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Power Crisis and the Corresponding Strategies

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Abstract

Power crisis today contains not only the phenomenal of power storage, but also the problem of environment pollution caused by electric power industry. China has experienced fast development in the past 30 years and correspondingly, people's living level is higher than the past. As a result, with the fast development of economy, the people's demand on energy and power is more and larger than the past. In practice, although the burden of power supply has released in certain degree via building more power stations, power crisis is still in existence because of the flaw in electricity industry structure and technique aspects. In the paper, we analyze national stage of China in electricity industry aspect, and then we provide two typical cases about Power Crisis and coping strategies. Finally, we present relevant policies and strategies to tackle with the corresponding problem of China power crisis.

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1. Introduction

In 21st century, all countries are facing the challenge of energy. Power crisis is one of the greatest crises in energy. Many experts and scholars have researched in energy policies to against electric energy crisis. Engineering education in general and power engineering education in particular is discussed by Jorge. F. Dopazo and Albertom. Sasson (1978)[1]. H.L. Zhou [2] and J.X. Liu[3] had researched wind power industry. Grid-connected PV systems are researched by Muhammad Quamruzzaman and Kari Mujibur Rahman (2008)[4]. U.A. Korde had researched ocean wave in his paper (2002)[5]. Shi Yongqian had talked about nuclear power in his paper [6]. The Corresponding Strategies to against electric energy crisis will be researched in the future. In this paper, many strategies have been given. It contains

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structural strategic adjustment of power industry, designing more reasonable grid layout, constructing new power plant, renewable energy construction, developing intelligent power grid and so on.

2. Current situation of electric power industry in china

As it is shown, the proportion of thermal power in national installed capacity is further higher than other energy power. Wind power and nuclear power doesn't reach 3% of the total installed capacity. As we all know, the main material to produce thermal power is coal which would let out large amount of Carbon dioxide and Sulphur dioxide. According to statistics of 2006, Chinese power industry's Herfindahl-type of index is 0.1833. In china, the central government makes all kinds of relative plans of the development of power industry. However, power technology of china is further behind of developed countries. In 2007, each KWH electric power needs fuel 334g coal in china, which is higher 29g than American. Furthermore, in western china, there is enough energy, especially hydro energy. Northeast of China has little energy, but in these places, the power consumption is large.

Table 1. Statistics of Power installed capacity in China, 2007-2009^[7]

	<i>Thermal power</i>	<i>hydropower</i>	<i>wind power</i>	<i>Nuclear power</i>	<i>The total</i>
2009	6.5205	1.9679	0.1613	0.0908	8.7407
2008	6.0132	1.7000	0.1200	0.0910	7.9253
2007	5.5442	1.4526	0.0403	0.0885	7.1329

3. Case analysis

3.1. California's failure case

In 1970s, America power industry was still traditional public utilities. In order to improve enterprise' yielding and operational efficiency, states successively introduce relative regulations to encourage independent power plants to construct new power plants.. After 1980s, American energy experience fast development. Natural gas and coal are the main raw materials of power generation. Their prices are consistently down. Because public utility companies and independent power plants signed long-term contract, public utility companies faced heavy losses. Reform policies of the federal energy regulatory commission and California government: first, the federal energy regulatory commission's allowed public utility companies remove contract with independent power plants and compensated precipitation cost to independent power plants. Second, commission considered that spot trading is the best way to keep effectiveness of market and banned forward transaction. California' power crises [8].

3.2. Success case of Japan to coping with power crises

In the past Second World War, Japan had experienced twice power crises . The first crisis was happened in the period of Japan economy soaring. In the period of 1955-1972, average growth rate of GDP of Japan was high to 9%. However, power supply couldn't follow the step of economy development. The second power crisis was happened under the background of twice Oil crisis. Positive measures of Japanese government: for the first power crises, the government of Japan mainly resorted to policy of developing electricity, put power industry on the core position of energy industry and adjusted structure of energy. For the second power crises, the Japanese government adopted comprehensive energy policy that considers economic development and environmental protection.

4. China’s corresponding strategies and policies

4.1. Institutional reform in electricity market

First, China’s government should promulgate reform laws to clear the direction of reform and the status of the power industry and set up technical indicators to track and predict the feasibility of laws.

Second, Because of the complexity and specialty of the power industry’ reform, among developed countries, the reform must be improved by governments, and be supported by technology. SERC should increasingly improve and consummate its regulatory functions.

Third, the reform should contain decomposition of business and management of centralization. Breaking the monopoly and introducing competition are the core of reform of power industry. So the authority should clearly define monopoly and competition, make the part of competition follow the laws of value, demand and supply, make the part of monopoly regulated by SERC.

Fourth, the reform should be paid more attention to coordinate prices of coal and electricity, carry out the new mechanism of bidding, and strength Market-oriented consumer guide.

Fifth, The government should make up National Power Technology Innovation System and put power technological innovation as the important force for power industrial upgrading and the development of new industries.

4.2. Exploit renewable energy-power

As we all know that fossil energy source is the main reason of emission of Carbon dioxide. Exploitation of new energy is an efficient strategy [9].

- Exploit Hydropower

Hydroelectric power is one category of the power industry. China has abundant water resources. However, the utilization rate of water resource is only about 35%, the degree of exploitation is far lower in China than developed countries. The generation of Hydropower is only less than conventional energy sources of coal. With the pressure of reducing emissions of carbon dioxide is increasing, the role of Hydropower in the aspect of reducing carbon dioxide emissions is becoming more important. Therefore, the government of China should make related policies to develop Hydropower, to strengthen the protection of ecological environment and improve our existing system.

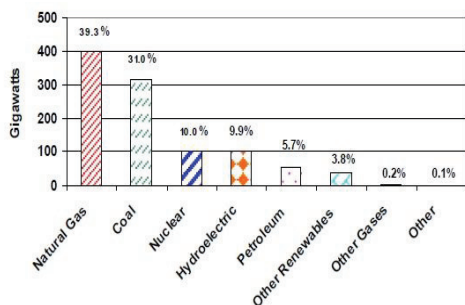


Figure 1. U.S. Electric Power Industry Net Summer Capacity, 2008 [2]

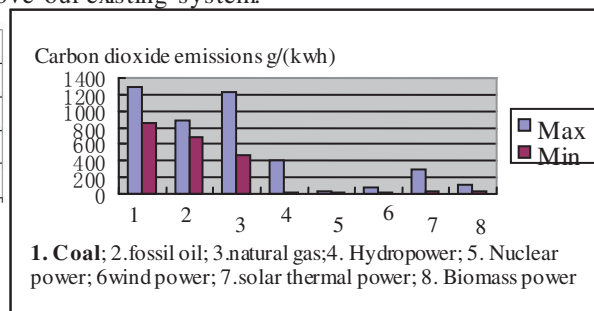


Figure 2. Comparison of Greenhouse Gas Emission in Whole Energy Chain [10]

- Exploit wind power

Wind power [6] as one of clean and renewable energy, countries of the world is increasingly pay attention to develop it. The total storage of wind power is about 2.74×10^9 MW in the planet. In 2009, the

generation of wind power 157,900 MW. Therefore, the government should build a combining technical innovation system which involves business-oriented, industry, academia, and research.

- Exploit solar thermal power

Abundant solar radiation is an important source of energy. Solar energy is inexhaustible, clean, cheap, and free to use human energy. In recent years, generation of solar thermal power has achieved a series of breakthroughs in technology. Cost has significantly reduced. More than 20 blocks large-scale solar thermal power plant in the world is running. Many scientists predict that by the end of the century and the beginning of the next century, solar power and conventional electricity price may be reduced to the same level.

- Exploit nuclear power

Nuclear power plant can produce large amounts of electricity and only expend little nuclear fuel. The cost per kWh is lower t 20% than thermal power plant. Nuclear power station still can reduce traffic volume of fuel. For example, a coal-fired power plant of 100 million kilowatts consumes 3-4 million tons of coal in every year. While the same nuclear power plant only expend 30-40 tons uranium fuel each year. Another advantage of nuclear power is clean, no pollution, is almost zero emissions.

- Develop rural renewable energy power

In China, rural areas have abundant hydropower, solar, wind, biomass, etc. In this article, we take Biomass power generation as an example to prove the potential of rural renewable energy power.

The so-called biomass power generation is that using cotton rod, straw stalks and other agricultural and forestry wastes as raw materials to generate electricity. The whole process of power generation link together to form a comprehensive utilization of biomass power generation, building green chains of straw, which will ring the original agricultural production chain which can be recycled into a closed-loop chain, is a completely turning waste into eco-economic model.

4.3. Comprehensive management of energy demand

‘Demand side management’ [11] refers to using an effective incentive measures to guide users of electric power to change the way of consuming electric power, and improve the end-use efficiency, optimize resources, improve and protect the environment, to achieve the minimum cost of electricity services provided by the power management activities. Management strategies of electricity power demand:

First, formulate and modify relevant laws, regulations and policies to ensure administrative measures to be put into practice. In a global perspective, countries with better Demand Side Management, there are stringent laws and regulations. For example, the government of USA has introduced the “National Energy policy-act”, “Public Service Management Policy-act” and other laws and regulations, and developed a large number of mandatory energy efficiency standard to power companies and electricity consumers.

Second, reform and improve the system of electric price. Adopt a flexible price that is different price in different time and widen gap of seasonal prices, and improve the load rate of power grid.

Third, construct multi-incentive mechanism. Government could adopt price and economy means to enhance motivation of power companies and electricity customers for demand side management. Government could make a found for demand side management subsidies.

4.4. Cultivate high-quality power talents

With the progress of technology and reform of management mechanism, power enterprises are gradually transforming from the original manufacturer into integration in production, management and service. When power industry is experiencing fast development, the structural contradictions of human

resource in power industry gradually appear. Labour Department and electricity power enterprises should cooperate to cultivate high-skill talents

Power Engineering Education [1] is specialized to train high sophisticated professional of power system. With the development of power industry, more and more intelligent products will replace the original products. So the requirement to professional' major knowledge is increasingly high such as low-carbon technologies, the technologies of intelligent power grid and so on. It not only requires electrical engineers to grasp the power' major knowledge, but also requires them proficient in mathematics and computer knowledge. The government should establish a special education fund and combine with appropriate incentives to support the training of power engineers.

5. Conclusions

This paper is started with the national stage of China's power industry and the international hot topic about coping electric energy crisis. Then two typical cases about corresponding with strategies against power crisis are given. Lastly, the paper is from the aspects of institutional reform in electricity market, technological innovation and energy conservation, exploiting renewable energy-power, developing rural renewable energy power, comprehensive management of energy demand and cultivating high-quality power talents to discuss how to cope with power crisis.

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References

- [1] JORGE F. DOPAZO, ALBERTO M. SASSON, Personal Views on Power Engineering Education from an Industry Vantage Point[J]. *Transactions on education*, AUGUST 1978,21(3);
- [2] U.S. Energy Information Administration, Form EIA-860, "Annual Electric Generator Report;
- [3] J.X. Liu, "On the Status Quo of the Wind Power Generation and the Incentives of Its Development and Utilization," *Taxation Research*, No.279, August, 2008.
- [4] Muhammad Quamruzzaman, Kazi Mujibur Rahman, Development of Control Strategy for Load Sharing in Grid-Connected PV Power System [J], *IEEE- Electrical and Computer Engineering*, 2008.
- [5] U.A. Korde, "Latching control of deep water wave energy devices using an active reference," *Ocean Engineering*, vol. 29, pp. 1343-55, 2002.
- [6] H.L. Zhou, "The development prospects and strategy of China's wind power industry," *Electrical technology*, the 6th issue, 2006;
- [7] China's electric statistical yearbook 2005-2009[M]. Beijing: China Electric Publishing House(Ch);
- [8] California Independent System Operator Market Design 2002 Project Comprehensive Market Design Proposal; Apr. 2002.[Online]. Available :<http://www.caiso.cnmldocs/2003101110/200301101649569474.pdf>;
- [9] Chemi J A, Kentish J. Renewable energy policy and electricity market reforms in China. *Energy Policy* , 2007 , 35 :3616 – 3629;.
- [10] Mettam GR, Adams LB. How to prepare an electronic version of your article. In: Jones BS, Smith RZ, editors. *Introduction to the electronic age*, New York: E-Publishing Inc, 1999, p. 281–304
- [11] Zhang Bin Primary Energy and Electricity Consumption Forecast of China from Perspective of Historical Trend of OECD Countries [J]. *Electric Power Technologic Economics*, 2009, 21(1);