

Green Finance and the Economics of Clean Energy Transitions for Sustainable Development

Eugine Balayo Sifuna^{1*}, Stephnora Oluchi Adeyanju¹, Opeyemi Ezekiel Adedokun², Oluwaseyi Joseph Olukayode³, James Benjamin Kelechi⁴ and Kolawole Abiola⁵

¹Faculty of Social Sciences, Higher school of Economics, Myasnitskaya Street, 9/11, Room 529, Moscow, 101000, Russia

²Graduate Business School, Higher school of Economics, Myasnitskaya Street, 9/11, Room 529, Moscow, 101000, Russia

³Biology institute, Tomsk State University, 36 Lenin Avenue, Tomsk, Tomsk Oblast, 634050

⁴Institute of Environmental Engineering, Peoples' Friendship University of Russia, Moscow 117198, Russian Federation

⁵Department of Soil Science and Land Management, University of Benin, P.M.B. 1154, Ugbowo, Benin City 300283, Nigeria

DOI: <https://doi.org/10.51583/IJLTEMAS.2026.150900056>

Received: 14 September 2026; Accepted: 19 September 2026; Published: 09 October 2026

ABSTRACT

Green finance has become an important mechanism for aligning capital allocation with clean-energy transitions and sustainable development. This structured integrative review synthesizes 84 substantive journal articles published between 2002 and 2025, supported by three methodological sources. Literature was identified through Scopus, Web of Science, and Google Scholar searches conducted in June–July 2026 and synthesized narratively across six themes: green-finance instruments and market pricing; cost of capital and project finance; policy and risk allocation; financial development and digital finance; directed technological change; and sustainable-development outcomes. Of the 84 substantive studies, 44 were published from 2020 onward, representing 52.4% of the evidence base. The review finds that green bonds can mobilize capital and support investment and innovation, although pricing advantages vary with issuer quality, verification, market conditions, and use-of-proceeds credibility. Financing costs are strongly associated with renewable-energy deployment, particularly in developing economies where macroeconomic and project risks can constrain investment. Stable policy, risk-sharing mechanisms, financial development, and digital access are generally associated with improved investment conditions, while carbon pricing and renewable-energy support can influence the direction of technological innovation. Evidence on economic growth and sustainable-development outcomes remains heterogeneous across countries, institutional settings, and empirical methods. Overall, green finance appears most effective when financial additionality is linked to measurable environmental performance, technological learning, broader access to capital, and credible governance. The review provides an integrated framework linking financial instruments, investment conditions, transition outcomes, and sustainable-development effects across diverse national contexts.

Keywords: green finance; clean energy transition; renewable-energy investment; green bonds; cost of capital; sustainable development; climate finance

INTRODUCTION

The clean-energy transition is a capital-allocation challenge as well as a technological transformation. Renewable technologies require substantial upfront investment, have long asset lives, and depend on

financing arrangements that distribute construction, policy, market, and operational risks across investors (Steffen, 2018). Financing institutions influence which technologies progress from demonstration to deployment because public, private, and mixed financiers differ in mandates, risk tolerance, and investment horizons (Mazzucato & Semieniuk, 2018). Financing conditions also evolve with technological maturity and investor experience, producing technology-specific changes in required returns (Egli et al., 2018). These characteristics make the cost and structure of capital integral to the pace of decarbonization rather than a secondary consideration (Calcaterra et al., 2024). In developing economies, high financing costs can reinforce carbon-intensive investment pathways even where renewable resources are technically attractive (Ameli et al., 2021).

Green finance seeks to redirect capital through labeled bonds, credit programs, investment standards, risk-sharing instruments, and policy-linked funding. Cross-country evidence associates green finance with greater renewable-energy deployment, although the strength of this relationship varies across financial and institutional settings (Alharbi et al., 2023). Evidence from 53 countries similarly links green finance with renewable-energy development (Hou et al., 2023), while studies of BRICS economies associate green finance with renewable investment and environmental protection (Zeng et al., 2023). Corporate green bonds provide a firm-level mechanism by linking borrowed funds to environmental projects and organizational commitments (Flammer, 2021). Their contribution to the transition, however, depends on whether proceeds finance credible transition activities rather than merely refinance existing assets with limited additional environmental value (Maltais & Nykvist, 2020).

The economics of green finance also encompasses pricing, risk, information, and portfolio choice. Differences in green-bond yields may reflect investor preferences for environmental attributes, but the associated premium is neither uniform nor persistent (Larcker & Watts, 2020). A systematic review shows that the green premium varies with issuer type, certification, currency, maturity, and market design (MacAskill et al., 2021). Carbon emissions are also reflected in equity-market pricing, suggesting that transition exposure enters investors' assessments of expected returns (Bolton & Kacperczyk, 2021). Equilibrium models of sustainable investing further show how environmental preferences can affect asset prices and the cost of capital (Pástor et al., 2021). Divergence in environmental, social, and governance ratings complicates this process because inconsistent measurement alters the information available to investors (Berg et al., 2022).

Sustainable development broadens the evaluation of green finance beyond issuance volumes and short-term returns. Life-cycle assessment shows that green-bond-financed renewable projects can differ materially in environmental performance even when they share the same financing label (Gibon et al., 2020). European evidence links green finance with sustainable-development outcomes through financial and institutional pathways (Afzal et al., 2022). Reviews of climate-finance policy indicate that capital mobilization depends on instrument design, implementation capacity, and the allocation of public and private risk (Bhandary et al., 2021). Evidence from developing countries further suggests that digital-economy capacity can strengthen the relationship between green financing and energy transformation (Nepal et al., 2024), while climate risk can alter the strength of the green-finance–energy-transition relationship (Lee et al., 2024). Against this background, the present review examines how finance is associated with clean-energy investment, innovation, market performance, environmental quality, economic growth, and distributional outcomes, with particular attention to recent evidence, cross-country heterogeneity, and the strength of the underlying empirical mechanisms.

METHODOLOGY

This study employed a structured integrative review with narrative synthesis to examine the relationships among green finance, renewable-energy investment, financing costs, financial-market pricing, policy and institutional risk, technological innovation, economic growth, environmental outcomes, and sustainable development. An integrative approach was considered appropriate because the literature contains heterogeneous research designs, including panel-data estimations, event studies, asset-pricing analyses,

surveys, real-options models, theoretical and equilibrium models, and life-cycle assessments, for which a common statistical effect measure is not consistently available (Lucas et al., 2007).

Literature Search and Information Sources

The literature search was conducted during June–July 2026 using Scopus, Web of Science, and Google Scholar. Scopus and Web of Science served as the principal bibliographic databases, while Google Scholar supplemented the search. Only English-language publications were considered. Search terms covered green finance and green bonds, financing costs and project finance, renewable and clean energy, financial and digital finance, policy and climate risk, technological innovation, environmental performance, economic growth, and sustainable development. The Boolean search strategy combined key concepts as follows: ("green finance" OR "green bond" OR "climate finance" OR "sustainable finance" OR "financial development" OR "digital finance" OR "project finance" OR "cost of capital") AND ("renewable energy" OR "clean energy" OR "energy transition" OR "low-carbon transition" OR "green innovation") AND (investment OR financing OR deployment OR emissions OR "economic growth" OR "sustainable development")*. Search syntax was adapted to each source. The review followed a structured integrative evidence-identification approach, and no review protocol was prospectively registered.

Eligibility Criteria

Studies were eligible when they were English-language journal articles and examined at least one substantive relationship among green finance, renewable-energy investment or consumption, financing costs, green-bond pricing, project finance, financial development, digital finance, climate or policy risk, technological innovation, environmental performance, economic growth, or sustainable development. Studies were retained where their findings contributed directly to at least one of the six analytical themes used in the review. Records were excluded when they were duplicates; were not published in English; were not substantive journal articles; fell outside the conceptual scope of the review; or did not examine a sufficiently direct relationship between the financial, energy-transition, innovation, environmental, or sustainable-development variables considered in the review. Studies concerned exclusively with technical or engineering characteristics of energy technologies, without an economic, financial, policy, innovation, environmental, or development dimension relevant to the review framework, were also excluded. Methodological papers used solely to guide the synthesis were retained as supporting references but were not counted as substantive studies.

Screening and Study Selection

Duplicate records were identified using DOI, title, author, and bibliographic information and removed before analysis. Bibliographic metadata were checked against DOI records, and incorrect DOI–title matches were corrected where necessary. DOI verification confirmed bibliographic identity and was not treated as an assessment of methodological quality. Screening was not conducted independently by multiple reviewers; therefore, no inter-reviewer agreement or disagreement-resolution procedure was applied. Eligibility decisions followed the predefined criteria described above. The final substantive corpus comprised 84 journal articles published between 2002 and 2025, including 44 published from 2020 onward (52.4%). Three additional sources which are Lucas et al. (2007), Rodgers et al. (2009), and Campbell et al. (2020) were used only for methodological guidance. The manuscript therefore includes 87 references: 84 substantive studies and three methodological sources.

Data Extraction and Thematic Coding

Each substantive article was coded by financial instrument or condition, capital-allocation mechanism, policy or institutional setting, financial outcome, energy or environmental outcome, geographic context, and sustainable-development relevance. Each study was assigned to one dominant theme to avoid double counting: green-finance instruments and market pricing (22), cost of capital and project finance (12), policy and risk allocation (13), financial development and digital finance (12), directed technological change (10),

and growth, environmental, and development outcomes (15), totaling 84 studies. A second stage compared mechanisms, direction of findings, geographic settings, empirical approaches, and sources of heterogeneity across themes, consistent with narrative-synthesis guidance (Rodgers et al., 2009). Because study designs, variables, settings, and outcomes differed substantially, statistical pooling was not undertaken. Reporting followed relevant SWiM principles for synthesis without meta-analysis (Campbell et al., 2020). Findings were interpreted according to methodological strength and consistency, with stronger evidence distinguished from limited evidence and weaker observational findings described more cautiously in Table 1.

Table 1. Thematic distribution, methods and evidence gap in included studies (n = 84)

Literature cluster	n (%)	Main methods/data	Core finding	Key evidence gap
Green-finance instruments & pricing	22 (26.2)	Event studies, bond pricing, surveys	Green-bond effects vary by issuer, verification and market conditions	Limited evidence on additionality and verified impact
Cost of capital & project finance	12 (14.3)	WACC models, project finance, panels	Financing costs strongly shape renewable deployment	Sparse project-level evidence in developing economies
Policy design & risk allocation	13 (15.5)	Panels, real-options, policy reviews	Stable policy and risk-sharing improve investment conditions	Few cross-country comparisons of policy effectiveness
Financial development & digital finance	12 (14.3)	Panel models, financial indices	Financial depth and digital access support renewable adoption	Limited causal and project-level evidence
Technological change & green innovation	10 (11.9)	Patent data, firm panels, policy analysis	Policy and finance can redirect innovation toward clean technologies	Weak links from innovation to deployment and emissions
Sustainable-development outcomes	15 (17.9)	Panel/time-series studies, LCA	Growth and environmental effects vary across countries and contexts	Limited distributional and SDG-specific evidence
Total	84 (100)	—	—	—

Green-Finance Instruments and Capital Mobilization

Green bonds are the most developed labeled instrument in the corpus. Event-study evidence indicates that shareholders may respond positively to green-bond announcements, consistent with signaling environmental commitment or improved access to finance (Tang & Zhang, 2020). Corporate green-bond issuance is associated with improved environmental performance and higher green investment, although these relationships depend on issuer behavior (Flammer, 2021). Evidence from the European Union suggests that green bonds can support climate mitigation when proceeds finance projects with measurable emissions benefits (Fatica & Panzica, 2021). Issuer characteristics and third-party verification also help explain variation in the green-bond premium by reducing uncertainty about environmental quality (Bachelet et al.,

2019). Surveys of European asset managers further show that institutional demand reflects investment mandates, diversification objectives, client preferences, and beliefs about environmental impact (Sangiorgi & Schopohl, 2021). Capital mobilization requires more than the issuance of a labeled security. Green bonds are more likely to support a low-carbon transition when proceeds are additional, traceable, and aligned with the issuer's transition strategy (Sartzetakis, 2021). Firm-level evidence indicates greater credibility when green debt is linked to corporate climate targets rather than treated separately from emissions planning (Tuhkanen & Vulturius, 2022). Green-bond issuance is also associated with corporate performance through financing, reputational, and innovation channels, although effects vary across firms (Tan et al., 2022). Central-bank policy can influence global green-bond issuance through changes in liquidity, yields, and broader financing conditions (Mertzanis, 2024). Digital-currency development may also interact with green-bond markets by affecting settlement, information, and financing channels in a net-zero economy (Xin et al., 2024). Sustainable-finance frameworks further emphasize credit enhancement, aggregation, and long-term institutional investment for renewable-energy projects that lack direct access to bond markets (Taghizadeh-Hesary & Yoshino, 2020).

Table 2. Green-finance instruments and their transition mechanisms

Instrument	Capital-allocation mechanism	Economic effect	Transition outcome	Source
Corporate green bonds	Ring-fenced proceeds and issuer signaling	Broader investor demand and possible financing advantage	Investment, innovation and environmental-performance change	(Flammer, 2021; Tan et al., 2022)
Verified green bonds	External review and clearer use-of-proceeds information	Lower information asymmetry; pricing depends on issuer quality	Greater credibility of financed environmental assets	(Bachelet et al., 2019; Maltais & Nykvist, 2020)
Project finance	Contractual allocation of construction, market and operating risks	Asset-specific leverage and reduced balance-sheet pressure	Deployment of capital-intensive renewable projects	(Steffen, 2018)
De-risking and climate-finance policy	Guarantees, concessional capital and policy-risk mitigation	Lower hurdle rates where risks are not privately manageable	Mobilization in capital-constrained markets	(Schmidt, 2014; Bhandary et al., 2021)
Digital and green credit	Expanded screening, payments and access to investment funds	Lower transaction costs and wider financing reach	Energy transformation through green investment	(Nepal et al., 2024; Lin & Xie, 2025)
Climate-risk and ESG allocation	Portfolio tilts, engagement and risk-sensitive pricing	Reallocation from carbon exposure toward preferred assets	Transition incentives with measurement and rating uncertainty	(Giglio et al., 2021; Pedersen et al., 2021)

Green-Bond Pricing, Greenium and Market Risk

Evidence on the greenium is conditional rather than uniform. Comparisons of matched green and conventional bonds identify yield differences associated with investors' pro-environmental preferences (Zerbib, 2019). Corporate green-bond issuance may offer a financing advantage, but the magnitude varies with currency, credit rating, maturity, and issuer quality (Gianfrate & Peri, 2019). Municipal-bond evidence further shows that the value of the green label changes over time, limiting its treatment as a fixed pricing attribute (Karpf & Mandel, 2018). Comparisons across green and conventional bonds also reveal heterogeneous pricing across market segments (Hachenberg & Schiereck, 2018). In tightly matched samples, the absence of a consistent premium suggests that credit risk and bond characteristics explain much of the observed yield difference (Larcker & Watts, 2020). A broader review similarly identifies verification, liquidity, issuer sector, and sample design as important sources of variation in estimated premiums (MacAskill et al., 2021).

Green bonds also interact with conventional assets and macroeconomic shocks. Their co-movement with equity, energy, and fixed-income markets influences whether they provide diversification benefits or transmit price shocks (Reboredo, 2018). Connectedness estimates show that spillovers vary over time and across financial markets (Reboredo & Ugolini, 2020). Volatility analysis indicates that the green-bond market has a distinct risk structure rather than functioning as a risk-free environmental asset (Pham, 2016). Oil-price shocks can affect green-bond performance through inflation, energy-substitution, and investor-risk channels (Azhgaliyeva et al., 2022). During the COVID-19 disruption, changing correlations among climate bonds, stocks, gold, and oil altered the relative usefulness of these assets as hedges (Dutta et al., 2021). Time-varying relationships between green and conventional bond benchmarks also reflect broader macroeconomic conditions (Broadstock & Cheng, 2019).

Cost of Capital, Project Finance and Investment Deployment

Renewable-energy deployment is highly sensitive to financing costs because much of the lifetime cost is committed before electricity is generated. Developing and transition economies with deeper financial systems tend to record stronger renewable-energy investment, linking financial intermediation with project realization (Brunnschweiler, 2010). Project finance isolates project cash flows and allocates risk contractually, making it particularly relevant for capital-intensive renewable assets (Steffen, 2018). The weighted average cost of capital can materially affect the levelized cost of solar power and may reverse apparent resource advantages across locations (Ondraczek et al., 2015). Electricity-sector modeling reaches a similar conclusion, showing that capital costs influence which low-carbon technologies enter economically efficient decarbonization pathways (Hirth & Steckel, 2016). De-risking mechanisms can also lower required returns by transferring or mitigating policy and market risks that private investors may be unable to absorb efficiently (Schmidt, 2014). Financing risk varies across technologies, countries, and project stages. Investor experience and technological learning can reduce financing costs over time, although the pace differs between solar and wind projects (Egli et al., 2018). Historical analysis shows that perceived renewable-energy investment risk changes with policy design, market maturity, and macroeconomic conditions (Egli, 2020). Financing institutions may also shape technological direction because different investors support different scales and stages of innovation (Mazzucato & Semieniuk, 2018). Cross-country modeling suggests that high capital costs can create a climate-investment trap in developing economies by raising renewable-energy costs and sustaining fossil-fuel investment (Ameli et al., 2021). Global scenarios likewise indicate that reducing the cost of capital could accelerate energy-transition investment in developing countries (Calcaterra et al., 2024). Overall, green finance is most likely to support deployment when it reduces a binding financing constraint rather than simply relabeling existing capital.

Policy Design, Institutions and Risk Allocation

Public policy shapes renewable-energy investment through revenue certainty, market access, permitting, and policy durability. Panel evidence across OECD countries links policy design and institutional conditions with renewable-energy investment (Polzin et al., 2015). Venture-capital investors tend to favor instruments

that match the technological and commercial risks of cleantech development (Bürer & Wüstenhagen, 2009). Strategic investment frameworks describe renewable-energy decisions as an interaction among policy, market structure, firm resources, and managerial interpretation (Wüstenhagen & Menichetti, 2012). Behavioral evidence further indicates that managers' perceptions of risk and opportunity influence investment decisions even when financial indicators are similar (Masini & Menichetti, 2012). In the United States, uncertainty surrounding the production tax credit was associated with delays in wind investment, illustrating the importance of policy stability (Barradale, 2010).

Support instruments also differ in how they allocate risk. Real-options analysis shows that feed-in tariffs, certificates, and other support schemes alter the timing and value of investment under uncertainty (Boomsma et al., 2012). Mean-variance analysis likewise finds that tariff and premium systems generate different revenue-risk profiles for renewable-energy investors (Kitzing, 2014). Uncertain climate policy can raise hurdle rates because firms retain the option to delay irreversible investment (Blyth et al., 2007). Reviews of climate-finance policy indicate that implementation quality and public risk allocation influence whether financial instruments mobilize private capital (Bhandary et al., 2021). Green-bond policies may also support green innovation and environmental improvements when issuance incentives are aligned with local transition objectives (Lee et al., 2023). Climate risk further conditions the relationship between green finance and energy transition, making institutional resilience an important component of transition policy (Lee et al., 2024).

Financial Development, Digital Finance and Renewable-Energy Adoption

Financial development can support renewable-energy investment by expanding credit supply, improving risk diversification, strengthening payment capacity, and increasing access to long-term capital. Cross-country panel evidence identifies a positive relationship between financial development and renewable-energy consumption (Anton & Afloarei Nucu, 2020). Earlier research on emerging economies similarly links financial development with energy demand, suggesting that environmental outcomes depend on which technologies receive additional finance (Sadorsky, 2010). Financial capital may support a shift toward renewable energy or reinforce coal use, depending on relative costs and institutional incentives (Best, 2017). Global multidimensional analysis further shows that banking systems, capital markets, and other components of financial development have distinct relationships with renewable-energy use (Sun et al., 2023). Evidence from Ghana also identifies domestic financial capacity as an important condition for renewable-energy consumption (Prempeh, 2023).

Recent studies extend this analysis to digital access, financial stability, and economic openness. In BRICS economies, the relationship between financial development, technological innovation, and renewable-energy use varies with economic openness and financial stability (Athari, 2024). Evidence from developing countries suggests that the digital economy can strengthen the contribution of green finance to energy transformation by improving information flows and transaction capacity (Nepal et al., 2024). Chinese evidence identifies green investment as a channel through which digital finance supports energy transition (Lin & Xie, 2025). At the global level, however, substantial cross-country heterogeneity remains in the relationship between green finance and renewable-energy deployment (Alharbi et al., 2023). Multi-country evidence also indicates that institutional and income differences condition these relationships (Hou et al., 2023). Digital finance is therefore most relevant where it reduces screening and transaction costs without weakening project appraisal or environmental verification.

Innovation, Carbon Pricing and Technological Change

Environmental prices and policy signals can influence the direction of technological change. Higher energy prices are associated with greater energy-saving innovation because they increase the expected returns to efficiency technologies (Popp, 2002). Patent-based evidence shows that renewable-energy policies affect innovation differently across technologies, with responsiveness varying by technological maturity (Johnstone et al., 2010). International evidence also shows that climate-mitigation technologies diffuse unevenly across countries, highlighting the importance of technology-transfer capacity (Dechezleprêtre et

al., 2011). The European Union Emissions Trading System was associated with increased low-carbon patenting among regulated firms, providing evidence of a directed innovation response to carbon pricing (Calel & Dechezleprêtre, 2016). Evidence from the automotive sector similarly indicates that fuel prices and carbon-related policies influence whether firms innovate in cleaner or conventional technologies, while prior knowledge contributes to path dependence (Aghion et al., 2016).

Finance can reinforce these innovation incentives by affecting access to risk-bearing capital. Firm-level patent evidence shows that fossil-fuel and renewable-energy knowledge bases respond differently to energy prices and policy incentives (Noailly & Smeets, 2015). Green-bond policies may also support green innovation when financed activities are linked to research, infrastructure, and environmental improvement (Lee et al., 2023). Chinese evidence associates green finance with renewable-energy technology innovation (Shi & Shi, 2025).

Climate risk can further strengthen or weaken the relationship between green finance and energy transition, altering innovation incentives across exposed economies (Lee et al., 2024). Digital finance and green bonds may also evolve together by reducing transaction frictions and broadening the funding base for net-zero technologies (Xin et al., 2024). Evidence of an innovation effect is strongest when financial interventions are accompanied by measurable changes in patents, deployment, emissions performance, or technological learning.

Sustainable Development Outcomes and Distributional Implications

The relationship between renewable energy and economic growth varies across country groups, time periods, and empirical methods. OECD panel evidence identifies long-run associations between renewable-energy consumption and economic growth (Apergis & Payne, 2010). European evidence reports a neutrality result under a different specification, illustrating the sensitivity of findings to methodological choices (Menegaki, 2011). A broader panel study suggests that renewable-energy consumption can contribute to economic growth, although substantial country heterogeneity remains (Inglesi-Lotz, 2016).

Evidence from major renewable-energy-consuming countries also links renewable use with growth, with effects differing across national contexts (Bhattacharya et al., 2016). European Union research that separates fossil energy, renewable energy, emissions, and output further shows that growth and decarbonization cannot be represented by a single relationship (Bölük & Mert, 2014).

Country-level studies reinforce the context-dependent nature of these outcomes. Evidence from Brazil identifies distinct relationships among renewable energy, nonrenewable energy, and economic growth (Pao & Fu, 2013), while Turkish evidence reports an asymmetric renewable-energy and growth relationship that differs from several panel-based findings (Ocal & Aslan, 2013). Research on emerging economies also links income growth with renewable-energy demand, suggesting that development can expand clean-energy markets where institutional conditions support substitution (Sadorsky, 2009).

European findings, however, question whether renewable-energy deployment automatically promotes growth, underscoring the need to distinguish investment costs from longer-term productivity effects (Marques & Fuinhas, 2012). Green bonds are also associated with higher clean-energy investment and improved environmental quality when financing reaches emissions-reducing projects (Shah et al., 2024).

Evidence from BRICS economies similarly links green finance with renewable-energy investment and environmental protection (Zeng et al., 2023). European evidence further presents green finance as a potential sustainable-development mechanism, although outcomes depend on financial inclusion and institutional capacity (Afzal et al., 2022). Thus, the evidence suggests that sustainable-development outcomes depend not only on the availability of green finance but also on the institutional and financial conditions through which capital is allocated. Table 3 summarizes the main enabling conditions identified across the literature, their economic mechanisms, clean-energy outcomes, and links to relevant Sustainable Development Goals.

Table 3. Enabling conditions linking green finance with sustainable development

Enabling condition	Economic mechanism	Clean-energy outcome	SDG relevance	Source
Predictable policy	Reduces revenue uncertainty and the option value of delay	Earlier renewable investment	Affordable and clean energy; climate action	(Polzin et al., 2015; Barradale, 2010)
Lower cost of capital	Reduces leveled cost and expands bankable project pipelines	Faster deployment in developing economies	Clean energy; infrastructure; reduced inequalities	(Ameli et al., 2021; Calcaterra et al., 2024)
Credible standards and verification	Improves information quality and limits mislabeling	Capital reaches projects with clearer environmental attributes	Production responsible for climate action	(Bachelet et al., 2019; Gibon et al., 2020)
Financial depth and digital access	Expands credit, payments, risk sharing and investor reach	Higher renewable consumption and investment	Clean energy; industry and innovation	(Sun et al., 2023; Lin & Xie, 2025)
Innovation capability	Transform policy and finance into patents, learning and deployment	Lower technology cost and improved transition capacity	Industry and innovation; climate action	(Shi & Shi, 2025; Calel & Dechezleprêtre, 2016)
Climate-risk governance	Prices transition exposure and align portfolios with risk appetite	More disciplined capital allocation	Climate action; strong institutions	(Krueger et al., 2020; Bolton & Kacperczyk, 2023)

DISCUSSION

The reviewed evidence supports a financing chain that begins with instrument design and extends to measurable development outcomes. Corporate green bonds are associated with changes in investment and environmental performance when proceeds are linked to identifiable projects (Flammer, 2021). Life-cycle assessment nevertheless shows that financed assets can differ substantially in resource use and emissions performance (Gibon et al., 2020). Alignment between corporate climate targets and green debt can strengthen the credibility of transition claims (Tuhkanen & Vulturius, 2022). Pricing studies find no universal greenium, indicating that lower borrowing costs are an empirical outcome rather than an inherent feature of the green label (MacAskill et al., 2021). Divergence in ESG ratings adds further measurement uncertainty because investors may classify the same issuer differently (Berg et al., 2022). Green finance is

therefore most additional when it changes the quantity, cost, timing, or environmental quality of capital directed toward clean-energy activities.

The cost of capital emerges as a major cross-theme mechanism. High required returns increase renewable-electricity costs even where resource conditions are favorable (Ondraczek et al., 2015). In developing economies, macroeconomic and project risks can create a climate-investment trap by making clean-energy assets more expensive to finance (Ameli et al., 2021). Lower capital costs can support greater transition investment, although broad subsidies may create fiscal costs without addressing the underlying sources of risk (Calcaterra et al., 2024). Policy stability also matters because uncertainty can increase the value of delaying irreversible investment (Blyth et al., 2007). Climate-finance policy is therefore most effective when supported by credible implementation and appropriate public-private risk allocation (Bhandary et al., 2021). Evaluation should trace how instruments such as guarantees, green-credit rules, and bond standards affect financing constraints and whether these changes are followed by measurable deployment and emissions outcomes.

Recent literature increasingly emphasizes climate-risk pricing, digital infrastructure, and transition credibility. Institutional investors generally treat climate risk as financially material, although practices vary across organizations (Krueger et al., 2020). Carbon tail risk can increase demand for protection against severe transition-related outcomes (Ilhan et al., 2021), while global equity evidence indicates that carbon-transition risk is reflected in asset prices across markets (Bolton & Kacperczyk, 2023). Responsible-investment models further show how environmental preferences can be incorporated into portfolio decisions alongside expected return and risk (Pedersen et al., 2021). Evidence on green returns also suggests that realized performance may reflect changing environmental preferences rather than persistent abnormal returns (Pástor et al., 2022). Future climate-finance research would benefit from clearer counterfactuals, more consistent transition metrics, project-level emissions data, and greater attention to who receives capital and who bears transition costs (Giglio et al., 2021).

CONCLUSION

Green finance can support clean-energy transitions when it reduces binding financing constraints, allocates risk to actors able to manage it, and links capital to verified environmental performance. Green bonds, project finance, credit programs, digital platforms, central-bank measures, and carbon policies operate through different mechanisms and should not be assessed by issuance or investment volumes alone. More informative evaluation follows the pathway from financial instruments to financing costs, project deployment, technological learning, emissions reduction, economic performance, and distributional outcomes. Stable institutions and credible standards are important for limiting policy uncertainty, greenwashing, and fragmented disclosure. Developing economies require particular attention because high financing costs can prevent strong renewable-resource potential from translating into affordable investment. A sustainable-development perspective also requires consideration of access to finance, local capabilities, employment, environmental quality, and exposure to transition costs. Overall, the evidence suggests that green finance contributes most effectively to sustainable development when financial additionality, environmental integrity, technological capability, and accountable governance are considered together within a coherent transition strategy.

REFERENCES

1. Afzal, A., Rasoulinezhad, E., & Malik, Z. (2022). Green finance and sustainable development in Europe. *Economic Research-Ekonomska Istraživanja*, 35(1), 5150–5163. <https://doi.org/10.1080/1331677x.2021.2024081>
2. Aghion, P., Dechezleprêtre, A., Hémous, D., Martin, R., & Van Reenen, J. (2016). Carbon taxes, path dependency and directed technical change: Evidence from the auto industry. *Journal of Political Economy*, 124(1), 1–51. <https://doi.org/10.1086/684581>

3. Alharbi, S. S., Al Mamun, M., Boubaker, S., & Rizvi, S. K. A. (2023). Green finance and renewable energy: A worldwide evidence. *Energy Economics*, 118, 106499. <https://doi.org/10.1016/j.eneco.2022.106499>
4. Ameli, N., Dessens, O., Winning, M., Cronin, J., Chenet, H., Drummond, P., Calzadilla, A., Anandarajah, G., & Grubb, M. (2021). Higher cost of finance exacerbates a climate investment trap in developing economies. *Nature Communications*, 12(1), 4046. <https://doi.org/10.1038/s41467-021-24305-3>
5. Anton, S. G., & Afloarei Nucu, A. E. (2020). The effect of financial development on renewable energy consumption. A panel data approach. *Renewable Energy*, 147, 330–338. <https://doi.org/10.1016/j.renene.2019.09.005>
6. Apergis, N., & Payne, J. E. (2010). Renewable energy consumption and economic growth: Evidence from a panel of OECD countries. *Energy Policy*, 38(1), 656–660. <https://doi.org/10.1016/j.enpol.2009.09.002>
7. Athari, S. A. (2024). The impact of financial development and technological innovations on renewable energy consumption: Do the roles of economic openness and financial stability matter in BRICS economies? *Geological Journal*, 59(1), 288–300. <https://doi.org/10.1002/gj.4863>
8. Azhgaliyeva, D., Kapsalyamova, Z., & Mishra, R. (2022). Oil price shocks and green bonds: An empirical evidence. *Energy Economics*, 112, 106108. <https://doi.org/10.1016/j.eneco.2022.106108>
9. Bachelet, M. J., Becchetti, L., & Manfredonia, S. (2019). The green bonds premium puzzle: The role of issuer characteristics and third-party verification. *Sustainability*, 11(4), 1098. <https://doi.org/10.3390/su11041098>
10. Barradale, M. J. (2010). Impact of public policy uncertainty on renewable energy investment: Wind power and the production tax credit. *Energy Policy*, 38(12), 7698–7709. <https://doi.org/10.1016/j.enpol.2010.08.021>
11. Berg, F., Kölbel, J. F., & Rigobon, R. (2022). Aggregate confusion: The divergence of ESG ratings. *Review of Finance*, 26(6), 1315–1344. <https://doi.org/10.1093/rof/rfac033>
12. Best, R. (2017). Switching towards coal or renewable energy? The effects of financial capital on energy transitions. *Energy Economics*, 63, 75–83. <https://doi.org/10.1016/j.eneco.2017.01.019>
13. Bhandary, R. R., Gallagher, K. S., & Zhang, F. (2021). Climate finance policy in practice: A review of the evidence. *Climate Policy*, 21(4), 529–545. <https://doi.org/10.1080/14693062.2020.1871313>
14. Bhattacharya, M., Paramati, S. R., Ozturk, I., & Bhattacharya, S. (2016). The effect of renewable energy consumption on economic growth: Evidence from top 38 countries. *Applied Energy*, 162, 733–741. <https://doi.org/10.1016/j.apenergy.2015.10.104>
15. Blyth, W., Bradley, R., Bunn, D., Clarke, C., Wilson, T., & Yang, M. (2007). Investment risks under uncertain climate change policy. *Energy Policy*, 35(11), 5766–5773. <https://doi.org/10.1016/j.enpol.2007.05.030>
16. Bolton, P., & Kacperczyk, M. (2021). Do investors care about carbon risk? *Journal of Financial Economics*, 142(2), 517–549. <https://doi.org/10.1016/j.jfineco.2021.05.008>
17. Bolton, P., & Kacperczyk, M. (2023). Global pricing of carbon-transition risk. *The Journal of Finance*, 78(6), 3677–3754. <https://doi.org/10.1111/jofi.13272>
18. Bölük, G., & Mert, M. (2014). Fossil & renewable energy consumption, GHGs (greenhouse gases) and economic growth: Evidence from a panel of EU (European Union) countries. *Energy*, 74, 439–446. <https://doi.org/10.1016/j.energy.2014.07.008>
19. Boomsma, T. K., Meade, N., & Fleten, S. E. (2012). Renewable energy investments under different support schemes: A real options approach. *European Journal of Operational Research*, 220(1), 225–237. <https://doi.org/10.1016/j.ejor.2012.01.017>
20. Broadstock, D. C., & Cheng, L. T. W. (2019). Time-varying relation between black and green bond price benchmarks: Macroeconomic determinants for the first decade. *Finance Research Letters*, 29, 17–22. <https://doi.org/10.1016/j.frl.2019.02.006>
21. Brunnschweiler, C. N. (2010). Finance for renewable energy: An empirical analysis of developing and transition economies. *Environment and Development Economics*, 15(3), 241–274. <https://doi.org/10.1017/s1355770x1000001x>

22. Bürer, M. J., & Wüstenhagen, R. (2009). Which renewable energy policy is a venture capitalist's best friend? Empirical evidence from a survey of international cleantech investors. *Energy Policy*, 37(12), 4997–5006. <https://doi.org/10.1016/j.enpol.2009.06.071>
23. Calcaterra, M., Aleluia Reis, L., Fragkos, P., Briera, T., de Boer, H. S., Egli, F., Emmerling, J., Iyer, G., Mittal, S., Polzin, F. H. J., Sanders, M. W. J. L., Schmidt, T. S., Serebriakova, A., Steffen, B., van de Ven, D. J., van Vuuren, D. P., Waidelich, P., & Tavoni, M. (2024). Reducing the cost of capital to finance the energy transition in developing countries. *Nature Energy*, 9(10), 1241–1251. <https://doi.org/10.1038/s41560-024-01606-7>
24. Calel, R., & Dechezleprêtre, A. (2016). Environmental policy and directed technological change: Evidence from the European carbon market. *Review of Economics and Statistics*, 98(1), 173–191. https://doi.org/10.1162/rest_a_00470
25. Campbell, M., McKenzie, J. E., Sowden, A., Katikireddi, S. V., Brennan, S. E., Ellis, S., Hartmann-Boyce, J., Ryan, R., Shepperd, S., Thomas, J., Welch, V., & Thomson, H. (2020). Synthesis without meta-analysis (SWiM) in systematic reviews: Reporting guideline. *BMJ*, 368, l6890. <https://doi.org/10.1136/bmj.l6890>
26. Dechezleprêtre, A., Glachant, M., Haščič, I., Johnstone, N., & Ménière, Y. (2011). Invention and transfer of climate change–mitigation technologies: A global analysis. *Review of Environmental Economics and Policy*, 5(1), 109–130. <https://doi.org/10.1093/reep/req023>
27. Dutta, A., Bouri, E., & Noor, M. H. (2021). Climate bond, stock, gold and oil markets: Dynamic correlations and hedging analyses during the COVID-19 outbreak. *Resources Policy*, 74, 102265. <https://doi.org/10.1016/j.resourpol.2021.102265>
28. Egli, F. (2020). Renewable energy investment risk: An investigation of changes over time and the underlying drivers. *Energy Policy*, 140, 111428. <https://doi.org/10.1016/j.enpol.2020.111428>
29. Egli, F., Steffen, B., & Schmidt, T. S. (2018). A dynamic analysis of financing conditions for renewable energy technologies. *Nature Energy*, 3(12), 1084–1092. <https://doi.org/10.1038/s41560-018-0277-y>
30. Fatica, S., & Panzica, R. (2021). Green bonds as a tool against climate change? *Business Strategy and the Environment*, 30(5), 2688–2701. <https://doi.org/10.1002/bse.2771>
31. Flammer, C. (2021). Corporate green bonds. *Journal of Financial Economics*, 142(2), 499–516. <https://doi.org/10.1016/j.jfineco.2021.01.010>
32. Gianfrate, G., & Peri, M. (2019). The green advantage: Exploring the convenience of issuing green bonds. *Journal of Cleaner Production*, 219, 127–135. <https://doi.org/10.1016/j.jclepro.2019.02.022>
33. Gibon, T., Popescu, I. T., Hitaj, C., Petucco, C., & Benetto, E. (2020). Shades of green: Life cycle assessment of renewable energy projects financed through green bonds. *Environmental Research Letters*, 15(10), 104045. <https://doi.org/10.1088/1748-9326/abaa0c>
34. Giglio, S., Kelly, B., & Stroebel, J. (2021). Climate finance. *Annual Review of Financial Economics*, 13(1), 15–36. <https://doi.org/10.1146/annurev-financial-102620-103311>
35. Hachenberg, B., & Schiereck, D. (2018). Are green bonds priced differently from conventional bonds? *Journal of Asset Management*, 19(6), 371–383. <https://doi.org/10.1057/s41260-018-0088-5>
36. Hirth, L., & Steckel, J. C. (2016). The role of capital costs in decarbonizing the electricity sector. *Environmental Research Letters*, 11(11), 114010. <https://doi.org/10.1088/1748-9326/11/11/114010>
37. Hou, H., Wang, Y., & Zhang, M. (2023). Green finance drives renewable energy development: Empirical evidence from 53 countries worldwide. *Environmental Science and Pollution Research*, 30(33), 80573–80590. <https://doi.org/10.1007/s11356-023-28111-w>
38. Ilhan, E., Sautner, Z., & Vilkov, G. (2021). Carbon tail risk. *The Review of Financial Studies*, 34(3), 1540–1571. <https://doi.org/10.1093/rfs/hhaa071>
39. Inglesi-Lotz, R. (2016). The impact of renewable energy consumption to economic growth: A panel data application. *Energy Economics*, 53, 58–63. <https://doi.org/10.1016/j.eneco.2015.01.003>
40. Johnstone, N., Haščič, I., & Popp, D. (2010). Renewable energy policies and technological innovation: Evidence based on patent counts. *Environmental and Resource Economics*, 45(1), 133–155. <https://doi.org/10.1007/s10640-009-9309-1>
41. Karpf, A., & Mandel, A. (2018). The changing value of the ‘green’ label on the US municipal bond market. *Nature Climate Change*, 8(2), 161–165. <https://doi.org/10.1038/s41558-017-0062-0>

42. Kitzing, L. (2014). Risk implications of renewable support instruments: Comparative analysis of feed-in tariffs and premiums using a mean–variance approach. *Energy*, 64, 495–505. <https://doi.org/10.1016/j.energy.2013.10.008>
43. Krueger, P., Sautner, Z., & Starks, L. T. (2020). The importance of climate risks for institutional investors. *The Review of Financial Studies*, 33(3), 1067–1111. <https://doi.org/10.1093/rfs/hhz137>
44. Larcker, D. F., & Watts, E. M. (2020). Where's the greenium? *Journal of Accounting and Economics*, 69(2–3), 101312. <https://doi.org/10.1016/j.jacceco.2020.101312>
45. Lee, C. C., Song, H., & An, J. (2024). The impact of green finance on energy transition: Does climate risk matter? *Energy Economics*, 129, 107258. <https://doi.org/10.1016/j.eneco.2023.107258>
46. Lee, C. C., Wang, F., & Chang, Y. F. (2023). Towards net-zero emissions: Can green bond policy promote green innovation and green space? *Energy Economics*, 121, 106675. <https://doi.org/10.1016/j.eneco.2023.106675>
47. Lin, B., & Xie, Y. (2025). How does digital finance drive energy transition? A green investment-based perspective. *Financial Innovation*, 11(1), 94. <https://doi.org/10.1186/s40854-025-00772-1>
48. Lucas, P. J., Baird, J., Arai, L., Law, C., & Roberts, H. M. (2007). Worked examples of alternative methods for the synthesis of qualitative and quantitative research in systematic reviews. *BMC Medical Research Methodology*, 7(1), 4. <https://doi.org/10.1186/1471-2288-7-4>
49. MacAskill, S., Roca, E., Liu, B., Stewart, R. A., & Sahin, O. (2021). Is there a green premium in the green bond market? Systematic literature review revealing premium determinants. *Journal of Cleaner Production*, 280, 124491. <https://doi.org/10.1016/j.jclepro.2020.124491>
50. Maltais, A., & Nykvist, B. (2021). Understanding the role of green bonds in advancing sustainability. *Journal of Sustainable Finance & Investment*, 11(3), 233–252. <https://doi.org/10.1080/20430795.2020.1724864>
51. Marques, A. C., & Fuinhas, J. A. (2012). Is renewable energy effective in promoting growth? *Energy Policy*, 46, 434–442. <https://doi.org/10.1016/j.enpol.2012.04.006>
52. Masini, A., & Menichetti, E. (2012). The impact of behavioural factors in the renewable energy investment decision making process: Conceptual framework and empirical findings. *Energy Policy*, 40, 28–38. <https://doi.org/10.1016/j.enpol.2010.06.062>
53. Mazzucato, M., & Semieniuk, G. (2018). Financing renewable energy: Who is financing what and why it matters. *Technological Forecasting and Social Change*, 127, 8–22. <https://doi.org/10.1016/j.techfore.2017.05.021>
54. Menegaki, A. N. (2011). Growth and renewable energy in Europe: A random effect model with evidence for neutrality hypothesis. *Energy Economics*, 33(2), 257–263. <https://doi.org/10.1016/j.eneco.2010.10.004>
55. Mertzanis, C. (2024). Central bank policies and green bond issuance on a global scale. *Energy Economics*, 133, 107541. <https://doi.org/10.1016/j.eneco.2024.107541>
56. Nepal, R., Liu, Y., Dong, K., & Jamasb, T. (2024). Green financing, energy transformation and the moderating effect of digital economy in developing countries. *Environmental and Resource Economics*, 87(12), 3357–3386. <https://doi.org/10.1007/s10640-024-00922-6>
57. Noailly, J., & Smeets, R. (2015). Directing technical change from fossil-fuel to renewable energy innovation: An application using firm-level patent data. *Journal of Environmental Economics and Management*, 72, 15–37. <https://doi.org/10.1016/j.jeem.2015.03.004>
58. Ocal, O., & Aslan, A. (2013). Renewable energy consumption–economic growth nexus in Turkey. *Renewable and Sustainable Energy Reviews*, 28, 494–499. <https://doi.org/10.1016/j.rser.2013.08.036>
59. Ondraczek, J., Komendantova, N., & Patt, A. (2015). WACC the dog: The effect of financing costs on the levelized cost of solar PV power. *Renewable Energy*, 75, 888–898. <https://doi.org/10.1016/j.renene.2014.10.053>
60. Pao, H. T., & Fu, H. C. (2013). Renewable energy, non-renewable energy and economic growth in Brazil. *Renewable and Sustainable Energy Reviews*, 25, 381–392. <https://doi.org/10.1016/j.rser.2013.05.004>
61. Pástor, L., Stambaugh, R. F., & Taylor, L. A. (2021). Sustainable investing in equilibrium. *Journal of Financial Economics*, 142(2), 550–571. <https://doi.org/10.1016/j.jfineco.2020.12.011>

62. Pástor, L., Stambaugh, R. F., & Taylor, L. A. (2022). Dissecting green returns. *Journal of Financial Economics*, 146(2), 403–424. <https://doi.org/10.1016/j.jfineco.2022.07.007>
63. Pedersen, L. H., Fitzgibbons, S., & Pomorski, L. (2021). Responsible investing: The ESG-efficient frontier. *Journal of Financial Economics*, 142(2), 572–597. <https://doi.org/10.1016/j.jfineco.2020.11.001>
64. Pham, L. (2016). Is it risky to go green? A volatility analysis of the green bond market. *Journal of Sustainable Finance & Investment*, 6(4), 263–291. <https://doi.org/10.1080/20430795.2016.1237244>
65. Polzin, F., Migendt, M., Täube, F. A., & von Flotow, P. (2015). Public policy influence on renewable energy investments—a panel data study across OECD countries. *Energy Policy*, 80, 98–111. <https://doi.org/10.1016/j.enpol.2015.01.026>
66. Popp, D. (2002). Induced innovation and energy prices. *American Economic Review*, 92(1), 160–180. <https://doi.org/10.1257/000282802760015658>
67. Prempeh, K. B. (2023). The impact of financial development on renewable energy consumption: New insights from Ghana. *Future Business Journal*, 9(1), 6. <https://doi.org/10.1186/s43093-023-00183-7>
68. Reboredo, J. C. (2018). Green bond and financial markets: Co-movement, diversification and price spillover effects. *Energy Economics*, 74, 38–50. <https://doi.org/10.1016/j.eneco.2018.05.030>
69. Reboredo, J. C., & Ugolini, A. (2020). Price connectedness between green bond and financial markets. *Economic Modelling*, 88, 25–38. <https://doi.org/10.1016/j.econmod.2019.09.004>
70. Rodgers, M., Sowden, A., Petticrew, M., Arai, L., Roberts, H., Britten, N., & Popay, J. (2009). Testing methodological guidance on the conduct of narrative synthesis in systematic reviews. *Evaluation*, 15(1), 49–73. <https://doi.org/10.1177/1356389008097871>
71. Sadorsky, P. (2009). Renewable energy consumption and income in emerging economies. *Energy Policy*, 37(10), 4021–4028. <https://doi.org/10.1016/j.enpol.2009.05.003>
72. Sadorsky, P. (2010). The impact of financial development on energy consumption in emerging economies. *Energy Policy*, 38(5), 2528–2535. <https://doi.org/10.1016/j.enpol.2009.12.048>
73. Sangiorgi, I., & Schopohl, L. (2021). Why do institutional investors buy green bonds: Evidence from a survey of European asset managers. *International Review of Financial Analysis*, 75, 101738. <https://doi.org/10.1016/j.irfa.2021.101738>
74. Sartzetakis, E. S. (2021). Green bonds as an instrument to finance low carbon transition. *Economic Change and Restructuring*, 54(3), 755–779. <https://doi.org/10.1007/s10644-020-09266-9>
75. Schmidt, T. S. (2014). Low-carbon investment risks and de-risking. *Nature Climate Change*, 4(4), 237–239. <https://doi.org/10.1038/nclimate2112>
76. Shah, S. S., Murodova, G., & Khan, A. (2024). Achieving zero emission targets: The influence of green bonds on clean energy investment and environmental quality. *Journal of Environmental Management*, 364, 121485. <https://doi.org/10.1016/j.jenvman.2024.121485>
77. Shi, X., & Shi, D. (2025). Impact of green finance on renewable energy technology innovation: Empirical evidence from China. *Sustainability*, 17(5), 2201. <https://doi.org/10.3390/su17052201>
78. Steffen, B. (2018). The importance of project finance for renewable energy projects. *Energy Economics*, 69, 280–294. <https://doi.org/10.1016/j.eneco.2017.11.006>
79. Sun, Z., Zhang, X., & Gao, Y. (2023). The impact of financial development on renewable energy consumption: A multidimensional analysis based on global panel data. *International Journal of Environmental Research and Public Health*, 20(4), 3124. <https://doi.org/10.3390/ijerph20043124>
80. Taghizadeh-Hesary, F., & Yoshino, N. (2020). Sustainable solutions for green financing and investment in renewable energy projects. *Energies*, 13(4), 788. <https://doi.org/10.3390/en13040788>
81. Tan, X., Dong, H., Liu, Y., Su, X., & Li, Z. (2022). Green bonds and corporate performance: A potential way to achieve green recovery. *Renewable Energy*, 200, 59–68. <https://doi.org/10.1016/j.renene.2022.09.109>
82. Tang, D. Y., & Zhang, Y. (2020). Do shareholders benefit from green bonds? *Journal of Corporate Finance*, 61, 101427. <https://doi.org/10.1016/j.jcorpfin.2018.12.001>
83. Tuhkanen, H., & Vulturius, G. (2022). Are green bonds funding the transition? Investigating the link between companies' climate targets and green debt financing. *Journal of Sustainable Finance & Investment*, 12(4), 1194–1216. <https://doi.org/10.1080/20430795.2020.1857634>

84. Wüstenhagen, R., & Menichetti, E. (2012). Strategic choices for renewable energy investment: Conceptual framework and opportunities for further research. *Energy Policy*, 40, 1–10. <https://doi.org/10.1016/j.enpol.2011.06.050>
85. Xin, B., Jiang, K., & Santibanez Gonzalez, E. D. R. (2024). The coevolution effect of central bank digital currency and green bonds on the net-zero economy. *Energy Economics*, 134, 107587. <https://doi.org/10.1016/j.eneco.2024.107587>
86. Zeng, H., Iqbal, W., Chau, K. Y., Raza Shah, S. A., Ahmad, W., & Hua, H. (2023). Green finance, renewable energy investment and environmental protection: Empirical evidence from BRICS countries. *Economic Research-Ekonomska Istraživanja*, 36(2), 2125032. <https://doi.org/10.1080/1331677x.2022.2125032>
87. Zerbib, O. D. (2019). The effect of pro-environmental preferences on bond prices: Evidence from green bonds. *Journal of Banking & Finance*, 98, 39–60. <https://doi.org/10.1016/j.jbankfin.2018.10.012>