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Editorial: Energy-environment sustainability: progresses and impacts of clean energy system construction

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Editorial on the Research Topic
Energy-environment sustainability: progresses and impacts of clean energy system construction

Energy serves as a fundamental pillar for human survival and development, yet the extensive exploitation of traditional fossil fuels such as coal, oil and other high-carbon energy resources has caused severe ecological and environmental Research Topic. To address these pressing challenges, a transition toward efficient and clean energy alternatives must be prioritized through energy portfolio diversification, production methodology innovation, and sustainable utilization practices. Thus, clean energy system construction is urgent, especially in the context of the net-zero economy. Furthermore, international R&D capital can drive innovation in clean energy technologies, enhancing green total factor productivity by promoting efficient, low-carbon production processes. Industrial agglomeration can also facilitate the sharing of sustainable practices and energy-efficient infrastructure. It is essential to identify the paths of efficient and clean use of various energy resources and evaluate the impacts of vigorous energy development on the environment and ecosystems. Regarding this Research Topic, focusing on the clean utilization of traditional fossil fuels, exploring new energy resources, and understanding the impacts of energy development and utilization are very attractive and promising.

Wang and Zhang proposed an ELG model that integrates Empirical Mode Decomposition (EMD), Long Short-Term Memory (LSTM), and Gradient Boosting Machine (GBM) to enhance the prediction accuracy of biofuel production. By leveraging EMD for data preprocessing, LSTM for temporal dependency extraction, and GBM for output optimization, the ELG model demonstrates exceptional accuracy and robustness in forecasting microalgae biofuel production efficiency. This high-precision prediction capability optimizes resource allocation and enhances economic feasibility. The model not only advances technological and scientific understanding in microalgae biofuels but also offers a reliable framework for other renewable energy applications.

Zhang et al. investigated the current state of green economic development (GED) in China and underscored the role of optimizing the energy consumption structure (ECS) in driving GED. China's GED exhibits a fluctuating upward trend overall, yet regional

imbalance persist, with the eastern region outperforming the central and western regions. Optimizating ECS significantly enhances GED and demonstrates a notable spatial spillover effect. The spatial effect of ECS optimization on GED is shown as Central Region > Western Region > Eastern Region. The upgrading of ECS serves as a key driver for GED advancement. Breaking down regional barriers is essential to foster shared GED progress, while also leveraging the mechanisms of industrial structure to maximize its potential.

Abudureheman and Yiming focused on the R&D activities in the energy field and explored the spatial impacts of energy-saving R&D on urban carbon emission performance in China and its internal transmission mechanisms. Their findings reveal that energy-saving R&D significantly enhances urban carbon emission performance, with utility-type energy-saving R&D playing a more critical role than invention-type R&D. Energy-saving R&D enhances urban carbon performance primarily through the transmission mechanism of technical effects, while structural and urbanization effects exert negative impacts on carbon emission performance due to the existence of energy rebound. Energy-saving R&D exhibits significant spatial spillover effects on urban carbon emission performance, with economic factors being more influential in this spatial dynamic.

Jiang et al. conducted an in-depth analysis of the impact of the New Energy Demonstration City policy on urban green innovation capabilities using data from 218 Chinese cities. It was found that the policy significantly enhances cities' green innovation capabilities, a conclusion that holds true even after robustness checks. Technological investment and public environmental awareness were found to be two critical pathways through which the New Energy Demonstration City policy enhances urban green innovation capabilities. The pilot policy of the national-level Big Data Comprehensive Experimental Zone has partially amplified the effectiveness of the New Energy Demonstration City policy in driving urban green transformation. This research provides a new perspective on understanding the dynamics of urban green innovation and provides valuable insights for future research and policymaking.

Zhang et al. conducted a comprehensive analysis of the factors influencing carbon emissions in Beijing's transportation sector. They found that private road carbon emissions account for about 77.97% of the road traffic carbon emissions, making it the decisive factor in the total road carbon emissions. In the public domain, development level (the added value of transportation GDP) and energy intensity (the ratio of the amount of energy consumed to the amount of traffic turnover) are the two most critical factors affecting carbon emissions, contributing 25.20% and −38.71%, respectively. In the private domain, private car usage, energy consumption, and vehicle structure (the proportion of vehicles consuming different energy in the total number of vehicles) are the three key factors, with contribution values of 60.17%, 47.86%, and −12.99%, respectively. Indirect carbon emissions from electricity account for about 13.6% of public road carbon emissions and about 0. 9% private road carbon emissions. These results offer valuable insights for decision-making in adjusting city transportation energy structure and promoting electrified transportation.

Liu et al. emolyed panel data covering 284 Chinese cities during the period 2011–2020 to examine the impact of the digital economy on green total factor productivity (GTFP). Their empirical restults reveal a significant positive impact of the digital economy GTFP, mainly due to technological innovation pressures. However, the impact of the digital economy on GTEP shows an initial increase, followed by gradual decrease and then an increase, creating an even more important gap between resource-rich and undeveloped cities where its advantages are limited. This study proposes environmental-conscious governmental action on blueprinting policies regarding the digital repercussions on GTFP.

Gao et al. applied a spatial effect model to analyze the impact of industrial agglomeration and international R&D capital technology spillover on air pollution. The empirical findings expose spatial autocorrelation and dependence between air pollution, international R&D capital, and industrial agglomeration, revealing that they have a single threshold impact. The study reveals that while industrial agglomeration generally benefits air pollution reduction, surpassing the threshold value amplifies the positive impact of international R&D capital technology spillover on mitigating air pollution. This research holds significant theoretical and practical implications for promoting sustainable economic growth, particularly in China.

The goal of this Research Topic is to explore and identify variuos technologies and strategies for clean energy utilization and environment impact assessment of energy development, which can be applied for clean energy systems construction. This Research Topic aims to highlight the most advanced achievements in the energy-environment sustainability, which should inspire and guide the future direction of sustainable energy practices.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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The author(s) declare that no Generative AI was used in the creation of this manuscript.

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