

Study on the Path of Inter-provincial Power Market Construction in Southern Regions

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Abstract. First of all, it summarizes the characteristics of two typical centralized regional markets, such as the unified balance and regional balance in foreign countries. Secondly, on the basis of analyzing and summarizing the main problems and solutions in the process of regional power market construction, combined with the experience of foreign regional power market construction, this paper proposes a development path and construction ideas in line with the situation of the southern region's power market.

1. Introduction

China's power resources and market demand are not balanced. The western power resources are relatively abundant, while the power market is relatively small. The eastern and central regions have larger market sizes and less primary energy. There is also such a problem in the southern power grid area. 90% of the hydropower installations on the supply side are concentrated in Yunnan, Guangxi, and Guizhou. 90% of the coal production is concentrated in Guizhou and Yunnan, while the demand side is 75% of the electricity load and 80% of the gross national product is concentrated in Guangdong, Guangxi and other provinces. At the same time, as China's economy shifts from medium-to-high-speed growth to development "new normal", economic downward pressure still exists. The southern region's electricity consumption is maintained at a growth rate of around 5%. In the southern region, there is an increasing problem of overcapacity and continuous decline in utilization hours. Prominently, problems such as clean energy consumption and inter-provincial coordination have gradually spread from local to regional, and it is difficult to completely solve the problem within a short period of time simply relying on the provincial market mechanism. Under this circumstance, constructing a regional electricity market based on cross-regional inter-provincial transactions is an effective way to achieve optimal allocation of resources within a larger scope, and is of great significance for promoting the sound development of the power industry.

In the research on China's regional electricity market, the literature [1] analyzed the organizational form of regional electricity market, proposed a regional market organization model suitable for China's national conditions, and discussed the regional market pricing mechanism. Literature [2] proposed four typical regional common electricity market models, comparing the advantages and disadvantages of various models. Literature [3] used microeconomics theory to qualitatively analyze the welfare effects of regional electricity market transactions, and believed that the total social welfare in the regional trading mode is higher than the total social welfare in the regional trading mode. In the study of the typical regional electricity market, the literature [4] introduced the electricity situation and the



electricity market trading mode in the Nordic region I, and expounded the formation driving force and market trading mechanism of the Nordic electricity market. The above-mentioned documents are introduced from the perspective of regional market model design and the reference of foreign regional power market. The design model is also more general, and does not consider the development status of the southern region.

In this context, the paper will analyze the model of typical foreign regional electricity market, introduce the current situation and outstanding problems of inter-regional and inter-provincial transactions in southern China, and put forward the development path and construction ideas of inter-regional and inter-provincial electricity market suitable for Southern China.

2. Introduction of typical regional power markets abroad

According to the characteristics of regional market composition, the typical foreign regional electricity market models can be roughly divided into two types: the centralized regional unified balance represented by PJM and the centralized regional balance represented by Nordic electricity market.

2.1. Centralized and balanced regional market

Unified and balanced centralized regional market is characterized by unique transaction dispatching organization, unique market rules and unified balance. It is composed of several regional entities. Each regional entity uses the unique market rules to conduct transactions in the only trading institution, and unified balance and centralized optimization are carried out by the unique regional dispatch.

As the independent dispatching and trading center of the regional power grid, PJM is the only authoritative power trading platform in the regional market. It is responsible for running and managing the power system of the regional spot market formed by 13 states in the United States and Washington, D.C. All kinds of market participants can only complete the physical delivery of generating power through PJM spot market (day-ahead + real-time), and participate in all kinds of over-the-counter financial transactions according to the need to avoid risks. PJM market participants only need to focus on the sole market discipline or manual. The dispatching department of PJM is solely responsible for balancing the supply and demand of regional power grids and formulating all generation plans and real-time balancing of regional power grids. The lower level dispatching or local Transmission Companies is only responsible for line switching operation and accident handling ^[5].

2.2. Zoning balanced regional market

The characteristics of centralized regional market with regional balance are: multiple trading or dispatching institutions, common market rules, and regional balance. Taking the "big market" as the main platform for the unified and optimized allocation of power generation resources, the "small market" mainly meets the individualized and differentiated trading needs of the balance of near consumption. Different market models and trading varieties can be used in each "small market". The "big market" is composed of several "small markets", which is based on the market rules recognized by market members. It is closely linked up and forming a unified "big market" by scheduling coordination mechanism, transaction timing division, data communication interface specification and other measures. These two types of regional markets have the same characteristics, that is, the transaction needs of all market participants on the large market platform are aggregated and optimized according to the unified rules to achieve the optimal allocation of resources in the whole region, including cross-regional spot markets (day-ahead, day-in-day) and intra-regional medium and long-term transactions and real-time balanced markets.

Nord Pool, the Nordic Exchange, is the only authoritative power trading institution responsible for organizing market participants from member countries to participate in day-to-day, day-to-day and medium-to-long-term intra-market transactions, while medium-to-long-term transactions are only allowed within the same price range. The market participants abide by the Nordic unified spot market rules. The Nordic Exchange recently balanced the vast majority of electricity supply and demand, prepared cross-border trans-zone trading plans and issued them to national power dispatching agencies,

which are responsible for the implementation of domestic intra-regional medium-and long-term contracts. In the real-time operation stage, transmission congestion in the price interval and instantaneous power balance in the price interval are solved by the operation of the domestic real-time equilibrium market by power dispatching agencies of various countries ^[6].

Under the economic system in which the province is the entity, the southern region carries out the strategy of "power transmission from west to east". Except for the state mandatory plan, the other transactions are mainly carried out within the framework agreement between the provincial and regional governments. However, the problems faced by the development of electric power in the southern region and the differences of market competition environment are still existing. It needs to be solved through different market mechanisms. In this case, the coexistence of regional market and provincial market will exist for a long time, and the centralized balanced Nordic subregion will be more useful for the construction of a unified power market in the southern region.

3. Problems and solutions in the construction of Southern Regional Electricity Market

At present, the rules of each provincial market in the southern region are formulated according to the resource structure and economic environment of the province. There are many problems in the construction of regional electricity market. The main problems and solutions are as follows:

3.1. Inter-provincial barrier problem

The key to breaking the inter-provincial barrier lies in the relatively reasonable transaction compensation and benefit-sharing mechanism for local governments and parties. It can take measures from the government, users, power generation, etc., such as urging the government to further liberalize the purchase of electricity between users. The right to choose, innovative trading methods, enrich the trading varieties, and establish reasonable compensation and incentive mechanisms to promote the development of inter-provincial transactions. It is also possible to improve the government's willingness to accept power transmission between provinces by reasonably compensating for the loss of fiscal and tax revenues of the receiving provinces and establishing a perfect renewable energy quota system. For the province's thermal power units to enter the shutdown due to the clean energy outside the province, the thermal power unit can be transferred by the thermal power unit and the clean energy unit outside the province to give a certain economic compensation to the thermal power units that participate in peaking and other auxiliary services.

3.2. Price mechanism problem

Coal-fired thermal power units generate a large amount of pollutant emissions and negative externalities to the social environment. Through the establishment of carbon emission rights and the quota-based green power certificate trading market, internal costs are externalized, so that the equilibrium price of the electricity market can truly reflect the actual value of electricity commodities.

3.3. The connection between medium-and long-term transactions and spot transactions

The mature electricity market abroad has a remarkable feature, that is, the combined electricity market of multi-state and multi-national, while the majority of electricity delivery is completed by spot transactions. Combined with the experience of foreign spot market construction, the unified spot market is the most powerful entry point for the construction of Southern regional electricity market. Based on the priority guarantee of the medium and long-term agreement plan, the medium and long-term market and spot market in each province and region are closely linked to stimulate market vitality through a broader trading channel. For example, in the medium and long-term market to determine the annual contract electricity, combined with the maintenance plan, water supply situation will be divided into monthly annual contract electricity, monthly market to deal with annual transactions in the unfinished electricity and monthly plan and load forecast deviation, the contract electricity redistribution, to achieve the optimal allocation of resources. In the spot market, it is mainly used to

balance the deviated electricity generated in the medium and long-term market, complementary hedging.

3.4. Balance of supply and demand

Because there is little deviation between one week's load forecasting and day-ahead trading load forecasting, weekly trading can be carried out, and complementary hedging can be formed with day-ahead spot to increase transaction flexibility and price elasticity.

4. Development path of regional electricity market in southern China

At present, under the condition of "inter-provincial barriers" existing, it is a feasible way to construct and perfect the provincial power market in advance. Firstly, to optimize the allocation of power resources within the provincial scope, and on this basis, to promote the construction of regional power market and further improve the efficiency and efficiency of the optimal allocation of resources. Therefore, this paper proposes to promote the construction of a unified Southern regional market in accordance with the "three-stage" development path^[7].

The first stage is to improve laws and regulations, improve policies and systems, and foster markets at all levels.

In order to build regional electricity market, it is necessary to revise and perfect relevant laws and regulations, such as the Electricity Law, and make clear the main body and boundary of regional electricity market construction by means of laws and regulations. We should formulate corresponding policies, put forward standardized medium and long-term, spot market trading rules and relevant convergence norms, establish regional market conventions, and compatible with the development of individualized and differentiated needs of different regions. We will cultivate power generation enterprises, power sales companies, power users, integrated energy service providers and other types of market players to lay the foundation for the integration of regional and provincial markets.

The second stage is the stage of market convergence.

The medium and long-term cross-regional and cross-provincial transactions operate on the same platform, and explore the establishment of a price mechanism for the unified clearing of some trading varieties across the region. Inter-regional and inter-provincial incremental spot is taken as the transitional mode of regional unified market construction to realize the synchronous operation and rational convergence of the two-level market. At the same time, we should consider the supporting mechanism of the southern regional market, establish the mechanism of market risk prevention and control, information disclosure and supervision, and constantly strengthen the market trading service capacity.

The third stage is the stage of market unification.

Finally, a unified power market system in southern China is formed, which is mainly composed of inter-regional and inter-provincial long-term physical contracts, day-ahead spot transactions and intra-provincial spot markets. The construction framework of regional electricity market is shown in Figure 1.

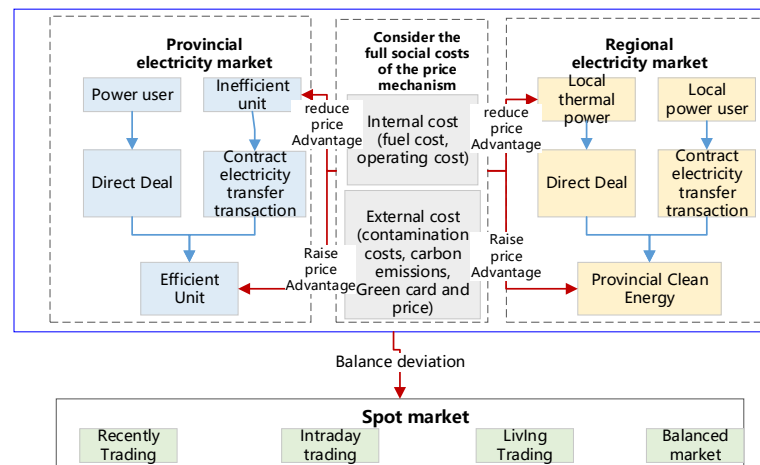


Figure 1. construction framework of regional electricity market

5. Conclusion

Accelerating the establishment of regional power market and optimizing the allocation of power resources in a wider range are not only the objective needs of the inverse distribution of energy resources and power loads in China, but also the effective ways to achieve win-win results among power users, power sales companies, power generation enterprises, power grid enterprises and the government. On the basis of summing up the typical power market in foreign countries and combining with the current situation and main problems of power market construction in southern China, this paper puts forward a "three-stage" development path, that is, to perfect laws and regulations, cultivate all levels of markets, and then to start the integration of the markets in each province, and finally to build a regional power market.

At this stage, this paper only studies and analyzes the regional market model and development path selection, and has not yet formed a mature market system. In the follow-up, it will continue to study in detail from the specific transaction variety design, inter-provincial transmission and distribution price and transaction price formulation, the distribution of the interests of the market participants and other aspects.

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