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Visualizing the sustainable development goals and natural resource utilization for green economic recovery after COVID-19 pandemic

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ABSTRACT

After the COVID-19 outbreak, this study examines the influence of modifications in China's Sustainable Growth Goals (SDGs) and economic development goals on Chinese enterprises' energy conservation and emissions reduction behavior. Meanwhile, the COVID-19 epidemic has erupted, displacing the flimsy traditional techniques. As a result, the post-COVID-19 pandemic emphasizes the need for a long-term sustainable development method compatible with the local and regional environmental systems. The main objective of this study is used as a roadmap to steer the post-COVID-19 pandemic on a sustainable green path by emphasizing sustainable energy strategies to connect in SDG-related efforts. The investigation in this paper begins with examining significant impacts in the energy industry and their impact on progress toward sustainability. The empirical findings that the CO_2 emissions reduction objectives in long-term development plans had a considerable impact on energy saving and emissions reduction, lowering energy consumption intensity by 3.33% and carbon emission intensity by 4.23% between 2010 and 2019. Besides, the results and long and short run techniques are built to describe the Sustainable Development Goals interface, with the result revealing that Sustainable Development Goals enhance the green economic recovery performance. Furthermore, this study recommends that the key natural resources and green economic recovery policies to overcome the climate change impacts by COVID-19 pandemic.

1. Introduction

Authorities have implemented a wide range of green innovation strategies around the world in response to climate change and growing public concern about environmental issues(Shang et al., 2021), including policies to promote green brands, environmentally friendly innovations, and green finance such as green bonds(Xu et al., 2022). The increasing externality of environmental contamination necessitates green innovation in public administration(Qiu et al., 2022). Green innovation and green financing go hand in hand when it comes to protecting the environment, with the former providing funding for R&D into new clean energy technologies and ecologically friendly processes and goods(Li et al., 2021). Although governments' attitudes and attempts to safeguard the environment are reflected in green finance, green innovation reflects a more holistic approach to tackling environmental deterioration and innovation in the production and use of green energy. While conventional climate-related environmental quality solutions have received much attention, academia has mostly ignored one growing field: climate finance(Hu et al., 2021). To meet the Paris Agreement's net-zero carbon reduction targets and promote environmentally sound development, the term "climate finance" refers to capital flows for low-carbon and weather growth that have either direct or indirect effects on reducing GHG emissions or adapting to climate change (H. Gao et al., 2021). Nations provide beneficiary emerging economies with multipurpose assistance via climate financing, which funds low-emissions and environmental preservation programs and investments. It's possible to split climate financing into two classifications: adaptability and mitigation(Jin et al., 2022). Climate finance has been

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the subject of a growing number of studies. Fairness in climate change responses has been studied extensively(Liu et al., 2021), but climate financing has also been learned about recipient nations' adaptation ability to climate change. About climate finance and carbon dioxide emissions, little is known to date, and the connection between climate finance and emissions reductions is confusing at best.

Using assets and carbon-demanding development models has elevated green innovation and green financing to essential assessments in past years, and experts generally agree that they have a favorable impact on environmental quality. According to, earlier research(Qin et al., 2022) on green innovation focused mostly on financial assistance for clean energy R&D and environmental preservation expenditures. There is a dearth of research documenting environmental management-related green trademarks or patent requests, the ultimate barometer of green innovation. Few studies have also examined if ecological effectiveness, green finance, and green technology do not have unidirectional cointegration linkages, nor have they experimentally evaluated if environmental energy and green finance may affect green innovation (Han et al., 2022). have not been explored. There may be opportunities for green goods and procedures based on existing ecological quality effectiveness and green finance growth if the nexus between quality environmental efficiency, green finance, and innovation can be identified. These issues can be addressed by authorities to enhance environmental performance and financial growth by implementing strategies to stimulate green innovation and improve the distribution of financial resources, which can ultimately better encourage the whole world to advance in a sustainable, green, and environmentally friendly manner(Dong et al., 2021). Consequently, this research is attempting to reveal the link between these three factors and to determine how environmental performance, green financing, and green innovation all affect each other in the short- and long-term(Zhao et al., 2020).

These studies examine the changes that have occurred throughout this time, from renewable energy transition and energy affordability to presenting holistic ideas and practical solutions for energy sustainability from the perspective of governments and policymakers. Nevertheless, the new study considers the Covid-19 pandemic, which could have a significant economic impact on green developments and increase the growth of the green investment.

2. Literature review

2.1. Nexus among economic performance and innovation

Long-term balance between environmental performance, green financing, and innovation in emerging nations. One of the most obvious benefits of green innovation is its ability to increase the use of renewable energy sources while simultaneously enhancing efficiency in energy use (Zhao et al., 2020).For one thing, greater eco-innovation and the potential to produce more clean energy might attract more global financial assistance for clean energy R&D and renewable energy manufacturing, which in turn improves the environmental protection of green financing. Businesses are more likely to invest in green technology if there is more green innovation. This leads to greater global financial support and improved ecological effectiveness. In light of the above, we believe green innovation is essential to green finance and environmental efficiency(Lu et al., 2022).

The following illustrates the relationship between environmental effectiveness, green funding, and innovation. There are several ways in which higher environmental productivity might encourage people to live in more environmentally friendly surroundings. Second, according to(Ullah et al., 2020), higher environmental effectiveness is generally associated with the adoption of more environmentally friendly technology. This trend will likely continue as long as green innovation projects are designed to be long-term. Even more importantly, governments are spending more on clean and renewable energy manufacturing R&D due to increased financial support for green initiatives. We may deduce from this that ecological effectiveness and green funding have an impact on green innovation(Zhang et al., 2022). Through the selection of technical initiatives with high success possibilities, the financial sector discovers the finest possible technologies and accelerates technological innovation(Xiuzhen et al., 2022). Financial institutions help people save more money and use their money more effectively, resulting in greater efficiency in the use of resources and the development of new technologies. Banks and share prices harm economic development, but found that the financial sector has an overall positive impact, indicating that the financial industry is a growth engine regardless of the nation's bank or market structure.

2.2. Green finance and natural resources development

Investments in green technologies are essential for boosting green growth rates. Natural resources and capabilities mostly influence the effectiveness of green economic and social development via green technical advances. Since "innovation" and "introduction" are the primary means of technological advancement, we employ these two lenses to rationally examine the connection between endowed natural resources and green interest rates(Sun et al., 2019).

According to one school of thought, there is a "crowding out" impact of the endowment of natural resources on technical innovation in the renewable energy industry. The phenomenon of "crowding out" shows itself in four distinct ways. First, regions brimming with natural resources are more likely to have an economic structure predicated on extracting those resources, resulting in the extraction sectors "crowding out" industrialization(Sun et al., 2019). To some degree, the development rate of the green economy is stifled by the fact that the steel industry typically has a greater technical level and more frequent innovations and R&D actions than the renewable extractive industries sector. Second, there is a larger outflow of intellectual resources that might be used to innovate in the resource extraction industry from places that are wealthy in resources but fail to invest in talent acquisition. Economies in the area may be lacking in renewable technology creativity expertise since the natural resource industry's prevalence as the major product sector with low productivity and increased and the diversion of potentially inventive human capital to the core business sector(Iram et al., 2020).

Thirdly, technical innovations to increase resource and manufacturing efficiency are discouraged in mineral resource locations due to fewer resource restrictions and fewer opportunities for such gains in economic growth. Finally, the immediate advantages of exploiting natural resources are substantial, and these resources might be seen as "windfalls" in some sense. Because of this, areas wealthy in natural resources would likely prioritize the development of sectors based on these resources, even if these industries rely on a relatively low level of technical input for the growth of their economy(Abbas et al., 2022). Consequently, innovation and economic growth funding suffer in the long run. Recent research has revealed proof of the effects of Covid-19 pandemic on petroleum variability, adding to data from previous worldwide catastrophes. A recent study (Getis and Ord, 2010)examined this topic by comparing economic growth and asset price volatility before and after the Covid-19 pandemic. The research (Ikram et al., 2019)which used innovative wavelet parameters, found that during the Covid-19 outbreak in China, commodities prices for land and resources exhibited more volatility. Natural resources are claimed to have a medium-term, causal relationship with economic expansion, but only in one direction. Also, using this method, reveal that crude prices for natural assets were unstable before and after the development of the Covid-19 pandemic(Mohsin et al., 2019). The opposite conclusion was drawn from this research, which concluded that the cost of commodities derived from natural resources does not affect the economy's health.

The impact of Covid-19 on the variability of mineral wealth (oil prices in particular) has also been experimentally examined in research by(Xia et al., 2020). It has been shown through these analyses that Covid-19 spread significantly and favorably affects the liquidity of Earth's resources and oil stock prices. In addition, the demand for and supply of these resources have a substantial and beneficial impact on driving up natural resource prices, even in the face of the Covid-19 pandemic. Shocks to either the demand or supply in an area may significantly impact the market's volatility. Moreover, it has been shown (Jayanthakumaran et al., 2012) that a 4% decline in OPEC oil output dramatically raises oil prices in the gas nations, which may have a major influence on the fluctuation of natural resource prices in the oil-importing industries. Covid-19 active cases, its mortality ratio, and reports of negative oil prices all contribute to natural resource inflationary pressures, according to a study of the pandemic's propagation (Mohsin et al., 2021).Despite this, the studies all agreed on the significance of the link between various events and crises and the unpredictability of natural assets. Nonetheless, a significant part of the business prosperity of the nations and regions has been overlooked in these analyses.

A barrier for emerging nations is their degree of financial growth since this might limit their ability to benefit from technological transfers that would otherwise help them accelerate their economic progress (Rohr et al., 2022). Despite some conflicting views, the research has debated the role of finance in the economy over various time horizons and situations(Wang and Zhang, 2021). Green finance is predicted to influence long-term economic development because of its role in the financial system. In light of past research, this effect is achieved via various pathways. Sustainable economic growth may be completed by the use of renewable energy, according to several studies (Taghizadeh-Hesary and Taghizadeh-Hesary, 2020) points out that using nonrenewable energy leads to uncontrolled environmental deterioration and diminishes organic assets, making it impossible to maintain a system.(DILANCHIEV & TAKTAKISHVILI, 2021). Green bonds exclusively support low-carbon projects that affect climate change management or adaptability, natural resource and wildlife protection, and pollution avoidance. In terms of energy expenditures, fossil fuels take the lead. (Ahamd, 2019)(Chang et al., 2022). It is possible to indirectly participate in clean energy or green technology initiatives via bonds since the responsibility is dispersed across a wide range of investors. A secondary market gives investors liquidity and a means of exiting the company. Those with short-term investing views are likewise drawn to this trait. There are several reasons why green bonds should be promoted to increase investments in clean energy and environmentally friendly technologies(Saboori et al., 2017).

Furthermore, the impact of new technologies on achieving sustainability, along with their role in the electricity system, digitalisation, and economics, is examined. The Econometric technique is employed in Section four to examine and quantify the strengths, weaknesses, opportunities, and dangers of achieving energy sustainability. To be more pragmatic, one must examine these ideas from the perspective of political bodies and policies. As a result, a pre-COVID approach to energy sustainability from political China, Eurasia, Australasia, Africa, and Latin America is investigated. This interaction results from a careful examination of the Sustainable Development Goals (SDGs)' aims and selected indicators. In addition, the current study takes into account both the pre-and post-Covid-19 pandemic periods, which is one of the article's groundbreaking roles following the Covid-19 pandemic spread.

3. Econometric investigation

3.1. Theoretical background

(Perch-Nielsen et al., 2010)and(Gössling and Lund-Durlacher, 2021) identified increases in production and income as critical reasons for rising energy demand. According to the aforementioned theoretical framework, econmic development(GDP), investment in alternative energy(IRE),wind energy output and green finance were all presented as control variables by(Munir et al., 2020). Because of this, we may represent the relationship between green economic growth and natural resources development:

$$ln\ GER_{it} = \mu_i + \alpha_1\ ln\ NRR_{it} + \theta_1\ ln\ PGDP_{it} + \beta_1\ ln\ IRE_{it} + \beta_2\ ln\ IND_{it} + \beta_3\ ln\ GF_{it} + \beta_4\ ln\ EGL_{it} + \varepsilon_{it} \tag{1}$$

Methodologically, this study employed a total of five variables derived from the theoretical assumption: economy (proxied by GDP) estimated in constant US$ 2010, investment in alternative energy (IRE), green economic recovery(GER) wind energy output (REL), and green finance (GF). The research of(Sovacool et al., 2021) inspired the present study, which focuses on the nexus between the volatility of crude oil prices for natural materials and economic effectiveness. As the economic impact of the Covid-19 pandemic continues to be felt most severely in China. This paper analyzes the impact of NRV on China's economic performance both before and after the COVID-19 pandemic, in part because of the current trend in China demonstrating policies targeting environmental protection. The effects of IRE, REL, and GF on China's economy during the COVD19 pandemic have also been analyzed. The above framework calculates the impact of rising income and living standards on energy use. How do natural resource and sustainable development goals contribute to green economic growth, and what are the processes behind this relationship? We use the dynamic threshold model further to understand the nature of their interplay (8). Through these two routes, finance may boost output: by encouraging the accumulation of capital and the development of innovative technologies and by facilitating the allocation of resources to projects with the potential for comparatively significant profits. That means that rising energy costs may be affected by economic prosperity via a multiplier effect on increased production. With this in mind, this research builds a dynamic panel threshold model with total natural resources development and sustainable development goals. It examines a rise in green economic growth in the context of varying levels of financial development.

3.2. Model development

This paper uses the novel Difference-in-Difference(DID) type method to estimate this paper's econometric models to see if low-energy-consuming enterprises' tax reduction policies can help them innovate and assess the dynamic impact of tax reduction policies. Our econometric models are presented as follows:

$$(GPI)_{i,t} = \beta_0 + \beta_1 \times POSTCOVID_t + \beta_2 \times \beta_2 \mathrm{NRT}reat_i + \beta_3 \times POSTCOVID_t \times energy\ resourcesTreat_i + \beta_i \times X_{i,t} + u_t + \gamma_i + \varepsilon_{i,t}$$

Where the dependent variable Green process innovation t $(\mathrm{GPI})_{\mathrm{i,t}}$ is the innovation spending as a percentage of total assets. In terms of our independent variables, $\mathrm{POSTCOVID}_t$ is a dummy variable that is either 1 or 0 following the execution of the tax reduction strategy? energy $\mathrm{resourcesTreat_i}$ Showing the dummy variables, we set it to 1 if the company consumes little energy and to 0 otherwise. β_3 Parameters are to figure out the primary variable.

3.3. Variable description

The main reason is that we are particularly interested in the nations that are still emerging. First and foremost, emerging economies in the early phases of modernization focus on climate strategy and ecological conservation regarding international justice(Sueyoshi and Goto, 2012). Second, developing nations have fewer financial and technological resources to deal with weather change and ecological damage than industrialized ones(Akpolat and Bakirtas, 2020). For the third time, emerging economies are the primary receivers of climate funding because of the trade-off between manufactured goods and environmental deterioration due to economic concentration(Hanssen et al., 2018).

Carbon dioxide emissions (metric tons per capita) are a key source of GHG and may be used to track environmental deterioration caused by human activities associated with economic development. Because it is one of the most significant factors in the climate-related environmental decline, such a measure has long been employed as a proxy for environmental quality(Zhu et al., 2018). If we are serious about reducing greenhouse gas emissions, we need to reduce the amount of CO2 we produce. This is a big factor in both global warming and the degradation of the environment. To quantify environmental sustainability, we focus on the World Development Indicators (WDI) generated carbon dioxide emissions.

Climate financing is quantified by comparing the GDP of the receiving nation to three kinds of global climate money: overall climate funds, international climate management funds, and climate adaptability funds. Annually, the OECD Development Aid Committee (DAC) compiles official growth advisory data, and other resource flows from regional and transnational growth collaboration sources(Scarpellini et al., 2019). To avert hazardous human interference with the climate system, mitigation funding primarily tries to stabilize GHG concentrations in the environment. Investing in renewable energy, such as solar photovoltaics and wind turbines is the most common form of mitigation funding. On the other hand, finance for climate change(Munda and Nardo, 2009) adaptability focuses on enhancing natural systems' capacity to withstand the present and future effects of climate change by boosting their adaptive capacity and raising their durability. This is a total of mitigation and adaptability banking, which refers to expenditure and funding operations that support additional money for climate change mitigation and low-carbon growth objectives.

A two-period averaging method is utilized to cope with climate money's dynamic impact, given that recipient nations require many years to complete projects. The planning process may be broken down into three stages(McCartney et al., 2021): It is possible to determine whether or not the same recipient got climate financing in the year (t) by utilizing a technique known as the variations; and if the recipient nation obtained climate finance in the year (t), the funds are shared evenly among years (t) and (t + 1). In other words, if climate funding is not received in a given year, it would not be included; (iii) we aggregate the total amount of climate finance flows, which provides for monies received in t and t-1 years. Other methods of smoothing out periods have the same effect.

Recipient nation population (POP), industrial value added (IVA), foreign direct investment (FDI), and energy intensity are all elements that might impact ecological sustainability at a country level (EI). It has long been recognized in the research that population has a significant impact on environmental quality(Ibn-Mohammed et al., 2021). However, some believe that a growing population harms environmental quality because it leads to higher levels of energy use and carbon emissions(H. W. Chen et al., 2010), while others believe the opposite, arguing that a growing population can help to reduce energy use and emissions by increasing the productivity of public services and fostering commercial coalescence(Vasylieva et al., 2019).

4. Data and descriptive statistics

4.1. Data source

This study uses the China energy Market & Accounting Research Database to obtain the from energy industrial firms Statistics data collected by regional confirmed Covid-19 cases instances in China from 2021 to 2022. The dataset includes detailed information about each firm's basic features and a diverse set of financial metrics from the cash flow energy markets, financial announcement, and financial equilibrium sheet, respectively. The post-COVID-19 world necessitates long-term growth, but the recovery period focuses on the economy. Because the benefits of energy sustainability are aligned with both economic and sustainable development, we are compelled to promote it. The elements influencing energy sustainability from post-COVID-19 situation perspectives are examined.

4.2. Descriptive statists

Table 1

shows descriptive data for the paper's primary variables, including renewable energy development, green economic and natural resources policy-related variables, financial intermediation, and basic business characteristics. Regarding innovation measurement, the percentage of enterprises engaged in innovation is approximately 39.3 percent, and the mean clean energy investment in innovation is around 0.031. The difference between indicators is that low-energy-consumption businesses are more inventive. Furthermore, the program helped 70.5 percent of China's publicly traded companies. Furthermore, enterprises that have experienced financial limitations show substantial variability in both the KZ and SA indexes. .As evaluated by the firm, ROA and ROE are around 2.2 percent and 4.5 percent, respectively. These study areas still using renewable energy-consuming very low-level enterprises had higher financial status indicators, such as coverage energy and economic ratio, liquidity, and markets cash flow, with mean values of 3.433%, 0.766%, and 0.031%, respectively. Furthermore, the overall sales growth rate is 49.4 percent, and Tobin's Q is at 3.399. Lastly the firm size is approximately 30.455, and the age is approximately 3.344.

For Eq. (1), we estimate the influence of green-finance-system standards on greenwashing by adding fixed effects and firm- and industry-level control variables in Columns 1–3. No doubt, the findings in Column 3 are more accurate than those in Columns 1 and 2 since they include all the control variables and fixed effects. Post and Treat's combined effects on greenwash are positive and important, as shown in Table 1, with a correlation of 0.214 at the 1 percentage importance level, indicating that (Rempel and Gupta, 2021)a one-unit standard deviation in the pollution-control target causes a 21.3percentage increase in greenwashing for heavily polluting firms. Using the results to support our hypothesis, we may conclude that green financing standards enable greenwashing by polluting companies.

4.3. Main results

4.3.1. Renewable and sustainable energy transitions

Green efficiency, and green innovation are all negatively affected by green credit regulation due to financial limitations(Bai and Dahl, 2018). Firms make a variety of options in response to varying degrees of financial restriction. High liquidity helps provide regular operations and output for companies with fewer financial constraints, even though they may incur non-compliance expenses due to environmental control policy. As a result, enterprises in this category are less inclined to seek outside funding sources like green loans or engage in green washing practices to minimize the credit effect. Environmental control policies may significantly impact businesses that are already under financial pressure, but this can be alleviated by enterprises that are already under financial pressure and have a strong motivation to ease the impact of such limitations(Neralić and Kedžo, 2019). As a result, they may have a strong reason to green wash to fulfill strategy criteria and get easier access to green finance (see Table 4).

Financial restrictions have a major impact on green washing, according to Table 2, which indicates how businesses' green washing actions are influenced by the green finance standards depending on the extent of financial limitations. In Table 2, Index both reveal that financial burdens have a positive and substantial influence on greenwashing. Financial limitations have a negligible effect of 0.4 percent (Gürlek and Tuna, 2018) on the WW and SA indices, according to columns 3–4, but the 2017 Guidelines dramatically increase the financial restrictions. When it comes to the second state, we examine the link between economic conditions and strategy shocks and greenwashing.

Table 1
Descriptive results.

Variable	(1) Obs.	(2) Mean value	(3) Std.Dev.	(4) Minimum	(5) Maximum	(6) Control variable	(7) Treat	(8) Difference
R&D Dummy	44,344	0.533	0.530	1.000	0.000	0.533	0.560	−0.054***
R&D	44,344	0.030	0.035	0.000	0.456	0.021	0.019	−0.008***
Post-COVID	44,344	1.345	0.475	1.000	2.000	0.339	0.347	−0.008
Natural recourses	44,344	0.705	0.456	0.000	1.000	0.000	1.000	−1.000
KZ	15,470	5.533	2.051	5.030	7.091	4.766	3.350	0.089***
WW	13,612	2.273	0.120	0.677	1.540	1.210	1.233	0.022***
ROA	18,756	0.040	0.050	−0.240	0.290	0.030	0.023	0.007***
ROE	18,645	0.055	0.088	−0.520	0.450	0.063	0.065	0.009***
Economic growth	36,411	0.405	0.474	−0.754	2.685	0.522	0.625	−0.041***
Tobin's Q	21,541	2.365	3.114	0.621	52.441	3.652	3.254	−0.547***
Firm size	40,325	19.474	1.321	11.414	32.471	18.325	19.652	−0.085***
Firm age	25,478	3.411	0.747	0.000	4.254	3.254	3.254	0.254***

Note: ***, ** and * is for level of significance at 1%, 5% and 10%.

Table 2
Results of probit test and OLS testing.

	Dependent variable: Real Investment Cost per Capita (in logs)		
Variables	Probit	OLS	Margins
R&D Dummy	−0.0213	−0.0344**	−0.0633*
R&D	(0.0194)	(0.0115)	(0.0301)
Post-COVID-19	−0.0367***	−0.00748**	−0.0242***
Natural recourses	(0.00822)	(0.00359)	(0.00714)
KZ	−0.864***	−0.268	−0.726
WW	(0.334)	(0.292)	(0.466)
ROA	−0.101	−0.164	−0.312
ROE	(0.384)	(0.233)	(0.345)
Tobin's Q	0.00677	−0.000832	0.000678
Firm size	(0.00522)	(0.00367)	(0.00543)
Firm age	0.785***	0.283	0.604**
	(0.280)	(0.227)	(0.342)
Intensity (logs)	−2.067**	−0.00237	−0.438
	(0.537)	(0.305)	(0.462)
Constant	−4.535*	−2.708	
	(2.700)	(2.222)	
Observations	334	334	334
Log likelihood	−87.282	−284.247	
R-squared	0.445	0.277	

Note: ***, ** and * is for level of significance at 1%, 5% and 10%.

Results are provided in Table 5 Panel B, and we discover that green financing standards greatly influence companies in groups with high financial restrictions but have no effect on those in groups with minimal financial limits(Kaakeh et al., 2021).

When it comes to job prospects, an IRENA analysis shows that the jobs gained from the energy transition outnumber the jobs lost from fossil fuels globally (three times more job chances). The level of employment varies depending on the technology. For both models, provide insignificant estimates. Furthermore, at the 1%, 5%, and 10% levels, the empirical estimates of EG-J and EG-J-Ba-Bo yield highly statistically significant estimates. The null hypothesis of no co integration relationship between the under-discussion variable is thus rejected. Furthermore, the altered energy sector demands improved market architecture that encourages short-term flexibility via appropriate pricing signals(Steffen et al., 2020). And cross-border electricity trade is a favoured upgrade for improving market stability.

Furthermore, the energy transition will ensure that the climate targets are met, and governments and energy policies will play a larger role in this process. Installing carbon capture devices would be capital demanding, and after COVID-19, it is nearly impossible to market quickly (Quitzow et al., 2021). However, by adopting an eco-friendly approach, it is feasible to RE recourses that produce clean and cheap energy for the country. In such circumstances, integrated modelling evaluation would be beneficial (Pappas, 2021). In light of Model-1's findings, all three FMOLS, Random effect, and CCR estimators show that total natural resources have a negative impact on world economic performance over the given time period. Alternative sustainable means of manufacturing renewable energy from natural gas from the trash can be studied in light of a lack of money and renewable resources (Raza et al., 2021).

Furthermore, the quickening of the transition would push the research scholar to use much more of the pre/post-COVID-19 pandemic period's short-run relationship between natural resource commodity price volatility and economic performance. In addition, the scientific community might make a significant contribution by estimating the geographical renewable energy potential. Studies for China and other regions, as well as challenges and policy requirement(Gumashta and Gumashta, 2021; Kenny and Mallon, 2021; Padhan and Prabheesh, 2021), Accelerating the review and approval of new projects, as well as the issue of licenses, At a 1% level, TNR considerably affects economic performance by 0.633 (FMOLS), 0.687 (DOLS), and 0.698 (CCR). The magnitude of influence fluctuates significantly, but the direction of influence remains constant. Furthermore, from a policy standpoint, we require creative policy mechanisms that promote sustainable growth while being cost-effective (Rivera-Ferre et al., 2021).

4.4. *Global energy sustainability*

Once the results were obtained, AMG and CCEMG estimation methods were tested for their resilience. Our findings are shown in Table 3 using the FMOLS method, which is a completely altered ordinary least squares (FMOLS).(Gumashta and Gumashta, 2021). According to FMOLS results, external variables' effects on economic growth are similar to those found by the AMG and CCEMG estimation method. On the other hand, a little shift in the amplitude of the correlation coefficients has been discovered. A rise of one percent in green finance, resources and energy expenditure, nation resource taxation, and technological innovation raises the economy's performance by 0.162, 1.545, 0.662, and 1.496%. The projected findings are statistically significant at all three stages (1%, 5%, and 10%)(Falagiarda et al., 2020; Melo-Oliveira et al., 2021; Rivera-Ferre et al., 2021).

4.4.1. *RE sources into the energy transition*

It is necessary to mobilize green financial possessions to fully utilize renewable energy sources and achieve satisfactory energy efficiency. Simultaneously, associated financial and economic hurdles that cause the Group of the eight-nation energy sector to lag behind other regions must be overcome(S. Gao, 2020) are not important and are all near 0, inferring that there was no important variation in green technology innovation among the therapy group and that of the control group before that year. Since 2017, columns (1) and (2) show significant positive coefficients, indicating that following the policymaking, there were important variations among firms in the therapy and control

Table 3
Baseline estimations.

Tests	(1) Probit test	(2) Tobit test	(3) Fixed Effect	(4) Probit test	(5) Tobit test	(6) Fixed Effect
R&D Dummy	−0.655***	0.017***	−0.031***	0.035	0.006***	−0.004
R&D	(0.006)	(0.001)	(0.001)	(0.018)	(0.001)	(0.002)
Post_COVID	−0.099	−0.004***	0.015***	0.026**	0.011***	0.012***
Natural recourses	(0.110)	(0.001)	(0.002)	(0.011)	(0.002)	(0.002)
KZ	0.088***	0.009***	0.003***	0.017***	0.004***	0.004***
WW	(0.023)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
ROA				−0.002	−0.002***	0.002**
ROE				(0.059)	(0.000)	(0.001)
Tobin's Q				−0.683***	−0.010***	−0.009***
				(0.022)	(0.000)	(0.000)
Constant	−1.093***	−0.003***	0.244***	−3.334***	0.183***	0.115***
	(0.408)	(0.001)	(0.006)	(0.463)	(0.006)	(0.008)
Year	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes
Observations	26,293	45,236	23,336	22,162	22,162	22,162
R-squared			0.169			0.214

Note: in parentheses ***p < 0.01, **p < 0.05, *p < 0.1.

Table 4
Results of model 1 to 9 testing.

Variables	Model (1) lnGS	Model (2) DFC	Model (3) EDI	Model (4) lnGS	Model (5) DFC	Model (6) lnDY	Model (7) lnDY	Model (8) EFC	Model (9) lnIY
C	−2.28	0.03	0.83	−0.76	0.02	−11.22***	−12.65***	2.00***	6.67***
R&D Dummy			3.60***	2.40	−0.03***	2.53			
R&D	0.27***	-68×20^{-4}*					0.25*	-6.56×20^{-5}	0.03
Post COVID	0.83***	8.53×20^{-4}	0.53**	0.88***	5.85×20^{-4}	3.20***	2.89***	-2.34×20^{-3}	0.58***
Natural recourses	3.05*	0.04***	3.44**	3.48**	0.04***	−3.07	−3.65	0.05***	0.84**
KZ	−0.87	-4.26×20^{-3}	−0.57	−0.82	-3.35×20^{-3}	−0.33	−0.24	0.02**	−0.06
WW	3.73***	−0.02***	2.88**	4.23***	−0.03***	−2.02	−2.00	5.32×20^{-4}	0.38
ROA	−0.84*	0.02**	−0.46	−2.02*	0.02**	2.88**	2.93***	3.33×20^{43}	0.20
ROE	0.30	0.25	0.22	0.27	0.27	0.22	0.40	0.07	0.32

Note: in parentheses ***p < 0.01, **p < 0.05, *p < 0.1.

groups, which meets the concept of parallel trends based on temporal trends. This is because the spread of current technologies and the creation of new ones take time. It is also important to note that the impact of communications architecture on green technology innovation is influenced by(Shahrestani and Rafei, 2020) factors such as regional factor flow, economic growth, and human capital.

Even though they were chosen at random in terms of geographic allocation and economic growth, the pilot towns are still being scrutinized because of concerns about other possible contradicting variables that may influence the results of SDG dynamics relations in Table 2. This research uses IV estimate as a robustness test to address the issue of strategic endogeneity. The two-stage least squares approach is used to assess the robustness of the benchmark findings based on the IV method, which (Hanif et al., 2019) adopted (2SLS).

4.5. Financial modelling

The findings are congruent with those of (Gumashta and Gumashta, 2021), who identified a favorable association between green money and renewable energy investment. Green bonds have little impact on renewable energy investments in the first year of COVID-19. Except for Model 7, the ADF test boosts renewable energy sources by 0.4356 and 0.4576. Green finance encourages investments in solar, wind, and hydro energy. The energy transition is a terrific approach to accelerate progress toward sustainability, but it can only be done by emphasizing the affordability issue at the consumer level. The perception of energy affordability is frequently based on an individual's perspective rather than societal considerations (Melo-Oliveira et al., 2021). From the standpoint of energy production, affordability is defined as the prospective economic profitability in relation to the investments made. Governmental approaches and energy policies, on the other hand, can be effective in achieving cleaner energy goals but ineffective in promoting energy affordability due to the uncertainties involved. Overall, energy affordability is a complicated issue that necessitates multifaceted climate change problems facing both developing and non developing world, and RE sources must modify their perceptions of energy affordability. The rate of global electrification is also influenced by affordability. Electrification has numerous advantages for both producers and consumers(Aramburu and Pescador, 2019; Y. Chen et al., 2019; Diao et al., 2019; Turner and Schlecht, 2019). Consumer affordability is only attainable while the energy cost decreases with app effects. As a result, reducing poverty will aid in the resolution of these complex affordability concerns.

The standard deviation of each city's height is employed as an experimental variable in the first stage of the experiment. As a purely operational variable(Filippini and Greene, 2016), terrain relief meets the relevance requirement. When it comes to building telecommunications structures, higher terrain relief impacts both the cost and signal quality of such architecture, which in turn affects the effectiveness with which the system as a whole operates (Lang et al., 2021). The empirical findings of the study, on the other hand, support the use of effective techniques to increase RE. Lack of legislative reforms and poorly performed and implemented reforms targeted at boosting electrification.

The empirical data for the major indicator of post-COVID-19 and green economic variables in Table 3. We employ three alternative estimating methodologies depending on the dependent variables. In particular, the FMOLS findings show that a one percent increases in natural resource volatility affects economic performance by 0.255

percent. A 1% increase in improving sustainability, renewable power output, and green finance, on the other hand, improves economic performance by 0.544, 0.355, and 0.677 percent, respectively. At the 1%, 5%, and 10% levels, the results were highly statistically significant. Our findings highlight the importance of Using the probit and Tobit approach; this fills a vacuum in the literature addressing the pre and post Covid-19 conditions of China's natural resources, commodity pricing volatility and economic performance (Ulucak et al., 2020).

4.6. Pre-COVID pandemic testing

All UN member states endorsed the 2030 Agenda for Sustainable Development (2030 ASD) in 2015, including 17 SDGs. 'Clean and cheap energy (SDG 7) and 'climate change mitigation (SDG 13) were major global challenges. It reflect comparable conclusions to those previously mentioned. Nonetheless, varying magnitudes are recorded. In particular, a 1% increase in natural resource volatility reduces China's economic performance by 0.83 percent. A 1% rise in Model 1(DEF), Model 2, or Model 3 boosts economic performance by 0.657, 0.7687, and 0.8746 percent. At all levels of significance, i.e., 1%, 5%, and 10%, the estimated results are highly statistically significant. As a result, the Robust regression findings corroborate the empirical results obtained using FMOLS, DOLS, and CCR. Furthermore, the obtained results were consistent with previous empirical studies conducted in various regions of China.

The Breitung-Candelon (BC) spectral Granger causality test finds the causal link in all runs, including the long, medium, and short runs. On the other hand, the horizontal red line suggests a 5 percent level of a significant relationship between the variables that better understand dynamic situations and change directions in Table 5. The scenarios described in the next paragraphs are based on a qualitative approach and scenario analysis(Reilly, 2012), a foresight methodology. The ramifications of the pandemic for political stability are explored both at the domestic (intrastate) and international (global) levels in the scenarios presented here(Gielen et al., 2019).

4.7. Green financial results

We used financial constraints mechanism to build interaction terms between instrumental factors and time for 2SLS regression since using time-invariant instrumental variables in fixed-effects models is difficult (He and Guo, 2021). Using terrain relief as the instrumental variable, rows 1, 2, and 3 in Table 6 show the findings; rows 4, 5, and 6 in Table 6 show the results using fixed-line penetration as an instrumental variable. The impact of the Broadband China strategy on business green technology innovation is still considerable after accounting for exogenous variables via these parameters(Taghizadeh-Hesary et al., 2021). The first frame's instrumental variable's F-value is much over 10, suggesting that weak equipment is not a concern. This supports the hypothesis that improved telecommunications infrastructure encourages the development of environmentally friendly new technologies. To summarize, the Broadband China program supported green technology innovation in pilot regions of both high and poor quality. The policy had a stronger effect on encouraging low-quality green technology innovation than on encouraging high-quality green technology innovation. Because of China's lack of green technology, enterprises may be more difficult to achieve high-value levels in its green technology innovation(Kamyk et al., 2021).

The negative and significant correlations for fiscal decentralization, renewable energy R&D, and institutional quality indicate that strengthening these characteristics lowered CO_2 emissions in the sample countries. Three alternative models are estimated in this investigation. The impact of Tobin's Q, Financial constraint = WW, Financial constraint = KZ, and RE on CO_2 emissions is estimated in the first model. Natural resource rent and income (GDP), on the other hand, have a positive relationship with CO2 emissions. Long-run elasticities for fiscal decentralization, GDP, natural resource rent, institutional quality, and renewable energy R&D are 0.026, 0.801, 0.129, 0.142, and 0.043, respectively, in Model 1.

FDI is also regarded as capturing possible technological spillover effects from other sources of expenditure since emerging nations cannot finance expensive abatement programs aimed at reducing emissions, combating climate change, and protecting the ecosystem without foreign help. Last but not least, we take into consideration EI since nations with intensive energy sources generally depend on fossil fuels to maintain their economic growth, making climate financing renewable energy investment more difficult to undertake(Yoshino et al., 2021).

4.8. COVID-19 related cases check

The global interconnectivity is 20.17 percent in the pre-COVID-19 period and 22.77 percent in the post-COVID-19 period. That after COVID-19 infection, total spillover effects increased dramatically, with approximately 34.58 percent of interconnectedness in all sectors.

On the other hand, the horizontal red line suggests a 5 percent level of a significant relationship between the variables. Table 8 depicts the imagined bureaucratic politics mechanism. China renewable energy preference might differ from one country to the next, and are impacted

Table 5
Results of GMM analysis for strengths factor.

Variable	(1)	(2)	(3)	(4)	(5)
	POLS	RE	FE	Two-way	GMM
R&D Dummy	0.8300	2.4547***	2.7743***	1.2573**	2.7252***
R&D	(2.4346)	(4.6543)	(5.3653)	(3.5583)	(5.6032)
Post-COVID	3.7587***	3.6774***	0.8780***	0.5099	0.9853***
Natural resources	(25.8990)	(30.8800)	(5.0746)	(0.8044)	(5.388)
KZ	0.0026**	0.0033	−0.0077***	−0.0033*	−0.0054**
WW	(4.3734)	(3.0659)	(−5.4585)	(−3.8777)	(−3.5600)
ROA	−0.0446***	−0.0347	0.0335	−0.0368	0.0072
ROE	(−6.5599)	(−3.5809)	(0.8877)	(−3.3854)	(0.6682)
Tobin's Q	−0.0114*	−0.0072	0.0454	0.0354	0.0313
Firm size	(−2.7364)	(−0.3998)	(2.6054)	(2.2586)	(1.3192)
Firm age	−0.0087***	−0.0097***	−0.0076***	−0.0077***	−0.0075***
	(7.6366)	(6.3785)	(5.5776)	(7.7232)	(6.2249)
cons	−7.7748***	−8.8627***	−3.0624	0.7657	–
	(−22.7232)	(−8.6738)	(−2.6533)	(0.2808)	–
R2	0.7505	0.6558	0.5838	0.8565	0.6910
F/Wald	65.8855***	563.223***	87.86327***	55.8826***	71.5562
Obs.	480	480	480	480	470

Note: in parentheses ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table 6
Financial constraints mechanism investigation.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Probit	Tobit	Fixed Effect	Probit	Tobit	Fixed Effect	KZ	WW
Financial constraint = KZ	−0.045*	−0.004***	−0.006***					
Financial constraint = WW				−0.298***	−0.044***	−0.051***		
				(0.088)	(0.007)	(0.008)		
Post-Covid-19							0.048**	−0.038**
							(0.001)	(0.001)
Treat							−0.027	−0.017***
							(0.003)	(0.000)
DID Effect							−0.044**	−0.001***
							(0.001)	(0.000)
Financial growth	−0.08	−0.002***	0.08	0.009	−0.001***	0.001	−0.073	−0.076
	(0.081)	(0.011)	(0.008)	(0.073)	(0.056)	(0.043)	(0.075)	(0.076)
Tobin's Q	0.084*	0.0052***	0.007***	0.059*	0.006***	0.007***	−0.084	−0.003*
	(0.074)	(0.028)	(0.084)	(0.084)	(0.002)	(0.001)	(0.018)	(0.001)
Firm Size	0.230***	−0.002***	−0.005***	0.062***	−0.008***	−0.007***	0.625***	0.007*
	(0.025)	(0.000)	(0.000)	(0.005)	(0.000)	(0.000)	(0.000)	(0.000)
Firm Age	−0.744***	−0.008***	−0.008***	−0.525***	−0.005***	−0.004***	0.004	0.004
	(0.019)	(0.002)	(0.003)	(0.002)	(0.001)	(0.001)	(0.031)	(0.003)
Constant	−0.385***	0.089***	0.078***	−3.410***	0.225***	0.221***	−3.144***	2.425***
	(0.241)	(0.009)	(0.009)	(0.155)	(0.008)	(0.009)	(0.039)	(0.003)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	12,524	12,524	12,524	12,524	12,524	12,524	12,524	12,524
R-squared			0.202			0.185	0.254	

Note: in parentheses ***p < 0.01, **p < 0.05, *p < 0.1.

Table 7
Covid-19 correlation exploration.

	(1)	(2)	(3)
	Probit	Tobit	Fixed Effect
DID result	−0.070	0.007***	0.007***
	(0.041)	(0.002)	(0.001)
DID Effect*Confirmed cases	0.018**	0.001***	0.002***
	(0.004)	(0.000)	(0.000)
Financial growth	0.070***	−0.001	0.005*
	(0.030)	(0.001)	(0.002)
Tobin's Q	−0.011	0.009***	0.007***
	(0.010)	(0.002)	(0.002)
Firm Size	0.098***	−0.009***	−0.005***
	(0.021)	(0.000)	(0.000)
Firm Age	−0.455***	−0.015***	−0.016***
	(0.038)	(0.001)	(0.001)
Constant	−2.171***	0.199***	0.245***
	(0.499)	(0.008)	(0.009)
Year	Yes	Yes	Yes
RE Industry	Yes	Yes	Yes
Observations	5377	5377	5377
R-squared			0.180

Note: in parentheses ***p < 0.01, **p < 0.05, *p < 0.1.

by leadership and a variety of other political issues. To engage in sustainable development at this point, a system to incorporate environmental and societal advantages into climatic goals is critical. The action frame specifies the goal's many targets. The green financial market is better integrated with copper RE and fossil fuels during the COVID-19 pandemic period. This stage entails all actions necessary to formulate solid policy and political approaches before execution. The highest spillovers between pairs occur when switching from RE markets (2.39 percent, 4.33 percent) to fossil fuel energy (1.30 percent, 3.60 percent) (4.77 percent, 09.03 percent). Furthermore, a proper feedback mechanism is required to modify tactics and improve implementation efficacy.

In the COVID-19 pandemic period, the spillover effects across these three markets are greater than in the pre-COVID-19 period. Meanwhile, RE and green recovery have the largest spillover effects, implying that the metal market contributes more to overall connectedness. Before the COVID-19 outbreak, the value of net connectivity alternated between positive and negative. This suggests that the importance of these eight variables shifts throughout time. However, during the ongoing COVID-19 pandemic, financial variable and RE are the main net communicators of overflow. The function and prominence of international organisations must be strengthened, since a return to the multilateral paradigm for addressing global concerns appears to be the most sensible course of action. The analysis found that green financial allocation for renewable energy investment is 98% significant. In addition to typical climate change activities, lowering global emissions and promoting renewable energy investment with green financial energy can provide better results.

When renewable energy investments are combined and regressed for 2021, the results are favorable. Green bonds have little impact on renewable energy investments in the first year of COVID-19. Except for Model 7, green funding favors renewable energy sources with factors of 0.3956 and 0.67545. Green finance encourages investment in solar, wind, and hydro. The mentioned findings are congruent with (Mohammadi et al., 2015), who found substantial and good results. Renewable energy and energy efficiency are key to any energy policy adjustment.

Green standards encourage solar, wind, and hydro energy investment sources with 0.423, 0.6754, and 0.7654, respectively. More green regulations, such environmental levies, can stimulate greener energy sources in China. This is due to a change in renewable and clean energy investment sources, an environmental panacea.

There is a complicated relationship between several SDGs, with one influencing the other in a synergic or trade-off impact (Reghenzani et al., 2019). As a result, knowing the connections between the SDGs is critical for determining the best path to achieving the objective with the least amount of work. The authors provide a fresh quantitative analysis to demonstrate the SDGs connection. Interaction between SDGs can be seen in two ways. Progress on one goal can impact other goals, and progress on one goal can depend on progress on another.

The term implies the aim affects others. According to dynamic-wind energy, Green bonds and green rules have a big, positive influence on wind energy investment. Green bonds and green standards have a big influence, as according them. Table 8 shows the moderating influence of green regulation on Inv3, with the interaction term (GPR*GREENREG) being significantly negative but lower than the direct negative impact of

Table 8
Robustness check.

	Dependent variable: Hazard of Investment								
Variables	1	2	3	4	5	6	7	8	9
R&D Dummy	−3.306**	−2.287***	−2.299***	−0.667***	−0.670***	0.0403	0.350	−0.350	−0.235
R&D	(0.287)	(0.306)	(0.305)	(0.305)	(0.327)	(0.374)	(0.366)	(0.352)	(0.355)
Post-COVID	−2.676***	−2.798***	−2.773***	−0.889***	−2.026***	−0.558**	−0.502*	−0.595**	−0.565**
Natural resource	(0.287)	(0.275)	(0.284)	(0.275)	(0.266)	(0.366)	(0.355)	(0.334)	(0.334)
KZ	−2.858***	−3.088***	−3.084***	−2.263***	−2.254***	−0.466	−0.277	−0.345	−0.296
WW	(0.348)	(0.357)	(0.365)	(0.222)	(0.336)	(0.446)	(0.466)	(0.388)	(0.404)
ROA	−4.638***	−3.500***	−3.532***	−2.637***	−2.624***	−0.895**	−0.505	−0.809***	−0.962**
ROE	(0.460)	(0.430)	(0.436)	(0.447)	(0.464)	(0.566)	(0.538)	(0.455)	(0.463)
Sales growth		(0.00732)	(0.00672)	(0.00677)		(0.0205)	(0.0275)	(0.0286)	(0.0237)
Tobin's Q		−0.00883***	−0.0246***		−0.00822**	−0.008534	−0.0245**	−0.0293***	−0.0294***
Firm size		(0.00267)	(0.00289)		(0.00462)	(0.00584)	(0.00704)	(0.00577)	(0.00567)
Firm age			0.648***	0.846***	0.547**	−0.735*	−0.0434	0.522*	0.485*

Note: in parentheses ***p < 0.01, **p < 0.05, *p < 0.1.

GPR, which was 0.138, significant at 1%.

Although green bonds are appealing, equity financing may also be used to invest in clean energy and green technologies(Callens and Tyteca, 1999). In recent years, it has been shown that many stockholders are unwilling to participate in sin-stocks that are hazardous to the ecosystem and human health or exploit social well-being, regardless of their gains. Over several generations, there has been a boom in environmental and socially conscious share expenditures. These expenditures concentrate on the company's policies on environmental and social issues such as climate change, as well as corporate governance. Despite the COVID-19 pandemic, sustainable spending throughout the world totaled USD 36.3 trillion, a 15percentage increase in two years. Several studies have shown that the shares in the Environmental and Social Accountability Index can withstand market downturns, such as the international financial crisis, commodities price shocks, or the COVID-19 outbreak(Ponce and Khan, 2021). Using stock markets to finance clean energy and green technology initiatives has several benefits. Investors benefit from this market's disclosure standards because it creates a more secure environment and allows for more investment. In addition, the company's ownership is distributed among(Sigala, 2020) stakeholders, which suggests that these stockholders will have different viewpoints on the initiatives, which might lead to a better appraisal.

The relationship of SDG with other targets is depicted in Table 8. The shift to a low-carbon economy is the first and most important. Furthermore, the sample size for this study was limited to 25 energy companies operating in China; this produces a lot of job possibilities and reduces energy importation, which helps the economy grow(Khan et al., 2021). As renewable energy grows, companies will be under increased pressure to support the energy transition, and innovations in renewable will have piled up as a result of improved collaborative circles throughout the accelerated transition period.

After evaluating and discussing the results of the Markov-Switching models, Table 7 shows evidence of post estimation diagnostics(Zahid et al., 2022). Breusch-Godfrey test, Durbin Watson test, heteroskedasticity, skewness, and kurtosis all show up in the results. . These studies, conducted before the Covid-19, show that natural resource commodity price volatility has no impact on a country's macroeconomic performance. On the other hand, uncertainty causes panic and has a negative impact on economic and manufacturing activity. This has a negative impact on the country's economic success. Focusing on energy transition while keeping environmental limits in mind will result in pollution-free energy generation and job possibilities and economic growth(Khan et al., 2022). This also entails addressing poverty issues to some level, such as energy availability and affordability issues, which can be gradually addressed with the help of quality education. With the rapid spread of clean energy, green techniques in SDG 9 will be well-established, and innovations, particularly in recycling, reusing, turning waste energy to useful energy, and boosting efficiency, will all contribute to instilling sustainability in every action. Plastic usage and disposal are two further adjustments that the world requires (Sharaunga et al., 2019).

5. Conclusions and policy implications

After the COVID-19 outbreak, this study examines the influence of modifications in China's Sustainable Growth Goals (SDGs)development goals and natural resources utilization for green economic recovery on Chinese enterprises' by employing econometric estimation on the period of 2010–2020.As a result, the post-COVID world emphasizes the necessity for long-term development and methods compatible with the ecosystem. We proposed that this study be used as a roadmap to steer the post-pandemic scenario onto a sustainable development goals and development of green economic recovery by emphasizing energy sustainability as a strategy to engage in SDG-related efforts.

Including sustainability development goals and green economic recovery objectives in long-term development plans had a considerable impact on energy saving and emissions reduction, lowering energy consumption intensity by 3.33 percent and carbon emission intensity by 4.23 percent. A growing trend toward such techniques could yield even better outcomes for renewable energy investment. Furthermore, during the outbreak of the COVID-19 pandemic, the correlation between the two sets of indicators increased dramatically. Our findings also imply that investors who choose to go green will not lose money in terms of risk-adjusted returns. It is easier for firms to direct their operations now that investors may convert to green investments without sacrificing financial rewards. Renewable and sustainable energy transitions are more important than ever before, as help to boost employment prospects and influence market dynamics in a unique way. The ideas for accelerating the transition are presented through the eyes of the power plant, transportation, and construction industries. The importance of prioritising investment and the employment picture and labor market developments that are significantly influenced (in a favorable way) by the energy transition are stressed. The energy sector's digital transformation benefits the sustainable energy sector in various ways. To determine the prioritised strategy in light of current pandemic consequences, green policies play an important role in lowering the negative impact of geopolitical risk on hydro energy investment.

On the other hand, when it comes to determining the political viability of energy sustainability, both developing and industrialized countries use a variety of methodologies. Unilateral approaches are represented in one extreme scenario, whereas multilateral approaches are highlighted in the other. Furthermore, the reality appears to be less encouraging, given the lacklustre response to the pandemic and the plan for a rapid increase of fossil fuel use even in affluent countries, both of which exposed multilateralism's flaws and emphasised a general preference for self-interested acts.

5.1. Policy implications

Overall, this article serves as a reminder that a well-designed, environmentally friendly fiscal policy can aid post-pandemic economic recovery and the transition to long-term growth. These results point to two major policy consequences. First, corporate managers must adopt a green approach to financial liquidity management in terms of management dynamics. As a result, resolving all of these constraints will be a helpful approach for future investigations. Identifying and implementing common ground remains beneficial during the recovery period, but after a normal situation has been restored, much attention must be paid to long-term development. Whether or not the SDGs can be achieved by 2030, putting out the greatest effort to do so is what matters most and should be the top priority. The authors of this study propose that sustainable development be viewed through the lens of energy sustainability.

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