The Status quo and Issue of the Guangdong Electricity Market

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Abstract. With the implementation of electric power industry reform in China, establishing the efficient electricity, which can be suitable for China's national conditions, becomes one hot topic. Guangdong is the earliest pilot in this reform, and it has the most active market trading in China. So it is imperative to analyse the status quo and issue of the Guangdong electricity market, consequently the experience and problem can be referenced when the other province or region establish the electricity market.

1. Introduction
In the March 15, 2015, the "Several Opinions on Further Deepening the Reform of the Electric Power Industry" issued [1]. It means the new round of market-oriented reform has begun. As is known, the electricity market is main way to optimize power resources allocation, and it also is the important mission in the round of electric power industry reform in China [2-3].

Guangdong Province is the leader in the electric power industry reform, and it has the most active electricity market in China. So analyzing the state quo of Guangdong electricity market and finding out the issues and solutions are imperative. It can provide some suggestions for building the Southern China regional electricity market and spot market establishment in other provinces [4-5].

2. The state quo of the Guangdong electricity market
As the earliest reform pilot of electricity retail market and spot market, the development Guangdong electricity market is representative and can provide experience for the electricity market construction of other provinces and regions. Therefore, it is meaningful to analyse the current situation of Guangdong electricity market. In this section, the status quo of power system and market will be discussed

2.1. The Status quo of the Guangdong Power System
In 2017, the total load and electricity consumption in Guangdong are 11.5 million kWh and 59.9 billion kWh, respectively. It is estimated that the total load will reach 13800, 15930 and 175 million kWh in 2020, 2025 and 2030, respectively. The total electricity consumption will reach 7120, 8290 and
893 billion kWh, accounting for 53%, 53% and 51% of the overall Southern China (including the Guangdong, Guizhou, Hainan, Guangxi and Yunnan).

Under the background of the Energy Structure Reform, the power supply-demand situation is changing in Guangdong.

On the one hand, the nuclear and wind power in the proportion of power mix in Guangdong is increasing. By 2017, the installed capacity of the coal power has reached 58970MW; the gas power is 15830MW; the hydropower is 8390 MW; the pumped storage is 6080 MW; the nuclear power is 10470 MW, the wind power is 3900MW and the photovoltaic power is 1190MW.

Up to 2030, the coal power will reach 78420MW; the gas power 29780MW; the hydropower 8520MW; the pumped storage 12080MW; the nuclear power 28150MW; the wind and photovoltaic power is 23600 MW and 6000MW, respectively. The power mix of Guangdong in 2017 and 2030 is as shown in the Fig 1.

![Figure 1. The power mix of Guangdong in 2017 and 2030](image)

On the other hand, as the scale of inter-provincial power transactions from Western China to Eastern China continuously increasing, the amount of outsourcing electricity from other Province in Guangdong is growing. During the “13th Five-Year Plan” of China, the capability of resources allocation by the power grid in Southern China (including the Guangdong, Guizhou, Hainan, Guangxi and Yunnan) has been further enhanced. By 2020, the inter-provincial power transmission channel with the "eight-AC and eleven-DC" structure in the Southern China region will form, and the power transmission capacity will be more than 53000MW. In 2017, the volume of outsourcing electricity in Guangdong accounts for 25% of its total available installer capacity. It is estimated that the proportion will be 25%, 21% and 20% in 2020, 2025 and 2030. Although, the proportion falls slightly, the capacity will still grow, as shown in the Table 1.

| Year | 2017 | 2020 | 2025 | 2030 |
|------|------|------|------|------|
| Capacity(MW) | 36080 | 46580 | 46580 | 48580 |

2.2. The current situation of the Guangdong electricity market

By 2018, the basic framework of the Guangdong electricity market with the “the Long-term market plus the Spot Market” has been established.

In 2017, the electricity traded in the market is 115.7 billion kWh. Among them, the bilateral transaction is 83.7 billion kWh, with the 199% increasing compared with the last year; the centralized
transaction is 31.96 billion KWh with the 100% increasing; the generation right transfer transaction is 8.26 billion KWh.

Meanwhile, the number and scope of electricity market participants in Guangdong are gradually expanding. By the end of June 2018, a total of 7081 market participants were eligible for market access, with an increase of 16.5% over the end of 2017.

The rules of “Medium and Long-Term Transactions in Guangdong Electricity Market” issued in August 2018 clarifies the latest contents of the medium and long-term market. The trading cycle can be multi-year, annual, monthly, weekly and daily. The medium and long-term contracts are price-differentials contracts, which are settled according to the price of spot market. At this stage, the unified settlement point is as the settlement node of medium and long-term contracts. With the market development, market participants are allowed to choose settlement nodes by themselves. The day-ahead energy price of the unified settlement point is the weighted average of the day-ahead price of the whole market in the corresponding period. The new rule are mainly designed to match the spot market, and the different with the rules in 2017 is shown in the Table 2.

| Contents                        | Rules of 2017          | Rules of 2018                      |
|--------------------------------|------------------------|-----------------------------------|
| Decomposed contracted power    | Without                | With                              |
| curve                          |                        |                                   |
| Settlement point                | Without                | With                              |
| Bidding mode                   | Price-differentials    | Energy price                      |
| Bidding rule                   | Centralized            | Centralized and Continuous bidding|
| Cycle                          | Yearly and monthly     | Yearly, monthly, weekly and daily |
| Contract form                   | Physical               | Price-differentials               |
| Inter-provincial               | Planned by power grid  | The increment part can access into the |
|                               | company                | market                            |

3. The issue and solution of the Guangdong electricity market
According to the state quo of the Guangdong electricity market in the Section 2, there are some issues in the Guangdong electricity market. Because the market mechanism should adapts to power system situation. In this section, we will propose the issues and solutions of the Guangdong electricity market.

3.1. Establish the market mechanism for the renewable energy
The proportion of the renewable energy in the power mix is increasing, so it is necessary to consider the method for the renewable energy trading in the market. The renewable energy quota system and green certificate trading will subsidize renewable energy, accelerate the realization of renewable generation without the subsidy and increase its competitiveness. In the foreseeable future, it is clear that renewable energy costs could be lower than thermal power.

At present, the power generation enterprises participating in the electricity market mainly include coal-fired units, gas-fired units dispatched at or above the provincial level and admitted by the government in Guangdong Province, as well as coal-fired units outside the province that transmit electricity to Guangdong Province by "point-to-network" special line transmission mode.

In 2017, the installed capacity of coal and gas turbines in Guangdong accounted for 70% of the installed capacity of the province and 52% of the available installed capacity of the whole society. Other types of units and foreign electricity accounted for a large proportion. Whether to realize the same-stage competition of different types of units, especially renewable energy generation, will directly affect the role of market-oriented mechanism in the optimal allocation of resources in different types of energy.
3.2. Establish the market mechanism for the power system adequacy and flexibility
Due to the limited controllability of the nuclear and renewable energy and the difference between peak and valley load, the thermal power will undertake more obligation of power system regulation. The ancillary services market mechanism must to be further improved, thus it can guarantee the power system flexibility. Meanwhile, it is necessary to explore the possibility of the establishment of capacity market. The capacity market is one way to avoid the market power and ensure long-term peak load capacity is adequate in the system.

The centralized ancillary services is carried out in the trading stage of spot electricity market, and operates independently from the energy market. Reserve, reactive power regulation, automatic voltage control, black start and other ancillary services still maintain the current compensation mechanism. On the bidding day, the power dispatching organization synthesizes the demand of frequency control capacity, the quotation order of frequency control auxiliary service and the unit combination calculated by the safety constraints unit combination (SCUC) in the electricity market before the day, and forms the pre-clearing result of frequency control units through the frequency control auxiliary service market. When calculating the clearance of electricity market before the day, adjustments shall be made separately.

It can be seen that the energy market and market operate separately in Guangdong spot market, which is conducive to the initial operation and stable operation of the market. However, in fact, there is a physical coupling relationship between reserve and frequency control services and energy market, which is a natural integration. Therefore, the joint optimization of auxiliary services including reserve and frequency control services and energy is an important part of market development.

Meanwhile, with the continuous increasing penetration of renewable energy, such as wind power and photovoltaic power generation, they usually quote zero or even negative prices in the spot market in order to give priority to clearing, thus lowering the average electricity price in the spot market, leading to the decline of the profitability of conventional power sources, and thus inhibiting the investment willingness of conventional power sources. So capacity market is necessary to some extent.

3.3. Cancel of the unified settlement point mechanism and centralized trading in medium and long term market
The unified settlement point make the medium and long term market lose the risk aversion function. It is suggested to allow medium and long-term transactions to choose settlement points independently. Also, transmission right market should be designed and constructed as soon as possible, thus the market participants can avoid spot market price fluctuations.

At present, Guangdong has not established the transmission rights market. However, due to the nodal pricing mechanism, the lack of transmission rights market will lead to the market participants without the tools to avoid the congestion pricing fluctuation. From the actual situation of nodal electricity price market in foreign countries, there are abnormal congestion prices in the more serious period and nodes, which will bring greater risks to market users.

3.4. Establish the market mechanism for the inter-provincial power transaction
Now, it should enrich the varieties of inter-provincial market transactions categories, and expand the market transactions scale. Establish the regional market in the Southern China (including the Guangdong, Guizhou, Hainan, Guangxi and Yunnan) gradually, optimize the allocation of regional resources and improve the efficient utilization of inter-transmission channels.

In the initial stage of the Southern China regional market, considering the traditional dispatching mode, the experience gained in the new round of power market reform and the development of the technical support system, the first step is to carry out the joint optimization of the medium and long-term transactions within the southern region based on the capacity constraints of the inter-provincial contact lines. The provinces and districts still adopt independent days. Day-ahead and real-time scheduling mode. Such a way of starting is conducive to ensuring the balance of power consumption and the security of power system in each province. It is operable and easy to realize. At the same time,
it has a long-term foothold and lays a foundation for the development of regional market in the next stage.

4. Conclusion
In this paper, the state quo and issue of the Guangdong electricity market are analyzed. With the renewable energy and nuclear power increasing and the inter-provincial transmission channel strengthening, the electricity market of Guangdong faces the new change. So we proposed the four issues and solutions for the electricity market development of Guangdong, including the renewable energy trading mechanism, capacity and ancillary service market mechanism, improve the medium and long term market and inter-provincial power transaction mechanism.

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