



Analysis on Priority Power Generation and Purchase After the Reform of Coal-Fired Electricity Price in China

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Abstract. Chinese government has just liberalized the coal-fired electricity price and industrial and commercial catalogue electricity price in 2021, which will prompt fully liberalization of power generation and utilization plans. This paper analyzes the composition of power generation and users after coal-fired electricity price reform, summarizes four scenarios of relationship between priority power generation and purchase in different provinces, considering power grid agency. Then, three schemes of matching solutions for priority generation and purchase are purposed. Taking into account the practicality and stability of electricity reform, the surplus priority power generation can be distributed to power grid agency users at this stage. In the future, the surplus inter-provincial priority generation need to be distributed to all industrial and commercial users to maintain market fairness.

Keywords: Priority Power Generation · Priority Power Purchase · Power Grid Agency · Reform of Coal-fired Electricity Price

1 Instructions

China's new round of power system reform proposes to establish a priority power purchase system to ensure the use of electricity by users who have no bargaining power, and to establish a priority power generation system to ensure clean energy power generation, regulated power generation priority access to the system. Other power generation and utilization plans are gradually liberalized through market transactions such as direct transactions and electricity markets [1].

In October 2021, the National Development and Reform Commission issued document No. 1439. It is proposed to orderly release the on-grid electricity price of all coal-fired power generation, promote industrial and commercial users to enter the market, purchase electricity according to market prices, and cancel the sales price of electricity in the industrial and commercial catalogue. For users who have not purchased electricity directly from the electricity market, the power grid company will purchase electricity as an agent.

Before document No. 1439 is issued, the priority purchase electricity accounts for about 35%, and the priority generation electricity accounts for about 65%. After all industrial and commercial enterprises enter the market, the scale of priority power purchase

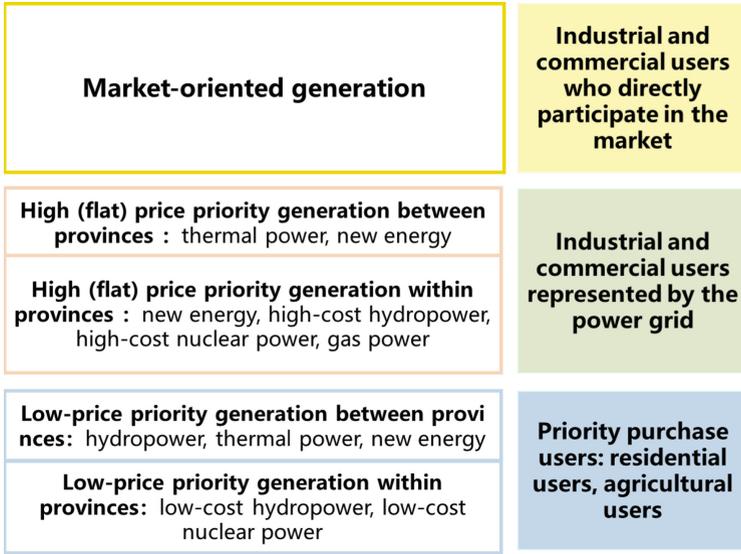


Fig. 1. Composition of power generation and users

is 27%. After all coal-fired power generation is released, the priority power generation is reduced. Due to the large difference in provinces, it is necessary to rearrange priority power generation plan according to the actual situation, and effectively connect with power grid agency.

2 Scale Analysis of Priority Power Generation and Priority Power Purchase

2.1 Composition of Power Generation and Users

The power generation side is divided into two categories: priority power generation and market-oriented power generation [2]. Among them, low-price priority power includes low-cost hydropower, low-cost nuclear power, and inter-provincial low-cost electricity (hydropower, thermal power, new energy, etc.); high (flat) price priority power includes new energy, high-cost hydropower, high-cost nuclear power, gas, high (flat) price electricity between provinces (including thermal power, new energy, etc.).

The user side is divided into priority electricity purchase users such as residential users, agricultural users, industrial and commercial users represented by the power grid, and industrial and commercial users who directly participate in the market [3] (Fig. 1).

The composition of electricity generation and consumption in different provinces varies greatly, which can be summarized into the following four scenarios.

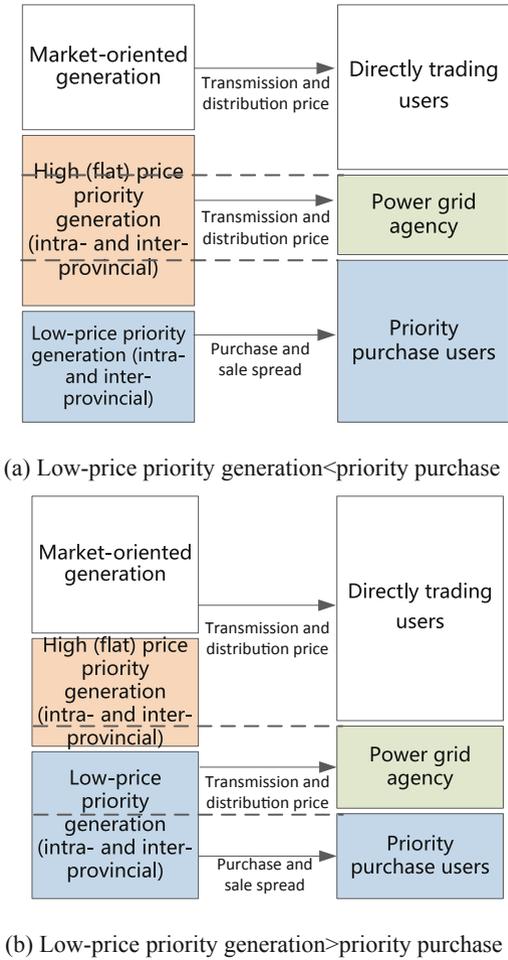


Fig. 2. Priority generation > priority purchase + power grid agency

2.2 Scenario 1: Priority Generation > Priority Purchase + Power Grid Agency

In this scenario, the scale of priority power generation exceeds the sum of priority power purchase and grid agency industry and commerce, and it is necessary to study the issue of excess high (parity) price priority power generation entering the market (Fig. 2).

Possible problems:

- The grid agency users match the priority power generation, and the grid agency user’s price may be significantly different from the market-based users’ price, causing doubts about the fairness of the market.

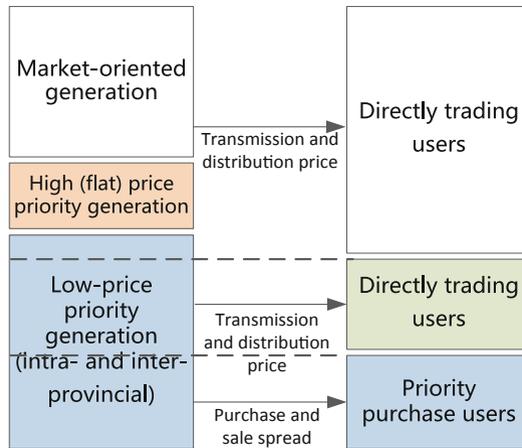


Fig. 3. Low-price priority generation > priority purchase + power grid agency

- High (parity) price power generation is facing pressure to enter the market, including both intra-provincial and inter-provincial electricity, and it is necessary to study the opening plan.

2.3 Scenario 2: Low-Price Priority Generation > Priority Purchase + Power Grid Agency

In this scenario, the scale of low-price priority power generation exceeds the sum of priority power purchases and grid agency users, and it is necessary to study the issue of high (flat) price priority power generation and surplus low-price priority power generation entering the market (Fig. 3).

Possible problems:

- As in scenario 1, the grid agency users match the priority power generation, and the grid agency user's price may be significantly different from the market-based users' price, causing doubts about the fairness of the market.
- Both high (flat) price and some low-price priority generation are facing the pressure to open the market, and they need to study the open plan.
- There is a surplus of low-cost hydropower in high-water seasons and shortages in dry seasons in large hydropower provinces, and it is necessary to study and propose treatment principles.

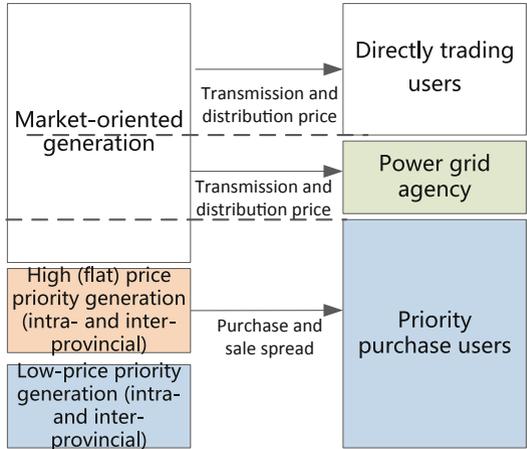


Fig. 4. Priority generation < priority purchase

2.4 Scenario 3: Priority Generation < Priority Purchase

In this scenario, power grid companies will give priority to purchasing electricity through low-price and high (parity) price priority generation, and the insufficient part will be purchased in a market-based manner (Fig. 4).

Possible problems:

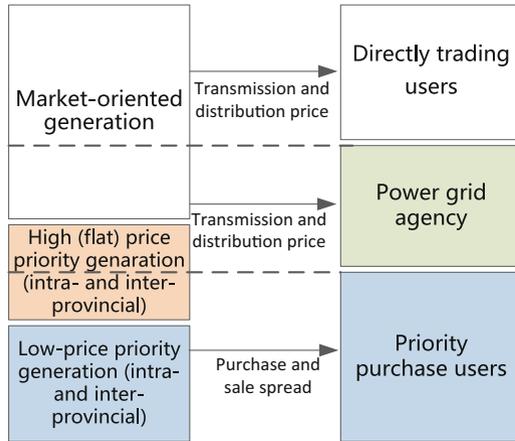
- Power grid companies need to purchase part of the market-oriented power generation to ensure priority purchase of power, and the resulting profits and losses need to be shared among all industrial and commercial users.

2.5 Scenario 4: Priority Purchase < Priority Generation < Priority Purchase + Grid Agency

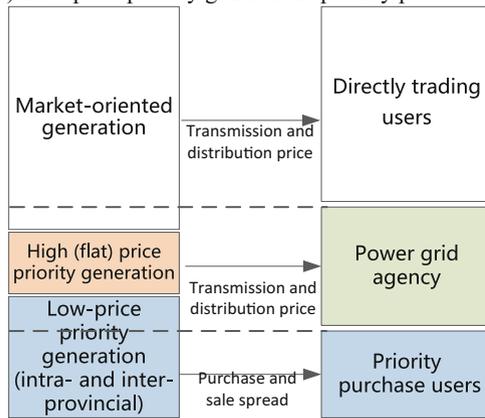
In this scenario, there is a surplus after the priority power generation guarantees the priority power purchase, and it is necessary to study the processing method of the surplus power generation.

Possible problems:

- Grid agency users match part of the priority power generation, which may cause significant differences between grid agency user prices and market-based user prices, raising questions about market fairness. Especially in the situation shown in Fig. 5(b), under the current situation of high coal-fired electricity prices, the grid agency user price will be significantly lower than the market-based user price.



(a) Low-price priority generation < priority purchase



(b) Low-price priority generation > priority purchase

Fig. 5. Priority purchase < priority generation < priority purchase + grid agency

3 Matching Solutions of Priority Generation and Purchase

3.1 Scheme 1: The Priority Power Generation Is Given Priority to Protect the Priority Purchase Users, and the Surplus Priority Power Generation Is Distributed to the Grid Agency Users

The priority power generation is given priority to protect the preferential purchase users, and the surplus priority power generation (including inter-provincial and intra-provincial) is distributed to the power grid agency users, and the remaining power purchase demand of the agency users is purchased by the power grid company through a market-based method. The weighted average of all the electricity purchased by the grid company is used to calculate the price of electricity sold to the agency users (Fig. 6).

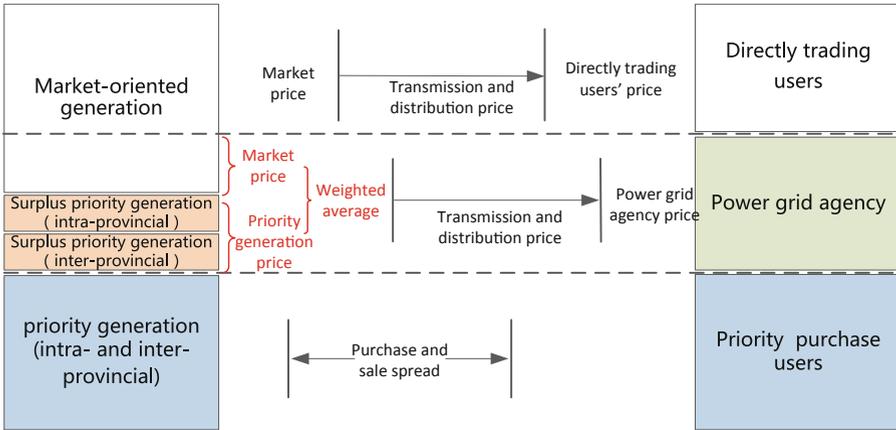


Fig. 6. Scheme 1

Advantages:

- Simple operation, smooth connection with existing priority power generation processing methods.

Disadvantages:

- There may be significant differences in the electricity price of grid agency users and market-oriented users, causing market fairness disputes. If the power grid agency user price is significantly lower than the market-based user price, it may lead to a decrease in the willingness of users to directly participate in the market; if the power grid agency user power price is significantly higher than the market-based user power price, power grid companies may face public opinion doubts.
- The surplus priority generation especially the inter-provincial surplus priority generation is facing the pressure to enter the market, affecting the convergence of inter-provincial and intra-provincial transactions.

3.2 Scheme 2: The Priority Power Generation Is Given Priority to Protect the Priority Purchase Users, and the Surplus Priority Power Generation Is Distributed to All Industrial and Commercial Users

The priority power generation is given priority to protect the priority purchase users, the surplus priority generation (including inter-provincial and intra-provincial) is first purchased by the power grid company, and the remaining power purchase demand of the agency user is purchased by the power grid company through a market-based method. The price of electricity sold by the power grid company to the agency users is formed by the market-based power purchase price, and the profit and loss formed by the difference between the weighted average price of the surplus priority generation and the

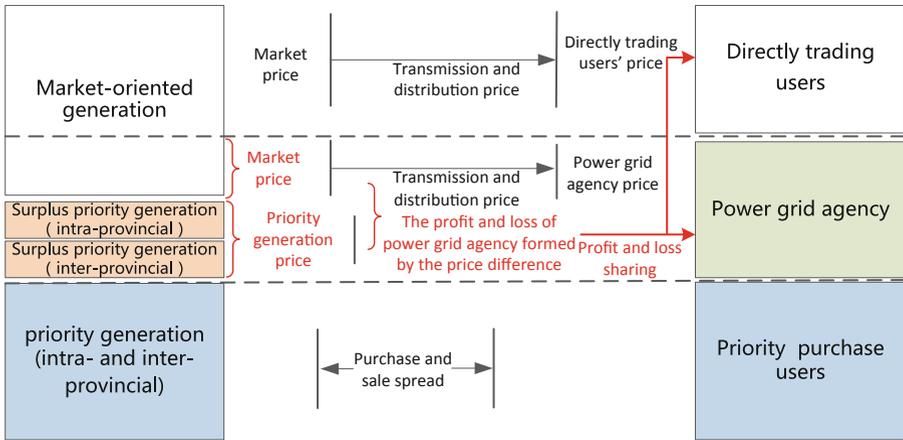


Fig. 7. Scheme 2

market-based power purchase price of the power grid is distributed to all industrial and commercial users (Fig. 7).

Advantages:

- The price of grid agency users is close to that of market-oriented users, which is conducive to maintaining market fairness and promoting the smooth development of the power grid company’s agency power purchase.
- The profit and loss formed by the price of the surplus priority generation and the market-oriented transaction price, which can be shared or apportioned among all industrial and commercial users through the way of benefit transmission, which can reduce all parties’ concerns about the liberalization of transaction between provinces.

Disadvantage:

- The operation process is relatively complicated, and it is necessary to accurately settle the settlement and clearly record the surplus power and profit and loss of different generation types.

3.3 Scheme 3: The Superior Priority Generation Is Given Priority to Protect the Priority Purchase Users, the Surplus Intra-provincial Priority Generation Is Distributed to the Grid Agency Users, and the Surplus Inter-provincial Priority Generation Is Distributed to All Industrial and Commercial Users

The priority generation is given priority to protect the priority purchase users, and the surplus intra-provincial priority generation is distributed to the grid agency users (that is, the method of Scheme 1); the inter-provincial priority power generation is first purchased by the power grid company, and its weighted average price is related to the market-based power purchase of the power grid. The profit and loss formed by the price difference shall

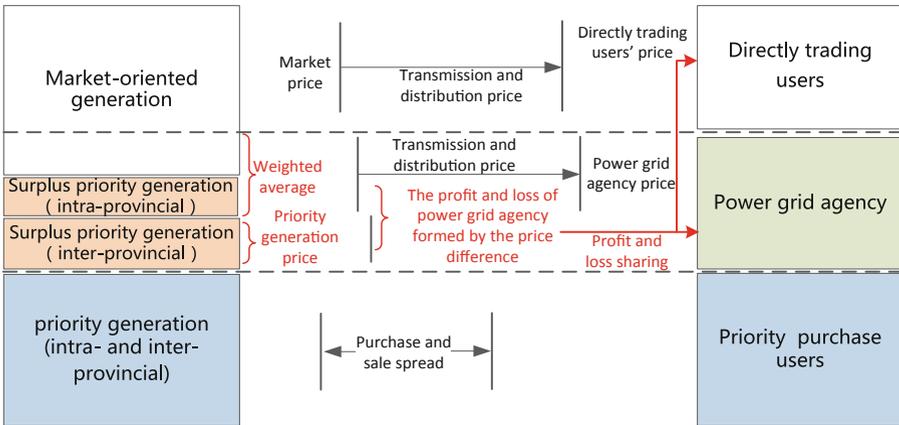


Fig. 8. Scheme 3

be apportioned to all industrial and commercial users (that is, the method of Scheme 2) (Fig. 8).

Advantages:

- Combining the advantages of Scheme 1 and Scheme 2, it can reduce the difference between the grid agency user price and the market-oriented user price to a certain extent, and ensure that the electricity purchased outside the province is uniformly purchased by the grid enterprise, contributing to the connection between inter-provincial and intra-provincial transactions. At the same time, the operation is simplified compared with Scheme 2.

Disadvantage:

- The profit and loss formed by the surplus inter-provincial priority generation are distributed to all industrial and commercial users, and the actual operation still has certain complexity. In addition, there may still be a certain difference between the electricity price of grid agency users and market-oriented users.
- According to the calculation, if the profit and loss generated by the surplus inter-provincial priority generation are distributed to all industrial and commercial users according to the Scheme 3 under the background of coal-fired electricity price rising, some of the receiving provinces may incur larger sharing costs, affecting the market transaction price. So taking into account the practicality and the stability of electricity reform, Scheme 1 is recommended at this stage, and will gradually transition to Scheme 3 in the future.

4 Conclusion

This paper analyzes the composition of power generation and users after coal-fired electricity price reform, summarizes four scenarios of priority power generation and purchase

for different provinces, purposes three schemes of matching solutions for priority generation and purchase, and recommends the best scheme after comparison. The following conclusions are drawn:

- After coal-fired electricity price reform, the power generation side is divided into priority power generation (including low-price power and high/flat price power) and market-oriented power generation. The user side is divided into priority purchase users, power grid agency users and market-oriented users.
- The relationship between priority power generation and purchase can be summarized into four scenarios, priority generation > priority purchase + power grid agency, low-price priority generation > priority purchase + power grid agency, priority generation < priority purchase, priority purchase < priority generation < priority purchase + grid agency.
- Taking into account the practicality and stability of electricity reform, the surplus priority power generation can be distributed to the grid agency users at this stage. In the future, the surplus inter-provincial priority generation need to be distributed to all industrial and commercial users, to maintain market fairness.

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