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Development of Electricity Trading Vector Benefit Evaluation Model

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Abstract: In order to ensure the smooth progress of the new round of electricity reform and reduce market operation risks, it is necessary to study the impact of the market rules on the market performance through the power market simulation before the formal implementation of the market rules, in order to test the rationality of the trading rules and discover the existence of the defects in the rules, so as to further optimize and perfect the market design, establish corresponding market risk control strategies, and resolve risks in the stage of market design and rule making. This article is based on the fact that users of production and consumption can trade their own elastic load capacity on the feature vector trading platform, that is, when they respond to the imbalance of distributed generation/power consumption of production and consumption groups, the environmental protection benefits of distributed power generation can be reflected before they can obtain corresponding response power Subsidies for environmental benefits. According to the principle of power trading evaluation, the eigenvector model is used for analysis, and the simulation experiment environment is used to simulate the reasonable range of benefits in power trading, which proves that the research content of this paper is true and effective, and plays a popular role in power trading evaluation.

1. Introduction

Energy cross-regional electricity trading refers to the bundling of surplus wind power, photovoltaic power and other energy power with thermal power after energy consumption in energy-rich areas is sent to areas with large power gaps through high-voltage transmission networks for consumption. There are many coordination factors that need to be considered in energy cross-regional power transactions. In addition to the main trading parties on the power side and load side, cross-region grid attributes, national policies, and power market related factors must also be considered[1-2].

Production and consumption users use feature vector technology to update the unbalanced electricity and electricity prices of production and consumption groups in real time, to promote the production and consumption users to actively respond to the intermittent and volatility of distributed power generation with the benefit of electricity consumption, reduce the reserve capacity of distribution networks, and reduce fossil energy. Production and consumption users take the initiative to reduce their dependence on the main grid and reduce the volatility and indirectness of distributed generation to the distribution network. This paper analyzes the main coordination factors that need to be considered in power trading, combines the main coordination factors to build a vector benefit evaluation model, and studies the power generation cost model that balances electricity[3-4].



2. Analysis of the benefit of electricity consumption based on the characteristics of eigenvector technology

2.1 Production and consumption user electricity price setting

In order to verify that the response of production and consumption users is unbalanced electricity, it has economic benefits. Therefore, the benchmark price plus flexible price is adopted in the production and consumption group, which is represented by W . The electricity purchased from the power supply company is based on the benchmark electricity price plus environmental protection costs, represented by Q (namely, the cost of purchasing electricity from the production and consumption groups is fixed[5-6].

$$W = \sqrt{1 + CR_{\cos e}} \quad (1)$$

$$Q = \sqrt{1 + C'\gamma_{\cos e}} \quad (2)$$

In equation (1, 2): C, C' are expressed as the profit coefficient of photovoltaic and power grid sales; $R_{\cos e}$ $\gamma_{\cos e}$ are the traditional and photovoltaic power generation cost.

2.2 Electricity response pricing method based on feature vector

Electricity trading within the electricity trading user group based on feature vector technology is independent of the electricity sold by the grid company, so the flexible electricity price is only used as an incentive for the adjustment of distributed generation/electricity unevenness within the production and consumption group. Mainly because[7]:

1) The current power market environment determines that power generation companies have no right to sell electricity directly to consumers, so the incentive signal of flexible electricity prices is invalid for power generation companies;

2) The distributed generation in the production and consumption group is volatile, and the unbalanced response of the production and consumption users is subjective. It is difficult for local power supply companies as power sales centers, dispatch centers, and maintenance centers to coordinate real-time electricity prices on the distribution side frequently. Change real-time transaction electricity prices.

Therefore, the production and consumption group needs to purchase the missing electric energy from the power supply company at a fixed electricity price of Q , and connect the excess electricity to the grid at a fixed market price of m . Electricity transactions between production and consumption users are operated on an intelligent platform based on feature vector technology, introducing a real quotation mechanism that reflects production and consumption users, and real-time quotation and settlement[8-9].

(1) When the production and consumption group lacks electricity, the electricity cost is settled by using the formula (3):

$$B_{total1} = Q \left(\sum_{i=1}^n T_{need}^i - \sum_{i=1}^n T_{produced}^i \right)^2 - (1 - R_{\cos e}) \quad (3)$$

2) When producing and dissipating the surplus electricity of the group, the electricity cost is settled using the formula (4-19):

$$B_{total2} = W \left(\sum_{i=0}^m T_{produced}^i - \sum_{i=0}^m T_{need}^i \right)^2 - (1 + \gamma_{\cos e}) \quad (4)$$

Among them, T is the total photovoltaic power generation of the production and consumption group; $\sum_{i=1}^n T_{need}^i$ is the unbalanced power of the production and consumption group response; $\sum_{i=0}^m T_{produced}^i$ is the balanced power of the production and consumption group response

3. Framework of electricity trading evaluation model

The power transaction evaluation model is divided into a target layer, a criterion layer and a plan layer, which correspond to the evaluation object, evaluation module and evaluation element respectively. The corresponding index in the evaluation module is set as a sub-index, and the index in the evaluation element is set as a sunlight index[10]. The overall evaluation model framework is shown in Figure 1.

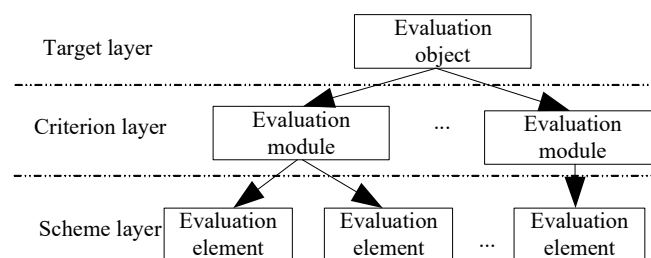


Fig.1 Framework of power transaction evaluation model

Among them, the standard-level evaluation module indicators are selected based on the common screening of the power market, the purpose is to reflect the current status of the power market transaction, the standard-level indicators are refined for the program-level indicators, and the absolute value represents the relative value indicator. The evaluation process reflects the core evaluation points of each power transaction evaluation.

The selection process of power transaction evaluation indicators, the specific construction process is shown in figure 2:

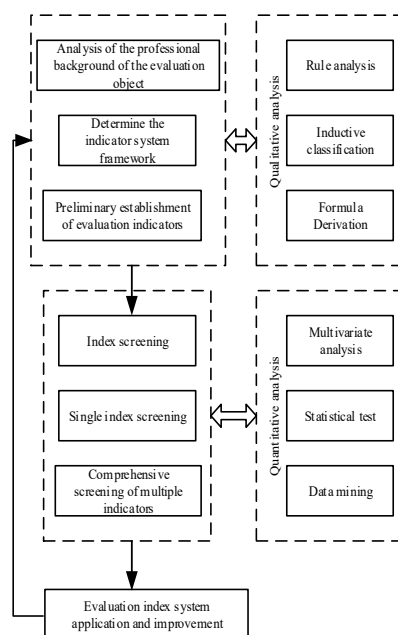


Fig. 2 Construction process of comprehensive evaluation index system

From the analysis in Figure 2, the qualitative analysis and calculation process mainly includes rule analysis, inductive classification and formula derivation. It mainly analyzes the professional background of the evaluation object, determines the index system, and thus initially establishing the overall evaluation index.

4. Simulation experiment

4.1 Simulation experiment environment

In the experimental scenario, a penalty power price is set in the user's full power transaction mode. In order to facilitate the research, the trading volume of power generators and power purchasers is declared in a single segment, and the market adopts a uniform marginal price for clearing. Each experiment set 200 experiments, each experiment 5000 rounds. Among them, the user trading mode in the first 100 experiments uses part of the electricity transaction, and the deviation electricity is settled according to the catalog electricity price; the last 100 experiments adopt the full electricity transaction, and the deviation electricity generated is settled according to the penalty electricity price set in the experiment. The penalty price is 0.675 yuan/kWh. Calculate the average value of the bidding results under each experimental scenario separately to make a comprehensive evaluation of the market.

4.2 Benefit evaluation analysis of different user electricity trading models

Figure 3 shows the changes in the market marginal clearing price corresponding to the partial supply of electricity to the market and the full amount of electricity to the market under different supply-demand ratio conditions.

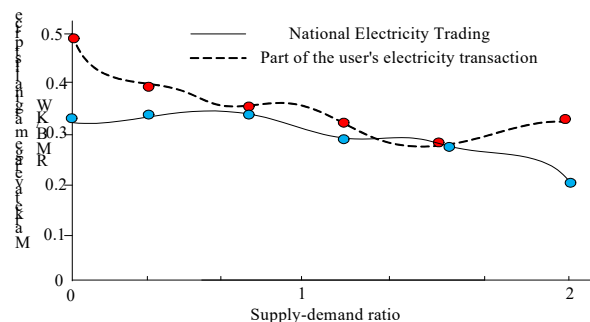


Figure 3 Changes in the marginal clearing price of partial electricity consumption and full electricity transaction of users

It can be seen from Figure 3 that the market clearing electricity price under the user's full electricity trading model is higher than the market electricity price under some electricity trading models. It can be seen from the calculation that when the supply-demand ratio is in the range $[1.5, 2.0]$, the average market price of electricity in the user's partial power trading mode is about 0.262 yuan/kWh, and the profit margin on the power generation side is about 7.82%; while the average market electricity price in the full power trading mode It is about 0.282 yuan/kWh, and the profit margin on the power generation side is about 16.05%. This is because under the user's full electricity trading mode, the deviation electricity is no longer settled according to the catalogue electricity price. Once the electricity purchaser's quotation strategy is unreasonable, the lost market electricity will be settled according to the deviation assessment electricity price, which causes the electricity purchase cost to rise. After recognizing the risk of full electricity entering the market for trading, e-commerce has relatively reduced the willingness to test the low price, and the quotation is more rational, no longer excessively reducing the profit margin on the power generation side.

5. Conclusion

Part of the electricity consumption of users participates in the market, and the model of remaining deviations from the electricity price catalogue is actually a disguised electricity price preferential policy, which violates the principle of fair competition in the market and is not conducive to the continuous development of the electricity direct trading market; Cultivate the risk awareness of power users to participate in the market, and guide users to make rational offers. Through experimental analysis, it is proved that the feature vector processing power evaluation benefit researched in this paper has practical application value and has the effect of combining with the physical reference evaluation.

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