The marketization process of electricity purchase and power generation and its significance in China

Chenghui Tang* and Fan Zhang1
1State Grid Energy Research Institute CO.,LTD, Beijing, 102209, China
*Corresponding author’s e-mail: tangchenghui@sgeri.sgcc.com.cn

Abstract. China’s electricity purchases and power generation have been subject to deterministic catalogue tariffs for a long time. With the continuous improvement of China's electricity market reform, more and more parts of electricity purchase and power generation use market-based methods to determine electricity prices. This paper reviews the marketization process in China's electricity purchase and power generation. In view of whether or not to participate in the electricity market, this paper classifies different types of electricity purchase and power generation in China. Finally, it summarizes the significance of China's electricity purchase and power generation marketization.

1. Introduction
Since 2002, China's electricity purchases and power generation have been dominated by plans. That is, power plants sell electricity to grid utilities, and power users (including industrial, commercial, and residential users) buy electricity from grid utilities. In the planning mode, power sales by power plants and electricity purchases by power users are all implemented by the government's pre-determined catalogue tariffs. Only very few large sized users participate in market-based transactions by “power direct exchange trading”, and determine the electricity purchase price in the electricity market[1]. The above electricity users are named “direct transaction user”. In the market-based mode, the power generation price and the electricity purchase price are determined by contract in a market-oriented manner. In the planning mode, the power generation price is a fixed grid purchase price (catalogue tariff), and the electricity purchase price is another fixed catalogue tariff.

In recent years, the degree of marketization of China's electricity purchase and power generation has gradually increased. The “power direct exchange trading” by large sized users has gradually been liberalized [2]. Until recently, the electricity purchases and power generation plans have been fully liberalized [3]. This indicates that China's electricity purchases and power generation are shifting from a planned-based stage to a market-based stage, and China's power marketization has further expanded. This paper introduces the marketization process of China's electricity purchase and power generation, current types of electricity purchase and power generation, and summarizes the significance of China's electricity purchase and power generation marketization.

2. The marketization process of China's electricity purchase and power generation

2.1. Full planning stage of electricity purchase and power generation
Before 2002, as an annual power balance program, China's electricity purchase and power generation plan played an important role in ensuring the balance of power supply and demand and the safe and stable operation of the power grid, especially during periods of tight power supply.
2.2. “Power direct exchange trading” of large sized users pilot project
In 2002, China began to promote the marketization of power generation plan management. After various provinces explored, it finally formed a pilot project called “power direct exchange trading” mode for large sized users, as shown in Figure 1 [1]. The provinces began to loosen the control of power generation plans and instead a part of the annual (monthly) power generation plan by “power direct exchange trading” for large sized users. Since then, the situation of power generation plan and market electricity coexistence has been initially formed. Prior to 2015, “power direct exchange trading” of large sized users became the main way of electricity liberalization.

Figure 1. The marketization process of China's electricity purchase and power generation.

2.3. Liberalization of the electricity purchase and power generation by national policy
In 2015, China proposed to gradually liberalize electricity purchase and power generation through the establishment of “priority power purchase and priority power generation” systems by national policy, as shown in Figure 1 [2]. Through the orderly cancellation of electricity purchase and power generation plans for some larger sized users, market competition mechanism was introduced at the power supply and demand sides to improve the marketization degree of power industry.

2.4. Electricity purchase marketization of coal, steel, nonferrous and building materials industries
In 2018, China released the electricity purchase and power generation plans for the four major industries of coal, steel, nonferrous metals and building materials, as shown in Figure 1 [4]. A market-based pricing mechanism of “reference price and floating mechanism” was established. Since the four major industries of coal, steel, nonferrous metals and building materials have relatively high electricity consumption and certain economic affordability, they were chosen to carry out pilot projects for power generation marketization. 60% of the electricity in the four major industries was selected for marketization after the release, and the remaining part still implemented the catalogue price. Since the supply and demand of electricity is relatively loose during these years, some of the electricity prices participating in the market have declined, and the marketization of electricity purchase and power generation plans has shown its role.

2.5. Electricity purchase marketization of all operating power users
In June 2019, China's electricity purchase of all operating power users (larger sized users, small and medium sized users, as shown in Figure 1) was all liberalized, improving the degree of marketization of electricity purchase and power generation. Operating power users refer to all power users except for residents, agriculture, important utilities, and public welfare services, as well as plant power and transmission losses necessary for power production and supply [3].
3. Types of electricity purchase and power generation

Power users can be divided into non-market users and market users from the perspective of electricity purchase in China. Before June 2019, market users were mainly users of “power direct exchange trading” in the coal, steel, nonferrous and building materials industries. After June 2019, non-market users only have priority purchase users (non-operating power users). Other business users are operating market-oriented users who can choose to purchase power in the electricity market.

| Power users | Types of electricity purchase | Power prices |
|-------------|-------------------------------|--------------|
| Residents, agriculture, important utilities, and public welfare services, as well as plant power and transmission losses necessary for power production and supply | Non-operating power users | Catalogue price |
| All other power users | Operating power users | Contract price in the electricity market |

Power generation can be divided into “priority power generation” and “non-priority power generation”. The “priority power generation” is divided into two parts: “guaranteed quantity and price” and “guaranteed quantity with price bidding”. The “guaranteed quantity and price” uses a fixed on-grid tariff (the catalogue electricity price). The “guaranteed quantity with price bidding” uses the contract price in the electricity market.

| Power generation | Types | Power prices |
|------------------|-------|--------------|
| Hydropower, wind power, photovoltaic | Priority power generation | Catalogue price (part of guaranteed quantity and price) and contract price in the electricity market (part of guaranteed quantity with price bidding) |
| Nuclear power | Priority power generation | Catalogue price (part of guaranteed quantity and price) and contract price in the electricity market (part of guaranteed quantity with price bidding) |
| Other non-water renewable energy sources such as biomass energy | Priority power generation | Catalogue price |
| Peak shaving and frequency-regulation electricity; cogeneration unit “heat-set electricity”; electricity of national plan for cross-provincial transmission, etc. | Priority power generation | Catalogue price |
| Thermal power (ordinary thermal power) | Non-priority power generation | Contract price in the electricity market |
| Coal-fired self-supplied power plants (after taking on relevant social responsibilities) | Non-priority power generation | Contract price in the electricity market |

4. The significance of China's electricity purchase and power generation marketization

Three main significance of China's electricity purchase and power generation marketization are summarized in this paper. First, the market can determine the price and reduce the energy cost. Second, power users could purchase power in many ways and the power grid utilities become a guaranteed
power supply. Last but not least, electricity purchase and power generation marketization could promote the renewable energy consumption in China.

4.1. The market determines the price and reduces the energy cost
The traditional electricity price mode has been changed. The market-based price formation mechanism was determined. Power users and power generation enterprises can negotiate and sign contracts by themselves. They can determine the electricity price in a flexible manner. In order to gain more market share, power generation companies need to compete and lower prices to win, so as to increase power production efficiency and reduce electricity prices through the invisible hand of the market. For example, in 2018, the electricity amount of “power direct exchange trading” in the State Grid's operating area reached 1,225.7 billion kWh with a year-on-year increase of 37.1%, reducing the electricity cost and the average electricity price of electricity users by 37.3 billion yuan and 30.1 yuan/kWh, respectively. The full liberalization of the electricity purchase and power generation for all operating power users will greatly increase the proportion of market-based power consumption and continue to reduce energy costs.

4.2. Power users could purchase power in many ways and the power grid utilities become a guaranteed power supply
Power grid utilities are no longer the sole seller of small and medium-sized users, but becomes a guaranteed power supply, which have to supply power for the users outside the electricity market. Small and medium-sized users can participate in market-based transactions to purchase electricity through “power direct exchange trading” with power generation companies or sales companies. Small and medium-sized users can purchase power through power grid utilities during the period of not participating in the electricity market.

4.3. Promoting renewable energy consumption in China
The electricity purchase and power generation marketization could effectively cooperate with China's current renewable energy “priority power generation” policy. According to the renewable energy resource conditions and consumption conditions such as hydropower, wind power and solar energy, a certain amount of guaranteed quantity of power generation part will be set up, which uses a fixed on-grid tariff (the catalogue electricity price). The rest part, i.e., “priority power generation” that beyond the guaranteed quantity use market-based price.

5. Conclusion
This paper introduces the marketization process of electricity purchase and power generation in China. The types of electricity purchase and power generation are summarized and compared for a clearer understanding of “priority power purchase and priority power generation”. Finally, the significance of China's electricity purchase and power generation marketization is discussed.

Acknowledgments
This work was supported by SGCC Science and Technology Project “National unified electricity market framework design and quantitative assessment technique study”.

References
[1] Notice on the issuance of the power system reform plan. State Council of China. http://www.gov.cn/zhengce/content/2017-09/13/content_5223177.htm
[2] Several opinions on further deepening the reform of electric power system. Central Committee of the Communist Party of China. http://www.ndrc.gov.cn/fzgggztzgg/ggkx/201504/t20150409_676931.html
[3] Notice on the full liberalization of the electricity use plan for operating power users. National Development and Reform Commission of China. http://www.ndrc.gov.cn/zcfb/zcfbtz/201906/t20190627_939771.html

[4] Notice on actively promoting power market trading and further improving the trading mechanism. National Development and Reform Commission National Energy Administration of China. http://www.ndrc.gov.cn/zcfb/zcfbtz/201807/t20180718_892653.html