New Waves Of

Power Sector Reform In China

Workshop Report and Working Papers

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STATE DEVELOPMENT PLANNING COMMISSION
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FOREWORD

Over the past two decades, China's power sector has grown rapidly to become the second largest in the world. This tremendous growth is the result of far reaching reforms that have transformed the centrally and administratively run government department of the early 1980s into corporatized and business oriented power companies at the national, regional and provincial level.

Nevertheless, the sector faces both structural and operational problems which, if not resolved, will jeopardize the hard-won progress. Some examples of today's problems are: increasing power prices due to untapped efficiency and inter-provincial and inter-regional trade potential; discrimination between generators due to monopoly and monopoly powers; and unnecessary impacts on the environment due to the proliferation of small and highly polluting units.

The demands of the growing economy and the needs of Chinese citizens must be met at affordable prices. The Chinese government has therefore decided to accelerate and deepen its reforms with the objective of fostering competition and ensuring environmentally sustainable development of the sector.

The State Council has entrusted the State Development and Planning Commission (SDPC) to explore options to move forward with a new waves of reforms. As part of a wide consultation, SDPC organized a workshop on October 9-10, 2000 to discuss issues and problems facing the power sector and options to address them in light of both domestic and international experience.

This report presents: (a) a narrative summary of the presentations and discussions held during the workshop; (b) two annexes summarizing the results and lessons learned from power sector reform in U.K. and Australia; (c) three working papers summarizing the discussions of an expert meeting held on October 11, 2000 dealing with market size, transmission and new and old plants issues; and (d) a paper summarizing the preliminary results of the Restructuring and Economic Regulatory Assistance Project sponsored by the Energy Foundation.

To conclude, I would like to extend my thanks to: the World Bank and the Energy Foundation for their assistance and support in organizing the workshop; to all the international experts for their responsiveness and valuable advice; to the members of the Workshop Organization Committee in SDPC; and, last but not least, to all participants for their constructive comments and useful insights.

Li Yanmeng
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ABBREVIATIONS AND ACRONYMS

ACCC	Australian Competition and Consumer Commission
Btu	British Thermal Unit
CCGT	Combined Cycle Gas Turbine
CEGB	Central Electricity Generating Board (UK)
CfD	Contracts for Differences
COAG	Council of Australian Governments
CSEP	China Sustainable Energy Program
CTC	Competitive Transition Charge
DGES	Director-General of Electricity Supply (UK)
FERC	Federal Energy Regulatory Commission (US)
FGD	Flue-Gas Desulfurization
GW	Gigawatt
HHI	Herfindahl-Hirschman Index
IPP	Independent Power Producer
kWh	Kilowatt hour
MOF	Ministry of Finance
MWh	Megawatt Hour
NCC	National Competition Council (Australia)
NECA	National Electricity Code Administrator (Australia)
NEMMCO	National Electricity Market Management Company (Australia)
NETA	New Electricity Trading Arrangements (UK)
NGC	National Grid Company (UK)
NGMC	National Grid Management Council (Australia)
NPV	Net Present Value
NSW	New South Wales, Australia
OFFER	Office of Electricity Regulation (UK)
OFGEM	Office of Gas and Electricity Market (UK)
PNG	Papua New Guinea
PPA	Purchase Power Agreement
PPC	Provincial Power Company
REC	Regional Electricity Company
RMB	Renminbi (Chinese Currency)
RPI	Retail Price Index
SCADA	Supervisory Control and Data Acquisition
SCORES	State Council Office for Restructuring the Economic System
SDPC	State Development and Planning Commission
SEB	State Electricity Board (India)
SEPA	State Environmental Protection Administration
SETC	State Economic and Trade Commission
SPCC	State Power Corporation of China
WTO	World Trade Organization

SECTION 1. WORKSHOP ON THE NEW WAVES OF POWER SECTOR REFORM IN CHINA

WORKSHOP SUMMARY

A Workshop on the New Waves of Power Sector Reform in China was held in Beijing on October 9-10, 2000. The Workshop was sponsored by the State Development and Planning Commission (SDPC), with the assistance of the World Bank and the Energy Foundation. The workshop agenda and the list of participants follow this summary.

Workshop Background

China's power sector has evolved considerably since the early 1980s when it was run as a central department with administrative units at the provincial, prefecture, municipality, and county level. At that time, investment decisions were administratively determined, as were prices, which were insufficient to cover all the costs of supply.

Today, the power sector has been corporatized and decisions are taken on a commercial basis. The State Power Corporation of China (SPCC) was established in 1997 and holds, on a holding-company basis, the state's ownership rights in the provincial power companies. Although investments still require central government approval, they are no longer financed out of budget allocations, but, instead, by both equity and debt from a variety of public and private sources. Private ownership of power assets, previously unlawful, was legalized in the 1995 Electricity Law. In addition, prices today generally reflect long-run marginal costs, particularly in the more advanced coastal area.

Despite the progress over the past twenty years or so, the sector faces both structural and operational problems which, if not resolved, will constrain the reform process and, hence, the ability to improve the sector. Some examples of problems today are: the single buyer model without competition for the market and in the market; the potential benefits from inter-provincial and inter-regional trade have not been aggressively pursued; small, heavily polluting coal plants have been established and operate, although they are not an optimal use of resources; more broadly, the system is outdated and, even with an installed capacity on the order of 300 GW, there are still power shortages.

The Workshop was structured with these problems in mind, along with a determination to move forward with the reforms, so as to resolve the problems. The primary objective of the Workshop was to identify, from both domestic and international experience, what elements would indeed constitute a New Waves of Power Sector Reform.

Opening Session

The opening session raised a number of broad themes. Mr. Zhang Guobao, Vice Chairman of SDPC, discussed some of the problems in the power sector and focused his attention on several matters: the fact that power shortages continue to be a problem in certain parts of China and that new investment is required, not just to meet new growth, but also to replace those elements of the system that are outdated. In short, the investment needs are substantial. He stressed that new policies are necessary and that management needs to be improved. Mr. Zhang noted that other countries have reformed and that there must be lessons that would be useful for China.

An issue raised by Mr. Zhang, and a theme for the Workshop, was whether the complexities in China – such as rapid growth, large geographic size, local versus national issues – called for a uniquely Chinese reform plan. An alternative way to put it is that each country has some unique features that require the reform plans and processes to be customized to suit the circumstances. That is, while one may learn from the experiences elsewhere, it is unlikely that any can be replicated precisely in another context.

Mr. Yoshihiko Sumi, Director, Energy and Mining Development Sector Unit, The World Bank noted that, while China itself may be different, its power sector problems are common internationally. He stressed that the reform process needs to continue and made particular reference to moving beyond the single buyer model and to unbundling the sector. Messrs. Zhang and Sumi, as well as Mr. Douglas Ogden emphasized that they were looking to the Workshop to provide some guidance, perhaps a road map, as to the way forward.

Mr. Ogden, Vice President and Director, China Sustainable Energy Program (CSEP), of The Energy Foundation, broadly agreed with the earlier points regarding the problems in China, and the need to continue the reform process. In addition, Mr. Ogden emphasized that support for energy efficiency and for the development of clean energy technologies, and the associated health and environmental benefits, should be explicitly considered in the restructuring process. As later discussed by others in more detail, if such consideration is not given at the outset, valuable opportunities may inadvertently be precluded.

Mr. Li Yanmeng, Deputy Director General, DI, SDPC was in broad agreement with the need to reform and to introduce competition into the sector. He emphasized the need to increase efficiency and to provide consumers with choice, as now they can choose only how much power to use. Mr. Li also raised the issue of China's uniqueness and raised the question of what this would mean for the way forward. China's uniqueness, according to Mr. Li, stemmed from the confluence of several factors: it is a developing country and it is developing rapidly; electricity consumption levels and management quality, for example, vary considerably from region to region; and China is, simultaneously with reform of the sector, moving from a planned to a market economy, which requires changes in law and regulation on a broad scale. As noted earlier, while the lessons from elsewhere would be pertinent, China's reform process – indeed any country's reform process – must be cognizant of local conditions

Mr. Jia Yinghua, Deputy Director General, Department of Power, State Economic and Trade Commission (SETC), the final speaker at the opening session, addressed the need to develop a proper legal and regulatory framework. These are crucial and, although there may be differences in specifics, over the course of the two-day workshop, there would be no disagreement with this view. In addition, Mr. Jia emphasized that China should continue to utilize pilots to introduce competition nation-wide. He also discussed the need to coordinate the growth and reform of the sector with overall economic development. And crucial to the overall growth and improved efficiency of the sector, according to Mr. Jia, is the development of an improved power grid.

Session II: Competitive Markets in Practice

An introduction to the subject was provided by Ms. Sally Hunt. She noted that there

have been basic reforms in the sector in a number of countries, particularly in the 1990s, and that what was once both rare and dramatic is now commonplace. Her view, shared by later speakers as well, is that most of the problems that China now faces have been dealt with elsewhere.

There are four basic market model stages: monopoly, single buyer, wholesale competition (perhaps with direct sales to large consumers), and retail competition. According to Ms. Hunt, a reform process need not go through all the stages; she noted that, for example, Argentina, the UK, Australia, and Norway avoided the single buyer and went directly to wholesale or retail competition. Ms. Hunt, and many others later on, stressed the need for a high quality reform process and solid law and institutions to move from one model to another.

Reform and restructuring have to be seen as a long, complicated process that requires a well-crafted strategy, long-term commitment, and strong institutional capacity within government. This is an important lesson from other countries. The institutions that are charged with the responsibility need proper staffing and proper budgets in order to see the process through.

Another basic point made is that competition and ownership are separate "dimensions." Put another way, for example, a change in the ownership of generation does not mean that there is, by that fact alone, competition in the market. Competition requires a large number of sellers, and buyers who have access to good (that is, reliable, and up-to-date) information. In addition, to allow competition to work in the power sector, it is necessary to have good market rules and settlement agreements, high quality regulation, and the absence of distortions in the market that could be a result of one or more companies exercising 'market power'.

Internationally, the impetus to restructure the sector has often differed from country to country. Although there can of course be more than one 'driver', in some instances it has been that costs and tariffs have been too high (US), or that investment needs are too substantial to be met by government resources (Mexico); in other cases, the reform was driven by ideology (UK) or by inadequate service quality (Argentina). And in at least one case (India), reform was required because the sector's revenues were well below costs and basic changes in structure and regulation were necessary to make the sector creditworthy.

Despite the differences in impetus, where competition has been introduced, the reform countries have expected and found certain benefits: lower costs because resources – labor, capital, fuel, and so on – are used more efficiently; more efficient operation, as decisions are decentralized, and those responsible for decisions are given proper incentives. In short, significant benefits have accrued where it is price, rather than central direction, that elicits supply and rations demand. And as Ms. Hunt noted, even those who were initially skeptical saw benefits.[1]

[1]The typical domestic electricity bill in the UK has fallen from £ 352 in April 1990 to £ 246 in April 2000, allowing for inflation. In the same time period, industrial prices are estimated to have fallen by between 31% and 35% depending upon maximum demands and load factors. In Argentina, according to Mr. Caruso, the benefits included a substantial reduction in plant unavailability (from 51.9% to 21.8%) between 1992 and 1997; and during the same time period, installed capacity increased from less than 15,000 MW to over 20,000 MW. In addition, average monthly wholesale prices (both energy only and energy plus capacity) decreased significantly. For example, in Feb/Apr,

One of the key questions for the workshop – albeit addressed only briefly in Ms. Hunt's introductory remarks – is the size of the market. How 'big' should it be? The answer, put succinctly, is "as large as possible". The boundaries of a market are limited by the extent and potential size of the grid. Clearly, some areas will be too small to have real competition and, equally clearly, competition cannot take place if there are too few generators or if, regardless of the number, some wield sufficient power to raise prices above competitive levels.

It is important to stress, however, that the optimum size of the power market – or, indeed, any market -- is determined by technical and economic criteria rather than by, for example, administrative boundaries. In Australia and the US, for example, markets extend beyond state borders. And in Latin America, they are international. One can generalize here: that is, in any instance (and in any country) in which the size of the market is constrained by considerations other the technical and economic, one can anticipate, at a minimum, higher maximum prices and greater price volatility than would otherwise be the case.

Ms. Hunt's view of the structural essentials for a competitive market is that generation must be separated from transmission; market based pricing and dispatch must be introduced; contracts (such as the pool settlement agreement; the transmission connection and use of system agreement) need to be properly designed and adhered to; and regulation of the design of the system operator should be firm and done early (as was often not the case in the US, which is an important lesson learned). Later discussions added other factors, such as a sufficient number of generators, open access to the grid, and proper regulatory oversight of the market to ensure that competition is indeed fair.

As for regulation, China is faced with problems that are similar to many countries; India and the US are two examples. That is, in each country, there is both a strong center, as well as states or, in China's case, provinces. On the other hand, the size of efficient power markets will not be consistent with political boundaries. Even if, at any given time, a power market and political boundary may be the same, with economic grid expansion, it will not remain so. Inevitably, this raises issues concerning regulation. The US, in particular, has suffered from overlaps and blurred lines between federal and state regulation. And India is presently taking legislative steps to address these concerns. The message for China is that careful consideration be given to these lessons as the new electricity law is being drafted.

Peter Bradford and Peter Egger made some additional comments as discussants. Broadly, each concurred that there may be different drivers to reform and that reform has to accommodate the different arrangements in each jurisdiction, which could be a country, a state, a province, or some combination. Both would also agree that effective competition at the wholesale level requires the separation of generation from transmission, as well as effective regulation of the remaining monopoly businesses. Mr. Bradford recommended strongly that the process not be allowed to stall, since being

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1992, the energy price was slightly above $US 40/MWh; and in Feb/Apr 1997 it was less than $US20/MWh. Others, however, pointed out that several regional markets in the US have experienced significant price volatility, due at least on part to market design and possible market power problems. This underscores the need to develop an expert regulatory agency in China.

caught midway between a vertically integrated monopoly situation and a competitive market may yield the poorest outcome. He also noted that to get the most benefits from reform one needs to ensure that there can be a 'demand response': that is, consumers see the 'real' prices and can react to them and demand reduction measures may compete on equal terms with new generation sources. In the US last summer (especially in California), electricity was often purchased at prices as high as $6.00 per kWh; this was far above the price that would have sufficed to reduce demand by enough to avoid or lessen the purchase. The cost of these episodes was very high.

Mr. Egger noted that the process in Australia was facilitated by the preparation done by the companies in parallel with the evolving changes in the law. This is an important lesson learned and will be applicable to China. As later discussed in more detail (Session VII), while it will be necessary to revise China's Electricity Law, the sector entities can continue to make progress in parallel. Mr. Egger also noted, as regards implementation in Australia, that an open and transparent consultative process for the development of market rules was quite valuable.

The panel discussion continued with commentary from Ms. Hunt, and Messrs. George Gilboy and Luis Caruso. Mr. Gilboy gave what he called the private capital perspective and emphasized the need to have a consistent IPP and PPA process so as to send positive messages to the market.

Mr. Caruso added a number of useful points from his Latin American perspective. The principle trigger for reform in Latin America was the insufficiency of capital, which was exacerbated by rapid growth. This is a characteristic of the present situation in China. In Latin America, the financial constraints evidenced themselves in decreases in quality, notably shortages and generally poor service.

In light of this, the policy objectives were to put in place an industry that would meet all needs, at economic prices, with an assurance of high quality service; to eliminate the drain on public sector resources; and to eliminate endemic corruption. Stated broadly, the way forward in Latin America was, according to Mr. Caruso, to have "Competition where possible, regulation where necessary". And while each country had its own characteristics, there was a common pattern. This included restructuring the industry into separate businesses according to the type of regulation required; creating competitive producer markets; regulating transmission and distribution quality standards and tariffs; setting rules for the efficient operation of the system; promoting the progressive integration of markets and systems, both within and across national borders; providing full protection of the law to all participants; and creating institutions (such as system and market operators) to operate the market in compliance with the rules.

It would be reasonable to conclude that while China's problems may be complicated by, for instance, its size and the weakness of its financial markets, the problems that it faces have been present and successfully dealt with elsewhere. Many countries, such as Argentina and Brazil have been developing and growing; this has exacerbated the problem of capital shortages, which are endemic to all developing countries. Still other countries, such as Poland and Hungary, have undertaken infrastructure reform in the context of a broader transition from a planned to a market economy. In short, while China – indeed, any country – is unique, its infrastructure problems are not. The lessons to be learned from other countries will, of course, have to be customized for China's environment; but China can build upon those experiences.

Session III: Introducing Competition in Stages–A Framework for Discussion

Mr. Egger presented a three-stage framework for the introduction and gradual evolution of competitive markets in China. He noted at the outset that provincial energy pools and regional 'bilateral' markets could operate in parallel and that the provincial markets should be reformed in three stages.[2] Others pointed out that the reform process should not necessarily be confined to the provincial level, as in some cases inter-provincial markets are already in operation in China. The following discussion addresses the provincial level only; but the principles would be similar if the market were larger.

Stage 1, according to Mr. Egger, would be a transitional stage in which generation would be separated from the provincial power company's transmission and dispatch. A mandatory energy pool would be formed with the generators as sellers and the provincial power company as the single buyer; and a process of negotiating "vesting" style contracts for differences (CfDs) would be undertaken. An independent regulator would be established and a transmission profit center would be formed within the power company. Mr. Egger noted that, during Stage 1, the state-owned single buyer continues to have direct buyer risk. It was later explained by Mr. Harvey Salgo (Session VII) that the present Electricity Law would allow for the Stage 1 structure and operations.

Stage 2 is wholesale market competition, in which the Government owned entities are removed from direct exposure to market volatility; that is, they no longer have a direct price risk. This is an important benefit. At this stage, transmission is separated from distribution and incorporated under company law. Transmission pricing would of course need to be developed. The distribution businesses would also be incorporated. At this stage the independent regulator would need to be fully operational and market rules would need to be approved. A CfD market, in conjunction with the remnants of the 'vesting' style CfD contracts, would operate between generation and distribution companies and, if some large consumers participate, between them and the generation companies as well. Stage 2, as explained by Mr. Salgo in Session VII, is much more problematical under present law. His recommendation was that it would be wise to amend the law before proceeding to Stage 2.

Stage 3 is the establishment of a retail market. At this stage, the wholesale market would be fully established and the distribution companies would be separated into network and retail companies; this separation is sometimes described as wires and retail supply. All customers would have a choice of suppliers. The progression to Stage 3 is not possible under the present Electricity Law.

Mr. Egger also discussed the evolution of regional markets. He recommended that bilateral markets be developed prior to a regional energy pool market. Market traders should be established in each provincial market, and provincial market rules (assuming each has an energy pool) should be harmonized so as to form regional market rules. Once the rules are harmonized, regional energy pools can be established. Ultimately, consumers will be able to choose between retailers within the region: that is to say, between retailers in different provinces.

[2] Note of the editor: The presentation of Mr.Egger is based on a study carried out to develop competitive power markets in Zhejiang province, one of the six provinces selected by the government authorities as pilot to further power sector reform.

Mr. Egger's presentation elicited some comments from the attendees; these comments were along two broad themes. First, since the power sector is quite capital intensive, concern was raised about the market's ability to attract the requisite capital. Put another way, the concern was that while competitive markets might provide short-term benefits, they might not be adequate to meet long-term system expansion requirements. Second, concern was raised regarding the system's need to be in dynamic balance at all times, as electricity cannot be stored. It was suggested that the UK might have been able to achieve system reliability and security only because UK has a developed transmission system, which is not the case at present in China.

Both Ms. Hunt and Mr. Egger responded. Taken together, their response was that other industries – such as hotels and even apple orchards – are quite capital intensive and do quite well worldwide as competitive industries. And indeed, in the power sector reforms have led to significant investments in the sector. It would be useful to add, as a reminder, that these investments are likely to be forthcoming only if the proper preparation is undertaken for the establishment of the markets, market rules, and regulation.

As for system reliability and security, Mr. Egger noted that they have improved dramatically since reforms were first implemented in Australia. In particular, he stressed that the transmission system has been bolstered and that interconnections between markets have led to improvements. Ms. Hunt added that reliability can be improved when customers are able to 'see' the market prices and react. This latter issue -- the ability of customers to see and react to spot market prices -- was emphasized by others as well. The point may be put this way: if the prices in the market vary hour-by-hour but customers do not receive such signals (and are billed, say, only monthly), they do not have the opportunity to alter their consumption when hourly prices 'spike' at high levels. This inability of demand to respond means that there is no opportunity to dampen the spikes by curtailing usage. Ms. Hunt's comments, described this way, would mean that a demand response would be able to reduce market price volatility and result in a more stable system for any given amount of capacity. Mr. David Moskovitz elaborated later on the importance of designing market rules that allow direct consumer responses, as well as demand bidding by energy service firms, distribution companies, and others.

Session IV: Separation of Generation from Transmission and Distribution

Mr. Ranjit Lamech discussed the generation ownership linkages in China and their implications for reform. Mr. Lamech built on earlier comments and stressed that generation companies should be completely separated – on both a management and ownership level -- from transmission and distribution. This is necessary in order to ensure fair treatment of all generators and to minimize the risks faced by new investors.

The number of generating companies cannot be stated in a manner that satisfies all circumstances, but there are some useful generalities. First, and most obvious, is that competitive markets function best when there are a large number of producers and where, of course, barriers to entry are minimized. Second, as a reasonable 'rule-of-thumb', if there are about 5 or 6 companies of approximately the same size, this would tend to be adequate. On the other hand, if there are 5 or 6 and one is clearly dominant, this would not work well. In this regard, Mr. Lamech noted that in some areas relatively large power plants are a problem; in particular, he referenced Beilungang in Zhejiang, with 30% of the capacity in the market.

Several other experts cautioned that while 'rules-of-thumb' can give guidance, they cannot provide a definitive final answer; local conditions and the exact nature of the market must be examined carefully and more generating firms would be desirable. One should also add that these structural concerns are not the only issues. Even if one has the 'proper' number of competitors, a competitive market will be jeopardized if, for example, the producers collude to raise prices. So, there must be adequate market monitoring, as well, for the protection of consumers; that is, both proper market structure and proper regulation are necessary.

Mr. Lamech went on to discuss two key problems, their consequences and possible solutions. First, he noted that there are very few 'State Agents' who perform ownership functions in the sector and, hence, ownership concentration is high and competitive pressures are diluted. Four main Central agencies (including two investment companies), together with about a dozen provincial investment companies, have ownership and management control of approximately 90% of China's power generation. Mr. Lamech is of the view that consideration should be given as to whether more such agencies can be created and used to diversify ownership and control; banks, investment funds and trusts, and separate holding companies were suggested.

A second concern is that private (that is, non-state) participants in the sector generally lack management control which is important to achieve efficiency gains and limit market power in a bid-based market. Despite the hundreds of joint ventures and listed companies (over 35), management control remains concentrated in a limited number of provincial and central power companies. Mr. Lamech raised the question as to whether or not the majority of shares can be sold to domestic and international investors, so as to transfer both majority ownership and management control to them.

As stated many times, the benefits of competition are dampened or eliminated with concentrations of ownership and management control. To a very large extent, the benefits come with the elimination of both existing concentrations and prospective entry barriers; the combination will increase the diversity of management approaches, skills, and new technologies.

Mr. Hao Weiping, Deputy Director, Department of Basic Industries, SDPC made some comments as a discussant. Mr. Hao broadly agreed that there are many problems and emphasized the need to make significant efforts to resolve them. He also stressed the need for China to seek policies that will attract clean energy resources.

An attendee noted that some companies have been trying to accumulate rather than divest assets and wondered about the proper HHI index. Mr. Lamech explained the HHI index and how it works.[3] An explanation (footnote below) makes clear the reason for his

[3] The HHI is a handy, albeit rough, guide to a competitive market structure and is calculated as follows. The greatest degree of concentration is where a single firm has 100% of the market. The HHI takes the square of firm market shares and sums them. Thus, where one firm has 100% of the market, the HHI is 100^2 or 10,000. On the other hand, where there are, say, five firms with equal shares in the market (i.e., 20% each), the HHI will be $20^2 + 20^2 + 20^2 + 20^2 + 20^2 = 2000$. In general, the lower the HHI, the more competitive the market; and values in the range of 2000 to 2500 are considered to be reasonably competitive. Note that if the 5 firms just alluded to have unequal market shares, meaning some are larger than others, the HHI increases and the degree of competitiveness is reduced. Thus, the HHI is consistent with intuition.

suggestion that 5-6 generating companies was a reasonable rule-of-thumb. A point worth repeating, however, is that these rules-of-thumb were developed for other industries and should be treated as rough guidelines. Other factors – such as the relative size of each company, the quality of regulation, the relative efficiencies of each company, and the special nature of electricity compared to other products – are quite relevant considerations.

Naturally, the number of generating companies to set up is only one issue. Another is the substance of those companies: What assets does each contain? This is a matter to be studied carefully, primarily to achieve the right balance (base plant, peaking plant) within and among the generating companies. It should also be noted that the issue of old and new plants, and how they should be treated, was raised numerous times during the discussions. This issue has arisen in all countries that have undertaken power sector reforms and there are ways to address the problem.

Mr. Eliot Wessler continued the discussion of the separation of generation from transmission and agreed that it is a necessary step to creating competitive markets. Mr. Wessler emphasized that, whatever the mechanism for effectuating the separation and for the creation of the market, the result must be that all participants – and potential participants – have confidence that they will be treated fairly. Even the perception that generators that are affiliated with a transmission entity will receive favorable treatment – in either access to the transmission system or in pricing – will affect the level of competition and, of course, the willingness to undertake new investments.

Some have argued that there should be an exception to the general rule concerning the separation of generation from transmission: that is, in the provision of ancillary services. The international experience to date is that the provision of ancillary services can be adequately provided without such common ownership, a point stressed by Ms. Hunt during her presentation earlier. In UK, the national grid company kept the pumped storage plant after unbundling, but divested it a few years later when ancillary service could be priced.

There are a number of key steps in separating generation from transmission so as to ensure a competitive environment: transmission tariffs must be 'unbundled' and separately stated; the information on the availability of transmission services and the prices for such services must be transparent; transmission prices must be set so as to properly encourage efficient operation and, where necessary, new investment. The issues associated with transmission were later discussed by Mr. Caruso (Session V).

The key steps in establishing unbundled generation service are to identify generation markets that are or could be competitive and to establish appropriate market rules. Rules for competitive markets would include a framework for governing so-called bilateral contracts between buyers and sellers and auction rules that would govern the operation of spot energy markets.

Mr. Wessler stressed that the separation of generation from transmission, while an essential step, does not ensure that markets will be competitive. What will ensure it, as all speakers have recognized, are proper rules, proper regulation, the removal of artificial barriers to entry into the market, and the divestiture of the ownership of the generation assets, where there is common ownership of both transmission and generation. Mr. Wessler's comments here are consistent with Mr. Lamech's who, it will be recalled, was

concerned with both common ownership and the degree of concentration of that ownership in the hands of a very few parties in China. Mr. Wessler shares these concerns as well.

In the US, approximately 15% of the generation have been divested during the past three years or so. The prices received for the assets have, in general, been a good deal higher than expected, resulting in a reduction of pre-divestiture stranded costs. One assessment is that of an estimated US$200 billion of stranded costs, there has been a reduction of about $70 billion. One reason for the relatively high prices is that the divestiture tends to put the generating plants in the hands of companies that, with the new competitive market incentives, believe that they can operate more efficiently than the present owners.

Mr. Wayne Shirley, as discussant, noted that any rules-of-thumb regarding the number of generating companies required for competition depend upon assumptions about the quality of regulation. In general, the weaker the regulatory environment, the greater the number of companies that are necessary. Mr. Shirley also noted that renewable technologies – such as wind power – depend upon clear open access rules and enforcement and, in addition, cannot compete unless their unique characteristics are recognized in pricing. For example, if, say, a wind machine and a thermal plant have the same capacity (MW), given the vagaries of the wind, the energy available from each will be quite different. In his view, proper transmission pricing should reflect such differences so as not to penalize renewables. As would be emphasized in Session VI, these types of issues – as regards renewable technologies and energy efficiency – should be given consideration during the design of the reform process and the implementation of the new markets.

Mr. Shirley also noted that where there is common ownership of transmission and generation, there is – as others have also noted – a concern that one's own generation would be favored. He also stated that that the special nature of renewable technologies, including the fact that they are limited in terms of their location – may need special consideration in transmission pricing and access. Finally, he commented that very serious consideration should be given to requiring that older plants be cleaned up, and reconfigured to meet more modern environmental standards, before they are divested. To do otherwise may be to miss an important opportunity and cause new owners to resist later government attempts to require clean-up.

Messrs. Caruso and Salgo provided some additional international examples of generation divestiture practices. Mr. Caruso noted that in Argentina a 1991 presidential decree established the main guidelines for subsequent power sector reform. The Secretary of Energy issued Resolution 38 that created the wholesale power market consistent with the guidelines in the decree. At this time the entire industry was state owned and the resolution itself did not introduce any ownership changes. Most of the generation (and bulk transmission) was in the hands of four companies owned by the Central Government. There were also more than twenty provincial generation and distribution companies.

The Government's tools for reforming the sector and introducing competition were, first, to vertically segment (regardless of ownership) generation, transmission, and distribution. Horizontal segmentation was also utilized, where in each generating plant was considered a different agent in the market. The wholesale market's operation was

centralized and in the control of an independent system and market operator.

The view of the Government in Argentina was that diversity encourages independent thinking, different organizational 'cultures' and is a source of beneficial competitive tension. At the early stage of the reform, ownership was in the hands of government, yet there was still some diversity and competitive tension because of different companies, different jurisdictions, different labor unions and different agencies in charge (Department of Energy, Nuclear Energy Commission, Binational Entities, Provincial Governments). At a later stage, diversity and competition were further enhanced allowing in private investors.

Mr. Salgo discussed the situation in India, which in many ways is quite different from that in China. Indian reform was prompted primarily by the financially bankrupt status of most of the State Electricity Boards (SEBs); hence, the most important objective was the creation of credit-worthy successor entities. There has been relatively little divestiture of generation. In the state of Orissa, 49% of the shares of the thermal power company, plus management control, were auctioned off and ultimately sold to a US company. It is likely that, as reform proceeds in India, a greater degree of emphasis will be placed upon the proper reconfiguration of the SEB's generating business and upon the divestiture of shares. The proper configuration, as has been discussed earlier, is essential for competition; and the divestiture, while also essential for competition, may also be a required component of any plan to return the sector to credit-worthiness. Mr. Salgo concluded that, as regards generation divestiture, India has few examples that are pertinent to China today. On the other hand, one of the lessons learned from India is that, whatever may be the impetus to the reform process, careful attention should be paid to the reconfiguration of the generation business.

Some additional comments on generation separation and divestiture were made by Messrs. Bradford and Egger. Mr. Bradford noted that divestiture in the US was voluntary and had never been ordered. Regulators had initially expected that generation and transmission could be separated and that proper market behavior could be ensured through open access requirements and through Codes of Conduct enforced by the regulators. That option has come to be seen as a decidedly second-best. In any event, the round of divestitures was spurred by the decision of a company in the US Northeast to sell its assets. The unexpectedly high price encouraged other utilities to do the same.

Mr. Bradford also recommends that there be a clear policy that the benefits from asset sales flow back to consumers as a set off against higher prices or any stranded costs that might otherwise result from restructuring. In the US, according to Mr. Bradford, the responsibility for stranded costs – in particular, the customer responsibility for their payment – was not handled well because the federal and state governments failed to secure the competitive market benefits that they had hoped to get in return. Both Mr. Bradford and a later comment from the audience noted that where the government owns the assets and absorbs the stranded cost responsibility, the issue is very different in character than it was in the US, although the fundamental need to redeem strandable expectations -- whether those of workers, investors, local governments or favored customers -- will exist during any restructuring. The fundamental principle is that when one or another of these expectations is paid off, the government should be firm in insisting that it gets what it is paying for.

Finally, Mr. Bradford commented that retail competition markets[4] cannot work until consumers and others can respond to prices by shifting loads to other time periods, conserving electricity, or by utilizing on-site generation (which, in certain hours, may be less expensive than the spot market). It is interesting, according to Mr. Bradford, that in the US over the last 25 years, conservation has been the major supply resource.

Mr. Bradford also added that there are certain to be lessons learned regarding market design and market rules from the recent experience in California and New England. This view was shared by others as well.

The experience in Australia was varied, according to Mr. Egger. Victoria separated its power plants into seven companies with the size determined by expected sale value. Each was sold in the open market. He also noted that the interconnection between Victoria and New South Wales (NSW) provided an additional source of generation competition.

NSW was separated into three government owned companies based upon amount of capacity, shared infrastructure, coal contracts and labor. Privatization was not pursued. A similar outcome was reached in Queensland, with a fourth company established as a 'Market Trader' to manage government bilateral contracts with IPPs where it was not possible to renegotiate these contracts. The Market Trader was allocated bilateral contracts representing a market share of 25%. In the Queensland market, there was no interconnection available to NSW. Queensland operated as an isolated sub-market within the national market, using national market rules. This policy provided incentives to build transmission interconnection and removed the need for a complex process to harmonize the market rules when the interconnection was commissioned.

South Australia separated into three companies and an inter-connector with Victoria allowed for additional competition. Tasmania's system was separated into one generation company, with no connection to Victoria.

Session V: Restructuring Transmission and Distribution

The first part of this session addresses the preparation for wholesale competition. Recall that, in Session III, the concept of Stages 1, 2, and 3 toward the progressive development of competitive markets was introduced. Mr. Egger here explained further the steps that would be required to move to Stages 1 and 2. Stage 3, retail competition, is not discussed.

The preparation for Stage 1 competition involves a number of important activities. The following list is not in any order of importance or priority. The steps include management separation of generation from transmission and the setting up of the energy pool and the CfD market. Market rules need to be determined and transmission connection

[4] It should be pointed out that the terms 'retail' and 'wholesale' competition are not uniquely defined. For example, some use the term 'wholesale' competition to include purchases by both distribution companies and some large consumers. To others, 'wholesale' includes purchases by only those entities that resell the electricity; that is, the definition would include distribution companies but not large consumers. This latter definition describes how the term is used in the US and how it was used by Mr. Bradford. In the US, no end use consumer, regardless of its size, can purchase until there is some degree of retail competition. On the other hand, in the UK, for example, wholesale competition includes large consumers.

agreements need to be finalized. In addition, the regulatory principles that will govern the new relationships must be established.

According to Mr. Egger, it is also important at this stage to establish the transmission pricing methodology, as well as market information systems and the information publication process. Stage 1, in Mr. Egger's view is a transitional stage that moves the sector from where it is today to a more competitive structure. At this stage, transmission and distribution would, if presently bundled, remain as such; and the purchaser would be a 'single buyer', albeit with prices determined by bidding into the market, in contrast to how prices are determined today.

Stage 2 is more complex and builds upon Stage 1. At this stage transmission and distribution become separate companies which will of course require, among other things, the identification of the assets and liabilities of each company. Contracts (transmission connection agreements and CfDs) must be novated (that is, distribution companies substituted for the single buyer). In addition, market rules must be appropriately revised to allow for the new arrangements, including the involvement of contestable customers. This will also necessitate that the market information systems be revised to meet Stage 2 requirements. Mr. Egger suggests that, at this stage, there should be in place a program for transferring ownership of generation and distribution from the power companies to Government. It might be useful to add, however, that since there are numerous complex and difficult policy decisions to take in these matters – such as number, size, configuration of generation and distribution companies – it could be beneficial to start the program earlier, at least at the conceptual level.

Mr. Caruso presented information and his views concerning the transmission requirements for moving to competitive markets. A competitive market should of course be designed to promote efficiency in both the operation and expansion of generation. Decisions on plant size and technology should be based upon signals from the market; as described earlier, in competitive markets, price induces supply (and rations demand). As Mr. Caruso correctly points out, however, decisions on plant location require information on transmission costs. In addition, of course, proper decisions cannot be made unless there is an assurance of open access to the transmission system, which is a basic, fundamental requirement.

In a competitive market all participants undertake transactions through an open access transmission system. Such access should be granted automatically to all agents and enforced by the regulator. And dispatch rules should be transparent and non-discriminatory. Transmission service costs are recovered through transmission charges and should be efficient – to induce the best overall use of the system – and fair to all participants. Mr. Caruso identified and discussed various transmission pricing methodologies, along with the advantages and disadvantages of each; these issues can be examined in the Annex. An important point made by Mr. Caruso is that in many growing economies there is likely to be the need for very substantial investments in transmission; and this puts an even higher premium on establishing the proper transmission signals. Transmission, as a monopoly service, will of course be regulated, which means that transmission prices will be set by that agency. As noted above, the regulator will also enforce the open access rules.

It is also necessary to work out what will be, in Mr. Caruso's words, the transmission system's "expansion mechanism". The need for expansion could be initiated by the

System Operator or by market agents. But the investments must be approved by the regulator, since transmission is a monopoly and the costs of new investments (as well as operating costs) will be borne by all parties and, ultimately, by electricity consumers. How these costs are allocated will depend upon the pricing methodology adopted, as alluded to above.

The core of Mr. Caruso's message may be summarized as follows. The transmission system is at heart of the competitive market. As a monopoly business, it must be properly regulated. Proper regulation will enforce open access to the system by all agents and develop and implement a pricing regime that encourages efficient use of the system and minimizes the costs associated with system expansion.

It would be useful to note some issues associated with market integration across provinces and regions. In other countries, as discussed in other sessions, the economic expansion of markets – which, of course, means grid expansion – has been stymied by, among other things, overlapping and inconsistent regulation. As both Mr. Bradford and Mr. Wessler explained, this is a problem that has plagued the US restructuring effort. Mr. Caruso emphasizes that market integration requires consistent wholesale and transmission pricing concepts across administrative boundaries. This is another way of saying that in the development of the new electricity law, it would be most valuable to address these issues. The US has paid a price for having legislation that has not been able to satisfactorily resolve inter-state and state-federal conflicts. This is a valuable lesson for China.

The discussion of transmission was followed by a panel discussion regarding the separation of distribution from transmission.

Mr. Moskovitz set forth and elaborated on four important transmission principles. The first was to create the right structure. He cautioned against the US model of an ISO that had no ownership of transmission and limited duties and rights, including expansion. Second was to create the right incentives through the regulatory approach taken; most important was to create within the transmission entity the incentive to balance the incurrence of congestion costs against transmission construction and to consider alternatives to transmission construction. His third principle was to incorporate a demand response. He explained some of the shortcomings of several US markets and how a full range of demand response by all market participants could be achieved. Finally, he noted that some transmission pricing approaches can limit renewable resource options, which could present barriers to China's goals of developing the western part of the country.

There were some useful points that may be summarized as follows. One issue is the separation of the entire distribution business from transmission, without regard to the disaggregation into smaller distribution companies. Clearly, to do so would require a delineation of those assets that belong to transmission and those that belong to distribution; the allocation would be based primarily on voltage levels. But assets are only one side of the equation; decisions also need to be taken, as part of a financial plan, regarding the allocation of liabilities as well.

The disaggregation of the distribution business into smaller companies is a more difficult exercise. The decisions will turn on a number of factors including potential sale value, 'political' considerations, the desirability of having comparable mixes of customer

categories, and so on. In Australia Victoria separated into 5 companies; and as for the other jurisdictions, there were 6 in NSW, 2 in Queensland, and I each in South Australia and Tasmania. In the Indian states that have initiated reforms, the numbers also vary, but the considerations are broadly the same.

Mr. Moskovitz made three main points relating to the distribution sector. His first point was to create the right incentives for distribution company investment in energy efficiency. He recommended regulation based on revenue caps to assure that distribution companies were not encouraged to simply increase sales. Next, he pointed out the rapid technological and economic advances in new, very small generating technologies. New high efficiency cogeneration and fuel cell options were stressed due to favorable environmental characteristics and their ability to reduce transmission and distribution costs. Next, Mr. Moskovitz noted problems in US approaches to environmental regulation that were not compatible with competitive generation markets. He urged the audience to consider environmental reforms simultaneously with power sector economic reforms.

Session VI: Assuring Sustainable Development

Messrs. Bradford and Moskovitz made presentations on sustainable development. Their comments were consistent with one another and, thus, will be taken together.

The presentations focused on the relationship between power sector restructuring and the environment. A key lesson is that in addition to overarching policies such as Renewable Portfolio Standards and System Benefit Charges many restructuring decisions and market rules can have important positive or negative environmental effects. As other speakers have also noted, these issues should be addressed at the design stage so as to avoid unintended consequences.

It was recommended that the restructuring working groups include environmental and public health officials and that the group's mandate should specifically include analyses of the mitigation of environmental and health impacts. The speakers also recommended that, as may be practical, market mechanisms should be utilized to achieve reductions in emissions beyond those that may be mandated. Any impacts that cannot be fully mitigated should be accorded some weight in the selection of resources. In addition, resource procurement rules and tariff policies should reflect the value of energy efficiency.

Some of the important design and implementation issues that affect sustainability are as follows.

Demand response. This is a point made by others and, it would seem, reflects a consensus view. As noted earlier, if prices are established on, say, an hourly basis and consumers do not 'see' such prices in each hour, they cannot react. In this case, reaction could include load shifting, conservation, or the use of on-site generation. Mr. Moskovitz noted however that incorporating the demand-side in the wholesale market means much more than offering customers real time prices. He noted for example that most customers with the needed metering choose to contract for fixed prices. He also noted that most customers do not, and perhaps will not, have the needed metering. What is needed is to design markets so business ventures that specialize in energy efficiency, load management, and small on-site generation can bid demand reduction

into the market in direct competition with supply bids.

Intermittent resources. Resources such as solar and wind are intermittent in that the hour-by-hour output will not be as predictable as it is for fossil generation. Rules can be adopted that either help or hinder the development of these resources. For example, if the pool adopts a bidding rule that requires all generators to state their hourly levels of generation on a day ahead basis, together with penalties if the stated output is not satisfied, the implications for solar and wind are obvious.

Capacity costs and reliability pricing. Pools differ as to whether they have capacity requirements or separate capacity markets. Pools also differ as to how they determine operating reserve requirements. Messrs. Bradford and Moskovitz pointed out that whether or not there is a capacity market, the level of required reserves will influence the type of capacity that will be built. They recommend that consideration be given to the impact upon clean energy resources in the making decisions about market design.

Divestiture. It was emphasized here, and had been mentioned earlier by Mr. Shirley, that when generation is separated from transmission, the new owners of generation will of course have certain rights and responsibilities. One expectation is that the new owners will not be able to pass on the costs of environmental clean-up to consumers and, so, they will not undertake such obligations on their own – other than to meet known legal requirements. This will make it difficult to impose additional clean-up obligations. The advice offered, therefore, is to make such obligations an explicit part of the separation process. If so, the potential buyers' assessment of the responsibilities may be reflected in the prices offered for the assets although US experience shows the environmental obligations have had little noticeable impact on the price offers.

Transmission pricing for intermittent resources. The point was made that while there is no single, clearly established system for transmission pricing, some approaches will be biased against the construction of intermittent resources such as wind. If price is based upon installed capacity, for example, a 100 MW wind farm would pay the same as a 100 MW gas plant, even though its energy output (sometimes called 'capacity factor') might be substantially less. And pricing based upon distance could be problematic if renewables are generally located in remote areas far from the major loads. The core recommendation here is to utilize transmission pricing methodologies that treat renewables and energy efficiency in an efficient manner that is consistent with other national goals. According to Messrs. Moskovitz and Bradford this could include some sort of congestion pricing.

Other points were made by Messrs. Moskovitz and Bradford. However, the core of their message was that sustainability including environmental considerations, and the potential for energy efficiency and relatively benign generation sources, should be an explicit goal of the reform and restructuring process. If not, there can be both unintended consequences and lost opportunities.

Session VII: Legal and Regulatory Reform for Competitive Power Markets

Mr. Salgo discussed the extent to which competitive power markets could be implemented within the existing legal framework. Mr. Salgo noted that a legal framework consists of more than the Electricity Law, and also includes decisions taken and decrees promulgated. In his later discussion, Mr. Clifford Garstang usefully added that, for

example, property and contract laws are also part of the legal framework.

The broad conclusion reached by Mr. Salgo – and concurred in by Mr. Garstang – is that the present law would allow the sector to evolve somewhat. To be specific, it is clear that single buyers are permitted under present law and that pursuant to a 1999 decree generation is to be separated from transmission. And it also seems clear that if the single buyer made purchases on the basis of competitively bid prices, this would be permitted under the law. In other words, the law would not require the single buyer to set prices and make purchases in any specific manner. Thus, one could legally establish, for instance, a pool that requires bids on an hourly basis and, as a result, sets hourly market clearing prices. In addition, the law allows for, and indeed encourages, the development of trading among provinces and regions. It would also be possible, as a legal matter, to structure Contracts for Differences (CfDs) between buyer and seller to mitigate price volatility and to provide a reasonably assured revenue stream to the sellers. Finally, and in short, what Mr. Egger earlier called Stage 1 competition would be possible under the present law.

As one moves further along the competitive market path, the law is more problematic. It is evident that the law did not contemplate, and cannot be interpreted to allow, large consumers (or any consumers) to contract for their own supply. This places severe constraints on wholesale competition (here interpreted to include large consumers; see footnote 4) and would obviously also preclude retail competition.

But there is a more general point to be made concerning these matters. That is, even if one could interpret the law to allow for limited wholesale competition, it would not be wise to move too quickly to that stage. All the experts concurred that the proper development of competitive markets requires high quality regulation, and this is not a feature of the present law. In addition, a revised law should more specifically clarify transmission and distribution functions. In any event, Mr. Salgo's recommendation is that progress continue to be made, in parallel with the development of a new law, to reconfigure the single buyers into competitive arrangements that will be a step toward greater degrees of competition. Ultimately, the law allows for such progress to be made.

Mr. Garstang added that there are several other legal areas that will require attention for the development of competitive power markets. Competition policy: this will be required not only for the electricity sector, but for others as well in view of China's coming accession to the World Trade Organization (WTO). Company law: China's company law, in Mr. Garstang's view, is adequate for the early stages of reform and competition; but weaknesses in its governance provisions will become evident as the sector progresses and ownership is diversified. Some examples are: minority shareholder rights, the role and functions of boards of directors, and the maintenance and disclosure of information. Contract law: China has made improvements in contract law, but more will be required. Contractual rights and obligations – and the ability to enforce same – are essential to the proper functioning of a market. Capital markets: will need to continue to be liberalized to facilitate both expansion and the divestiture of assets.

Mr. Bradford made a presentation concerning the characteristics of sound regulation. It is evident that all the speakers reported that, from their experiences in other countries, high quality regulation is essential. Good regulation must be independent of the regulated entities. One might add that where ownership of the regulated entities is in the private sector, the reason for the independence is immediately obvious. But this is also

the case where government is the owner as the failure to separate ownership from regulation has exacerbated problems in numerous countries.

The regulator should also be free from excessive political interference. It is inevitable that some regulatory decisions will be difficult and controversial. These decisions, indeed all decisions, should be taken freely by the regulators and not be subject to excessive pressure or, worse, modification or reversal, by government. Regulated prices should be established according to principles that reward efficient operation and good performance, penalize the converse, and have a reasonable relationship to the costs of providing the regulated service.

The regulatory process should be open and transparent and the staff should be selected on the basis of competency in pertinent fields, such as engineering, finance, economics, accountancy, and so on. The regulator should have ongoing interactions with the stakeholders on substantive issues; this is sometimes known as a 'consultative' process. In addition, all decisions should be written and should describe the evidence relied upon and how the conclusions were reached; the decisions should be made available to the public. All these policies, taken together, will encourage confidence in the regulator and the regulatory process among all stakeholders.

Finally, there should be a continuity and stability in regulatory policies. This is best ensured by independence from the political process and a reliance on good information as the basis for making its decisions.

Mr. Bradford's points are well taken, but a comment from one of the attendees is also quite important. That is, a new agency might not be needed. The problem in China is fragmented among different agencies and it might be easier to consolidate them in one of the existing agencies rather than to create a new one. However, it is argued that creating a new agency could be a fresh start, so as to have new ways of operating and to introduce regulatory methods that are better adapted to a market economy. It was mentioned earlier that the reform and restructuring process is long and complicated and requires a commitment from government. Part of that commitment must be a reconsideration of the responsibilities of government institutions where those responsibilities conflict with the requirements to implement proper regulation and policy. Proper regulation, as discussed by several experts, would ultimately require that regulatory functions be located in one agency and policy functions located in another. Each should be professionally staffed with adequate budgets. In the absence of such a regulatory and policy structure, and if overlapping and conflicting authority were to persist, the reform process would be jeopardized.

Concluding Session

Ms. Song Mi, Director General, BID of SDPC, presented the concluding remarks on behalf of the State Development and Planning Commission. Ms. Song described the workshop as being very successful and having achieved its objectives. From the presentations of the various speakers, the attendees learned that different countries have followed different models during power sector restructuring. There are many lessons and rich experiences which are applicable to China. China, like all other countries, has its unique features. China could build upon the experiences of others, but has to customize them to its environment.

Ms. Song pointed out that the speakers had made many good proposals for China's power sector reform. Particularly, the attendants achieved a better understanding and reached consensus in the following aspects:

a. It is necessary and urgent to implement power sector restructuring in China. China can learn from the lessons from other countries to avoid mistakes, but should design reform based on its environment.
b. The fundamental objective of restructuring is to break the monopoly and introduce competition into the power sector. The essential first step to introduce competition is the separation of generation from the grid. It is also important to have a strong regulatory agency and good market rules in order to have a fair market.
c. The reform must be conducive to development. China is a fast developing country. The interaction between reform and development should be carefully balanced. The ultimate objective is to promote the efficient development of the power industry.
d. The primary impetus for reform is to improve efficiency and reduce cost.
e. China should have both short-term target and long-term target. The relation between the two has to be carefully managed.
f. The restructuring should be conducive to environmental protection and to sustainable development. Particular consideration should be given to environment and sustainable development during the restructuring process. Proper market structure and market rules should be developed to promote the development of clean energy and renewable energy.
g. Considerable consideration should be given to the role of laws and regulations in the reform process. Laws should be amended to support reform at the appropriate time.

WORKSHOP AGENDA

Workshop on
New Waves of Power Sector Reform in China

(Sponsored by the State Development and Planning Commission, with the assistance of the World Bank and the Energy Foundation)

October 9 - 10, 2000
Beijing Shangri-La Hotel, China

Day 1 – October 9th

Opening Session **The Need for a New Waves of Power Sector Reform**

Chairperson: Madam Song Mi, Director General of Department of Basic Industries, SDPC

8:30 – 8:50 **Opening Remarks Speeches**
Mr. Zhang Guobao, Vice Chairman, SDPC
Mr. Yoshihiko Sumi, Director, Energy Sector, WB
Mr. Douglas Ogden, Vice President & Director, CSEP, EF

8:50 – 9:10 **Emerging Problems and Reform Goals**
Mr. Li Yanmeng, Vice Director General of DI, SDPC

Objective:
To establish a context for the move to competitive power markets by reviewing:
(a) the reforms of the past two decades and the substantial gains achieved.
(b) the limitations and inefficiencies of the single buyer structure at the provincial level.
(c) the goals/objectives for introducing competition and the constraints.
(d) the need for a comprehensive and well-defined policy/strategy to introduce competition.

9:10 – 9:20 Mr. Jia Yinghua, Vice Director General, Department of Power, *SETC*

Session II **Competitive Markets in Practice**

Chairperson: Madam Song Mi, Director General of DBI, SDPC

9:20 – 9:50 **An Introduction**
Ms. Sally Hunt

Objective:
To introduce concepts and provide a concise overview of:
(a) The implications of competition in the power – focus on: clear definitions; how the roles and operations of existing sector entities and government agencies will change; expected benefits.
(b) Clarify frequent concerns – for example: what the criteria to determine an acceptable market size; are there limits, maximum and/or minimum; do system operators need to own key generation facilities – how can control be achieved without ownership.

(c) The minimum structural, regulatory and institutional changes required to implement competition and achieve the benefits.

9:50 – 10:30 **Panel Discussion – International Experience**
Mr. Peter Bradford (USA)
Mr. Peter Egger (Australia)
– 15 minutes each + 10 min Q&A

Objective:
Each speaker should focus on:
(a) the policy objectives for introducing competition and the institutional background in which competition was introduced;
(b) the expected benefits of reform and the actual benefits achieved;
(c) problems experienced during implementation
(d) useful lessons from the implementation experience (what should have been done differently)

10:30 – 10:45 Coffee Break

10:45 – 11:25 **Panel Discussion -- International Experience (continuation)**
Ms. Sally Hunt (UK)
Mr. George Gilboy(USA)
Mr. Luis Caruso (Latin America)
– 10 minutes each + 10 min Q&A

Session III **Introducing Competition in Stages – A Framework for Discussion**
Chairperson: Madam Song Mi, Director General of DBI, SDPC

11:25 – 12:00 **Staged Introduction of Competition – A Framework**
Mr. Peter Egger

Objective
To provide a concise overview of:
(a) the proposed 3-stage approach to gradual introduce and expand competition in the Chinese power sector – stressing the structural, institutional and capacity building requirements at each stage;
(b) the appropriateness of implementing competitive power markets at two-levels, the provincial level and the regional level;
(c) why stage 1 (generator competition) is an important transitional stage and the main benefits will accrue from a rapid transition to wholesale competition.

12:00 – 12:30 **Questions and Open Discussion**

12:30 – 1:30 Lunch

Session IV **Separation of Generation from Transmission and Distribution**
Chairperson: Mr. Li Yanmeng, Vice Director General of DI, SDPC

1:30 – 1:45 **Generation Ownership Linkages in China**
Mr. Ranjit Lamech, The World Bank

Objective

To provide an introduction to:
(a) cross-holdings and vertical ownership linkages that exist in China;
(b) key issues/problems that arise from such ownership linkages when competition is to be introduced (e.g. discriminatory dispatch and access, market power, etc.)
(c) stranded costs that might arise when competition is introduced

1:45 – 2:00 **Discussant**:
Mr. Hao Weiping, Deputy Director, DBI, SDPC,
Representatives from SETC
Representatives from SPCC

2:00 – 2:30 **Generation Separation – Key Considerations and Transitional Issues**
Mr. Eliot Wessler

Objective
(a) to show how ownership of generation by transmission and distribution companies, and generator market power, has or can undermine competition;
(b) mandating and implementing generation separation/divestiture;
(c) review the different mechanisms to deal with stranded costs – their advantages and disadvantages;
(d) discuss regulatory safeguards and practice to ensure that generators will behave competitively, by reference to the experience in US power markets and the role of FERC and the State Commissions.

2:30 – 2:45 **Discussant**:
Mr. Wayne Shirley

2:45 – 3:00 **Questions and Open Discussion**

3:00 – 3:40 **Panel Discussion: Generation Separation/Divestiture – International Practice**
Mr. Luis Caruso (Latin America)
Mr. Harvey Salgo (India)
– 15 minutes each + 10 min Q&A

Objective:
Each speaker should provide an overview of:
(a) the mechanism used to implement generation separation – the tradeoffs (firm size and composition); the options evaluated; reasons for method/process selected; how the process was conducted; what were the outcomes.
(b) useful lessons for China.

3:40 – 4:00 Coffee Break

4:00 – 4:40 **Panel Discussion -- Generation Separation/Divestiture -- International Practice**
Mr. Peter Bradford (USA)
Mr. Peter Egger (Australia)
– 15 minutes each + 10 min Q&A

4:40 – 5:30 **Questions and Open Discussion**

Day 2 – October 10th

Session V	**Restructuring Transmission and Distribution** Chairperson: Madam Song Mi, Director General of DBI, SDPC
8:30 – 8:50	**Preparing for Wholesale Competition** *Mr. Peter Egger* Objective To review and emphasize the key requirements and conditions that must be satisfied to move to stage 2 (wholesale competition) – focus on main transmission and distribution restructuring issues. Presentation will introduce the main issues to be considered for the transition.
8:50 – 9:20	**Restructuring Transmission to introduce competition** *Mr. Luis Caruso* Objective Provide a clear overview of the transmission restructuring required to implement competitive power markets. Focus on: (a) open access and ownership issues; (b) principles and policies to ensure integration of provincial and regional markets.
9:20 – 9:40	**Discussants***:* *Mr. Wayne Shirley* *Mr. Eliot Wessler* *Mr. George Gilboy*
9:40 –10:00	**Questions and Open Discussion**
10:00 – 10:40	**Panel Discussion: Preparing the distribution sector for wholesale competition** *Mr. Peter Egger, (Australia)* *Mr. Luis Caruso (Latin America)* *– 15 minutes each + 10 min Q&A* Objective Each speaker should outline the key steps taken to restructure distribution in the above countries/regions. Focus on: (a) criteria/process used in defining the number and size of distribution firms; (b) how changes in ownership were implemented (c) capacity building needs and preparing distributors to handle power purchase risks
10:40 – 11:00	Coffee Break
11:00 – 11:40	**Panel Discussion: Preparing the distribution sector for wholesale competition (continuation)** *Mr. Wayne Shirley (USA)* *Mr. George Gilboy(USA)* *Ms. Sally Hunt (UK)* *– 10 minutes each + 10 min Q&A*

11:40 – 12:30	**Questions and Open Discussion**
12:30 – 1:30	Lunch

Session VI	**Assuring Sustainable Development** Chairperson: Mr. Li Yanmeng, Vice Director General of DI, SDPC
1:30 – 1:45	**Environmental Sustainability Considerations in Power Market Reform** *Mr. Peter Bradford* Objective To review key considerations and safeguards that may be built into the reform process to ensure an environmentally sustainable market transition.
1:45 – 2:00	**Assuring Sustainable Development** *Mr. David Moskovitz* Objective Describe the role of the power sector in environmental protection and the opportunities and options to carry out reforms to produce environmentally beneficial results.
2:00 – 2:30	**Questions and Open Discussion**

Session VII	**Legal and Regulatory Reform for Competitive Power Markets** Chairperson: Mr. Li Yanmeng, Vice Director General of DI, SDPC
2:30– 3:00	**Competitive market implementation within the existing legal framework** *Mr. Harvey Salgo* Objective To discuss how competition can be introduced within the boundaries of the existing legal framework. This discussion should be based on a review of the existing Electricity Law in China (1995) and should aim to show the extent of key reforms possible without fundamental changes to the Law.
3:00 – 3:15	**Discussant***:* *Mr. Clifford Garstang*
3:15 – 3:30	Coffee Break
3:30 – 4:00	**Regulatory Requirements** *Mr. Peter Bradford* *Mr. David Moskovitz* Objective To expand on the main points in the 1996 report on power regulation in China, with the discussants stressing the split Federal-State regulatory experience in the USA and Indian. To discuss: (a) recommended institutional and functional separation of regulatory functions at the Central and Provincial levels; (b) clarify the roles and functions of the Central and Provincial regulators.

4:00 – 4:20	**Discussants***:* *Mr. Eliot Wessler (USA)* *Mr. Harvey Salgo (India)*
4:20 – 5:00	**Questions and Open Discussion**

Session VIII	**Workshop Summary** Chairperson: Mr. Li Yanmeng, Vice Director General of DI, SDPC
5:00 – 5:30	**Workshop Summary** Madam Song Mi, Director General of DBI, SDPC (Assisted by Harvey Salgo, Zhao Jianping, Sally Hunt, Peter Bradford, Wayne Shirley)

WORKSHOP PARTICIPANTS

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56	Wu Xuan	State Power Economic Research Center	
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60	Wang Binghua	SPCC	Deputy Director
61	Qi Zhijian	SPCC	
62	Zhao Zunlian	SPCC	Director
63	Xu Weiliang	SPCC	
64	Jiang Shaojun	SPCC	Director
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84	Xia Qing	Tsinghua University	Deputy Dean
85	Yan Maosong	Shanghai University	Professor
86	Yuan Feng	Beijing Zhongjingtong Investing Consultant Ltd.	Vice President
87	Zai Aimin	Beijing Qianheren Science and Technology Corp. Ltd.	
88	Gong Zhengzheng	China Daily	Journalist
89	Xie Haoran	Economic Daily	Journalist
90	Liu Wei	China Economic Herald	Journalist
91	Shi Shilin	China Economic Herald	
92	Wang Shuishi	China Economic Herald	
93	Tan Yajia	China Economic Herald	
94	Lu Bicheng	China Economic Herald	Editor and Journalist
95	Feng Yajing	China Economic Herald	Deputy Director
96	Liu Lijun	Economic Herald	

97	Zhang Kuanlin	People's Daily	Editor and Journalist
98	Pan Shantang	Beijing Branch of Xinhua News Agency	Deputy General Manager
99	Wang Shumin	Guohua Electric Power Company	Deputy General Manager
100	Cao Leren	Huaneng Group Company	Deputy General Manager
101	Sun Yaowei	Huaneng Group Company	Division Director
102	Li Yanxi	China Development Bank	
103	Jiang Zhaozu	China International Engineering Consulting Company	Deputy Director
104	Liu Jingsheng	China International Financial Company Ltd.	Deputy General Manager
105	Guo Jiang	China Energy Saving Investment Company	Deputy Director
106	Jue Zongpan	China Consulting Company, Energy Projects Dept.	Director
107	He Yuansen	Sichuan Power Bureau	Assistant to the Director
108	Yang Weili	Xinjiang Power Bureau	Director
109	Han Huiming	Shandong Power Group Company	Director
110	Wu Donghui	Guangxi Power Company Ltd.	Deputy Director
111	Shi Hongde	Ertan Hydro Power Development Corp. Ltd.	Deputy General Manager
112	Tang Yizhi	Hainan Power Company Ltd.	Secretary General
113	Zhu Jiben	Shanghai Baogang Power Plant	Head
114	Gan Guangzhong	Shanghai Baogang Power Plant	
115	Luo Shanbao	Guizhou Power Corporation	
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121	Wang Wanfeng	Henan Jiaozuo Wanfang Group Company	Director
122	Mao Yushi	Tianze Company	Council
123	Yang Mingzhou	China Power Enterprise Union	
124	Wang Yonggan	China Power Enterprise Union	Vice Secretary General
125	Zhang Changyuan	China Power Enterprise Union	
126	Tang Zhongnan	North China Power Corporation	Adviser
127	Pan Kunhua	China Investment Power Company of China Development and Investment Corporation	Vice General Manager
128	Gao Lingyun	International Cooperation Agency for Tourism in People's Consultative Conference	Vice General Manager

Representatives from the Energy Foundation

129	Steve Judd	Energy Foundation	
130	Yang Fuqiang	Energy Foundation	
131	Peter Bradford	Energy Foundation	
132	David Moskovitz	Energy Foundation	
133	Douglas Ogden	Energy Foundation	
134	Lu Hong	Energy Foundation	
135	Wayne Shirley	Energy Foundation	

Representatives from the World Bank

136	Yukon Huang	World Bank, Beijing	Country Director and Chief of Mission
137	Yoshihiko Sumi	Energy & Mining, World Bank, Washington DC	Sector Director
138	Noureddine Berrah	World Bank, Washington DC	Lead Energy Specialist
139	Elaine Sun	World Bank, Beijing	Lead Energy Specialist
140	Zhao Jianping	World Bank, Beijing	Senior Energy Specialist
141	Cliff Garstang	World Bank, Washington DC	Senior Legal Counsel

142	Ranjit Lamech	World Bank, Washington DC	Senior Energy Specialist
143	Sally Hunt		Consultant
144	Peter Egger		Consultant
145	Luis Caruso		Consultant
146	Harvey Salgo		Consultant
147	Other Representatives		
148	Lei Meiling	Royal Netherlands Embassy	
149	Bai Ailian	Commercial Section, Australian Embassy	Commercial Attache
150	Wang Ying	Commercial Section, Australian Embassy	Project Officer
151	Peng Yan	Development Section, UK Embassy	Project Officer
152	Xavier Chen	International Energy Agency (IEA)	Special Assistant to the President
153	Penny De Vual	British Embassy, DFID	
154	Luo Shike	Cambridge Energy Research Associates	
155	Gao Chengzhi	Cambridge Energy Research Associates	
156	Gilbert Gilboy	Cambridge Energy Research Associates	
157	Eliot Wessler	Federal Energy Regulatory Commission (US)	Director

SECTION 2: SUMMARY OF INTERNATIONAL EXPERIENCE

POWER SECTOR RESTRUCTURING IN AUSTRALIA

The national electricity market in Australia was formed as the result of many events. Some of the events occurred at the national government level and some of the events occurred at the jurisdictional government level. The early events were experienced during the 1980's. Many of the events occurred during the 1990's.

The national electricity market was finally formed as a cooperative legal agreement between five of the eight jurisdictional governments in Australia. These were: NSW, Victoria, Queensland, South Australia and the Australian Capital Territory and they are known as the "participating jurisdictions." The remaining jurisdictions (Tasmania, Northern Territory and Western Australia) have an opportunity to join the national electricity market at some future time, in accordance with the National Competition Law and their individual electricity reform objectives.

In 1989, the National Government established an inquiry into the efficiency of the energy industry in Australia. This was the trigger for the development of the national electricity market. It took another ten years for the electricity supply industry to be re-organized to a point where the national electricity market could commence.

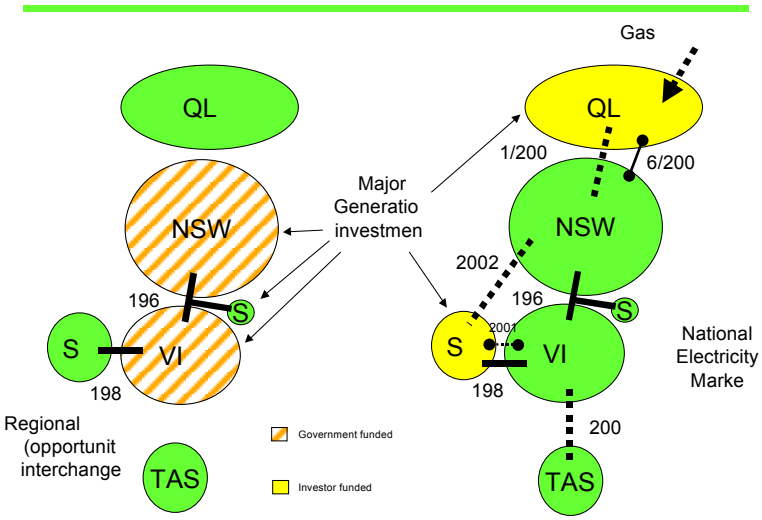


Figure 1 : Electricity supply arrangement before and after market commencement

During the ten-year period (1989 to 1998), each participating jurisdictional government (as well as the national government) became involved in the design issues associated

with development of an electricity market. Before explaining the unique issues that each jurisdiction encountered during the ten-year period, it is useful to consider the electricity supply arrangements prior to and after the formation of the national electricity market. This can be best described by reference to Figure 1.

The left-hand arrangement shown in Figure 1 describes the electricity supply industry before the commencement of the national electricity market. The jurisdiction of the Australian Capital Territory is shown as "S" which represents Snowy Hydro as well as the load center of Canberra. Each jurisdiction had an electricity supply industry. The jurisdictions of NSW, Victoria, Australian Capital Territory and South Australia were interconnected and operated on the basis of a commercial contract, known as the "Interconnection Operation Agreement". This operated in a manner similar to the proposed East China Regional Market, except that it was cost based (rather than price based). The contract was structured on the principle of a voluntary bilateral contract and allowed jurisdiction A to sell power to jurisdiction B if the cost of production in jurisdiction A was cheaper than the cost of production in jurisdiction B. The Interconnection Operation Agreement was in operation nine years prior to the commencement of the national electricity market. It will be noted in the left-hand arrangement that the electricity supply industries of Queensland and Tasmania were isolated. There was no interconnection between Queensland and NSW, and there was no interconnection between Tasmania and Victoria. Plans to form these interconnections had been discussed but funding could not be easily justified. Justification became easier after the commencement of the national electricity market due to the involvement of private investors.

The right-hand arrangement shown in Figure 1 describes the electricity supply industry in December 2000, two years after the start of the national electricity market. The "opportunity interchange" contract between NSW, Victoria, Australian Capital Territory and South Australia has been terminated and replaced by the National Electricity Code (market rules). The Queensland government had agreed to operate its isolated electricity supply industry in accordance with the National Electricity Code from the start of the national electricity market. However, the Tasmanian government did not join the national electricity market in 1998. Instead, it has nominated 2003 as the date when it will operate its electricity supply industry in accordance with the National Electricity Code. In the period between 1998 and 2000 the Tasmanian government has operated an isolated power market based on Tasmanian government approved market rules and will continue with these rules until interconnection with Victoria is in place.

The impact of the national electricity market on the formation of interconnectors can be observed from Figure 1. A new direct current interconnector (approximately 200 MW capacity) was commissioned between NSW and Queensland in mid 2000. A new alternating current "regulated" interconnector (approximately 1,000 MW capacity) is being built between NSW and Queensland and is to be commissioned in January 2001. A new alternating current interconnector (approximately 250 MW capacity) is planned to link South Australia with NSW and is due for commissioning in the year 2002. A new direct current interconnector (approximately 200 MW capacity) is approved to connect Victoria with South Australia during the year 2001. The capacity of the new interconnector planned to interconnect Tasmania with Victoria in 2003 will be approximately 600 MW. The funding of these interconnectors has been justified largely on the relative prices of each wholesale price region which has been established as part of the national electricity market.

The right-hand arrangement shown in Figure 1 also identifies shifts in generation investment that have occurred since the commencement of the national electricity market. The national electricity market quickly changed the focus of generation funding. The pool prices in NSW and Victoria dropped to very low values due to surplus power plant capacity, whereas the pool prices in Queensland and South Australia rose to high values due to a lack of generation capacity. As a consequence, all investment in power plants shifted to Queensland and South Australia and stopped in NSW and Victoria. The shifts in resource funding for both interconnectors and power plants was one of the fundamental objectives of the national electricity market and in this regard the national electricity market has been an outstanding success. In addition, the building of a natural gas pipeline between Papua New Guinea (PNG) and Queensland has become a major investment project and is based on the emerging energy market opportunities and environmental limitations of coal.

This Attachment will explain how each government (national and jurisdictional) was affected by the reform process, the changes required to the regulatory framework and how the industry was restructured as reform developed.

National Government Involvement

In accordance with the Australian Constitution, the National Government had only a small direct involvement in the electricity supply industry. This was associated with the development of the Snow Mountains Hydro Electricity Scheme during the 1950s and 1960s due to the involvement of the three jurisdictional governments who were affected by the water contained within the scheme. In the 1980's the National Government assisted the jurisdictional governments of South Australia, Victoria and NSW by coordinating the plans for interconnection between Victoria and South Australia.

During the 1970's and early 1980's instances of inefficient practices were evident in many jurisdictions. During the 1980's the national government became concerned with the poor performance of generating plant in all jurisdictions, the massive funding required for each power plant and the competition for these funds between the jurisdictional governments. This became particularly evident once the exchange rate was floated in 1983. Evidence of electricity industry funds being used by jurisdictional governments on other industry initiatives, or in non-productive infrastructure was observed. Commercial and administrative accountability was low due to past structural barriers.

In 1989 the National Government undertook a productivity review of the national energy industry and concluded that savings of around A$6 billion could be achieved if the industry was reformed. This review coincided with the work being carried out in England for the commencement of a National UK electricity market in 1990. In conjunction with this review, the National Government established the Council of Australian Governments (COAG), a forum for national cooperative decision making on areas where the National Government did not have direct constitutional power.

In 1990, the National Grid Management Council (NGMC) was formed, funded in part by the National Government and the jurisdictional governments, to facilitate the design of a national electricity market. The NGMC, which consisted of government and industry officers, became the interface between COAG and the electricity industry. The NGMC

set up many committees and working groups supported by people from electricity industry organizations across the nation. In effect, the NGMC became the project manager for the introduction of market rules and market information systems. The Council was later (1997) replaced by NEMMCO and NECA, when all governments had agreed the structure of the market.

Following on from the productivity review, the National Government undertook a second review in 1992 and 1993, this time on "competition policy". This review provided the foundation for a new national Competition Law, which aimed to provide third party access to government assets and infrastructure. Competition Law covers much more than the electricity industry – it covers gas and water, railways, ports, telecommunications, the legal systems, the medical system, etc. The Australian Competition Law was established in 1995 and applied to all jurisdictional governments. To implement the Competition Law, the National Government created a new government agency called the Australian Competition and Consumer Commission (ACCC). This new agency was formed by the amalgamation of two previous agencies (the Pricing Surveillance Authority and the Trade Practices Commission).

Amending the existing national Trade Practices Act 1974 formed the statute on Competition Law. This arrangement had the effect of making the ACCC the national economic regulator for all industries and the protector of consumer's rights. The ACCC has been given legal powers to enforce the Competition Law and to impose penalties for a breach of the Law. The National Government also established a National Competition Council to monitor the performance and advise on policy for Competition Law. Both the ACCC and the NCC act on behalf of the National Government, but operate at "arms length" from the National Government. Together, the NCC and the ACCC operate to administer and maintain competition policy, allowing the National Government to "independently" consider the strategic implications of that policy and to enhance the policy where necessary. For this reason, the ACCC is often referred to as an "independent" regulator, whereas it is more accurately referred to as a national industry regulator.

For 8 months, between November 1993 and June 1994, the National Government and jurisdictional governments of NSW, Victoria, Queensland, South Australia, Tasmania and the Australian Capital Territory agreed to participate in a national Paper Trial. Most electricity businesses within each jurisdiction participated in the exercise. This Paper Trail was organized to operate in parallel with existing organizational activities – for this reason, none of the existing commercial arrangements were modified. The exercise was similar to a nation wide university modeling experiment, where the generation bids were made in accordance with real plant availability, but the exercise did not impact on the actual dispatch of generating units. Separate market rules were prepared to govern the Paper Trail, market information systems were specially designed and built (although much was leveraged off the NSW internal market practices at the time), and settlement of the market was undertaken on a monthly cycle. An official audit of the conduct of the Paper Trail was undertaken and conclusions drawn as to the merits of the market rules.

The Paper Trial resulted in the following two significant events:

- A national committee was formed to manage the design and preparation of a set of national market rules (later to become the National Electricity Code) for wholesale competition, access to transmission infrastructure and administrative practices.

- Each jurisdictional government raised the level of commitment to electricity reform. The Victorian government who introduced an early version of competition in wholesale electricity in July 1994, immediately after the finish of the Paper Trial led this.

Competition Law was the foundation stone for the introduction of competition in the electricity industry. At the same time as this Law was being prepared (1994 and 1995), the Council of Australian Governments approved policy statements on the formation of a competitive electricity industry (April 1995), firming up on the introduction of a national electricity market and the objectives of such a market. These policy statements became the guidelines for the lower level activities undertaken by jurisdictional governments and industry as it considered the commercial and political implications of the structural changes necessary to introduce competition in electricity. The major objectives established to guide the formation of the national electricity market were:

- The market should be competitive;
- Customers should be able to choose which supplier (including generators and retailers) they will trade with;
- A person wishing to enter the market should not be treated more favorably or less favorably than if that person were already participating in the market;
- A particular energy source or technology should not be treated more favorably or less favorably than another energy source or technology;
- The provisions regulating trading of electricity in the market should not treat intrastate trading more favorably or less favorably than interstate trading of electricity.

Up to 1997, each jurisdictional government had legislative powers to control the electricity industry in their jurisdiction. This “decentralized” model had worked extremely well for 100 years, but evidence of inefficient practices suggested that a “new decentralized” model which removed jurisdictional boundaries was needed. In 1997, as a result of cooperation between jurisdictional governments, the National Electricity Law was introduced which permitted the introduction of a national electricity market.

The new National Electricity Law was established in such a way as to allow jurisdictional governments the choice of participating in the Law. The National Government offered an innovative funding incentive to encourage the jurisdictional governments to exercise their choice in a favorable way. Whilst all jurisdictional governments supported the policy statements arising from the COAG meetings, only five of the jurisdictional governments elected to participate in the formation of the national electricity market. The historic agreement was signed in 1997 and allowed for the formation of the national electricity market. This “market” was a collection of electricity systems all operating under the same set of market rules. Although one electricity system was isolated from the other systems, it was still operated as part of the national electricity market structure. This means that the same set of market rules, the same Market and System Operator, and the same industry regulator were used to manage the isolated electricity market within that jurisdiction. The design of the market information systems was identical in the isolated electricity system, as were the administrative processes. The jurisdictional government of the isolated electricity system chose this arrangement to remove the harmonization shock that would have otherwise occurred at the time of interconnection, planned for several years after market commencement.

The National Electricity Law is a relatively short and simple statute that provides governance of the electricity market. It establishes the following key structural elements:

- two incorporated companies (the National Electricity Market Management Company and the National Electricity Code Administrator);
- a National Electricity Code (the market rules);
- a National Electricity Tribunal, to manage the enforcement of the National Electricity Code; and
- penalties for the breach of the National Electricity Code.

The National Electricity Market Management Company (NEMMCO) is a company formed under Company Law with shareholders. Shareholding is restricted to the governments of each participating jurisdiction, with one share being held by a nominated Minister from each jurisdiction. NEMMCO is responsible for operating the national electricity market in accordance with the National Electricity Code and for developing the market so as to improve its efficiency. National Electricity Market Management Company (NEMMCO) carries out the role performed by a "Market and System Operator", and is separate from the transmission network companies. At the time of choosing this model, the Victorian government was operating with a market and system operator that was separate to transmission, whereas the NSW government was operating with a combined transmission, market operator and system operator. The advantages and disadvantages of both structures were available to guide the final national solution.

The National Electricity Code Administrator (NECA) is a company, also formed with shareholding jurisdictions, but with responsibilities for providing "light handed regulation" of the national electricity market, including providing formal controls for any changes to the Code. NECA's role includes enforcement of the Code and the assessment of any breaches. The National Electricity Code is a legal instrument (similar to a Regulation) but with a formal public consultation and approval process that involves both NECA and the ACCC.

The national electricity market was established as a wholesale market with multiple sellers (generators) and multiple buyers (retailers), separate transmission network businesses and separate distribution network businesses. The wholesale market commenced in December 1998. In July 1999 the regulation of all transmission network businesses (transmission prices and quality of service) was passed from the separate jurisdictional regulators to the ACCC in accordance with transitional arrangements contained within the National Electricity Code. The regulation of the distribution networks remains with the jurisdictions until such time as they agree to hand this responsibility to the ACCC. Responsibility for the development of the retail electricity market also remains with the jurisdictional governments, unless they request assistance from the National Government or unless their policies impact directly on the wholesale market. Not withstanding this separation of responsibility for the retail markets, the jurisdictional governments must restrict their retail competition policies to the guidelines established by the national Competition Law. If a breach of Competition Law occurred, the ACCC would be able to intervene.

The development of the retail competition market is now the major focus for the

governments of Australia. The retail competition rules partly involve modification to the National Electricity Code and partly require the development of new rules to protect customers. The jurisdictional governments are working together to develop, wherever possible, national policies and processes to govern retail competition. However, each jurisdictional government has to consider the implication of retail reform on the different experiences and practices within their jurisdictions. As a consequence, they require control of policy design and timelines to effect a smooth transition to a national competitive retail market in electricity.

Formation of the National Electricity Code (Market Rules)

The national electricity market is governed by the National Electricity Code (market rules). This Code was developed over many years in accordance with directions provided by the National Grid Management Council.

In the period between 1990 and 1993, the NGMC published several policy guidelines on possible elements of a competitive electricity market. These guidelines resulted in the formation of a set of market rules for the management of the national Paper Trail (late 1993 and 1994). In late 1994, after the completion of the Paper Trail, the NGMC formed a National Market Code Development Committee. It was within this committee that the structure and content of the National Electricity Code, as it operates to day, was formed.

The National Electricity Code consists of two major parts, the competition rules and the access rules. The competition rules govern the trading arrangements for sellers and buyers in the wholesale electricity market. The access rules govern support functions, such as connection to the transmission network, transmission pricing, system security arrangements, dispute resolution, enforcement rules and rule changes. Both parts are required to be separately approved by the ACCC in accordance with Competition Law.

During the course of preparing the draft National Electricity Code, each jurisdiction made use of its emerging characteristics. For instance, the early 1996 version of the draft National Electricity Code was used by the NSW government to form the basis of the NSW market rules. This was beneficial, since it minimized harmonization shocks at the time when the market became national, and it was an opportunity to test the viability of the draft rules. In 1997, the Queensland government made use of the pending National Electricity Code as the market rules for their isolated electricity market. Additional rules were added to manage the transitional rules required by each government. In 1998, Tasmania used the structure of the National Electricity Code as the foundation for their isolated electricity market even though the government had not formally joined the national electricity market. Between 1996 and 1998, Victoria progressively adjusted their jurisdictional market rules to adopt the emerging new national market rules.

The National Electricity Code and its amendments are required to be approved by the ACCC in accordance with the competition requirements of the national Trade Practices Act 1974 (Competition Law). The final draft of the National Electricity Code was submitted to the ACCC in October 1996. The approval process was managed in the following way:

- The draft National Electricity Code was formally submitted by the NGMC in November 1996.
- The draft National Electricity Code was published as a public document.

- The ACCC carried out an investigation on the anti-competitive elements of the National Electricity Code.
- The ACCC invited submissions on the draft National Electricity Code from industry, interested parties, consumers and the public.
- The ACCC released two interim determinations, one in support of the competition rules and one in support of the access rules. The ACCC advised of changes that they required enabling each part of the Code to be approved.
- The ACCC conducted a public conference on the National Electricity Code to consider the issues regarding the interim determinations.
- As a result of comments raised at the public conferences, the ACCC reviewed its interim determination and published a final determination.
- The National Electricity Code was then formally converted into a legal document.

The approval process by the ACCC took over 2 years to complete. The development process, from commencement in 1994 to formal approval in 1999, took nearly five years to complete. It is noted that the period of five years is conservative, since the ability of the teams to prepare such a large and complicated document was assisted by the experiences gained from the National Paper Trial and the experiment with an internal market prior to that period.

It can be observed that the task of preparing and approving the first set of market rules, which are to apply nationally to all electricity businesses, is a large exercise and its formation and approval should not be rushed. Further, by the time the market rules are submitted to the national regulator for approval, the national regulator has to have mature skills in place to manage the large task of examining the submission and forming a conclusion as to the merits of the competition and access rules presented in the document.

Changes to the National Electricity Code follow a similar process, but in general the time for investigation and approval is reduced. Nevertheless, a period of six to twelve months could be expected when seeking to make changes to the National Electricity Code. The process has been designed to ensure that adequate industry and public consultation has been carried out on any Code change proposal and that the proposal does not introduce anti-competitive barriers.

NSW Government Involvement

BACKGROUND EVENTS

In 1950 the NSW electricity industry was restructured following years of significant shortages of power. At this time, the local (community) governments were restricted to retailing and network activities (the interface with the consumers) and all responsibility for generation (and subsequently transmission) was handed to a new organization (the Electricity Commission of NSW, later to become Pacific Power). The number of local electricity distributors was reduced from approximately 190 to 42 at this time by amalgamation. This is an important starting point for market reform in NSW as it created commercial interfaces, and hence a higher level of accountability, between all entities.

The NSW electricity industry had been developed on a large source of black coal. During the next 20 years, transmission development allowed power plant expansion to

occur at coal mines away from cities and power supply enjoyed a period of stability. During the 1970s the NSW government recognized that inefficient practices were developing within the electricity industry, however an expected energy boom in the late 1970s masked this growing issue. This was compounded by the underground mining techniques used in NSW (compared with the open cut techniques available in Queensland)

In the period 1980 to 1985, the NSW electricity system experienced a series of significant events, including the failure of three out of four generating units at a relatively new power plant, low availability of power plants (around 65%), swings in load growth, from positive 5% to negative 2%, large increases in electricity tariffs (25% in one year), funding restrictions for the completion of an approved power plant expansion program, environmental concerns preventing the opening of an open cut coal mine and management resistance to providing timely information. During this period, an opportunity was taken by the government to reduce the number of Distributors from 42 down to 25 through amalgamation of smaller entities to form larger entities.

Between the mid 1980s and 1990, the NSW government commenced administrative reform of generation and transmission management structures.

FORMATION OF AN "INTERNAL" ELECTRICITY MARKET

In 1989 and 1990, the NSW government, through its generation and transmission corporation, examined the developments of the UK electricity market and approved an initiative to introduce “internal” competition within the organization. In 1991, a restructure of the organization into competing business units was carried out, followed by the introduction of an internal electricity exchange “ELEX market” in January 1992. The internal market commenced as a “variable and fixed capacity contract” market to enable commercial practices to be introduced across the organization, not only in power plants but also in all service entities in other parts of the organization (such as Information Technology services). Once these new processes had been established, the market was transformed into an energy pool, which was essentially a mandatory power pool with a corporate finance unit as the single buyer). This internal power market was ring fenced in the accounts from the external tariffs and revenue arrangements with Distributors. Hence, there was no impact on consumers. However, the internal cost of generation could now be tracked using the internal market systems and a comparison made with external tariffs.

Many advantages were able to be derived from the operation of the ELEX market. These are summarized as follows:

- The design of the UK market was able to be tested and refined. Several design features were not utilized, such as capacity uplift payments, since they were considered to introduce distortions into the spot price.
- Separation of transmission from market and system operation was tested.
- Transmission pricing issues were able to be explored.
- The concept of financial contracts (CfDs) was able to be tested.
- The many detailed issues involved with introducing market information systems were experienced.
- Market settlements processes were able to be developed and refined.

- Internal service agreements were introduced at the same time in most parts of the organization.
- The competition spirit influenced all parts of the organization in some way, with many people trained in competitive market concepts.
- Debate on market reform principles at the national level was able to be entered into with detailed knowledge and insight as to the merits of adopting one approach over another. This was particularly important during the national Paper Trial, where many of the concepts identified in the ELEX market were tested across the participating jurisdictions.

These internal competition arrangements remained until 1995, at which time the internal market was reformed to enable the NSW government to commence an external wholesale competitive power market.

The NSW government supported the COAG policy on electricity market development and participated in the development of the National Electricity Code.

FORMATION OF THE NSW ELECTRICITY MARKET

In 1995, the NSW government changed the NSW Electricity Law to allow for the formation of competitive power markets. This included the formation of a separate Law to manage the Transmission network, the market operator and the system operator. At the same time, the government decreased the number of distributors (from 25 to 6) and increased the number of generator companies from (1 to 4) as well as allowing private generation to enter the market. At this time, the transmission business within the power company was formed into a separate government owned agency.

These structural changes were completed in time for a commencement of the NSW electricity market in March 1996, with multiple sellers and multiple buyers. The market operated for two months with an administered price cap (similar to having a 100% vesting contract) whilst all market information systems were tested. In May 1996, the administered price cap was removed and the market operated as a spot energy pool market, supported initially with simple vesting CfDs set at 85% of the system demand. All sellers and buyers were able to negotiate CfDs for the remaining 15% of the market. The vesting contracts were scheduled to progressively lower their coverage in steps, and to be phased out at the end of 2000, in line with the Victorian government vesting contracts. As the vesting contracts dropped off in quantity, the sellers and buyers were able to enter into negotiated CfD contracts to manage their risk exposure.

The NSW market commenced in March 1996 with the latest available draft market rules that had been prepared for the national electricity market. At this time, national Competition Law was in operation and the ACCC was required to authorize the rules, including the use of vesting CfD contracts to manage the transition funding impacts from the market on participants.

The market operated smoothly and in May 1997 the NSW market was harmonized with the Victorian market to allow trade to flow across the jurisdictional boarder. For a period of 14 months (March 1996 to May 1997) the Interconnection Operation Agreement" did not operate since it was cost based and required generators (who by now were competing companies) to share their costs of production. This limitation created an

urgent need to combine the isolated NSW and Victorian electricity markets. The harmonized NSW and Victorian markets operated for a further 18 months (until December 1998) at which time responsibility for managing the separate NSW and Victorian markets were handed over to NEMMCO and NECA.

During 1996, retail market contestability for consumers became an important priority for the NSW government. Each distributor was allocated a License to operate as a retailer and a License to operate as a network business within NSW. Codes of Practice, in matters such as customer service standards, accounting practice and metering, were established to ensure that the distribution businesses operate within government policy guidelines. A retail market development program was introduced with only the large consumers being able to select their retailer in the first few years.

The development of the retail market is the major topic of reform for the NSW government at the present time. In December 2000 the NSW government passed legislation to require distribution companies to allocate their network and retail businesses to separate incorporated companies. This program is required to be completed prior to July 2001.

RESTRUCTURING OF GENERATION, TRANSMISSION AND DISTRIBUTION

In 1994, at the completion of the Paper Trial, the NSW government placed the transmission function of the power company into a subsidiary company as the first of two steps to separate transmission from generation.

In early 1995, legislation was enacted to allow the transmission subsidiary to become a separate government agency. The NSW government approved an agency structure that consisted of a transmission function (500kV and 330kV), a market operator and a system operator, with the market and system operator functions being ring fenced from the transmission responsibilities. The power company was retained as a generation company consisting of seven power plants and a number of small hydro generators. A government policy unit was formed to advise on market implementation policy. NSW had already established an electricity industry regulator.

In mid 1995, the NSW government enacted legislation that required the amalgamation of the 25 distribution companies (132kV and below) into six larger distribution companies. Two of the distributors were city based whilst the other four distributors were rural based. The 2.7 million consumers in NSW (with maximum demand of approximately 11,800 MW) were allocated to the new distributors as follows:

- Company 1: city based with 1.3 million consumers;
- Company 2: city based with 0.7 million consumers;
- Company 3: rural based with 0.33 million consumers;
- Company 4: rural based with 0.11 million consumers;
- Company 5: rural based with 0.22 million consumers;
- Company 6: rural (outback) based with 0.05 million consumers;

The companies were formed with new Boards of Directors, a new Managing Director and shareholding restricted to the NSW government. The new companies were given six months to complete their amalgamation program and preparation for competing in the

wholesale electricity market.

In early 1996, the NSW government separated the power plants (total capacity of approximately 14,300 MW) into four companies with each company having the following features:

- Company 1: two coal power plants with eight units and a total capacity of 4,640 MW.
- Company 2: four coal power plants with eight units and a total capacity of 4,240 MW.
- Company 3: one coal power plant with four units, two hydro power plants, one pump storage power plant and a total capacity of 2,900 MW.
- Company 4: NSW share of the Snowy hydro scheme with many units and available capacity of approximately 2,500 MW.

The companies were formed with new Boards of Directors, a new Managing Director and shareholding restricted to the NSW government. The formation of these new power companies was controversial and is generally regarded as a first step in the unbundling of generation. Reasons for the staged approach involved shared infrastructure, capacity concentrations at several sites, long term coal contracts, and labor opposition. In 1997 a major study was carried out into the further separation of the power plants but due to major community opposition and the pending Olympic games program, the reform agenda was placed on hold. It is possible that further unbundling will occur at some later stage.

In December 1998, at the commencement of the national electricity market, the NSW government handed over the system operation and market operation responsibilities of the transmission agency to NEMMCO. The transmission agency retained its planning and maintenance responsibilities and was transformed into an incorporated company with government shareholding.

Victorian Government Involvement

BACKGROUND EVENTS

The Victorian electricity industry was structured in a different way to the NSW electricity industry. In Victoria, one power company was responsible for all of the following functions: generation, transmission, system operation, distribution network and retail sales. The Power Company sold most of the electricity directly to consumers, but some was sold to a number of small municipal distribution companies, who in-turn on sold to consumers.

The Victorian electricity industry was established on a large source of brown coal. The impact of generation expansion was to concentrate power stations within a small locality, creating a large workforce within small townships. In addition, brown coal power stations are more expensive to build than black coal power stations. Hence, Victorian government had a higher funding requirement than the NSW government for the same capacity power plant. The concentration of generation capacity in a small area introduced environmental problems for the community, labor problems for the Victorian government and transmission design issues for the power company. These factors were expensive to manage and resulted in a funding difficulty, which became evident during the 1980s.

The funding difficulties were accompanied by large tariff increases, and subsequent reviews of the management of the power company. In addition, the generation expansion program adopted by the Victorian government in the mid 1980s created funding competition with the generation expansion program adopted by the NSW government. These issues were of such proportion as to create management tensions between the power companies in the Victorian and NSW jurisdictions. As a result, the Victorian government proceeded with its own generation expansion program creating a further funding difficulty. The totality of these problems created a funding crisis for the Victorian power company leading to a near-bankruptcy position.

In the early 1990s, and as a result of the funding crisis, the Victorian government initiated a privatization program to sell its power company generation assets. The program commenced slowly, but accelerated with a change in government in 1993. In that year the government announced the plans for a major restructuring of the Victorian electricity industry. In mid 1994, (and at the end of the National Paper Trail), the Victorian government commenced operation of the Victorian electricity market. The introduction of the electricity market was accompanied with a full restructuring of the power company.

The Victorian government supported the COAG policy on electricity market development and participated in the development of the National Electricity Code.

FORMATION OF THE VICTORIAN ELECTRICITY MARKET

The Victorian electricity market commenced in July 1994 as a "capacity pool" which contained spot trading for production in excess of the assigned capacity contracts. This design is generally known as a "net pool" and is the design that is currently being adopted by the UK government. The limitations of this design, when compared to the internal spot market operating in the NSW power company, were quickly identified.

In July 1995 the Victorian government transformed the "capacity market" into an energy pool ("gross market"). This competitive power market has a "pure" common clearing price, which was not distorted by capacity uplift payments. At the same time, the Victorian government introduced "vesting contracts" that were based on the CfD principle but which had some unusual conditions. These extra conditions added distortions to the market, as Victoria experienced in the years ahead. The vesting contracts were established for a period of five years (end of 2000) at which time they would cease. It was proposed that the sellers and buyers would then have the opportunity to replace the vesting contracts with negotiated CfD contracts (this activity is occurring at the current time). The vesting contracts were set at 95% of the demand and were set to reduce in accordance with the reduction in franchise consumer loads as these consumers became contestable.

In 1996 the Victorian government approved the refinement of the market rules to align with the emerging draft National Electricity Code which had been adopted by the NSW government.

In 1997, the Victorian and NSW governments endorsed, and the ACCC approved, the harmonization of the two individual market rules to enable market trades to be carried out across the NSW-Victorian border. The Interconnection Operation Agreement, which had been dormant for 14 months, was officially terminated. The harmonized market

rules commenced in May 1997 and formed the early version of a national electricity market with two wholesale price areas. At this time, the draft National Electricity Code had been submitted to the ACCC but had not received interim approval.

The harmonized market continued for another eighteen months before it was replaced by the national electricity market arrangements.

The development of the retail market is the major topic of reform for the Victorian government at the present time.

RESTRUCTURING OF GENERATION, TRANSMISSION AND DISTRIBUTION

Prior to mid 1994, the Victorian power company was a fully integrated structure consisting of generation, transmission, system operation, distribution and retail sales. With the commencement of the market, the power company was unbundled in several steps:

- In the first step (late 1993 to late 1994), all generation was allocated to a single generation agency, transmission was allocated to a separate agency, system operation and transmission expansion was allocated to a separate agency and distribution was allocated to five separate agencies. A government policy unit was formed to advise on market implementation policy. A new electricity regulator was formed.
- In the second step (1995), the distribution agencies were transformed into incorporated companies and sold to private investors. The sale program was completed within 12 months. Characteristics of the distribution companies, which covered 2.0 million customers (and maximum demand of approximately 7,700 MW), were as follows:
  - Company 1: rural based, with 0.53 million customers;
  - Company 2: city based, with 0.23 million customers;
  - Company 3: city/rural based, with 0.23 million customers;
  - Company 4: city based, with 0.52 million customers;
  - Company 5: rural based, with 0.47 million customers;
- In the third step (1996), the generation agency was separated into five incorporated generation companies and sold to private investors. The sale program was completed over the following two years. Characteristics of the generation companies, which had an installed capacity of approximately 8,200 MW, were as follows:
  - Company 1: coal fired, single site, 2 generating units with total capacity of 1,000MW;
  - Company 2: coal fired, single site, 4 generating units with total capacity of 2,000MW;
  - Company 3: coal fired, single site, 4 generating units with total capacity of 1,450MW;
  - Company 4: coal fired, single site, 8 generating units with total capacity of 1,600MW;
  - Company 5: gas fired, two power plants, 2 generating units with total capacity of 970MW;
  - Company 6: hyrdo, 10 power plants, 21 generating units with total capacity of 460MW;

— Company 7: Victoria's share of Snowy hydro scheme with many units and available capacity of 1,200MW;

- In the fourth step (1997), the transmission agency was transformed into an incorporated company and sold to a private investor.
- The system operation agency was expanded to include market operations and retained as a government agency until the start of the national electricity market in December 1998, at which time the agency responsibilities were passed over to NEMMCO and the agency closed down.

The major factor used in determining the manner in which the power plants and distribution consumers were grouped was the sale value of the company formed by the re-structure.

It is observed that the Victorian government approached the re-structuring of the transmission, system operation and market operation functions in a manner that was different to the NSW government. In Victoria, the reformed transmission company had responsibility for the maintenance of the transmission assets and for the connection of new customers. The transmission planning responsibilities (transmission expansion), the system operation responsibilities and the new market operation responsibilities were given to a separate and newly formed agency. At the start of the national electricity market, the transmission planning responsibility was transferred to another government agency.

As a contrast, in NSW the transmission agency was initially assigned responsibility for all functions (transmission planning, transmission maintenance, system operation and market operation). At the start of the national electricity market it retained the transmission planning responsibility.

Queensland Government Involvement

BACKGROUND EVENTS

The Queensland electricity industry had been developed on a large source of black coal. In the mid 1970s, the industry was structured in a manner similar to the NSW electricity industry, except that the corporations had limited commercial accountability and represented an agency structure rather than a commercial trading structure. The power agency had responsibility for generation and transmission, and there were seven separate distribution agencies. However, unlike NSW, a separate government agency was responsible for the generation and transmission planning program. In addition, Queensland had a larger geographic coverage but had a lower population than NSW. As a consequence, generation and transmission planning presented major funding problems.

Queensland face several major problems in the 1980s. First, they had a growing population, which was moving north from Victoria and NSW – generation expansion was not able to keep up with the growth in electricity demand. Second, they had to compete for funding allocations with the other jurisdictional governments. Third, they were confronted with labor problems (but unlike the other jurisdictions, these problems were experienced within the distribution agencies). However, Queensland had several major advantages over the other two jurisdictions. They had open cut black coal mines, which provided the lowest cost black coal in Australia. They also had good power plant

availability and low power plant manning levels, unlike the Victorian and NSW power companies.

In 1984, the generation and transmission entities (planning and operation) were combined and in this regard closely resembled the NSW power company, although government's management accountability was limited when compared to the NSW structure.

In the mid 1980's a tariff competition broke out between the Victorian, NSW and Queensland governments. Prior to this time, NSW was considered the tariff leader, followed by Victoria and then Queensland. However, as substantial tariff rises were being announced in NSW and Victoria, Queensland advised of a tariff reduction. By the early 1990s, Queensland had the lowest tariff of the mainland jurisdictions. This made Queensland an attractive place to live and the population grew, along with the growth in electricity. This overall performance added to the management reform initiatives undertaken within the NSW power corporation.

In the early 1990s, the Queensland government abandoned a planned hydro development of 600 MW due to environmental considerations. In addition, the government agreed to sell a large power plant to an aluminum producer to enable the expansion of the aluminum smelter to proceed. These two actions delayed the generation planning program and created substantial delays in adding future generation capacity. These delays had an unfavorable effect on the subsequent performance of the Queensland electricity industry.

In 1993 and 1994 the Queensland government participated in the National Paper Trial. The Queensland government supported the COAG policy on electricity market development and participated in the development of the National Electricity Code.

In early 1995, and to address the potential problem of a delay in the generation expansion program, the Queensland government agreed to the building of a transmission inter-connection with NSW (capacity of 500 MW – to be in service by 1999), the commissioning of approximately 750MW of fast start (but high priced) gas turbine power plants and the addition of base load generation capacity (between 600 and 1400 MW between 2003 and 2006). In early 1996, the following events occurred:

- The National Government was seeking commitments from jurisdictional governments for a national electricity market;
- The interconnection with NSW was meeting large community resistance, both from conservationists and land holders;
- The government lost the election, which was held in early 1996.

The new Queensland government negotiated a new transmission corridor with the community, increased the transmission capacity of the interconnector to 1000 MW and agreed to participate in the forthcoming national electricity market. The new government then set about the task of restructuring the power corporations to enable Queensland to participate in an electricity market.

The development of the retail market is the major topic of reform for the Queensland government at the present time.

FORMATION OF THE QUEENSLAND ELECTRICITY MARKET

For the above reasons, the formation of a Queensland jurisdictional electricity market was substantially delayed compared to Victoria and NSW.

In July 1997, the Queensland government commenced the first phase of an electricity market based on variable and fixed capacity contracts. This was the setting up phase and was followed in January 1998 with an energy pool market using the draft National Electricity Code as market rules and NEMMCO as the market manager. This gave NEMMCO a test market in which to operate and perfect its market systems prior to the official commencement of the national electricity market in December of that year. Note that in January 1998, Queensland was still operating as an isolated electricity system and that interconnection with NSW had been delayed until the end of 2000.

The Queensland government achieved enormous benefits form this early participation in the electricity market. First, the Queensland electricity growth rate was high and during the year the common clearing price rose to high levels and reached $5,000/MWh (the maximum value allowable under the market rules) in a few trading intervals. The impact of these price rises was to put pressure on:

power plant management to improve the performance of their plants; and
retail companies to improve their risk management techniques.

Second, in August of that year a major power plant had all units trip due to an internal equipment failure. The price rose to $5,000/MWh for many hours. The impact of this event was to alert all other power plant traders that a major event had occurred and that all available generation capacity should be immediately placed in service. The market response averted a major load shedding event with prices returning to normal as the units were returned to service. The event also signaled to other power plant managers to beware of this type of equipment failure problem and hence provided a faster communication of plant failure information than had occurred under previous arrangements.

Third, the Queensland government, in the years before market start, had established power purchase contracts with private investors equal to approximately 25% of market share. The government tried to renegotiate these contracts to enable the power plants to participate in the energy pool. However, the private investors, who were liable for loans that were secured by the contracts, were unwilling to renegotiate (or more accurately, their financiers were unwilling to accept a higher risk). As a consequence, the government established a Market Trader corporation and assigned the power purchase contracts to this entity. Based on long term forecast market prices the entity was projected to lose approximately $80m per year over the life of the contracts based on low pool prices. Actual performance was totally opposite. Due to the volatility in spot prices, focussed attention on the power purchase contracts to extract maximum gains from the contracts and advanced skills in risk management (compared to power plant operational skills), the Market Trader returned a surplus in the first two years of operation.

Fourth, and an extremely important event, one private investor was given permission by the ACCC (and in accordance with the National Electricity Code) to install a transmission inter-connector (with capacity of 180 MW) between NSW and Queensland. The private

interconnection was placed in service in mid 2000, in advance of the regulated inter-connector.

Fifth, the higher Queensland pool prices and the private investor interconnector put pressure on the regulated inter-connector to speed up its planned completion date.

Sixth, the higher pool prices published from the Queensland wholesale price area has encouraged private investors to seek generation Licenses in the Queensland jurisdiction. These private investors plan to add approximately 2,200 MW of coal fired generation to the Queensland region of the national electricity market over the next three years. In addition, a private investor has been granted a gas License to bring gas from Papua New Guinea to Queensland to support the Queensland government's environmental policy. The introduction of this quantity of natural gas into Queensland is expected to be accompanied by an additional 1,000 MW of medium priced gas fired generation.

Seventh, and due to the low cost coal fuel base and the large interconnection capacity about to be placed into service, Queensland expects to be a major electricity exporter to the southern part of the national electricity market in the future.

As a consequence, the Queensland government has been able to achieve major efficiency improvements within its electricity industry, achieve funding of new power plant expansion requirements, announce major changes to future environmental policies and remove the political attention given to the industry over the last 10 years.

RESTRUCTURING OF GENERATION, TRANSMISSION AND DISTRIBUTION

Prior to mid 1995, the Queensland electricity industry consisted of a power agency (generation and distribution) and seven separate distribution agencies. Following the agreements adopted by COAG to form a national electricity market, the Queensland electricity industry was restructured in several steps:

- In the first step (mid 1995), the generation responsibilities were separated from the transmission responsibilities. As a result, a single generation company was formed. The transmission responsibilities were then combined with the distribution responsibilities in the following way. A holding company was formed for all entities, with the transmission responsibilities being placed with a subsidiary company and the distribution agencies continuing to operate in their previous capacity.
- In the second step (mid 1997), the transmission subsidiary was formed into a separate company. The network and retail businesses of the distribution agencies were separated. The seven network businesses remained as distribution network agencies, but the retail businesses were formed into three retailer companies. The holding company was transformed into a Market Trader agency. An economic industry regulator was formed and a government policy unit was formed to advise on market implementation policy.
- Characteristics of the retail companies, which covered 1.4 million customers (and maximum demand of approximately 6,300 MW), were as follows:
  - Retail company 1: city based, with 1.0 million customers;
  - Retail company 2: coastal based, with 0.3 million customers;
  - Retail company 3: city/rural based, with 0.1 million customers;

- In mid-1998, the Queensland government combined retail companies 2 and 3 and in doing so reduced the number of retailers in the jurisdiction to two.
- In mid-1999 the Queensland government combined six of the distribution network agencies to form one large network corporation. The structure of the distribution sector became:
  - Retail company 1: city based, with 1.0 million customers;
  - Network company 1: city based.
  - Retail company 2: coastal/rural based, with 0.4 million customers;
  - Network company 2: coastal/rural based.
- Characteristics of the generation companies, which had an installed capacity of approximately 7,700 MW, were as follows:
  - Company 1: coal, hydro pump storage and gas, three power plants, 7 generating units with total capacity of 1,950MW;
  - Company 2: coal, hydro and gas, four power plants, 11 generating units with total capacity of 2,600MW;
  - Company 3: coal fired, five power plants, 12 generating units with total capacity of 1,680MW;
  - Market Trader 4: coal and gas, five power plants, 12 generating units with total capacity of 2,420MW;
- The system operation responsibilities were passed over to NEMMCO.
- The Queensland government advised the community that the electricity industry would not be privatized.

The generation and retail companies were formed with new Boards of Directors, a new Managing Director and shareholding restricted to the Queensland government. The new companies were given six months to complete their amalgamation program and preparation for competing in the wholesale electricity market.

South Australian Government Involvement

BACKGROUND EVENTS

The South Australian electricity industry was established on limited fuel sources, using lignite coal and fuel oil, and from the late 1960s natural gas. Due to the fuel costs, the South Australian electricity tariffs were higher than those of NSW, Victoria and Queensland. The electricity system was relatively small when compared to NSW and Victoria, having an installed generation capacity (including interconnection) of approximately 2,800 MW and a maximum demand of approximately 2,400 MW in 1999.

In the mid-1940s the South Australian government established a single power company to manage the electricity industry. The company consisted of generation planning and operations, transmission planning and operations, system operations, distribution network services and retail sales.

In 1980 the National Government facilitated a series of studies to provide transmission interconnection from Victoria to South Australia. This would give the South Australian government access to cheaper electricity generation of Victoria and NSW. The studies allowed an agreement to be signed with the three jurisdictional governments to build the interconnector (with capacity of 500 MW import to South Australia). The 275kV interconnector was subsequently placed in service in late 1989. This provided one-third

of the South Australian government's requirements for electricity at that time.

The three jurisdictional governments shared in the cost of the interconnector in accordance with their long-term benefits expected from the interconnector. At the time of approving the interconnector, the jurisdictional governments entered into a 20-year commercial agreement (the Interconnection Operations Agreement) to voluntarily trade surplus electricity on a cost of production basis.

South Australia often experienced very hot days during summer and its maximum demand occurs at this time. During the 1990s, as the hot days occurred each year, there was evidence of a growing air-conditioning load. In early 1993, the hot period covered both South Australia and Victoria and lasted for several days. Plant failures in Victoria reflected in the Interconnection Agreement and required the South Australian government to shed load. This happened on two separate occasions during the hot period. Discussions between the three jurisdictional governments were undertaken to increase the interconnector capacity but no agreement on cost could be reached. The events of 1993 were to be repeated in 1999 and 2000, but this time (since the national market had commenced) the impact could be seen as a price signal. As a consequence, it encouraged the fast tracking of generation and transmission expansion plans by private investors.

The South Australian government did not introduce an electricity market prior to the commencement of the national electricity market. However, the South Australian government supported the COAG policy on electricity market development, participated in the development of the National Electricity Rules and was the lead jurisdiction in the establishment of the National Electricity Law. Immediately prior to the commencement of the national electricity market, the South Australian government restructured the power company.

RESTRUCTURING OF GENERATION, TRANSMISSION AND DISTRIBUTION

Following the agreements adopted by COAG to form a national electricity market, the South Australian electricity industry was restructured in several steps:

- In 1997, the South Australian power company was restructured into business units consisting of generation, transmission and system operation, distribution network and retail sales.
- In 1998, and just prior to the commencement of the national electricity market, the South Australian government transformed the power company business units into separate agencies. Three generation agencies were formed, a transmission agency, a distribution network agency and a retail sale agency. A government policy unit was formed to advise on market implementation policy. An electricity industry regulator was also established at this time.
- The South Australian community would not permit the government to sell these agencies to private investors (which was attractive to the government in order to retire excessive debt). Instead, the government undertook to lease the agencies to private investors. A 100-year lease period was proposed.
- In mid 1999, the South Australian government passed legislation permitting the lease of the electricity industry assets.

- In early 2000, the distribution network and retail agency (with approximately 0.75 million consumers and a maximum demand of 2,400 MW) was leased to a private investor. During negotiations the lease was subsequently increased to 200 years. On receiving the lease, the distribution network and retail businesses were immediately grouped into separate companies by the private investor – the retail company was then leased to an independent third party that was a private electricity retailer.
- During the year 2000, the three generation agencies were leased. Characteristics of the generation agencies, which had an installed capacity of approximately 2,400 MW, were as follows:
  - Agency 1: coal or gas, one power plant, 8 generating units with total capacity of 1,280MW;
  - Agency 2: coal fired, two power plants, 5 generating units with total capacity of 700MW;
  - Agency 3: gas and diesel, four power plants, 9 generating units with total capacity of 380MW;
- The transmission network (mainly at 275kV), including the interconnector to Victoria, was leased in mid-2000 to a private investor.
- By late 2000 all companies had been leased.
- The system operation responsibilities had been passed over to NEMMCO in December 1998.

The entry into the national electricity market was successful for the South Australian government. Within two years the high pool prices had attracted over 1,000MW of combined cycle gas turbine power plants which were being placed in service progressively from 1999 onwards. In addition, private investors had received approval to interconnect Victoria with South Australia with a transmission capacity of 200 MW. A further regulated interconnector was being planned between NSW and South Australia, with a capacity of 250 MW. Due to the lease of the transmission assets, the South Australian government had successfully removed themselves from the difficulties previously experienced in funding transmission expansion.

Australian Capital Territory Government Involvement

BACKGROUND EVENTS

The Australian Capital Territory (ACT) electricity supply industry was only a distribution power company with approximately 125,000 consumers. It had no separate generation or transmission capacity and received all electricity by direct transmission from NSW.

The ACT government participated in the National Paper Trail, supported the COAG policy statements and was one of the founding jurisdictions that agreed to establish the national electricity market. The company commenced trading in the market in December 1998.

RESTRUCTURING OF DISTRIBUTION

The ACT government realized that the power company was too small to survive in the retail market and investigated various structural options, such as sale, lease, joint

venture or amalgamation with a NSW distribution company. Agreement was reached on a joint venture with a private retail electricity investor who had obtained the retail lease in South Australia (and was also one of the distribution companies in Victoria). The new joint venture partner had experience in gas retail and this arrangement offered the ACT consumers a wider energy choice. The joint venture arrangements were completed in late 2000.

The novelty of the ACT government's approach to electricity reform highlights the many various options that are available to governments during and after the introduction of a competitive power market.

Tasmanian Government Involvement

BACKGROUND EVENTS

Tasmania is a mountainous island to the south of the Australian mainland. Consequently, the Tasmanian electricity industry was based on hydro generation, with no interconnection to the mainland - the closest jurisdiction is Victoria. Due to the hydro power, the Tasmanian government provided the lowest electricity tariffs in Australia. From approximately 1930, a single power company who had responsibility for generation, transmission, system operation, distribution network and retail sales managed the Tasmanian electricity industry.

During the late 1970s the Tasmanian government experienced severe environmental protests at the flooding of a valley for the purpose of electricity generation. Although the hydro power plant was eventually placed in service, it established a growing awareness in the Australian community to the activities of the electricity industry everywhere. This community concern was evident on many occasions after this event, and was a major cause of the delays to the Queensland government's generation plans in the early 1990s and the delays to the NSW to Queensland interconnector experienced during the mid 1990s.

In the 1980 study into interconnection between Victoria and South Australia, the study of an interconnector between Victoria and Tasmania was also considered but rejected due to cost. By the early 1990s, the Tasmanian government's hydro generation expansion plans had been completed as no further access to hydro generation sources was available. It was evident that the uncertainty regarding future generation expansion plans had restricted the industrial development of the island.

During 1993 and 1994, the Tasmanian government participated in the National Paper Trial and was a supporting member of the COAG policy on the development of the national electricity market.

In 1997, the government lost the election on a policy of privatizing the electricity industry. The new government consequently adopted an alternate strategy for participating in the electricity market. By mid-1998, the new government had restructured the power company into a single generating corporation, a transmission and system operation corporation and a distribution corporation that was responsible for both network service and retail sales. An industry regulator had been established and market rules had been published, structured on the draft National Electricity Code but substantially altered to meet the Tasmanian government's limited competition model. The major changes were

in regard to generation bidding and dispatch, with dispatch managed by agreed contracts and regulated tariffs.

The Tasmanian electricity market commenced operation without an energy pool in July 1998.

- Characteristics of the generation corporation, which had an installed capacity of approximately 2,200 MW, were as follows:
  - hydro run of river and pump storage, twenty-seven power plants, 57 generating units with total capacity of 2,300MW;
  - oil fired, one power plant, 2 generating units with total capacity of 240MW;
- Characteristics of the distribution corporation were:
  - maximum demand of approximately 1,600 MW;
  - a consumer base of approximately 250,000.

Following the commencement of the national electricity market in December 1998, the Tasmanian government invited expressions of interest from private investors for an interconnector (under-sea cable) between Tasmania and Victoria. As a result, the government has issued a tender to one private investor to build the interconnector (275kV HVDC, capacity 600MW) with a planned in service date of 2003.

The Tasmanian government has announced plans for the transfer of its isolated electricity market to the national electricity market in 2003 at the time of commissioning of the interconnector between Tasmania and Victoria.

Conclusion

In Australia, the controls between the National Government and the jurisdictional governments are different to those between the Sate Council of China and the Provincial governments. Even so, there are many points to be learnt form the Australian experience. These points are summarized as follows:

a. The transition from a centrally controlled electricity industry to a market controlled electricity industry will take many years.
b. Each area will have different requirements and will experience different challenges in restructuring of electricity companies.
c. General competition laws are required to provide policy on market behavior and access to infrastructure by third parties.
d. Changes to the Electricity Law are required to provide for the regulation of competitive power markets by an industry regulator, the enforcement of the market rules and the application of penalties for the breach of those rules.
e. The electricity market requires new skills. The learning of these new skills during the transition from a centrally controlled power company to competing and supporting companies is the major challenge for governments. The development of “pilot” competitive power markets is an important step in building up the new skills. The development of national market rules offers one opportunity to build up these new skills. The process is slow and requires people who have had some actual experience in operating pilot and trial markets.
f. Strong regulation skills are required to manage the initial approval of the market rules and the many alterations that will be required in the early years after the start of the

market. The regulator should be established several years before the market needs to have an approved national market rules.

g. The wholesale electricity market should have as many sellers as possible. Merger and acquisition rules under Trade Law should control the re-structuring of sellers once the market has commenced.
h. There should be multiple buyers all allocated with adequate consumers at the start of each wholesale market.

Provincial governments have an important contribution to make in the transition to a national electricity market, particularly as agents of a national regulator for the introduction of retail competition. The use of funding incentive should be considered by the State government to manage the speedy transition to a national electricity market.

ELECTRICITY RESTRUCTURING IN ENGLAND AND WALES

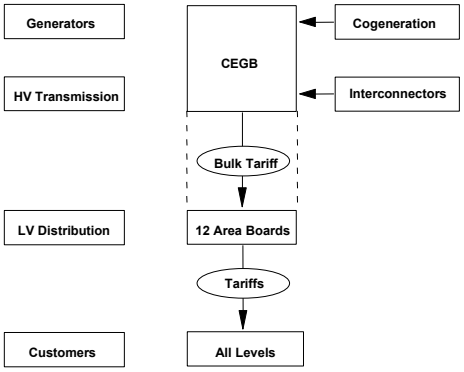
Background

The Central Electricity Generating Board (CEGB), which owned 60,000 MW of generating capacity, was privatized as part of the Conservative Government's widespread reforms of the UK public sector during the 1980s and 1990s. The reforms were driven in part by an ideological commitment to reducing the role of the state, and a desire to raise funds. At the time of the reform, energy sales were growing by only about 2 percent per year and peak demand was almost static. However, the CEGB had been demanding huge financial resources for a massive program of investment in nuclear power to displace British coal. The Government believed that the generation business, at least, could find more efficient ways to carry out its investments and operations, if given the right incentive.

By the time the Government White Paper setting out the new structure was published in 1988, both British Telecom and British Gas had been privatized as integrated monopolies. Although neither company had been privatized for long, Ministers already showed a dislike for regulated private monopolies. The new structure of the electricity industry was therefore driven by a strong desire to promote competition in order to provide good incentives for efficiency.

Prior to restructuring, the CEGB had a complete monopoly on generation and transmission. It produced, bought, sold and delivered electricity to the 12 Area Boards, as shown in Figure 2. The Area Boards in turn had a distribution and retailing monopoly over their customers. To create competition, the CEGB's generation was to be separated from its transmission business and broken up into more than one company.

Figure 2 : England and Wales Structure Prior to Privatization



The Reform

The process of reform has continued for the past eleven years. Figure 3 lists the steps of the reform process to date.

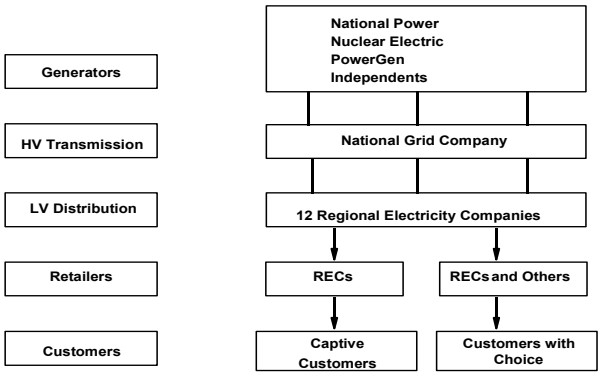
Figure 3 : Timetable of Reforms in the United Kingdom

DATE	EVENT
Feb 1988	Government publishes White-paper outlining industry structure
1989	Electricity Act passed to provide the legislative basis for industry restructuring
Sep 1989	OFFER (Office of Electricity Regulation) established under the DGES (Director-General of Electricity Supply) – the independent regulator.
Mar 31, 1990	Vesting of the new companies: CEGB split into the National Grid Company (NGC), PowerGen, National Power and Nuclear Electric.
	Hundreds of "Vesting Contracts" signed
	12 Regional Electricity Companies (RECs) formed from the 12 Area Electricity Boards
	Ownership of NGC passed to the 12 RECs
April 1, 1990	Pool operation commences.
	Retail competition opened to >1MW load
Dec 1990	12 RECs privatized
Mar 1991	60 percent privatization of National Power and PowerGen
Apr 1994	Retail competition opened to 100kW - 1MW load
Mar 1995	40 percent privatization of National Power and PowerGen
April 1995	Golden shares in RECs lapse, and takeovers/mergers begin
Dec 1995	NGC privatized
	NGC's pumped storage sold to Mission Energy (USA)
Jul 1996	Privatization of British Energy (modern nuclear plant, excluding Magnox)
1995-96	First round of divestiture by National Power and PowerGen (to Eastern Electricity)
Sep 98 – June 99	Staged opening of competition to under 100 kW customers
1999->	Second round of divestiture by National Power and PowerGen (to a variety of owners)
2000	Utilities Act combines electricity and gas regulation under OFGEM (Office of Gas and Electricity Markets)
2001?	Replacement of the Pool with the New Electricity Trading Arrangements (NETA)

Industry Organization

The CEGB was broken up and separate companies were formed for generation, transmission and distribution, as shown in Figure 4. The government used a new law to transfer assets and personnel from the CEGB to the new companies. The process of creating new companies is called "vesting". Vesting Day was March 31 1990, when all the contracts between the new companies were signed.

Figure 4 : England and Wales Structure at Vesting



Generation

Three generating companies were formed: National Power, PowerGen and Nuclear Electric. At vesting, these three companies accounted for 91 percent of total generation. The remainder came from independent power producers (IPPs), co-generators and interconnections with France and Scotland. Entry to the industry was made as simple as possible, and RECs were encouraged to contract with new generators; until 1993, the prices to small consumers were subject to price caps; after 1993 contract costs could be passed to customers, although after 1996 this pass-through was limited in some respects.

Transmission

NGC was formed to own and operate the transmission grid. It is the System Operator and the Transmission Owner, and in effect it also became the Market Operator, following rules established by the Pool, which was a separate organization. NGC is national in scope and although competing transmission companies are not prohibited, no license for

such a company has ever been issued, so that NGC has a de facto monopoly on constructing new lines. (However, there is not much demand growth, and there is little need for new lines, so the scope of the monopoly has never been tested). Initially NGC was given the pumped storage plant, which plays an important role in frequency control, but this was sold to Mission Energy (US) in 1995.

Distribution

At vesting the 12 Area Electricity Boards were transformed into 12 Regional Electric Companies (RECs). A study was done to decide how many RECs there should be, and the study concluded that the existing organizations should be kept just as they were. The RECs were privatized in December 1990 with the Government maintaining a "golden share" in each until April 1995. (A golden share prevented takeovers by other companies) With the lapse of the golden shares ownership of all 12 RECs has been the subject of mergers or acquisitions. Ownership of the RECs now includes multi-utilities, companies with major interests in generation and foreign (US) companies. The most significant change is the integration of some RECs with UK generators: ManWeb (Scottish Power), East Midlands (PowerGen) and Southern Electric (merged with Scottish Hydro). National Power took over MEB's retail business through a complex web of contracts. British Energy took over South Wales retail business but subsequently sold it to London Electricity (which in the meantime had been bought by EDF of France.

Trading Arrangements

In England and Wales the Pool Rules provide the mechanisms for short-term trading of electricity. However, 80-90 percent of the traded electricity is hedged through medium- and long-term bilateral contracts. These contracts are structured as CfDs. Parties to any such contract settle it outside the Pool's settlement procedures, usually between themselves rather than via any exchange.

There is just one market in England and Wales, and a single national price. (England and Wales landmass is only 600 miles from end to end) Locational differences are taken into account in transmission charges, not in the Pool price. One useful reform in the rules was made in 1994 to improve incentives for efficiency. "Uplift" is a charge to users that comprises all the costs arising from transmission constraints, generation shortfall and demand-forecast errors, plus specific payments for ancillary services. Uplift grew from 1990 because no one had any incentive to reduce the cost. Since 1994, NGC has to pay a proportion itself, which has reduced the cost of uplift, by small investments in the transmission system, and improved management.

The initial design of the UK pool is well known, and in any event it is due to be changed soon. A discussion of NETA – the New Electric Trading Arrangements -- is given later in this note. (Implementation has just been pushed back to March 27 2001)

Regulation

An Independent Regulator was established by law. It used to be called OFFER (the OFfice of Electricity Regulation) but it was combined with the gas regulator in 1998, and is now called OFGEM (Office of Gas and Electricity Markets). A visit to the website of OFGEM, at www.ofgem.gov.uk will show how much work goes on there. No fewer than 78 public papers produced in the period July-November 2000 alone can be downloaded

from the website.

Regulation is carries out via the "licenses" under which the companies operate. Each company has a separate license that governs their rights and obligations. For example, the price a regulated company may charge is a clause in the license; when prices are changed, the license condition changes. One of the duties of the regulator is to promote competition, and the current regulator recently tried, and failed, to control market power by changing the generators' licenses (see below). He failed because the companies can, and did, appeal to the Competition Commission, which supported their position.

Figure 5 : The Distribution Xs (%) in the United Kingdom

Note: A negative X means that prices are allowed to rise. A positive X implies a reduction.

	Before Review	*After 1994 Review*			*After 2000 Review*				
	1990-1995	**1995-1996**	**1996-1997**	**1997-2000**	**2000-2001**	**2001-2002**	**2002-2003**	**2003-2004**	**2004-2005**
Eastern Electricity	-0.25%	11%	10%	3%	3%	3%	3%	3%	3%
East Midlands Electricity	-1.25%	11%	13%	3%	3%	3%	3%	3%	3%
London Electricity	0.00%	14%	11%	3%	3%	3%	3%	3%	3%
Manweb	-2.50%	17%	11%	3%	3%	3%	3%	3%	3%
Midlands Electricity	-1.15%	14%	11%	3%	3%	3%	3%	3%	3%
Northern Electric	-1.55%	17%	13%	3%	3%	3%	3%	3%	3%
NORWEB	-1.40%	14%	11%	3%	3%	3%	3%	3%	3%
SEEBOARD	-0.75%	14%	13%	3%	3%	3%	3%	3%	3%
Southern Electric	-0.65%	11%	10%	3%	3%	3%	3%	3%	3%
SWALEC	-2.50%	17%	11%	3%	3%	3%	3%	3%	3%
South Western Electricity	-2.25%	14%	11%	3%	3%	3%	3%	3%	3%
Yorkshire Electricity	-1.30%	14%	13%	3%	3%	3%	3%	3%	3%

Source: The UK Electricity Industry Charges for Electricity Services 1997/98, CRI Statistics Series; OFGEM: Reviews of Public Electricity Suppliers 1998 to 200: Distribution Price Control Review, Dec 1999.

The regulator also sets the prices for the monopoly transmission and distribution parts of the industry. The method for this is an RPI-X limit applied to average prices or total revenues, where RPI is the retail price index (a measure of inflation) and X is the specified level of real decrease (or increase if negative). There is also some provision for some costs to be shared with or passed through to consumers. X is set in advance in a review that happens every two to five years. The application of this methodology has been contentious, since, in the 1994 review at least, the Regulator reduced prices far more than the companies felt was fair. Since then, the annual efficiency reduction, below inflation, has been 3% for all RECs. (See Figure 5 above)

Stranded costs

The UK market was expected to produce prices below the existing tariffs; this would have resulted in low valuations for the plants and low sale prices. In fact, the valuation of the generating plant was estimated at 5 billion pounds, while it was carried on the

accounting books at 25 billion ponds. Although the government could have written off the excess book value, (and did, to some extent) the UK Treasury did not want to sell the plants at such a low price, and it used four tools to recoup its "stranded costs":

Only the large customers could buy at the market price for the first 4-8 years; the smaller customers paid the old tariffs. The distribution companies signed Vesting contracts with the generators. This paid for the coal subsidy until it was phased out.
Only 60% of the generating companies were sold initially at the low price justified by the low market prices – the other 40% was sold some years later at a much higher price, after the excess capacity was closed.
A levy (tax) of 10% was charged on all sales, to pay off some of the stranded costs of the nuclear plant.

The distribution and transmission companies charges were raised (and only reduced after several years).

Results

NEW INVESTMENT IN GENERATION

One of the aims of the privatization was to prevent the CEGB from going ahead with a massive program of nuclear construction to replace British coal. In this it has been successful. Apart from the one nuclear plant already in construction in 1988, all the incremental investment has been in gas. A considerable amount of old capacity has been closed. Gas-fired generation in the form of CCGT capacity accounts for 85 percent of the 16.9 GW of new generating capacity added to the system between vesting and 1997/98. One of the side effects has been a large reduction in the industry's emissions of sulfur oxides and carbon dioxide.

Figure 6 below shows the development in total electricity plant capacity since privatization. Also included is a breakdown of the capacity available from conventional steam stations, nuclear stations and CCGT over the same period.

Figure 6 : Generating Plant Capacity in the United Kingdom, 1991-1998

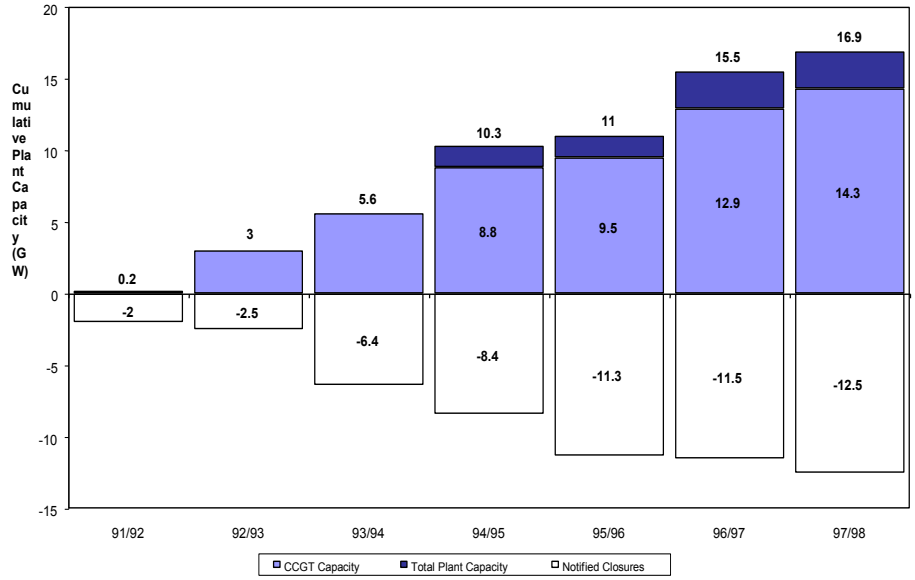
MW (month end)

	Total Capacity	Conventional Steam Stations	Nuclear	CCGT
Dec 1999	75,305	38,761	12,956	17,195
Dec 1998	73,153	38,327	12,956	15,418
Dec 1997	72,696	40,618	12,946	12,803
Dec 1996	73,271	41,422	12,916	12,462
March 1996	70,126	41,476	12,762	9,377
March 1995	68,937	42,152	12,019	8,540
March 1994	69,050	44,981	11,894	5,613
March 1993	67,506	47,841	11,353	1,279
March 1992	70,535	51,520	11,353	331
March 1991	73,525	54,644	11,353	76
March 1990	74,207	55,416	11,083	-
March 1989	70,348	54,397	8,308	-

Source: UK Energy Statistics, DTI (various years)

By 1998 CCGTs accounted for 17 GW or 23 percent of installed capacity. The additions to generation are offset by 12.5 GW of plant closures and a further 5.5 GW of mothballed plant. Changes in generating plant capacity over the period 1991–1998 can be seen in Figure 7 below.

Figure 7 : Main Changes to Generating Plant Capacity in the United Kingdom (1991-1998)



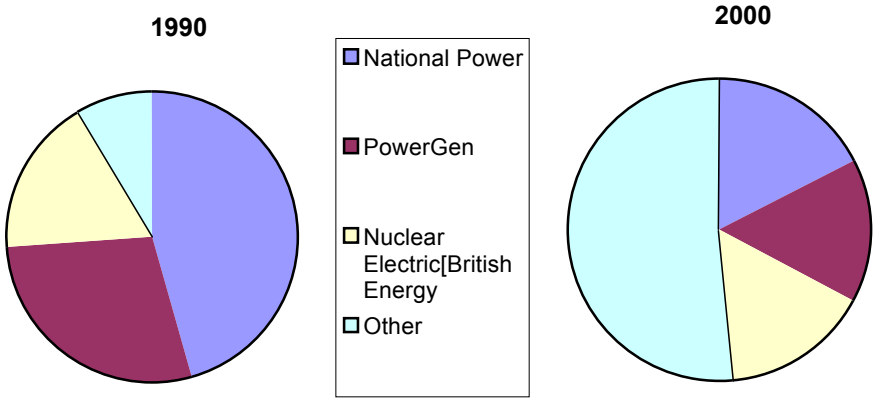
Source: National Grid Company

Market Power in Generation

Initially three generators controlled over 90% of the market; by March 2000 this figure was now down to 49%, and still falling, boosted by the divestiture of 6,000 MW of coal-fired plant by National Power and PowerGen to Eastern Group in mid-1996 and further divestitures in 1998-00 (See Figure 8). However, entrants have mainly built baseload plant, so that while the two big generators (National Power and PowerGen) account for only 33% of the output, they still control most of the **mid merit** plants that set the market price -- between them they set prices in 51% of the hours. This had led the regulator to propose more stringent rules for control of market power.

Figure 8 : Market Shares in England and Wales

	1990/91	1995/96	1996/97	1997/98	Oct 97 - Sept 98	Apr 99- Mar 00
National Power	45.5%	31.5%	24.1%	21.0%	22.1%	17.5%
PowerGen	28.4%	23.1%	21.5%	19.6%	19.3%	15.3%
Nuclear Electric[British Energy]	17.4%	22.5%	17.3%	16.7%	16.4%	15.8%
Others	8.7%	22.9%	37.1%	42.7%	42.2%	51.4%

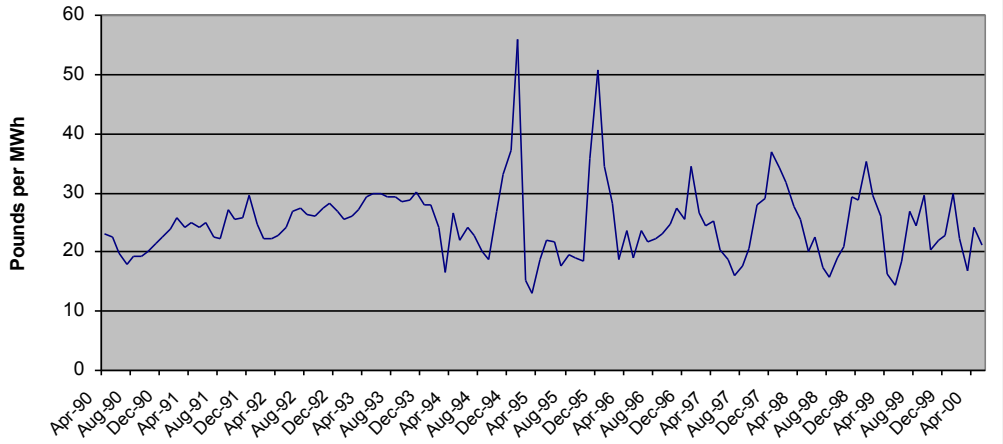


Source: OFFER

The aspect of the market that worries the regulator is that while costs have fallen, prices have not fallen as much. OFGEM claims that all input costs for generators have dropped significantly since privatization. Capital costs for new plant are down 40 percent, spot gas prices down 50 percent, coal prices down 28 percent. There have also been dramatic improvements in labor productivity. In spite of this, the decline in Pool prices has been "only" 2.1% per year since 1994 (See Figure 9).

When the Pool began, there was excess capacity in the industry and spot market prices were low as was to be expected. (Since virtually all sales were covered by vesting contracts, this did not result in a decline in prices to most consumers at the time). It was expected that market prices would rise over the first few years as old plant was closed, and settle at the long run marginal cost or the "entry price", which was computed to be an annual average of about 29 pounds/MWh. The spot market price did indeed rise to 29 pounds, and has now fallen back to 25 pounds. But the target has moved – the "entry price" has fallen to 21 or 22 pounds. The regulator believes that the excess of 3-4 pounds/MWh is due to the market power of the generators.

Figure 9 : Wholesale Electricity Pool Prices in the United Kingdom, 1990-2000 [5]



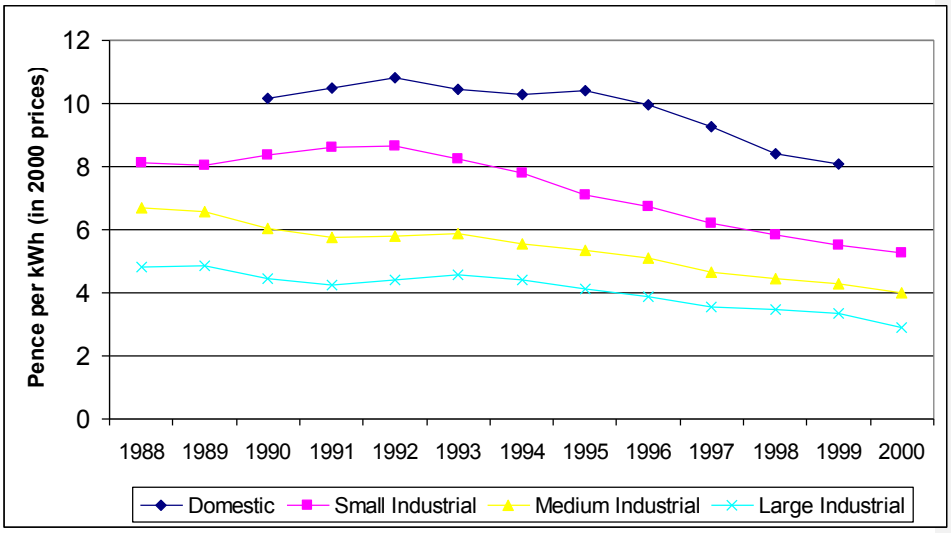
In April 2000, the regulator decided to introduce a "market abuse condition" into the licenses of seven generators (AES, British Energy, Edison Mission Energy, Magnox Electric plc, National Power, PowerGen and TXU Europe). The condition would have allowed OFGEM to take action if a generator were found to be abusing a position of substantial market power. However two of the seven generators (AES and British Energy) did not consent to the modification of their license and their case was sent to the Competition Commission. In June, Edison was investigated under the market abuse condition because its decision to withdraw 500MW of generating capacity. OFGEM calculated that Edison's action had raised Pool prices by 10% for nearly 60 days. In July Edison agreed to restore the plant to the system. Even so, in December 11, the Competition Commission decided not to permit a market abuse license condition to be included in the licenses of the two companies. As a consequence, OFGEM will have to withdraw the market abuse license condition from the licenses of the six generators who had previously accepted it.

Retail Electricity Prices

Overall, since vesting in 1990, electricity prices have declined in real terms for all sectors, as shown in Figure 10. Households faced the smallest decrease, of 20% in real terms between 1990 and 1999; while small industrial customers received the largest reductions, 34% in real terms between 1990 and 1999. However, note that in 1989, the year before privatization, prices for large and medium industrial consumers were significantly reduced (by 7-8 per cent), while those for small industrial users (and residential consumers) were increased.

[5] Pool Purchase Price, October 1997 prices.

Figure 10: Average Annual Final Electricity Prices in the United Kingdom 1988-2000[6]



Customer Switching

In 1990, customers with maximum demand greater than 1 MW could choose their supplier. During the first year of competition, around 25 percent switched to another supplier, as shown in Figure 11. As of 1998, 63% of the largest customers had switched. From April 1994, the right to choose a supplier was extended to sites with a maximum demand of between 100 kW and 1 MW. By June 1999, all 26 million customers were able to choose their supplier. What is apparent from the table below is that as time goes on, more customers switch, and that the smaller customers are following the same pattern as the larger, but somewhat fewer are switching.

Problems emerged in 1994 with the metering necessary to extend choice to smaller customers. Only 3000 of the 9000 sites registering for retail competition have the necessary meters installed in time. The remaining sites either did not have a time of use meter or the necessary communications links installed; in the short term, they have had to rely on load profiling in place of time of use meter readings. The total cost of introducing retail access for this group of customers was £24 million, rather than the expected £10 million. The introduction of retail competition for smaller customers was delayed for 6 months to one year since the RECs did not have the necessary software and settlement systems in place. Rather than allowing all customers to begin switching suppliers on the same date, the process was phased in over a nine month period; even then, the costs of implementing the scheme has been estimated at over £800 million.

[6] Industrial prices are for Great Britain. Industrial categories are defined as **Large**: greater than 8.8 TWh per year; **Medium**: between 0.8 TWh and 8.8 TWh per year; **Small**: less than 0.8 TWh per year. Domestic prices are for England and Wales and are based an annual consumption of 3,300 kWh, including VAT. Prices are in constant 2000 values (using the GDP-deflator).

Figure 11: Customer Switching in the United Kingdom, 1990-1998

	1990/1	1991/2	1992/3	1993/4	1994/5	1995/6	1996/7	1997/8
Over 1 MW								
Customers Not Switching	72%	64%	68%	63%	56%	49%	43%	37%
Customers Switched to Another REC	4%	10%	12%	19%	23%	26%	29%	33%
Customers Switched Elsewhere	24%	26%	20%	18%	21%	25%	28%	30%
APPENDIX A *Total*	100%	100%	100%	100%	100%	100%	100%	100%
100 kW - 1 MW								
Customers Not Switching					75%	68%	62%	59%
Customers Switched to Another REC					20%	26%	31%	32%
Customers Switched Elsewhere					5%	6%	7%	9%
Total					100%	100%	100%	100%

Quality of service

Overall standards of performance have improved, with fewer payments made for failing to meet standards. More dramatic is the drop in the number of domestic disconnections, from 54,691 in 1992 to 383 in 1998. The RECs achieved this massive reduction by installing pre-payment meters, using modern "smart" technology, so that non-paying customers effectively disconnected themselves. In addition, customer complaints and payments for missed appointments are down by 80 percent over the same time period.

Changes in the England and Wales Pool -- NETA

In 1997-8 the Pool was reviewed and recommendations made for significant changes. A new system called NETA would replace the Pool. These changes were planned for implementation by April 2000 but have been delayed to March 2001. (The original Pool was designed and put in place in about 1 year!)

The main complaint of the Regulator, that triggered the changes, was that the Pool encouraged the abuse of market power (more often called "oligopoly power" in this context). Under the Pool, all electricity had to be sold on the spot market, which the large generators could influence, whereas a system of physical contracting would remove the influence of the Pool price. A new system has been designed to permit generators and customers to schedule physical flows on the network, and although participants will be able to make up shortfalls by paying for "imbalances", the aim is to make the imbalance market unappealing, so that participants are forced to contract. There will be no transparent spot price, but there will be two half-hourly imbalance prices, for buy/sell. These prices will be set at some average of the bids and offers, (not at the marginal price, as in the Pool) and although there will be no prohibition on making use of imbalances, the hope is that this system will force more traders into short-term bilateral contracts.
There are other more minor changes proposed, but this is the central one. Interestingly, there is no proposal for locational energy prices, although this has been introduced in most of the markets that were started after the UK.

There is no doubt that despite the complexity of the old Pool, the new system is even more complex, if only because the participants have to notify NGC of all their contracts,

and because of the complex structure of half-hourly offers and bids. The old system was criticized for the complexity of its daily offers, but they simply reflected generator cost conditions. Under NETA, traders must submit up to *[10 - to be checked*] "bid-offer pairs" for deviations from the "final physical notification" that they submit 3.5 hours in advance. Each "bid-offer pair" specifies the quantity of the deviation (in MW), a price for making the deviation at NGC's request, and a different price for reversing this trade. The delays testify to the difficulties in arranging for secure information transfers between traders and the new market.

However, there seems to be some confusion about the intent. OFGEM was convinced that a real-time process of competing for short-term contracts on a pay-as bid basis would *in itself* reduce oligopoly power, as compared to a single daily auction that named market-clearing prices.[7] No one presented analytical evidence for or against this proposition during the early discussion of NETA. However, during a recent Competition Commission procedure, OFGEM agreed that NETA would not remove the potential to exert market power and a recent academic paper suggests that average market prices will be higher, not lower, as a result of the reforms.

[7] It is easy to show that the *existence* of contracts does reduce the market power of those with contracts. And in fact most of the power in the UK has always been contracted in advance. However OFGEM's argument was that the *process* of making short-term contracts for dispatch would limit oligopoly power.

SECTION 3: WORKING PAPERS

Working Paper 1: **Transmission Structure and Organization in Competitive Markets in China**

Working Paper 2: **Guidelines for Sizing a Competitive Power Market in China**

Working Paper 3: **Dealing with Different types of Plants in a Competitive Power Market**

Working Paper 4: **Restructuring and the Environment**

TRANSMISSION STRUCTURE AND ORGANIZATION IN COMPETITIVE MARKETS IN CHINA

Working Paper 1

Introduction

1. This working paper attempts to answer the following questions and issues raised by SDPC:

    a. How should the transmission grid be structured once generation is separated? Specifically:
        - Should the transmission be provincial, regional or national level?
        - If a national transmission company is desirable, should the relation to the next level be as subsidiaries or as branches?
        - How should transmission related functions, such as system operations (dispatch) and market operations, be organized?

    b. At what level, or how big should competitive markets be established? Specifically, how should the scope of the competitive market be defined? (This question will be addressed in more detail in a separate working paper -- Guidelines for Sizing of a Market).

    c. Should distribution be separated from transmission?

2. There are no universal answers to these questions. Different solutions have been adopted by different countries with successes and problems in all cases. The recommended options for China draw upon international experience combined with China's unique goals and circumstances.

3. The State Development and Planning Commission (SDPC) has indicated a number of the Government's goals and objectives. The Government of China intends to:

    a. introduce competition in generation, as a transition to wholesale competition with access (choice of supplier) for distributors and large consumers;

    b. take steps to separate generation from the transmission;

    c. ensure that markets are as big as technically and economically feasible – regional in most cases – to increase electricity trade and develop China's large hydro power and renewable energy potential; and

    d. restructure the power sector in ways that further China's environmental and economic development strategies.

4. In the proposed competitive market arrangement, transmission (and distribution) remain natural monopoly services and hence must be regulated with regard to price,

quality of service and network expansion.

5. On the issue of regulating transmission and market rules there is convergence of opinion – irrespective of the option chosen for the structure of transmission, the market rules and the rules for transmission pricing should be harmonized nationwide. With harmonized market rules and transmission pricing, market integration and trading can take place more easily, resulting in the greatest benefit to China. This is easiest to accomplish if a State (i.e. National) level regulatory agency establishes a single consistent set of market and transmission rules. The recent experience in the US, where reforms are handicapped because of the split between Federal and State regulatory jurisdictions, argue strongly for national leadership in setting up market rules and transmission policies.

6. Although it is a useful learning exercise to develop market rules on a "pilot basis" in a few provinces, it is recommended that the market rules and the experience from these pilots be quickly used to define common market and transmission pricing rules. Some variation between regions to accommodate differences in reform pace and readiness for change should be allowed, but the national level regulator should approve these variations to ensure that there are no impediments to future integration of markets. The national regulator should have the authority to set the market rules and transmission tariffs, and establish criteria for local regulators (perhaps at the provincial level) to oversee pricing and service quality for distribution. The national regulator should also develop the correct incentives for the transmission company to be efficient.

Structure of the Transmission System

7. Beginning with the basic policy objective to establish competitive markets of the widest scale possible, there are essentially two options worth considering for the structuring of the transmission function in China:

   a. Option 1: A National Transmission Corporation, with regional (and if necessary provincial) branches or corporate subsidiaries.

   b. Option 2: Multiple Regional Transmission Companies, with provincial branches or subsidiaries.

8. Option 1, a National Transmission Corporation with regional branches would be the preferred structural approach for China. (The two options are compared in Figure 12.) It is also recommended that the National Transmission Corporation be organized with branches or divisions in each area, rather than as separate subsidiaries that own their assets. This will enable structural changes, such as increasing the size of the market, to be made easily as the grid is developed.

9. The main reason for establishing a National Transmission Corporation in China stems from the crucial need for developing inter-regional transmission. A National Transmission Corporation would be more likely to base its transmission expansion decisions on the best interests of the country. For various reasons, regions may oppose transmission interconnections with other regions and thereby constrain trade.

10. A National Transmission Corporation could play a major role in: building interconnections between regional pools; brokering bilateral electricity trade between separate regional pool markets to encourage the economic transfers of energy; and facilitating mergers between regional pools when economic and technical conditions are met.

11. The Tax Problem. It is useful to note that there are specific tax issues in China that constrain trade between provinces and regions. Generating plants and small, inefficient coal mines are significant sources of local taxes and employment. Provinces are unwilling to increase power imports if it means displacing local generation sources because they lose the tax revenue and could face difficulties during the restructuring process if social issues are not adequately addressed. This constrains the development of low-cost hydro/renewable resources and economic energy trade. While a National Transmission Company can play some role in increasing economic trade, it is paramount to change the tax regime.

12. The main advantages of the proposed solution are:

    a. The structure assures that the expansion of markets will not be constrained by corporate or institutional structures;

    b. The structure requires the least change from the present. Since the State Power Corporation of China (SPCC) currently owns all the transmission assets, even those at the regional and provincial level, the creation of a National Transmission Corporation with regional branches should be reasonably straightforward. Reform is a major administrative, political and behavioral change process that requires both time and effort. The priority separation of generation from transmission will require considerable resources. It may indeed be counterproductive to expend limited resources to drastically reorganize the existing transmission system into regional or provincial companies too early in the reform process.

    c. This solution also gives SPCC a major role in the reform. SPCC would become one of the largest (if not the largest) transmission companies in the world. If it were to be further divided, it could become a major roadblock to continued reform. The addition of the market functions to its portfolio of functions, recommended below, will also give it an important role in the development and implementation of the competitive market.

Figure 12: Comparison of Structural Options for Transmission

	National Transmission Corporation with Regional Branches/Subsidiaries	Regional Transmission Companies
Advantages	Makes it easier to adopt and implement common market rules and transmission pricing mechanisms nationwide allowing effective market integration and increased trade. Facilitates expansion of the inter-regional system and the development of trade	The identification of accurate transmission costs for each regional and provincial company would be easier. Thus, it would be easier to ensure clear accountability of transmission companies in meeting their performance standards. The Regional Transmission Company

	National Transmission Corporation with Regional Branches/Subsidiaries	Regional Transmission Companies
	between competitive regional markets. Could be a good institutional mechanism to give the State Power Corporation of China (SPCC) an important role in the competitive market framework and to align internal support. It will allow strong project team capabilities to develop. The fully integrated management structure is a good first step in reforming the transmission function. It provides the flexibility for creating a more decentralized regional management structure with strong skills.	structure will create competitive tensions between these companies due to their desire to demonstrate technical and commercial performance capability. Regional companies may be quicker in identifying transmission expansion needs, and making transmission expansion decisions within the region leading to increased efficiency within a region. Regional companies organized around an energy pool would be more likely to respond to market needs faster and would be conducive to more efficient and effective market operation.
Disadvantages	The identification of accurate transmission costs for each provincial and regional market might be difficult. A National Transmission Company may seek to cross-subsidize transmission prices within China. This would make it difficult to correctly assess the economic and financial viability of individual lines and would be inefficient. The identification and construction of necessary transmission capacity may take longer, owing to possible centralization of planning and approval authority (a real risk in China). This would increase the short-term costs of inefficiency. The tendency by the National Transmission Company to micro-manage the energy pools in the regional and provincial levels could seriously impede the effective and efficient operation of the markets.	There would be no clear institutional mechanism or responsibility for the construction of inter-regional transmission lines to increase trade. A new role would have to be found for the State Power Corporation of China (SPCC). There may be a tendency for Regional Transmission Companies to develop market rules that restrict trade and market integration.

CHOOSING BETWEEN LOWER LEVEL BRANCHES OR SUBSIDIARIES

13. A subsidiary is a separate legal corporate entity. It has its own board of directors, and own balance sheet, and in effect owns the assets in its control. A branch does not. A subsidiary is appropriate when there is a question of subsequent asset divestiture, since a separate corporate entity is a pre-condition for divestiture. However, since divestiture is not a matter for consideration by the State Council, there are no benefits to be gained in adopting this structure.

14. A subsidiary has more managerial and decision-making autonomy than a branch. As a separate legal entity with its own Board of Directors, it could be more difficult for the management of the National Transmission Corporation to control because of the potential for friction between corporate layers. The main reason for a National Corporation with *branches* is that a subsidiary company, such as a provincial/regional transmission corporation, would be weakened by the expansion

of trade and the consolidation of markets. Therefore, a subsidiary will be less likely to build the transmission that would enable trade to be expanded, unless there were clear incentives to do so.

15. Furthermore, as the transmission is expanded, the optimal size of an organizational unit will increase. Subsidiaries are more difficult to reorganize than branches. Therefore it would be preferable to organize the company with branches or divisions in each area, rather than as separate subsidiaries. This will enable changes to be made as the grid is developed.

16. In summary, it is recommended that the National Transmission Corporation be reorganized with regional branches. However, there may be strong institutional reasons or constraints not taken into consideration in this working paper to organize lower level entities as subsidiaries. If this is indeed the case, the benefits sought through the organization in branches should be encouraged through appropriate corporate governance mechanisms.

DECISIONS ON ORGANIZING TRANSMISSION-RELATED FUNCTIONS IN A COMPETITIVE MARKET

17. The three major transmission-related functions in a competitive market are:

- ❑ Ownership of the wires: expansion; maintenance; switching; holder of transmission contracts;
- ❑ System operator: dispatch /system control; purchaser of ancillary services; arranging transfers between areas;
- ❑ Market operator: receiving bids, setting price for spot market; metering; settlement.

18. These functions can be, and have been, split between different entities in various ways in different countries, to avoid certain conflicts of interest. In general there are two broad approaches. In the first approach, often referred to as the Transco model, the transmission owner also functions as the system operator and market operator. In the second approach, known as the ISO-Gridco model, the transmission owner, and the system and market operator are separate; an independent system operator (ISO) provides all operating and dispatch instructions while one or more independent grid companies builds, owns, and maintains the physical grid facilities. The advantages and disadvantages of each approach are outlined in Figure 13.

Figure 13: Comparison of the Transco and ISO-Gridco Model

Element	Combined transmission owner and system operator (Transco model)	Independent system operator and separate transmission owner(s) (ISO-Gridco model)
Features	Entity is a publicly- or privately-owned regulated for-profit corporation that owns and operates all transmission facilities in its geographic area	Independent system operator is usually a nonprofit entity that operates but does not own the transmission facilities in its region. The operator has leasing or transmission control agreements with each of the entities that owns the

Element	Combined transmission owner and system operator (Transco model)	Independent system operator and separate transmission owner(s) (ISO-Gridco model)
		transmission facilities in its region Tariffs to recover capital and operating costs of the transmission facilities are collected by the independent system operator and remitted to transmission owners. The operator may charge a separate grid management fee to cover its operating costs.
Advantages	Better able to raise capital, implement projects, and make fast decisions on grid expansion. Easier to implement where system operators and transmission owners have been integrated.	More likely to make unbiased decisions about transmission expansion. Better able to make unbiased assessments of power market operation.
Disadvantages	Difficult to design incentives that lead to unbiased operational and investment decisions. For example, to maintain voltage at a particular location, the Transco may prefer to install new capacitors, even if it would be cheaper to purchase reactive power from a generator. The Transco may also favor increasing grid transport capacity to meet growing load at a particular location, even if new generation is a cheaper alternative.	Difficult for the independent system operator to expand the grid because it must rely on other entities to finance and implement investments. (This problem has recently emerged in the United States.) Without a profit incentive, independent system operators may become bureaucratic and inefficient organizations. Difficult to design an institutional framework in which the independent system operator has clear responsibility for expanding the grid and requires the transmission owner to do so. May be difficult to design a workable governance scheme that ensures that independent system operators are truly independent of market participants.
Examples	National Grid Company (United Kingdom), Statnett (Norway), Polish Power Grid Co. (Poland)	CAMMESA (Argentina), NEMMCO (Australia), IMO (Ontario, Canada), five U.S. independent system operators (California, New England, New York, Texas, Mid-Atlantic), REE (Spain). Proposed for Brazil, Mexico, and Peru.

19. While there have been more competitive markets that have adopted the ISO-Gridco approach, there is emerging consensus that the Transco approach may indeed be better, particularly in the early stages of the reform process. For example, in Australia, NSW used this structure to commence its "pilot" energy pool market. The UK continues to use the Transco approach. There are no examples of Transco systems with consolidated functions having worked badly[8], whereas the ISO-Gridco

[8] Although there have been complaints (from generators) that the combined system operator in the Transco model does not impose adequate/fair penalties for non-performance on the transmission part of the combined entity, as easily as it does on separate unaffiliated generators.

approach has had some real problems.

20. The Transco approach is recommended in the first stage of wholesale market development in China. This Transco solution also has the advantage of not changing the existing system, but adding to it the new market operator function. This expansion in the portfolio of function would also be a way to gain the support of SPCC. The major argument against combining all the functions together would be the difficulty of regulating such a powerful company. The regulator needs to be given strong powers to oversee the Transco, and to use these powers to create incentives for efficient operation of the grid.

21. In summary, there are four main reasons why the Transco approach is recommended at the early stage of market reform:

    - ❑ The security of the high-voltage transmission grid throughout the country is better controlled if a single entity is charged with this responsibility in each regional/provincial competitive market area. While a separate system operator may be given clear legal responsibility to manage grid security, it may find it difficult to accomplish if there is too much disruption to the support functions during the establishment of multiple sellers and buyers.
    - ❑ As generation is to be completely separated from the grid, the potential for discriminatory dispatch that often leads to a preference for the ISO-Gridco model is not an issue. There may be a few problems during the transition to full ownership separation of generation – but this could be mitigated by the mutual oversight by the generators themselves.
    - ❑ As there will be only a single owner of all transmission assets, at least initially, there is again no particular reason for creating a separate system operator. Countries that have multiple owners of transmission assets (e.g. the USA, Argentina) have had to create a separate system operator. This is not the case in China.
    - ❑ The implementation issues that arise with the creation of a separate ISO may detract from the other important implementation tasks, and hence the Transco approach may be preferable.

22. At some future point in the operation of the wholesale market it may be necessary to consider the use of an ISO-Gridco structure to enable conflicts between monopoly service providers from occurring. In particular, there may be a need to remove any temptation for the transmission function to apply indirect pressure on the operation of the market rules. Such pressure would be observed by sellers and buyers and undermine the operation of the competitive power market.

Size of Markets and Relationship to the Organization of Transmission Companies

23. The size of individual competitive markets is determined by a number of factors, of which transmission is an important consideration. Assuming that option 1, the National Transmission Corporation structure were to be chosen, it would have to be divided into smaller management areas (branches is the preferred option) for

purposes of assigning clear responsibilities for network development, maintenance, system control and market operation.

24. Some entity will have to run each of the regional or provincial energy markets. This entity will be responsible for dispatching generators, maintaining the wires, determining the prices and settling the accounts. It is crucial to ensure that the entity is dedicated to making the market work and has good incentives to promote competitive markets in the regional or province whilst maintaining strong control over system security. Thus, it is more appropriate to organize the branches or subsidiaries around one individual competitive market. The entity should have full autonomy and flexibility to operate the market and to respond to market needs within the overall framework of the national regulator and in accordance with the market rules.

25. A few basic guidelines concerning how a competitive market area may be defined. (These guidelines are developed in more detail in Working Paper 1 – Guidelines for Sizing a Competitive Power Market in China)

    - ❑ It must be an area where participants are subject to the same single set of market rules and means of payment. Within the area all generations and purchasers submit their information to the same system and market operator. There cannot be two markets covering the same area because there is only one set of transmission wires.

    - ❑ It should be an area within which transmission constraints are small compared to the constraints between areas. Often, this is the area that can be served by a central control room. In some cases in China at present this is a region; in a few cases it is a province. As the transmission constraints are removed, the market scope can be widened if market rules are harmonized.

    - ❑ It should be emphasized that existing system control areas should not be used as a basis for delineating markets. The objective would be to combine as many existing provincial (or sub-provincial) control areas into a single market to the extent permitted by transmission constraints.

Should the Distribution Companies be Separated?

26. A market requires many buyers as well as many sellers. A major reason for separating the distribution companies would be to provide many buyers. This is what makes a market work. Under wholesale competition, the distribution companies are the purchasers for all but the large consumers. The distribution companies purchase at contract (Contract for Differences – CfDs) prices and at wholesale spot prices. Having many distribution companies will provide competition in the CfD contract market.

27. It has been said that since transmission and distribution are both “wires” companies there is no reason for them to be separate. The reasons for separating distribution from transmission are as follows:

- First, the work that a distribution company performs (reading meters, preparing bills, maintaining local poles and wires) is very different from that of transmission, and there is not an obvious synergy. For companies that are already separate, there is no reason to integrate them.

- Second, the distribution company has a commercial function, of purchasing power. This could produce internal conflicts with the transmission company, although they would not be nearly so great as those with the generators. But the expansion of transmission lines to those distribution companies owned by the transmission company, rather than those that were not, could be a problem.

- Third, the allocation of scarce funds within a combined transmission and distribution company may lead to poor or uneven transmission or distribution expansion plans.

28. So on balance it is better if the distribution companies are separate. For companies that are currently integrated, the costs of making the separation may introduce a delay in the process. Such a delay would be acceptable during the single buyer stage. The separation should be completed by the multiple buyer stage. The clear separation of distribution and transmission would make transmission and distribution pricing and costing much easier.

29. In some provinces in China, distribution entities are already separate, although in some cases they are so small that they will not have much bargaining power as purchasers and may need to consolidate their purchasing. However, it would be important to ensure sufficient number of distribution companies so as to allow the wholesale market to develop.

30. If competition in the retail market is to occur at a later date, a method must be found to prevent a distribution company from cross-subsidizing its retail activities from its regulated network activities. If the distribution company also has a transmission function then it has additional monopoly revenue with which to support the retailer function. Care must be taken to design adequate controls on the use of monopoly regulated revenue.

31. Regardless of how the transmission system is structured, it is important for the operation of the market that there be some demand response to the market price. This can be partly achieved by the demand response of large customers to price, although many large customers with the capability to control demand choose to take fixed prices. Therefore, the use of demand-side management and interruptible tariffs will rest with distribution companies and other retailer entities. A fair proportion of the load (say 50%) should be able to choose not to consume, and to reduce market prices by doing so. This ensures that the spot market clears - i.e. supply matches demand at all times, which increases reliability. To achieve the demand response by large consumers it is important to offer large customers real time prices or give them access to the spot and contract market the same interval as the market clearing interval. This would be one of the market operations responsibilities of the transmission company.

GUIDELINES FOR SIZING A COMPETITIVE POWER MARKET IN CHINA

Working Paper 2

Introduction

1. This working paper presents a set of guidelines for establishing the size of competitive power markets in China. The discussion on these guidelines includes both basic principles and practical implementation issues that should be considered in sizing a competitive power market. In these guidelines, power market refers to an energy pool developed in a given geographic area, electricity trading between these areas/markets are referred to as bilateral markets. A bilateral market is an early form of market. An energy pool is an advanced form of market. Market design and implementation should aim to move from an early form of market, to an advanced form of market.

Summary of Conclusions

2. In general terms a competitive market is bound by the following two criteria:

    a. A market must have **one set of rules** governing its operation; different rules must mean different markets. This puts an **upper limit** on the size. However, if the whole of China had one set of rules it would not mean that it had to be organized as one market. The decision would then depend on the other criteria.

    b. A market generally covers an area where generators and wholesalers are physically interconnected and coordinated by **a central control room**. The central control room would: receive bids; creates dispatch schedules; issues dispatch instructions; and establish the market price for each trading period. The central control room also controls the flows over the interconnectors between its area and adjoining areas. This condition puts a **lower limit** on the size because it makes no engineering sense to have two "central control rooms" in the one market with few transmission constraints. However, there can be, and often are, subsidiary control rooms within an area.

3. Between the upper and the lower limit, there is some flexibility. *A* market can cover two or more areas that are interconnected, using one central control room provided that the rules are the same. It would also be possible, but perhaps not very practical, to include two or more areas that were weakly interconnected in the same market. If they were not interconnected at all they would be separate markets in an economic sense, since they could not affect each other.

4. The **practical upper limit** depends on the ability to reorganize the companies

within the area – the smaller the area the quicker this will be accomplished. However, the larger the area, the more players there will be, and the greater the potential for effective competition between participants.

Guidelines for Sizing a Competitive Power Market

5. A competitive power market should be sized to a single dispatch area which would have a single set of market rules. When expanding the scope of the single dispatch area, and hence the competitive market area, the application of a common set of market rules would have to be ensured. It is possible that the scope of the area that has adopted the same market rules is wider than the single dispatch area – but this would represent separate markets. The harmonization of market rules between separate dispatch areas would allow the competitive market area to be extended more easily and sooner to cover these separate dispatch areas.

6. The five guidelines discussed in more detail to assist in sizing competitive power markets are:

    - **Guideline 1 – A single dispatch area with no serious transmission constraints**: considerations for combining separate dispatch areas; establishing essential support activities such as transmission, system operator and market operator; and, the implications of separate wholesale price areas.

    - **Guideline 2 – Common market rules**: the main components of a comprehensive set of competitive market rules and key decisions to develop them.

    - **Guideline 3 – Adequate number of market participants**: the need for adequate numbers of separate buyers and sellers in the competitive market, and the need for separate management of these firms.

    - **Guideline 4 – Adoption of market operating systems and skills**: the influence that information and metering systems and skills will have on market size.

    - **Guideline 5 – Similar starting and entry conditions for participants**: ensuring a level playing field of initial conditions and contracts for all participants in the new market.

7. Guideline 1 - Single Dispatch Area with No Serious Transmission Constraints

a. A competitive power market should be sized to a single dispatch area. In defining the single dispatch area, technical and operating information on existing dispatch areas would have to be analyzed to determine the following:

b. Issue 1.1 – Combining existing dispatch areas:

    - The existing system configuration in China will likely comprise many

separate dispatch areas. Some of these dispatch areas may be hierarchical, with a lower level dispatch area giving operating instructions within the area based on system security criteria (e.g. tie-line flows, import/export limits, etc) specified by a higher level dispatch center. Others may operate in parallel. It may be possible to combine two (or more) of these dispatch areas into a single dispatch area to form a competitive power market. Before making a decision on the size of competitive markets in China, it is important to assess the interconnection between these dispatch areas and determine: (a) whether these interconnected dispatch areas could be combined into one dispatch center area (with full responsibility on all operating instructions such as receiving bids, scheduling dispatch, issuing dispatch instructions, setting prices, etc) and adequate system security maintained, and (b) whether the interconnected dispatch center areas could be combined into one dispatch center area within a reasonable period of time.

- If combining dispatch center areas would increase system security risks, then it would be preferable to combine these areas when these risks can be minimized – perhaps when the system is strengthened through additional investment. If the organizational change required to combine these areas would take too long and thereby postpone the benefits of competition in the existing dispatch area, then the power market should be sized to existing dispatch center areas. A plan should be prepared to guide the formation of a single dispatch area at a later time.

c. Issue 1.2 – Ease of establishing common support activities

- Within a single dispatch area, essential competitive market support activities need to be established. The main support activities required are:
  - ❑ Transmission activity (separate from distribution and generation).
  - ❑ Market operator
  - ❑ System operator (including dispatch and maintenance of system security)

- The above three activities are considered common as they must be used by all participants in the single dispatch area. For example, the common transmission network is needed to connect all participants within the market. The common market operator and system operator are the institutions that define the single dispatch area and competitive market. The costs of these activities need to be identified as well as the appropriate organization formed and incentives created.

- The costs of these common support activities, and the allocation of these costs to all market participants (i.e. the pricing of these support services) would have to be determined in a fair and equitable manner. The price of these activities would be best set by a government agency based on transparent principles to give market participants the confidence that the prices accurately reflect the costs of the service.

- Key considerations and recommendations regarding the organization of

transmission operations and the establishment of the market operator and system operator have been addressed in the working paper on transmission structure and organization (see Working Paper 1).

d. Issue 1.3 – The Allowable Number of Wholesale Price Areas

- Owing to geographic locations of loads and generators and the transmission line capacity/limitations connecting these loads and generators, the "true" wholesale electricity price is not the same at all points within a single dispatch area. To achieve an efficient market within the single dispatch area analysis would have to be done to determine an appropriate separation of wholesale price areas. Each wholesale price area is often represented as a point in the transmission network where separate prices are determined. In theory, there can be hundreds of wholesale price areas with as many separate prices. However, it is sometimes most convenient to establish a fewer number of wholesale price area nodes, such that within each price area the price can be held uniform without greatly affecting the efficiency of the market outcome. The lower the number of wholesale price areas the greater will be the liquidity of the financial contracts for differences (CfD) market.

- The determination of wholesale price areas will require judgments to be made based on load flow analysis on the network under a variety of operating conditions. The considerations would be:
  - ❑ How many transmission lines can be identified that would reach their transfer limit under normal trading conditions?
  - ❑ How often will these limits be reached?
  - ❑ Are there technical considerations that require separate wholesale price areas to encourage market efficiency
  - ❑ Is the price to be set at each node, or by area

- There may be legal constraints within the framework of the existing Electricity Law (1995) to the creation of multiple wholesale price areas within the competitive power market. The interpretation of such legal provisions would have to be evaluated and amendments considered if necessary.

8. Guideline 2 Common Market Rules

a. A competitive power market should have a single set of market rules to establish a common basis for agreements/transactions between participants within the single dispatch area. The size of the market will depend on the ability of the participants within the proposed single dispatch area to design and establish the wholesale competition rules. There are three main components to the wholesale competition rules:

- Wholesale Trading Rules: These define: the market boundary; dispatch procedures; credit risk and capital reserves; and settlement procedures
- Network Access Rules: These rules define: transmission connection;

transmission pricing; distribution network connection; distribution network pricing; system security criteria; metering and measurement standards.
- Market Administration Rules: These rules define: registration of participants; enforcement; dispute resolution; procedures for changing rules; provincial differences which are to remain for a short period.

b. To advance the preparation of the wholesale market rules the following issues should be clarified:

- Who will prepare the wholesale competition rules?
- Who will approve the wholesale competition rules?
- What is the process for changing the wholesale competition rules?
- What is the legal status of the wholesale competition rules?
- Will the wholesale competition rules have the force of Law, or will they have special exemption?
- How will wholesale competition rules be enforced if there is a breach?
- Who will enforce the wholesale competition rules if there is a breach?

9. Guideline 3 Adequate Number of Market Participants

a. The size of the competitive power market should be sensitive to the need for an adequate number of seller companies and buyer companies, and will hence depend on how many such companies can be easily formed within the single dispatch area (adequate competition depends on the extent that sellers are separated from each other). If a power market is too large then the task of converting all organizations to a company structure may take a long time. In this situation the power market should be sized to a smaller area during the initial stages of the competitive market.

b. Issue 3.1 – Number of generation companies
- As a thumb-rule the market should have as many separate generation companies as possible (and no less than 5 truly separate, independent companies). A large number of firms is preferable.[9] There is no upper limit to the number of generator companies that can operate in a competitive power market. The companies do not need to be comparable in size. Rather, they need to be comparable in their competitive characteristics. If a grouping of power plants is required, then the group should be selected on the basis that its net variable cost is similar to other generation companies. Vesting CfD contracts can be used to restore generation companies to a fair competitive condition.

c. Issue 3.2 – Number of buyers
- There should be the potential to create a large number of independent buyers (distributors and large consumers).

d. Issue 3.3 – Management Teams for separate companies
- For these sellers (generators) and buyers (distributors and large

[9] These issues are discussed in more detail in the forthcoming report on Fostering Competition in China's Power Markets (Chapter 5.)

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consumers) to operate as independent companies with separate interests, it would, as a first step, be necessary to create separate management teams. This would have to be followed later by ownership reform.

e. Issue 3.4 – Legal Right for buyers and sellers to contract
   - The sellers should be generator competitors who can trade under Contract Law. The buyers should be retailer competitors who can trade under Contract Law.

10. Guideline 4 Adoption of Market Operating Systems and Skills

a. The size of the competitive power market to be formed will be influenced by the pace at which necessary market operating systems and skills can be adopted. In order for the proposed competitive market area to operate as an effective market there would be need for:
   - market participants to have sufficient skills to operate in accordance with the wholesale competition rules;
   - adequate electricity metering systems to be installed prior to the start of the competitive market;
   - the development, testing and adoption of information systems to handle bidding, dispatch and settlements in the market.

b. The sizing of the market is influenced by the skills and processes of each competitor. A 'single buyer' stage will assist in developing these skills. If adequate training has not been completed and company processes have not been developed then the power market should be sized to a smaller area to allow the single buyer stage to be experienced by the people within the dispatch centre area.

c. Issue 4.1 – Market skills
   - There is a range of skills necessary for operating in a competitive market. These include: financial management; generator contracting; business planning; risk management and asset planning. A strategy for developing these skills should be defined. The use of 'trial' and 'pilot' markets are two techniques that help develop competition skills. The 'single buyer' is a suitable technique for developing competition skills during the transition to a wholesale market.

d. Issue 4.2 – Metering Systems
   - The size of a competitive power market will be limited to those areas with the single dispatch area which have installed appropriate electricity metering systems prior to the start of the competitive market. Each generator and wholesale power area must have an electricity meter to be able to participate in the market. Decisions will have to be made on the design standards for the metering systems.

e. Issue 4.3 – Market Information Systems
   - The size of a competitive power market will depend on the ability to build and test market information systems. It will be easier to build and test these systems in a smaller area rather than a bigger area. A power

market requires the following wholesale market information systems: a competitor registration system; a bidding and pricing system (including SCADA); a dispatch system (including AGC); a settlements and a credit risk management system; and a publication system. These systems must be designed, implemented and tested before the market commences. The market rules should (theoretically) be approved before the market system design is commenced. In practice, the design of the market information systems is commenced when the market rules are in an advanced draft stage.

11. Guideline 5 Similar Starting and Entry Conditions for Participants

a. The power market should be sized in a manner that provides similar starting and entry conditions for participants to ensure that no competitor is unfairly advantaged or disadvantaged. As the initial quality of the asset base and the operating skills and practices of each competitor will vary, the market designer should attempt to provide equal entry arrangements for each competitor. This would include:

- A fair capital structure for government owned generating units;
- Improvements in generator technology;
- A reasonable allocation of customer numbers for retailers;
- Obligation for dividend payments for all government-owned participants,
- Similar technical and environmental requirements on all generator competitors;
- Vesting contracts that introduce minimum distortion into efficient price outcomes.

b. If a power market is sized too large at the beginning then it will introduce unfair advantages and disadvantages to competitors who previously operated in separate dispatch center areas. The larger the power market the harder it will be to make the necessary adjustments in the market rules.

DEALING WITH DIFFERENT TYPES OF PLANTS IN A COMPETITIVE POWER MARKET

Working Paper 3

Introduction

1. This working paper aims to address two concerns raised by SDPC:

   a. What are the implications of a competitive market for plants with different cost structures?

   b. Will the competitive market price result in an overall increase in the consumer's tariff?

2. It must be noted that answering these questions, and especially the second one, would require detailed analysis and modeling of market functioning that are beyond the scope of this paper. The following remarks highlight the problems that could be encountered and the generic solutions to address them.

Implications of the Competitive Market Regime on Generators

THE CURRENT SITUATION

3. China has two sets of tariffs: Purchase Tariff, under which the Provincial Power Companies (PPC) buy from generators, and Customer Tariffs, under which the PPCs sell to customers. They are linked, since the PPC has to pass the total cost of purchases to the customers, or it will make a deficit.

4. In the Chinese power sector, roughly one-third of the existing generation plants were constructed prior to 1986 using State budget resources. These plants are fully depreciated and the average purchase tariff covers only the variable costs, staffing costs, and fixed maintenance costs. Thus, these plants are being paid average prices well below market prices. In 1986, the “new plant, new price” policy was introduced, and power companies were encouraged to diversify sources of generation financing. Under the “new plant, new price” policy, each plant is compensated based on a plant-specific average purchase tariff. The average purchase tariff covers both capital and variable costs. Depending on the terms of the debt, capital costs are recovered over a 10 to 15 year period, which is shorter than the economic life of the assets. Those plants reaching 15 years will be fully depreciated and paid off soon. Due partly to the 10 to 15 year recovery, new plants are being paid average prices above the market prices

5. The average tariff level for each plant is approved annually by the State Development and Planning Commission. To establish the average tariff level, debt repayment requirements and expected variable costs are divided by 5000 to give

average price per kWh. The dispatch is contractually assured for 5000 hours per year. Excess hours are compensated at the same rate, although the marginal costs for these hours are clearly lower (since fixed costs have been paid in the initial 5000 hours). This means the plants are always wanting to run, either to recoup their fixed costs if they have run less than 5000 hours, or to make excess profits if they have already run. The potential for conflicts-of-interest in dispatch is evident if the dispatcher has an economic interest in the generation. Here the dispatcher can favor his own plants and therefore make more profits, or he can dispatch other plants for less than the 5000 hours causing them to lose money.

6. The average wholesale prices for power purchased by provincial power companies are the mixed average of prices of the various old and new plants. In a particular province, the averaged wholesale price level depends, to a large extent, on the proportion of the capacity of old plants to new plants. In the more developed coastal provinces where new capacity accounts for a dominant proportion of the total installed capacity, the averaged wholesale price (thus the average consumer tariff) is approaching or higher than the market price. While in some inland provinces, where the new capacity has a smaller share, the averaged wholesale prices are lower than market prices.

THE COMPETITIVE MARKET

7. In the proposed competitive market arrangement, generators will bid to the dispatcher, who will dispatch in order of the bids, from least cost to highest cost. The spot market price will be set at the highest bid with the effect that some generators will run more than 5000 hours, and some will run less. All generators are paid the same spot price for all their output, but they may have contracts10 that effectively swap the contract price for the spot price for some of their output. The contract acts to supplement (favorably or unfavorably) the generator's cash flow from the spot market.

8. In a market regime, all generator revenues come from either contracts for the sale of energy, spot revenues for the amount not contracted, CfD contract cash flows and certain sales of ancillary services, which we can ignore here. If all revenues for production came from the spot price (that is, there are no bilateral contracts), all plants that are running would be receiving the same price per hour, and a different price in each hour.

9. Not all revenues come from the spot price – in the UK for instance 90% come from contracts. The spot price, however, acts as a guide to efficient contracting – the contract price for each hour will be the expected value of the spot price in that same hour. So eventually, while contracts can protect the retailers and the customers from volatility and risk, the market price will be the major determinant of the generators' revenues. This is a radically different way of remunerating plants than the current regime, and the source of the problems specified above.

10. If all revenues come from the market, whether by market priced contracts, or by spot sales, plants with similar output will receive similar revenues, whereas now they do not – their revenues depend on their age. This does not mean that plants

[10] Contracts for Differences (CfDs) – which may be vesting or market based.

with high capital cost will be at a disadvantage in the market.

a. Plants with high debt are generally newer plants with lower operating costs. For these plants the market price will generally exceed the plant's operating cost. The plant will lose money if the margin above the plant's operating cost is too little to cover the plant's fixed cost.

b. Because the plants with high debt (therefore new plants) generally have lower variable costs than fully depreciated plants, they will be dispatched more in a competitive market and the old plants will be dispatched less.

c. Old plants with little or no capital costs will not have an advantage bidding into the market. The bids will be based on marginal costs (fuel and avoidable maintenance) not on capital costs. These plants will still need to recover staffing and other fixed maintenance costs.

11. Each generator's production is a result of how they are dispatched in a competitive market. The resulting production levels for each generator can be quite different from their pre-market guaranteed production levels. The competitive power market will force the reallocation of production between generators. This reallocation will be relative to the variable cost of production. Since it would generally be expected that the variable cost of new plant would be lower than the variable cost of old plant, it would follow that:

    a. the new plant will be exposed to a lower price but would operate for more hours than their pre-market contract terms.

    b. the old plant will be exposed to a higher price but would operate for fewer hours than their pre-market contract terms.

12. In respect to both new plant and old plant, the impact of these changes will affect the plant's net operating income. The net operating income is used to pay capital costs. The market value of the plant is the Net Present Value (NPV) of the net income over the life of the plant.

    - (Market price * kWh sold) – (fuel + staffing + maintenance) = Net income
    - Market Value of plant = NPV of Net income over life of plant

13. This market value will not be the same as the depreciated value on the books. The market price will cover the fuel cost and other variable costs for any plant that runs. Because all plants are paid the market price, all plants, except the marginal plant, will recover a margin. The margin is available to cover the plant's capital cost, fixed staffing and maintenance costs. If the margin is inadequate to cover staffing and fixed maintenance costs, the plant should be closed, or held on reserve standby until adequate reserve margins are established. Any margin in excess of fuel and other variable costs plus staffing and fixed maintenance cost contributes to net operating income and the plant's market value.

14. Understanding the relationship between how markets establish market prices and how these prices determine a plant's market value also relates to how well China achieves environmental goals. For example, adding Flue Gas Desulfurization

(FGD) to a plant increases the plant's capital cost and the operation of the FGD increases the plant's operating cost. Yet, if the marginal plant is an older plant without FGD, the market price of electricity will not change at all. In this case, the addition of FGD reduces the clean plant's net operating income and its market value. As a result, the plant owner will oppose the FGD requirement. If, however, pollution fees, or uniform Generation Performance Standards are imposed, then the cost of the marginal plant also increases and the market price will increase. The market will then help reduce pollution through an economically efficient mix of FGD and other pollution control options.

Consumer Prices

THE PROBLEM

15. If the current generation component of consumer prices is below market prices moving to market based prices for generation means the new revenues of the generation sector will increase and in the aggregate the generation sector will experience a windfall or negative stranded costs. If nothing else is done, prices to consumers will initially increase to cover the higher generation prices. The initial increase will decline as the generation sector becomes more efficient due to market competition. There are, however, a number of policy and economic options available to avoid any overall tariff increase to consumers. (The generation portion of the tariff may increase but other portions of the tariff could be reduced.) These options are described below.

16. In addition, individual generators will face either large windfalls or suffer serious losses if the market price replaces the current "old plant and new plant" prices. This problem is a source of inequity between plants. This problem is also addressed by the options described below.

POSSIBLE SOLUTIONS

17. There are four general types of solutions that may be employed to address the problems:
    a. Asset sale
    b. Debt reassignment
    c. Taxes, subsidies or transfers
    d. Vesting contracts

18. The solution that works best depends on specific conditions as well as how the overall restructuring plan is designed.

ASSET SALE

19. There are many variations of asset sales that have been used around the world. For example, one option involves the government purchasing all the plants at the existing book value, and selling them back to the same people at the estimated market value. Excess or deficit of sale proceeds would accrue to the government. A variant of this was done in Spain.

20. A second option is to sell plants at auction to qualified buyers, who would bid at

their own estimates of market value. This has been done in the US. Sales can also be arranged where assets are grouped into approximately equal mixes of old and new plants where each group manifests approximately the same cost structure and environmental profile. This places the new owners on equal footing and allows the disadvantages and advantages of each type of plant to be offset within each company.

21. The ability of an asset sale to avoid an initial price increase (or decrease) depends on what is done with the gains (or losses) from the asset sales. If the gains are returned to consumers, overall consumer prices remain unchanged. The generation portion of the tariff may increase, but other portions of the tariff decrease. This is the approach that was used in the US.

DEBT ASSIGNMENT

22. Concerns about consumer prices can also be addressed though debt assignment. For example, if the market value of existing generation exceeds the cost of existing generation, the adjustment mechanism of debt reassignment could be applied. Existing debt relating to transmission and distribution assets for example could be reassigned to the generating assets. Through this approach, the cost of existing generation could be increased to match generation's market value. Meanwhile the cost of the transmission and distribution system would be reduced. The result would be higher consumer prices for generation and lower consumer prices for transmission and distribution.

TAXES, SUBSIDIES AND TRANSFERS

23. The government can tax or subsidize the excess or deficit. This has been done in both the UK and the US. In the UK, the stranded costs of the nuclear plants were recovered by a tax on sales. In the US, high consumer prices were reduced by financing through local governments with tax-free bonds – a form of subsidy. This solution can be applied to the price level and to individual plants

24. When generation companies remain in government ownership, the revenues could be adjusted between plants by means of transparent government dividend transfers. For example, the dividends produced by the low variable cost plant can be collected by the government and then reassigned to the high variable cost plant in the form of a transparent subsidy.

THE VESTING CONTRACT

25. The vesting contract (i.e. contract for differences – CfD) is a contract that can be used in the initial transition. Vesting contracts can be used to solve problems both of the level of prices and of the level of production from individual plants. Vesting contracts can apply to each plant separately.

26. Many variations of vesting contracts are possible. For example, a plant with costs that are less than the market price may be required to enter into a contract for a period of years to deliver electricity at its low existing price rather than the higher market price. The plant can either produce the electricity or if the market price falls below its operating cost, the plant can fulfill its contract by purchasing power from

the spot market. In either case it is paid the vesting contract price.

27. Another variation can be explained with the following example:

    a. Assume an old plant was allocated 1,000 hours per year for production in the pre-market contract but during its operation in the competitive power market its variable cost was so high that it would be expected to operate for a much smaller number of hours per year (at those times when the spot price exceeded the generator's variable cost). Prior to market start, it was forecast that the generator would operate for only 100 hours. The cash flow to be paid to the generator for this production could be estimated and a vesting CfD contract designed to provide the generator with an additional cash flow that would have the effect of restoring the total generator cash flow to the pre-market contact value (without the need for the generator to consume fuel for the remaining 900 hours).

    b. The additional CfD cash flow for the old plant could be obtained from a similar but opposite CfD adjustment to the low variable cost new plant. That is, the new plant would be assigned a vesting CfD that acted to give up some of the additional cash flow that had been obtained from their longer hours of production. This mechanism acts to reallocate cash flow within the wholesale market without having any impact on the consumer tariff.

    c. One may ask what is the point of these vesting contracts – if we have a market, why go back and replicate the old contracts? The answer is first to smooth the transition – all new plants will have to rely on market revenues only, and the old ones will gradually work their way out of the old regime. Second, the spot market itself will induce efficiency by rationalizing the dispatch and offering incentives to improve maintenance and output.

STRANDED COSTS

28. The stranded cost is the difference between the (depreciated) capital value on the books of the company and the market value of the plant under competition (explained above). Virtually all plants will have positive or negative stranded costs, which is the equity problem whose solutions were discussed above. It is apparently unlikely that there will be aggregate positive stranded costs in China. Both the US and the UK had high tariffs (because of high costs), above the expected market level, while if anything the reverse is true in China.

Attachment 1 is a brief discussion of stranded cost recovery mechanisms in the UK and the US.

Country Examples on Dealing with Stranded Costs (Attachment)

THE UK SOLUTION

1. The UK market was expected to produce prices below the existing tariffs; this would have resulted in low valuations for the plants and low sale prices. Although the government could have written off the excess book value, the UK Treasury did not want to sell the plants at such a low price, and it used four tools to recoup its "stranded costs":

2. Vesting Contracts: Only the large customers could buy at the market price for the first 4-8 years; the smaller customers paid the old tariffs. The distribution companies signed vesting contracts with the generators. This paid for the coal subsidy until it was phased out.

3. Asset Sale: Only 50% of the generating companies were sold initially at the low price justified by the low market prices – the other half was sold some years later at a much higher price, after the excess capacity was closed.

4. A taxation levy *(tax)* of 10% was charged on all sales, to pay off some of the stranded costs of the nuclear plant.

5. The distribution and transmission company charges were raised (and only reduced after several years).

THE US SOLUTION

6. The treatment of stranded cost varied from one state to another. In many states there are no stranded costs and in low-cost states stranded costs are negative. In California, the private companies being subjected to competition argued that they were entitled to recover all their investment. There was some dispute about this, but the companies prevailed, more or less, as a matter of policy. Initially, estimates were made of the size of the stranded costs, with a view to charging them as a separate "competitive transition charge (CTC)". However, this computation is very, very sensitive to the estimate of the market price, with the size of the CTC nearly tripling for a small change in the market price. (These are not the California numbers, only for the purpose of explanation)
    - current revenue 4, market price 2.5, stranded cost (CTC) 1.5; or
    - current revenue 4, market price 3.5, stranded cost (CTC) .5

7. If the CTC were computed as 1.5, and the market price turned out to be 3.5, the customers would be paying 1.5 in stranded cost, plus 3.5 in market price, for a total of 5, which was unacceptable. Alternatively, the companies might be receiving .5 in stranded costs and only 2.5 in the market, leaving them with a total of 3, when they needed 4.
    - Therefore schemes were introduced that set the customer price at 4, in a transition period, and any excess that the 4 produced above the market price was considered a "CTC payment". This has been called netback pricing.
    - In addition, the companies had to sell off (divest) many of their generating

plants. The purchasers assessed the value of the plants based on their own view of future market prices. The plants were sold at a substantial gain and the gain was used to reduce other stranded costs.

8. One of the problems with trying to calculate stranded costs is that the number hinges heavily on predictions of market prices. Market price predictions generally turn out to be wrong. This argues in favor of a clear reconciliation mechanism.

RESTRUCTURING AND THE ENVIRONMENT

Working Paper 4

Introduction

1. There is an inescapable linkage between energy use and the environment. Pollution from electric power plants affects the air, lakes and streams, agricultural crops, land, animal habitat, and human health. The environmental impacts of electricity production are large and they are experienced locally, nationally, and globally. For most countries, the environmental harm caused by producing electricity is rivaled only by that of the rapidly growing transportation sector. Electricity production is almost always the single largest stationary source of air pollution.

2. While many governments wish to create abundant low-cost electricity for their citizens and economy, doing so by ignoring the environmental consequences risks creating other large costs for society such as higher health costs and reduced agricultural production. It is far more efficient to take environmental impacts into account at the time an electricity system is planned, expanded, and reformed rather than after the fact when the environmental harm has occurred and large vested financial interests resist change. Studies have reported that the pollution from power plants and other sources currently costs China between 30 and 100 billion RMB. This cost is far greater than any estimate of the cost of reducing pollution.

3. Restructuring an electric power system invariably affects the environment and, as discussed later, many of the environmental effects of restructuring are the result of market structure and design rules that often appear to have no obvious environmental connection. For a nation alert to these effects, restructuring is an opportunity to improve not only economic performance but environmental quality as well. For a nation either unaware of these effects or indifferent to them, restructuring may well result in unnecessary damage to public health and the environment.

Discussion

There are five areas we discuss in more detail.

CHINA'S GOALS WILL DETERMINE WHETHER RESTRUCTURING LEADS TO A MORE SUSTAINABLE POWER SECTOR.

4. No one model of restructuring fits all countries. International experience shows that each country that has restructured its power sector has sought to achieve different goals and was facing a different set of problems and constraints. Thus, the most important step in any electric utility restructuring is to identify and clearly articulate the country's goals and constraints. China's goals may include:

a. Reducing electricity costs;
b. Attracting private capital at reasonable cost;
c. Assisting the economic development of western provinces;
d. Maximizing public revenues from the sale of government owned assets; and
e. Reducing the environmental impacts of the electricity sector.

5. Constraints are equally important to understand and may include the following:

a. Prices should not increase as a result of restructuring;
b. National security or economic conditions may force the use of local resources;
c. Rapid reductions in the workforce may not be possible; and
d. Current tax revenues and distribution among different jurisdictions must not change significantly.

6. A full and complete understanding of China's goals and constraints will help shape and determine the pace of industry restructuring. The lesson from other countries is clear. If electricity sector reform is to be done in a way that produces sustainable outcomes, the process must begin with high-level officials making it clear that environmental protection and sustainability are high-priority goals of restructuring.

7. The power sector reform process in China is in the early stages. Now is the time for policymakers at the highest levels to make it clear that the reform of the industry should be a driver and a model of sustainability.

ENVIRONMENTAL REGULATIONS SHOULD BE REFORMED TO CONFORM WITH NEW INDUSTRY STRUCTURES.

8. Historically, China's approach taken to environmental regulation has been based on a government-owned or government-regulated system. As the power sector is reformed, it is important to simultaneously reform environmental regulations to assure that the regulatory approaches are compatible with a competitive generation market.

9. The US has made two expensive environmental mistakes that should not be repeated by China. First, older power plants have historically been allowed to produce more emissions than newer plants. Although setting lower standards for older plants has some logical appeal, it has had unintended consequences that become especially troubling in light of our rapid transition to competitive markets for generation. The right to emit more pollution than new plants provides a competitive advantage to the older plants. The older and more polluting plants were expected to be retired but the advantage of being allowed to emit more pollution than newer plants has provided a strong incentive to keep these plants running, and consequently polluting.

10. Second, the US has focused too much on one pollutant at a time. First, we regulated particulate matter and dust. Next our attention turned to SO2, and then to NOx. Next the focus will be on fine particulates, mercury, and CO2. Dealing with one pollutant at a time has been inefficient and expensive; control options targeting one pollutant have inevitably resulted in higher emissions of those pollutants that are yet to be regulated. Minimizing the cost of pollution control and the environmental damage caused by electricity production requires consideration

of all of the major pollutants at the same time.

11. There are many options for making environmental regulation compatible with a restructured generation market. The best options include emission fees, Generation Performance Standards, and cap and trade approaches.

EMISSION FEES

12. As the electric industry is reformed and relies increasingly on markets and competition, sustainability may be best achieved by including the full cost of pollution in the cost of electricity. There are many ways to accomplish this and China's "polluter pays" policy provides an excellent starting point. If sustainability is to be achieved, the "polluter pays" policy must have three essential characteristics. First, the fees must apply to all major pollutants. Second the fees must be high enough to reflect the full damage cost imposed by pollution. This will encourage investment in control equipment and cleaner sources of power. Third, revenues from the fees should be used to reduce pollution or promote the development of clean sources of power.

GENERATION PERFORMANCE STANDARDS

13. Power plant emissions in the US, and most other countries, have traditionally been regulated on the basis of pounds (or kilograms) of emissions per unit of fuel burned (e.g., lb or kg/mBtu). Historically, this input-based regulatory option was adopted because it could be applied to all industrial and commercial sectors being regulated, not just power plants. This method was also consistent with the U.S. practice of setting different standards for power plants depending on plant age and fuel use. However, using non-uniform, fuel input-based standards has led to unintended negative consequences. It encourages the construction and operation of plants with higher emissions and lower efficiency, encourages less efficient plants to continue operating, fails to provide incentives for pollution prevention, and is not compatible with competitive markets for generation.

14. To address these shortcomings, the US is turning its attention to output-based standards. Instead of specifying the amount of pollution per unit of fuel or heat input, output-based standards specify a given amount of emissions per kWh produced. Ideally, the output standards would be uniform for all plants and trading would be used to reduce the cost of compliance. Output-based standards encourage greater thermal efficiency in the generation of electric power regardless of plant age or historic fuel use. Using uniform output-based emission standards is important for electricity markets in the process of evolving to competitive markets since they reward facilities that are efficient in production and promote the development of new and cleaner facilities.

CAP AND TRADE

15. Cap and trade approaches to minimizing pollution can be combined with output-based standards. A typical cap and trade approach sets an overall cap on the level of permitted pollution (set on a local, national, or even international geographical basis) and then encourages affected parties to trade among themselves to most efficiently achieve the required cap. The trades are accomplished through the

creation of pollution credits, one credit for each permitted ton of pollution (e.g., SO_2), with auctions or other allocation methods used to distribute the credits initially. Businesses can choose to either cut their pollution output or purchase pollution credits, and will select the least-cost option. Some businesses will find that it is most economical to reduce pollution output below required levels and will then sell their unused pollution credits at an auction to the highest bidder. Our experience with cap and trade shows that stringent caps can protect health and the environment and trading can substantially reduce the cost of pollution reduction.

CREATE AN EXPERT REGULATORY BODY.

16. The creation of a single, well-qualified and expert regulatory body is an integral part of power sector reform. This has become increasingly apparent in other parts of the world. Experience shows that flaws and weaknesses in power market rules are quickly identified by the market participants. Competitive businesses seek and find opportunities to profit in ways that were not originally anticipated. Some of these actions may be contrary to the public interest. A competent regulatory body must be created and delegated the authority to identify and detect behavior that is contrary to the public interest and take corrective action.

17. The creation of an expert regulatory body is essential to successful power sector reform. The agency should be established, staffed, and trained as soon as possible because one important role for the regulator is to design the new rules for the marketplace. International experience demonstrates the benefits of careful regulatory oversight of the restructuring process.

18. The regulatory commission must have very broad scope and authority over the utility and the market institutions. The regulatory commission must have sufficient staff to carry out its duties and mandates.

19. Experience in the US shows that the model of separate and independent federal and state regulators impedes the efficient development of wholesale generation markets. A better approach followed in many other countries would be to have a single central agency with regional branches that focus on regional market issues, as well as provincial branches that focus on service quality, consumer complaints, and distribution pricing issues. All of the regional and provincial branch offices would be under the direction of the central regulator at least with respect to the operation of wholesale generation markets.

NEW REGULATORY APPROACHES SHOULD CREATE THE RIGHT INCENTIVES.

20. One of the first jobs of the regulators will be to establish the rules that control the prices and profits of the monopoly transmission and distribution companies. There are several alternative approaches, each of which creates its own set of internal incentives. The question utility managers will ask is “How do we make money under the new set of rules and requirements?” Our experience shows that there are two basic options: price caps and revenue caps. Price caps set the price per kWh that the distribution utility may charge for the distribution services it provides. If sales increase up the utility will probably collect too much money from consumers. Revenue caps set the total amount of revenue (or sometimes the amount of revenue per customer) that the distribution utility may recover from customers. With

revenue caps, increases or decreases in sales have little, or no, effect on profits. Thus, price caps tend to reward increased sales and discourage energy efficiency; revenue caps encourage cost reductions without discouraging energy efficiency.

MARKET STRUCTURE AND DESIGN SHOULD CONSIDER THE ENVIRONMENT.

21. Many market structure decisions and market design rules can have profound effects on the environment. A few examples are described below.

MARKET POWER

22. A fundamental prerequisite of a competitive wholesale generation market is the absence of vertical or horizontal market power. Structural separation of generation from transmission and distribution is vital. Control of generation must also be spread among enough owners to assure that concentration of ownership does not distort prices. The US markets have not done a good job in this area.

23. Some say that having four or five equal sized generating companies is adequate to ensure a competitive market. We believe that while this rule of thumb may make sense in markets for commodities such as wheat, rice, and oil, the electricity market is so different that more protection is needed. The need to instantaneously balance demand and supply and the inability to store electricity makes this market much more susceptible to market power manipulation than other markets. For this reason we believe that the number of generating entities competing to serve any given buyer or set of buyers should be substantially larger, preferably in the range of at least ten generating companies, roughly of equal size.

SEPARATION OF GENERATION FROM TRANSMISSION

24. Creating a competitive generation market in China will require the separation of generation from transmission. It will also require existing ownership of generation to be split into many smaller companies. How the generation is divided has significant environmental implications.

25. Our recommendation on the division of existing generating assets into as many companies as possible that are roughly equal in size is aimed at creating the most competitive market for generation possible and meeting other goals as well.

26. China's environmental goals and polluter pays policies suggest that needed environmental reforms include the adoption of market-based systems such as generation performance standards (which would impose uniform output-based emission limits for generating companies). It will be very difficult to impose these needed reforms on generating companies after the completion of power sector reforms, since competing generators will have very different fuel sources and emissions. The ability to make needed environmental reforms would be substantially improved if the allocation or division of generating capacity took emissions into account. Thus, we suggest that the newly created generation companies should each have roughly the same average air emission characteristics.

27. In addition, the separation process will give the new owner certain rights,

obligations, and expectations. One expectation is that the new owners of competitive generation should not be able to pass pollution control costs onto consumers. This will make it more difficult to impose cleanup obligations on the new owner after separation is completed. Our advice is to review the environmental performance of existing generation and make cleanup requirements a part of the separation process. This way, the value of the generation assets, upon separation, can be made to reflect the cost of clean-up.

MARKET DESIGN

28. Most power pools use supply-only bidding regimes. In the usual model of a competitive supply market, spot market prices are determined a day in advance by utilities, or in some regions by an independent system operator (ISO), power exchange, or a similar entity. A supply curve is determined using either marginal costs or bid prices to rank order the plants, beginning with the cheapest plants. The highest-cost resource called on in each hour sets the spot market price for all energy sold in that period. To the extent that there is any demand curve, it is an engineering construct based on factors such as yesterday's demand, the weather, and the day of the week. It is not based on the utility customer's willingness-to-pay or on actual production costs. Consequently, even though the merit order dispatch of a utility or pool may rank supply resources according to cost, the intersection of the supply and demand curves, while reflecting historic load patterns, expected weather, and related factors, is economically meaningless because the demand curve was not itself shaped in response to the supply curve.

29. In the U.S., the absence of a demand response combined with market power has produced prices that have been extraordinarily volatile and peak prices that have been so high as to place in question the political sustainability of the restructuring efforts. It is vitally important that energy efficiency, load management, and other demand responses be made an integral part of power pool design.

30. In addition, experience to date in some areas, California in particular, has been that virtually 100% of energy is traded on day-ahead markets or shorter-term markets. The absence of a significant forward market has accentuated the volatility of prices. The stability that is associated with forward markets enhances reliability from a planning point of view and may foster a more stable financial environment. China should consider requiring a significant part of the market to be procured through forward markets.

INTERMITTENT RESOURCES

31. Some of the cleanest generation options, such as wind and solar, are intermittent. The hour-by- hour output of any individual facility will not be as predictable as it is for most fossil generation. As a result, renewables will be disadvantaged if the market rules require all generators to state their hourly levels of generation a day or more in advance and then impose penalties if the day ahead schedules are not met. Pools that have, or are considering, penalties of this type do so to address market power concerns. A far better solution to market power issues is to fully separate generation from transmission and to be sure that generation ownership is widely dispersed.

CAPACITY COSTS AND RELIABILITY PRICING

32. Pools differ with respect to their treatment of capacity costs. Some pools have no capacity requirements and no capacity markets, and other pools have both. Pools also differ in how they determine operating reserve requirements. The presence and design of a capacity market and the level of required operating reserves can influence how much and what kind of new generation gets built. China should consider rules that do not discourage renewables.

33. Some pools allocate the costs of ancillary services, such as spinning and non-spinning reserves, to load. Other pools allocate some of these costs to generation in proportion to the level of reserves caused by different generators. Allocating the cost of generation-related reserves to the generation that causes the cost to be incurred will influence the types and sizes of plants that are built.

STRANDED COSTS

34. The most contentious issue in the US restructuring process has been stranded costs. Utilities with generating or other fixed assets that cost more than they would be able to recover in a competitive environment have labeled the difference as stranded costs. In some cases, utilities have also asked, and have generally been allowed, to recover other costs which amount to ongoing subsidies to existing plants that otherwise would not be competitive. This practice creates the risk that older and more polluting plants will remain in service. In other states, regulators have provided strong incentives to utilities to invest in pollution control equipment by allowing pollution control costs to be included in stranded cost charges.

INTEGRATED RESOURCE PLANNING (IRP) IN SINGER-BUYER MODELS

35. Single-buyer systems are generally based on long-term contracts. Consumers are obligated to pay for the contracts and have no ability to choose their own sources of supply. In a spot market it is clear that a 2-cent bid is better than a 4-cent bid. In the long-term market, comparing bids is not so easy. Specific plant operating conditions, the plant's location, the allocation of risk, long- term environmental performance, and non-generating alternatives to any plant are all factors that influence which bid wins. Integrated Resource Planning (IRP) is the best way to analyze these factors and deliver the least-cost energy services.

TRANSMISSION PRICING

36. There is no single established system for pricing transmission services. Some pricing options will bias new construction against intermittent sources such as wind. For example, if transmission prices are based on the generating capacity connected to the grid, a 100 MW wind farm with a 35% capacity factor (or perhaps 35% coincidence factor) would pay the same transmission fee as a 100 MW fossil generator with a 90% capacity factor. Pricing based on distance may also discourage renewables if the renewable resources are located in more remote areas. Also, the absence of congestion pricing can discourage investment in energy efficiency and load management. We believe the best approach is to use some system of congestion pricing and, to the extent that the revenues from these charges are inadequate to cover transmission costs, the remainder should be

spread across all electricity sales on an energy basis.

TRANSMISSION REGULATION

37. The transmission entity (or entities) will be a monopoly and its prices and revenues will be regulated in some fashion. It is important that the transmission firm be regulated in a way that provides incentives for an efficient tradeoff between new investment in transmission and investment in transmission alternatives including energy efficiency, load management, and efficiently located new sources of generation.

DISTRIBUTED RESOURCES

38. Distributed resources include several rapidly developing technologies including a new class of small (less than 100kW) clean micro-turbines and fuel cells. These new technologies can provide electricity and thermal energy on-site and in some applications they can substitute for expensive distribution system expansion. New pricing systems are being developed now under which distribution companies can send efficient signals telling customers and developers where these systems make the most economic sense.

39. By delivering electricity locally, fewer, in any, transmission and distribution lines will be needed. These new technologies offer to do to the electric industry what wireless cellular telephones are doing for the telephone industry. Restructuring the electric sector should not create or perpetuate barriers to the development of these technologies.

Conclusion

40. Restructuring the power sector is a complex but worthwhile process. The process must begin with agreement at the highest levels of government of the goals to be achieved. Designing and implementing the reforms will need the participation of industry, government officials from many disciplines, as well as environmental decision-makers. Important steps toward assuring a benign and sustainable restructuring could include the following:

    a. The creation of an ongoing power sector restructuring working group to oversee the restructuring plan and which includes environmental and public health officials. The group's charter or mandate should specifically include analysis and mitigation of environmental and public health impacts.
    b. To the extent practicable, market mechanisms should be employed to achieve reductions in emissions beyond those achieved by direct prohibition.
    c. Environmental and public health impacts that cannot be fully mitigated should be given weight in the choice among future power supply options.
    d. Particular attention should be paid to assuring that resource procurement and tariff methodologies reflect the value of energy efficiency, which can be understated in methodologies based entirely upon costs and prices as conventionally calculated.

41. The foregoing steps are necessary because restructuring based solely on

privatization, on the creation of competitive markets, and on the reduction of prices will create strong pressures to run the least expensive power plants *even when those plants are least expensive because they do not meet prudent environmental standards.* A restructuring plan that ignores this fact is likely to create incentives to build and run the most environmentally harmful (but cheapest) plants even more than would be the case if restructuring had not taken place at all. Such restructuring also creates incentives to minimize the pollution control costs of new plants in order to be sure that they are the lowest cost competitors.

42. Creating restructuring programs through working groups that do not include environmental and public health officials may make a consensus seem easier to reach, but this is a false harmony, for the environmental and public health impacts will cause continuing friction between the energy sector and those concerned with its external costs and impacts. Eventually these concerns will have to be dealt with through retrofitted solutions, but the costs will be much higher than if they had been dealt with from the beginning. And, of course, the deaths and damages will also have been much greater than necessary.