



Medium and long term market model of typical foreign electric power and its enlightenment

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Abstract. In the process of promoting the construction of China's medium and long term electric power market, the relevant theoretical achievements and practical experience of foreign typical countries have high reference value. This paper first analyzes the concept and functional positioning of the power medium and long-term market, and then analyzes the power medium and long-term market mechanism of typical countries such as the United States, Northern Europe and the United Kingdom. Finally, based on the practical experience of the above typical power medium and long-term market, the paper puts forward enlightenment and suggestions for the power medium and long-term market in China.

Keywords: International power market; Power medium and long-term market; Market mechanism; Experience and inspiration

1 Introduction

In 2015, the Central Committee of the Communist Party of China and The State Council issued "Several Opinions on Further Deepening the Reform of the Electric Power System", marking the official launch of a new round of China's electric power system reform. The document and its supporting documents have a programmatic design for promoting the construction of the power market in line with the national conditions, and it is clear that it is necessary to gradually establish a complete power market with medium - and long-term transactions to avoid risks and spot market to discover prices. At present, China's power medium and long-term market has been basically established, and 14 spot market pilot construction areas in the country have gradually carried out settlement trial operation. In this context, the key contradictions in the delivery of medium and long-term contracts in the spot market, the determination of medium and long-term trading curves, the design of medium and long-term trading mechanisms, the preferential power generation and other government pricing

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under the dual-track model or the decomposition of government-led contracts have become increasingly prominent[1-4].

With the release of the "Guiding Opinions on Accelerating the Construction of a National Unified Electricity Market System", China's electricity market reform has entered the deep water zone, facing many complex problems and challenges, which is related to the unreasonable and inaccurate positioning of the relationship between the medium and long-term market and the spot market in China. Therefore, to find the medium and long term market function positioning, straighten out its relationship with the spot market, is to promote the deepening of the power market reform.

2 Electric power medium and long term market concept and functional positioning

The electricity market is generally divided on a time scale into spot markets, including day ahead, day ahead and real-time, and contracts derived from spot, traded ahead and delivered in the future. The latter is generally referred to as the medium and long-term market in China, which currently includes at least medium and long-term physical contracts for physical delivery and financial settlement contracts for difference. In foreign countries, the definition of finance is generally followed, and the contracts applicable to the power market but not belonging to the spot market such as forward, futures, swaps, options and other contracts are uniformly defined as power derivatives, and the corresponding market is called the power derivatives market or the power forward market.

As the main part of the electricity marketization transaction, the power medium and long term market occupies an important position in the power market of our country. On the one hand, it reflects the expectation of the overall market for the future supply and demand situation, plays the role of the anchor point of the spot market price, and can effectively guide the market subject to offer prices in an orderly manner. On the other hand, medium - and long-term market transactions have certain positive significance for market entities to reduce risks and lock in returns. In the medium and long term, the market will form a long-term stable price signal to guide power investment and power supply balance.

3 International typical national electricity medium-and long-term market

3.1 United States PJM electricity market

American PJM power market is divided into main market and auxiliary market, the main market includes: OTC market, bilateral market, negotiation market[5-6]. The auxiliary market includes: capacity market and financial market. PJM's medium - and long-term power trading contracts are CFDS, which do not require physical execution and only have differential cash settlement functions. The PJM Power Financial Mar-

ket has introduced financial derivatives to meet the needs of members to avoid price risk. Currently, there are four PJM power market futures contracts traded on the New York Mercantile Exchange (COMEX). First, the western hub peak load PJM monthly contract based on real-time node marginal price; The second is the 50MW peak load PJM monthly contract of the western hub based on real-time node marginal price; The third is the 5MW peak load PJM monthly contract of AEP Dayton Hub based on real-time node marginal price; The fourth is a 5MW peak-load PJM monthly contract for AEP Northern Illinois Hub based on real-time node marginal price. In addition, special financial derivatives such as financial transmission rights and virtual bidding are introduced to provide corresponding tools for market players to avoid price risk and blocking risk in the spot market of electricity. Its market system is shown in Figure 1.



Fig. 1. PJM electricity market framework in the United States

In the power market with day-ahead market and real-time market represented by PJM in the United States, it is generally not required that the forward contract must be physically delivered, that is to say, the financial delivery of the forward contract is allowed: according to the electricity price delivery in the real-time market. For example, a power plant and a user signed a contract to supply 100MW in a certain hour, if the actual output of the power plant is only 80MW, 80MW electrical physical delivery, and another 20MW financial delivery. As shown in Table 1.

Table 1. PJM power medium and long term market trading mechanism

breed	Trading venue	Subject of transaction	Delivery time
Electric power futures	NYMEX、ICE	Base-load capacity, peak-load capacity	Monthly, quarterly, annual
Power option	NYMEX、ICE	Power futures corresponding to base charge and peak charge	Monthly, quarterly, annual
Financial transmission right	ISO	Power futures corresponding to base charge and peak charge	1 month, 3 months, 1 year, 3 years
Virtual bidding	ISO	Power futures corresponding to base charge and peak charge	1 day
Weather futures	ICE	HDD or CDD index	Monthly and annual

3.2 Nordic electricity market

The medium and long term market of the Nordic power market includes both on-exchange and off-exchange trading, on-exchange trading is mainly organized by Nasdaq, and trading varieties include forward contracts, futures, options and CFDS. In the medium and long term, the off-site contract is mainly carried out in the form of bilateral negotiation and signing[7-8]. Its market system is shown in Figure 2.

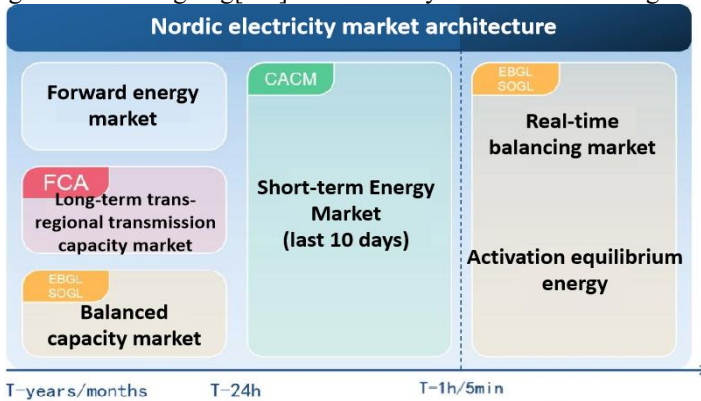


Fig. 2. Nordic electricity market architecture

In terms of trading varieties, forward contracts and futures are for the next few years of electricity energy trading, futures contracts in days, weeks, months as units, forward contracts in months, quarters, years, years as units. The settlement Price of the forward contract is determined by bilateral negotiations, and the settlement price of the futures contract is generally the System Price of the Nordic electricity market.

In terms of transaction execution, long-term contracts such as forward contracts, futures, bilateral contracts can be freely selected for physical execution or financial settlement. As shown in Table 2.

Table 2. Nordic power medium - and long-term trading varieties

Trading venue	Variety category
EEX	Electric power futures
	Power option
	Price zone contracts for Difference
OTC market	Forward contract trading
Over-the-counter bilateral market	Personalized contract trading

3.3 Japan electricity market

In September 2019, the Tokyo commodity exchange (TOCOM) opened a power "futures market" for the pilot board, with plans to spend three years nurturing the market

before officially launching it. At present, the current electricity financial derivatives in Japan can be generally summarized as electricity futures and forward contracts. Among them, power futures are organized by the Tokyo Commodity Exchange (TOCOM) on the floor or off-floor trading. Forward contracts are organized on the Japan Electricity Exchange (JPEX).[9-10]

In forward trading, trading members, etc. are required to transfer electricity and receive money during the transfer period by means of the trading method prescribed by the exchange on a one-year, monthly or weekly basis according to the regulations of the exchange. As shown in Table 3.

Table 3. Japanese electricity futures market trading mechanism

Breed	Trading venue	Subject of transaction	Delivery time	Delivery mode
Electric power futures	Inside, TOCOM	Base-load energy Peak load capacity	monthly	Cash delivery
Forward contract	Inside, JEPX	Base-load energy	Weekly, monthly, annual	Physical delivery

3.4 Electricity market in Germany

The German electricity market uses standardised "block" products. Deviation is adjusted by self-owned power plant, self-supplied power supply, controlled load control or outsourcing[11-12]. Its market system is shown in Figure 3.



Fig. 3. German electricity market framework

Over-the-counter transactions are generally signed bilateral long-term agreements, accounting for 75% of the total electricity transactions, and the price of the spot market is referred to when signing. When there is or is expected to be a shortage of power generation in the spot market, there will be a strong demand for consumer hedging, which will also increase prices in the long-term market.

The spot market is divided into day auction, day auction and day trading.

The equilibrium group is a virtual market base unit in which power generation and electricity consumption must be in balance. When self-balancing is not achieved inside the unit, electricity must be bought or sold to maintain balance. When there is a deviation between prediction and actual, the balancing group must bear the balancing cost of the system.

4 Comparison and experience of medium and long term mechanism of international electricity market

4.1 Comparison of medium - and long-term mechanisms of international electricity market

From the perspective of foreign medium and long-term market, the countries that carry out the over-the-counter bilateral medium and long-term market are the United States, the United Kingdom, and Germany, and the transaction targets include the agreed curve and the agreed base load electricity; The countries that carry out the centralized medium and long-term market on the floor are Japan, the United States PJM, the United Kingdom, and Northern Europe, and the trading targets include hourly electricity, baseload electricity, and peak-load electricity. This is shown in Figure 4.

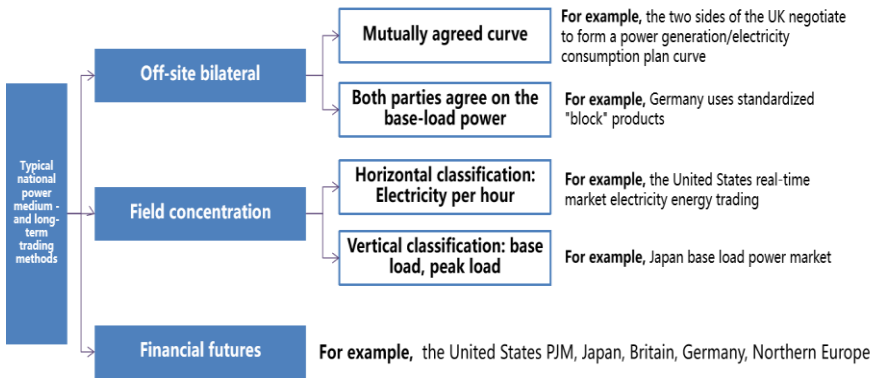


Fig. 4. Typical national power medium - and long-term trading methods

From the perspective of foreign construction practice, the functions that the power market can play in the medium and long term can be summarized as: risk management, Price discovery, Financing means, Government regulation.

4.2 Experience reference

1) The power medium and long-term market generally starts with bilateral over-the-counter trading, and gradually carries out on-exchange trading after adjusting and improving the market for a long time. Under the premise of incomplete relevant mechanisms, it may be difficult to achieve effective risk management functions by too

aggressively promoting the internalization of the power medium and long-term trading market. Therefore, China's power medium - and long-term time-sharing trading should be mainly carried out in bilateral form at the beginning.

2) The design of power trading products should be as simple and standardized as possible, on the one hand, it is conducive to the construction of a unified power market, on the other hand, it is conducive to the medium and long-term connection with the spot. Therefore, we can learn from the Nordic energy block trading model, and design and develop flexible time-standard energy block trading that ADAPTS to our country.

3) China's electricity trading institutions should provide standardized contract templates, electronic trading systems and clearing support for market participants; In the medium and long term, centralized, many-to-many exchange trading can be carried out through the integrated mode of futures and spot trading to ensure the coordinated development of the medium and long term market and the spot market. Easy process, using it to provide market making, brokerage services, the formation of effective support for market liquidity.

4) Power trading institutions can improve the medium and long-term market supervision mechanism at the same time, step by step, limited release of financial institutions that meet the entry threshold to participate in the trading process, use them to provide market making, brokerage services, and form effective support for market liquidity.

5 Conclusions

This paper summarizes the overall structure of the medium and long-term foreign market by investigating the market mode, operation, theoretical results and practical experience of the mature power market system at home and abroad. Based on the summary of the practical experience of the national level power market system design, operation rules, operation conditions and so on, this paper analyzes the reference significance and enlightenment of the foreign typical market trading mode to the power market trading in China. Based on the current power grid operation characteristics and the medium and long term power market construction in China, the applicability, influence degree and experience of different market modes are analyzed. On this basis, the future construction objectives and construction modes of China's medium and long term power market are defined.

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