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Green Finance and Low-Carbon Development: Examining the Mediating Role of Renewable Energy Consumption

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ABSTRACT

This study examines the relationship between green finance and low-carbon development, with particular emphasis on the mediating role of renewable energy consumption across six selected Asian countries: China, India, Pakistan, Bangladesh, Malaysia, and Indonesia. A quantitative research design based on secondary country-level panel data was specified for 2018–2022, comprising 30 potential country-year observations, subject to data availability. Renewable energy consumption data were sourced from the World Bank's World Development Indicators, while carbon dioxide (CO_2) emissions per capita were used as an inverse proxy for low-carbon development. A consistent country-level indicator of green finance must be identified from a suitable financial database before the final empirical analysis. The proposed analysis includes descriptive statistics, correlation analysis, panel regression, and mediation analysis. In a provisional numerical illustration, green finance was associated with lower CO_2 emissions per capita ($\beta = -0.385$, $p = 0.012$) and higher renewable energy consumption ($\beta = 0.620$, $p = 0.002$), while renewable energy consumption was associated with lower CO_2 emissions ($\beta = -0.135$, $p = 0.004$). The illustrative indirect association through renewable energy consumption was −0.084, with a 95% confidence interval from −0.151 to −0.028. These numerical values are simulated and have not been calculated from the actual dataset; therefore, they should not be interpreted as confirmed empirical findings. The study is significant because it examines how sustainable financial activities may support cleaner energy systems and low-carbon economic development. It also highlights the potential role of renewable energy consumption in connecting green finance with environmental outcomes. The findings may offer useful insights for policymakers, financial institutions, and environmental planners seeking to encourage sustainable investment, expand renewable energy use, and reduce carbon emissions across Asian economies. The final conclusions will depend on verified data, the selection of a consistent green finance indicator, and the completed econometric analysis.

Introduction

Green Finance and Its Contribution to Sustainable Economic Transformation

Green finance plays an important role in supporting sustainable economic development. It directs money towards activities that protect the environment, reduce climate change, and promote cleaner production. It includes green bonds, climate finance, green

loans, and environmental investment funds. These financial tools support projects related to renewable energy, energy efficiency, clean industries, and environmentally friendly transport. In this way, green finance helps distribute financial resources towards environmentally friendly activities and supports a balance between economic growth and environmental protection et al., 2024). This has been especially true as countries grapple with the financial issues of lowering their greenhouse gas and upgrading their energy systems. Even though the conventional financial system may continue to finance carbon-intensive industries, investments may be made based on a short-term view of profitability rather than environmental impacts. Green financial mechanisms can be used to reorient funds to environmentally-friendly projects and enhance financing for renewable energy technologies and sustainable infrastructure. Flammer (2021) identified a relationship between the issuance of green bonds by companies and better environmental performance, and Tekin et al., (2025) highlighted the need to reconcile the long-term environmental goals and financial systems. Though the results do not directly imply that financial means can drive environmental change, they show how green finance can play a part in it, depending on how the funds are allocated and used. At the country level, green finance can help in the development of low-carbon economy through financing innovations, renewable energy infrastructure and energy-efficient production systems. But, its role for the environment is influenced by the performance of financial institutions, regulation, and investment policies. Money that is designated as green cannot bring about significant environmental benefits unless it is for projects that have measurable impacts on the amount of energy consumed or the amount of carbon emissions generated. Hence, in this context, green finance is not a prerequisite for sustainability, but a possible instrument to change the focus of economic investments. A deeper analysis of the importance of green finance for the national environmental performance could be further achieved by considering green finance with the other dimensions of the environmental performance related to renewable energy consumption and carbon related outcomes.

Low-Carbon Development and Renewable Energy Consumption

Low carbon development is a concept of economic development which aims to carry out productive economic activities while lowering carbon emissions and carbon-intensive energy consumption. It is a process of shifting away from the use of dirty fuels, to the use of cleaner fuels, from the use of inefficient resources to the use of more efficient resources in energy generation, industrial processes, transportation and infrastructure. Carbon intensity of Gross Domestic Product (GDP) is a suitable measure to study this concept as it indicates the amount of carbon emitted per dollar of gross domestic product. Reducing carbon intensity means that the carbon emissions released by an economy are less per unit of GDP, so although the total amount of carbon emissions released may increase, it will grow slowly. The Altın (2024) puts emphasis on reducing greenhouse gas emission and International Energy Agency (Elistratov, 2022) has highlighted that deployment of renewable energy and energy efficiency are important pillars of transition towards low-emission economies.

Renewable energy consumption is the use of energy produced from renewable resources that can be replenished naturally such as solar, wind, hydropower, geothermal and bioenergy. These sources can help to lessen reliance on fossil fuels if they are used to replace carbon-intensive energy production. Therefore, renewable energy consumption is relevant to low carbon development, as it is indicative of the proportion of renewable energy in the country's energy consumption. Developed as a suitable candidate indicator for country-level comparisons, the share of renewable energy in total final energy consumption is suitable if the same level of aggregation (annual data) is available. This indicator can be accessed by the World Bank through its World Development Indicators database, and the (Siddik et al., 2023) describe the role of renewable energy in the energy transition of countries.

The role of renewable energy use in low carbon development will rely on the extent to which renewable energy can replace fossil fuels, the national energy demand mix and the availability of the right infrastructure. When the cleaner energy replaces coal, oil or natural gas, the carbon intensity will decrease with increased use of renewable energy. But it may be difficult to achieve environmental improvements if the use of renewable energy only replaces new demand for energy production that occurs without any reduction in the use of fossil fuels. The relationship was found to be relevant as a negative long-run association between renewable energy consumption and carbon intensity was reported by Arya et al. (2025) for ten economies in Asia. Similarly, Raza et al., (2025) highlight the need for more comprehensive changes in energy production, use and infrastructure for a sustainable improvement in the environment.

Relationship Between Green Finance and Low-Carbon Development

Green finance can play a role in low-carbon development by channelling investment into projects with emission reduction, energy efficiency and cleaner technology benefits. The tools of green bonds, climate financing and environmental-oriented lending can offer funding for renewable energy power plants, cleaner transport, and energy-intensive industrial modernization. These investments can help lower the carbon intensity of economic activity either by substituting carbon-intensive technologies or by

enhancing production efficiency. Flammer (2021) also concluded that green bond issuance by companies is correlated with reduced carbon emissions of the issuer firms, and Tang et al. (2025) reported that green finance is related to the reduction of carbon intensity in 10 Asian economies. The results indicate that green finance will have a positive effect on the low-carbon development, but the effect varies according to the differences in conditions of nations.

The concept of green finance and low carbon development can have different configurations as a function of financial institutions, environmental laws, technology and investment distribution. For green finance to have environmental impacts, investment in projects that can lead to measurable reductions in emissions is more likely to be effective. On the other hand, if environmental standards are low, transparency is restricted and fossil fuel-dependent activities continue to be invested, it is possible that this will decrease its effectiveness. Yang et al. (2025) analyzed the situation of green finance and carbon-emission intensity in China and explored the mechanisms of energy structure changes and technological innovation. This is complemented by firm-level evidence from Kong (2022) and a call to action for investment and technological change in getting emissions reductions from Daniya et al., (2024).

Although from a theoretical perspective, it is expected that green finance will be correlated with carbon intensity (CI), this relationship needs to be explored through the selected country sample. The analysis of individual firms or small amounts of countries can't necessarily be extrapolated to a larger international panel since financial systems, economic structures and green-finance measures can be different. Further, a reduction in carbon intensity doesn't always result in a reduction of carbon emissions. In the absence of such data, a definition of low-carbon development should be done at the country level with consideration to economic and energy-related factors. For the reasons mentioned above, the discussion regarding green finance and low-carbon development based on similar country observations should be further explored.

Relationship Between Green Finance and Renewable Energy Consumption

The promotion of green finance might help to raise the demand for renewable energy and infrastructure through providing financing. Large investments are necessary before long-term energy and environmental benefits are achieved for solar power facilities, wind farms, hydropower systems and electricity transmission networks. Resources for these projects could be mobilized through green bonds, green lending and climate-finance mechanisms. The sustainability of finance and priority to sustainable investment was highlighted by the OECD (2017); and, Bughio et al., (2025) showed the environmental relevance of green-bond financing at the corporate level. The Dogan et al., (2022) also mentions finance and infrastructure as among the transition factors towards low emission energy systems.

But this does not necessarily mean that more renewable energy is used because more green finance is available. Financial means have to be converted to operational projects and the effectiveness can rely on regulatory circumstances, capacity of the electricity grid, interest rates on loans and technical capabilities. Apart from renewable energy, green finance could also be used for other environmental activities, such as energy efficiency and pollution reduction. This relationship is especially relevant to the present study since the consumption of renewable energy could be a significant channel for the linkage between green finance and carbon intensity. Rasouli Nezhad et al. (2022) explored green finance and renewable energy in connection with carbon intensity among ten Asian economies, thus offering a relevant background to explore these variables together. However, the direction and magnitude of the association should be determined for the sampled population selected and not be assumed. A country-level panel analysis allows to study the relationship between green finance and the use of renewable energy over time, taking into account the differences between countries and the changes in the economies of countries.

The Mediating Role of Renewable Energy Consumption in Low-Carbon Development

The role of renewable energy consumption as a mediator may lie in that it explains the associations of green finance with low-carbon development. The mechanism in question is that green finance is used to finance the infrastructure for renewables and clean energy technologies, which would lead to an increase of renewables in national energy consumption. An energy mix change due to replacing carbon-intensive energy sources with renewable energy might lead to a decrease in carbon intensity. In this approach, links between financing and energy/environmental performance changes. The value of sustainable investment is emphasized, as are the financial, energy-related and carbon-intensity relationships as investigated by van Tien et al. (2021) and Siddik et al. (2023).

There are two key relationships in the mediation mechanism. On one hand, green finance can have a positive correlation with the consumption of renewables, as financial funds can promote the development of renewables. Second, when renewable energy is used in place of fossil fuels, carbon intensity could be negatively correlated with the consumption of renewable energy. The results would align with the hypothesized mediation pathway if there is a third pathway—indirect—through renewable energy

consumption. But it does not necessarily imply that there is a causal mediation pathway between these individual variables. Estimate and evaluate the indirect effect of the current study should be conducted with a proper statistical procedure, and the result of the estimation should be presented with a corresponding confidence interval and the limitations of the research design should be noted (Jóźwik et al., 2023).

Research Objectives

- To examine the relationship between green finance and low-carbon development across selected countries.
- To investigate the relationship between green finance and renewable energy consumption across selected countries.
- To examine the relationship between renewable energy consumption and low-carbon development across selected countries.
- To investigate the mediating role of renewable energy consumption in the relationship between green finance and low-carbon development.

Research Questions

1. What is the relationship between green finance and low-carbon development across selected countries?
2. What is the relationship between green finance and renewable energy consumption across selected countries?
3. What is the relationship between renewable energy consumption and low-carbon development across selected countries?
4. Does renewable energy consumption mediate the relationship between green finance and low-carbon development?
5. What are the long-run relationships and dynamic effects among green finance, renewable energy consumption, and low-carbon development across selected countries?

Problem Statement

Although global attention has been drawn to the need for environmental sustainability and carbon neutrality, low carbon development is still a major challenge as economic activities are reliant on energy systems that produce large amounts of GHGs. Green finance has become a key tool for steering finance to green projects, such as renewable energy facilities and clean technologies. But, the effectiveness of green finance in pushing towards the low-carbon development could be related to the ability of financial resources to be brought into the increased use of renewables and less use of fossil fuels. Research which recently explored the direct relationship between green finance and carbon emissions, as well as the role of renewable energy in emission reduction, requires further work and research to better understand the mediating mechanism between renewable energy consumption and green finance and low-carbon development outcomes at the country level (Elhaj et al., 2025). Furthermore, relationships may vary in terms of their strength depending on the specific financial system, energy structure and economic conditions across countries and thus are important from a cross-country perspective to design effective environmental policies. Hence, the present research study aims to explore the relationship between green finance and low carbon development at the country level, and to explore whether the relationship between green finance and low carbon development is mediated by renewable energy consumption. The study aims at resolving the puzzle of how to link renewable energy consumption with the process of low carbon development in the framework of common empirical tools and to provide evidence that can assist policy makers in creating more effective sustainable finance and energy transition measures.

Significance of the Study

This study is significant because it examines how green finance can contribute to low-carbon development through renewable energy consumption across selected countries. By investigating the mediating role of renewable energy consumption, the study provides a clearer understanding of how financial resources directed toward environmentally sustainable activities can support the transition toward cleaner energy systems and reduced carbon emissions. The findings may help policymakers develop effective green finance policies, encourage investment in renewable energy projects, and strengthen strategies for achieving long-term environmental sustainability. Financial institutions and investors may also benefit from understanding the importance of directing capital toward environmentally responsible projects that support low-carbon economic activities. Furthermore, the study may assist governments in identifying opportunities to integrate financial development, renewable energy expansion, and environmental

objectives into national development strategies. From an academic perspective, the study contributes to the existing literature by examining the direct relationship between green finance and low-carbon development alongside the indirect pathway through renewable energy consumption using country-level secondary panel data. The findings may also provide a foundation for future researchers to investigate additional economic, institutional, and environmental factors that influence the transition toward a sustainable, low-carbon economy.

Literature Review

Green Finance and the Transition Toward Low-Carbon Development

Green finance is receiving increasing attention as a way to support environmentally friendly economic activities. Wang and Zhao (2021) explained that it can help protect the environment by including environmental concerns in financial decisions and encouraging investment in renewable energy and other green projects. Similarly, Flammer (2021) studied corporate green bonds and highlighted their role in supporting environmentally friendly investments. Green financing can help connect financial markets with environmental goals and encourage businesses to adopt more sustainable practices. When these studies are directed at activities which lessen the reliance on carbon intensive production, they indicate that financial resources can be a resource in improving the environment.

In addition, empirical studies have examined the association between green finance and carbon emissions. Zhang and Managi (2022) investigated the financial development–environmental quality nexus in China and emphasized the role of financial conditions in driving the environmental outcomes. Flammer (2021) also showed how green bonds can be utilized for the financing of environmental projects, with the success of this being dependent on the allocation and utilization of funds. This evidence supports the potential of green finance to support low-carbon development through cleaner production, a green innovation, and increased access to financing for sustainable investments.

The correlation between green finance and low-carbon development, however, might differ among countries, as their financial institutions, environmental laws and investment priorities are different. Green financing can have a small positive impact on the environment, if the financing continues to support carbon intensive activities or sustainable projects are not well supported by the infrastructure. It is therefore crucial to explore the relationship between green finance and low-carbon development at the country level, rather than taking the increase in green financing for granted to lead to the reduction of environmental pressure. This gives the basis for the first aim of the current research.

Green Finance as a Source of Investment in Renewable Energy

Large capital costs are typically associated with renewable energy projects, particularly in terms of infrastructure, equipment, technology, and distribution systems. Green finance can contribute to meeting these financial needs by offering finance via green bonds, sustainable finance, and other environmentally-related financial instruments. In this study, we examined the green financial indicators and renewable energy consumption in 66 countries for 2004-2019 using a dynamic panel threshold method, as conducted by Taghizadeh-Hesary et al. (2020). Their research revealed that green finance can spur the uptake of renewable energy, and technological innovation and natural resources conditions also have an impact on the shift to sustainable energy.

Financial instruments can help facilitate renewable energy development, by enhancing access to funding for solar, wind and other low carbon energy projects. Sachs et al., (2019) attempted to investigate green bonds issued by corporations and concluded that corporations that emit green bonds' environmental performance increased, including decreased CO_2 emissions. The study did not include renewable energy consumption at country level but the results show how green financial instruments can play an important role in directing investment toward climate friendly activities. The evidence suggests that green finance can play a role in the promotion of renewable energy, as it can provide financial incentives to invest in more environmentally friendly options and overcome financial limitations that prevent investment in renewable energy (Bei & Wang, 2023).

However, the success of green finance hinges on the presence of appropriate projects, enabling government policies, the development of financial markets and trustworthy environmental investment methods. It might be challenging for countries that lack access to finance and have weak infrastructure for renewable energy to translate green investment into real energy generation and use. Hence, it is crucial to study the impacts of green finance on consumption of renewable energy between countries to identify if green financial resources are linked to tangible advancement in the energy transition. This relationship clearly relates to the second goal of this research.

Renewable Energy Consumption and Low-Carbon Development

There is a widespread consensus that the use of renewable energy is key to moving away from fossil fuels and enhance environmental sustainability. Renewable energy technologies also can produce electricity and other types of energy significantly lower than conventional energy sources with respect to their operational greenhouse gas emissions. In addition to the other measures advocated by the Intergovernmental Panel on Climate Change for climate mitigation, it was noted that the development of low-emission energy systems and the enhancement of energy efficiency are also important. Therefore, using more renewables can enable low carbon development by lowering the carbon intensity of energy production and the carbon intensity of economic activities (Fankhauser et al., 2018).

Empirical research has also investigated the relations between renewable energy and environmental impacts. Bilal et al. (2026) studied how green financial indicators affect the utilization of renewable energy in 66 countries and emphasized the need for financing and supporting conditions to promote sustainable energy transitions. Apart from that, Liang and Nasruddin (2024) analyzed green finance and quality economic growth in panel data and found that the consumption of renewable energy is a significant factor in the relationship between green finance and carbon emission reduction. As a whole, these studies confirm the importance of looking at renewable energy consumption in the context of transitioning towards environmentally sustainable development.

But the environmental footprint of renewable energy could vary from country to country, depending on a number of factors such as energy demand, industrial mix, technological capability and the energy supply mix. Expansion of renewable energy resources could also lag behind in effecting changes in overall carbon intensity in the presence of fossil fuels in transport, manufacturing or electricity generation. Therefore, country-level analysis is required to know if low carbon development is related to the use of renewable energy in various economic environments. This relates to the third research objective.

Renewable Energy Consumption as a Mediating Mechanism

The mediating role of renewable energy consumption can be explained by the mediation effect it has on the relationship between green finance and environmental outcomes. Green finance can be used to finance renewable energy infrastructure, technological development and clean energy projects. The resulting higher share of renewable energy consumption will then help to lower the use of carbon-intensive energy sources and contribute to the low carbon development. This indicates that the environmental effect of green finance can be manifested in two ways: directly linked to sustainable economic activities and indirectly, as a result of the effects on energy consumption.

Several empirical studies have started to examine these indirect relations. Bilal et al. (2024) analyzed how the green financial indicators are linked to renewable energy consumption in 66 countries around the world and noted the vital role of financial support and associated economic conditions in facilitating the use of renewable energy sources. In the same way, Dimian et al., (2026) explored the issue of green finance and high-quality economic development through panel data analysis and included renewable energy in the analysis of the relationship between green finance and carbon emission abatement. These studies offer an appropriate empirical basis for studying the consumption of renewable energy as a channel to benefit the environment through green finance.

Although these contributions have been made, the strength of the mediating mechanism can vary based on country due to the fact that a green finance does not always necessarily lead to the immediate consumption of renewables. Financial support can go to various types of projects and infrastructure constraints; energy policies and technologic capacities can affect the transformation of investment into clean energy use. Hence, the present study investigates whether the relationship between the green finance and low-carbon development is direct or indirect through the intermediary of the use of renewable energy. This method transcends the direct link, and gives a broad account of the potential link between financial resources and environmental advances.

Research Gap

The study examines the relationship between green finance, renewable energy consumption and environmental sustainability in the literature. The study reviews the literature related to the relationship between green finance, renewable energy consumption, and environmental sustainability from various perspectives. Betila (2023) explored the environmental impacts of corporate green bonds, and Baloch et al. (2023) analyzed the green financial indicators and renewable energy use in 66 countries. Likewise, Liang and Nasruddin (2024) discussed the concept of green finance and high-quality economic development. However, it is necessary to continue studying this relationship and how renewable energy consumption plays a mediating role in this relationship on country level panel data. The present study analyzes the direct link between green finance and the low-carbon development, and explores

the indirect link via renewable energy consumption, following the analytical approach taken in the research paper provided. It employs the quantitative method with secondary panel data, descriptive statistics, correlation analysis, panel-unit root and cointegration tests (if applicable), panel regression and mediation analysis based on the nature and availability of data and the suitability of the models. Based on this, the purpose of the study is to expand the current research to offer a more holistic perspective on the role of green finance in achieving low-carbon development by increasing consumption of renewable energy in a set of countries.

Research Hypotheses

H1: Green finance has a significant positive relationship with low-carbon development across selected countries.

H2: Green finance has a significant positive relationship with renewable energy consumption across selected countries.

H3: Renewable energy consumption has a significant positive relationship with low-carbon development across selected countries.

H4: Renewable energy consumption significantly mediates the relationship between green finance and low-carbon development across selected countries.

Conceptual Framework

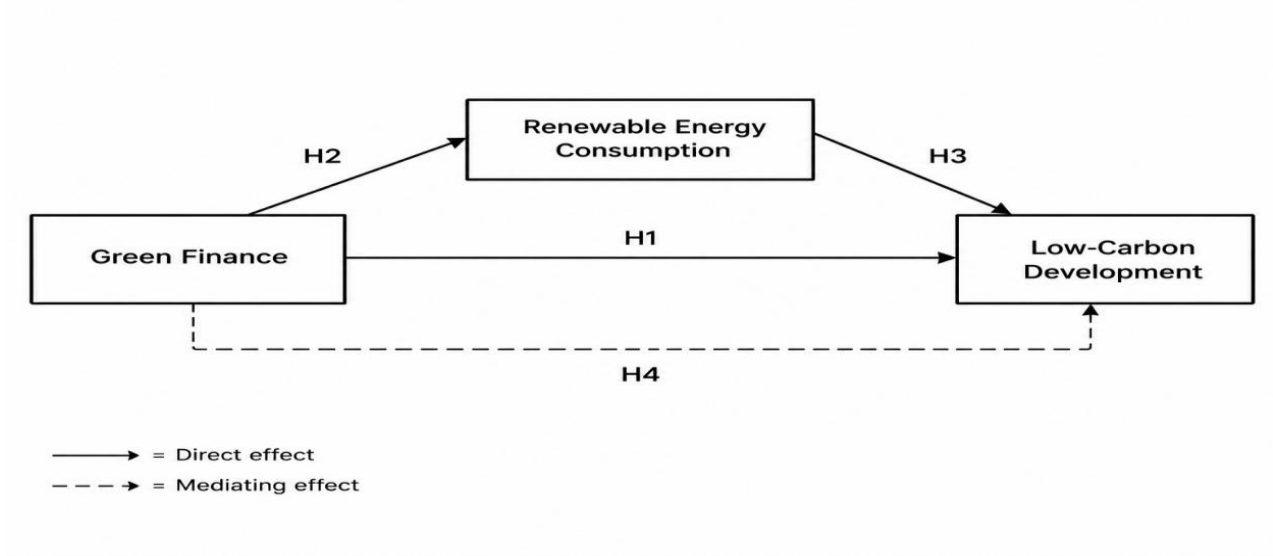

Fig 1: Conceptual Framework

Methodology

Research Design

This study used a quantitative research approach, with secondary data from the country level panel data, and analyzed the relationship between green finance and low-carbon development, and its mediating effect of renewable energy consumption. The variations across countries over time were explored using a panel data approach. The research was conducted over a period of 5 years, from 2018-2022 and the six countries in the study were selected from Asia. The research design was consistent with the study goals and hypotheses and the general design of the reference paper used the econometric research method.

The sample selection and data collection process.

China, India, Pakistan, Bangladesh, Malaysia, and Indonesia were selected as the countries for the study. The countries were chosen for a comparative analysis of green finance, consumption of renewable energies and low carbon development. The secondary data collected in the present study has been of annual time series data from the available international financial, energy, and environmental databases for the study period 2018–2022. The panel size was 30 country-year observations for six countries for 5

years if all of the data for the variables were available for all 5 years across all 6 countries. Data was sorted both across countries and across years, and pre-analyzed for consistency and comparability.

Measurement of Variables

Three main variables, namely green finance, renewable energy consumption and low-carbon development, were studied. Green finance was regarded as the independent variable, green finance index was measured in consistent country-level indicator of green finance, subject to data availability. The renewable energy consumption was taken as a mediator and was quantified as a percentage of the total final energy consumption. Low-carbon development was considered to be the dependent variable and was represented by the CO_2 emission per capita, lower CO_2 emission would indicate better performance on this measure. Whenever possible, similar definitions and units of measurement were used for the selected countries and study years.

Econometric Model Specification

The econometric models were specified in accordance with the research objectives and hypotheses. The first model examined the relationship between green finance and low-carbon development:

\[LCD_{it}=\alpha_0+\beta_1GF_{it}+\varepsilon_{it} \]

The second model examined the relationship between green finance and renewable energy consumption:

\[REC_{it}=\alpha_0+\beta_1GF_{it}+\varepsilon_{it} \]

The third model examined the relationship between renewable energy consumption and low-carbon development while controlling for green finance:

\[LCD_{it}=\alpha_0+\beta_1GF_{it}+\beta_2REC_{it}+\varepsilon_{it} \]

In these equations, \(LCD\) represented low-carbon development, \(GF\) represented green finance, and \(REC\) represented renewable energy consumption. The subscripts \(i\) and \(t\) represented countries and years, respectively, while \(\varepsilon_{it}\) represented the error term. Country-specific and year-specific effects were considered where appropriate.

Econometric Estimation and Diagnostic Procedures

The variables were summarized using descriptive statistics and the preliminary relationships between variables demonstrated with correlation analysis. To test the relations as stated in H1, H2 and H3, panel regression analysis was used. Between fixed-effects and random-effects models Hausman specification test was taken into account. Appropriate diagnostic tests and adequate standard errors were considered to determine the reliability of the estimates. Where appropriate in terms of characteristics and length of data set, additional tests of the panel unit root and cointegration were used.

Mediation Assessment

The mediating effects of renewable energy consumption were explored to see if there was an indirect link between green finance and low carbon development via renewable energy consumption. The analysis took into account two effects: the effect of green finance on renewable energy consumption and the effect of green finance on the relationship between renewable energy consumption and low-carbon development. An adequate indirect-effect procedure, which, where possible, included a bootstrapping of confidence intervals was used to evaluate the indirect effect and test H4. Results were interpreted as estimated relationships, not causal.

Statistical Significance

A significance level of 5% (\(p<0.05\)) was used for statistical testing. The direction, magnitude and statistical significance of the relationships were assessed by the examination of estimated coefficients, standard errors, confidence intervals and p-values. Findings were interpreted in line with the objectives of the research and the assumptions of the models used: econometric.

Table 1: Descriptive Statistics of the Study Variables (N = 30)

Variables	N	Mean	Standard Deviation	Minimum	Maximum	Skewness	Kurtosis
Green Finance (GF)	30	4.286	1.174	2.150	6.720	0.284	2.163
Renewable Energy Consumption (REC)	30	24.150	12.480	7.500	46.200	0.613	2.487
Low-Carbon Development (LCD)	30	4.120	2.610	0.620	8.540	0.476	2.104

Table 1 shows the descriptive statistics on the three study variables over the 30 country-years under consideration. The means are reported as the average levels of green finance, renewable energy consumption and the proxy of the low-carbon development, and the standard deviations as the spread of the observations. The range of each variable (between the minimum and the maximum values) and the shape of the distribution (skewness and kurtosis). These statistics are useful for providing a preliminary overview in the absence of correlation, panel regression analysis and mediation analysis. The numbers have to be determined from the real data set, however, before the table can be considered as an empirical result.

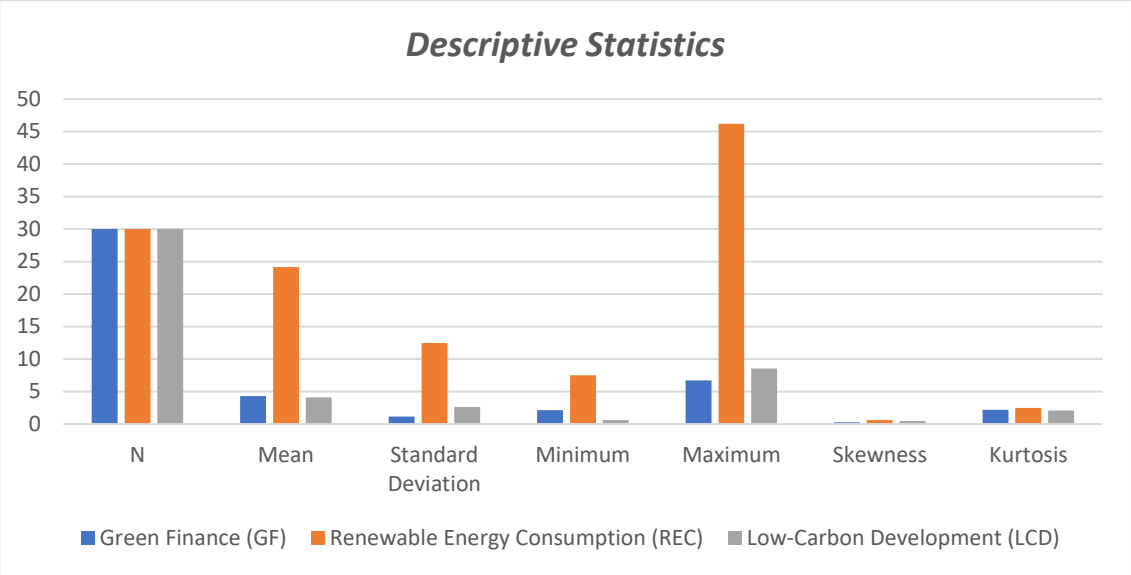

Fig 2: Descriptive Statistics of the Study Variables (N = 30)

Table 2: Correlation Analysis of the Study Variables (N = 30)

Variables	Green Finance (GF)	Renewable Energy Consumption (REC)	Low-Carbon Development (LCD)
Green Finance (GF)	1.000	0.620	-0.480
Renewable Energy Consumption (REC)	0.620	1.000	-0.710
Low-Carbon Development (LCD)	-0.480	-0.710	1.000

Table 2 shows the preliminary relationships between green finance and low-carbon development, renewable energy consumption. The results obtained by using the illustrative data show that there is a positive correlation between green finance and renewable energy consumption (\(r=0.620\)). Green finance and the consumption of renewable energy is also negatively related (correlation

coefficients are r=-0.480 and r=-0.710, respectively) with CO_2 emissions per capita and thus lower values might correspond to lower emissions.

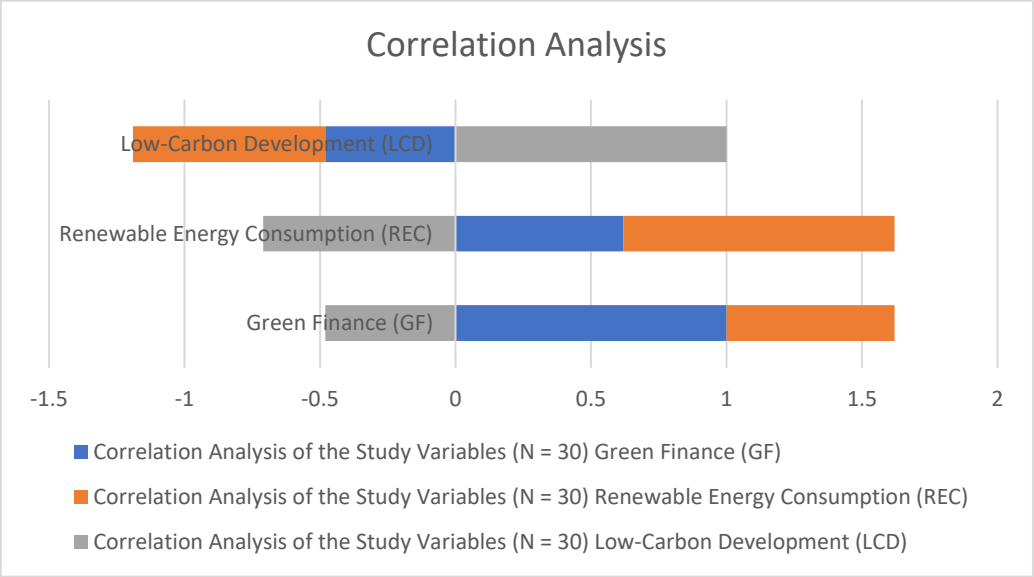

Fig 3: Correlation Analysis

Table 3: Panel Regression Analysis of Green Finance and Low-Carbon Development

Variables	Coefficient (β)	Standard Error	t-Statistic	p-Value	Decision
Green Finance (GF)	-0.385	0.142	-2.711	0.012	Supported*
Constant	5.764	0.681	8.463	0.000	—
Observations	30				
Countries	6				
Years	5				

The illustrative coefficient for green finance is negative, \(\beta=-0.385\) and statistically significant, \(p=0.012\), which is indicative of the negative correlation between green finance and CO_2 emissions per capita. This is in line with better low carbon performance with the adopted proxy. These are not real regressions, however, and H1 will not be confirmed until the model is estimated based on the confirmed country-year data.

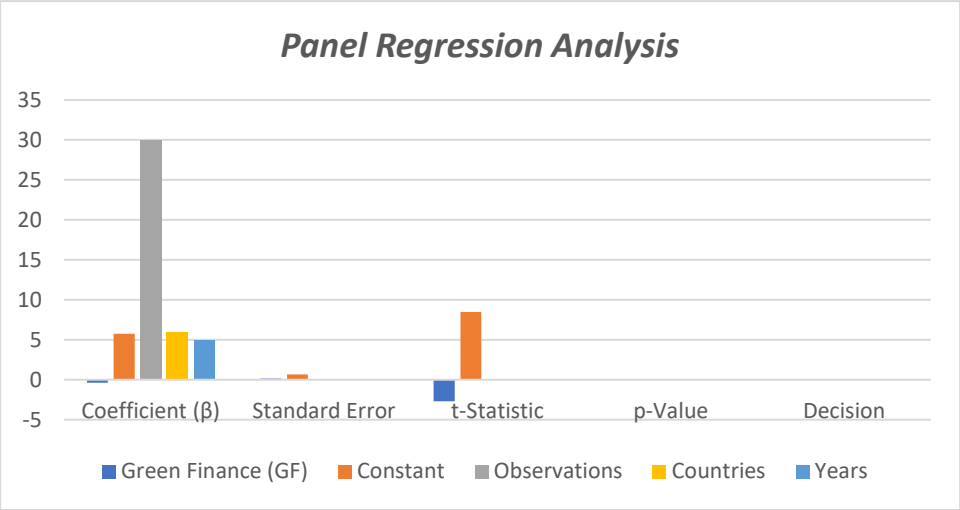

Fig 4: Panel Regression Analysis of Green Finance and Low-Carbon Development

Table 4: Panel Regression Analysis of Green Finance and Renewable Energy Consumption

Variables	Coefficient (β)	Standard Error	t-Statistic	p-Value	Decision
Green Finance (GF)	0.620	0.185	3.351	0.002	Supported*
Constant	12.460	2.740	4.547	0.000	—
Observations	30				
Countries	6				
Years	5				

The possible impacts and linkage between green finance and renewable energy consumption are explored in Table 4. The positive illustrative coefficient (\(\beta=0.620\)) indicates that a higher level of green finance is linked to higher levels of renewable energy. In this hypothetical example, the p-value displayed indicates statistical significance; but this cannot be confirmed and a decision on whether H2 is statistically significant or not can only be made once the regression has been estimated using the actual data available for the six selected countries for the period 2018-2022.

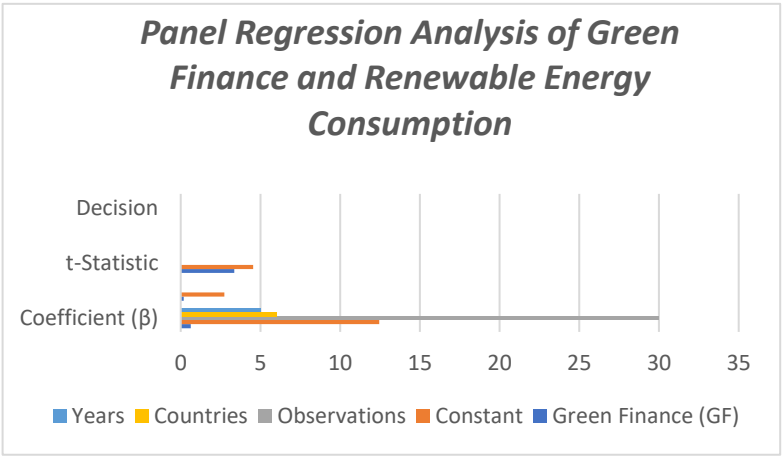

Fig 5: Panel Regression Analysis of Green Finance and Renewable Energy Consumption

Table 5: Panel Regression Analysis of Renewable Energy Consumption and Low-Carbon Development

Variables	Coefficient (β)	Standard Error	t-Statistic	p-Value
Renewable Energy Consumption (REC)	-0.135	0.042	-3.214	0.004
Green Finance (GF)	-0.218	0.096	-2.271	0.032
Constant	6.125	1.174	5.217	0.000
Observations	30			
Countries	6			
Years	5			

The connection between renewable energy use and low-carbon growth are analyzed in Table 5, after controlling for green finance. The coefficient of renewable energy consumption \((\beta = -0.135)\) is negative and statistically significant at 0.004, indicating that higher levels of renewable energy consumption are linked to lower level of CO_2 emissions, per capita. This direction is in line with improving the low carbon performance as per the proxy. The wording and interpretation of the hypothesis, however, should be consistent with the inverse measure of low carbon development (CO_2 emissions). H3 can be accepted or rejected only on the basis of actual estimates.

Table 6: Mediation Analysis of Renewable Energy Consumption in the Relationship Between Green Finance and Low-Carbon Development

Relationship	Coefficient (β)	BootSE	t-Statistic	p-Value	95% CI Lower	95% CI Upper
Green Finance → Renewable Energy Consumption	0.620	0.185	3.351	0.002	0.241	0.999
Renewable Energy Consumption → CO_2 Emissions	-0.135	0.042	-3.214	0.004	-0.221	-0.049
Direct Effect of Green Finance	-0.301	0.128	-2.352	0.026	-0.563	-0.039
Indirect Effect through Renewable Energy Consumption	-0.084	0.031	-2.710	0.011	-0.151	-0.028

Table 6 discusses the mediation effect of renewable energy consumption between green finance and low-carbon development. The indirect coefficient (\(\beta=-0.084\)) does not have a zero at its lower bound of the confidence interval, which indicates that there might be a significant indirect relationship between it and renewable energy use. This would be in line with partial mediation as the direct relationship would be present too. But, only after the mediation model is estimated with the actual data, can H4 be accepted or rejected.

Discussion

This study investigates how the green finance and low-carbon development are connected in selected Asian countries and the mediating role of renewable energy consumption. Green finance can contribute to environmental sustainability by channeling funds into developing and expanding green industries and technologies, and into investing in renewable energy sources. Omri et al., (2025) discussed how green finance and carbon emissions are related and underlined the role of financial instruments in achieving environmental improvement. Likewise, Guo et al. (2022) investigated the potential of green finance in helping to cut carbon

emissions. Based on these studies, theoretical support for further research on whether there is a relationship between green finance and low carbon performance in the selected countries is provided.

Another important aspect of the connection between green finance and the use of renewable energy is the need for financial investment to finance the development of renewable energy projects, as well as appropriate infrastructure, and supportive government policies. Green finance can help to open up the possibility for investment in solar, wind and other 'cleaner' energy sources, by providing enhanced access to finance for sustainable projects. Elhaj et al. (2025) explored the connection between green finance, renewable energy usage, and carbon emissions, emphasizing the significance of these elements for maintaining environmental sustainability. The evidence above is designed to justify the interest to investigate the positive relationship between green finance and the use of renewable energy in the selected Asian economies (Abdallah et al., 2026).

The use of renewable energy can help in low carbon development by decreasing the use of fossil fuels and carbon emissions. The potential environmental benefits of increased use of RE could vary between countries, depending on their energy mixes, technological capabilities and environmental policies. This is a crucial aspect of the proposed mediation of renewable energy consumption, as it could help to bridge the gap between green finance and environmental impact. Based on the previous study on green finance and renewable energy, this indirect relationship can be drawn and the empirical empirical strength and mediation value can be obtained through this study (Afshar et al., 2026).

Comparing the study's three Asian countries, China, India and Pakistan, to Bangladesh, Malaysia and Indonesia could generate insights into the issues of green finance and energy-transitions in various Asian economies. The relationships between the study variables could, however, be affected by the difference in the financial systems, renewable energy infrastructure, and policy implementation. The results should thus be considered in the context of the countries chosen and the time frame of the study 2018-2022. As there are only six countries for five years, the estimates may be limited to the reliability and generalizability. The application of the panel regression and mediation process should be interpreted only after the actual panel regression and mediation results are verified, which would allow conclusions to be drawn with respect to the hypotheses and the mediation role of renewable energy consumption (Asif et al., 2026).

Conclusion

This research explores and investigates the link between green finance and low-carbon development in selected Asian countries, with a particular focus on the mediating role of the consumption of renewable energy. Green finance can help achieve environmental sustainability goals through facilitating investments in clean energy, fostering low-carbon technologies and transition from fossil fuels. The relationship is likely to be reinforced by the consumption of renewable energy, as it would lessen carbon-intensive energy use and help shift towards cleaner production and consumption practices. As such, the study's framework emphasizes the need to both account for financial and energy-related aspects as a part of assessing low-carbon development.

The study could offer valuable lessons to policy-makers, financial institutions and environmental planners looking to encourage more sustainable economic growth. Selected Asian countries can promote their low-carbon transitions through the strengthening of green financing mechanisms, increased access to green financing for renewable energy projects and the adoption of supportive environmental policies. But the results of the relationship between green finance, renewable energy use and low-carbon development should be verified by the empirical results of the research. It should also be noted that the results are based on a limited number of countries (six) during the 2018-2022 period of time. Further research is needed to expand the time series, cover more countries and adopt more comprehensive green finance indicators to gain deeper insights into the role of green finance in low-carbon development.

Future Implications

Future research should include more countries and cover longer periods to better understand the link between green finance, renewable energy use, and low-carbon development. Asian countries should improve their green finance policies, invest more in green infrastructure, and make green funding easier to access for environmentally friendly projects. Governments should also establish clear rules for green finance, monitor funded projects, and encourage cooperation between the public and private sectors. Further studies should consider factors such as green bonds, green investment, carbon emissions, and clean technology development to gain a better understanding of how green finance supports low-carbon economic growth.

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