

Guangdong Electric Power Market Reform:
Options and Impact

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1. Introduction

The electricity industry of China's Guangdong Province has been in a process of reforms since the 1980s. The reforms have so far greatly promoted the industry development, advancing the provincial electric power system to the largest in the country (Zeng, et al., 1999; Zhang, et al. 2001). Achievements notwithstanding, the industry is facing numerous difficulties that challenge both reform policy makers and academics. The province needs high speed capacity expansion and power imports in the foreseeable future to meet the continued demand surge. End-users in Guangdong are paying the highest tariffs in the nation. The technological structure of the existing generation capacity is highly undesirable because large number of tiny generating units and oil-fired capacity are adversely affecting economic and energy efficiencies of electric power supply.¹ Power generation is causing increasing environmental damages. However, the most challenging is probably the fact that there lacks an adequate mechanism to solve these problems and promote efficient and sustainable growth of the electric power industry. On one hand, reforms in the past twenty years not only have not fundamentally changed the traditional mode of central government planning of provincial electric power supply and development, but also have contributed to the evolving problems of the industry and showed their limitation. On the other hand, utility de-integration and market competition represents an attractive alternative to policy makers, but little is known of the reform roadmap and the potential impact.

This paper examines the utility market reform scenario in Guangdong Province and provides a basic quantitative assessment of the possible impact of the reform policy on electricity tariffs and system development. Market competition among de-integrated electricity and service providers has been the new direction of utility industry reforms in many countries (Newberry, 1999, Joskow, 1998). It is also influencing reform policy making in China (World Bank 2002, DRC2002). However, most discussions so far are focused on the national reform policy because of the non-federalist nature of the Chinese government. Two recent studies have also looked at

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¹ According to Guangdong Provincial data, 35 percent of the province's 33.6 GW capacity consisted of units with less than 50 MW, while large modern units (300 MW or more) accounted for only 41 percent in 2001. 29 percent of provincial capacity was oil-fired.

the reform issues in Guangdong Province thanks to the discretion the province uniquely enjoys in implementing central government policies. Zhang, et al. (2001) investigated the impact of past reforms on electricity industry development and associated greenhouse gas emissions. ECPMLP (2000) proposed a gradual approach to reforming the industry based on international experience. Our research takes a closer look at the reform options given the provincial realities and conducts a quantitative impact analysis.

The rest of the paper is organized as follows. In Section 2, we review the past reform experience of the Guangdong provincial electric power sector and discuss their limitations. We maintain that the reforms thus far have significantly diversified the economic structure of the once state monopoly, but have not fundamentally changed the old central planning style of control and operation. A new reform approach focusing on market competition is necessary and unavoidable to tackle evolving difficulties faced by the Guangdong's electric power industry in its development. In Section 3, we discuss issues and difficulties associated with the competitive utility market reform in Guangdong and analyze the provincial reform scenarios. We argue that, although the central government mandates the creation of regional wholesale markets and competition, actual electricity market and industry conditions as well as many transitional issues make a partially competitive provincial wholesale market a plausible reform scenario in the near future. A step by step transition from this beginning to a fully competitive regional market, as conditions for such a market are gradually met, represents an appropriate and low risk approach. In Section 4, we use a Markal type of model to analysis the potential impacts of the likely reform scenario on Guangdong's wholesale tariffs and power industry development. We show that there will be a very small room for gradual tariff reductions after wholesale competition is introduce. With the help of various safety measures built in the reform model, serious tariff spikes during the tight market may be avoided under competition. Capacity shortage and little downward pressure of competition on tariffs will allow further investment in power generation though LNG, nuclear and wind power will be uncompetitive against coal given the current fuel price structure and restriction on the scope of competition. Section 5 summarizes the study.

2. Past reform achievements and challenges

2.1 Past reforms

The reform process in the electricity sector of Guangdong Province as well as the rest of the country began in 1979 when the central government decided to transform the national economy from central planning to market resource allocation. Reforms of the Guangdong electricity sector have been guided by the central government's policies since then. Changes took place in three major areas of the provincial electricity sector in the first two decades of the transition.

Beginning with the 1980s, the national government initiated reform policies in the electricity

sector in line with the economy wide reforms to introduce market mechanism to enhance efficiency. For example, there have been continuous efforts to relax the government control of prices and allow them to function to replace quantity command under central planning. Although electricity price reform has been extremely slow as compared to many other industries, the concept of capital cost has been introduced. Labor and fuel costs have become more responsive to market conditions. Meanwhile, there have also been continuous efforts to change government operated production units under central planning to commercially autonomous enterprises. They included replacing revenue repatriation to the responsible state agency with a tax system and enacting a corporate responsibility system with incentives for profit and capital retention at the enterprise level (World Bank, 1994). These reform measures were more actively implemented in Guangdong's electricity sector as compared to the sector in general because the central government granted the Province the pilot status in the market reform experiment, and the provincial government enjoyed more discretion in implementing central policies.

In the mid 1980s, the central government started to decentralize investment control in the power generation sub-sector and introduce "Cost Plus" tariff formula to encourage new investors.² As an exception among all provinces, it further delegated the operating control of its power generation and T&D assets located in Guangdong to the Guangdong Provincial government in support of the reform experiment. Faced with one of the most serious power shortages and unique liberal policy environment in the country, the Guangdong provincial government began raising funds for power generation projects and encouraging local government and non-government enterprises to build new capacity. Generation capacity expanded rapidly in the ensuing years. What makes Guangdong's experience further different is that the new policy attracted so many investors beside central and provincial governments that they own two thirds of the total capacity in the province as compared to most provinces in which provincial and central governments typically own a very large share of capacity.

During the latter half of the 1990s, the focus of the central reform policy shifted to separating government and business operation in the electricity industry and the economy in general. As often discussed in the literature, government and business were indistinguishable in the Chinese electricity industry (Xu 2002, Zhang 2003). The government administrated power sector operations according to planned quantities. Such Soviet type of economic organization proved to be inefficient and gave state owned enterprises no incentives to perform. The reform to separate the two began at the national level in 1997 when the central government created the State Power Corporate to manage the industry and eliminated the Ministry of Electric Power Industry the next year. The same separation was carried out in Guangdong Province following the change in the national government. The provincial Bureau of Electric Power Industry was abolished in

² The "Cost Plus" formula guarantees a 12 – 15 percent rate of return for new power plants, while maintaining the old tariff structure for old power plants built under central planning. The new pricing also allows for an accelerated capital repayment schedule, usually 10 years.

February 2002. Its administrative functions were transferred to other government agencies. Its business operations were taken over by the provincial power corporation.

These reform measures have significantly changed the provincial electricity sector in many respects. The industry grew from 4.2 GW of generating capacity in 1985 to 33.6 GW in 2001, making the sector the largest provincial power system in the country. With the growth of the market environment and the support of the provincial government, electricity has become a very attractive industry to various investors. There has been impressive advancement in electricity technology and energy efficiency. Economic efficiency of power companies have also been improved (GDTRDC 2002, Zhang, et al. 2003).

Meanwhile, these efforts have also proved to be inadequate in terms of transforming electricity into a market oriented industry. Tariffs, though raised to cover the cost of system expansion, continue to be controlled by the central government; provincial electricity development is still subject to constraints of central planning and government interference. Government owned power companies still lack important rights to make independent business decisions in response to market incentives, as their modern corporate status would otherwise suggest. Not only were previous reforms incomplete, policies to promote industry growth of the past two decades also had adverse side effects on the sector's long term development, which have only recently become apparent as the capacity expansion has eliminated the chronic power shortage.

2.2 Difficulties of provincial electricity development

After more than twenty years of reform, the provincial power sector continues to face multiple difficulties in its development. One primary problem is to maintain fast industry growth for an extended period in the future. Guangdong predicts that provincial power demand will grow at an average annual rate of 6 to 7 percent in the coming few years, which means that 3 GW new capacity must be put into operation every year. Not only is the size of the development challenging, but the concern is that there lacks a market mechanism to encourage investment and allocate financing, and that increase in supply may lag behind rising demand as a result.

One particular cause of this concern is associated with the different perspectives and development priorities between central and Guangdong provincial governments. As is known, the central government made it a long-term strategy in the late 1990s to promote economic development in the western regions as well as a priority to develop energy resources there to be delivered to the coastal areas. Consequently, it has banned new power projects in Guangdong province in order to make room for the western hydro power imports, believing such imports would be sufficient to satisfy the demand increase in Guangdong.³ Such national priority as a

³ According to the 10th Five year plan, 11.2 GW capacity from the southwest will be available for Guangdong by 2005, accounting for 22% of the province's total installed capacity. It is scheduled to deliver 51 TWh, accounting

political mandate is worrisome to Guangdong as the Province sees a different perspective. Guangdong's power sector predicts a rapid increase in power demand and a need to add new capacity even taking into account future western power available for Guangdong. Banning all new power plants risks future power shortage. (Indeed, a serious power shortage already returned to the province in 2002 after a brief period of market balance in the late 1990s because of lack of new capacity.) In addition, there are also uncertainty and reliability issues associated with southwestern electricity imports such as seasonality of southwestern hydropower, compatibility of planned dispatch and Guangdong load curve and increase in power demand within western areas. In case significant amount of electricity cannot be delivered as demanded, the power supply of Guangdong will be severely affected.

Equally problematic in new capacity development is the fact that electricity is no longer an industry operated solely by the central government in the fashion of command and control. While multiple domestic enterprises and companies from Hong Kong, Macau, Taiwan and other foreign countries all want to get a foothold in the Guangdong power market thanks to the growth perspective, the traditional practice of central planning can no longer serve as a mechanism to determine who among different investors should be awarded new projects. From the provincial point of view, granting new projects becomes difficult because it is hard to balance various interests and maintain delicate political relationships between central and provincial/local governments and between domestic and foreign capitals. It is highly desirable to create a new market and competitive mechanism through de-integration and separation between government and business so that investment opportunities can be awarded to the best suitors on the commercial basis and with minimal political interference. Even this is easily said than done. Long term growth is always a big problem challenging electricity industry reforms. It has not been resolved in many developing countries that have already carried out utility industry restructuring.

A second problem is that electricity tariffs are extremely high in Guangdong Province. The prices paid to the power generators are actually the highest among all provinces and municipalities in the country. High tariffs in Guangdong, like tariff increases nationwide, are the direct consequence of the reform policy of "cost plus" pricing to encourage investment during the 1980s. The lopsided emphasis on expansion made it impossible for the government to effectively supervise and control costs. Cost of supplying electricity rose rapidly as a result. The unparalleled high tariffs in Guangdong, however, are also due to several factors provincial specific factors. To begin with, Guangdong lacks indigenous primary energy resources and it is situated far away from the country's energy resources in the northern and southwestern areas. Fuel costs and cost of long distance transportation and power transmission are higher than that in most provinces. Further, the urgent need for electricity fueled by rapid provincial income growth and the rush to build a lot of oil capacity until the mid 1990s have also contributed to high

for 26% of Guangdong's demand.

generation costs. Finally, the government management structure of the power system with multiple intermediate links and complicated relationships have seriously increased management costs and led to uncontrollable electricity price markups and added fees. The high electricity tariffs have crippled the competitiveness of Guangdong products in domestic and overseas markets, seriously obstructed further provincial economic development, and had an adverse effect on the implementation of “export oriented development strategy.”

Lowering electricity tariffs requires that the present “cost plus” pricing mechanism, industry monopoly and opaque government operations associated with cost verification, price setting and supervision be reformed. A good alternative is to introduce competition and proper regulation into wholesale power markets. However, any change in electricity pricing is politically and economically difficult.

A third problem is that the provincial electricity system features a suboptimal capacity makeup. Power plants in Guangdong consist, distinctively from the rest of the country, of a very large proportion of small and oil-fired generating units. According to the official statistics, by the end of 2001, units of 50 MW or smaller in size amounted to 11.9 GW, or 35 percent of the total provincial capacity, while units of 300 MW or larger in size accounted for only 41% of the total installed capacity. The make-up of many small units prevents the power system to exploit economy of scale and is highly inefficient. By the same statistics, 29 percent of the provincial total installed capacity was oil-fired. Large share of oil-fired capacity and high fuel cost make power production in Guangdong very uneconomical.

Optimizing the energy and technology structure of power generation implies large investment in clean power supply including natural gas, nuclear and wind power and increase in hydropower imports. It also involves replacement of small power plants with large plants. However, the experience in recent years has shown that it is difficult to close small power plants through administrative orders, which led to dissatisfaction and resistance from investors, or for the government to buy up and dismantle them due to the cost. A good method is to introduce competition and let market mechanism gradually weed out these inefficient small power plants.

Fierce conflicts among generators and their political backers during dispatch constitute a fourth problem in the Guangdong provincial power sector. The prevailing dispatching rule in the Chinese power industry including that of Guangdong originates from central planning and is characterized by production quotas allocated among power generators hierarchically by the central, provincial and local governments (see Zhang, et al. 2001). The system had little problem during years of chronic shortage as all power generated were dispatched. However, this traditional dispatch rule did not function well as the shortage turned into surplus for the first time in 1997 and 1998. Aggravating the problem was the increasing imports of hydropower from southwestern provinces mandated by the central government and large new capacity that kept coming online. Highly politicized negotiations by various investors to protect their dispatch at

others' expenses and monopolistic behavior of the integrated power system seriously impaired the orderliness of dispatch and impeded the fairness of the process. Obviously, the dispatch which is subject to political power rather than economic merit of power producers no longer fits market development in the electricity sector and is causing much dissatisfaction among investors. There is an increasing demand for an open, just and fair dispatch mechanism. Cost based supply competition should provide such a mechanism.

One last serious problem is the environmental pollution from power generation. In Guangdong, fossil fuel based power plants account for 73 percent of the total installed capacity, and produce 76 percent of electricity output. In addition, many plants are small and dirty, and most plants have no desulfurization equipment. For quite some time during the rapid expansion, there was a weak awareness of environmental protection among policy makers and the public. The scarce capital was primarily used to develop generation capacity. Little was allocated to protect the environment. There was and still is a lack of price and other policy instruments to internalize environmental costs of power generation and promote clean technology and renewable energy. As a result, the electric power sector has caused severe environmental damages, especially due to SO₂ emissions. According to the provincial statistics, the amount of sulfur dioxide discharged by the power industry accounts for 61% of total sulfur dioxide emissions in the province. To reduce the adverse environmental impact, policies and measures need to be laid down and incorporated into the competition rules of future power markets to encourage clean development and punish pollution.

2.3 Toward the new reform

What becomes clear from the above discussion of the past reforms and difficulties is that the reforms have fundamentally changed the growth pattern and industry structure of the Guangdong electric power sector. Sectoral development is no longer an affair of centrally planned industrialization, but a demand pulled growth with short-run business fluctuations. Neither is the central government the sole industry operator and representative of all economic interests. Various investors invest in the sector with diverse economic interests.

The traditional planning mechanism which features both quantity allocation of investment, financing, production and governmental prioritizing and balancing final use of electricity does not suit the new industry reality any more. It proves incapable of economically efficient and politically acceptable allocation of investment opportunities and financing during market shortage and fair and merit-order dispatch while business is slack. The reforms thus far have neither in a meaningful way changed the old planning practices nor embraced a new allocation mechanism. Introduction of economic incentives and "cost plus" pricing have promoted growth but not allocation efficiency and, as a result, led to high electricity costs and suboptimal capacity expansion. A new reform approach focusing on market competition and regulation is badly needed to solve the problems the industry faces in its future development.

3. Guangdong Market Reform Scenarios

3.1 National reform policy (2002 --)

The problems of the Guangdong electricity sector reflect the general difficulties of the country's electricity industry, though at a far more complex level and with acute impact on the rapidly growing local economy. The central government started the popular de-integration and competitive utility market reform in December 2002 in a hope to resolve these urgent problems.⁴

According to the government reform decision (State Council Document 2002[5]), the focus and the main means of the reform are to break up the industry monopoly and serious regionalism. Through the means, the central government seeks to achieve multiple ends. The overall objectives of the reform include to (a) create a fair and competitive power market, at least a wholesale market as the first stage, with independent regulation and new electricity pricing system; (b) improve efficiency and lower costs; (c) optimize resource allocation and promote development and national grid interconnections; (d) incorporate into pricing mechanism environmental charges and incentives for renewable energy; and (e) continue the rural electricity structural reforms.

As the first step of restructuring, the central government eliminated State Power Corporation (SPC) at the end of the year 2002, and started to reorganize the corporate assets (see Appendix 1). The SPC's generation assets were reassigned into five state-owned independent generation companies. These five generation companies have been created equal to ensure competition. Each has similar size of capacity (32 GW controlled and 20 GW in equity held), thermal - hydro capacity make-up, same market share in each and every region, and a listed window company to access financial markets. Meanwhile, the SPC's main T&D assets and end-user services were transferred into a new integrated State Grid Company, which would operate in northern China. The SPC's T&D assets and end-user services operations in the three southern provinces (Guangxi, Yunnan and Guizhou) were merged with the Guangdong Provincial T&D and Hainan Island T&D to form the new China Southern Grid Company, which was created as a jointly held company with Guangdong Province being the majority holder. The same separation and assets reshuffling is underway among the provincial subsidiaries of the former SPC. Generation assets

⁴ It was the industry monopolistic behavior and regionalism revealed at the dispatch during slack market of the late 1990s that made the State Council finally determined to break up the integrated system and promote competitive regional markets. Power industry monopoly and Sichuan provincial protection caused the dispatching difficulty of Ertan Hydropower station, the largest hydropower station in China. It was built in the late 1990s to supply power to Sichuan Province. However, since its commission, it was only able to sell two thirds of the contracted power and at a very low tariff of just above two cents. This created great financial stress for Ertan Hydropower Station. See, People's Daily July 10, 2000 for the detail.

of the subsidiaries are being reallocated into the five state generation companies, and their T&D parts are being relabeled as provincial subsidiaries of the State Grid Company in the north, and minority partners of the China Southern Grid Company in the south. The new organization of the industry that is emerging features two integrated government power delivery and services monopolies, one in the north and one in the south, and five state-owned generation companies operating and competing against each other nationwide. In addition, independent power producers originally outside the SPC system will continue to operate and compete against the five state generation companies.

The first ever State Electricity Regulatory Commission (SERC) was also created in March 2003 as part of the industry restructuring. The Commission is a statutory law-enforcement agency directly under the State Council of China. As the economic regulator, it is expected to promote competition in the regional and later national power markets, enhance operational efficiency in transmission and distribution, and create incentives to promote sustainable energy sources.

SERC is assigned ten specific responsibilities by the State Council⁵: (1) be in charge of overall regulation of the country's electricity sector, create and lead the national regulatory system; (2) make propositions about new regulatory laws or relevant law amendments, and formulate regulatory rules for the sector and for market operations; (3) participate in government's planning of power sector development, draft power market development plan and regional wholesale market design, and examine and finalize operational model of the market and trading and distribution set-ups; (4) supervise wholesale market operations ensuring market order and fair competition, and regulate transmission, distribution and other non-competitive business of power supply; (5) supervise, in coordination with other organizations, the compliance of technical, safety, quota, quality and environmental standards in the power sector and license and administer power supply business; (6) Make tariff adjustment propositions according to market conditions to the government pricing authority, review tariffs, and regulate pricing standards of auxiliary services; (7) investigate illegal activities of power companies and arbitrate market disputes according to law; (8) implement policies regarding power sector social services and make recommendations for policy adjustments, be in charge of power market statistics collection and publication; (9) implement power sector structural reform plan laid out by the State Council and make further reform proposals; (10) carry out other orders handed down by the State Council.

SERC is currently trying to work out a functional sub-national structure with clear responsibility assignment and clarify its relationship with other government agencies involved in electricity sector operations, especially the State Development and Reform Commission which controls tariff setting and project approval. It is also trying to set up two or three regional wholesale markets on trial basis in some areas of China. SERC has chosen the Northeast Grid covered area

⁵ See SERC website http://www.serc.gov.cn/djh/djhjj/djhjj_zyzz.htm.

as the first to experiment regional wholesale market trading soon.

3.2 Guangdong Reform Scenarios

The government of Guangdong Province has been keeping pace with the national reform policy, and motivated by the unparalleled problems in the provincial power sector to move faster and more drastically. Anticipating the reform toward market and competition, the Provincial Planning Commission initiated in January 2001 studies of the competitive wholesale utility market model and potential impact of such market on Guangdong's power industry and economic growth. The original Guangdong Provincial Electric Power Corporation was also separated into a grid corporation and a generation corporation in August 2001 in preparation for market competition. This provincial initiative is more than one year earlier than the separation at the national level. However, the Chinese governmental framework stresses central leadership and local compliance. The central government so far strictly forbids any province to design and implement its own reform policy. It stresses the principle of overall national design, coordinated effort and cautious step by step implementation due to the wide-range of drastic changes in the sectoral organization and operation the new reform model entails. Consequently, Guangdong's utility market reform will be shaped, as it has been, first of all by the national reform model.

The utility market reform model that SERC envisages for the country including Guangdong consists of several basic elements although the details are still being crafted and to be experimented on a small scale.⁶ According to the "Guiding Opinion on Establishing Regional Power Markets", the reform will first focus on creating regional wholesale markets in five areas where interconnected regional grids already exist and in provinces covered by the newly created Southern Grid Company. The reason for choosing regional rather than the higher national or the lower provincial markets is that it is unrealistic at this stage to create the former and it is thought a good approach to breaking the "provincialism" which was a major culprit of the competitive market reform itself. There may be two forms of regional wholesale markets. A "unified regional market" is a single power market covering all wholesale trading within the region. A "common regional market" is a layered regional market with electricity traded and prices determined in provincial/local markets, but the operations of these provincial/local markets within the common regional market are subject to the same trading rules and regulations.

Participants in regional markets will include a regional market operator (with local representatives in the case of "common market"), competing independent power producers, government owned integrated T&D company as the single buyer, economic regulator (probably SERC's regional branch) and large end-users procuring directly from power producers on a trial

⁶ SERC has chosen the Northeast Grid as the testing ground of wholesale market competition because the region is not experiencing power shortages that is bothering places like Guangdong and has a relatively strong regional transmission system.

basis.

Regional markets will be cleared primarily by competitive contracts (weekly, seasonal, annual and long-term). They are likely to account for 80 percent of the sales and even higher if markets are tight. The rest of the supply will be sold on the spot markets. There can be two alternatives for power producers with respect to their participation: either they commit all their capacity to competition (full capacity competition) with 80 percent and 20 percent split between competitive contracts and spot markets; or they sign contracts with buyers in physical terms for most of their capacity and commit to spot market competition a small portion of their capacity according to some mandate or regulation (partial capacity competition).⁷

This description of the market is still vague with respect to some important issues. For example, the reform plan does not specify what will be the new price setting rule and how different prices will be regulated. It is also not known how the current investment approval practice will be changed so that investment is guided by the market but also complies with the government policy to maintain order and national priority. More seriously, the plan does not spell out how the market development will gain political and institutional support. In particular, regulated regional markets imply that the central government and the State Grid Company will see their operation and control, especially over project approval, dispatch and pricing, weakened and interests lost. They also mean that provincial governments will have to give up their control over and interests in its electricity sector. This is incompatible with the existing province-based economic management system, in which a provincial government is directly responsible for the province's income growth, employment, tax revenue among other duties, and therefore has great interests in protecting its electric power sector. Specifying these issues entails significant adjustments of the roles of multiple levels of government and broader changes. The issues are still under agonizing discussions.

Given the policy uncertainty, the reform model to be implemented in Guangdong may have four variations in the near future depending on the scope of market and competition (see Table 1). As one option, the reform may start with a unified regional wholesale market in southern China in which Guangdong's power producers and consumers become participants. Alternatively, the wholesale market may be more provincial based as a first step. In this model, competition will be confined to among power producers within the province. A part of the market will be set aside to comply with the state mandated priority of southwestern hydropower imports, ideally on a competitive contractual basis. Within each market model, there are two further options of either full supply competition or a combination of competition and non-competitive or semi-competitive supply agreements.

⁷ SERC Document [2003] No. 21. See <http://www.sp.com.cn/dlfg/200311240037.htm>. See also, Huang and Shang (1999), Zhao and Xin (2002) and DRC 2001 for background discussions.

Table 1: Guangdong Provincial Reform Options

	Option 1	Option 2	Option 3	Option 4
Market structure	Unified southern regional market with full competition	Unified southern regional market with partial competition	Provincial market with full competition	Provincial market with partial competition
Types of exchange	Contracts; Spot market; Large end-user procurement	Contracts; Spot market; Large end-user procurement	Contracts; Spot market; Large end-user procurement	Contracts; Spot market; Large end-user procurement
Inter-provincial trade	Compete in contract and spot markets; Volume depends on transmission capacity and costs	Competitive part same as Option 1; Non-competitive part determined by agreements	Participate in provincial contract market	Participate in provincial contract market
Pricing mechanism	Bidding merit order; Transmission constraints determine provincial price difference	Competitive part same as Option 1; Non-competitive part determined by government price bureaus	Bidding merit order of provincial power providers	Competitive part same as Option 3; Non-competitive determined by government price bureaus
New power plants	Full participation in regional contract and spot markets	Competitive part same as Option 1; Non-competitive part signs PPA with the grid company	Full participation in provincial contract and spot markets	Competitive part same as Option 3; Non-competitive part signs PPA with the provincial grid
Tariff structure	Capacity price based on availability plus energy price based on market competition	Competitive part same as Option 1; Non-competitive part follows traditional peak-trough pricing	Same as Option 1 for provincial market; Traditional peak- trough pricing for inter-provincial exchanges	Same as Option 1 for competitive part of provincial market; Traditional peak-trough pricing for non-competitive part of provincial market and inter-provincial exchanges
Prerequisites	Enough supply to meet demand within the	Adequate interconnection; Same	Enough supply to meet provincial	De-integration between

	region; Adequate interconnection; Same stage of government-business separation, generation-transmission de-integration and establishment of legal framework.	stage of government-business separation, and generation-transmission de-integration.	demand; De-integration of generation and transmission, establishment of legal framework.	generation and transmission.
Advantages	Complete market; Full competition, Efficient resource allocation	Learning by doing	Full competition; Easy handling of provincial specific issues	Learning by doing; Easy handling of provincial specific issues; Easy treatment of transitional difficulties, esp. stranded cost.
Disadvantages	Market difficult to operate; High operational costs; Harsh prerequisites; high market risk, esp. price manipulation by provinces with excess capacity under tight market	Insufficient competition; complicated operation due to existence of both competitive and non-competitive supplies	Less ideal resource allocation between provinces; Difficulties associated with provincial market operation and inter-provincial exchange negotiations; Existence of market risk under insufficient supply	Insufficient competition; Appropriate only as experiment or transitory stage

The central government and Guangdong provincial government differ in their preferences with regard to the reform options. The central government priority, as it is shown in its market experiment in the Northeast, is to establish regional wholesale market (Options 2 or 1). Guangdong Province clearly prefers the alternative provincial market with partial competition as a first step (Options 4). The difference reflects different perspectives of reform objectives and concerns of the center and province. As indicated in the national reform policy, the central

government seeks to achieve general and broad goals including country-wide energy development priorities, industry and national grid development, market-based pricing mechanism that encourages energy conservation and development of environmental protection technologies, open and fair rules of market operation, preparedness of the potential impact of WTO on the electric power industry. The emphases of the Guangdong provincial government, however, are more pragmatic and on lowering electricity prices to increase the competitiveness of Guangdong's products in domestic and overseas markets, expanding power supply and optimizing energy structure in a sustainable manner, and avoiding conflicts among stakeholders with different political background during new project development and electricity dispatch.

As much as the central government insists on focusing on the creation of regional wholesale markets, such effort is faced with three sets of difficulties. These difficulties give Guangdong reasons to think that provincial wholesale market and partial competition may actually be a more plausible scenario, at least as the first step.

Availability and reliability

The first difficulty relates to the issue of supply availability as a precondition for competition. Competition among generators in the wholesale market in most countries is undertaken when spare capacity is abundant. Except that Argentina continued to invest in generating facilities after its power market reform (benefiting from cheap natural gas power generation), almost no sizable new generation capacity was built in other countries after utility restructuring. One lesson the California energy crisis has shown is that lack of capacity was one of the major reasons for the crisis. Guangdong, as well as China, will need large investment and capacity expansion for a long time in the future. Long-term stable markets are necessary for the expansion, especially the development of hydroelectric, nuclear and other power projects with long construction periods. How to balance between competition for high efficiency and stable conditions for development is challenging.

Indeed, the uncooperative power shortage that has occurred in the country since 2002, coincidentally with the announcement of the latest market reform, has already relieved pressure for competition from both end-users and suppliers. The situation is leading the central government to re-emphasize industry investment and expansion as it is introducing the wholesale market reform. For example, the central government is already changing its position on the objectives of the utility market reform from price competition to industry expansion. The regional market experiment in the Eastern China Grid area, one of the two pilot areas chosen by SERC, has been postponed. Only experiment in the Northeastern Grid area which is not affected by power shortage is proceeding. In Guangdong, the acute power shortage is also pushing off the agenda for competition. The priority, at least for the next few years as the provincial government perceives it, is to expand generation capacity and T&D networks. There will be no meaningful competition until the market condition changes.

A second issue relates to reliability of outside capacity to supplement Guangdong's indigenous supply. This is one of the most serious concerns to Guangdong as discussed in the last section. While the central government has been turning down new power plants in Guangdong and mandates the Province to import southwestern hydropower instead, Guangdong fears that the imports are insufficient to either meet the level of market demand or match the load curve. Hydro power stations integrate the functions of flood control, irrigation, shipping, water supply as well as electricity generation. These other functions than power generation are all closely linked with the social and economic development of the Southwestern regions. It is hard to think that hydro power stations will be allowed to pursue maximum profit at the expense of all alternative uses of water. However, the potential problem of insufficient water for power generation has not been considered by central government planners when they decide how much Guangdong's demand will be set aside for southwestern hydropower imports. In order to secure hydropower imports so as to better manage the provincial electric power market, the Guangdong government sees it necessary that various services and prices of hydro projects be clarified including water charges for power generation, and that flood control, irrigation, water supply and shipping be the primary functions and power generation secondary with a designated department in charge of its dispatch.

Transitory difficulties

An immediate concern with respect to the transition from the existing system to the new market model is the fairness of competition between old and new power plants. The new power plants with a heavy burden of capital repayment and interest costs are at competitive disadvantage against the old plants that had no capital cost or have basically paid back the loans. A potential outcome may be that, contrary to the original reform intention of optimizing the industry structure, highly efficient new power plants fail to compete with inefficient old power plants. A second difficulty is the treatment of existing power purchase agreements (PPAs). Some power plants have signed long-term PPAs with local governments or enterprises which specify amounts of electricity off-take and contracted tariffs. Some of these PPAs also involve foreign power producers. They need proper treatment when switching to the competition mode to avoid serious damage of to the government reputation and image. According to the central government principle, the issue of existing PPAs should be handled through re-negotiation and purchase of contract ownerships. If the disagreement cannot be so resolved, original contracts will be honored. These problems vary by provinces, and are easier to treat by individual provinces than in a unified regional market.

In Guangdong, the provincial government has two options dealing with the fair competition and stranded cost issue of the new power plants as it is stipulating competition rules. The fairness of competition to the new power plants may be achieved either through market valuation of old power plants and merger and acquisition among power companies, or by setting different price

caps according to the types of power plants. Either approach is feasible. The former is easy to practice but may possibly result in the rise of wholesale prices; the latter is good for controlling the rise of electricity price, but its operation is complicated. In terms of PPAs problem, there are only a small number of new plants in Guangdong which have outstanding PPAs with the grid. Most of these contracts are in the form of provincial and local government guarantees of rates of return to investors. These contracts will be properly handled by the provincial and local governments.

Readiness

A regional wholesale market that covers multiple provincial administrations requires comparable structural and organizational reforms among participating provinces. In this respect, Guangdong has completed separation between government and business as well as de-integration between generation and transmission. However, such is still not the case in the other provinces joining the regional market. It will take time for other participating provinces to carry out and finish similar reforms. Even if the government and business are nominally separated in all provinces, the continued power shortage may prolong the strong government involvement in organizing investment and control of tariffs, dispatch as well as other supply operations at the expense of market development. More fundamentally, it will require broader governmental reforms to minimize the incentives to different administrations to intervene in the market to protect respective local interests.

Further, regulation becomes vital for fair competition after electric power markets are created. Lack of proper regulation may easily lead to electricity crisis as there will be inevitably imperfections and lacks of rules associated with power markets as they evolve and there is also little successful international experience of utility market reform to learn from. For a regional wholesale market to function, it is important that a regulatory commission is established that is independent of government as well as electricity enterprises with clearly defined functions and a legitimate and empowered organizational structure. This is still absent in the central government reform plan.

Overcoming these existing problems and the lack of underpinning foundation of a regional market entails tremendous economic, technical, political and legal difficulties. It will be a prolonged process if previous reforms are of any indication. As these difficulties persist, a provincial market with partial competition (Option 4) seems a more plausible reform scenario for Guangdong as the first stage of the reform. A gradual transition from this beginning to fully competitive provincial and then to regional markets represents an apt and low risk approach. In the next section, we investigate the potential impact of introducing a partial competitive provincial power market on the wholesale tariffs and capacity investment in the Guangdong electricity sector.

4. Impact of the Reform

4.1 Wholesale Market Design

We use Markal model to quantitatively simulate the impact of market reform on future utility industry growth. The exercise focuses on the plausible scenario (Option Four) that complies with the market choices sanctioned by the central government. The specific market design follows the Argentina type of single buyer model, in which independent power producers within the province compete to sell on the wholesale market and integrated transmission and distribution system serves as single purchaser. However, some large end-users will be allowed to buy directly from power producers. Such single buyer model is less than ideal because it will maintain the monopoly of the integrated transmission and distribution system and limit efficiency improvement, especially in electricity delivery and end-user services. Nevertheless, it will allow for unified management of electric grids, therefore ensuring better quality and safety of power supply. Besides, participation of large end-users in direct purchase from the wholesale market, which will account for only two percent of total demand, will serve as a learning opportunity and provide experience for a full open market in the future.

The competitive wholesale market will consist of contract market, spot market and real-time market. 70 percent power supply will compete in the contract market. A large long-term contract market will lower the risk of severe price volatility and may also prevent collusions of large companies in the market. It may be disadvantageous for power producers whose fuel costs are volatile such as oil-fired power plants. The rest 30 percent of power supply will be subject to spot market and real-time market competition.

Also consistent with the general principle of the state reform plan, the competitive wholesale price will consist of capacity price and energy price. The main consideration of allowing for capacity price is the long-term need for capacity expansion in the province as well as the entire country. Capacity payments will encourage investment in power generation and avoid potential predicament of California, where no investment has been made in power supply for many years. Capacity price will be regulated to reflect market conditions and may become a policy tool for the government to regulate capacity development. The competitive wholesale price will be subject to a price ceiling to ensure reasonable price and price stability.

Such choice of the wholesale power market grants only very limited competition and functioning of price. It reflects the policy preference for stability and controlled change of both provincial and central governments. The only difference between the national and provincial governments is that the former prefers national development priority and regional market while the latter concerns about provincial power availability and potential problems of regional market due to the lack of preconditions.

4.2 Rules of Operation

Since the operational rules of wholesale market competition are still lacking in the reform plan of the central government, the simulation in this section adopts several assumptions with respect to provincial market design and operational rules. These assumptions are based on careful studies conducted recently in the province and reflect the policy preference of the provincial government.

Participating power producers

Not all power plants will be pushed to market competition initially. Power plants that will compete in the provincial wholesale market include power plants that are currently subject to the provincial government dispatch plan, plants that are connected to the provincial 220 KV main grid and those on municipal 110 KV grids. These participating power plants will be granted licenses to operate. They must adhere to relevant competition rules and not engage in unfair competition. They must obey the dispatch orders from the dispatch center unconditionally when the reliability and security of the system are in danger. They are, however, entitled to obtain necessary market information.

Several types of power producers will be exempt from competition due to various reasons. First, southwest hydro power will not participate in competition thanks to the mandated off-take by the central government. The off-take contract between Guangdong and southwestern provinces will specify negotiated deliveries and tariffs. They may participate in the competition on Guangdong's contract and spot markets in the future as inter-provincial wholesale power market develops gradually and transmission capacity increases. Second, Daya Bay Nuclear Power Plant will be exempt from competition. The plant is under cooperation with China Light and Power of Hong Kong. According to the original contract, most power generated is supplied to Hong Kong, with only a very small amount delivered to Guangdong end-users. The contract is still in effect. New nuclear projects under construction or being planned such as Ling Au Nuclear and the Third Nuclear Power Companies may be required to compete. Third, small hydro power stations in Guangdong will not be required to participate in competition. These stations are often scattered and poorly equipped. Many service local distributional systems only. Finally, other non-participating power plants include pumped storage stations, co-gen plants, power plants using renewable energy (such as wind power, city waste, etc.) and captive power plants.

Power exchange

The Power Exchange will be temporarily placed within the Provincial Electricity Dispatch Center which is in turn controlled by the provincial grid company. Its responsibility includes membership registration, projections of daily, monthly and annual power market supply and demand trends, making purchase plans on the contract market and the spot market, managing and

operating the market, and evaluating and making the settlements. It is also responsible for the confidentiality of the reported data from power generation companies.

Contract market and competition

Most electricity will be sold competitively on the contract market in order to avoid price spikes and maintain steady supply. There will be annual and monthly contracts. Operationally, electricity specified in annual contracts are allocated to each month. The monthly allocation as well as electricity by monthly contracts are then allocated into each day. The daily load curve will be divided into three segments: Peak, off-peak and shoulder. Power producers will compete for different segments.⁸

Further, power producers competing in the contract market will be grouped into different categories according to the types of fuel they use and debt repayment arrangements. Power producers will compete against power plants in the same category initially. This competition restriction will be gradually relaxed so that all participants compete in the same contract market.

Competition rules may allow a power plant to submit multiple bids before bidding is closed. However, each revision of the bidding price is subject to a limit of 20 percent from the previous bid. For example, if a generation unit bid 5 cents per KWh for a specific section of load curve, the revision of this bid can neither be 20 percent more nor less than 5 cents. This is different from the familiar competition rule elsewhere that permits only single bid from each participating power plant and requires merit order dispatch based on submitted bids. The reason for multiple bidding is to encourage more competition, in case a plant initially bids unrealistically high.

Power producers that cannot fulfill their contracted supply will be considered breaching contract and will be penalized. Similarly, if the Power Exchange fails to off-take power according to the contracts, it will have to compensate the suppliers for the lost revenue.

Spot market and competition

Spot market will include day-ahead and real time markets. The day-ahead market provides bids for the next day, which is divided into 48 half hour sections. Detailed rules of price determination and order of dispatch are still under intense discussion. A price band and/or other types of averaging formula will be used to ensure price stability.

In the actual operation of the power system, the power dispatch center maintains the right to

⁸The actual observation in Guangdong indicates the following load curve. Peak hours: 9:00-12:00, 19:00-22:00; Off-peak hours: 0:00-7:00; and, shoulder hours 7:00-9:00, 12:00-19:00, 22:00-24:00.

adjust contracted output of generating units in the day-ahead market and financial compensations accordingly. The power exchange will also be responsible for paying ancillary services in the real-time market such as stand-by capacity, ramping costs, etc.

Capacity price

Following Argentina model, Guangdong will include capacity payment in the wholesale market price because of the provincial need to encourage capacity investment. Capacity price will be used mainly to compensate for depreciation and capital cost of power plants.

Empirical investigation indicates that the average depreciation and capital cost of a representative new power plant in Guangdong amount to about RMB 400 per KW per year. This will be the capacity price paid to the available capacity of power plants.

Market regulation

Guangdong's power industry is currently under the management and supervision of multiple provincial government branches, including the provincial Economic and Trade Commission, Development and Planning Commission, Price Bureau, Department of Hydro resources, Department of Finance, Environmental Protection Bureau, and so on. They control every aspect of power industry operation from new project development and financing, power generation, pricing and dispatching, energy resources planning and renewable energy development, environmental protection to the enforcement of industry technical, quality and safety standards (see Li, 1999). This organization is not suited for market competition. A provincial electric power regulatory commission is needed to facilitate the new wholesale market operation.

The provincial regulatory commission as it is envisioned by the provincial government will be a not-for-profit agency directly under the provincial government and independent of both utility enterprises and functional or policy departments of the administration. As a provincial level commission, it will also be under the leadership and guidance of the SERC and its South China regional office. The Provincial Electric Power Regulatory Commission will have a certain degree of authority.

The provincial commission will be charged to supervise power market competition and competing companies' behavior according to the "Guangdong Electricity Grid and Power Market Regulations" soon to be promulgated. The commission's main functions fall into several areas:

(A) Approving market access. The commission approves market access and issues operation licenses to qualified applicants according to the regulation. There will be power generation, transmission and distribution licenses for different operators.

(B) Designing and perfecting market rules and trading system. This includes market structure, procedures of entry and exit, proportions of contract to spot markets, operating rules of the market, supervision of measurements and standards, prevention of market barriers, as well as handling of accidents and transmission congestions.

(C) Supervising market to ensure legal and proper business conducts and fair competition.

(D) Recommending tariff adjustments to the government pricing authority. The adjustments may be with respect to capacity price, compensation for auxiliary services, price cap, monopolistic transmission and distribution prices.

(E) Enforcing standards of quality, safety and environmental protection in power production and supply to ensure high quality power supply and clean environment.

(F) Making policy proposals to the provincial and central governments, such as policies regarding investment promotion, encouragement of clean source of energy for power generation, treatment of stranded costs, etc.

(G) Promoting demand-side management, information provision, electricity R&D, etc.

4.2 Data and Methodology

In order to understand the potential impact of wholesale market competition on tariffs and industry development, we participated in the government study that surveyed 234 power plants within the province, accounting for 91.5% of total provincial installed capacity in 2000.⁹ Comprehensive cost, cost components and other operation and financial data have been collected. For our purpose, we have also made projections of future trend of power demand, decommissioning of old plants and new capacity development.

The simulation model we use is the Competitive Cost Analysis Model (CCAM). CCAM is developed by Guangdong Techno-economic Research and Development Center (GDTRDC) on the basis of MARKAL optimization model.¹⁰ With the help of GAMs computer program, the model simulates generations of the competing power plants by each hour of the day and calculates their respective competitive costs. Iterations yield optimal generation associated with the competitive cost. Supplies of power plants are rank ordered by their costs for specific time periods along the load curve. The order is then used to analyze competitive market tariffs.

⁹ Power plants not included in the survey are mostly small local hydro stations.

¹⁰ GDTRDC (2002) contains detailed explanation of the model.

The exercise constitutes several steps. Firstly, marginal supplier is found for each time period that balances the load of the period. The cost of this supplier is the marginal cost, which constitutes the basis of market tariffs. A quantity weighted average of marginal costs of all time periods along the load curve gives the average cost of annual power generation. The average cost plus reasonable rate of return and capacity payment constitutes reasonable competitive market price paid to the power generators. Secondly, by varying the ratio of supply through competitive contracts to sales on the spot market, an optimal combination is found that implies least upward price pressure. Thirdly, the market tariff established through competition is then compared with the base year (2000) actual average price which the grid paid to the power producers to evaluate the price trend after the utility wholesale market competition. Finally, some of the model assumptions are changed to test the sensitivity of the result and evaluate the risk of wholesale market competition.

4.3 Results

The results of our simulation indicate that there will be a power shortage for both 2003 and 2004, with maximum load shortage reaching 2,600 and 700 megawatts respectively. The market will return to balance in 2005 if all new plants already under construction or planned can come online by then. Therefore, reform risks are likely to be smaller if wholesale market competition is introduced after 2004.

Tariffs

Under wholesale market competition, our simulation projects that there is a small room for competitive generation tariffs to fall gradually over time. The impact of competition on tariffs will be minimal in the beginning because of the tight market because of the tight supply condition and a relatively large share of oil-fired power plants in operation. Expensive power generated by oil combustion will keep marginal cost, hence tariffs, high. Average tariff reduction will be around 0.2 to 0.4 cent per kWh, a 5 to 8 percent reduction from the pre-reform level of 4.6 cents per kWh. In longer terms, as oil-fired plants are gradually replaced by new coal-fired power plants and increase in imports of western hydropower, the margin of tariff reduction may reach 1 cent per kWh.

While the market condition indicates that the risk of price instability is small if the wholesale power market competition is introduced after 2004 when the demand-supply gap narrows, our analysis also suggests that the immediate implementation of the reform is also feasible if proper measures are taken, for example, setting competition rules sensibly; strengthening regulation; speeding up new project approval and construction; accelerating inter and intra provincial transmission capacity; and lowering fuel price risks originated from international fuel market changes. Our analysis shows that, although the range of the tariff reduction will not be significant after the reform, neither are competitively determined market tariffs likely to be higher than the 2000 pre-reform level given proper market rules and effective regulation.

Capacity development and supply

Wholesale market reform will have impact on the development of both provincial generation capacity and electricity imports from the region. Our simulation indicates that competition is less likely to adversely affect capacity expansion in Guangdong. The result shows that the average wholesale price (excluding value added tax) in the specified reform scenario will not be lower than 4 cent per kWh. Future new coal-fired power plants will be competitive and able to make a reasonable profit as long as their total generation costs are on par with that of the large Taishan power plant under construction (4.6 cents per kWh) and capable of supplying base load according to contracts as well as competing partially on the spot market for off-peak load.¹¹

Among other types of capacity than coal-fired, wholesale market competition is likely to have some adverse impact on LNG plants. According to the technical and economic feasibility study of the Huizhou LNG plant to be built in Guangdong, at 4,000 operating hours per year, the plant will be able to generation power at an average cost just below the 6 cents per kWh peak load price, desulfurization cost included (calculated for a representative September work day in 2005). However, if LNG plants can only supply peak load as the current central government policy specifies, they can only operate in a range of 3,100 – 3,400 hours per year according to our model-based calculation. Lowering operating hours will result in higher generating costs, rendering LNG generation capacity non-competitive. As natural gas is clean and appealing, Guangdong sees a great need to develop natural gas generation capacity. To this end, central government pricing and other supporting policies are required in order to increase LNG's competitiveness.

Nuclear power development under wholesale market competition will also face tough competition. Generally, nuclear power capacity is for base load generation. Again, our calculation for September 2005 shows the base load price in the province is cent 3.6/kWh. This is significantly lower than the existing planned tariff of cent 6/kWh for the nuclear power as well as nuclear generation cost. To lower the cost and increase the competitiveness of nuclear power, it is necessary to speed up the process of nationalization and domestic manufacturing of nuclear power generation equipment and increase economic efficiency of the plants. In addition, as the nuclear power plants built in the early days have smaller financial burdens by now, a possible way to make nuclear power competitive is to bundle these power plants and new nuclear power together in contract bidding.

Wholesale market competition will not likely affect the provincial hydropower development. The

¹¹ Phase I of Taishan Power Plant consists of two 600 MW units. Investment cost is about \$608 per KW. Operating costs include 315 gram per kWh coal consumption and 0.3 cents of desulfurization cost among others. Total cost of generation is estimated at 4.6 cents per kWh including desulfurization cost and tax.

potential of further hydropower growth within the province has become limited after many years of development. Most new projects will be of small scale. The cost of these hydro stations will not likely to be high, especially if the projects suit local conditions, control the construction costs and subscribe to 30 year depreciation allowed for by the No. 701 Document of the State Development and Planning Commission. Furthermore, hydropower stations also have the comprehensive benefits of flood prevention, irrigation, navigation, and water supply. Small local hydroelectricity plants are also one of the effective measures to help the mountainous areas eradicate poverty. Therefore, the provincial people's congress has made this law to boost the development of the small hydro electricity plants. Thus the implementation of utility wholesale market competition is likely to have little influence on the development of small hydroelectricity plants.

The cost of wind electricity is still higher than that of conventional power stations. Moreover, it is of poor quality because of its reliance on weather conditions. Wind power cannot compete with conventional power plants. Nevertheless, wind power is a source of clean and renewable energy, therefore should be supported by the government policy. What preferential policies government should give to wind power for its participation in price competition is a question subject to further research.

In our reform scenario, the provincial wholesale power market competition will not likely to decrease Guangdong's demand for power imports. Guangdong's power market will remain tight for the next few years. Electricity tariffs will remain high despite the introduction of partial competition. Hydropower from southwestern provinces will continue to be competitive at its present level of cent 3.8/kWh (cent 3.3/kWh excluding value added tax). As long as the generation and transmission costs are properly controlled, these supplies from outside the province will be able to participate in Guangdong contract and spot market competition though they are not required to do so.

In addition to Southwestern hydropower imports, Guangdong typically purchases some electricity from Hong Kong when it runs short of electricity. This import is not to be affected by competition because the amount of trade is small, electricity from Hong Kong is cheap and most purchase is for peak hours. Not only the import from Hong Kong will continue under competition, the cheap Hong Kong power also serves to restrain tariff hikes.

Sensitivity of the results

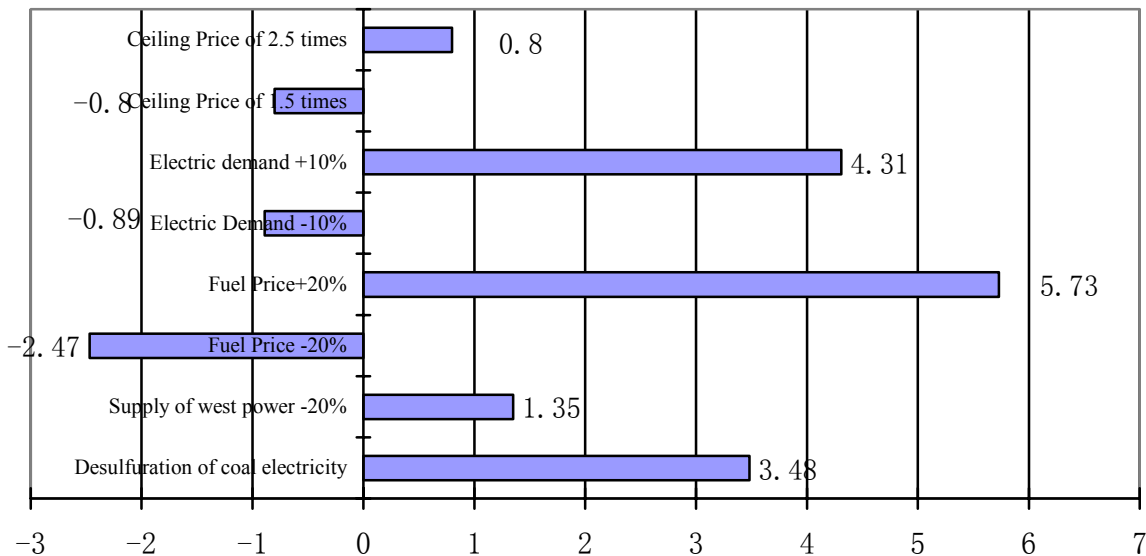
In order to test the sensitivity of the simulation results, we analyzed the effect on tariffs of changes in market demand, fluctuation of fuel prices, availability of southwestern hydropower and installation of desulfurization equipment in coal-fired power plants. The test results are summarized in the following figure. It shows that equilibrating electricity tariffs on the provincial wholesale market will be particularly sensitive to alternative market demand, changes

in fuel prices and cost of desulfurization equipment for coal-fired power plants.

Risk assessment

Inasmuch as one of the important objective of utility market reform is to improve efficiency and lower tariffs, a primary risk of the reform and concern of the central and provincial policy makers is the surge of wholesale power tariffs once the utility market reform is implemented. Under the scenario we consider, the risk of price instability is due to three previously discussed factors. One such factor is that there is a serious possibility that the power shortage in Guangdong which began in 2002 will last until at least 2005. Power generators may very well exploit the opportunity and hike the tariffs, to the detriment of the reform goal of lowering tariffs. A second factor is that there are many expensive oil-fired power plants in Guangdong which is unparalleled in the nation. If the market price is determined by marginal cost under competition, these expensive oil-fired power plants will cause large scale grid-wide tariff increases. Another factor that will affect Guangdong in particular is the fluctuation of fuel, especially oil, price. As our sensitive test shows, fuel price fluctuation will significantly influence wholesale power market tariffs. Large scale oil price increases will cause tariffs on the Guangdong power market to sky rocket, jeopardizing reform efforts.

Chart of sensitivity analysis (unit: fen per kilowatt-hour)



This risk may, however, be effectively avoided by setting appropriate operating rules for wholesale market competition. For example, for temporary demand increase and power shortage which accounts for less than one percent of a year’s time, a reasonable cap may be implemented to avoid spiral price increases. For price risks related to the high cost of oil-fired power generation, the risk may be controlled through maintaining proper shares of contract and spot

market competitions or allowing separate competitions among different types of generators. However, higher electricity tariffs caused by increases in the fuel (oil) price are a problem irrespective of power market competition or not.

To sum up, wholesale power market competition in Guangdong does not necessarily increase risks provided rules of market and competition are properly set. The risk is further minimized if competition is implemented after 2004 when the gap between supply and demand narrows.

5. Conclusion

The current round of power market reform in Guangdong as well as in the entire country represents an all new approach to supplying electricity from the traditional model of government operation under central planning. Inherently difficult, the reform is particularly challenging to Chinese policy makers due to the general lack of market experience and a huge need of capacity expansion to fill the supply shortage. To maintain stability, Guangdong shares central government's vision of a gradual market reform process, which as the first step focuses on wholesale market competition. Meanwhile, considering the actual market and industry conditions, and if the Guangdong government has the discretion, it is prepared to implement a provincial wide wholesale power market as the first step. Power plants within the province excluding nuclear, pumped storage, small hydro and renewable capacity will have to compete for supply contracts or on the spot market. To be safe, only twenty percent of power will be competitively supplied on the spot market, while the other eighty percent will be supplied through monthly, seasonal and annual contracts. Similarly, a cap of 1.5 times of the existing government set wholesale price will be maintained for peak load bids. Neither are bidding prices for off-peak load allowed to exceed the pre-competition tariffs set by the government.

Preparation work has been carried out in Guangdong in the past few years. The provincial dispatch center developed the "Power Contract Market Trading System" software in collaboration with Tsinghua University. In May 2002, Guangdong Pricing Bureau and Guangdong Provincial Economy and Trade Commission lowered the retail tariffs of the provincial grid from cent 6.9/kWh to cent 5.9/kWh. The provincial government further made various adjustments in the industry management system so that it is compatible with market competition. The utility market reform was slated to begin in Guangdong in the second half of 2004.

However, a serious power shortage has developed since 2002 which requires careful planning to shift demand off peak. Moreover, the central government promulgated the [2002] No. 5 electric power industry reform decree. The central policy has mandated Guangdong to first form and participate in China Southern Grid and the regional market which also include several other southern provinces. Consequently, power market reform in Guangdong has been halted until further directives. Nevertheless, electric power market reform to introduce competition is

inevitable. Guangdong is well prepared to carry out the reform as it is uniformly laid out by the central government for the nation.

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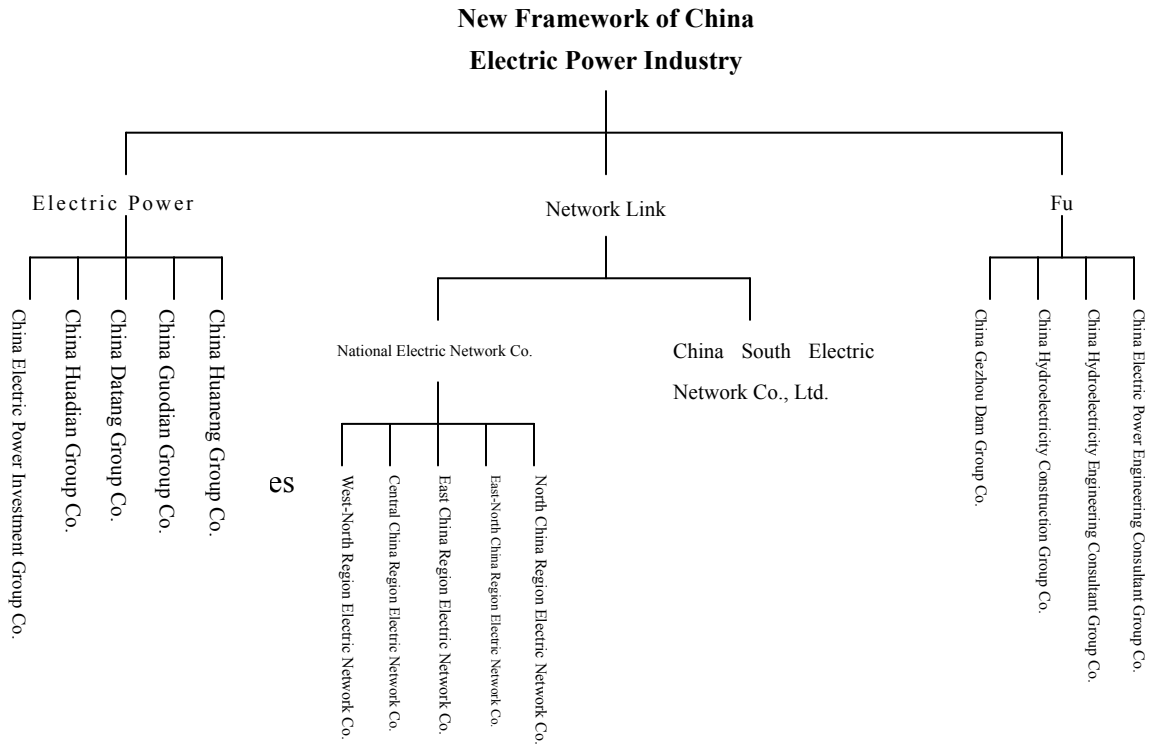
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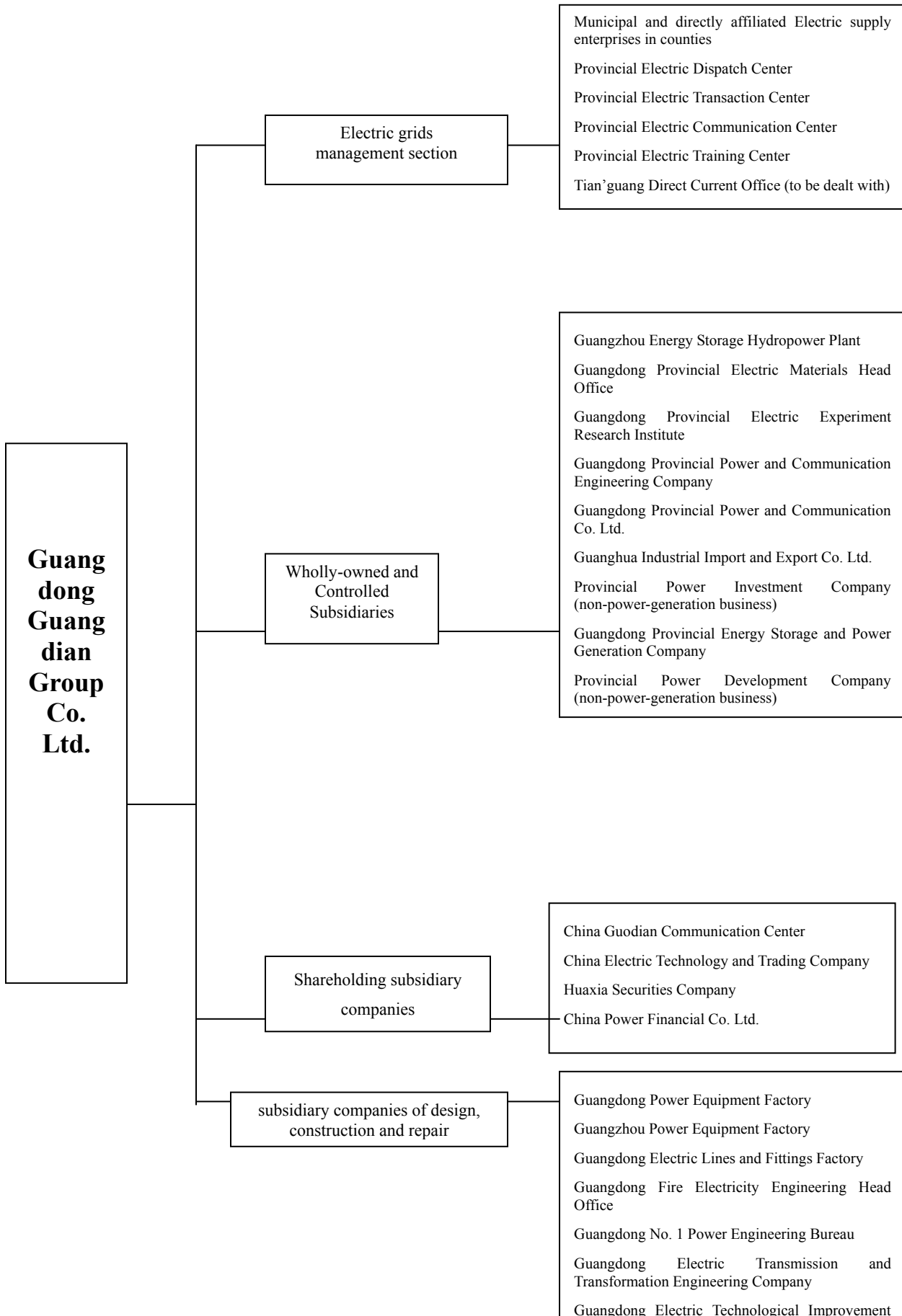
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Appendix 1: New Structure of the Chinese Electric Power Industry



Structural diagram of Guangdong Guandong Group Co. Ltd.



Structural diagram of Guangdong Yuedian Assets Administration Company

