170 kWh energy saving and emission reduction

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Many studies have been carried out on carbon emission reduction, and different studies are committed to different links of carbon emission reduction. This paper reviews the relevant literature from three aspects: the analysis of the influencing factors of carbon emission reduction, the prediction model of carbon emission reduction, and the random uncertainty of carbon emission reduction.

The research and achievements of other scholars are shown in the Table 1.

Since the end of 2019, COVID-19 has swept the world, and the world situation has become more complex, which has profoundly affected and changed global and regional energy consumption and carbon emissions. Wang et al. analyzed the various impacts of COVID-19 on China"s environmental development, and discussed Chinese future economic development and its impact on the world economy by scenarios (Wang and Su 2020; Wang et al. 2021, 2022; Whang and Zhang 2021). It also needs to explore the development mode of carbon emission reduction of power grid enterprises to adapt to the new international environment.

Generally speaking, there are few studies on carbon emission reduction of power grid enterprises, and there are few studies on the evaluation method of carbon emission reduction contribution of power grid enterprises. In addition, the research on carbon emission reduction mostly focuses on one of the above aspects, and there is a lack of research that integrates the three aspects. Therefore, under the background of the national evaluation of carbon reduction contribution of energy industry (Su 2021), this research has important theoretical and practical significance.

As a link and platform connecting the upstream and downstream of the power industry, power grid enterprises will play an important strategic supporting role in realizing China"s carbon peak and carbon neutralization strategic objectives. Through the in-depth implementation of the new energy security strategy of "four revolutions and one cooperation," take measures to support clean energy consumption, realize fine line loss management, and improve the proportion of energy consumption and power efficiency of power terminals, so as to contribute to the goal of carbon peak and carbon neutralization.

In accordance with the carbon emission reduction plan, China Southern Power Grid has strengthened the allocation of clean energy and helped the five southern provinces build a low-carbon and clean energy structure. The installed capacity and electricity of non-fossil energy in the whole network have accounted for more than 50% for 5 consecutive years; continuously optimize the power grid structure, control the line loss rate at 5.59%, and save 3.66 billion kWh and 1.07 million kW of power on the demand side (China Southern Power Grid 2020).

Due to the difficulty of data collection of comprehensive energy service emission reduction, energy supply,

and energy efficiency service emission reduction, this example only considers three parts: reducing line loss emission reduction, consuming clean energy emission reduction, and electric energy substitution emission reduction.

In order to systematically analyze the influencing factors of the contribution of power grid enterprises to carbon emission reduction (Lin and Qi 2018), starting from the three sub indicators constituting the contribution of power grid enterprises to carbon emission reduction, based on artificial experience and literature review, 26 influencing factors on the three sub-indicators of carbon emission reduction contribution are collected. The details are shown in Fig. 1 (note: the length of high-voltage transmission line refers to the length of >= 220 kV AC transmission line, and the availability factor of high-voltage transformer refers to the availability factor of transformer >= 110 kV and above).

Influencing factors of carbon emission reduction contribution

This paper studies a variety of influencing factor screening methods and compares the traditional principal component analysis method, grey correlation degree method, and PLS-VIP method. Compared with PLS-VIP method, the influencing factors screened by principal component analysis method and grey correlation degree method have a higher repetition rate of influencing factors among sub-indexes and poor performance in the preliminary trial calculation learning accuracy. Therefore, PLS-VIP method is determined to be used as the influencing factor screening method in this paper.

Based on the preliminary collection of influencing factors, this paper uses PLS-VIP screening method (Liu and Jiang 2017; Liu 2016) and considers the VIP value of influencing factors and the actual correlation. Thirteen main influencing factors are screened from three aspects: consumption of clean energy emission reduction, reduction of line loss emission reduction, and electric energy substitution emission reduction. The details are shown in Figs. 2 and 3 (note: the 13 influencing factors obtained by screening are shown in bold text in the figure).

PLS-VIP screening results of influencing factors of carbon emission reduction contribution