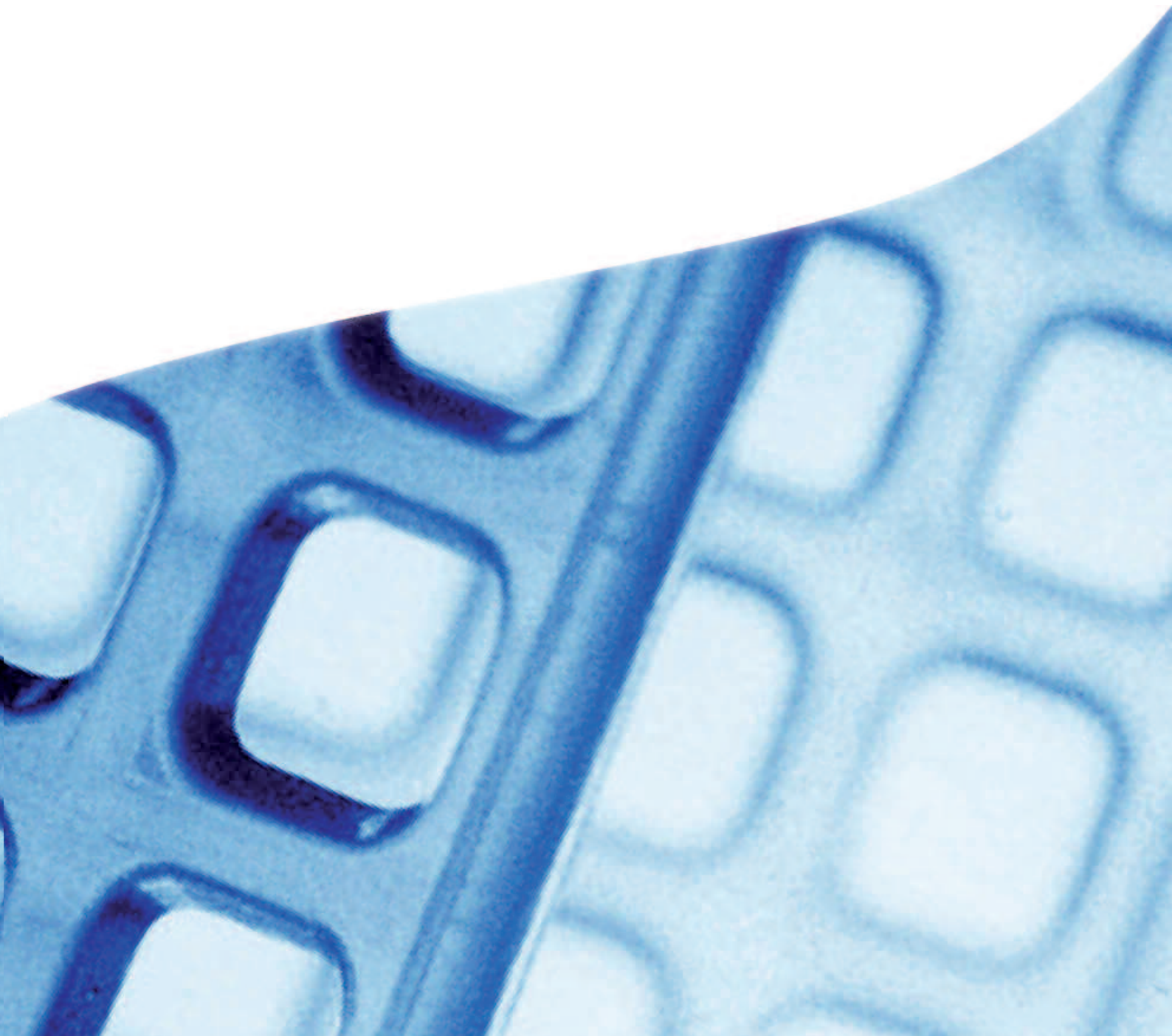


# Investment in China's Demanding and Deregulating Power Market



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Following the three power market surveys in 2001, 2002 and 2003-2004, Capgemini began the fourth survey of the power market in July 2005. Unlike previous editions, this survey focuses on China's power market, and the theme for this survey is: *Investment in China's Demanding and Deregulating Power Market*.

Three key questions demonstrate the demanding nature of investment in China's power market:

- Will the energy policy and market incentives guarantee the achievement of a sustainable equilibrium between the supply and growing power demands in the long run? The current fervent wave of investment should lead to a balance of power supply and demand at short-term, following the power shortages period that began in 2002. When will the next round of tight balance of supply and demand happen?
- How does the industry meet the increasing environmental protection demands from both the Chinese public and policy makers? Although China is not under immediate pressure to reduce CO<sub>2</sub> emissions, the government has brought forward the strategic direction for adjusting the power mix and promulgated the China Renewable Energy Law in

2005. However, more effective incentives and measures are expected to enable the realization of these objectives.

- To what extent has the partially delayed progress of deregulation affected the investment decisions among different players? Since the announcement of Article Five by the State Council in 2002, the separation of generations from grids has achieved remarkable results, regional power market establishment are being experimented, and the work on the separation of non-core assets from grids necessary for separation of transmission from distribution is also in progress. However, the power shortage in the latter half of 2002 has left a negative impact on the planned reform progresses and objectives.

Very often overseas and private investors in the power sector express concern with the fairness of market access and of wholesale market competition rules. Analysts and experts in the Chinese power industry have demanded the liberalization of the retail price scheme in the course of deregulation to allow more effective response mechanism to function both for the supply as well as for the demand side.

The structure of this survey covers four

topics, focusing on forecasts for investment opportunities as well as risks in the next few years in the sector, and possible short-term investment strategies to manage the challenges:

- How is power investment in China meeting the growing power demands brought along by China's strong economic growth? Especially how to assess the periodical influences of the investment waves on power capacity's adjustment?
- Taking into consideration the fossil fuel prices, the environmental protection requirements, the decision-making process, the construction cycle and other factors, what will the next power mix look like? What are the strategic attitudes of the investors towards the development of coal power, natural gas power, hydropower and nuclear power?
- In a gradually opening power sector, how are the players reacting to the increasingly intensified competition?
- How to optimize the regulatory system of the power market in China in order to increase the transparency of the reforms and to encourage more foreign capitals to participate in the power investment program? Following the three power market surveys in

Figure 1 Distribution of Interviewees and Respondents of Valid Questionnaires (100% = 146 Persons)

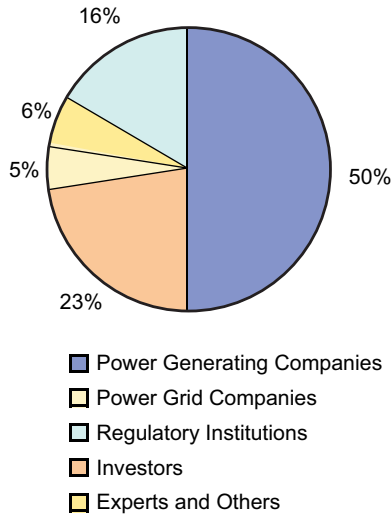
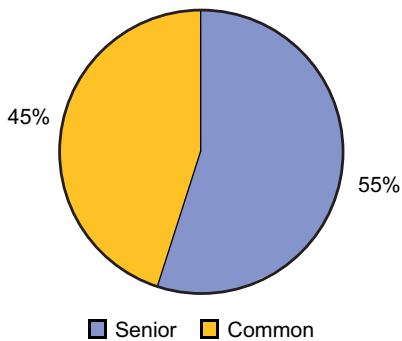


Figure 2 Distributions of Face-to-face Interviewees' Level (100% = 47 Persons)



Capgemini, in association with Electricité de France (EDF) and China Electricity Council (CEC), conducted this survey between July and December 2005.

The joint survey team carried out interviews with 47 middle to senior executives, while sending out 120 questionnaires and receiving 146 valid questionnaires in all (see Figure 1). The interviewees were made up of middle to senior executives of power generation and grid enterprises, different types of investors in the power sector, external experts and relevant professionals in the power sector. 55% of the interviewees in the face-to-face interview sessions were senior executives (see Figure 2). The team also conducted interviews with relevant people from the power regulatory organizations to understand how the regulatory bodies came into being evolved and the roles that these organizations have played in the reform of the power market.

This survey has focus particularly on the investment and operations in the power generation side of China's power sector. All the viewpoints of the interviewees and questionnaire respondents shared with Capgemini are personal views on China's power sector and do not represent any companies or organizations to which the individual interviewees affiliated. We are grateful to all those who have been interviewed by the team or completed the questionnaires for the views and opinions on China's power sector they have shared with us.

I hope that you will enjoy reading our survey of the Chinese market, and that the information and analysis will be useful for you.

**Colette Lewiner**

Senior Vice President & Global Leader Energy, Utilities & Chemicals Practice CapgeminiCapgemini, in association with Electricité de France (EDF) and China Electricity Council

## Companies to which the Interviewees or Questionnaire Respondents Belong

### Power Generating Companies

China Huaneng Group  
 China Datang Corporation  
 China GuoDian Corporation  
 China HuaDian Corporation  
 China Power Investment Corporation  
 China Three Gorges Project Corporation  
 Guohua Energy Investment Corporation  
 SDIC Electric Power Company  
 China Guangdong Nuclear Power Holding Co., Ltd.  
 Beijing Energy Investment Holding Co., Ltd.  
 Shenzhen Energy Group Co., Ltd.  
 Shandong Luneng (Group) Co., Ltd.

### International players/Private Power Companies

Electricité de France (EDF)  
 Peak Pacific (China) Investment Ltd.  
 Merrill Lynch (Asia Pacific) Ltd.  
 Hong Kong Zhonglian Power Finance Ltd.  
 Farsighted Investment Group Co., Ltd.

### Regulatory Organizations

National Development and Reform Commission (NDRC)  
 State Electricity Regulatory Commission (SERC)  
 State-owned Assets Supervision and Administration  
 Commission of the State Council (SASAC)

### Grid Enterprises

State Grid Corporation of China (SG)  
 China Southern Power Grid Corporation (CSG)  
 SG Northeast Power Grid Company  
 SG North China Power Grid Company  
 SG East China Power Grid Company  
 SG Northwest Power Grid Company  
 SG Liaoning Electric Power Company  
 CSG Guangdong Grid Company  
 CSG Guangxi Grid Company

### Professional Institutions and Others

State Power Economic Research Centre  
 China Development Bank  
 China Power Engineering Consulting Group Corporation  
 China Shenhua Energy Corporation  
 Hunan Chendian International Development  
 Share-holding Limited Company  
 Shenzhen State Power Information Technology Inc.  
 North China Electric Power University  
 China Investment Consulting Co., Ltd

# Executive Summary

**The goal of this survey is to analyze the investment opportunities and risks for the power generation sector in China. The first necessary step was to look at the impacts of recent power shortage on deregulation progress and on the cyclic adjustment pattern of supply.**

A nationwide power shortage in the past 3 years spurred a new wave of physical investments into new power plants. The shortage also led to an overall delay in the opening of on-grid price competition in wholesale market. The majority of the industrial experts interviewed during the course of this survey believe that the balance of short-term demand and supply will be restored by end of 2006 with a trend of capacity under utilization. Just under half (49%) the questionnaire respondents agreed. It is a hope that with some sound over-capacity, price competition in the regional wholesale market can be opened again. From a long-term perspective however, the upcoming equilibrium, expected for 2006/7, with corresponding favorable conditions for deregulation will be replaced soon by a new wave of chronic capacity shortages. The following illustration would help readers to understand the magnitude of demand dynamics: to support the GDP growth

with an average rate of 6.5% for the next 15 years to achieve a four-fold increase of per capita income, China needs to add new annual capacity of 48GW in a steady state growth model, equivalent to two-thirds of UK's total installed power generation capacity today.

Remarkable progresses have been made in separating the generation from the grid and in splitting the state power monopoly into five national generation holding groups since March 2002, when the reform program was approved by Article Five of the China State Council. But the recent shortage forced the deregulating bodies such as the National Development and Reform Commission (NDRC) and the State Electricity Regulatory Commission (SERC) to postpone some of the deregulation measures such as separating the distribution and transmission networks and opening regional wholesale markets. The survey results reflected the concern regarding the decisiveness of the reform roadmap. 88% of interviewees believe that full-functioning wholesale price competition will take more than 3 years to realize, while 62% has the opinion that unbundling of transmissions and distributions could take even longer.

**Five major trends found in this**

**survey characterize the shifts and dynamics in the power investment environment in China**

1) The rigid and delayed adjustment pattern has a negative impact on the cyclical nature of adding supply capacity and increases the investment risk for all participants.

The adjustment of supply to demand changes in China's power market has not followed a smooth and gradual path since 1997 - the capacity expansion always takes a pattern of big leaps. The main cause for this delayed and abrupt adjustment is on one hand due to the rigid regime of planning and the high degree of regulation, which makes the approval of project applications bureaucratic process; on the other hand, the poor consistency of development plans (both for industry sector and regions) and the inaccuracy of data for the planners are also partly to blame.

2) Environmental concern does matter in long run and will cause shifts in tomorrow's energy mix.

It is a clear stated policy of the Chinese government to reduce its current heavy dependency on coal-fired power from 83% down to 60% in the year 2020. The planned targets set for a new energy mix in 2010 and 2020 total market share. So today's competitive

respectively favor the renewable energy forms. More strict enforcement of environmental laws is expected over the next 5-10 years and will therefore change the cost structure in favor of investments in nuclear power and renewable energies like wind and solar energy. However in the short-term, today's energy mix will continue even with a slightly higher coal-fired power percentage in portfolio than the official prognoses.

The portion of gas-fired power will increase rapidly in the economically prosperous coastal cities, although gas represents less than 5% of China's total energy consumption. This new trend will increase China's dependency on gas imports enormously by 2020. Estimates say that 50% of natural gas will have to be imported, which will raise energy security concerns in the face of the overall limited international gas and oil supply capacity and the need for the right infrastructure like pipelines and ports for LNG. Russia and central Asian countries will be the main suppliers for China and three pipelines are already under construction for this purpose.

### 3) A capacity consolidation wave is expected for 2007-2008.

The generation market was divided artificially in the 2002 unbundling program. No one (national) player should have more than 20% share of capacity in every province. The largest national players held less than 8% of total market share. So today's

competitive landscape is very fragmented by international standards and may not be at the right concentration level for efficient competition. The rationale behind the consolidation via merger move and for a more oligarchic competitive structure should be economies of scale in the following areas:

- R&D investments for large-scale technologies, like new clean coal and nuclear power technologies
- Roll out of standard business processes in operation and maintenance
- Strong position in secure long term PPA (Power Purchase Agreement) with local and central government to protect the investment interest

The survey suggests that the Big Five national players in generation will speed up their merger and acquisition programs to increase market share and optimize the capacity and operating scales. There will be an interest balance between regulatory agents SERC and NDRC on one side (who will argue for more competition via less concentration) and the State-owned Assets Supervision and Administration Commission (SASAC), as the agent for state assets efficiency, on the other side.

### 4) With the soaring of international

oil prices and the fluctuation of coal spot prices in China, the mid-term reaction of big power generation groups is to seek fuel sourcing integration to secure the supply. At the same time, more visible linkage between the electricity retail and wholesale prices could effectively contribute to demand side management DSM and will help to plan the investment decisions.

One of the key questions China's power industry faces is the ill-matching of the market-oriented, deregulated coal price and highly regulated wholesale price of power. Some coal suppliers simply ignore the fulfillment of the contract to the power plants, when it comes to abrupt price changes in trading. Although the government has tried to ease this tension by introducing a mechanism linking coal and power prices, so far it has been largely unsuccessful. In 2004, the average coal (for power generation) price rose by 41.7% for contracted part and 100-150% for new orders, whereas the price of the grid-connected electricity price was allowed to rise by a mere 4.5%. The profit margins of the power generation enterprises suffered enormously.

On the other end, energy consumption (especially for residential usage) has been heavily subsidized by the state, a legacy of China's "past planned economy." With the increased awareness of environmental cost on the

awareness of environmental cost on the GDP as well as the scarcity of resources, experts in China demanded that the retail electricity price should reflect the real energy costs. With an more efficient price adjustment mechanism both for the retail and wholesale markets, not only would plans for “green energy” and demand side management (DSM) benefit greatly, but also the general investment return and risk with conventional power projects can be assessed and dealt with more effectively. An uncertain price mechanism was named by interviewees as the number two factor affecting their investment decision.

#### 5) Changing role for Foreign Direct Investment (FDI) in power generation changes the way of market entry of international players.

In the 1980s foreign capital was one of the most important sources of finance for many power plant projects, favored by many local governments. Today, the relative importance of FDI inflow has fallen with respect to the total volume of invested capital. Policy makers in China are expecting a new generation of FDI, combining managerial know-how and state of the art technology, especially for clean coal and renewable energies. The big national power generation groups, controlled by national and regional state agencies, are also looking for strategic foreign investors to help them transform corporate governance, gain international competitive advantages

and access certain technologies, e.g. in nuclear sector.

#### For the incumbents, most of whom are large state-owned holdings of power plants, the survey highlighted some short-term investment tactics.

There is plenty of room for investment in conventional coal-fired projects in the long run; however, the oversupply expected for 2007 means a short-term high investment risk and suggests a cautious expansion strategy of taking over existing plants instead of building new ones. To further mitigate the impact of a possible price war, a consolidation of market share in target regions needs to be considered.

The incumbents need to strengthen their existing positions by applying the fuel sourcing integration strategy to neutralize the unstable wholesale price movement of coal, the primary energy source for electricity in China. Huaneng Group who bought about 100 million tons of coal to fire its 75 power plants across 23 provinces in China has recently revealed its plan to secure 30 million tons of coal by investing into mining stakes in 2006 and increase it to 80 million tons by 2010. There are many ways to implement a fuel sourcing integration strategy to ally with the mining field operators in the short term. However, an equity relationship may not be always the best way forward, because managing a mining operation requires a different set of skills and expertise.

Although for power generation companies it is difficult today to sign long-term supply contracts directly with large energy-intensive industrial users, they are allowed under certain circumstances to participate in the building of self-owned power plants for those big industrial customers. These short-term alliances in the form of joint ventures or management service contracts can be developed in a more effective way and used as an interim option for achieving the ultimate goal of a long-term supply contract.

An alliance strategy could be applied to team up with international strategic investors, in order to speed up the process of transformation and to access technological skills more effectively. Both Shenhua Mining Group and Hua-Neng Power Group are investing heavily in the coal-to-liquids and coal gasification related technologies, using international cooperation.

#### Foreign investors can play strategic roles alongside the value chain and improve existing business by considering new form of market entry.

Facing the changes in the demands and constraints of the Chinese power market as well as the need to reform the state-owned companies, foreign investors should focus on key investment opportunities alongside the value chain, which may bring their own advantages into full play.

In the coal-sourcing integration, there is already tense competition among the domestic players regarding mining business engagement. The true global energy players may avoid this field and use their unique advantages in channeling other supplementary fuel imports (e.g. natural gas) for power generation into China. This strategy will help them enter the lucrative market for certain coastal cities that strongly favor gas-fired generators. However, this move will require a high level of cooperation in terms of energy security not only between the EU and China, but also between other related exporting economies.

Also the periodic adjustment of existing, more conventional power generation capacity offers entry opportunities for international investors via merger and acquisitions, by taking advantage of the need to restructure the state-owned enterprises and adapt to “clean coal” technology.

Although the further unbundling towards retail competition might be postponed to a future date, grid companies in China are starting to prepare for new competition by adopting better and more efficient service offerings for customers. International players could grasp the emerging opportunities in customer relationship management and provide consulting in customer service, software solutions and energy-saving concepts, before being allowed to own and operate physical facilities.

### **There are huge investment opportunities for international equipment companies in the nuclear power sector in China, and technology transfer is the key to achieve success**

The development objective for China’s nuclear power has constantly been elevated. The declared goal is to raise the share of nuclear power capacity from the present 1.55% to 3.3% by 2020, with an installed capacity totaling 40GW. In order to achieve the objective, \$49 billion of investment will be needed. With more than 25 sites planned for the next 15 years, and with every site consisting of 2-4 units each above 1,000 MW, China is by definition the center of the global nuclear power industry. For international equipment players, technology transfer is the decisive factor in gaining a foothold in the nuclear power market. Although the Chinese nuclear industry has basically built its own skills in managing the so-called second generation of nuclear power technology, it is not yet able to design and build nuclear power stations above 1,000 MW level on its own, according to the common opinion of the experts we interviewed.

Because of the lengthy construction period, speed is key in the nuclear business and critical now for making the goals achievable. In order to maintain development momentum, China should follow a dual strategy: on the one hand give the green light for the quick start of some projects adapting the matured

second generation (G2 plus) technology; and on the other hand continue to negotiate with owners of the G3 generation technologies. Otherwise the endless discussions about the correct future technology standard (European or American) could jeopardize the development milestones China has set.

### **Wind power will benefit foreign capital equipment manufacturers, but the investment into this segment should be conducted with caution**

In 2005, China adapted the Renewable Energy Law with a clear intention to promote the development of wind energy among other new forms of energies. According to the State’s development plan, the target capacity for wind energy has been adjusted from 20,000 MW to 30,000 MW by 2020, which represents a very ambitious goal with an annual growth rate of 26%. Today’s global capacity for wind energy amounts to only 47GW after 30 years’ development.

This rapid catch up in wind energy provides a chance for international investors as well, especially equipment manufacturers. However, operational and assets investment in wind power generation faces some unfavorable factors such as the relatively high development costs, difficulties in grid management, the weather impact and off-set capacity, lack of implementation measures for on-grid incentives and other subsidy programs. Therefore, any investment decision should be made very carefully. In the coal-sourcing integration,

## Contributors

The survey team would like to thank all of the middle to senior executives, external experts and professionals of the power sector who accepted the interviews and filled the questionnaires for sharing your views and options.

Thanks to Electricité de France (EDF) Asia Pacific Branch, Mr. Hervé Machenaud, Executive Vice President of EDF Asia Pacific Branch and its China Division for collaboration and help, especially Mr. Didier Cordero, Mr. Rongming Yin, Mr. Guoping Zhou, Ms. Xin Fu and Ms. Li Li, for their significant efforts put in this survey.

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During this survey, Ms. Colette Lewiner, Global Head of Capgemini Energy, Utilities and Chemicals (EUC) and Mr. Theo de Hair, CEO Capgemini China gave indispensable guidance and support. Mr. William Easton, Head of Utilities Market Restructuring (UMR) under Global EUC of Capgemini shared Capgemini expertise with us on the previous three global power market surveys and gave vigorous guidance on the design of the questionnaires. Mr. Philippe Coquet and Ms. Sopha Ang from the Global EU&C Marketing and Communication Unit who supported the launch in China and organized the European and North American launch. Thanks all for your efforts.

This survey is just a beginning. Based on all your guidance and support, we have the confidence in delivering more quality researches and analysis on China power market in the following issues of the survey.

The survey team would like to thank all of the middle to senior executives, external experts and professionals of the power sector who accepted the interviews and filled the questionnaires for sharing your views and options.

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# Appendix

## Forecasting the Demand of Power with the Approach of Elastic Coefficient of Power Consumption

### Key Assumptions:

Assumption to GDP. The Base is the GDP in 2020 will be quadruple of the GDP in 2000. The compound annual growth rate (CAGR) of GDP is not less than 6.2% from 2004 to 2020 with the base. To simplify, we assume the CAGR of GDP is 7.5%-8% from 2005 to 2010 and 5.5%-6% from 2011 to 2020 respectively.

Assumption to Elastic Coefficient of Power Consumption. As we know, the average Elastic Coef was 0.81 during 1980-2000 in China, and elevated to more than 1.2 from 2002. Considering China entered the era of heavy chemical industry, the Elastic Coef will be still high. So we assume the average Elastic

Coef are 1-1.2 during 2006-2010 and 0.8 during 2011-2020 respectively.

The formulas used are as follows:

- Formula 1:  $D_n = A \cdot (1+i)^n = A(1+iGDP \cdot EC)^n$
- Formula 2:  $D_c = D_n / AUE$

The notation is defined as follows:

- $D_n$ : the power demand of year n
- A: the power consumption of 2004
- i: the growth rate of power demand
- $i_{GDP}$ : the CAGR of GDP
- EC: Elastic coefficient of power consumption
- $D_c$ : demand for installed generation capacity
- AUE: average utilization of generating equipment, for security of supply, AUE should not be too high, the appropriate AUE is 4500h to 4800 in China, we use 4500h for the calculation.

As to i, survey team set three scenarios:

- High scenario:  $i=9\%$ , 2005-2010;  $i=4.8\%$ , 2011-2020
- Reference scenario:  $i=8.25\%$ , 2005-2010;  $i=4.6\%$ , 2011-2020
- Low scenario:  $i=7.5\%$ , 2005-2010;  $i=4.4\%$ , 2011-2020

The power demand and demand for installed generation capacity for three scenarios are as follow table and Figure 44.

	Power demand in 2010 (TWh)	demand for installed generation capacity in 2010 (GW)	Power demand in 2020 (TWh)	demand for installed generation capacity in 2020 (GW)
High scenario	3668	820	5862	1300
Reference scenario	3519	780	5518	1230
Low scenario	3375	750	5192	1150

### Verify the Above Forecasting Results with Electric Power Consumption Per Capita Approach

The survey team also uses electric power consumption approach to roughly verify the forecasting results with the approach of elastic coefficient of power consumption.

All the provinces, Municipalities and autonomies are classified into three classes according to overall GDP and per capita GDP of 2004:

First class: includes Shanghai, Beijing, Tianjin,, Zhejiang, Jiangsu, Guangdong, Fujian, Shandong, Liaoning, Hebei. In these places, the electric power consumption per capita will be high, the amount will be 3300kWh in 2010 and 4500kWh in 2020; the population of

first class will reach 513.71 million in 2010, 579.7 million in 2020;

Second class: includes Henan, Heilongjiang, Inner Mogolia, Xinjiang, Jilin, Hubei, Shanxi, Hunan, Jiangxi, Anhui, Sichuan. In these places, the electric power consumption per capita will be moderate, the amount will be 2500kWh in 2010 and 3500kWh in 2020; the population of second class will reach 579.13 million in 2010, 611.17 million in 2020;

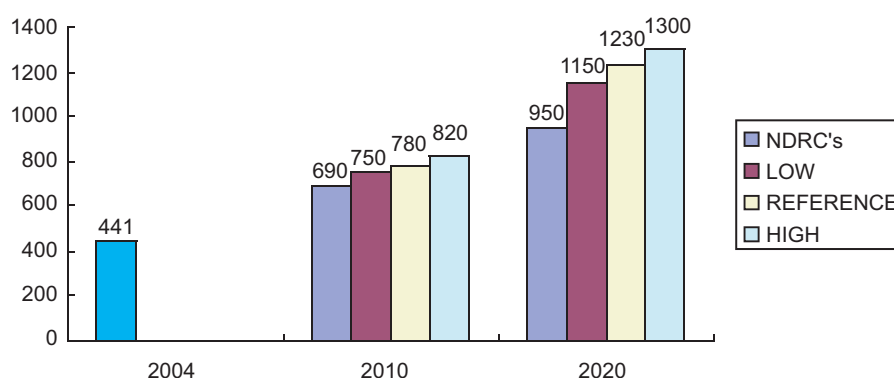
Third class: includes Chongqing, Guangxi, Yunnan, Shaanxi, Hainan, Gansu, Ningxia, Qinghai, Guizhou, Tibet. In these places, the electric power consumption per capita will be moderate, the amount will be 1500kWh in 2010 and 2500kWh in 2020; the population of third class will reach 261.2 million in 2010, 283.18 million in 2020;

Based on the above data, we can get the national overall power consumption is 3535 TWh in 2010 and 5456 TWh in 2020. The demands for installed generation capacity are 786 GW and 1210 GW respectively.

With the reerence scenario, the nationwide per capita electric power consumption are 2590 kWh in 2010 and 3750 kWh in 2020 respectively, both amounts get to the levels US hit during early 1950's and late 1950's.

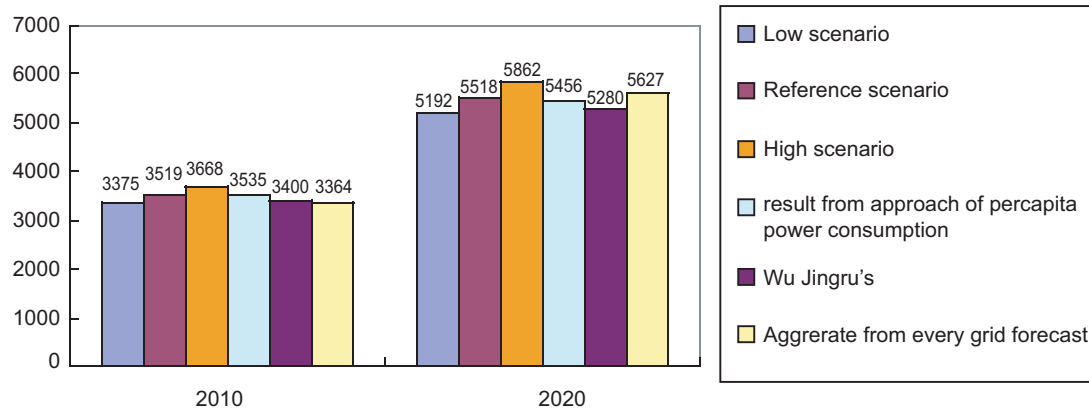
Comparison of each forecasting results (see Figure 45), we can find that the result from per capita power consumption is close to the reference scenario, so we choose the reference scenario as the following analytic basic.

**Figure 44 Forecast of installed generation capacity, 2010&2020 (unit: GW)**



Source: NDRC's, Capgemini analysis

Figure 45 Comparison of each forecasting results (unit: TWh)



Source: Mr. Wu Jingru's report, Capgemini analysis



## About Capgemini and the collaborative Business Experience

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