Analysis of Unbalanced Settlement and Development Proposals of Electric Spot Market Under the Integration of Planned Economy and Market Economy

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Abstract: Construction of Electric Spot Market has recently begun in China. The coexistence of planned economy and market economy in the electricity market may not change in a short time. Determining the unbalanced funds caused by the settlement of planned economy in the spot market is essential, this paper proposes and analyzes the advantages and disadvantages of three settlement methods in the spot market under the integration of planned economy and market economy. This paper emphasizes on the analysis of unbalanced fund caused by the planned economy in the spot market settlement. The different results of one-time and twice settlement of planned economy on unbalanced settlement in the spot market are discussed, and suggestions to the development of Electric Spot Market in China are proposed.

1. Introduction
In 2019, the first batch of 8 pilot projects of the spot market in China had carried out settlement trial operation. In order to guarantee the power consumption of non-bargaining power users and the priority of clean energy generation, the domestic market has established a system of priority power purchase and generation. At the same time, with the gradual liberalization of the scale of market-oriented transactions, the balance of electric power and electricity will transition smoothly from the planned-based approach to the market-based approach. Therefore, in the process of power market reform, the planned power which is arranged by power grid companies in a planned way and settled according to government pricing will coexist with the market power formed through market-oriented transactions for a long time in the future. How to coordinate the planning electricity and market electricity in the organization, transaction, settlement and other processes of the electricity spot market, and how to form the unbalanced capital in settlement of the spot market of the planning electricity of the power grid company, are the essential issues in the development of the electricity spot market in China.

The electricity spot market in China is in its infancy. Moreover, the coexistence of planned economy and market economy will exist for a long time. Reference [1-2] introduced the current situation of China's power market reform, designed the market construction path, and discussed the relevant critical technical issues. Reference [3] analyzed the role of the contract of difference(CFD) and proposed suggestions for the construction of CFD mechanisms in China's power market. Reference [4-5] studied the balance account mechanism of China's regional power market and put forward the design idea of the balance account. Reference [6-9] studied the management of grid congestion and congestion surplus, put forward suggestions on congestion management in China's
power market, construction of transmission right market, calculation and allocation of unbalanced costs in the spot market. However, at this stage, there are few studies on the unbalanced funds generated by the integration of the planned economy and market economy.

The rest of the paper is organized as fellows: Section 2 analyzes several modes of coexistence of planned economy and market economy in spot market based on node electricity price. Section 3 analyzes the components of unbalanced capital generated by the settlement of planned electricity under the decoupling mode of plan economy and market economy. Section 4 constructs an example to analyze and verify that the way of one-time settlement of priority generation in the spot market will generate unbalanced capital. Section 5 puts forward some suggestions for the development of China's electric spot market.

2. Analysis of Several Modes of Planned and Market Integration

Generally speaking, there are three integrating modes of planned economy and market economy: planned economy and market economy entirely decoupling, planned economy and market economy not decoupling, and planned economy and market economy partially decoupling.

2.1. Planned economy and market economy completely decoupling

The decoupling of planned electricity and market electricity means that in the transaction and settlement process, the electricity consumption of non-market users corresponds to the priority electricity consumption, and the electricity consumption of market users corresponds to the electricity consumption of the market side. Afterward, the priority electricity quantity that should be settled by the market-oriented power plant is calculated based on the actual power consumption of non-market users. The basis for settlement is the ratio of the priority power of the market-oriented power plants to the total priority power of the market-based power plants set in advance.

Advantages: (1) This mode adjusts the post-priority power of market-oriented power plants in equal proportions so that the purchase and sales price spread of the power grid crop is not affected by market development. (2) Even if the demand forecast of non-market users is not accurate, it does not affect the income of the power grid crop. (3) There is no need to set up another balanced account for the grid crop to handle the unbalanced funds for the purchase and sale of electricity.

Disadvantages: (1) This mode requires that the generation capacity of market-oriented units in each period is not less than the power consumption of market-oriented users. When the market scale gradually expands, users gradually enter the market, and the degree of market liberalization on the power generation side is limited, the operating conditions of this model will be challenging to meet. Therefore, this mode is limited by the market size and is usually suitable for the early reform period when the proportion of market-oriented power is relatively small. (2) When the market-oriented power plants or market users have a significant deviation in electricity, the units' revenue needs to be recalculated. The market fault-tolerant mechanism is inadequate.

2.2. Planned economy and market economy ultimately coupling

Coupling of planned electricity and market electricity refers to the interactive flow of power between the plan and the market during the transaction and settlement process. In each period, the non-market user's electricity consumption does not correspond to the priority electricity of the market-oriented power plant.

Grid companies, as electricity sales companies, sign electricity purchase contracts with non-market units in the wholesale market based on government-approved on-grid electricity prices, and in the retail market, and sign electricity sales contract with non-market users based on the government-approved catalog electricity price (after deducting the difference between purchase and sale price). The contract signed by the power grid company as a power sales company is an individual contract with "indefinite pricing". The priority contract amount of the priority power plants in the wholesale market is the actual on-grid electricity quantity, and the contract amount of the non-market users in the retail market is the actual power consumption. When the on-grid power of the priority plant is less
than the power consumption of non-market users, the power grid crop needs to purchase market electricity at the market price to meet the power demand of non-market users. When the on-grid power of the priority plant is higher than the power consumption of non-market users, the power grid needs to purchase the planned electricity meets the electricity demand of some market-oriented users. In this settlement process, the grid company needs to bear the corresponding unbalanced settlement funds.

Advantages: (1) There is no market size limitation. (2) When there is a significant deviation in market user measurement, it does not affect the linkage between market electricity and planned electricity, and there is no need to recalculate the settlement of the entire market as in the decoupling mode. The settlement is relatively simple. (3) The settlement consistency is right. There is no need for additional processing for settlement of base contracts, which is consistent with the settlement method of market contract settlement.

Disadvantages: (1) It is necessary to set up a balanced account of the grid company to handle the problem of unbalanced funds. (2) The government allocates priority electricity to non-market users based on their forecast of demand for non-market users. The accuracy of user forecasts directly affects the amount of priority electricity, and also directly affects the amount of balance account funds of grid companies. Therefore, the accuracy of non-market user demand forecasting is momentous.

2.3. Planned economy and market economy partly coupling
Partial decoupling of planned electricity and market electricity means that planned economy and market economy are decoupled when the generated energy of market-oriented units is more significant than that of market-oriented users, and planned economy and market economy is coupled when the generated energy of market-oriented units is less than that of market-oriented users.

Advantages: (1) This mode combines the advantages of the previous two modes as a transition mode from plan economy and market economy decoupling to coupling. (2) Compared with the plan and market decoupling mode, it can reduce unbalanced account funds Amount.

Disadvantages: (1) The settlement method is relatively complicated. (2) The error back-off mechanism is also more complicated than the planned economy and market economy decoupling mode.

3. Analysis of unbalanced funds under decoupling model in the electricity spot market
This article only analyzes the unbalanced funds caused by the planned economy and market economy integration mode in the electricity spot market based on node prices. The unbalanced capital caused by the congestion surplus of the spot market, the subsidy cost, and assessment cost to ensure the orderly operation of the market and the system in the spot market will not be analyzed.

In the early stage of the spot market, the proportion of market-oriented user's electricity is relatively small, and it is easy to meet the conditions of the planned economy and market economy decoupling mode. Moreover, under the decoupling mode, the income of the grid crop is not affected by the prediction accuracy of non-market users' electricity demand, and it is not necessary to set up a balanced account to deal with the purchase and sale imbalance funds. This article focuses on the analysis of the unbalanced capital composition of the electricity spot market under the decoupling mode. Overall, there are three parts of unbalanced funds under the decoupling mode of the planned power represented by the grid company. Imbalanced funds include unbalanced funds generated by planned electricity purchase and sales structure changes, and the unbalanced funds generated by planned electricity congestion[10], and imbalanced funds caused by the settlement of priority generation in the spot market.

3.1. Analysis of unbalanced funds generated by planned power purchase and sales structure change
With the development of the power market, the industrial and commercial users with the high price and low-cost units will enter the market, which will break the balance of power purchase and sale under the planned economy. The power grid purchases and sales planned power might not be able to
recover the corresponding transmission and distribution charges, resulting in the generation of unbalanced funds.

The calculation of this part of unbalanced funds is shown in equation (1).

\[ R_i = \sum_i P_{\text{catalog},i} \cdot Q_{\text{plan},i} \cdot P_{\text{spread}} - \sum_j P_{\text{approved},j} \cdot Q_{\text{plan},j} \cdot P_{\text{spread}} \]  

In Eq(1), \( R_i \) is the unbalanced funds generated by the planned electricity purchase and sales structure change. \( P_{\text{catalog},i} \) is the catalog electricity price of the non-market user \( i \). \( Q_{\text{plan},j} \) is the non-market user's actual electricity consumption. \( P_{\text{approved},j} \) is the approved on-grid electricity price for the unit \( j \) with priority generation capacity. \( Q_{\text{plan},j} \) is the settled priority generating capacity of the unit \( j \). \( P_{\text{spread}} \) is the equivalent "transmission and distribution price" paid by non-market users.

If \( R_i \) is positive, it means that the grid company's agent electricity can recover the corresponding transmission and distribution income, and there is a surplus. If \( R_i \) is negative, it means that the grid company's agent electricity cannot recover the corresponding transmission and distribution income.

### 3.2. Analysis of unbalanced funds generated by planned electricity congestion

In the spot market, the planned electricity needs to be delivered from the node where the unit is located to the node where the non-market users are located, which may cause the corresponding congestion costs. However, the planned electricity is settled by the fixed price, and the corresponding congestion costs are not paid so that the unbalanced funds may be generated.

The unbalanced funds generated by the planned electricity congestion are the difference between the congestion cost and the surplus returned to the planned electricity congestion. Before the establishment of a transmission right market, the Guangdong Electric Power Spot Market shared the total congestion surplus of the system according to the proportion of users' electricity consumption.

Without knowing the nodes of planned users and market users, it is impossible to accurately distinguish the impact of planned users and market users on system congestion. If planned users and market users are evenly distributed in each node, the congestion cost collected from the non-market users will be shared with the congestion cost returned to the planned electricity according to the proportion of electricity consumption. Moreover, the surplus is equal to zero.

When we know the nodes of planned users and market users, we can accurately calculate the congestion cost of planned electricity from the node of the unit to the node of non-market users.

The planned congestion cost includes the day ahead and real-time planned congestion cost. In the following formula descriptions, the measurement period is 1 hour, and the period marks are omitted in the following formulas to simplify the formula.

#### 3.2.1. Planned electricity congestion charge in the day-ahead market

In the day-ahead spot market, the planned electricity needs to be delivered from the node where the planned unit is located to the node where the non-market users are located. In order to simplify the calculation, the non-market users can adopt the unified settlement price of non-market users for settlement. Therefore, the congestion cost is calculated according to the price difference between the non-market users' unified settlement price and the unit node price, as shown in formula (2).

\[ R_{2,\text{DA}} = \sum_j \left[ Q_{\text{DAC},j} \cdot \left( P_{\text{NC, DA}} \cdot P_{\text{DA},j} \right) \right] \]  

\[ Q_{\text{DAC},j} = (Q_{\text{DAN}} - Q_{\text{DAM}}) \times (Q_{\text{TYG}},j / Q_{\text{TYG}}) \]  

In Eq(2-3), \( R_{2,\text{DA}} \) is the planned electricity congestion charge of the day-ahead market, \( Q_{\text{DAC},j} \) is the day-ahead planned electricity quantity of the planned generation \( j \), \( P_{\text{NC, DA}} \) is the day-ahead unified settlement point price for non-market users, \( P_{\text{DA},j} \) is the day-ahead node price of planned
generation $j$, $Q_{QAN}$ is the total bidding power of the market-oriented unit in the day-ahead market, $Q_{QAM}$ is the total declared electricity of the market users in the day-ahead market, $Q_{QGP,j}$ is the planned electricity quantity of the planned unit and $Q_{QTYGP}$ is the total planned electricity quantity of the market-oriented unit.

### 3.2.2. Planned electricity congestion charge in the real-time market

In the real-time market, it is necessary to transport the deviation between the real-time and the day-ahead planned electricity of the unit to non-market users. The calculation method of the real-time market planned electricity congestion cost is shown in equation (4).

\[
R_{2,RT} = \sum_j \left[ Q_{RTP,j} * \left( P_{NC,RT} - P_{RT,j} \right) \right] \tag{4}
\]

\[
Q_{RTP,j} = (Q_{RTN} - Q_{RTM}) \times \left( \frac{Q_{QGP,j}}{Q_{QTYGP}} \right) \tag{5}
\]

In Eq(4-5), $R_{2,RT}$ is the planned electricity congestion charge of the real-time market, $Q_{RTP,j}$ is the real-time planned electricity quantity of the planned generation $j$, $P_{NC,RT}$ is the real-time unified settlement point price for non-market users, $P_{RT,j}$ is the real-time node price of planned generation $j$, $Q_{RTN}$ is the total bidding power of the market-oriented unit in the real-time market, $Q_{RTM}$ is the total declared electricity of the market users in the real-time market.

When the specific node distribution of the plan and market users are known, the load-weighted average comprehensive electricity price of the planned user nodes can be directly calculated. The calculation method is shown in formula (6).

\[
P_{NC} = \frac{\sum_i (Q_{NC,i} \times P_{NC,i})}{\sum_i Q_{NC,i}} \tag{6}
\]

In Eq(6), $P_{NC}$ is the non-market users' unified settlement price. $P_{NC,i}$ is the node price of the non-market user $i$. $Q_{NC,i}$ is the electricity consumption of the non-market user $i$.

If the measurement of non-market users has not reached the measurement level of each period, the non-market user load of nodes can be calculated by deducting the market user load of nodes from the net outflow load of nodes.

The calculation method for the congestion surplus of planned electricity is as follows. The first step is to calculate the unified settlement price of system load in the day-ahead market and the real-time market, respectively, as shown in equations (7) and (8).

\[
P_{LU,DA} = \frac{\sum_k (Q_{k,DA} \times P_{k,DA})}{\sum_k Q_{k,DA}} \tag{7}
\]

\[
P_{LU,RT} = \frac{\sum_k (Q_{k,RT} \times P_{k,RT})}{\sum_k Q_{k,RT}} \tag{8}
\]

In Eq(7-8), $P_{LU,DA}$ is the day-ahead system load settlement price, $P_{k,DA}$ is the day-ahead node price of the load $k$, $Q_{k,DA}$ is the day-ahead electricity quantity of the load $k$, $P_{LU,RT}$ is the real-time system load settlement price, $P_{k,RT}$ is the real-time node price of the load $k$, $Q_{k,RT}$ is the real-time electricity quantity of the load $k$.

The system congestion surplus of day-ahead and real-time is shown in equations (9) and (10).
In Eq(9-10), \( R_{SCS,DA} \) and \( R_{SCS,RT} \) are the system congestion surplus in the day-ahead and real-time market, \( P_{j,DA} \) and \( P_{j,RT} \) are the node price of the unit \( j \) in the day-ahead and real-time respectively, \( Q_{j,DA} \) and \( Q_{j,RT} \) are the winning bid of the unit \( j \) in the day-ahead and real-time market.

The system congestion surplus shall be apportioned according to the proportion of planned user electricity. The calculation of the congestion surplus allocated by the planned electricity in the day-ahead and the real market is shown in equation (11) and (12).

\[
R_{PCS,DA} = R_{SCS,DA} \times \frac{Q_{NC,DA}}{\sum_{k} Q_{k,DA}}
\]

(11)

\[
R_{PCS,RT} = R_{SCS,RT} \times \frac{Q_{NC,RT}}{\sum_{k} Q_{k,RT}}
\]

(12)

In Eq(11-12), \( R_{PCS,DA} \) and \( R_{PCS,RT} \) are the congestion surplus allocated for the day-ahead and real-time planned power, \( Q_{NC,DA} \) and \( Q_{NC,RT} \) are the day-ahead and real-time planned users' electricity consumption, which is obtained by the system load pre-measurement deducting the total power declared by the market users.

The calculation of the congestion surplus allocated by the planned electricity in the spot market is shown in equation (15)

\[
R_{PCS,DA} = R_{PCS,DA} + R_{PCS,RT}
\]

(13)

Where \( R_2 \) is the unbalanced fund generated by the planned electricity congestion.

### 3.3. An analysis of the unbalanced capital generated by the settlement method of priority generation in the spot market

There are two methods of settlement of priority generation in the spot market: one-time settlement and twice settlement. One-time settlement refers to the priority generation at the generation side only settles once in the day ahead market based on the actual non-market users' electricity consumption. The twice settlement refers to the settlement of the priority generation on the generation side in two times. In the day-ahead market, the electricity trading center makes the first settlement of the estimated priority generation of market-oriented units. After the operation day, the electricity trading center makes the second settlement of the electricity deviation, which is the difference between the actual power consumption of the non-market user and the priority generation that settled in the day-ahead market.

In the two settlement modes, the settlement methods and results on the user side are the same. In the day-ahead market, the market users settle the difference between the declared electricity quantity and the long-term contract quantity using the day ahead node electricity price. In the real-time market, the market users settle the difference between the actual electricity consumption and the day-ahead declared electricity quantity using the day-ahead node electricity price. Moreover, non-market users settle the actual electricity consumption using the catalog electricity price.
In the twice settlement, the priority electricity (including external power) of the day-ahead settlement on the generation side is the difference between the system load forecast and the day-ahead declared electricity of the market users. The priority electricity of the real-time settlement is the difference between the actual power consumption of the non-market users and the day-ahead settlement quantity. Moreover, the priority electricity settled by the benchmark price of the on-grid unit is the actual power consumption of non-market users. The total amount of electricity settled by the day-ahead node electricity price is the difference between the day-ahead declared amount of market users and the long-term contract amount. The total amount of electricity settled by the real-time node electricity price is the difference between the actual total amount of market users and the day-ahead declared amount of market users. In the market and the planned electricity, the settlement balance with the user side can be achieved except for section 3.1 and 3.2.

Compared with the twice settlement, the difference between the actual priority electricity and the day-ahead settled priority electricity is handled differently in the one-time settlement. The one-time settlement will generate unbalanced funds in addition to section 3.1 and 3.2.

4. Example analysis

In order to explain the generation mechanism and calculation method of unbalanced funds in section 3.3, this paper constructs the following calculation example.

It is assumed that there are two units in the system, one market user and one non-market user. In order to simplify the analysis, it is assumed that no medium and long-term market integration contract has been signed.

It is assumed that there are two units A and B in the market, one market user X and one non-market user Y, and no long-term contract has been signed. The priority power generation proportion of unit A and B is 40% and 60%, respectively, and the benchmark price is 250 $/MWh. The declared load and actual power load of market user X before the day are 110MW and 100MW respectively, the power transmission and distribution fee is 150 $/MWh, the actual power load of non-market user is 100MW, and the catalog price is 500 $/MWh. The results of the day-ahead and real-time market-clearing are shown in Table 1:

| type                          | Day-ahead market | Real-time market |
|-------------------------------|------------------|------------------|
| System load forecast (MW)     | 200              | 200              |
| Unit A bid winning output (MW)| 120              | 120              |
| Unit B bid winning output (MW)| 80               | 80               |
| Market clearing price ($/MWh) | 320              | 350              |
| Market user x load (MW)       | 110              | 100              |

The user side settlement results are shown in Table 2:

| type                                         | Market user X | Non-market user Y |
|----------------------------------------------|---------------|-------------------|
| Day ahead declared deviation (MW)            | 110           | 0                 |
| Day ahead settlement deviation ($)           | 110*320=35200 | 0                 |
| Real-time power deviation (MW)               | -10           | 0                 |
| Real-time settlement deviation ($)           | -10*350=-3500 | 0                 |
| Transmission and distribution charges and others ($) | 100*150=15000 | 0                 |
| Non market user payment ($)                  | 0             | 100*500=50000     |
| Total revenue and expenditure of users ($)   | 46700         | 50000             |
| Total                                        | 96700         |                   |

The settlement results of generation side under the one-time settlement mode of priority generation are shown in Table 3:
The settlement results of generation side under the twice settlement mode of priority generation are shown in Table 4:

**Table 3.** Generation side settlement results under the one-time settlement mode of priority generation

| Type | Unit A | Unit B |
|------|--------|--------|
| Actual power consumption of non-market users (MW) | 100 | |
| Priority unit decomposition in day-ahead market (MW) | 40 | 60 |
| Income from priority electricity ($) | 40*250=10000 | 60*250=15000 |
| Day-ahead output deviation (MW) | 120-40=80 | 80-60=20 |
| Day-ahead settlement deviation ($) | 80*320=25600 | 20*320=6400 |
| Real-time output deviation (MW) | 0 | 0 |
| Real-time settlement deviation ($) | 0 | 0 |
| Total revenue and expenditure of unit ($) | 35600 | 21400 |
| Total ($) | 57000 | |

**Table 4.** Generation side settlement results under the twice settlement mode of priority generation

| Type | Unit A | Unit B |
|------|--------|--------|
| Actual power consumption of non-market users (MW) | 200-110=90 | |
| Priority unit decomposition in day-ahead market (MW) | 36 | 54 |
| Income from priority electricity in day-ahead market ($) | 36*250=9000 | 54*250=13500 |
| Day-ahead output deviation (MW) | 120-36=84 | 80-54=26 |
| Day-ahead settlement deviation ($) | 84*320=26880 | 26*320=8320 |
| Non-market user power consumption deviation between real-time and day-ahead (MW) | 100-90=10 | |
| Priority unit decomposition in real-time market (MW) | 4 | 6 |
| Income from priority electricity in real-time market ($) | 4*250=1000 | 6*250=1500 |
| Real-time output deviation (MW) | -4 | -6 |
| Real-time settlement deviation ($) | -4*350=-1400 | -6*350=-2100 |
| Total revenue and expenditure of unit ($) | 35480 | 21220 |
| Total ($) | 56700 | |

The grid charges the transmission and distribution price for market electricity and the purchase and sale price difference for non-market users. The grid settlement electricity fee is shown in Table 5:

**Table 5.** Result of grid settlement electricity fee

| Type | Market user X | Non-market user Y |
|------|-------------|-----------------|
| Transmission and distribution charges and others ($) | 100*150=15000 | 0 |
| Price difference between purchase and sale ($) | 0 | 100*(500-250)=25000 |
| Total revenue and expenditure of power grid ($) | 15000 | 25000 |
| Total ($) | 40000 | |

It can be drawn from Table 2-5 that under the twice settlement mode of priority generation, the sum of total unit cost and total grid cost is 96700, which is equal to the sum of total user side settlement cost (96700). Under the one-time settlement, the sum of total unit cost and total grid cost is 97000, and the difference between the sum of total user side settlement cost (96700) and the actual sum is 300. The result is equal to the difference (10) of the day-ahead settlement priority electricity multiplied by the difference (30) of the real-time day-ahead node electricity price. Therefore, the example verifies that the twice settlement mode in section 3.3 will not generate unbalanced funds except for section 3.1 and 3.2. In contrast, the one-time settlement will generate unbalanced funds except for section 3.1 and
3.2. The amount of unbalanced funds is the difference between the actual and the day-ahead settlement priority electricity multiplied by the difference between the real-time and the day-ahead node price.

5. Suggestions for the development of the spot market under the mode of coexistence of planned economy and market economy

China's electricity spot market will be in the stage of the coexistence of planned economy and market economy for a long time. It is necessary to find out the problems brought to market operation by this mode in time and put forward solutions to ensure the smooth progress of electricity market reform. Given the current situation of the development of the domestic spot market of electric power, this paper puts forward some suggestions based on the problems existing nowadays.

(1) Suggestions on the way of unbalanced funds allocation under the mode of coexistence of planned economy and market economy

The allocation of unbalanced funds will directly affect the interests of all market entities. It is an important measure to build a complete market-oriented system and realize the balance of market competition. A scientific and reasonable allocation mechanism of unbalanced funds should be built.

For the three types of unbalanced funds mentioned in Section 3, the amount of various unbalanced funds in different stages of market development shall be analyzed and evaluated. According to the principle of "who benefits, who bears" or the characteristics of unbalanced costs, the subject and method of cost allocation shall be determined, which can be shared by specific market subjects. The allocation mechanism of unbalanced funds shall be quantitatively analyzed for all types of market subjects. Finally, through the closed-loop verification of the unbalanced fund allocation mechanism, we can get the unbalanced fund allocation mechanism which can protect the interests of all parties and promote the effective and fair competition in the market.

(2) Suggestions on settlement method of priority electricity in the spot market

Under the twice settlement, the electricity declared by the users will directly affect the unit's revenue. In the early stage of the market, the accuracy of load forecasting may be relatively low. In order to make the unit revenue as far as possible not affected by the declared electricity of market users, the one-time settlement mode is suitable in the early stage of the spot market. However, the one-time settlement mode will generate unbalanced funds. Moreover, the amount of unbalanced funds is affected by the market user's declared energy in the day-ahead market. Due to the uncontrollable and unpredictable behavior of market users, the scale of the unbalanced capital is also uncontrollable, which may cause higher market risk.

From the perspective of market economics, the market should be the result of the typical game between the buyer and the seller. However, at present, the domestic spot market mostly adopts the mode of user not participating or volume not quoting to participate in the spot market. Therefore, it is necessary to adopt the user side volume quotation mode and twice settlement mechanism in the spot market.

(3) Suggestions on the development of the model of coexistence of planned economy and market economy

With the promotion of market reform, the scale of electricity market transactions will gradually expand. Limited by the market structure, such as Guangdong electric spot market, some market-oriented units may no longer have the capacity to continue to provide the priority electricity in the future, which may be challenging to meet the requirements of the decoupling mode of planned economy and market economy. In each spot trading period, there may also be an imbalance between market-oriented generation and market-oriented power consumption. The grid company needs to purchase planned electricity to sell to market users, or purchase market electricity to sell to planned users, which will generate corresponding unbalanced funds.

Therefore, it is urgent to study the linkage mechanism of the spot market under the uncoupled mode, establish the unbalanced capital channeling mechanism, and ensure the orderly operation of the market. The decoupling mode of planned economy and market economy should be taken into consideration. It is easy to realize the connection and transition with the current decoupling mode.
6. Summary and Prospect
The paper analyzes the characteristics, advantages, and disadvantages of the three modes of plan economy and market economy. It focuses on the unbalanced funds that may be generated in the spot market by the planned electricity of the grid company under the mode of plan economy and market economy decoupling. Moreover, the paper verifies the influence of the one-time and twice settlement modes on the unbalanced funds in the spot market. Finally, given the problems brought by the mode of planned economy and market economy integration, this paper puts forward some suggestions for the development of China's electricity spot market, which provides a reference for the construction and mechanism design of China's spot market under the mode of market integration.

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