Research on Wind Power Participation in Electricity Market in Northeast China

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Research on Wind Power Participation in Electricity Market in Northeast China

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Abstract. In China's current power generation plan, wind power belongs to the scope of guaranteed priority generation. But with the development of wind power industry and the promotion of electricity market construction, wind power participation in market transactions has become a trend. This paper first analyses the current situation of wind power industry under the background of electric power system reform, then introduces the situation and experience of Texas electricity market with good wind power development. According to the current situation of wind power development in Northeast China, the suggestions for wind power development are put forward and the development path of wind power in the electricity market environment is formulated.

1. Introduction

Wind power, as one of the most important energy sources in China, is an important part of the national energy transformation strategy. With the continuous development of China's wind power industry, the problem of wind abandonment has always been the bottleneck restricting the development of wind power industry. With the adoption of renewable resources quota system, renewable energy certificate and wind power construction warning policies, the problem of wind abandonment is gradually alleviated, and China's wind power industry continues to develop towards high quality. With the development of China's electricity market, it has become a trend for renewable energy to participate in market transactions and use market mechanism to promote new energy.

2. Current situation of wind power in Northeast China

Northeast China is rich in wind power resources and one of the large-scale renewable energy bases in China. In 2017, the development of wind power in Northeast China Power Grid was good. The annual power generation reached 53.395 billion kWh, an increase of 118.27 billion kWh over the same period of last year, and the abandoned wind power decreased. However, the government still lists Jilin, Inner Mongolia and Heilongjiang as warning areas and suspends wind power construction[1], which indicates that the development of wind power in Northeast China has a long way to go.

China's electric power system reform has brought tremendous changes to the power industry. In a recent UHV project involving new energy sources, the Chinese government has stipulated that wind power resources should be allocated by competitive bidding. It is also stipulated in the government

documents that all new centralized onshore wind power projects and offshore wind power projects with undetermined investors in the future should be allocated and determined through competition[2]. It all conveys the signal that wind power will be involved in market transactions. At present, the phenomenon of wind abandonment has been alleviated, and the economic benefits of wind power industry have been improved. In order to reduce the pressure of government subsidies and enhance the competitiveness of industry, wind power participation in the electricity market has become a trend.

3. The Enlightenment of Foreign Power Market on the Development of Northeast Wind Power

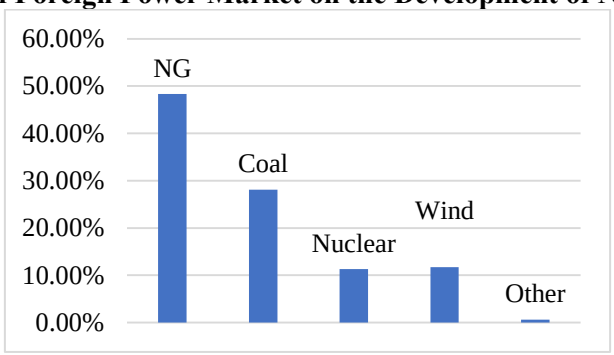

Figure 1. 2015 energy produced by fuel type in Texas electricity market.

Figure 1 shows the proportion of all types of power generation in Texas's power system in 2015. On October 27, 2017, the highest penetration ratio of new energy to renewable energy in the Texas grid reached 54%, the first time that the grid had such a high penetration of renewable energy in the operating environment of the electricity market. In the Texas electricity market mechanism, new energy and other power sources in the market jointly participate in the market quotation, and are treated indiscriminately in the electricity market. Although the government has some subsidies for new energy, it must also abide by the most basic market rules[3]. After research, there are three reasons to promote the development of wind power in Texas:

3.1. Flexible nodal electricity market mechanism

Texas initially adopted a zonal market structure, dividing ERCOT into four congestion management regions according to several major transmission sections. In December 2010, it was formally transformed into a nodal market, using more than 600 power price settlement points, aiming at improving price signals, improving dispatching efficiency and directly allocating local congestion costs. Nodal market consists of four sub-markets: CRR, DAM, RUC and SCED[3].

3.2. Precise prediction of wind power output

To cope with the fluctuation of wind power output, ERCOT generates and updates several types of wind power generation forecasting every hour. The forecasting can be divided into three types: total ERCOT wind power forecasting, short-term wind power forecasting and wind power resource production potential. In addition, in the real-time dispatching operation of the Texas electricity market, the deviation penalty will be imposed when the output of conventional units exceeds 5% or 5 MW of the base instruction value considering auxiliary service invocation. Considering the instability of wind power output, the penalty standard for deviation of wind farm should be relaxed, and only when the output of wind farm is higher than 10% of the base point instruction value under the condition of abandoned wind[4].

3.3. Coordination of transaction, dispatching and auxiliary services

Like most U.S. electricity markets, Texas has an independent system operator (ISO) that integrates dispatching and trading. In the nodal market of Texas, the operation Department is responsible for two

financial markets: the CRR market and the DAM market. The dispatching control center is responsible for SCED and RUC physical markets. The integration of electricity trading and dispatching ensures the transaction in spot market, and is more conducive to the absorption of wind power[3].

Figure 2 shows that more than half of the installed units in Texas power system are gas generating units, which are an ideal peak shaving resource. By establishing an appropriate pricing mechanism, new technologies can be attracted to the ancillary services market, thus promoting the rapid development of new energy in Texas.

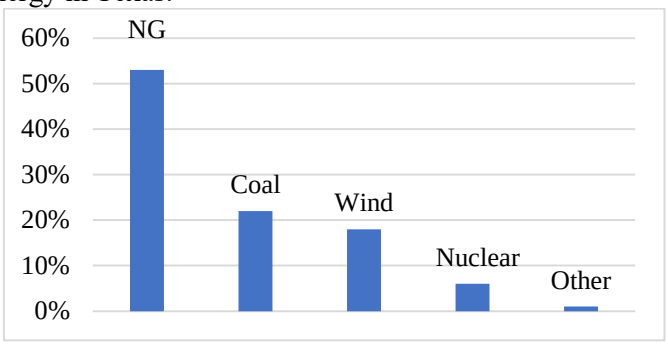

Figure 2. 2015 power supply installation in Texas electricity market.

In addition to the above three points, the healthy development of wind power in Texas is also related to such factors as adequate grid construction and abundant wind power resources. The enlightenment to Northeast China Power Grid lies in promoting the construction of ancillary service market, improving the accuracy of wind power output prediction, implementing wind power development policy, enhance users' awareness of environmental protection, and promoting the construction of electricity market.

4. Suggestions on Wind Power Development under the Background of China's Electric Power System Reform

4.1 Improving technical means to ensure wind power absorption

There are various means to promote clean energy consumption, both physical means and market mechanism. Through field investigation, in 2017, Northeast Power Grid adopted a series of measures: optimizing power grid structure, improving peak shaving auxiliary service market, strengthening dispatching management, and giving full play to regional power grid resources optimal allocation capacity. As the first power ancillary service market in China, the Northeast Power ancillary service market has effectively tapped the potential of peak shaving in the low valley of thermal power plants, improved the reliability of heating in winter in Northeast China, and realized a wider range of optimal allocation of peak shaving resources[5]. The next task is to refine the cost allocation of peak shaving ancillary services.

Using technical means to solve the problem of wind power absorption can also encourage the generation side to explore new models. For example, the Huolin River local power grid in eastern Inner Mongolia uses photovoltaic power generation to assist coal mining, and uses abundant wind power to produce aluminum[6]. In addition, when the technology is mature in the future, wind power and energy storage equipment can be combined to reduce the fluctuation of wind power by utilizing the rapid response ability of energy storage equipment.

4.2 Utilizing market mechanism to promote wind power development

In 2017, the "Rules for Wind Power Transaction in Eastern Inner Mongolia" promulgated by the Chinese Government proposed that the types of wind power related transactions should include direct electricity trading and power generation rights trading. Trading methods are divided into negotiation transaction, centralized bidding transaction and listing transaction. Considering the current situation of

wind power participation in market transactions in Northeast China Power Grid, it is imperative to increase the proportion of spot transactions between provinces and wind power transactions in North China.

With regard to the transaction of promoting wind power consumption, the intra-province transaction should encourage large-scale users to conduct direct transactions and promote wind-fire substitution transactions in an all-round way in the province[7]; the inter-provincial transaction should improve the existing cross-provincial transactions involving wind power, and it is suggested to increase the subsidies of users in North China to Northeast wind power in order to improve the enthusiasm and output of wind power. In addition, we can draw lessons from the Nordic market mechanism. When the wind power forecast is inaccurate, we can compensate for the deviation of electricity by real-time trading equilibrium market, and encourage relevant parties to strengthen the wind power forecast through market mechanism.

5. Wind Power Development Path under the Background of Electric Power System Reform

Reducing the cost of wind power development and improving its market competitiveness has always been the goal of the industry. One of the goals set by China's 13th Five-Year Plan for Renewable Energy Development is that by 2020, the price of wind power projects can compete with local coal-fired power generation platforms. Under the background of power system reform, we can first solve the problem of wind power consumption, then enrich the variety of transactions and improve the trading rules, and gradually involve wind power in market transactions. As shown in Table 1, we derive the development path of wind power in the electricity market environment.

According to the above analysis, it is considered that under the background of power system reform, wind power can refer to the following path to achieve its own development. At the same time, we should pay attention to the implementation of national policies while constantly exploring market mechanisms and technological means. Policy level should create a good investment environment for the development of the industry, including increasing power generation utilization hours, cleaning up illegal charges, establishing a reasonable market and price subsidies, etc.

Table 1. Development path of wind power in the electricity market environment.

Recent stage	Mid-term stage	Forward stage
1. Perfecting the market of ancillary services, tapping the potential of peak-shaving, 2. Strengthening dispatching management, 3. increasing the proportion of wind power transactions in Northeast China Power Grid.	1. improving electricity pricing mechanism, 2. constantly exploring new types of wind power transactions 3. promoting wind power bidding in northeast china	1. Further reduce the cost of wind power 2. improve the mechanism of wind power participation in market transactions 3. discover the true cost of wind power to enhance the competitiveness of wind power industry

6. Conclusion and Prospect

From the development history of China's wind power industry, the growth momentum of the past 20 years mainly comes from the policy drive. At the present stage, the economic benefits of wind power industry are gradually increasing, and the cost of technology is gradually decreasing. The driving force of industry development is turning into self-driving force under high economic returns. Under the background of power system reform, the wind power industry can not always survive on subsidies, so wind power is facing the path of continuous participation in market transactions.

According to this paper, Northeast China should adopt both technical means and market mechanism to promote the development of wind power. Combining with the established path, we should first solve the problem of wind power consumption, then enrich the trading varieties and

improve the trading rules, and gradually involve wind power in market transactions. Finally, the healthy development of wind power under the background of power system reform will be realized.

Acknowledgement
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