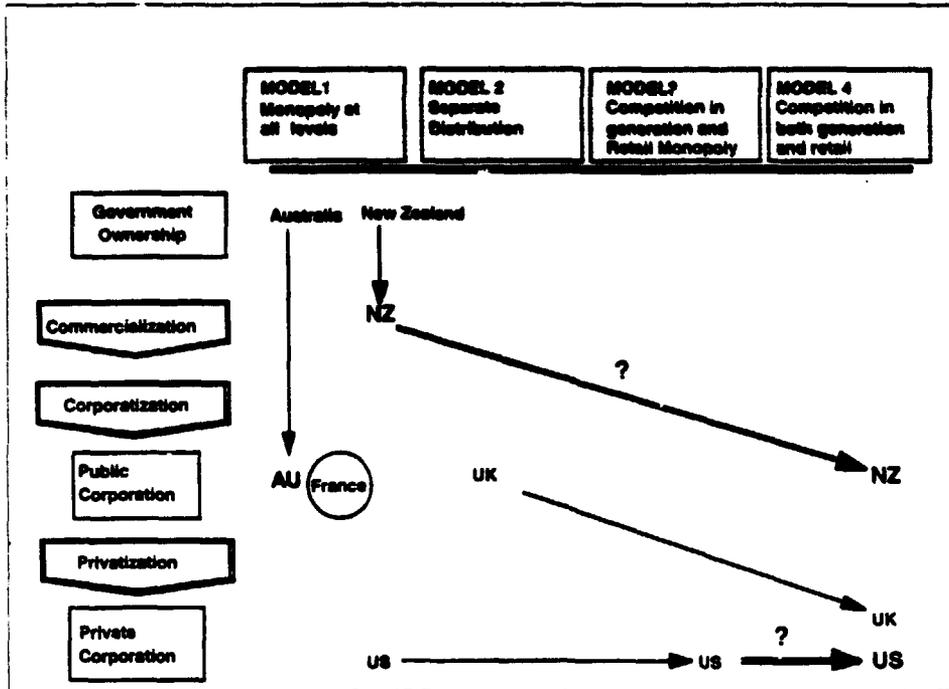
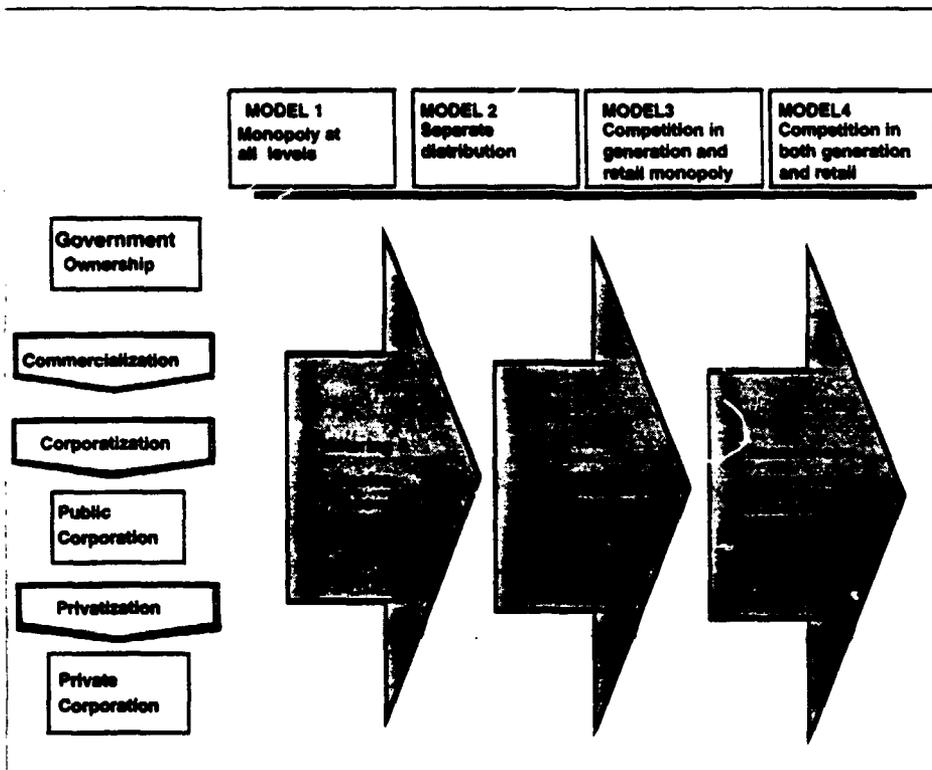


FIGURE 3: INTERNATIONAL EXPERIENCE



23. The vertical choices are government ownership and management; a government-owned corporation; and a private corporation. In moving from one to another, certain steps are required which are also shown on Figure 2. Corporatization and commercialization is the first move down the page, to a public corporation; privatization is the second move, to a private corporation. In the Chinese context, where government ownership and control, down to the most detailed level, are pervasive, the first task seems to be to move to commercialization and eventual corporatization.

24. The horizontal choices are the four models described in paragraph above. In the move from left to right across the page, more competition is introduced. The point was made that China needs to choose where to aim for on both dimensions, and also the path that it will follow to get there. The chart also shows where various countries are, and where they are moving to. The fact that so many countries are moving from one form of organization to another only emphasizes the extent of the changes in the power sector throughout the world.

25. The chart in Figure 1b can also be developed to show the transitional features necessary for the movements across the page. This is done in Figure 3. To move from Option 1 to Option 2, metering and transfer prices are necessary (transfer prices are the prices charged at wholesale by the generation company to the distribution company). To move from Option 1 or 2 to Option 3, (the Purchasing Agency) IPP contracts are necessary. To move to full competition, transmission access and markets are necessary.

HIGHLIGHTS OF THE DRAFT ELECTRICITY LAW

1. The Ministry of Electric Power (MOEP) has drafted a proposed new comprehensive electricity law for the power sector. As reported by MOEP, the purposes of the draft law are to (a) confirm the introduction of the socialist market economy into the power sector, (b) substitute regulation in a market economy for planning within a command and control economy, and (c) protect consumers.

2. The draft electricity legislation reflects many of the reforms recommended by the Chinese Task Forces following the Workshop on Strategic Options for Power Sector Reform, held in Beijing in July 1993. As drafted by MOEP, the new electricity law would be composed of the following nine parts.

PART I: Principles for Development of the Power Sector

PART II: Definition of Power Enterprises

PART III: Power Development and Construction

Part IV: Management of the Power System

PART V: Power Supply and Utilization

Part VI: Tariffs

PART VII: Rural Electrification

PART VIII: Enforcement

PART IX: Annex

3. The power enterprises (regional power group corporations and power companies) would be separated from the pricing bureaus at all levels of operation (e.g., complete separation of government administration from enterprise management). The "line" ministry, MOEP, would be responsible for supervising the power sector on behalf of the central government. The pricing bureaus would report to and be supervised by MOEP. MOEP would have the authority to supervise the regional power group corporations directly, in which case the regional power group administrations would be eliminated.

4. The draft law would define the functions, rights and obligations of the power enterprises. Management would have full autonomy to manage the power enterprises subject to regulatory approval, including the ability to plan investments, propose prices and raise finance (incur debt and issue bonds).

5. The draft legislation would establish an entirely new regime for tariffs:

- (a) The legislation would specify general principles that would serve as the basis for approving tariffs proposed by the power enterprises. The principles are that prices should permit recovery of (i) production cost, (ii) operation cost, (iii) a reasonable rate of return (profit) and (iv) taxes. The "new plant, new price" principle and multi-track pricing system would be abolished.
- (b) MOEP and State Pricing Bureau would establish general pricing policy based in the principles set forth in the law. The pricing policies would be applied by the power bureaus in evaluating tariffs proposed by the provincial power companies. However, those provincial power companies that belong to regional power groups would have to submit proposed tariffs to MOEP through the regional power group corporation. Independent entities located geographically within the group must also submit price proposals through the group.
- (c) Prices for new power plants would be established through negotiations. The negotiated price must be consistent with government established pricing policies. However, if there are no objections to the negotiated price, the price need not be reviewed and approved by the government. If there is objection, the price will be subject to arbitration by MOEP and the State Pricing Bureau.
- (d) Consumers tariffs will be proposed by the power enterprises based on government established pricing policies. All entities located within a power group must submit proposed tariffs to MOEP through the group. Provincial power companies that are not located within a group will submit proposed tariffs for all entities located within their territory to provincial power bureaus.
- (e) Local governments would not be able to impose add-ons and surcharges.

6. The draft legislation would install a new set of rules for sector planning and investment approval.

- (a) Power sector planning will be done by MOEP subject to review and approval by the State Planning Commission (SPC). MOEP plans will be developed based on plans developed by the provincial power bureaus.

- (b) **Once the plans are approved by SPC, the power enterprises will be responsible for plan implementation. It will be up to enterprise management to determine how best to satisfy the plan.**
- (c) **Individual power projects need not be approved by SPC if the projects are consistent with SPC approved plans.**
- (d) **The power enterprises would have some latitude to adjust their annual plans without prior government approval, although "amendments" would require approval of SPC. The difference between an "adjustment" and an "amendment," and the power enterprises ability to deviate from the state-approved power plan without prior governmental approval was not clear from the discussions with MOEP.**
- (e) **The legislation would not change the process for obtaining approval of projects.**

7. The draft legislation would require a franchise license to engage in distribution service. The franchise would be issued by the central or provincial, governments as appropriate. A license would not be required to engage in generation and transmission activities.

8. The draft legislation includes a specific endorsement of private investment in the power sector, and states that investors "ownership," as well as "economic interests," shall be protected. What that protection entails and how it is to be extended to the private sector was not explained and may not be addressed by the draft legislation.

9. Lastly, the draft legislation specifically addresses the relationship between power suppliers and consumers, with a reported emphasis on the protection of consumers' interests. Electricity would be considered as a commodity rather than a public service. The draft law would (a) progressively eliminate allocations, (b) guarantee quota and quality of power, (c) prohibit rejection of consumers' applications to use power, (d) provide customers compensation under certain circumstances, and (e) prohibit the "deduction" of "quota" from consumers.

10. The new law is intended to be accompanied by the State Council's issuance of five new regulations. These regulations will address (a) the management of electricity prices, (b) treatment and compensation for accidents, (c) utilization of foreign investment, (d) use of electricity in rural areas, (e) the management of joint investment power plants, and (f) issuance of distribution franchises.

CURRENT REGULATORY FRAMEWORK FOR THE CHINA POWER SECTOR

- 1. Government supervisory organizations currently control virtually all aspects of the power sector's operations. The regulatory framework for the power sector is confusing and often contradictory. The situation is the result of several factors, including the combination of supervisory government organizations with the power enterprises, the division of command and control responsibilities among multiple government organizations and the recent decentralization of certain regulatory functions to provincial and local governments. This later development further confused the situation by grafting additional layers of government supervision on an already complex regulatory framework.**
- 2. Under the current framework, the power bureau is the first and most immediate incidence of government control. The power bureau exists at the regional, provincial, prefecture and county levels. (At the regional level, the equivalent of the power bureau is the regional power group administration.) The power bureaus are combined with the power enterprises that operate at the same level. The power bureaus have mixed allegiances. In addition to being combined with the power enterprise, the power bureaus are administratively linked in a hierarchical fashion to the Ministry of Electric Power (MOEP). The power bureaus also report to the local government.**
- 3. For example, the Jiangxi provincial power bureau is combined with the Jiangxi provincial power company, reports to the East China regional power group administration (which is combined with the East China regional power group corporation), and is also considered to be part of the Zhejiang provincial government.**
- 4. The power bureaus serve several government regulatory functions. As part of a command and control economy, the power bureaus are responsible for preparing annual and five year production plans that are integrated into provincial and central government plans. The power bureaus are involved in determining allocations of both power production and consumption. Power bureaus also administer the contractual responsibility system, and appoint senior management for those power enterprises for which they have supervisory responsibility.**
- 5. In addition to the power bureaus, there are a multitude of central and provincial government organizations with supervisory responsibilities regarding the power sector, including the State Council, the Ministry of Electric Power, the State Planning Commission (SPC), the Ministry of Finance, the State Pricing Commission, Ministry of Foreign Trade and Economic Cooperation, the State Economic and Trade Commission, the State Energy Investment Corporation, the Ministry of Labor as well as parallel provincial**

organizations. In addition, central, provincial and local governments can impose legal obligations and surcharges on the power sector.

6. The complexity of the regulatory framework is best understood by focusing on the elements of government control.

Planning

7. Annual and five year plans are developed for the power sector and are approved by SPC. The process for submitting plans to SPC is not entirely clear. It appears that there is a dual track. Plans for the power sector appear to be submitted to SPC by both provincial governments and MOEP. The provincial submission will be part of a economic plan developed by the Provincial Planning and Economic Department using information provided by the provincial power bureau. MOEP will submit its own plan using information provided by the provincial power bureaus.

8. Power bureaus within a regional power group will submit their plans to the regional power group administrations. The regional power group administrations will then aggregate plans received from their member provincial and municipal power companies for submission to MOEP.

9. There is some confusion as to the role of provincial governments and MOEP in the planning process. Some, but not all, of the provincial power companies submit their plans to the provincial government before providing the plan to the regional power group administrations for submission to MOEP and SPC. In turn, at least one regional power group administration submits its plans directly to SPC without first having submitted its plan to MOEP.

Investments

10. With perhaps one exception, all power sector investments must be approved by SPC. The one exception appears to be for investments involving less than Y 200 million. Such investments can be approved by provincial and municipal governments—although the Zhejiang provincial power company reported that even these "small" projects have to be approved by SPC as part of an annual or five year plan.

11. Projects involving provincial power companies or using state funds must be submitted for SPC approval through MOEP. If a provincial company is part of a regional power group, the proposal must be submitted to MOEP through the regional power group administration.^{1/} If provincial government money is involved, as may be the case with joint-investment companies, the provincial planning commission will review the proposal and submit its comments directly to SPC.

^{1/} There may be an exception to this requirement. The Shanghai municipal power company/bureau reported that projects smaller than 300 MW could skip the regional group administration and be submitted directly to MOEP.

12. The role of MOEP in obtaining SPC approval for projects solely involving private investment and local funds is not clear. The Jiangsu Provincial Economic and Planning Commission and East China regional power group corporation/administration both reported that projects which do not utilize state funds could be submitted with the provincial planning commissions directly to SPC. In contrast, the Zhejiang provincial power company stated that SPC approval for joint-investment projects using provincial and local funds required submission through the regional power group administration and MOEP. MOEP agreed that projects involving private investment must be submitted to SPC through MOEP.

13. The actual process for obtaining project approvals is complex. As explained by MOEP, all projects (except those involving solely private foreign investment) involve four discrete approval steps.

- (a) Step 1. A prefeasibility report must be reviewed and approved by MOEP.
- (b) Step 2. A detailed feasibility study will be prepared that sets forth the details of the project and evaluates the project's financial viability, fuel, and financing sources. The feasibility study will be reviewed by MOEP and submitted to SPC for approval. The study will include an environmental analysis that will be separately submitted to government environmental organizations. The views of the environmental organizations will be provided to SPC.
- (c) Step 3. A detailed "preliminary design" will be developed. The design will be submitted to MOEP for technical review and then submitted to SPC for approval.
- (d) Step 4. The detailed plan for "project setup" will be developed and submitted to MOEP for its approval.

14. For projects involving joint ventures or joint-investment companies, the venture can only be set up and the project agreements negotiated after these approvals have been obtained.

15. MOEP recently issued a directive that applies the 14 management rights to the power sector. The new directive reportedly makes a modest change to this approval process. SPC approval is no longer needed for the preliminary design. The preliminary design does not even require MOEP approval for projects that are smaller than 600 MW and transmission facilities smaller than 500 kV, provided no foreign investment is involved in the project.

16. Projects involving a mix of foreign and domestic investments are subject to two additional requirements. First, a Memorandum of Understanding must be provided to MOEP which sets forth the total investment, the ratio of domestic to foreign investment, the duration of the joint venture, the sources of finance and an analysis of the risks of

foreign currency. Second, the feasibility study (that must be approved by MOEP and SPC) must include (a) an estimate of the total investment; (b) a summary of the project's reliance on foreign currency; and (c) an analysis of the rate of return to foreign investors. Finally, the use of foreign investment (or foreign debt) must be approved by the Ministry of Foreign Trade and Economic Cooperation ("MOFTEC"). If the foreign investment is less than \$30 million, permission to use foreign finance can be obtained from the provincial branches of MOFTEC.

17. There appears to be a more "stream-lined" approval process for projects that involve solely foreign investors. In these cases, MOEP explained that only two approval steps are required. The feasibility study for the proposed project (including the environmental analysis) must be submitted to MOEP and government environmental authorities for ultimate review and approval by SPC. The feasibility study must include draft project agreements, including the powers sales, fuel, and operation and maintenance agreements. After the feasibility study is approved by SPC, the charter creating the company may be drafted and relevant agreements negotiated. The proposed charter and project-related agreements are then submitted to MOEP and MOFTEC for approval. Once approved, the company may be established.

Pricing

18. Responsibility for establishing electricity prices is shared between the central, provincial and local governments. The central government establishes prices for projects built using nonstate resources ("collected fund plants"). These prices and principles are proposed by MOEP, reviewed by the State Pricing Bureau and approved by the State Council. The central government is also responsible for approving prices for projects built in one province which sells power in another province.

19. The provincial pricing bureaus ostensibly apply the pricing principles established by the central government to determine prices for power sold within their respective provinces, including power plants built with provincial, local and private funds. The provincial pricing bureau is responsible for approving customer rates. However, local pricing bureaus will approve add-ons and surcharges at the prefecture and county power level to cover the additional costs of distribution—subject to the provincial pricing bureau's concurrence.

20. The effectiveness of the provincial pricing bureaus is questionable. The resources of the pricing bureaus dedicated to the power sector is limited. They apparently rely in large part on the expertise of the provincial power bureaus, which are combined with the provincial power companies.

21. MOEP's new directive on the 14 Rights will make it clear that the power enterprise's have the right to propose prices, but is not otherwise intended to change the approval process. However, MOEP characterized the approval process slightly differently than the provincial governments and the provincial power companies. According to

MOEP, prices for power plants that are 600 MW (and larger) must be submitted to the central government for approval.

Finance

22. Government responsibility for financial aspects of the power sector are divided among many government organizations. The provincial power companies' financial needs are submitted to MOEP. MOEP balances the needs of the entire sector and then submits its financial proposal for the power sector to SPC. The plan is then implemented through the central government's financial institutions, such as the State Energy Investment Corporation (SEIC) and the Peoples' Construction Bank.

23. Decentralization of the financing of power projects has complicated the administration of the sector's finance. MOFTEC controls the power sector's access to foreign equity and debt. Provincial power companies' issuance of bonds requires the approval of MOEP and the State Planning Commission.

24. The degree of provincial involvement in approving financing is unclear. The Shanghai municipal power company/bureau reported that it can only issue stock with approval of both the central and municipal governments. The Zhejiang provincial power company believes the provincial planning commission must approve the issuance of bonds.

25. MOEP's new directive on the 14 Rights may help to clarify the situation. Under the new directive, a regional power group corporation (on behalf of itself or one of its member power companies) or a provincial power company (when it does not belong to a regional power group) may seek approval to raise finance through bonds, loans or the issuance of stock.

26. The source for governmental approval will depend on the nature of the financing. Bonds will have to be approved by the Ministry of Finance and the Peoples Bank of China. Stock issuances will have to be approved by the Ministry of Finance and the Securities and Exchange Commission. Foreign loans and equity will have to be approved by MOFTEC and the People's Bank of China. According to MOEP, MOEP will not be involved in financial decisions (other than indirectly through their control of the various power group administrations and power bureaus).

Allocations

27. Power production and consumption are initially allocated by the central government and then subdivided at each administrative level. For example the regional power group administration receives its allocation from the central government, and then allocates both production and consumption among group members. The provincial and municipal bureaus then allocate production among power suppliers and consumption among the prefectures and counties—which in turn allocate different power sources among consumers.

28. As described by MOEP, its new directive on the 14 Rights will result in MOEP making allocations to the provincial level. This arrangement will certainly curb the regional power group administrations' role regarding allocations. It would appear to be difficult, however, to eliminate entirely the regional power group administrations' responsibilities regarding allocations of power production. For example, the East China regional power group administration now approves "power production plans" for the entire regional group network on a monthly basis.

Quality of Service

29. There does not appear to be any organization at any governmental level that is responsible for supervising or regulating quality of service. Under each province, prefecture and county, there are "offices for planned, safe and effective use of electricity" (referred to as "3 customer services"). These offices were initially established to provide customer service for the "planned, safe, and conservation use of power." Apparently, these offices do not monitor performance or quality of service.

Costs of service

30. There does not appear to be any supervisory government organization that monitors the efficiency of power sector operations—other than the power bureaus themselves. Symptomatic of this is the fact that no supervisory government organization reviews the power agreements being negotiated between the provincial power companies and the variety of new nonstate owned power producers (Huaneng, joint-investment companies, joint ventures and foreign investors).

NETWORK TARIFF FOR COLLECTED FUND POWER PLANT (1993)

Name of Unit	Volume of Power GWh	Tariff of network Y/MWh	Tariff for users Y/MWh
No. 5 & No. 6 of Taizhou Power Plant	16.56	189.09	255.14
No. 5 & No. 6 of Zhenhai Power Plant	24.20	189.82	256.01
No. 1 & No. 2 of Wenzhou Power Plant	12.50	274.57	357.74
No. 4 & No. 5 of Changxin Power Plant	13.75	237.02	312.67
No. 1 of Xiaoshan Power Plant	1.50	211.59	282.14
Shituang Hydropower Station	1.03	301.06	389.54
Qinshan Nuclear Power Plant	10.00	228.43	30
Beilungang Power plant	8.20	469.01	591.14
No. 1-4 unit of Taizhou Power Plant	14.22	177.58	241.31
100 MG Zhenhai Power Plant	6.05	189.90	256.11
Total/Average	<u>108.01</u>	<u>230.36</u>	<u>304.67</u>

**CONSOLIDATED ADD-ONS ON TOP OF CATALOG PRICE
IN HANGZHOU CITY (1994)
Fen/kWh**

	Consolidated add-ons	Local add-on
Consumers with old quota		
Consumption within quota	0.10	0.01
Above quota consumption	0.28	0.01
Consumers without quota		
Industry	0.20	0.01
Commercial	0.367	0.01
Residences	0.035	0.015
Agriculture & fertilizer	0.005	0.00
NGOs, military & Government	0.10	0.00
Others	0.25	0.01

SHAOXING PREFECTURE CONSOLIDATED ADD-ONS (1994)
Fen/kWh

Area	General business						Special tariffs
	In-plan			Out-of-plan			
	Ave.	Peak	Off-peak	Ave.	Peak	Off-peak	
City	0.24	-	-	0.385	0.417	0.118	(1) Government, Party, Social NGOs, military, and school lighting: 0.22; (2) Water utilities: 0.22;
Shaoxing County	-	-	-	0.40	0.55	0.10	(1) For those who are originally exempted from agriculture electricity maintenance fee (County, district government owned large enterprises): Ave. 0.38, Peak 0.51, low 0.10; (2) Irrigation: 0.10; other agricultural production: 0.39; (3) Water utilities: 0.21;
Ziji City	0.44	0.55	0.20	0.60	0.80	0.20	(1) Irrigation: 0.10; (2) Water utilities: 0.25 (3) Lighting for production and business 0.60; Government, military and school: 0.35 (4) Fertilizer, in-plan: 0.05, out-of-plan:0.60
Shangyu City	-	-	-	0.47	0.60	0.28	(1) Cement and Steel: Peak 0.68, low 0.17; Brick kiln Peak: 1.12, low 0.17; (2) Agriculture 0.02, Government office, military, school: 0.03; (3) For those who are originally charged agriculture electricity maintenance fee: 0.03 in addition;
Chen County	-	-	-	0.41	-	-	(1) Non-residence lighting(Including NGOs): 0.37; (2) Agriculture: 0.02; (3) Large consumer: Peak 0.72, low 0.05; cement: Peak 0.38; low 0; Paper factory: Peak 0.352, low-0.08; Steel: Peak 0.294, low -0.10; Carbon factory: 0.55, low 0.165;
Xing Chang County	-	-	-	0.36	0.50	0.08	(1) Agriculture: 0.02 (2) Paper, cement factory: Peak 0.44' low 0.08; steel: Peak 0.36, low -0.05