Journal of Applied Science and Engineering Innovation, Vol.10, No.2, 2023, pp. 85-87
ISSN (Print): 2331-9062
ISSN (Online): 2331-9070

Research on Carbon Emission Forecasting of China's Construction Industry

Zhang Shuguo[1], Zhang Junwei[1]
[1] *Department of Economic Management, North China Electric Power University, Baoding, Hebei 071003, China*

Abstract: As the global population grows and urbanization accelerates, the construction industry has become one of the primary sources of global greenhouse gas emissions. Reducing carbon emissions from the construction sector is crucial to addressing the increasingly severe challenges of global environmental change. At present, research in the field of carbon emissions has been intensifying. Through literature research, this paper compares the current status of domestic and foreign research on the decomposition of carbon emission influencing factors and forecasting methods and briefly introduces the relevant models and their advantages and disadvantages to provide a reference for the research on carbon emission forecasting in the construction industry.

Keywords: carbon emission; construction industry; factor decomposition; forecasting methods

INTRODUCTION

In response to climate change caused by the greenhouse effect, the Chinese government has pledged to peak carbon dioxide emissions by 2030 and achieve carbon neutrality by 2060. As one of the three major sectors with high carbon emissions (industry, transportation and construction), the construction industry will play an essential role in energy saving and emission reduction in the future. Accurate forecasting of carbon emissions from the construction industry can promote the development of the construction industry in a more sustainable direction and facilitate the process of green, intelligent and low-carbon construction industry. This paper reviews the relevant literature on carbon emission forecasting in the construction industry from two perspectives: the decomposition of carbon emission influencing factors and forecasting methods, in order to understand the current status of research, research methods and research results on carbon emission forecasting in the construction industry, to improve the accuracy and operability of carbon emission forecasting in the construction industry.

DECOMPOSITION OF THE FACTORS INFLUENCING CARBON EMISSIONS

The study of factors influencing carbon emissions is a prerequisite for reducing emissions for the industry and can provide a theoretical basis for carbon emission forecasting studies. Currently, three types of models are used to study the factors affecting carbon emission: IPAT model and its extended model, factor decomposition analysis model and other models.

The IPAT model was primarily used to capture the impact of population activities on environmental stress and was later extended with the Stochastic Impacts by Regression on Population, Affluence and Technology (STIRPAT) model and Kaya properties. For example, Wang, et al. used the STIRPAT model to explore the driving forces of carbon dioxide emissions associated with energy consumption and found that the dominant contributors differed across time [Wang, et al., 2017]. Ghazali, et al. applied the extended STIRPAT model to study the impact of different factors on CO_2 emissions in ten newly industrialized countries [Ghazali, et al., 2019]. Han used the STIRPAT model to estimate the impact of urban agglomeration economies on carbon emissions, and the results show that both agglomeration specialization and diversification agglomeration can significantly contribute to carbon reduction in local and neighboring cities through agglomeration externalities [Han, et al., 2018]. Liu, et al. extended the Kaya equation to include energy structure and industrial structure, and used the LMDI method to decompose the primary carbon emission influencing factors. The study found that energy intensity could significantly suppress carbon emissions in the transportation industry in Hubei Province [Liu, et al., 2022].

Factor decomposition analysis models are another widely used method for identifying the drivers of carbon emissions. This model is used to decompose changes in the target variable into combinations of several factors to explore each factor's contribution to the target variable, mainly including exponential decomposition analysis (IDA) and structural decomposition analysis (SDA). In contrast, the IDA approach is simple and widely applicable, and can be further subdivided into various forms, such as LMDI and Laspayres methods. For example, Zhang and Da used the LMDI exponential decomposition method to examine the contribution of various factors to the growth of carbon emissions and carbon intensity from 1996 to 2010[Zhang, et al., 2015]. By constructing a modified Laspeyres decomposition model, Zang and

Wu decomposed the factors influencing carbon emissions into the total input effect, the input structure effect and the technological progress effect to decompose and calculated the changes in carbon emissions in China's industrial sectors from 2005 to 2018[Xu, 2021]. SDA based on input-output structure can be used for more detailed analysis. Based on the SDA model, Guan, et al. decomposed the factors affecting carbon emissions from the construction industry into Leontief effect, intensity effect and final demand scale effect, which improved the accuracy of the empirical research results[Guan, et al., 2016]. In addition, Grey Relational Analysis and Principal components analysis can also be used to explore the impact indicators.

RESEARCH ON CARBON EMISSION FORECASTING METHODS FOR THE CONSTRUCTION INDUSTRY

Domestic and foreign scholars have conducted a large amount of research on predicting carbon emissions from the construction industry, with research methods divided into top-down and bottom-up models, and combining them with scenario analysis to predict construction carbon emissions.

Top-down models are used to comprehensively explore the interactions between energy-consuming sectors and macroeconomic factors to predict future carbon emissions. Xiang, et al. used the STIRPAT model combined with LASSO regression analysis to find that carbon emissions from commercial buildings in China are expected to peak at 126 million tCO_2 in 2030 [Xiang, et al., 2022]. Zhao and Liu adopted the system dynamics approach to explore the influence relationship among subsystems of economy, energy, population and environment, indicating that the production of building materials is the main source of carbon emissions in the construction industry[Zhao, et al., 2019]. In contrast, bottom-up models predict or analyze a building's peak carbon emissions by summarizing end-use energy consumption from bottom to top and building energy consumption and carbon emissions at a regional or national level.. For example, Xie constructed a LEAP-based carbon emission prediction model for public buildings and used scenario analysis to predict the peak time and peak level of carbon emissions for public buildings in Chongqing[Xie, 2019].

Scenario analysis methods can combine top-down and bottom-up models to determine the path of carbon emission peaks. However, this approach is only a static projection that ignores the uncertainty of future variable changes. To address these shortcomings, scholars have attempted to conduct sensitivity analysis of variables at a fixed rate, while others have further tried to set different rates of change in different periods. The Monte Carlo simulation approach allows for better dynamic modeling as it can incorporate uncertainty analysis into the forecasting process. Regarding carbon emissions in the construction sector, Ma innovatively combined the IPAT model and Monte Carlo methods to predict the evolution of carbon emissions from Chinese buildings during the operational phase[Ma, 2020].

CONCLUSION

Previous studies have provided us with some models and evidence for carbon emission forecasting in the construction industry. However, at the same time, there are some things that could be improved, such as the lack of systematic analysis of influencing factors, the complexity of model establishment, and the uncertainty and randomness of variables. Therefore, in the future, it is necessary to dig deeply into the influencing factors of carbon emission, further improve and refine the prediction models, enhance the data quality and prediction accuracy, strengthen the analysis of the whole construction industry carbon emission system, and provide stronger support for carbon emission reduction decisions in the construction industry.

REFERENCES

Ghazali A, Ali G. "Investigation of key contributors of CO2 emissions in extended STIRPAT model for new ly industrialized countries: A dynamic common correl ated estimator (DCCE) approach." Energy Reports, v ol.5, pp.242-252, 2019.

Guan Jun, Jiang Lihong, Zhang Zhi, et al. "Structural decomposition analysis of carbon emission growth in China's construction industry." Journal of Engineering Management. vol.30, no.06, pp.7-11, 2016.

Han Feng, Xie Rui, Lu Rui, et al. "The effects of urb an agglomeration economies on carbon emissions: Ev idence from Chinese cities." Journal of Cleaner Prod uction, vol.172, pp.1096-1110, 2018.

Liu Yanhui, Li Yang. "Carbon emission measurement a nd decomposition of influencing factors of transportat ion industry in Hubei Province." Statistics and decisi on making, vol.38, no.15, pp.88-92, 2022.

Ma Minda. "Influencing factors and peak simulation stu dy of carbon emissions from building operation in C hina." Chongqing University, 2020.

Wang Changjian, Wang Fei, Zhang Xinlin, et al. "Exa mining the driving factors of energy related carbon e missions using the extended STIRPAT model based on IPAT identity in Xinjiang." Renewable and Sustai nable Energy Reviews, vol.67, pp.51-61, 2017.

Xiang X, Ma X, Ma Z, et al. "Operational carbon cha nge in commercial buildings under the carbon neutral goal: A LASSO–WOA approach." Buildings, vol.1 2, no.1, pp.54, 2022.

Xie Jiaoyan. "Discussion on carbon emission peaking a nd energy conservation and emission reduction of pu blic buildings in Chongqing based on LEAP model." Chongqing University, 2019.

Xu Ninghan. "Study on the synergistic path between carbon emission reduction target and high quality economic growth." Wuhan University, 2021.

Zhang Yuejun, Da Yabin. "The decomposition of energy-related carbon emission and its decoupling with economic growth in China." Renewable and Sustainable Energy Reviews, vol.41, pp.1255-1266, 2015.

Zhao Donglei, Liu Yisheng. "Research on carbon emission prediction of China's construction industry based on system dynamics." Henan Science, vol.37, no.12, pp.2025-2033, 2019.