

Cost Structure Analysis of Wind Power Enterprises Based on Mathematical Statistics

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Abstract: In recent years, under the background of gradual maturity of wind power technology, wind power generation with great market development prospects has achieved rapid development. The number and scale of wind power enterprises in many large-scale power generation groups are constantly expanding, which brings great challenges to the management of wind power enterprises. How to achieve benefit from management and how to reduce the operating cost of wind power enterprises are very important issues. The cost structure of wind power enterprises is analyzed in detail in this paper. Through the classification and comprehensive analysis of the cost, the key points of cost control of wind power enterprises are explored, and the relevant suggestions are put forward, which is of great significance to the healthy development of wind power industry.

1. Introduction

As a country with the fastest development of wind power industry in the world, China's wind power installed capacity and power generation have increased rapidly in recent years. According to the "wind power grid operation in the first half of 2020" released by the National Energy Administration (NEA), from January to June 2020, China's new wind power installed capacity is 6.32 million kW, with a cumulative installed capacity of 217 million kW. From January to June 2020, wind power generation will reach 237.9 billion kWh, a year-on-year increase of 10.9%.

With the rapid growth of wind power, the process of China's power market also presents a rapid development trend. The process of electricity marketization affects the wind power industry to a large extent, especially the competitive bidding, the weakening of power auxiliary service market and government subsidy policy, which makes the operation of wind power enterprises face new challenges [1]. How to continuously reduce the operating costs of wind power enterprises and improve the market participation of wind power enterprises in the context of power market development are the problems that wind power enterprises should consider.

The cost of wind power is higher than that of traditional fossil energy power [2]. Wind farms need large-scale investment in the initial investment stage, and they also need to operate and maintain the equipment after they are officially put into operation. It is very necessary to carry out comprehensive and advanced cost research on wind power enterprises. This paper takes the wind power enterprise of H power generation group as an example to analyse the cost of each link of wind power enterprise.

2. Investment Cost

2.1 Composition of Investment Cost

Investment cost is the sum of money expenditure of materialized labour and living labour consumed by fixed assets investment, mainly including construction and installation cost,

equipment purchase cost and other expenses. For wind power enterprises, the investment cost is the capital investment of wind farm development and construction period.

The construction of wind farm is a complete and continuous process from early development to equipment procurement, engineering construction and grid connection. The investment cost mainly includes equipment purchase cost, installation cost, construction engineering cost, land acquisition cost and interest cost during the construction period [3]. Among the various components, the equipment purchase cost accounts for the majority of the whole wind power investment cost.

The equipment purchase cost mainly includes the cost of wind turbine, tower, box transformer, primary equipment and secondary equipment. The installation cost mainly includes the installation cost of fan, box transformer, booster station equipment, on-site and outgoing line engineering, etc. The construction cost mainly includes the cost of wind turbine foundation, road construction, booster station civil engineering and other construction projects [4]; the land acquisition cost mainly refers to the compensation for land acquisition.

2.2 Characteristics of Investment Cost

The investment cost of wind power project has the characteristics of large one-time investment and long payback period [5]. The investment cost control level of wind power projects directly affects the unit cost per kilowatt in the infrastructure construction period, and also has an important impact on the production, operation and profitability of wind power projects in the whole life cycle.

2.3 Unit Installed Investment Cost (Unit Kilowatt Cost)

In recent years, the unit kilowatt cost of wind power projects in China shows a decreasing trend [6], as shown in the figure below.

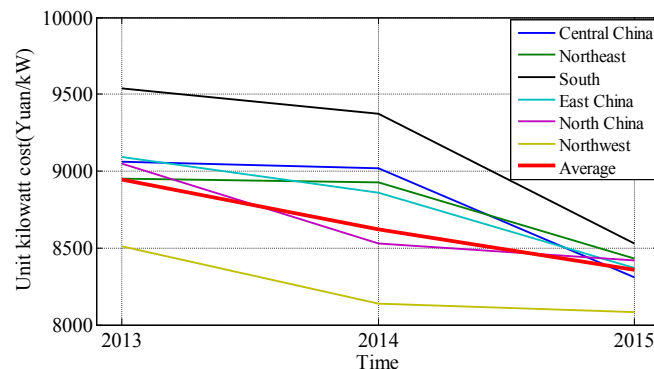


Figure 1. Trend chart of unit kilowatt cost of wind power projects in different regions and years

It can be seen from the figure that in recent years, the cost of wind power in China has decreased significantly, and there are differences in different regions. In southern regions such as Guangdong and Guangxi, the unit kilowatt cost is relatively high, while in northwest regions such as Shaanxi and Gansu, the wind energy resources are relatively rich, the wind power construction momentum is good, and the unit kilowatt cost is relatively low [7].

In recent years, with the development of wind power industry and the strict control of wind power enterprises on investment in construction period, the total project investment has been continuously optimized, and the unit kilowatt cost also presents a decreasing trend year by year. The figure below shows the unit kilowatt cost distribution of wind power enterprises of h power generation group.

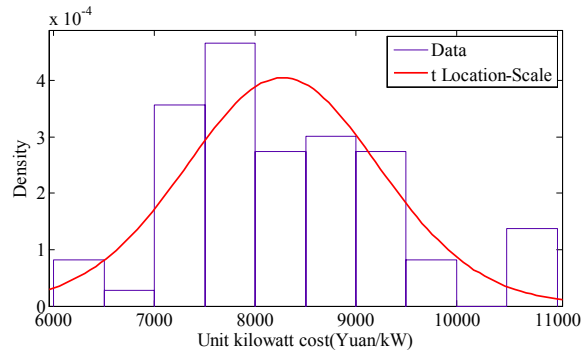


Figure 2. Distribution of unit kilowatt cost of wind power enterprises affiliated to H power generation group

3. Production costs

3.1 Composition of Production Cost

The production costs of wind power enterprises refer to the costs incurred in the operation of wind farms to ensure the normal operation of wind turbines, mainly including operation costs and maintenance costs, including material repair costs, staff salaries, depreciation costs, electricity (heat) costs, production and operation costs, commissioned operation costs and other costs.

(1) Material maintenance cost (MMC)

Material repair cost mainly includes regular maintenance cost, daily spare parts consumption, fan overhaul cost and two measures cost, which is specifically divided into material cost and repair cost.

(2) Employee compensation (EC)

Employee compensation refers to various forms of remuneration and related expenditures given by enterprises to obtain the services provided by employees, mainly including employee wages, social insurance, welfare, education and training funds, labor union funds, labor protection fees, housing accumulation fund and dismissal welfare.

(3) Depreciation cost (DC)

The depreciation expense refers to the depreciation expense included in the production cost calculated and drawn according to the fixed assets formed in the final accounts of the completed project. Specifically, based on the original value of the fixed assets for which depreciation is accrued, the depreciation expense is calculated according to the specified depreciation rate after deducting the provision for impairment and the residual value rate.

(4) Electricity (heat) purchase fee (E(H)PF)

The purchase electricity (heat) fee includes two parts: the purchase electricity fee and the purchase heat fee. The purchase electricity fee refers to the fee paid for purchasing electricity from the power grid to ensure the safe and stable operation of the wind turbine. The purchase heat fee refers to the heating cost purchased from the power plant for heating residents and businesses.

(5) Production and operation cost (POC)

Production and operation cost refers to the sewage charge, comprehensive utilization fee of fly ash, transaction fee of power generation right, test and verification fee, technical supervision service fee, etc. for normal operation of the unit.

(6) Commission operation fee (COF)

The entrusted operation fee refers to the fee paid to the operator according to the agreement signed by both parties by entrusting the repair, maintenance and operation of wind turbine, booster station, transmission line and other power generation equipment to the operator.

(7) Other expenses (OE)

Other expenses refer to the management expenses included in the production cost, including general management expenses, property insurance premiums, policy taxes, asset amortization, special management expenses, special expenses, etc.

3.2 Characteristics of Production Cost

The production cost of wind power enterprises can be divided into two categories, namely controllable cost and uncontrollable cost. Uncontrollable expenses mainly include depreciation and employee compensation, of which the depreciation is mainly related to the initial investment cost during the construction period of wind farm. Controllable costs mainly include operation and maintenance costs and daily operation and management costs [8].

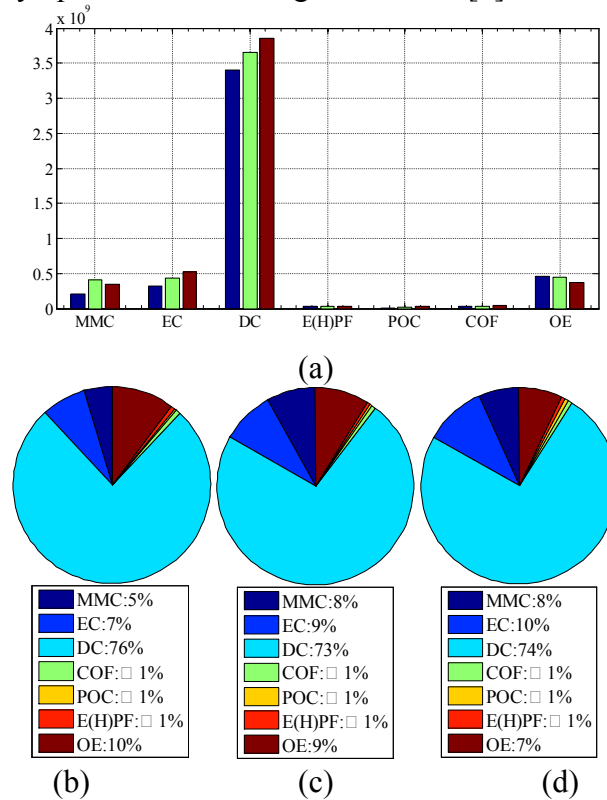


Figure 3. Production cost structure chart of wind power enterprise of H power generation group

It can be seen from the production cost structure chart of wind power enterprise affiliated to h power generation group that in the production cost, depreciation cost accounts for the largest proportion, followed by employee compensation, and material repair cost accounts for the largest proportion in controllable costs [9].

3.3 Material and Repair Costs

Based on the analysis of the material cost and repair cost of the wind power enterprise affiliated to h power generation group for three consecutive years, it is found that the cost of the newly put into operation wind power enterprise is lower, and the cost of the increase of the operation period increases accordingly.

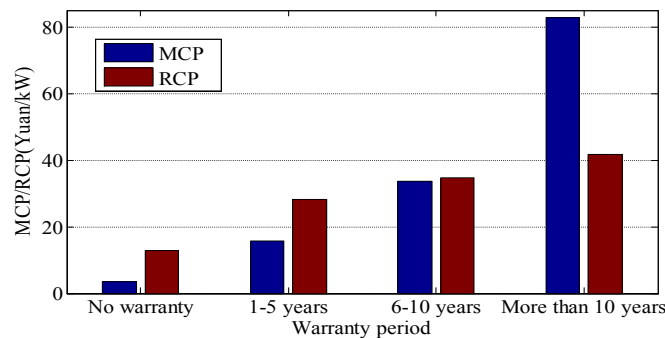


Figure 4. Material cost and repair cost per kilowatt

The wind power enterprises of h power generation group are classified into non warranty period,

warranty period of 1-5 years, warranty period of 5-10 years and warranty period of more than 10 years. The unit kilowatt material cost and unit kilowatt repair cost of each type are calculated respectively. The material cost and repair cost of wind power enterprises within the warranty period are relatively low, and the cost increases year by year after the warranty period, as shown in the figure above.

4. Financial Expenses and Related Taxes

Financial expenses refer to the expenses incurred by enterprises to raise funds, mainly including interest expenses, net exchange losses, handling charges of financial institutions and other expenses incurred in raising funds. The financial expenses of wind power enterprises are mainly the interest expenses formed by the fixed asset loans during the project construction period and the working capital loans after the project is put into operation [10]. Relevant taxes refer to other taxes and surcharges incurred by wind power enterprises except for enterprise income tax and value-added tax allowed to be deducted.

5. Total Cost

After wind power enterprises are put into operation, the annual total cost mainly includes production cost, financial cost, business tax and surcharges.

Taking the actual situation of the case wind power enterprise as an example, this paper analyzes the composition of the total cost. According to the analysis, the depreciation cost of the wind power enterprise accounts for the largest proportion of the total cost, about 51.52%, followed by the financial cost, about 28%, and the material repair cost accounts for the largest proportion, about 3.84%. The proportion of various costs of wind power enterprises is shown in Tab.1.

Table 1. Cost Structure of Wind Power Enterprises

Project	2016	2015	Average
Material repair cost	3.82%	3.86%	3.84%
Employee compensation	8.47%	7.47%	7.97%
Depreciation charge	52.93%	50.11%	51.52%
Electricity (heat) purchase fee	0.51%	0.52%	0.51%
Production and operation cost	0.81%	0.78%	0.79%
Commission operation fee	0.55%	0.41%	0.48%
Other expenses	6.27%	5.85%	6.06%
Financial expenses	25.91%	30.10%	28.00%
Business tax and surcharges	0.73%	0.90%	0.81%
Total	100.00%	100.00%	100.00%

According to the above analysis, the depreciation cost of wind power enterprises accounts for the largest proportion in the cost structure of wind power, and the depreciation cost in the production and operation stage is directly related to the investment in the construction period. Therefore, in terms of cost control, we should focus on reducing the depreciation cost and project cost, and take corresponding measures for different links to control the cost. At the same time, wind power enterprises should strictly control all aspects of the cost, realize the overall cost optimization of the enterprise, and establish a dynamic cost management system, so as to ultimately achieve the purpose of reducing the cost of the enterprise.

6. Conclusion

Through the analysis of the cost structure of each stage and link of wind power enterprises, the key points of cost control of wind power enterprises are summarized. It is suggested that the

effective control of these key points can improve the profitability of wind power enterprises, enhance the competitiveness of wind power enterprises, and promote the healthy development of wind power industry: First, strengthen the whole process management of capital construction projects, and constantly optimize the unit kilowatt cost. It can be seen from the analysis of cost composition that the initial investment cost of wind power enterprises is an important part of power generation cost. It is suggested to reduce the project cost and improve the investment efficiency by reasonably controlling the early development cost, reducing the land requisition cost, strictly controlling the construction cost, scientifically controlling the project progress, and adopting appropriate procurement methods to reduce the equipment procurement cost. Second, smart financing, taking various measures to reduce financial costs. Financial expenses account for a large proportion of the cost of wind power enterprises, and directly affect the business efficiency of enterprises. It is suggested that wind power enterprises should actively explore financing channels, intelligently formulate financing plans, actively strive for financial discount, reduce financial costs and improve enterprise benefits under the condition of ensuring the safety of capital chain and combining with their own actual situation. Third, scientific management and control of controllable costs such as material costs and repair costs, and classified management of similar wind power enterprise costs. Through the analysis of this paper, we can know that the cost of wind power enterprises is regular, such as material cost and repair cost. It is suggested that wind power enterprises should deeply study the cost characteristics of wind power enterprises. For large-scale wind power enterprises with group management, it is suggested to carry out classified management, accurate research and scientific management, so as to achieve the goal of creating benefits through management.

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