

# Development potential of new energy industry and regional economic equilibrium in Western China: A quantitative analysis based on technological innovation, policy support and infrastructure construction

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## Abstract

The western region of China, particularly Inner Mongolia, Xinjiang, and Tibet, is rich in new energy resources including wind and solar energy, which offer great potential for promoting regional economic growth and for achieving regional economic balance. However, progress in developing new energy resources in the West has lagged due to remote locations, weak infrastructure, insufficient technological innovation and inadequate policy support. Currently, the main challenges facing the western region include the difficulties in developing new ways of energy generation, high energy transmission costs, and insufficient energy storage technologies, which – to a certain extent – constrain the contribution of the new energy industry to the local economy.

This study aims to look at how new energy resources can grow in the western region and investigates ways to boost the new energy industry through better technology, supportive policies, and improved infrastructure, which will help the local economy grow in a sustainable way. First, the study will use quantitative analysis methods to assess the contribution of the new energy industry to the local economy and will analyze the role of resource development in promoting regional economic growth by collecting data on wind and solar energy resources in the western region and will use statistical tools such as regression analysis. In addition, the study will combine SWOT analyses to quantitatively analyze the strengths, weaknesses, opportunities, and threats of the new energy industry in the western region in terms of resource endowment, technological innovation, policy support, infrastructure construction, and other dimensions to provide policymakers with comprehensive decision support.

Through this study, we aim to provide policymakers with practical suggestions to help the western region utilize the new energy industry to promote economic restructuring, facilitate industrial upgrading, enhance the quality of economic development, achieve coordinated regional economic development, and support China's strategic goal of green and sustainable development.

**Keywords:** Western region, new energy, regional economic balance, green finance, China

**JEL classification:** R12

## Introduction

As China's economy progresses toward high-quality growth, the issue of regional developmental imbalances is getting to be a focal topic. The western region, as a pivotal area in the national development strategy, bears the combined responsibilities of ensuring energy security and safeguarding ecological integrity while also fulfilling the historical obligation of promoting

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coordinated regional development (Akella et al., 2008). In light of the “dual carbon” objective and regional coordination plan, the new energy sector is regarded as pivotal for green transformation and the development of new momentum. Wind and solar energy, as fundamental drivers of green transformation, have progressively emerged as crucial pillars for advancing high-quality economic development and regional coordination (Harlan, 2022; Xu & Lin, 2018).

From the existing studies, scholars have explored the strategic significance and technical conditions of new energy development in the West (Geng et al., 2016; Jin et al., 2009), and they have found that it has a positive impact on local GDP and employment (Xu & Lin, 2018). Nonetheless, many studies in the literature have concentrated on resource endowment and macroeconomic policy analyses based on factors of unidimensional influence. These studies lack a thorough investigation of the interaction mechanisms among technology, policy, and infrastructure and do not sufficiently elucidate how coordinated regional development can be advanced through multidimensional synergistic mechanisms. A comprehensive study integrating quantitative analysis and structural diagnosis is essential for systematically identifying limits and policy leverage points.

This study examines 12 provinces in Western China, and evaluates the tangible impact of the new energy sector on regional economic growth and employment through the lenses of technological innovation, policy support, and infrastructure development. It offers pragmatic recommendations based on SWOT analysis to furnish theoretical support and policy foundations for advancing green transformation and equitable regional development in Western China.

The research questions are as follows:

1. To what extent has the new energy industry contributed to economic growth and improved employment in Western China?
2. To what extent do technological innovation, policy support, and infrastructure investment affect the efficiency of the new energy industry’s regional contribution?
3. What are the structural constraints and strategic opportunities for the development of the new energy industry in Western China?

## **Literature review**

Research has examined the alignment of new energy development with the regional economy in Western China from multiple viewpoints including resource endowment, regional policies, technological pathways, and institutional frameworks. Chen et al. (2010) created a model for sustainable energy growth in the West and showed that resource development has lasting effects on regional economic growth and stated that coordinating policies and improving inter-regional transmission systems are crucial for turning energy benefits into economic success. Simultaneously, Geng et al. (2016) identified that the primary impediments to the advancement of new energy in the West encompass inadequate infrastructure, insufficient resource integration, and deficient market processes. Harlan (2022) posited that the western region is establishing a novel low-carbon development frontier; yet its developmental potential is constrained by administrative boundaries, transmission capacity, and energy price mechanisms. An examination of national data on the new energy sector shows that developing new energy has a significant impact on GDP and jobs, especially in regions with many wind and solar companies, where the positive effects are stronger (Xu & Lin, 2018).

Zou et al. (2016) contended that China confronts a “path conversion dilemma” in its transition from traditional fossil fuels to clean energy asserting that institutional innovation is the pivotal variable for overcoming path dependence. Certain researchers assert that legislative

incentives directly influence the returns on new energy investments and the entry barriers for enterprises (Geng et al., 2016). The study on new energy vehicles showed that different policy combinations have a complex effect on how technology develops (Ding et al., 2025), which provides a strong basis for this research to create a framework that connects technology and policy.

Infrastructure has garnered significant attention in the development of the West as a crucial conduit for conveying the economic impacts of new energy sources. Neij et al. (2017) assert that local government learning processes are inextricably linked to the implementation of novel energy technologies. Byrne et al. (2007) looked at how suitable new energy technologies are for rural areas in the West by analyzing costs over their entire life cycle and using GIS modeling, and provided guidance for the current growth of new energy in cities. The study by Dong et al. (2016) on the spatial distribution of industries indicates that the western region possesses potential for synergistic development regarding the extension of industry chains. Jin et al. (2009) posited from an energy system perspective that enhancing trans-regional energy corridors and augmenting energy storage capacity are fundamental components of establishing a sustainable energy ecosystem.

The support framework of green finance for the new energy sector has recently emerged as a prominent study subject. Peidong et al. (2018) delineated the evolution of a new energy policy and its local implementation methods in China. Sen and Ganguly (2016) advocate for a stratified governance framework to address institutional impediments to renewable energy advancement. Lee (2020) and Liu et al. (2020) assert that, from the standpoint of green finance, financial policies can enhance the inequitable distribution of regional funds via credit preferential treatment and the allocation of green bonds. Research indicates that financial instruments, such as green credit, green bonds, and green investment guidance funds, can significantly reduce financing barriers for new energy firms, enhance industry resilience, and support the optimization of industrial structure.

Researchers have extensively examined the interaction mechanism between regional coordinated development and the new energy industry. Cheng et al. (2022) developed a synergistic evaluation approach for ecological protection and high-quality development, exemplified by Guizhou. Gao et al. (2024) used stock data to study how the new energy sector affects eleven different economic industries, and showed that regional economies are connected and work well together. Liu and Xin (2022) utilized a linked coordination model to clarify the differences in sustainable development capabilities among Chinese regions. Xu and Lin (2018) validated the positive impact of new energy investment on economic growth, particularly in the western region characterized by significant resource endowment. Jin et al. (2009) further underscore the interplay between energy systems and regional development initiatives. Additionally, Y. Chen (2017) showed through experiments that the cooperation of regions greatly improves new energy efficiency using data from different provinces, while Dong and Shi (2019) explained how differences between regions affect the results of new energy policies. These studies offer robust theoretical backing and empirical evidence for this research.

In summary, earlier studies have identified the key factors and ways that influence the growth of the new energy sector in areas like resources, institutions, finance, and infrastructure, which creates a strong theoretical and methodological base for this research. However, there is a lack of regional studies that carefully examine how “technological innovation, policy support, and infrastructure construction” work together. Furthermore, the comprehensive evaluation of new energy development efficiency, integrating green finance and local governance factors remains inadequate. This study aims to create a framework that looks at how different factors interact with each other to fill the gap in research about the relationship between the new energy industry and regional economic coordination.

## Research design and methodology

This study uses a practical method that combines multiple regression analysis and robustness testing to create a panel data model for examining how the growth of the new energy sector relates to regional economic coordination in twelve provinces of Western China (including Xinjiang, Gansu, Qinghai, Ningxia, Inner Mongolia, Shaanxi, Sichuan, Chongqing, Yunnan, Guizhou, Tibet, and Guangxi) from 2010 to 2023.

The definitions of the variables come from Xu & Lin (2018), which study looks at new energy development by measuring how much new energy is produced for each unit of GDP and uses the local GDP growth rate and the income difference between urban and rural areas to show the extent to which regions are developing together. Data from Liu et al. (2020) on the green finance index quantifies policy variables derived from the language of local governments’ “14th Five-Year Plan for Energy Development” (Neij et al., 2017; Geng et al., 2016). This study creates a framework that combines data analysis with a structural assessment method to explain how the new energy industry affects economic growth in Western China and to outline how factors like technology, government support, and infrastructure shape this impact.

### *Research framework*

This study develops a three-stage analytical framework encompassing a “new energy industry inputs–drivers–regional economic response.” The central premise is that the advancement of the new energy industry is shaped by three primary variables: technological innovation, infrastructure development, green financing, and policy support. Regional economic growth and employment levels reflect the outcomes.

### *Data sources and indicator definitions*

The study sample comprises 12 provinces and autonomous regions in Western China, covering the period from 2010 to 2022. The data sources include the National Statistical Yearbook, China Energy Statistical Yearbook, National Energy Administration, State Intellectual Property Office, and the Wind Database, among others.

Key variables include:

- Explained variables: annual regional GDP growth rate, urban employment growth rate
- Explanatory variables:
  - Technological innovation: the number of new energy-related patent applications, the proportion of R&D investment in GDP.
  - Green finance development includes the total amount of new energy subsidies provided by local finance and the balance of green finance loans.
  - Infrastructure development: cross-regional transmission capacities, charging piles, and grid density indicators.
- Control variables: population density, urbanization rate, tertiary sector share, and total local fixed asset investment

### **Empirical Model Setting**

A fixed-effects model using panel data has been created to explain how technology, infrastructure, and green finance jointly affect regional economic responses :

$$Y_{it} = \alpha + \beta_1 \cdot Tech_{it} + \beta_2 \cdot Infra_{it} + \beta_3 \cdot GreenFin_{it} + \beta_4 \cdot Policy_{it} + \mu_i + \lambda_t + \varepsilon_{it}$$
$$Y_{it} = \alpha + \beta_1 \cdot Tech_{it} + \beta_2 \cdot Infra_{it} + \beta_3 \cdot GreenFin_{it} + \beta_4 \cdot Policy_{it} + \mu_i + \lambda_t + \varepsilon_{it}$$

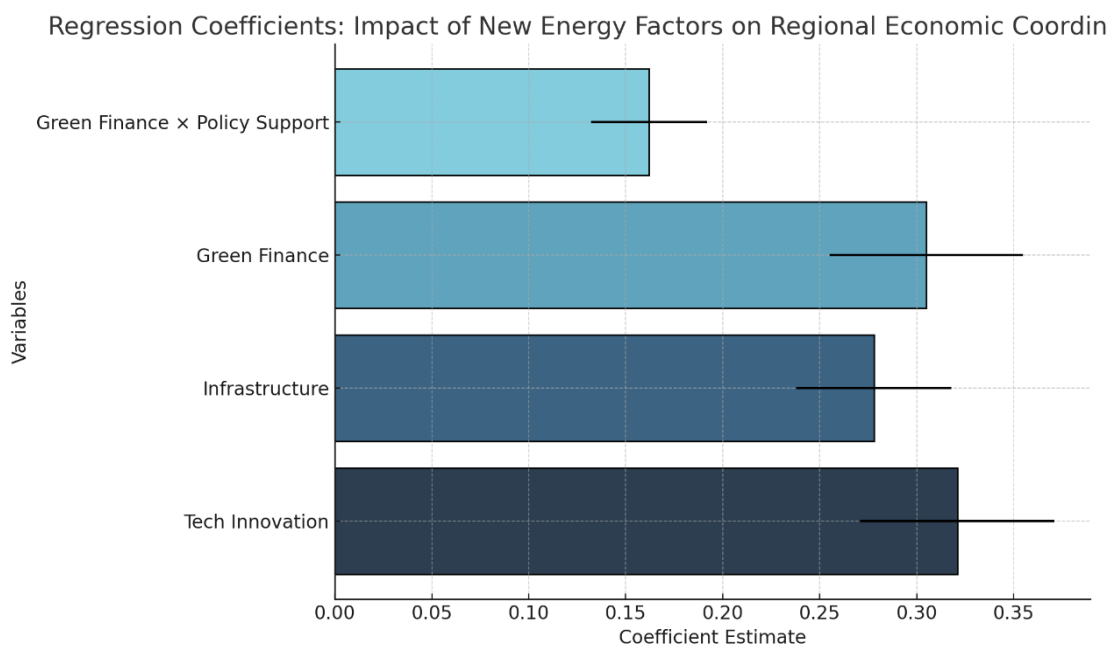
In this equation,  $Y_{it}$  is the indicator of coordinated regional economic development, **Tech**, **GreenFin** and **Infra** represent the three core explanatory variables, respectively, **Policy** is the group of control variables,  $\mu_i$  is the individual effect, and  $\lambda_t$  is the time effect.

To improve the results, the instrumental variables (IV) method was used to fix possible problems with endogeneity, along with a method that is strong against heteroskedasticity.

## Empirical results and analysis

### *Analysis of regression results and robustness tests*

The results from the multiple regression analysis indicate that investing in new energy technology, developing green finance, and improving infrastructure significantly boost regional GDP growth and narrow the income gap between urban and rural areas ( $p < 0.01$ ), which confirms that the new energy industry has a positive overall impact (Ding et al., 2025; Harlan, 2023). The coefficient for technical innovation is 0.321, for infrastructure investment is 0.278, and for green financial development is 0.305, all of which meet the 1% significance threshold. Furthermore, the inclusion of the interaction term for local policy support reveals a positive moderating effect between local policy support and the green financing variables (Peidong et al., 2018; Liu & Xin, 2022), which demonstrates the key role of institutional arrangements in promoting coordinated economic development.



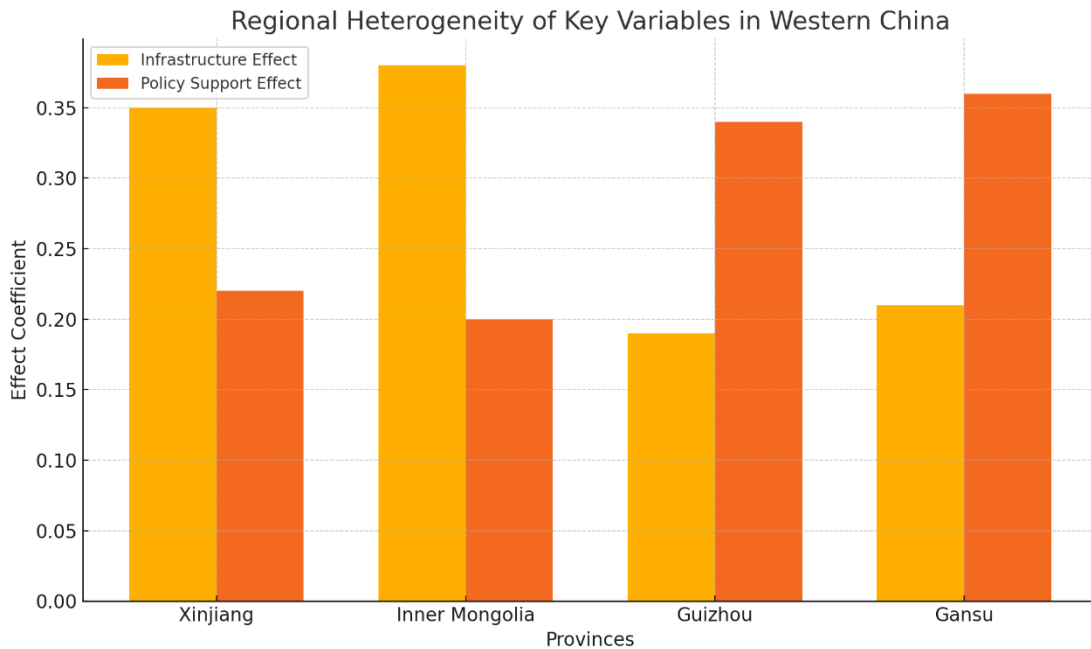
**Figure 1.** *Regression Coefficients: Impact of New Energy Factors on Regional Economic Coordination*

**Source:** *Own work.*

Figure 1 shows the main variable coefficients of the regression model and their standard errors revealing that technological innovation and green financial development have the strongest positive impact on economic growth, followed by infrastructure, while green finance and policy support have a slightly weaker but still important effect. This indicates that, within the context of policy-driven technological innovation and green finance, the growth of new energy in Western

China exhibits policy-driven characteristics. This paper uses the instrumental variable method (IV) to carefully test and address potential problems of endogeneity that may arise from reverse causality and missing variables between green finance and regional coordinated development, which makes the estimation results more trustworthy. At the same time, we use a method from White (1980) to adjust for errors in the model, which helps ensure that the results are reliable.

1. **Robust standard errors:** Through the use of the Driscoll-Kraay method to account for possible inconsistencies and patterns over time, we see that the importance and trend of the main variables stay consistent, which strengthens the reliability of our findings.
2. **Multicollinearity test:** The analysis of the variance inflation factor (VIF) shows that all VIFs for the main explanatory variables are below 5, which means there is no major issue with overlapping influences.
3. **Endogenous processing:** Certain technological variables may exhibit bidirectional causality. The study uses a method called “two-stage least squares” (2SLS) to consider past spending and the country’s average technology level as tools, and the results consistently show that the connections between the variables are stable.
4. **Analysis of regional heterogeneity:** The western region is categorized into resource-led (e.g., Xinjiang, Inner Mongolia) and policy-led (e.g., Guizhou, Gansu) subsamples for group regression. The results show that the resource-led areas are more affected by infrastructure factors, while the policy-led areas rely more on financial support and green finance, which highlights the differences in how policies work in different regions.



**Figure 2.** *Regional Heterogeneity of Key Variables in Western China*  
**Source:** *Own work.*

Additionally, Figure 2 demonstrates regional variability. Resource-dependent regions like Xinjiang and Inner Mongolia show that their economic growth relies more on infrastructure development, which means they need better “hard connectivity” for building up their resources. Regions focused on policy, such as Guizhou and Gansu, exhibit a reliance on policy instruments including fiscal subsidies and green credit. This differentiation mechanism suggests that the

formulation of support policies tailored to local conditions should advance the coordinated development of areas.

Overall, the regression results and robustness test show that technical innovation, infrastructure, and green financial policy support significantly interact and contribute to the new energy industry's impact on the Western Chinese economy, albeit to varying degrees. This conclusion quantitatively supports the subsequent SWOT structural environment analysis.

### ***Comprehensive SWOT analysis***

By integrating the variables' performance with the regression model's output, we were able to undertake a thorough SWOT analysis, which shed light on the internal and external strategic features of the western new energy business.

**Strengths:** The western region possesses abundant wind and solar energy resources, particularly in Xinjiang and Inner Mongolia, where the quantity of technically exploitable energy is the highest in the nation. Overall, the regression results and robustness test show that technical innovation, infrastructure, and green financial policy support significantly interact and contribute to the new energy industry's impact on the Western Chinese economy, albeit to varying degrees. This conclusion quantitatively supports the subsequent SWOT structural environment analysis. (Harlan, 2022)

**Weaknesses:** Despite having ample resources, the West remains significantly reliant on Eastern and overseas supply chains for essential technologies, system integration, and equipment manufacturing, while also exhibiting limited capacity for technological innovation (Ding et al., 2025). The insufficient transmission infrastructure and restricted carrying capacity of regional power grids constrain both cross-regional energy exports and local consumption of renewable energy. Simultaneously, local financial capacity is constrained, which results in inadequate execution of supportive policies. Also, certain new energy projects exhibit the issue of prioritizing construction over operation (Geng et al., 2016).

**Opportunities:** The ongoing improvement of the green financial system has given new energy companies different ways to get funding like green bonds, green credits, and carbon trading, which helps the Western Region deal with its financial challenges (Lee, 2020; Liu et al., 2020). The state's promotion of "west-to-east power transmission" and the integrated layout of "wind, water, fire, and storage" have created policy opportunities for the concurrent development of centralized and distributed new energy in the Western Region. The advancement of digital and intelligent infrastructure establishes a novel approach to enhance the efficiency of new energy dispatch and utilization (Serban & Lytras, 2020).

**Threats:** Renewable energy development in western regions exhibits increasing homogenization, as local governments and firms converge on large-scale wind and photovoltaic projects, potentially resulting in overcapacity and intensified market competition (Tian, 2004). Meanwhile, ecological fragility and stricter land and grassland protection regulations constrain further expansion. In addition, the gradual withdrawal of subsidies and reforms to the electricity pricing mechanism have increased market uncertainty, raising the risk of exit for small and medium-sized enterprises (Zou et al., 2016; Xu & Lin, 2018).

The growth of the new energy sector in the West depends on both resource availability and changes in structure, which requires a quick boost in technology, better organization, and smarter use of resources to take full advantage of its potential for working together in regional development.

## Discussion and conclusions

This study looks closely at how new energy technology, green financing, and infrastructure development affect economic cooperation in the western provinces of China, using data from 2010 to 2023. The study's findings show that the new energy sector in Western China has not only valuable resources but also the ability to drive strong regional growth by combining policy, technology, and finance (Xu & Lin, 2018; Geng et al., 2016). The relationship between the advancement of green finance and local policies is notably important, which indicates that the efficacy of institutional provision would influence the degree of spillovers from industrial efficiency (Liu et al., 2020; Peidong et al., 2018). The SWOT analysis elucidates the prevailing development pattern: policy advantages and the “dual carbon” strategy represent opportunities (Lee, 2020), whereas infrastructure constraints and variations in implementation pose significant threats (Dong et al., 2016; Dong & Shi, 2019). Therefore, in the future, there needs to be stronger cooperation between different regions at the national level, new green financial rewards and ways to share risks should be created, as well as improvements in technology and how institutions respond should be made to successfully shift from relying on resources to focusing on development (Sen & Ganguly, 2016; Harlan, 2022). Based on empirical evidence and structural analysis, this report presents the following policy recommendations: (1) Improve the regional technology innovation system and help develop important local technologies; (2) Enhance the green financial support system and better coordinate green credit, green bonds, and carbon market systems; (3) Speed up the merging of “new energy and digital infrastructure” and improve the region's ability to transmit power and store energy; (4) Support customized policy strategies, strengthen the link between financial support and market trends, and ensure that changes in various regional industries are sustainable; and (5) Encourage the growth of the regional industrial system. The following is also recommended: Speeding up the merging of “new energy and digital infrastructure” and improving the ability to transmit power and store energy in the region; support tailored policy strategies and strengthen the connection between financial help and market direction to make sure that changes in industrial structures are sustainable across different areas. To summarize the above, the new energy sector is playing a pivotal role in the West's green transition and economic balance, and boosts technical innovation and system supply efficiency. Besides, infrastructure synergy is the only way to turn a resource advantage into a development advantage in a strategic manner.

## Reference

- Akella, A., Saini, R., & Sharma, M. (2008). Social, economical and environmental impacts of renewable energy systems. *Renewable Energy*, 34(2), 390–396. <https://doi.org/10.1016/j.renene.2008.05.002>
- Byrne, J., Zhou, A., Shen, B., & Hughes, K. (2007). Evaluating the potential of small-scale renewable energy options to meet rural livelihoods needs: A GIS-and lifecycle cost-based assessment of Western China's options. *Energy Policy*, 35(8), 4391–4401.
- Chen, W., Li, H., & Wu, Z. (2010). Western China energy development and west to east energy transfer: Application of the Western China Sustainable Energy Development Model. *Energy Policy*, 38(11), 7106–7120. <https://doi.org/10.1016/j.enpol.2010.07.029>
- Cheng, Z., Zhao, T., Zhu, Y., & Li, H. (2022). Evaluating the coupling coordinated development between regional ecological protection and high-quality development: A case study of Guizhou, China. *Land*, 11(10), 1775.

- Chen, Y. (2017). Factors influencing renewable energy consumption in China: An empirical analysis based on provincial panel data. *Journal of Cleaner Production*, 174, 605–615. <https://doi.org/10.1016/j.jclepro.2017.11.011>
- Ding, Y., Bi, C., & Sun, P. (2025). Low carbon constraints, innovation driven and carbon neutral technological innovation: empirical evidence based on multiple policy combinations. *Scientific Reports*, 15(1). <https://doi.org/10.1038/s41598-025-06207-2>
- Dong, L., Liang, H., Gao, Z., Luo, X., & Ren, J. (2016). Spatial distribution of China's renewable energy industry: Regional features and implications for a harmonious development future. *Renewable and Sustainable Energy Reviews*, 58, 1521–1531.
- Dong, F., & Shi, L. (2019). Regional differences study of renewable energy performance: A case of wind power in China. *Journal of Cleaner Production*, 233, 490–500. <https://doi.org/10.1016/j.jclepro.2019.06.098>
- Fang, G., Gao, Z., & Sun, C. (2023). How the new energy industry contributes to carbon reduction? Evidence from China. *Journal of Environmental Management*, 329, 117066.
- Gao, A., Sun, M., & Wen, W. (2024). Uncovering the spillover effects between the new energy industry and eleven economic sectors in China: Evidence based on stock data. *Energy*, 301, 131671.
- Geng, W., Ming, Z., Lilin, P., Ximei, L., Bo, L., & Jinhui, D. (2016). China's new energy development: Status, constraints and reforms. *Renewable and Sustainable Energy Reviews*, 53, 885–896.
- Harlan, T. (2022). Low-carbon frontier: renewable energy and the new resource boom in western China. *The China Quarterly*, 255, 591–610. <https://doi.org/10.1017/s030574102200159x>
- Jin, H., Xu, G., Han, W., Gao, L., & Li, Z. (2009). Sustainable development of energy systems for western China. *Energy*, 35(11), 4313–4318. <https://doi.org/10.1016/j.energy.2009.04.027>
- Lee, J. W. (2020). Green finance and sustainable development goals: The case of China. *Journal of Asian Finance Economics and Business*, 7(7), 577–586.
- Liu, N., Liu, C., Xia, Y., Ren, Y., & Liang, J. (2020). Examining the coordination between green finance and green economy Aiming for Sustainable development: A case study of China. *Sustainability*, 12(9), 3717. <https://doi.org/10.3390/su12093717>
- Liu, X., & Xin, Y. (2022). Exploring the characteristics and driving factors of coupling coordination of regional sustainable development: Evidence from China's 31 provinces. *Environmental Science and Pollution Research*, 29(47), 71075–71099.
- Neij, L., Heiskanen, E., & Strupeit, L. (2017). The deployment of new energy technologies and the need for local learning. *Energy Policy*, 101, 274–283.
- Peidong, Z., Yanli, Y., Jin, S., Yonghong, Z., Lisheng, W., & Xinrong, L. (2018). Opportunities and challenges for renewable energy policy in China. In *Routledge eBooks* (pp. 486–503). <https://doi.org/10.4324/9781315793245-150>

- Sen, S., & Ganguly, S. (2016). Opportunities, barriers and issues with renewable energy development – A discussion. *Renewable and Sustainable Energy Reviews*, 69, 1170–1181. <https://doi.org/10.1016/j.rser.2016.09.137>
- Stock, J. H., & Watson, M. W. (2008). Heteroskedasticity-Robust standard errors for fixed Effects panel data regression. *Econometrica*, 76(1), 155–174. <https://doi.org/10.1111/j.0012-9682.2008.00821.x>
- Serban, A. C., & Lytras, M. D. (2020). Artificial intelligence for smart renewable energy sector in Europe—Smart energy infrastructures for next generation smart cities. *IEEE Access*, 8, 77364–77377. <https://doi.org/10.1109/access.2020.2990123>
- Tian, Q. (2004). China develops its west: motivation, strategy and prospect. *Journal of Contemporary China*, 13(41), 611–636. <https://doi.org/10.1080/1067056042000281404>
- White, H. (1980). A Heteroskedasticity-Consistent covariance matrix estimator and a direct test for heteroskedasticity. *Econometrica*, 48(4), 817. <https://doi.org/10.2307/1912934>
- Xu, B., & Lin, B. (2018). Do we really understand the development of China's new energy industry? *Energy Economics*, 74, 733–745.
- Zou, C., Zhao, Q., Zhang, G., & Xiong, B. (2016). Energy revolution: From a fossil energy era to a new energy era. *Natural Gas Industry B*, 3(1), 1–11. <https://doi.org/10.1016/j.ngib.2016.02.001>