Research on Electricity Market Mechanisms for Promoting Clean Energy Consumption

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Abstract: Under the background of new power reform, the installed capacity and power generation of clean energy in Jilin Province are increasing year by year, while the generation characteristics of renewable energy such as wind power and photovoltaic are random and volatile, which leads to the increase of system uncertainty and insufficient flexibility, which hinders the absorption of clean energy. Based on the implementation of the existing power market rules in Jilin Province, this paper puts forward the top-level design ideas and construction paths and steps of the power market, which have high applicability; and improves the market flexibility by improving the trading mode from the direct transaction in the province and the outgoing transaction.

1. Introduction

Since the publication of Zhongfa No .9, Jilin Province has actively implemented the spirit and requirements of the relevant documents on the reform of the national electric power system in the light of its own reality and development needs, and has carried forward in an orderly manner the reform of the transmission and distribution electricity price, the establishment of power trading institutions, the construction of the electric power market, the liberalization of the power distribution plan, the reform of the power sale side, and the local absorption of new energy. The province has actively expanded the scale of direct purchase of electricity by users, continuously expanded the market outside the province, expanded the scale of external power transmission transactions, gradually expanded the proportion of market-oriented transactions, and reduced the planned electricity volume year by year.

At the same time, the power market in Jilin Province has some problems, such as the contradiction of peak-shaving and imperfect market system. First of all, Jilin Province power supply load base is relatively small, the province's power growth is limited, Jilin Province straightening unit heating units account for more than 90% of thermal power units, flexible regulation of insufficient power supply, winter heating period, according to meet the minimum heating start-up mode to arrange the operation of thermal power units, power grid peak-shaving capacity is seriously inadequate; secondly, Jilin Province power market mainly to medium-and long-term transactions, has not yet formed a complete power market system[1, 2].

2. Overview of the Electricity Market in Jilin Province

At present, Jilin Province to carry out long-term power transactions, auxiliary services transactions and cross-provincial cross-regional transactions, no spot transactions.The medium and long term market of electric power is aimed at ensuring the continuous stability of market supply and demand, locking in income, avoiding the risk of price fluctuation, and the spot market is aimed at the efficient allocation of resources to ensure the balance of power supply and demand. Jilin

electric power market is based on medium-and long-term trading, promoting the development of medium-and long-term trading with power curve, taking into account the factors of power grid security, power supply structure and peak-shaving ability as a whole, exploring the feasibility of realizing the centralized spot market model, and realizing the seamless connection and coordinated development of the medium-and long-term market and the spot market.

2.1. Power Market Structure

Jilin electric power market is divided into electric power wholesale market and electric power retail market, as shown in figure 1. The electric power wholesale market transaction refers to the general name of the market transaction activities directly carried out by the main body of the market through the electric power trading platform, and the electric power retail market transaction refers to the general name of the market transaction activities between the selling company and the agent electric power users[3].

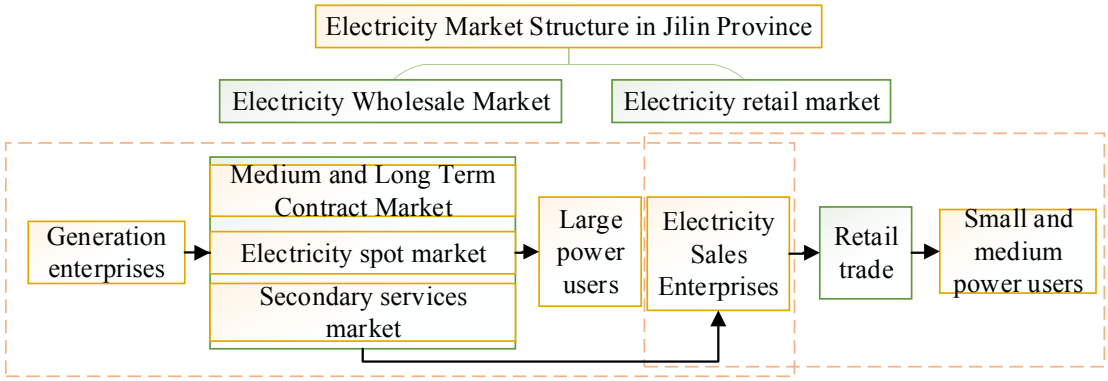

Fig 1. Electricity market structure of Jilin Province

2.2. Transactions

For the first three quarters of 2020, the electricity consumption of the whole society in Jilin Province is 58.148 billion kilowatt-hours, Up 2.58% year on year, the growth rate was 0.64 percentage points lower than the same period last year. The power generation side has completed a cumulative generation of 72.66 billion kilowatt-hours, Up 5.91% year on year, among them, the annual base power of the direct adjustment unit of the provincial company is 27.426 billion kilowatt-hours, Complete the annual base electricity plan 76.87. Jilin Electric Power Trading Center organizes the power generation enterprises in the province to participate in six Lugu DC outgoing transactions, one North China transaction and one Liaoning transaction, A total of 15.38 billion kilowatt-hours of cross-provincial and cross-regional electricity; Organization of four power generation deals, Achieved 3.66 billion kilowatt-hours of electricity; Organization of nine annual direct electricity transactions, Total transaction volume of 26.849 billion kilowatt-hours; Organize wind power enterprises in the province to participate in the annual cross-regional delivery transaction, A total of 3.679 billion kilowatt-hours of clean energy delivery transactions.

3. Construction Ideas and Paths

Under the framework of the national unified power market, the new energy in Jilin Province will realize the wide-scale optimal allocation of resources mainly through the way of participating in the power market, and the peak-shaving frequency modulation problem caused by the new energy volatility will be solved by flexible short-term trading[4],and gradually transition to a complete market system, including the medium and long term market and the spot market, as shown in Figure 2.

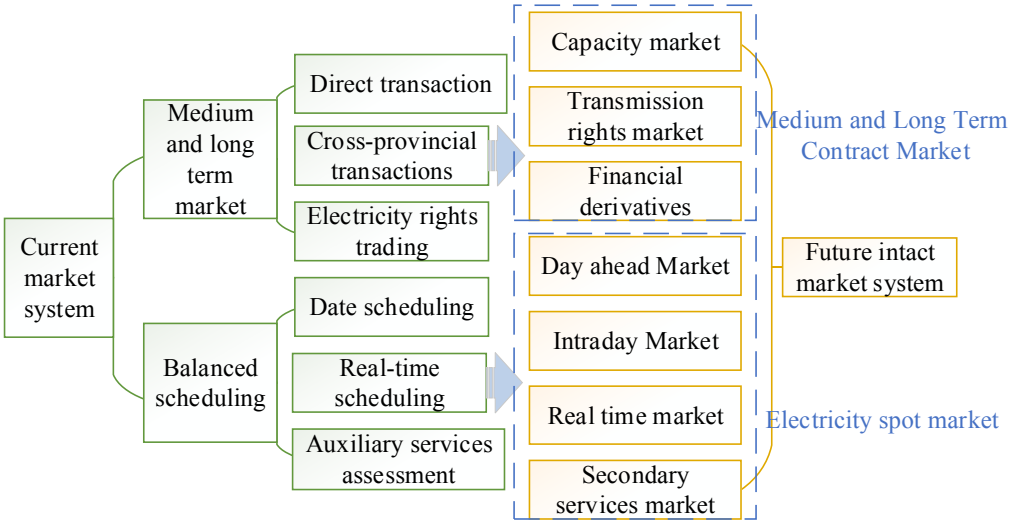

Fig 2. Power market system

Recent measures:establish a variety of medium and long-term inter-provincial trading mechanism to provide conditions for new energy cross-regional cross-provincial delivery; improve inter-provincial auxiliary service compensation and trading mechanism to promote all kinds of thermal power units for new energy peak-shaving; Implement new energy increment cross-regional cross-provincial spot market transaction, make full use of channel space and peak-shaving resources.

Building on existing inter-provincial transmission channels, inter-provincial power generation rights trading, new energy and self-owned power plant power generation rights trading, inter-provincial new energy direct trading, inter-provincial new energy outgoing trading, gradually liberalize cross-regional cross-provincial power generation plan, guide new energy to give full play to price advantages, through market competition to achieve priority outgoing[5].At the same time, establish and improve the medium and long term peak-shaving replacement trading, low energy and pumping electricity trading, emergency support trading and other mechanisms to mobilize thermal power and pumped storage power stations for new energy peak-shaving enthusiasm, to ensure that the power grid peak-shaving resources are sufficient. Construction of renewable energy increment cross-regional cross-provincial delivery spot market, flexible absorption of abandoned wind and optoelectronics.

Medium and long-term measures:gradually transition to the "medium and long-term market + spot market" model of the national unified power market system, through market competition to promote new energy generation prediction accuracy, through new energy and thermal power in real-time market bidding to achieve power balance, using the advantages of low marginal cost of new energy, through market competition to achieve new energy priority[6].

4. Market Mechanisms for Promoting Clean Energy Consumption

4.1. Direct Electricity Transactions in the Province

At present, the mode of direct electricity transaction in the province is basically carried out directly by thermal power enterprises and power users, and the mode of new energy participating in direct transaction is indirect participation[7].There is a need to introduce direct trading between new energy and electricity users. Among them, direct trading between new energy and electricity users is divided into bilateral negotiation, multilateral trading, listing and centralized bidding[8].

4.2. Electricity Outgoing Transactions

The economy of long-distance transmission of new energy alone is poor and fluctuates frequently and irregularly, which is not conducive to the safe and stable operation of power grid. Therefore, considering the rich new energy resources, the general coal resources are also very rich.

If wind power, photovoltaic and thermal power are bundled and sent out, and the external power is adjusted, the line power fluctuation can be reduced, which is beneficial to the safety and stability of the power grid and the transmission cost. According to the relevant literature and operation experience, generally speaking, the system stability is better when the proportion of new energy transmission is 30, and the stability level of the system may be affected beyond this proportion. It is suggested that the new energy and thermal power should be bundled out according to this proportion. At the same time, because the price of new energy is low after obtaining subsidy, the willingness of users to buy new energy is stronger.

Jilin Province is rich in wind and solar energy resources, but the power load level is low, the system scale is small, and the new energy cannot be digested on the spot. In order to fully tap the potential of existing medium- and long-term trading, priority should be given to cross-regional, short-term and temporary trading of new energy based on market bidding or bilateral consultation, so as to guide new energy sources in our province to reach outgoing transactions during the period of power surplus and low power consumption. On the basis of government subsidies to reduce the cost of new energy generation, all types of power supply are fairly competitive, and new energy has certain price advantages, which can promote the large-scale development of new energy and ensure the absorption and utilization of new energy.

5. Market Co-ordination Mechanism

5.1. Coordination Mechanism for Inter-provincial Transactions

Interprovincial electricity energy trading includes inter-provincial electricity medium-and long-term trading and inter-provincial spot electricity energy trading. Medium and long-term transactions, provincial transactions earlier than provincial transactions. On the basis of pre-balancing of the spot electric energy market in the province, the spot electric energy trade and the spot trade in the province are organized[9].The volume and price of the inter-provincial transactions are the boundary of the inter-provincial transactions, on which the intra-provincial transactions are carried out.

In the early stage of power market construction between provinces and provinces, provincial power companies, as inter-provincial traders who represent users in the province to participate in the inter-provincial power market transactions, play a vital role in promoting the optimal allocation of power resources across provinces and regions. At the same time, the provincial power trading center organizes the operation of the power market in the province, makes full use of the power resources in the province, provides backup for the clearing of electric energy between provinces, and ensures the balance of supply and demand of the provincial power grid[10].Combined with the actual situation of power trading between provinces and provinces and the future development direction of the power market between provinces and provinces, the operation mode of the two-level power market is put forward. The operating framework of the two-level power market is shown in figure 3.

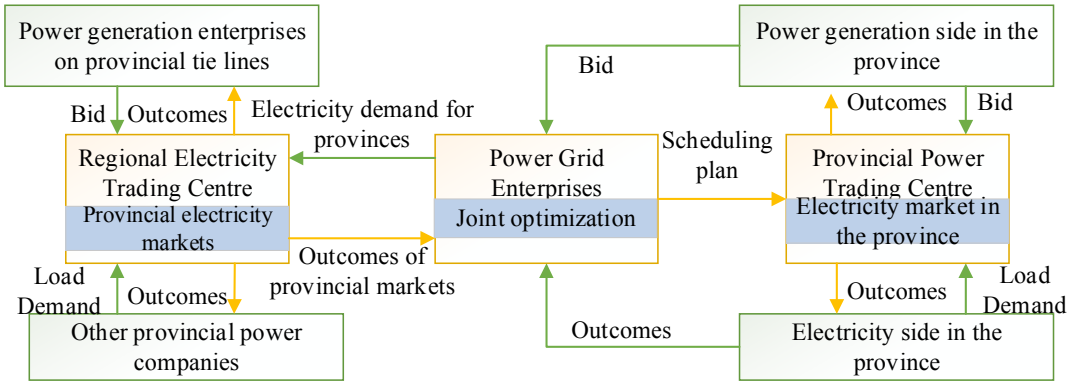

Fig 3. Operational framework of the two-tier electricity market

5.2. Medium and Long Term Linkage Mechanism for Spot Trading

Co-ordinate and coordinate medium-and long-term electric power transactions with the spot market, medium-and long-term transactions can be signed in one or more forms, such as physical contracts, price contracts, etc. The electricity contract formed by medium-and long-term bilateral transaction can be decomposed into time-sharing curve by both parties. The decomposition curve of medium and long term transaction physical contract should be carried out on the premise of satisfying the security constraints of power grid. For priority power generation, priority electricity purchase, according to the progress of market construction into medium-and long-term transactions. Promote the formation of medium-and long-term trading prices and spot market prices scientific and reasonable interaction mechanism[11].

The results of medium and long term trading of provincial electric power are carried out as the boundary condition of spot electric energy trading in the province, and the results of medium and long term trading of electric power in the province are only used as the basis for settlement, which does not affect the development of centralized bidding for total electricity in the spot market in the province.

5.3. Coordinated Development of Carbon and Electricity Markets

According to the common attributes and differences between the power market and the carbon emission right market, as shown in figure 4, the two markets will have a conduction effect on the price through the behavior of the participants in the common market. At the same time, there are many market participants, each has independent goals and decision-making ability.As two market participants, power generation enterprises trade with e-commerce in bilateral negotiation markets; declare electricity prices and electricity according to their own objectives in centralized bidding markets; participate in auctions in the primary carbon market according to actual carbon demand after obtaining carbon quotas; trade with other power generation enterprises in the secondary carbon market; and finally adjust the next quotation strategy according to the profits obtained. As a participant in the power market, e-commerce deals with power generation enterprises in the power market.

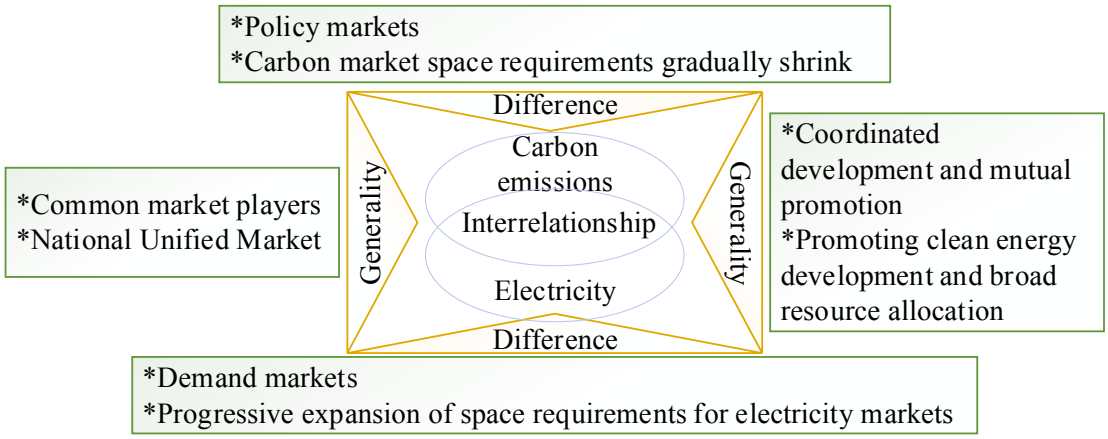

Fig 4. Interaction of carbon emission rights markets with electricity markets

At the macro level, energy saving and emission reduction constraints are reflected in the regulation of total carbon emissions, industry carbon emission baseline and renewable energy quota ratio, thus affecting the regional power balance. At the micro level, the initial carbon emission quota and renewable energy quota will affect the generating capacity of the unit within a specified time, and there will be more restrictions and constraints in the face of power trading production decisions. Using the law of market economy, reducing the actual value of electric power and establishing a low-carbon and clean power market are the key to realize the coordinated development of power market, carbon emission right market and green power certificate market.

6. Concluding Remarks

Based on the general situation of the electric power market in Jilin Province and the actual operation characteristics of the provincial power grid, this paper puts forward the power market mechanism suitable for clean energy consumption from the top level of the power market. It is of great significance in theoretical research and practical application.The market mechanism promotes the safe operation of power system, the orderly supply of electricity and the consumption of clean energy, and realizes the optimization of energy resources in a wider range.

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