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Abstract

In recent years, many countries, including China, America and European countries, have successively proposed Carbon Neutrality Plans. Under the background of Carbon Neutrality, natural gas, as a clean energy which produces less carbon dioxide emission than other fossil fuels, will definitely play a key role in future energy consumption. Therefore, for natural gas industry, it is of great significance to predict natural gas supply and demand under the background of Carbon Neutrality.

Long-range Energy Alternatives Planning System (Leap) is a system that can be used to predict regional energy supply, energy demand and carbon dioxide emission. In this paper, the LEAP system is modified and improved by using new parameters including a coefficient of comprehensive energy efficiency and the terminal effective energy consumption. Then, key parameters such as China's future energy consumption, carbon dioxide emission, and natural gas consumption were predicted by using a composite model of Back Propagation (BP) Neural Network and LEAP, and China's natural gas production was forecast by using Production Composition Model. Finally, based on the forecast results of natural gas supply and demand, several suggestions were put forward for the development of China's natural gas industry.

Research results show that under the background of Carbon Neutrality, the massive use of renewable energies and natural gas will help China deeply reduce its carbon dioxide emission, which will enable China to reach its Carbon Neutrality Goal in 2060. Prediction results also indicate that China's natural gas consumption and production still have huge potential for growth in the future: (a) China's energy consumption will reach its peak in 2035 with $59.4 \times 10^8 \text{tce}$; (b) the carbon dioxide emission will reach its peak in 2025 with $103.4 \times 10^8 \text{t}$; (c) natural gas consumption will reach its peak in 2040 with $6100 \times 10^8 \text{m}^3$, and the industrial sector and power plants will contribute the largest increase in natural gas consumption; (d) the peak natural gas production in China is about $2800 \sim 3400 \times 10^8 \text{m}^3$, with peak conventional gas production (including tight gas) ranging from $2100 \times 10^8 \text{m}^3$ to $2300 \times 10^8 \text{m}^3$, peak shale gas production ranging from $600 \times 10^8 \text{m}^3$ to $1050 \times 10^8 \text{m}^3$, and peak coalbed methane production ranging from $150 \times 10^8 \text{m}^3$ to $220 \times 10^8 \text{m}^3$.

In this paper, novel models, including a composite model of BP Neural Network and LEAP, and the Production Composition Model, were used to predict China's future energy consumption, natural gas supply and demand. The prediction results are meaningful to the development and planning of China's natural gas industry.

Key words: Carbon Neutrality; Carbon Dioxide Emission; Natural Gas Consumption; Natural Gas Production; Natural Gas Import