

Study on the Effect and Path of Energy Substitution Considering the Dual Constraints of Energy Security and Environmental Regulation

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Abstract

Under the constraint of the "double carbon" goal, China implements the carbon emission dual control policy to replace the original energy consumption dual control policy. This paper uses the historical data from 2000 to 2024 as the adjustment parameters of the SD model and sets three emission scenarios, namely high, medium and low, to predict China's carbon emissions from 2025 to 2060. The model predicts that the peak time of carbon emissions in the high-emission scenario is 2032, and there is still a gap of 1.8 billion tons of carbon emissions in 2060. In the medium emission scenario, the peak time is 2029, and carbon neutrality needs to be delayed until 2065. The low-emission scenario could peak in 2027, with net emissions falling to -360 million tonnes in 2060. The study confirmed that the dual control policy of carbon emission has advantages compared with the dual control policy of energy consumption. The former will increase the reduction rate of carbon emission intensity by 1.8 percentage points, and the proportion of non-fossil energy can reach 82% in 2060. However, the time lag effect of the policy is obvious, and the carbon market mechanism needs to operate for 8-10 years to show scale effects. The results show that under the low emission scenario, a cumulative investment of 34.8 trillion yuan in clean energy is required to ensure the peak in 2030 and achieve carbon neutrality in 2060. Energy security constraints reduce coal investment 12% more slowly than in the baseline scenario, requiring CCUS technology to balance emission reduction rigidity. The study proposes to construct a policy combination of "ladder carbon price + dependence early warning", and implement 4.5% annual carbon emission intensity constraint by 2030, in order to break the double constraint of environmental regulation and energy security.

Keywords

Dual Carbon Target, Carbon Emission Dual Control Policy, Energy Security, Energy Substitution