Research on New Energy High-rate Dissipation Strategy under the Background of Renewable Energy Quota System

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Abstract: In recent years, China's new energy has developed rapidly, and at the same time there have been serious problems of abandoning wind and abandoning light. In order to better solve the problem of new energy consumption, China officially implemented the renewable energy quota system in January 2019. Therefore, based on the current situation of new energy consumption in China, this paper first analyzes the impact of renewable energy quota policy from two aspects: capacity efficiency and grid connectivity effect, and then based on tapping local energy potential, accepting trans-regional power transmission, and optimizing outside the region. The corresponding new energy consumption strategy is proposed in the power transmission curve. Finally, based on the time series production simulation model, an empirical analysis is made on the consumption situation of a certain provincial power grid under different strategies in 2020. This paper provides a reference for promoting the proportion of new energy consumption in China.

1 Introduction

In recent years, issues such as the environment and resources have been widely regarded as important factors affecting the development of the entire human society. New energy, represented by wind power generation and photovoltaic power generation, is a clean, efficient and renewable product, and an effective way to solve energy shortage and environmental friendly development problems^[1-2].

Since 2011, China has continuously explored the implementation of the renewable energy quota system. The literature^[3-5] verifies the feasibility of implementing the quota trading system in China, and proposes the preliminary framework and countermeasures for the implementation of the quota system. Literature^[6-9] studied the operational mechanism and management mechanism of renewable energy quotas. The existing research on the quota system focuses on the feasibility and institutional arrangements of the implementation of the quota system^[10-11], and lacks a specific analysis of the impact of the policy after the implementation of the quota system. At present, the research on new energy consumption strategies mainly focuses on power supply regulation, grid interconnection and power substitution^[12], and lacks analysis of time series production simulation.

This paper first studies the allocation of quota indicators under China's renewable energy quota policy. From the two aspects of capacity effect and grid connectivity effect, this paper analyzes the impact of renewable energy quota policy on new energy industry

development and grid interoperability level, and then proposes corresponding The new energy consumption strategy and a comprehensive strategy to consider the process of optimizing the out-of-area transmission curve. Finally, an empirical analysis of the consumption situation of a provincial power grid before and after the new energy consumption strategy in 2020 is conducted, which is of guiding significance for promoting the sustainable development of China's non-water **renewable energy power generation**

2 Analysis of New Energy Consumption Strategy under the Renewable Energy Quota Target

2.1 Analysis of new energy consumption strategies

(1) By enhancing the local new energy development capability and technology level, the installed capacity and grid capacity can be increased. At present, new energy development in many provinces in China is still in the initial stage of development, and there is still room for improvement in technical level and cost competitiveness. Therefore, provinces can use local weather geography and other resources according to local conditions, and combine their own conditions to develop more suitable energy types and fully tap the potential of their new energy utilization.

(2) Play the role of trans-provincial trans-regional transmission channels and make rational use of calls

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outside the zone. Since the development of new energy sources such as wind power and photovoltaics will be constrained by natural resource conditions, under certain technical conditions, the available capacity of local new energy in many provinces is limited. In the case of full utilization of local new energy, provinces that have not yet reached the target of consumption quotas may consider to absorb surplus power outside the province through new energy transmission channels across provinces and regions.

(3) By optimizing the transmission curve, the win-win situation of new energy consumption level and quality level can be promoted. The curve optimization process of adding the power transmission line in the strategy can effectively improve the new energy consumption of the receiving power grid and obtain the maximum energy utilization efficiency of the entire interconnected area.

2.2 Time series production simulation model

The power system time series production simulation is the basic method for the new energy consumption analysis such as grid wind power. The simulation operation optimization objective function is as follows

$$\min F = \min \sum_{t=1}^T (F_{R,t} + F_{LOSS,t})$$

Where: $F_{R,t}$ is t-time system energy consumption cost; $F_{LOSS,t}$ is the penalty for the system loss of load for the t period; T is the number of scheduling periods.

The power generation cost of a thermal power unit is composed of coal consumption cost and start-up cost., Its expression is

$$F_{R,t} = \sum_{i=1}^N [u_{i,t} (a_i P_{i,t}^2 + b_i P_{i,t} + c_i) + S_{i,t}]$$

Where: N is the number of thermal power units; $u_{i,t}$ is the operating state of the thermal motor unit i during the t period; a_i , b_i , c_i is the cost factor of thermal power unit i ; $P_{i,t}$ is the output of the thermal power unit i during the t period; $S_{i,t}$ is the start-stop cost of the thermal power unit i during the t period. The system load penalty fee is

$$F_{LOSS,t} = C_{LOSS} E_{LOSS,t}$$

where: C_{LOSS} is the unit loss of load penalty fee; $E_{LOSS,t}$ is the expected value of the system's unloaded power during the t period. The constraint is:

(1) System power balance constraints

$$\sum_{i=1}^N P_{i,t} + \sum_{i=1}^{N_S} P_{S,i,t} + \sum_{i=1}^{N_W} P_{W,i,t} + \sum_{i=1}^{N_{line}} P_{line,i,t} = P_{L,t}$$

where: $P_{S,i,t}$ and $P_{W,i,t}$ are the power generation output of the photovoltaic power station and the wind farm

i in the t-time period, respectively; $P_{line,i,t}$ is the transmission power of the time zone contact line i , the positive value is sent, and the negative value is sent; $P_{L,t}$ is the system load of the time period; N_S and N_W are the number of photovoltaic power plants and wind farms, respectively; N_{line} is the number of contact lines.

(2) Conventional thermal power unit related constraints, including the upper and lower limits of the output force, the start and stop constraints, and so on.

(3) New energy power generation output operation constraints

$$0 \leq P_{W,i,t} \leq P_{W,i,max}$$

$$0 \leq P_{S,i,t} \leq P_{S,i,max}$$

where: $P_{W,i,max}$ and $P_{S,i,max}$ are the theoretical maximum power of wind farm i and photovoltaic power station i , respectively.

(4) Cross-regional tie line constraints

$$P_{line,i,min} \leq P_{line,i,t} \leq P_{line,i,max}$$

$$\sum_{t=1}^T P_{line,i,t} \Delta T = E_{line,i}$$

where: $P_{line,i,min}$ and $P_{line,i,max}$ are the minimum and maximum power limits of tie line i , respectively; $E_{line,i}$ is the protocol power of the contact line i in the time period T.

3 Empirical analysis

3.1 Basic scenario

Based on the power planning level of a province in 2020, regardless of biomass power generation (small proportion), the consumption of new energy in the system under the basic scenario is calculated. The installed capacity of the power grid in 2020 is about 33.86 million kW, 17.73 million kW, 1.2 million kW, 5 million kW, 2 million kW, and the total installed capacity is 59.796 million kW. The simulated consumption results are: the whole society uses 18 billion kWh of electricity, the new energy generation is 11.493 billion kWh, the new energy consumption ratio is 5.74%, the abandoned wind rate is 2.26%, and the light rejection rate is 0.16%. According to the "Guidance Opinions", the non-water renewable energy quota targets of the provincial power grid are considered to be 5%, 7%, 10% and 13% respectively. According to the production simulation results, the proportion of local new energy consumption in the basic scenario is 5.74%, which can meet the requirements of 5% of the consumption of electricity, but there is a certain gap from other targets, so it can be combined with the new energy consumption under different consumption strategies. Situation, analyze the effectiveness of each strategy.

3.2 Increasing the scene analysis of outbound calls

Assume that the province's new energy resources have been fully exploited and utilized under the basic planning level. According to the province's "13th Five-Year" power plan, a trans-regional transport channel with a capacity of 8 million kW will be put into operation in 2020. Out-of-area calls to achieve the 2020 renewable energy power quota target. Therefore, the new energy consumption of the provincial power grid under different utilization hours of the DC channel can be analyzed. The transmission data of the channel is shown in Table 1, and the results of the consumption are shown in Table 2. Thus, with the gradual increase of the outward power supply, the dual objectives of eliminating the landscape power and quality can be achieved under the 7% quota requirement. However, when the quota indicator is raised to 10% or even 13%, if only consider increasing the power supply outside the zone to meet the power consumption target, the abandoned wind rate and the light rejection rate of the power grid will seriously exceed the standard. Therefore, further consideration can be given to increasing the proportion of new energy transmission in the inter-zone channel. At present, due to technical limitations, the channel's new energy ratio can reach up to 75%. At this time, the inter-area channel transmission data that meets the 10% renewable energy consumption quota is shown in scenario 3, and the abandoned light rate is up to standard. There is a certain limit of the wind rate, and it can be considered to analyze the consumption method of the optimized tie line power transmission. In scenario 4, the new energy abandonment rate is seriously exceeded, and the single strategy of increasing the outbound call is not applicable to the indicator level.

Table 1 Cross-area DC channel transmission data

Scenes	Channel utilization hours/h	Conveying electricity/100 million kWh	Fixed power/10,000 kW	New energy ratio/%	Conveying new energy power/100 million kWh
scene 1	750	60	68.36	30	18
scene 2	1100	88	99.13	30	26.4
scene 3	1500	120	136.72	75	90
scene 4	2625	210	239.26	75	157.5

Table 2 Simulation results of different scenarios of a provincial power grid

Scenes	Local new energy consumption/100 million kWh	Input new energy/100 million kWh outside the	New energy consumption ratio/%	Abandoned wind rate/%	Light rejection rate/%

		zone			
Basic scene	114.93	0	5.74	2.26	0.16
scene 1	113.72	18.0	6.65	3.38	0.63
scene 2	111.85	26.4	7.00	5.00	1.91
scene 3	108.59	90.0	10.03	7.89	4.12
scene 4	101.00	157.5	13.06	14.34	10.61

3.3 Optimizing the scene analysis of the power transmission curve outside the zone

For the optimization analysis of scenario 3 in Section 4.3, consider the 3.3-line tie line transmission curve optimization process, and analyze the historical annual load characteristic curve of the province. The province's power grid summer July-August and autumn-winter November-1 The monthly load demand is large, and the load demand is small from May to June in spring.

Then, considering the peak period of photovoltaic power generation at the cross-channel channel and the power curve step constraint and power adjustment times of the DC channel, the power transmission curve of each day of the DC channel can be optimized, combined with the season of the above analysis. With the transfer characteristics, the power transmission curve as shown in Fig. 2 can be obtained.

Figure 2 Optimized cross-region channel power transmission curve

The optimized transmission curve is substituted into the model for production simulation, and the results of the new energy consumption of a certain provincial power grid in 2020 are shown in Table 3. The comparison shows that the optimized transmission curve effectively improves the abandonment and abandonment of the provincial power grid, improves the new energy consumption of the grid, and eliminates the non-regional grid through the optimized scheduling process of the tie line. Water renewable energy and improving the

economics of power grid operation have brought significant benefits.

Table 3 Simulation results of optimized power transmission curve under limiting effect

Scenes	Local new energy consumption /100 million kWh	Input new energy /100 million kWh outside the zone	New energy consumption ratio /%	Abandoned wind rate /%	Light reject ion rate /%
Fixed power transmission	108.59	90	10	7.89	4.12
Optimized power transmission curve	112.21	90	10.21	4.72	1.55

4 Conclusion

Based on the policy background of the development and utilization of renewable energy, this paper first studies the distribution of indicators in different regions under the quota policy, and clarifies that the establishment of renewable energy consumption quota indicators will affect the level of new energy development and consumption in various regions. situation.

Secondly, the theory of policy effects can be seen that the implementation of renewable energy quota policies can effectively promote the increase of new energy installed capacity, and strengthen the level of grid interconnection and expand the scope of new energy allocation; however, a high proportion of new energy sources may limit consumption. Therefore, when proposing the corresponding new energy consumption strategy, we can consider adding the tie line power optimization process, in order to realize the new energy consumption strategy of sending and receiving double-end win-win.

Finally, based on the time series production simulation model, taking a provincial power grid as an example, it is verified that the new energy installed capacity and the use of out-of-zone calls and other consumption strategies to respond to different quota policies.

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