

Reform in China's Electric Power Industry

- A Case Study of East China's Wholesale Electric Power Market -

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Preface

China's power industry has been reformed in various aspects since 1985. Though the first stage of the reform was the procurement of funding, from 1996, reform of the power industry system concentrating on the introduction of competition has proceeded, following the tendency of power industry liberalization in developed countries.

As the first step in introducing the principle of competition, the State Power Corporation of China was founded in January 1997, based on the policy of "separation of the functions of administration and business." Furthermore, to promote market competition, the State Power Corporation of China was divided into power generation sector and transmission/distribution sector in December 2002, as a part of reforms directed towards the liberalization of the electric power market. Although no great differences can be seen in the power supply system before and after separation of power generation from transmission/distribution, from March 2004, in the North China region, and from May 2004, in the East China region, pilot program of wholesale power market has been conducted. Currently, transaction amounts on the market in both regions are 20% and 10%, respectively. In both cases, the respective provincial (municipal) power

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companies purchase power as single buyers.

In this paper, issues and future direction of the present pilot program are concerned through an overview of the electricity market operation including amounts and prices traded in the East China region.

1. Economy, power supply and demand in the East China Region

The East China region comprises Shanghai Municipality, Jiangsu Province, Zhejiang Province, Anhui Province, and Fujian Province (see Fig.1-1).

Figure 1-1 East China Region



Total population within the region amounts to only 11% of the total population of China, however, annual economic growth rate has been more than 10% during the last decade. The statistics in 2003 shows that the growth rate of GDP in the whole East China region was 12.5%, exceeding that for the whole of China, 9.1%, and a high double-digit growth rate has been maintained for 12 consecutive years

since 1992. In 2003, the region's GDP accounted for 31.8% of the total GDP for China, playing the role of a powerful engine in the Chinese economy. This rapid growth of the region's economy and other factors, such as unusual weather conditions in recent years, have led to power shortages within the region since 2003. The amount of power supplied in the East China region in 2003 reached 411 GWh (a 17.0% increase from the previous year), of which 93.0% was thermal power (383 TWh), 7.0% was hydropower (29 TWh). In 2003, power supplied to the four provinces and Shanghai are as follows: 99TWh (24.1%) to Zhejiang Province; 128TWh (31.1%) to Jiangsu Province; 54TWh (13.3%) to Anhui Province; 61TWh (14.8%) to Fujian Province; and 69TWh (16.7%) to Shanghai Municipality.²

The total amount of consumption in the region in 2003 reached 452TWh, an increase of 19.1% on a year-to-year comparison. The growth rate of power consumption of the four provinces and Shanghai are as follows: 22% in Zhejiang Province, 20.7% in Jiangsu Province, 17.9% in Fujian Province, 14.2% in Anhui Province, and 15.3% in Shanghai Municipality.

2. The Wholesale Electric Power Market in the East China Region

Since the East China region has experienced the implementation of a Single Buyer System³ (1998-2001), following the Northeast China region, the region

² Figures in parentheses show the percentages of the supply amount of the respective provinces (municipality) to the total amount of the region.

³ Single Buyer (SB) means the business of mainly purchasing wholesale electric power from power producers and reselling it to the final users directly or via monopolistic retailers. The Single Buyer System (SBS) is a market liberalization model proposed by France in September 1994.

was designated as a test region for the wholesale electric power market by the State Electricity Regulatory Commission (hereinafter “SERC”). In May 2004, the first simulation test was commenced based on the “East China Power Market Experimental Program” (issued in November 2003) formulated by the SERC. In August 2005, the “East China Power Market Operation Code⁴” is issued, and the current simulation test is scheduled to proceed to a pilot operation stage by the first quarter of 2006. The progress of implementation of the wholesale power market in the East China region is examined as follows.

Participants in the wholesale electric power market: The participants in the East China wholesale electric power market can be divided into the East China Grid Company, who manages and operates the interconnections and electric power exchanges, provincial (municipal) electric power companies, power producers within respective areas, and power producers outside the region. In the East China region, types of power plants can largely be divided into Type A and Type B, where the Type A plants are coal-fired thermal power generation units with a single capacity of 100MW or more, and Type B plants are other power plants excluding Type A, i.e. self-generations, oil and gas fired thermal power units, nuclear power plants, and pumping stations. Power producers using Type A power plants are defined as Type A power producers, and those using Type B power plants are defined as Type B power producers. At the current stage, only Type A producers are allowed to participate in the market. Power producers outside the region refer to power suppliers outside the East China region such as,

⁴ The Code is also set up by the SERC as rules for operating the electric power market in East China region.

the Three Gorges Dams, generators in Central China, Yangcheng districts and so on. Although the East China district is the engine of China's economic growth, it has depended on power supply from outside the region for many years, as the power supply is insufficient due to a shortage of primary energy resources. The Code allows power producers outside the region to sell surplus power for exchange, as well as signing up a power purchase agreement⁵ with East China Grid Company as in the past. East China Grid Company established the East China Power Dispatching and Power Trading Center, which manages and operates the wholesale electric power market. The Type A power producers who wish to participate in market are requested to become members of the trading center and are required to register their eligible units (Type A unit); whereas, the provincial (municipal) power companies purchase necessary power sources from the wholesale power market as single purchasers. The current supply system is as illustrated in Fig. 2-1.

Types of transactions in the wholesale power market: The transaction types of wholesale power in the East China region can be largely divided into bilateral contacts and market exchanges. About 90% of wholesale power is bilateral traded between provincial (municipal) power companies and power producers through various electric power contracts, and the remaining 10% is traded in the market (see Fig.2-2). The principal contract types can be largely divided into those

⁵ In the case of outside-area power interchanges, the East China Electric Grid Company serves as the single buyer. The East China Electric Grid Company representing the power companies of the four provinces and Shanghai municipality procures the shortage portion of the power demand from outside the area and thus distributes the procured power according to the shortage states of respective provinces (municipality).

between power producers and provincial (municipal) power companies of respective areas, and between provinces (municipality). The power producers generally draw up “annual power purchase agreement” with power companies of respective areas, and sometimes draw up “annual power interchange contracts” with power companies for outside-area power interchanges upon the request of provincial (municipal) power companies. Furthermore, among the provinces (municipality), “bilateral inter-province power exchange contracts” are drawn up for interchanges of power among the province (municipality).

Figure 2-1 Power Supply System in the East China Region

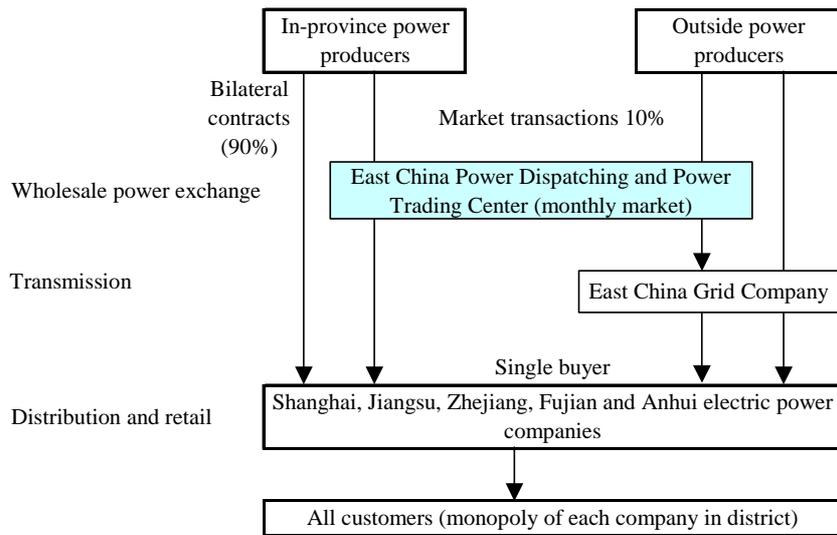
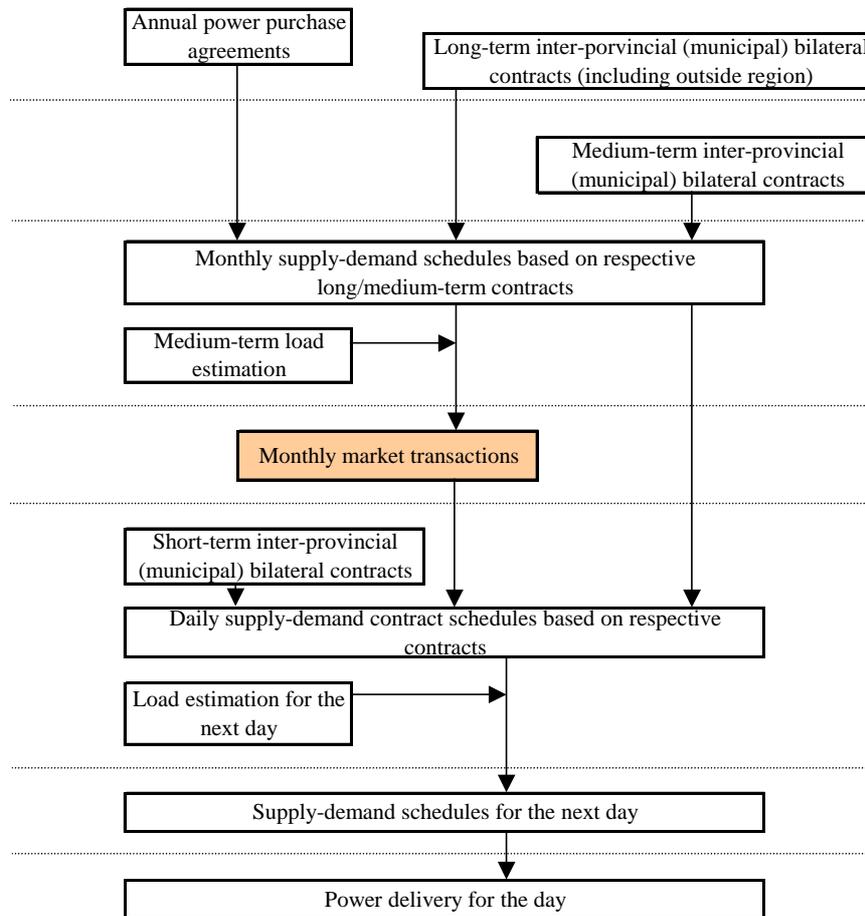


Figure 2-2 Power Source Allocation Methods

| Annual power purchase agreement portion | Monthly market transaction portion | Other contract portions |
|--|------------------------------------|--|
| Installed capacity*4,500h | Installed capacity*500h | Installed capacity * 1,500h |
| Operation hours set in annual power purchase agreement: 5,000h | | Operation hours set in other contracts: 1,500h |
| Annual operation hours 6,500h | | |

For exchange transactions, the current transaction commodities set in the East China Power Dispatching and Power Trading Center are handled in the monthly (for the following month) transaction market according to the peak time period (8:00-22:00) and the off-peak period (22:00-8:00).

Figure 2-3 Contract Implementation Methods



Transaction methods in the monthly transaction market: Each province (municipality) submits various existing contract schedules, and the maximum power output in the peak/off-peak periods for the next month to the East China Power Dispatching and Power Trading Center, based on a given format for the exchange by 17:00 of the third business day of the middle ten days every month.

The East China Power Dispatching and Power Trading Center calculates available transmission capacity of the inter-provincial connected lines for the next month based on the presented information, by 17:00 of the fourth business day of the middle ten days every month, and releases information on the purchasing and selling amount of power available in the exchange, the existing contract amounts for the next month to the power producers and provincial (municipal) power companies. The power producers and provincial (municipal) power companies bid on the amounts and prices of power selling and power buying from 8:00 of the fifth business day of the middle ten days every month to 17:00 of the twentieth day every month. The results are announced by 17:00 on the first business day of the last ten days every month.

When bidding, the power producers tender bids on the price (yuan/MWh) and generation amount according to the peak and off-peak time periods; whereas the provincial (municipal) power companies set prices that correspond to the amount of power generation in a maximum of four stages. Uncontrolled rises in the transaction prices of the exchange and risks are prevented by price cap regulation (at the peak time period: 482 yuan/MWh; at the off-peak time period: 310 yuan/MWh). After closing acceptance of bids, the data is processed by the East China Power Dispatching and Power Trading Center. This allows for the creation of curves for the power generation units in the order of the cheapest proposed price and for the purchasing price in the order of the highest proposed price. The price of the crossing point of the two curves is set as the system price and the amount is set as the transaction amount. When congestion of the connected lines

is expected, the region is divided into respective provinces (municipality), and the supply and demand balanced price (zone price) for each area (zone) is calculated. After the contract is settled in this way, the transaction participants receive notice of the amount of their own selling or purchasing corresponding to their own bid prices. This is completed by 17:00 of the first business day of the last ten days every month.

In the East China region, installation of a 15 minute-meter is imposed, which is the same as in the Northeast region. Respective system operators settle real time (every 15 minutes) delivery amount of their various contracts everyday and charge on a monthly basis (see Fig.2-3). The transaction amount relating to interconnections is settled by the East China Grid Company and the transaction amount within the respective provincial (municipal) area is settled by the respective provinces (municipality). The ancillary service currently provided is only Automatic Generation Control (AGC) and stand-by power sources. As service providers, even though all the market participants (system operators, power producers) have a duty of supply, an appropriate framework has not yet been sufficiently designed at the present stage. A pricing system for service charges and marketing of services will be sought in future.

Previous results: In the East China region, a total of 15 simulation experiments have been implemented centering on the monthly commodities from May 2004 to August 2005. The number of registered units has increased initially from 171 to 189 currently. In the same period, registered capacity increased from 43,387 MW to 50,707 MW. At present, the registered units account for 60% of the total power

plants of the East China region (see Table 2-1).

Table 2-1 Change of Registered United (Plant A)

| Year | Month | Tendered units | Units under inspection | Untendered units | Total |
|------|-----------|----------------|------------------------|------------------|-------|
| 04 | June | 148 | 20 | 3 | 171 |
| | July | 166 | 5 | 0 | 171 |
| | August | 174 | 1 | 0 | 175 |
| | September | 161 | 14 | 2 | 177 |
| | October | 145 | 32 | 0 | 177 |
| | November | 145 | 32 | 0 | 177 |
| | December | 152 | 21 | 10 | 183 |
| 05 | January | 144 | 24 | 15 | 183 |
| | February | 130 | 48 | 5 | 183 |
| | March | 137 | 44 | 2 | 183 |
| | April | 139 | 45 | 1 | 185 |
| | May | 139 | 46 | 2 | 187 |
| | June | 160 | 26 | 1 | 187 |
| | July | 183 | 1 | 3 | 187 |
| | August | 186 | 1 | 2 | 189 |

Figure 2-4 Change in Transaction Amount in East China Monthly Electricity Market

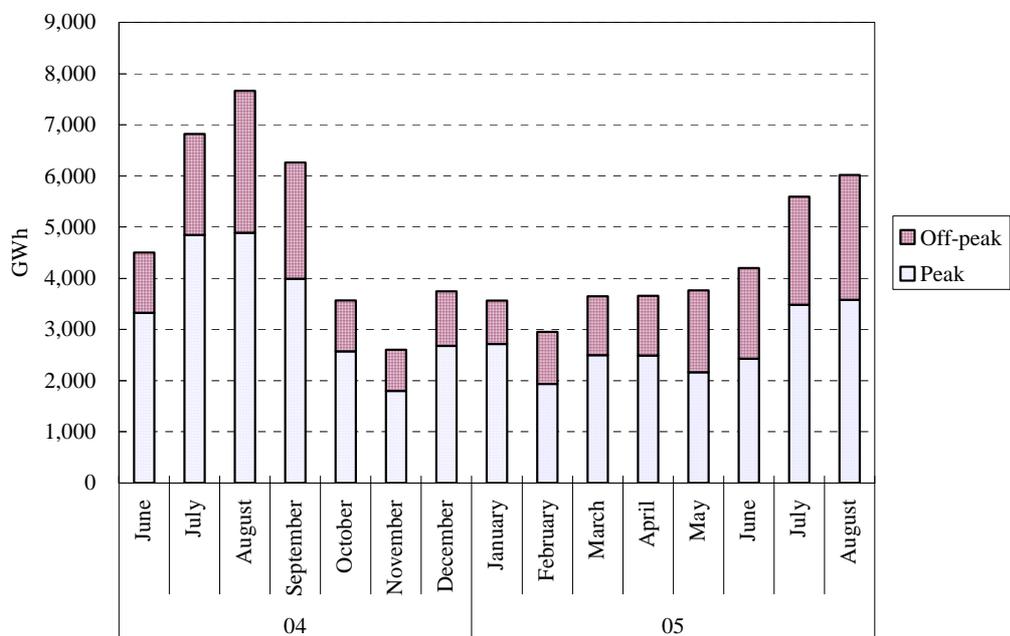
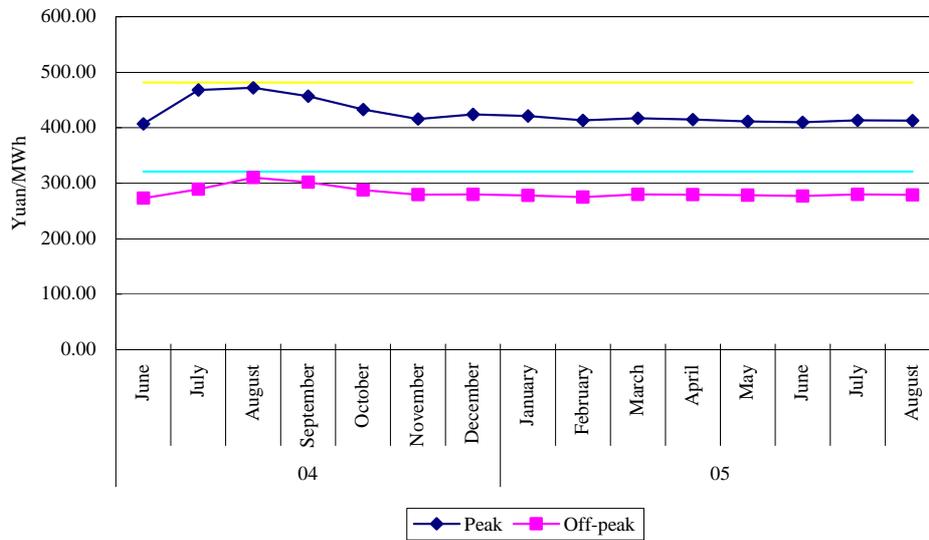


Figure 2-5 Change in Transaction Prices in East China Monthly Electricity Market



The total amount of transactions up to now has reached 68.6TWh, of which 45.4 TWh in the peak time period and 23.2 TWh in the off-peak time period (see Fig. 2-4). The transaction prices are as shown in Fig. 2-5. Since the East China region is short of power supplies, the transaction prices (both in the peak and off-peak time periods) on exchange are higher than those of various contract prices and have fluctuated little since October 2004.

3. Issues and future direction

The simulation experiments concerning the present wholesale power market in the East China region have been observed as described above. Through 15 tests, the following problems appeared in the regional market (four provinces and Shanghai Municipality):

1) Large gaps among the bidding prices. Since the reform and opening-up policy has been enforced in China, the government has placed an emphasis on the construction of power sources. To promote the development of power sources by

local governments, private enterprises and foreign investors, a type of power producer investment that is entitled to preferential treatment has been implemented from 1985 to 1998. This treatment has led to various generation costs among the power producers. For instance, in 1996, the average wholesale electricity prices by foreign investors was 665.28 yuan/MWh, 3.8 times that of domestic producers of 174.03 yuan/MWh. This allows for no competition in the wholesale bidding prices on the same basis. As a result, from these 15 transaction experiences, a total of 15 companies among 63 exchange market participants suffered financial losses through market transactions. While, the power producers that acquired benefits through the market transaction are those who have large old power generation facilities. Therefore, in the current stage, market transactions have created large gaps in benefits among the market entities.

2) Negative influence of transactions on reliable operation of system. Since the Chinese government has placed an emphasis on generation development as stated above, the construction of more transmission/distribution networks has been delayed, which has caused a bottleneck due to a lack of capacity in meeting demand. The recent increase in power transactions inside and outside the region, which was caused by the rise of the maximum load within the East China region has disturbed the reliable operation of the system. This has negatively impacted the system ability to maintain proper quality of power and reliability of supply.

3) Linkage of wholesale electricity prices with retail electricity prices. Recent rises in coal prices for power generation led to the first introduction of the fuel adjustment system in May 2005. Currently, only price increases in the retail

market are permitted if it is affected by an increasing in rising fuel costs. However, although the provincial (municipal) electric power companies purchase 10% of power sources from the market, they are not allowed to transfer the increased part of the purchasing cost to the retail electricity prices, so that the provincial (municipal) electric power companies face substantial risks from the fluctuations in market prices. Such risks tend to be high particularly in provinces (municipality) with larger demands.

As seen from the above, in the simulation experiments of the current wholesale power market, problems such as electricity prices, and ability to maintain reliability and stability of power supply have emerged. In the East China region, the simulation experiments are scheduled to move to pilot operation stages by the beginning of 2006. Therefore, the introduction of rational electricity pricing system and the formulation of standards and rules for secure and reliable system operation are urgently required for future market operations. It is important to construct a market design of bringing partial liberalization into view. The key to the success of future market operations depends on how to cope with the conflict over benefits among the provinces (municipality) and among producers caused by the transactions, how to spread the principles of the market mechanism into a monopolistic supply system.

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