Research on trading patterns of large users' direct power purchase considering consumption of clean energy

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Abstract. In order to reduce the stochastic volatility of supply and demand, and maintain the electric power system's stability after large scale stochastic renewable energy sources connected to grid, the development and consumption should be promoted by marketing means. Bilateral contract transaction model of large users' direct power purchase conforms to the actual situation of our country. Trading pattern of large users' direct power purchase is analyzed in this paper, characteristics of each power generation are summed up, and centralized matching mode is mainly introduced. Through the establishment of power generation enterprises' priority evaluation index system and the analysis of power generation enterprises' priority based on fuzzy clustering, the sorting method of power generation enterprises' priority in trading patterns of large users' direct power purchase is put forward. Suggestions for trading mechanism of large users' direct power purchase are offered by this method, which is good for expand the promotion of large users' direct power purchase further.

1. Introduction
With the continuous progress of reform process of China's electricity market, and after the separation of plant and network and open competition of generation side, there are growing calls of introducing competitive mechanism in sale side and improving electricity price system. As an important part of opening market competition, the development and implementation of direct purchase of electricity has an important significance.
The current direct purchase transaction mode of large users is negotiated bilateral transactions, centralized matching transactions and centralized bidding transactions. Bilateral contract transaction model of large users' direct power purchase conforms to the actual situation of our country, but large users direct transaction have a negative impact on clean energy consumption. So, comprehensive benefit evaluation technology of clean energy consumption is very important.

2. Trading patterns of large users' direct power purchase
Literature [1], [2] combined with China's current planning forms and the status quo of market transactions, the important principles of the scientific design of large users direct purchase of electricity is put forward. From the perspective of economics and market, the misunderstanding of large users direct purchase is analyzed in literature [3], the problems which existing in the direct purchase of large users in our country at present are explained and the solution is put forward. Two modes of large users direct purchase of electricity trading patterns is proposed in literature [4], and

trading rules and algorithms are designed. In literature [5], the influence of time sharing price and power quality is considered, algorithm for the fixed cost allocation problem of large user transfer cost is provided by postage stamp method，which can reduce cross subsidy.

3. Power generation characteristics

3.1 Traditional thermal power generation characteristics
Thermal power generation refers to the heat generated by oil, coal and natural gas to heat water, high temperature and high pressure steam can be formed, and the water vapor can drive generator to generate electricity. Thermal power plant's site is flexible, which can reduce loss of power transmission and distribution. The operation is stable and reliable, which is the backbone of the national grid power supply. Units are barely affected by the environment, climate and other adverse factors. But, utilization rate of traditional thermal power resources is low, operating cost is high, and wasting problem is serious. Besides, the time of start and stop is long, equipment operation and maintenance is difficult.

3.2 Sichuan hydropower generation characteristics
Sichuan gives priority to the development of hydropower, so that hydropower occupy the dominant position of power supply in Sichuan. By the end of 2002, hydropower installed capacity is 11 million 731 thousand and 500 kilowatts, accounting for 64.78% of the province's installed capacity, ranking first in the country. Hydropower became the main power supply power and peak power. In recent years, the national network of Sichuan electric power company has been taken various measures to utilize redundant power. The next step will continue to take various measures to consume surplus hydropower.

3.3 Characteristics of wind power generation
Wind energy resources are rich, clean and renewable. Compared with conventional thermal power units, the construction period of the wind farm is short, and the automation degree is high. It covers a small area, and abundant wind resource places tend to desolate sands or hilly area , which reduces the wind farm land costs in construction period. However, wind power also has certain limitations: the motive forcer of wind power is natural wind, so that wind speed and wind quantity are not controllable, and the wind is difficult to store.

4. Centralized matchmaking transaction mode based on large user priority classification

4.1. Centralized matching transaction mode

Centralized matching transaction mode refers to release the supply and demand information by electricity trading center through a unified trading platform. The two sides declare purchase and sale electricity and electricity price respectively. According to certain rules and security constraints to match . In the centralized matching mode, both sides reported electricity quantity and electricity prices before the deadline. Trading center will match in a fixed time. The core idea is "high-low match", seller in accordance with the offer from low to high priority scheduling. Buyers in accordance with the order from high to low priority, the highest priority between the buyer and the seller will be traded first, the transaction price is average price for both parties, and so on.

4.2. Establishment of priority evaluation index system for power generation enterprises

Big users are more willing to deal with power generation companies with good credit ratings, good social benefits, and good power generation. It is very important to determine the access conditions of the power generation enterprises for the relevant parties.
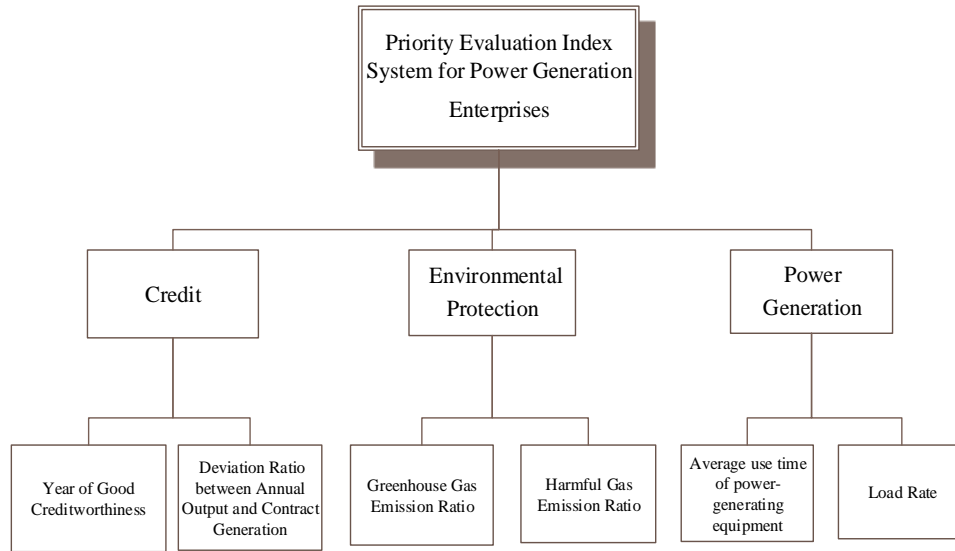
Figure 1..Priority evaluation index system.

4.2.1 Credit:

Credit is the integrity of power-generation firms in their production and management. Transaction risk can be reduced while trading with credible enterprise for both grid companies and customers.

Year of contract-credit: "contract-credit" is the most authoritative comprehensive assessment which declared by the government. Therefore, year of contract-credit is one of index which evaluate user's credit condition.

The deviation ratio between annual output and contract generation: the deviation is the default volume of annual transaction below the 97% of contact generation (power adjustment is included).

4.2.2 Environmental protection

Big users in direct power purchase are all required to conform to environmental policy by relevant files. Greenhouse gas emission ratio:

$$\eta_{ggr} = \frac{m_{gg}}{E_{out}}$$

(1)

E_{out} is the total switching energy, m_{gg} is the mass of greenhouse gas emissions.
Harmful gas emission ratio:

$$\eta_{hgr} = \frac{m_{hg}}{E_{out}}$$

(2)

E_{out} is the total switching energy, m_{hg} is the mass of harmful gas emissions.

4.2.3 Power generation

Average utilization hours of power generation equipment is the ratio between generating capacity and average capacity. It reflects the utilization level of time. The formula is：

$$T = \frac{Q}{Q_1}$$

(3)

Q is the generated energy, Q_1 is the average capacity.

Load rate is the ratio between the average load and the highest load. It reflects the different level of load. Bigger number means production is balance，so the priority is higher.

4.3.The priority classification of power enterprises based on fuzzy clustering
Fuzzy clustering analysis is a method to study the classification of a given object by using the fuzzy mathematics method. Taking into account the market may have a competitive and non- competitive units, bidding unit may also have non-competitive power, so the priority of the power plant needs to be considered in accordance with the two conditions which are bidding energy of the bidding units and non- competitive power in bidding units and non-competitive units' generation.

4.4 Centralized matching transactions that can promote clean energy consumption
Centralized matching transactions is the buyer in accordance with the offer from high to low priority, the seller in accordance with the offer from low to high priority. The first match is the highest priority buyers and sellers , and then match the inferior priority buyers and sellers.
Market clearing use the way of matching. The highest bid in consumptive power manufacturers and the lowest bid of inter provincial clean energy can match, according to the minimum amount of electricity as its turnover. After transaction is confirmed, and quoted price is eliminated, the match can carry on again according to the same way until one side does not offer, or both sides have offer but inter provincial clean energy price is higher than other side.

5. Conclusion
Trading patterns of large users' direct power purchase which considering clean energy consumption are analyzed in this paper, various power generation characteristics are summed up, trading patterns of large users' direct power purchase are introduced. Through the establishment of priority evaluation index system of power generation enterprises and analysis of priority problems of power generation enterprises based on fuzzy clustering, recommendations from the trading mechanism and development stage are put forward, which is conducive to the further expansion of large users' direct power purchase.

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