The Impact of Green Finance on Clean Power Generation: Evidence Based on China

Ziwei Yan, Chunying Cui* and Chenjia Liao

Department of Economics and Management, Wenhua College, room 417, 8 Wenhuayuan Road, East Lake New Technology Development Zone, Wuhan, Hubei, China
E-mail: dannycui@163.com
**Corresponding Author*

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Abstract

In order to test whether green finance at the provincial level can promote clean power generation (CPG) to promote clean power energy, this paper, based on the China provincial panel data from 2003 to 2018 and takes a sample of 30 provinces. The study finds that the credit supply in green finance can effectively promote CPG proportion. Furthermore, the promotion effect of CPG is more indeterminate in the provinces with large power output, while those with large power input are relatively small. This paper explains the above conclusions from the perspective of primary energy production and CPG structure: (1) Main new power generation capacity is clean energy in the huge energy consumption provinces, the effect of green finance is outstanding; (2) In provinces with the large coal-burning production, which are restricted by the industrial structure and energy structure, the effect of

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green finance on promoting CPG is not apparent, and the energy saving and emission reduction of traditional thermal power units are still the main focus.

Keywords: Green finance, clean power generation, carbon emission reduction, energy consumption.

1 Introduction

China proposed a long-term strategic goal of carbon peaking and carbon neutral in 2020, which provided a proactive policy guide for the world to actively address the challenge of climate change and mitigate global warming by reducing carbon emissions. As the largest developing country, China is also the largest emitter of carbon emissions in the current period, which is the pain of developing manufacturing powers [1]. Therefore, China faces a daunting task to achieve its long-term goal of carbon neutral. China's total carbon emissions reached 9.894 billion tons in 2020, of which 78 percent came from fossil fuel emissions from the power generation sector [2]. So China should solve the critical issue of cleaner production in the power generation sector to achieve carbon neutral by 2060.

Electricity is the universal energy in modern industrialized society, and there is a great potentiality for large-scale clean production. Sufficient clean power generation capacity is the essential guarantee for various carbon neutral methods [3]. Clean energy policymakers not only need to consider whether the immediate grid can achieve large-scale clean power generation to ensure that rapid urbanization is sustainable and environmentally inclusive [4], but also should fully consider the future demand explosion of the charging market and actively embrace the electrification era of mobile vehicles, which can provide enough clean power charging redundancy for charging mobile power machines [5]. Therefore, the future demand for CPG may be underestimated, requiring industrial policy authorities to promote the construction of related projects quicker, among which financial bias support is essential [6].

Due to the backwardness of productivity, coal is the most commonly used fossil energy in developing countries, and coal-fired power generation has become the primary mode of power production for industrial construction and urbanization in low-and middle-income countries [7]. The Chinese government has actively explored the CPG units, transformed and closed the traditional heavily polluting thermal power units in order to achieve energy conservation and emission reduction [8], which is guided by a series of industrial policies and market mechanisms. The ratio of coal-fired power generation in China was once as high as 88 percent in 2002. However, the proportion of fossil energy in China's existing generator stock has dropped to 65 percent with years of CPG construction. With a growing sense of social responsibility, financial institutions are actively engaged in environmental governance, resource-intensive use, and cleaner production. They have played a significant role in providing financial support to address the challenge of climate change. This paper takes CPG as a research object to find how GF promotes environmental protection projects in the power generation industry.

Some studies have pointed out that the contribution of financial support to environmental protection and energy conservation is very important [9]. With the deepening of green financial activities, aggregation of social and economic resources in the environmental protection sector have been promoted [10]. The experience of the development of Germany's clean energy industry shows that simply subsidies for clean production can easily lead to free-ridership, resulting in an unsustainable clean production process [11]. China's market-economy-oriented policies encourage clean production, which are conducive to promoting energy conservation and emission reduction through the improvement of financial supply structure [12]. Green finance is a valid carrier to promote economies to achieve sustainable development goals [13] and plays an important role in the promotion of clean technology in developing countries [14]. Similar studies in this field have paid attention to the long-term efforts of China's banking sector in providing green financial services [15], and the development of renewable energy in Asia as a whole also depends on the continuous penetration of Bond financing. Empirical evidences from Colombia, Egypt and other developing countries also verify that green finance has a remarkable impact on local pollutant abatement and sustainable development [17, 18].

At present, there are few studies on green finance promoting clean power generation, especially reducing the proportion of coal-fired power generation. In this paper, green finance is regarded as the key factor driving the process of clean power generation in China, and the inter-provincial panel data are used for analysis. We hope to add new empirical evidence in the aspect of financial structure supporting the sustainable development of local economy and society.

2 Hypothesis

According to the "Guidance on Building a Green Financial System" issued by the People's Bank of China on August 31, 2016, it is required that the banking system should serve the production projects in the fields of energy conservation, environmental protection, and clean energy from the aspects of project financing, operation and risk management through the development of green finance. The power generation industry is under extreme pressure to reduce emissions with the requirement of carbon-neutral long-term goal [19]. Chinese policymakers require that new power generation capacity should have at least a 1:1 rate of clean energy to fossil energy [20]. It means the power of newly installed hydroelectric, wind, photovoltaic, and nuclear power generation is no less than that of thermal power generation units in the same period. However, CPG projects need heavy investment, and the cost of clean power is much higher than that of traditional coal-fired power generation, so the project needs huge capital, and the financial support for the later operation is also very important [21]. Green credit, as the prime service form of green finance, has become an effective capital-oriented way in the market mechanism to support the vigorous development of CPG.

Based on that, this paper proposes hypothesis 1: clean power generation is strongly promoted by green finance.

If a region has a massive electricity consumption, it needs to purchase electricity or build new generating units to satisfy national economic growth and people's livelihood. The electricity comes from clean or green sources isn't grabbed by the purchasing region because of outsourced electricity. However, if it is self-built power generation, the state-oriented policy will encourage the construction of new energy power generation and thermal power generation units at a ratio of no less than 1:1. Under policy guidance, areas with new power plants have more incentive to add CPG projects [22], and green financial services are more likely to serve these projects.

According to that, this article puts forward hypothesis 2: In provinces with large consumption of electricity, green finance plays a greater role in promoting clean power generation.

The land is vast in China, so there is an interactive trade of power generation's input and output among different areas, which leads to green finance promotes CPG has a different effect. Specifically, northwest, southwest provinces have rich mineral and natural resources for power generation. In contrast, the eastern coastal provinces are densely populated and economically developed, which have a high demand for electricity but a low production capacity [23]. As a result, there has been inter-provincial energy trade in the transmission of electricity or power generation fuel from resource-based western provinces to the central and eastern regions. For the power exporting provinces, they rely on local rich resources to carry out power production. The local power industry is a pillar industry, with a large absolute index of energy conservation and emission reduction, and a large number of projects invested in clean energy construction. CPG is more likely to be covered in depth and width by local green finance services.

Therefore, it proposes hypothesis 3: Clean power generation in provinces with power output is more strongly promoted by green finance.

Moreover, the characteristics of the stock generation in the power output province may lead to the "replacement effect" of the stock transformation on the incremental construction of clean power generation. Large power output provinces may have many fossil energy resources for power generation in the early stage, constituting a mass of thermal power generation stock. In addition to CPG projects, green financial services also support many environmental improvement projects such as emission reduction, desulfurization, and thermal efficiency improvement of thermal power units in stock [24]. The more thermal power units in stock, the more diversions of green finance are, which constitutes the “crowding out effect”.

So, this article, puts forward hypothesis 4: Regions with a high proportion of fossil energy production may inhibit the promotion effect of green finance on clean power generation.

3 Models, Data, and Methods

3.1 Variable Selection

Explained variable is the proportion of CPG in the provincial region, which refers to the proportion of the generating capacity of clean energy in the total power production scale. Due to the big difference in power production scale among different provinces in China, it is impossible to simply use the total amount index to observe the progress of clean power generation in different regions. Therefore, this paper refers to the Clarke J A (2016) to use the proportion of total electricity generation of clean power stations as the index measurement to better measure the development level of clean power generation [25]. Clean energy power generation uses non-fossil energy such as water power, wind power, photovoltaic solar energy, nuclear energy, tidal energy, and geothermal energy, which doesn’t produce carbon dioxide emissions in power production and has no impact on the current total amount of carbon in the geological circle. It is a good carbon-neutral power generation energy. But it is too complicated to calculate the clean energy generation completely, so in this paper, the proportion of clean energy generation capacity is measured by calculating the thermal power electricity in the total power electricity by the formula (1):

$$CPGR = 1 - TPER/TEGR \tag{1}$$

The value range of CPGR is (0, 1), which is one minus the proportion of thermal power generation.

The core explanatory variable is the development level of provincial green finance. The green finance credit (GFC) is used as the proxy variable, because the main form of green finance is green credit (Taghizadeh-Hesary F & Yoshino N, 2019) [26], which means the financial loan is adopted to support the financing of green energy conservation and emission reduction projects, and credit discrimination is implemented for projects with high pollution and heavy emission.

Selection of control variables: There are many factors that affect the popularization of clean power generation, not only overt constraints from the traditional power production and consumption end, but also the production capacity of fossil energy, the inter-provincial differences in output and input of power production, international energy costs and power industry regulations. In this paper, the annual generating capacity of each province is selected to represent the regional power production capacity (Dabbaghiyan A et al., 2016) [27]. Similarly, the annual total power consumption of each province is adopted as the proxy variable of power consumption. The influence of power consumption not only includes the increasing effect of energy consumption brought by economic output growth, but also can reflect the characteristics of local industrial structure. There is no doubt that provinces with more energy-intensive industries consume more power. Besides, there is a substitution relationship between the total power generation of thermal units and the total clean power generation in the region, which should be included in the regression equation. Based on this, the provincial output of coal, crude, and gas, three important fossil energy sources, as the fuel for thermal power units, also affects clean power generation level. Hydroelectric power generation is the mainstream in the traditional clean energy generation mode, and it is also the clean power generation mode vigorously developed in China. This paper refers to the scale of hydroelectric power generation. Finally, the virtual variable ‘Export’ is introduced to indicate whether the province is the power output, and the power consumption of the province is calculated minus the generation, and the negative number is taken as the power input province, whose value is set to 0. The positive number is the output province, and the value is 1.

3.2 Model Setting

This paper constructs the metering equation of the proportion of green credit affecting CPG:

$$CPGR_{ij} = \beta_0 + \beta_1 GF_{ij} + \beta_2 X_{ij} + \theta_i + \mu_j + \varepsilon_{ij} \tag{2}$$

In the left side of the equation $CPGR_{ij}$ represents the CPG level of i province in year j, while in the right side of the equation. GF_{ij} represents the green credit index of i province in year j, and X_{ij} is the vector set of control variables that may affect the proportion of CPG. θ_i is the unobserved influencing factors at the province level; μ_j is observed influencing factors at the practical level; ε_{ij} is the unaffected residual disturbance term. According to the general setting, it presents a normal distribution with the mean value approach 0. β_0 is the intercept term of the equation, which reflects the impact of green credit on the proportion of CPG; β_2 reflects the impact of other factors that affect CPG. The key point of this study is to estimate coefficient β_2, in order to recognize the characteristics of the impact of green credit on CPG are.

3.3 Data Source

Annual panel data of 31 provincial administrative regions in China were compiled for this study. Data were collected from the "Annual China Energy Yearbook" and provincial statistical yearbooks from 2003 to 2018. After a comprehensive analysis of the data availability and the degree of data loss, Tibet was excluded, leaving 30 provinces, included municipalities as the total sample, which constituted the unbalanced panel. After the data collection is completed, logarithmic processing is performed. The descriptive statistical results are shown in Table 1.

4 Empirical Analysis

4.1 How Green Finance Affect the Clean Power Generation Rate

Models (1) and (2) show the regression results of only green finance, and models (3) and (4) show the regression results with control variables added.

Table 1 Description of variables

Variables	Obs	Mean	Std. Dev.	Min	Max
Clean power generation rate	480	0.5554639	0.1552168	0.1976876	0.9836767
Coal	480	1237.465	1757.902	0	9897.29
Crude	480	647.3719	1122.194	0	4840.12
Natural gas	480	32.37579	77.139	0	444
Generate electricity	480	1464.831	1108.324	58.59	5826
Water electricity	480	251.7486	459.6562	0	3157
Thermal power	480	1020.37	958.6395	0	5142.88
Electric comsumption	480	1447.31	1183.648	59.3	6323
Green finance index	480	0.1425938	0.090386	0.042	0.759
Theil index of industrial	480	1.064532	0.3581613	0.2558656	2.472887
Export province	480	0.4979167	0.5005173	0	1

The baseline regression results show that CPG is strongly promoted by green finance. The fixed-effect panel regression analysis was carried out according to the measurement equation of (2), and the baseline regression results are shown in Table 2. We establish four models respectively to illustrate the impact of green finance on CPG. Column (1) is the result of only adding green finance as an explanatory variable, and column (2) is the regression result which controls the fixed effect. It can be found that the development of green finance has a significant promoting effect on the increase of the proportion of CPG, and its correlation coefficient reaches 0.9079. After fixed effect is controlled, it also shows a great influence of 0.3951. The above conclusion passes the significance test at the statistical level of 1%. However, taking green finance as a single explanatory variable may lead to over-identification. Therefore, in column (3) and (4), we add control variables and include other factors that might affect the CPG ratio into the regression equation. The final result of the regression coefficient is 0.2957, which is still significant at 1% statistical level, indicating that the identification result of the regression equation constructed in 2.2 is proved.

The positive promoting effect of green finance on CPG rate reach 29.57%. Hypothesis 1 holds the view that clean power generation is strongly promoted by green finance is proved.

4.2 The Different Effect of Electric Export and Import Provinces

Models (5) and (6) are established through sample regression to observe the impact of green finance implementation on CPG rate in power output provinces. Models (7) and (8) are used to compare and analyze the impact of

Table 2 Regression of clean power generation

	(1)	(2)	(3)	(4)
Variables	Clean Rate	Clean Rate	Clean Rate	Clean Rate
Green finance	0.9079***	0.3951***	0.4722***	0.2957**
	(0.0445)	(0.0703)	(0.0967)	(0.1446)
LN_coal			−0.0160***	−0.0136***
			(0.0047)	(0.0047)
LN_crude			−0.0171*	−0.0155*
			(0.0087)	(0.0087)
LN_gas			−0.0188***	−0.0156***
			(0.0041)	(0.0041)
LN_generate			0.1680***	0.1256***
			(0.0335)	(0.0348)
LN_comsumption			−0.0386	0.0202
			(0.0418)	(0.0450)
LN_thermal			−0.0700***	−0.0765***
			(0.0249)	(0.0248)
Export province			−0.0200**	−0.0162*
			(0.0096)	(0.0098)
Constant	0.4260***	0.4504***	−0.1278	−0.4783
	(0.0068)	(0.0105)	(0.2962)	(0.4491)
Observations	480	480	253	253
R-squared	0.4807	0.5778	0.5448	0.5999
Number of id	30	30	20	20

Standard errors in parentheses, ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

green finance in power input provinces. Moreover, it turns out in provinces with large consumption of electricity, green finance plays a greater role in promoting clean power generation. The implementation of green finance may have different structural effects. The sample of provinces in China can be divided into power production (output) provinces and power demand (input) provinces, and power supply and demand can be transmitted across provinces.

Will this structural difference affect the emission reduction effect of green finance? In this paper, fixed effect regression by separated samples is used to test. We establish models (5) and (6) to observe the impact of

Table 3 Sample regression separately

Variables	(5) Clean Rate	(6) Clean Rate	(7) Clean Rate	(8) Clean Rate
Green finance	1.4926***	1.6386***	0.7830***	0.0244
	(0.1055)	(0.3771)	(0.0465)	(0.1751)
LN_coal		−0.0284***		−0.0157**
		(0.0093)		(0.0076)
LN_crude		−0.0242**		0.0020
		(0.0119)		(0.0166)
LN_gas		−0.0090*		−0.0351***
		(0.0049)		(0.0085)
LN_generate		0.1616***		0.0496
		(0.0528)		(0.0918)
LN_comsumption		−0.0118		0.1949***
		(0.0801)		(0.0683)
LN_thermal		−0.0478		−0.1104*
		(0.0332)		(0.0621)
Constant	0.3361***	−1.1988*	0.4741***	−1.9217**
	(0.0119)	(0.6233)	(0.0088)	(0.9005)
Observations	239	117	241	136
R−squared	0.4810	0.6982	0.5656	0.6553

Standard errors in parentheses, ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

green finance implementation on CPG rate of power output provinces. While model (7) and model (8) are adopted to compare and analyze the influence of green finance on electricity input provinces. Table 3 is shown the specific sub-sample regression results. Column (6) and (8) respectively report the promoting effect of green finance in the sample classification of power output provinces and input provinces.

The results indicate that after controlling the fixed effect of provinces and time, the average treated effect (ATE) of green finance on the power output provinces is noticeably higher than that on the power input provinces. Numerically, the coefficient of power output provinces is as high as 1.6386 and passes the significance test of 1% statistical level, as shown in the first line of column (6). Whereas the Coefficient of power input provinces is only 0.0244, which is not significant. The above results verify that hypothesis 2 is not valid. In provinces with large power consumption, green finance has no significant promoting effect on clean power generation. On the contrary, if hypothesis 3 was true, the clean power generation in the power-exporting provinces would be more promoted by green finance.

4.3 The Moderation Effect of Clean Power Generation

This article use moderation effect analysis to discuss the mechanism of the core result. Model (9), (10) and (11) are discussed whether the characteristics of large fossil energy-producing provinces have an impact on the role of green finance. Since the provinces with huge fossil energy have a large fossil energy production and consumption, this study adopts the major fossil energy consumption of each province to represent the factor endowments of local fossil energy, and constructs the moderation effect model to verify hypothesis 4. The results show that regions with a high proportion of fossil energy production may inhibit the promotion effect of green finance on CPG. Hypothesis 4, regions with a high proportion of fossil energy production may inhibit the promotion effect of green finance on clean power generation is true.

Table 4 Moderation effect of clean power generation

	(9)	(10)	(11)
Variables	Clean Rate	Clean Rate	Clean Rate
Green finance	−0.1540	1.1128**	1.5606**
	(0.8577)	(0.4811)	(0.6344)
LN_coal	0.0272		
	(0.0511)		
LN_crude		−0.0540*	
		(0.0303)	
LN_gas			−0.0602**
			(0.0294)
Gf_ generate			
Gf_comsumpt			
Control Variables	Controled	Controled	Controled
Constant	−0.4410	−0.7140	−0.7439
	(0.4553)	(0.4660)	(0.4643)
Observations	253	253	253
R-squared	0.6004	0.6058	0.6077

Standard errors in parentheses, ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

5 Conclusion

This paper discusses how green finance can improve the proportion of CPG in the region by establishing the inter-provincial panel fixed-effect model. And we find that the popularization of green finance has effectively promoted the increase of the proportion of clean electricity generation in the local area. The effect is more pronounced in power-exporting provinces. Through the moderation effect test of the mechanism of action, it can be seen that more fossil energy production base will have a shading effect on the promoting effect of green finance. Although the promoting effect of green finance is more remarkable in the provinces with large electricity consumption, their excessive energy consumption demand objectively hinds the further improvement of the proportion of CPG. Therefore, promoting the clean production of electricity actively is also need to strengthen the depth of green finance, and promote low-carbon substitution and clean power generation simultaneously. Then finally move towards zero-emission of electricity production.

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References

[1] He Y, Fu F, Liao N. Exploring the path of carbon emissions reduction in China's industrial sector through energy efficiency enhancement induced by R&D investment Energy 225, 120208. 2021.

[2] Li, Y., Yang, X., Ran, Q., Wu, H., Irfan, M., and Ahmad, M. Energy structure, digital economy, and carbon emissions: evidence from China. Environmental Science and Pollution Research, 1–24. 2021.

[3] Balaman, Ş. Y. Investment planning and strategic management of sustainable systems for clean power generation: An ε-constraint based multi objective modelling approach. Journal of Cleaner Production, 137, 1179–1190. 2016.

[4] Li, Y., Li, Y., Zhou, Y., Shi, Y., and Zhu, X. Investigation of a coupling model of coordination between urbanization and the environment. Journal of environmental management, 98, 127–133. 2012.

[5] Haidar, A. M., Muttaqi, K. M., and Sutanto, D. Technical challenges for electric power industries due to grid-integrated electric vehicles in low voltage distributions: A review. Energy Conversion and Management, 86, 689–700. 2014.

[6] Sueyoshi, T., and Goto, M. Can environmental investment and expenditure enhance financial performance of US electric utility firms under the clean air act amendment of 1990?. Energy Policy, 37(11), 4819–4826. 2009.

[7] Akinyele, D. O., Nair, N. K. C., Rayudu, R. K., and Seah, W. K. Clean development mechanism projects for developing countries: Potential for carbon emissions mitigation and sustainable development. In 2014 Eighteenth National Power Systems Conference (NPSC). IEEE. December, 1–6, 2014.

[8] Yue, H., Worrell, E., Crijns-Graus, W., and Zhang, S. The potential of industrial electricity savings to reduce air pollution from coal-fired power generation in China. Journal of Cleaner Production, 301, 126978. 2021.

[9] Geng, C., and Cui, Z. Analysis of spatial heterogeneity and driving factors of capital allocation efficiency in energy conservation and environmental protection industry under environmental regulation. Energy Policy, 137, 111081. 2020.

[10] Wen, S., Lin, B., and Zhou, Y. Does financial structure promote energy conservation and emission reduction? Evidence from China. International Review of Economics & Finance, 76, 755–766. 2021.

[11] Grosche, P., and Vance, C. Willingness to pay for energy conservation and free-ridership on subsidization: evidence from Germany. The Energy Journal, 30(2). 2009.

[12] Wen, S., Lin, B., and Zhou, Y. Does financial structure promote energy conservation and emission reduction? Evidence from China. International Review of Economics & Finance, 76, 755–766. 2021.

[13] Sachs, J. D., Woo, W. T., Yoshino, N., and Taghizadeh-Hesary, F. Importance of green finance for achieving sustainable development goals and energy security. Handbook of green finance: Energy security and sustainable development, 10, 1–10. 2019.

[14] Nassiry, D., and Wheeler, D. A green venture fund to finance clean technology for developing countries. Center for Global Development Working Paper, (245). 2011

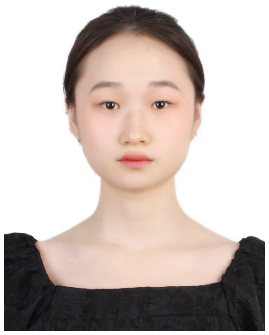
[15] Bal, Y., Faure, M., and Liu, J. The role of China's banking sector in providing green finance. Duke Envtl. L. & Pol'y F., 24, 89. 2014.

[16] Ng, T. H., and Tao, J. Y. Bond financing for renewable energy in Asia. Energy Policy, 95, 509–517. 2016.
[17] Ruiz, J. G., Arboleda, C. A., and Botero, S. A proposal for green financing as a mechanism to increase private participation in sustainable water infrastructure systems: The Colombian case. Procedia Engineering, 145, 180–187. 2016.
[18] Al Moatassem, B. M. Green Investment: Pathways to a Clean Growth Economy in Egypt. Научный вестник Волгоградского филиала РАНХиГС. Серия: Юриспруденция, 5(2), 43–57. 2019.
[19] Liu X, Yang X, Guo R. Regional differences in fossil energy-related carbon emissions in China's eight economic regions: Based on the Theil index and PLS-VIP method. Sustainability 12(7), 25–76. 2020.
[20] Tian ZH, Yang ZL, Cai RX. Analysis of carbon emission from energy consumption in Guangdong Province and study on influencing factors of carbon emission China Environmental Science 35(6), 1885–1891. 2015.
[21] Xie, Y. L., Huang, G. H., Li, W., and Ji, L. Carbon and air pollutants constrained energy planning for clean power generation with a robust optimization model—A case study of Jining City, China Applied energy 136 pp. 150–167. 2014.
[22] Xu SC, Long RY. Efficiency measurement and influencing factors of energy and carbon emissions in China Resources Science 29(3), 74–78. 2015.
[23] Wu J, Cui C, Mei X, et al. Migration of manufacturing industries and transfer of carbon emissions embodied in trade: empirical evidence from China and Thailand. Environmental Science and Pollution Research, 6 , 1–13. 2021.
[24] Aslani, A., Ghiasi, M. M., and Safari, M. Analysis of the Robustness of Canada Economy and Energy Supply/Demand Fluctuations. Strategic Planning for Energy and the Environment, 38(3), 7–26. 2019.
[25] Clarke J A, Connor G, Grant A D, et al. Regulating the output characteristics of tidal current power stations to facilitate better base load matching over the lunar cycle. Renewable Energy, 31(2), 173–180, 2006.
[26] Taghizadeh-Hesary F, Yoshino N. The way to induce private participation in green finance and investment. Finance Research Letters, 31: 98–103. 2019.
[27] Dabbaghiyan A, Fazelpour F, Abnavi M D, et al. Evaluation of wind energy potential in province of Bushehr, Iran. Renewable and Sustainable Energy Reviews, 55: 455–466. 2016.

Biographies

Ziwei Yan is a Bachelor student at the Wenhua College in Wuhan since autumn 2019. She was invited as the expert of China Society of Emerging Economics (CSEE) to analyze the trade potential issues between China VS. resource export countries in November 2021. Yan is currently completing the Bachelor degree in International Economics and Trade at Wenhua College, and considering to develop the new study of clean production and green energy.

Chunying Cui is an Associate Professor at the Wenhua College at Wuhan since autumn 2019. He attended the Huazhong University of Science and Technology, China where he received Ph.D. in Economics. resource export countries in November 2021. Cui has contributed some literature achievements about causal inference in Environmental Economics and Ecology Economics. He is currently establishing the Research Center of Digital Economics, and focus the digitalization procession in energy industrial.



Chenjia Liao is a Bachelor student at the Wenhua College in Wuhan since autumn 2018. Liao is currently completing the Bachelor degree in International Economics and Trade at Wenhua College, devoting herself to developing the study of digital economy and business environment and continuing to explore the role of the digital economy in facilitating trade.