The realistic problem of benefits maximization—Take A Power Generation Co., Ltd., the fourth largest power group in China, as an example

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Abstract. Under the influence of power market reform, spot trading and coal price rise, the development of power enterprises is facing more and more uncertainties. Power enterprises need to reduce power generation costs as much as possible on the basis of ensuring power supply. For this reason, this paper discusses the continuous rise of coal prices faced by power enterprises, the small fluctuation and increase of on grid electricity prices, and the implementation of power market and spot transactions. This paper collects and summarizes data, and then analyzes costs and benefits, business conditions and national policies, and puts forward solutions. It concludes that power enterprises should start marketing on the basis of providing social security, the coal purchase and storage strategy and the direction of energy transformation will be changed to minimize its costs and maximize its benefits. This paper has reference value for the operation and development of major power enterprises.

Keywords: Power enterprises; Maximize benefits; Electricity market.

1. Introduction

At present, we are experiencing great changes that have not been seen in a century. The global epidemic continues to spread, the conflict between Russia and Ukraine continues to ferment, and the European energy crisis further worsens. China's economic development is facing the triple pressure of shrinking demand, supply shock, and weakening expectations. The production, operation and development of enterprises are facing many challenges. Especially in the power market, with the continuous development of economic globalization, the competition in China's power market is becoming increasingly fierce. Strengthening cost management is the eternal theme of enterprise management. In order to gain an invincible position in the competition, power enterprises should also strengthen their cost management, take cost management as the leading strategy of enterprise development, constantly enhance their core competitiveness, and maximize their benefits.

Since the beginning of this year, China has effectively coped with the impact of unexpected factors, and the national economy has stabilized and rebounded. In the first half of the year, GDP grew by 2.5% year-on-year, and the electricity consumption of the whole society increased by 2.9% year-on-year. [1] This fully shows that the fundamentals of China's economy seeking progress while maintaining stability and long-term improvement will not change, and the trend of high-quality development of energy enterprises will not change. In November 2021, the 22nd Meeting of the central comprehensive Deepening Reform Commission pointed out that it was necessary to improve the multi-level unified power market system and accelerate the construction of the national power market. On January 18, 2022, National Development and Reform Commission，National Energy Administration jointly issued the guiding opinions on accelerating the construction of a national unified power market system

To sum up, under the current complex market environment and severe environmental forms, how to maximize the interests of power enterprises is an urgent problem to be explored. This paper mainly takes an electric power enterprise as an example, analyzes its cost system and analyzes the problems existing in current Chinese electric power enterprises, in order to promote the further development of

electric power enterprises. At present, power enterprises have three major problems: first, green development of energy is more urgent; second, competition in the power market is more intense; and third, the coal supply and demand market is more changeable. Therefore, we should propose solutions to the above three problems in order to maximize the benefits of power enterprises.

In view of the power market reform and spot trading system recently implemented by the state, this paper makes an in-depth study of this, and puts forward progressiveness improvement suggestions for the marketing mode of major enterprises, as well as providing reference for the later operation of the company.

The rest of this paper is arranged as follows: Section 2: literature review, section 3: establishment of cost system of power plant A, and section 4: conclusion

2. Literature review

2.1. Foreign research status

Foreign scholars' research on the topic of maximizing the benefits of the power industry mainly focuses on the risks faced by power enterprises in developing countries. Murat et al. (2022) analyzed the energy demand of developing countries and the risks of economic and political climate, and proposed the risks faced by power enterprises. In the same year[1], Gao et al. (2022) made a detailed analysis of coal-fired power enterprises through technical efficiency, and proposed how to make power enterprises have more high-quality power supply and money management[2]. Shadi et al. (2022) established ARIMA model and GARCH model on the spot price of electricity in European economies and predicted them, analyzing the similarities and differences between these European countries[3]. Mei et al. (2022) studied three kinds of electricity settlement mechanisms, simulated the electricity market, established the clearing and settlement model of the electricity market, quantitatively analyzed it, and put forward reasonable suggestions for the electricity price market[4]. Jerzy et al. (2022) assessed the impact of industry output fluctuations on electricity prices, compared the results of the HUPX market dominated by renewable energy and fossil fuel or nuclear energy supply, and concluded that renewable energy has a small impact on electricity price fluctuations, especially in the period of high energy demand[5].

2.2. Domestic research status

The research in China is later than that in foreign countries. At present, the main research focus is cost management. Wu(2020) analyzed the problems in cost management of power enterprises and proposed corresponding countermeasures against the background of macroeconomic downturn, narrowing of electricity price space and reduced profits[6]. Sun (2021) analyzed how to control the cost of coal-fired power enterprises under the trend of energy conservation and emission reduction, proposed the problems in cost control and how to solve them, and provided effective references for enterprises[7]. Jin (2022) proposed possible problems and targeted solutions for the cost accounting management of power enterprises from the perspective of full budget[8]; Jing et al. (2022) innovated and upgraded the marketing strategy to promote the progress of the power industry and improve profit[9].

Existing studies have conducted a large number of and in-depth studies on the issue of maximizing benefits, effectively expanded relevant theories and played an important role in the development of the academic community. However, previous studies by scholars ignored China's national conditions and the social contributions made by power enterprises as central enterprises in the context of double carbon. This article will analyze the profit situation of the power industry and put forward the future development trend and suggestions.

3. Benefit maximization analysis of power plant A

It is an eternal theme to maximize the benefits of enterprises and strengthen cost management. When it comes to the profits of power enterprises, we should first talk about costs. The main cost of power enterprises is the price of coal, and the main income is the amount of electricity sold.

This study takes a power plant as the main research object, which is a joint-venture power plant developed and constructed by China's fourth largest energy group Co., Ltd. Four 1000000 kW units are planned. As of July 2022, four 1000000 kW units have been built and put into operation.

In order to explore the cost system of power plants, a model between coal price and profit income is constructed and analyzed from the perspective of coal price and on grid price fluctuation. To find out whether the increase of on grid electricity price can make up for the cost increase brought by the rise of coal price.

As early as 2004, Dr. Zhang pointed out that traditional accounting analysis could not provide sufficient information for enterprise competition, so he proposed to use thermal economics method for analysis. And forecast the electricity price to maximize the benefits[10]. Wang (2016) proposed that cost management analysis should be carried out first to maximize benefits. Only by strengthening the cost control of power enterprises can the further development of power enterprises be promoted[11].

3.1. Coal prices volatility

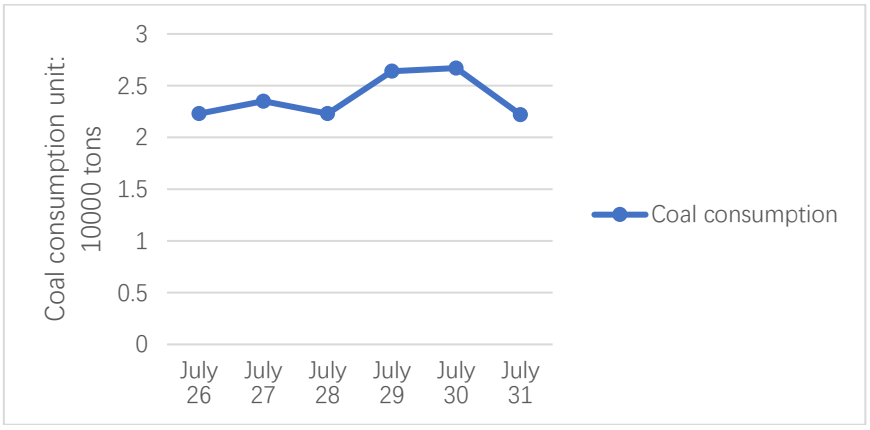

Figure 1. Single day coal consumption

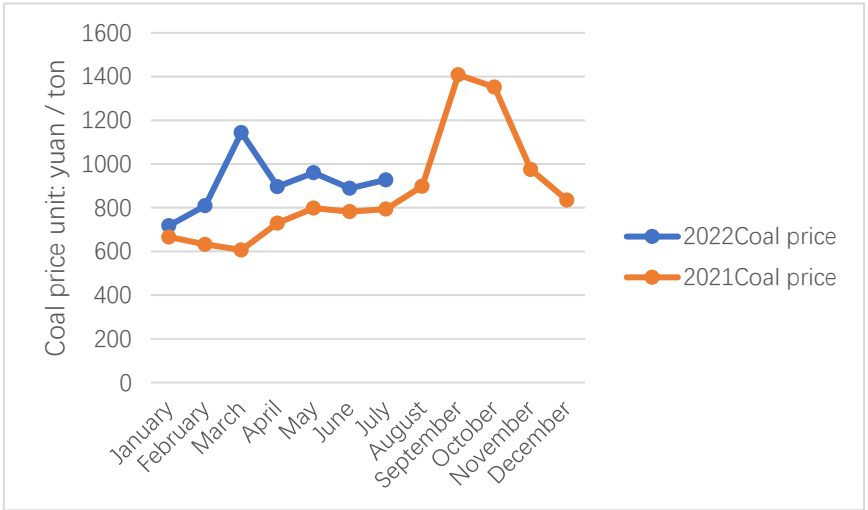

Figure 2. Price of thermal coal

Since the second half of 2020, the demand for coal in the power, steel, building materials and other industries has gradually rebounded, but the space for releasing new production capacity in the main coal production areas is limited, and the dislocation of production and transportation needs in the coal

market is relatively serious. In the short term, the supply exceeds the demand. With the continuous deepening of the supply side structural reform, the concentration, production control and market pricing power of the coal industry have been greatly enhanced. It is difficult to fundamentally reverse the coal market pattern dominated by sellers in the short term.

It can be seen from the above Figure2 that under the background of double carbon, the current coal market is facing the new tasks of stable supply and green development, and the frequent safety accidents in the mining industry in the first half of this year, resulting in the continuous rise of China's coal prices from the second half of 2021. Coal prices in the same period were much higher than those in previous years, resulting in a sharp rise in power generation costs.

3.2. Fluctuation of on grid price

From 2019 to the first half of 2022, the on grid price showed a slow rising trend. The income of power enterprises has increased.

In the first half of 2022, the average on grid price of the group was 518.05 yuan / MWh. In 2021, the group's average on grid electricity price was 430.02 yuan / MWh. In 2020, the group's average on grid electricity price was 404.4 yuan / MWh (including tax), a decrease of about 2.43% over the same period of the previous year. In 2019, the group's average on grid electricity price was 414.49 yuan / MWh, an increase of 1.16% over the same period last year after restatement.

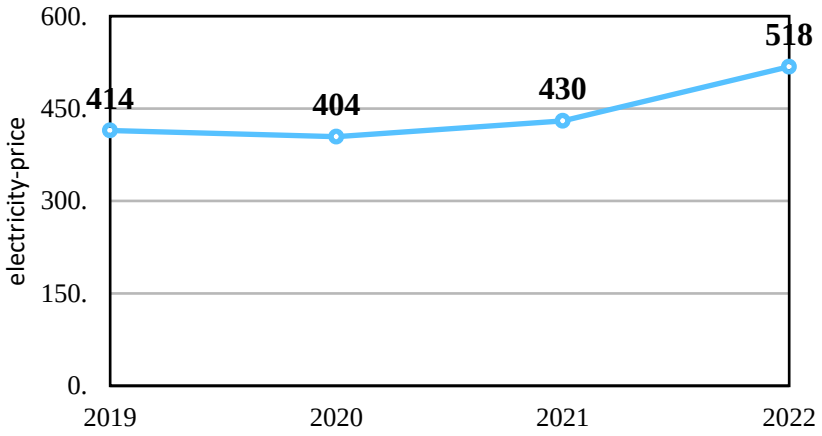

Figure 3. Electricity-price of the group from 2019 to 2022

On May 29, 2022,National Development and Reform Commission promulgated the notice of the national development and Reform Commission on further deepening the marketization reform of coal-fired power generation on grid price, which stipulates that in principle, the fluctuation of market transaction price shall not exceed 20%. The spot price of electricity is not limited by the above range. The fluctuation range of electricity price is much smaller than that of coal price. In the first half of this year, affected by the epidemic situation at home and abroad, macro-economy and other factors, the growth rate of electricity consumption in the whole society slowed down, resulting in new challenges for the operation of power enterprises

3.3. Benefit maximization analysis

3.3.1 Enterprise profit maximization

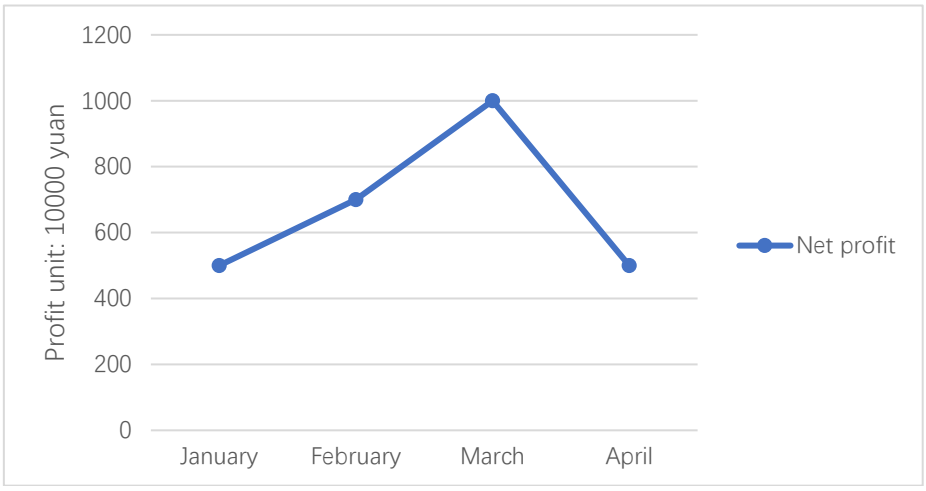

Figure 4. Change trend of net profit in the first half of 2022

The change trend of net profit can be seen intuitively from the above figure. From Figure 2, it can be seen th›at coal prices rose significantly in March 2022, but the net profit of enterprises reached the highest value instead. The reason is that it can be seen from Figure 1 that the on-grid electricity price has increased slightly since 2021 with the rise of coal prices. The enterprise has taken measures such as signing contracts in advance and storing coal at low prices to reduce the cost of power generation, greatly improve the competitiveness of the enterprise and strive for more power generation. Thus, while reducing costs, the company improved its profitability and significantly increased its net profit. By forecasting the fluctuation of coal price and electricity price, the economic benefits of enterprises have been improved.

3.3.2 Maximize social benefits

This enterprise is not only an electric power enterprise, but also a central enterprise. The central enterprise is not only for profit, but also for the important task of providing basic guarantees for people's lives and national economic development. At present, a bigger problem faced by power enterprises is the national policy and the social obligations of central enterprises.

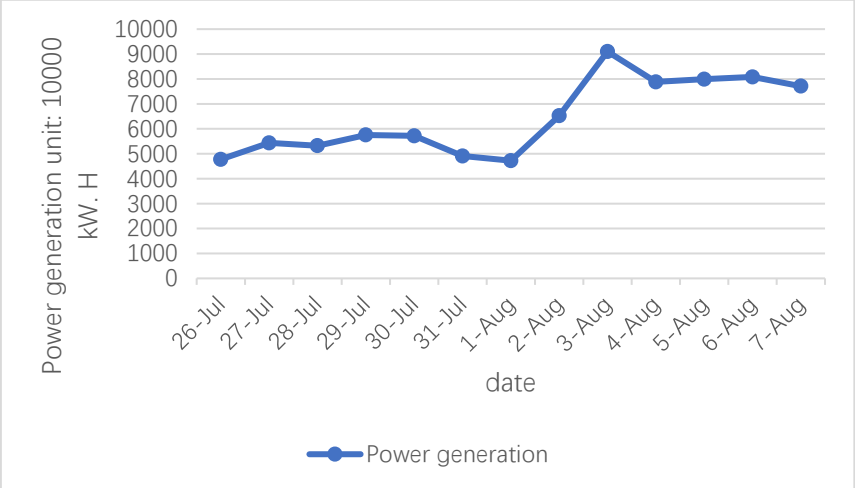

Figure 5. Power generation

From January to June 2022, the power generation of Shandong Province was 283.08 billion kwh, of which the thermal power generation was 246.36 billion kwh, accounting for about 87.03% of the power generation of Shandong Province and about 6.22% of the national power generation. It is the largest type of power generation in Shandong Province. The accumulated power generation of the

enterprise from January to June 2022 reached 8.861 billion kwh. In the first half of 2022, the power generation Co., Ltd. fully fulfilled the political and social responsibilities of the central enterprise, went all out to ensure power generation and heating, and successfully completed the safe and green power supply during the important periods of the "Winter Olympic Games", "winter Paralympic Games", and the national "two sessions". Under the great pressure of social responsibility, and coincided with the rise of coal prices, the company continued to lose money for several months. It reflects that the power enterprise is not a pure profit-making enterprise. When necessary, it should bear major social responsibilities to maintain the stable supply of electricity and the stable development of the economy.

In addition, as a central enterprise, it also shoulders many social benefits such as solving local employment problems, paying taxes and providing support for local and national finance.

4. Solutions and future development

4.1. Coal supply and price control

As the biggest cost of production and operation of enterprises, coal price is the key factor affecting benefits. Supply should be maintained to the maximum extent possible， control the price, scientifically study and judge the trend of the coal market, balance the relationship between coal price, inventory and consumption, continue to optimize the coal feeding structure, dynamically adjust the purchasing strategy and coal feeding opportunity, and try our best to reduce the coal price. It can also give play to the group's advantages in centralized fuel mining, strengthen strategic coordination with Changxie large mines and key customers, increase the group's self-produced coal, affordable Changxie coal and economic coal shipments and quasi liner transportation, and improve its supply guarantee capacity. We will strengthen the fight for import coal quotas and give full play to the resource support and price advantages of imported coal. Enterprises should also adhere to the "one chess game" of production and operation, continue to carry out fuel lean research, strengthen mixing and burning management, and ensure to maximize fuel efficiency and further save costs. Strengthen internal and external scheduling of port affairs, continue to improve the efficiency of coal ship receiving and unloading, avoid ship demurrage, and reduce fuel costs in an all-round way.

4.2. Developing clean energy with low cost

Respond to the national call for green development in incremental fields. In terms of wind power, wind power can be listed as the "No. 1 project" and the "No. 1 project" of enterprise development. Focusing on the idea of combining wind and scenery, centralization and decentralization, and land and sea, we actively follow the policy planning of decentralized wind turbines and offshore wind power.

4.3. Correctly grasp the relationship between electricity quantity, electricity price, coal price and income

Electric power enterprises should coordinate the demand and price to "generate electricity with efficiency". Adhering to the maximization of power generation efficiency as the fundamental, centering on the annual operating profit goal, we will coordinate the three markets of medium and long-term, spot and auxiliary services, constantly improve the level of marketing services, and effectively play the role of "ballast" of medium and long-term power contracts. We should pay close attention to the power generation demand of the power grid, actively participate in peak load regulation, scientifically arrange equipment maintenance, optimize the operation mode of public systems in the spot market, and do everything possible to improve power generation efficiency. We should actively follow the general trend of power market reform, correctly grasp the relationship between electricity quantity, electricity price, coal price and income, and take multiple measures to strive for efficient power generation. It is necessary to pay attention to reporting and communication

with superior companies, strengthen internal economic operation and optimal dispatching of the company, give priority to units with higher marginal contributions to undertake more power generation tasks, and ensure the maximization of power generation benefits.

5. Conclusion

To sum up, power enterprises should focus on providing basic living security for the country and society, secondly, how to balance the coal purchase price and the on grid price, actively carry out marketing, take the spot power transaction as an important node to improve efficiency, and better use policies to improve efficiency. Under the influence of the big environment, we will gradually develop to clean energy, reduce the cost of environmental protection and improve efficiency.

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