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Green Central Banking, Sustainable Finance, and Monetary Policy in Emerging Economies: Policy Lessons from a Systematic Review

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ABSTRACT

This paper aims to analyze the green central banking role in transforming sustainable finance and monetary policy in emerging economies. In particular, it examines changes in the integration of climate risk and opportunity into monetary policy mandates, regulatory approaches, and financial intermediation functions while also evaluating the institutional characteristics that facilitate or hinder these efforts. Methodologically, a PRISMA-based systematic literature review of 85 Scopus-indexed articles was conducted to identify key themes, policy pathways, and emerging debates surrounding green central banking and climate risk management in developing/EM countries within the broader global landscape of sustainable finance. The results indicate five overarching patterns. For starters, central banks seem to be extending their policy mandates well beyond normal price stability to combat climate-induced systemic risks. Second, physical and transition risks are slowly being incorporated into monetary policy, macroprudential regulation, and supervisory norms. Third, green bonds and other sustainable financial instruments continue to expand their role as a programming instrument working by reallocating capital from carbon-intensive investments to environmentally sustainable or low-carbon activities. Fourth, institutional quality, regulatory capacity, and inter-sectoral policy coordination play an instrumental role in promoting green finance initiatives. Fifth, green central banking has significant potential to bolster long-term financial stability while supporting low-carbon transitions. However, its real-world impacts are limited by data availability, uneven institutional readiness, and substantial practical disparities across emerging economies. This paper connects climate risk, sustainable finance, and monetary policy into a common narrative that offers both an academic contribution to the literature and policy implications for central banks and policymakers seeking to enhance climate-responsive financial governance in developing countries.

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■ INTRODUCTION

In the literature on modern monetary economics, green central banking and sustainable finance policies are gaining focus, as they can integrate environmental risk into both the financial policy framework and public governance frameworks. With integration, central banks can continue their traditional roles of maintaining price stability and financial system stability while also internalizing climate change and environmental degradation as long-term systemic risks. In this way, central banks contribute to shifting financial resources from polluting sectors to green sectors by setting clear sustainability targets, providing guidance for financial institutions, and formulating government policies that promote green financing (Thang & Ha, 2022). This mechanism not only enhances financial institutions' ability to evaluate environmental risks in credit and investment decisions but also encourages long-term economic restructuring, especially in developing and emerging markets with poor

institutional capacity and thus exposed to significant climate risk (D'Orazio & Thole, 2022; Ibrahiem et al., 2025). At the global level, providing a framework for central banks and financial regulators to align financing flows with international climate objectives is also key, especially in light of the Paris Agreement's targets to align financing flows with low-emission development pathways that are resilient to future climate change. The green finance system differs from conventional financial systems, in which financing effectiveness is assessed solely in terms of monetary efficiency. Rather, it incorporates environmental protection and resource efficiency as major determinants of investment effectiveness and promotes more sustainable and inclusive economic growth (Chu et al., 2023). From this policy standpoint, monetary policy is no longer neutral with respect to environmental considerations; rather, it becomes an intentional instrument aimed at steering the economic structure toward a low-carbon transition.

Since sound long-term monetary policy is also seen as a necessary condition for financial system stability, market participants are increasingly considering how extensively sustainability principles should be incorporated into their portfolios. Risks arising from climate change, such as physical and transition risks, can lead to deterioration in the quality of assets, credit risk, and ultimately financial instability in a comprehensive approach (Sarker, 2025). As a result, central banks have started to incorporate environmental risks into financial stability assessments, promote green bonds and sustainable securities-related instruments, and guide financing towards environmentally friendly projects (Inglesi-Lotz & Bohlmann, 2025). This policy has been shown to enhance the stability of the financial system against environmental shocks and to facilitate an economic transition towards a low-carbon system (Chan et al., 2024; R. Carè et al., 2024).

In addition, central banks can shape investment patterns through policy tools such as interest rate changes, purchases of green assets, and policies that encourage financial institutions to boost funding for sustainable projects. Transparent green investment standards and criteria are essential to the credibility of the green finance market, helping avoid supporting over-reporting or unsubstantiated claims about operational opportunities that lead to "greenwashing". Some studies suggest that green financial instruments, such as green bonds and sustainable credit policies, may reduce carbon emissions while also promoting the technological innovation needed for industrial transformation toward low-carbon economies (W. Zhang et al., 2025; C. Zhang et al., 2024).

Nevertheless, green central banking still has a long way to go and continues to encounter obstacles, particularly in developing economies. Many businesses, especially micro, small, and medium enterprises (MSMEs), face challenges accessing finance due to limited financial inclusion, low regulatory capacity, and high compliance costs associated with green standards. This again calls for fiscal and financial incentives in the form of subsidies and tax benefits, as well as measures to strengthen the long-term green bond market, so as not to make this transition unequal. Cross-sectoral policy coordination is critical to the efficient realization of green financing potential (Abdul Gafoor et al., 2024). Broadly, the literature establishes that green central banking and sustainable finance policies are strategic contributions towards changing the financial system in order to mitigate environmental risks, align national efforts with global climate commitments, foster economic growth while preserving planetary health and support financial stability through promoting a robust transition towards a resilient low-carbon economy (Thang & Ha, 2022; D'Orazio & Thole, 2022; Ibrahiem et al., 2025; Sarker, 2025; Inglesi-Lotz & Bohlmann, 2025).

The research is grounded in Institutional Theory as an analytical framework to help us understand how green central banking emerges through formal rules, regulatory norms, and organizational arrangements that constitute the field of financial governance. In this respect, with the intention of state-building, central banks play a significant institutional role in setting policy priorities and incentive structures for sustainable finance by embedding environmental considerations into financial systems. Research suggests that the issuance of green bonds and the effective integration of sustainability objectives in financial governance are associated with broader supervisory mandates and greater use of systemic risk mitigation instruments (Ibrahiem et al., 2025; Mertzanis, 2024). Also, central banks provide technical assistance and capacity building to promote institutional transformation, as well as guidelines on environmental risk disclosure to advance the green financing initiative. Institutional Theory discusses that collaborative and coordinated action between Central Banks, governments, regulators, and international organizations is also needed in order to enhance legitimacy of policies relating to agenda 2030 as well as their implementation capacity (van Zanten & Rein,

2023; Rosella Carè, 2023).

The literature on green central banking and sustainable finance has grown considerably in recent years as the stakes of climate change have become ever more critical. However, much scholarship here still focuses on developed economies or treats developing countries as a monolithic category. This kind of inclination restricts context-sensitive knowledge of how sustainable finance works across different institutional arrangements. Based on studies on the Indonesian case, previous research has shown that the governance of green finance is influenced by a multi-actor regulatory structure in which the Financial Services Authority (OJK) plays a dominant role among organizations that regulate sustainable finance (Setyowati, 2023). At the same time, Bank Indonesia contributes through macroprudential supervision, monetary instruments, and policy coordination with OJK. Empirical evidence also indicates that the effectiveness of green finance implementation in Indonesia is influenced by regulatory capacity, inter-institutional coordination, and the uneven institutionalization of sustainability practices across financial institutions (Putri et al., 2023). Studies also found that many green finance regulations remain OJK-driven, while Bank Indonesia's role is still developing and primarily operates indirectly through supervisory tools, oversight of green lending, and support for sustainable financial instruments (Rahmania et al., 2024). Moreover, the academic literature on Indonesian banking indicates that sustainability reporting, ESG governance, and the definition of "green" practices tend to be imbalanced at the institutional level, which reflects that challenges in implementation are not only arising from the abstract complexity of governance but also from visible variation in institutions' environmental readiness and their policy alignment (Handarumukti & Mori, 2026).

The dichotomy between monetary policy and green finance research persists in the literature. Most studies extend the analysis of monetary policy and financial stability, or of green finance instruments, but do not connect them directly; they miss a thorough understanding of the relationship between monetary policy uncertainty and the effectiveness of current green finance, particularly at the micro level. This gap is necessary to bridge, as in the low-carbon economic transition, central banks play broader roles than simply serving as macroeconomic stabilization authorities; they are also strategic actors that shape capital allocation and environmental risk exposure through monetary policy and financial regulatory frameworks (C. Wang et al., 2024). Moreover, earlier studies have generally focused on the effects of green finance policies on financial sector performance. In contrast, other important aspects of the policy adoption process and the underlying institutional drivers are not adequately investigated. This incomplete understanding of the sustainability policy-making cycle in developing countries such as Indonesia is largely due to the limited study of how this interaction among policies (regulations or incentives associated with the financial provision), the structure of the fossil fuel industry, each financial market, and global pressures on policy exists (Cojoianu et al., 2025). In addition, inconsistent definitions and dimensions of green finance in the literature have created uncertainty regarding the concept, which impedes the formulation of effective regulatory frameworks and financing instruments to green instrumental aims (Dhayal et al., 2025).

Another important gap is the lack of evidence for the effectiveness of sustainable finance policy implementation in Indonesia. Despite the introduction of many regulations aimed at stimulating green financing, very few studies assess how these policies affect bank profitability, market structure, and the financial system's resilience to high-impact-low-frequency (HILF) external shocks. Therefore, the extent to which they can make the national financial system more resilient amid transition risk and global volatility through green central banking policies (Ariefianto et al., 2025) remains uncertain. In response to this literature gap, this article presents a systematic literature review that consolidates concepts of green central banking, sustainable finance, and monetary policy in developing and emerging economies, with a focus on Indonesia's institutional context. The present work helps integrate and orient this diversity of studies towards policy by examining how climate-related factors are incorporated into central banking, financial intermediation, and regulatory frameworks. Moreover, this study provides a systematic mapping of the key themes, conceptual dimensions, and policy debates on green central banking, as well as a review of empirical evidence on its implications for financial stability and the transition to a low-carbon economy. This study thus adds value by providing a context-based analytical framework for the emerging-market linkages among climate risk, sustainable finance, and monetary policy. Consequently, this research is directed by these research

questions: (1) how does the literature explain the evolving role of green central banking in advancing sustainable finance and reshaping monetary policy in developing and emerging economies; (2) what institutional, regulatory, and policy factors influence the adoption and effectiveness of green central banking initiatives; and (3) how does the literature assess the contribution of green central banking to financial stability and the transition toward a low-carbon economy? This study will ultimately we hope contribute to the literature on green central banking while providing relevant policy insights for policymakers and other practitioners seeking to enhance climate-responsive financial governance in emerging markets.

■ METHOD

Research Design

This research utilized the Systematic Literature Review (SLR) method to characterize a transition in the roles of green central banking through sustainable finance and to examine how this transition may be reshaping monetary policy across developing & emerging economies, with a domestic focus in the institutional context of Indonesia. SLR was selected as it provides a structured, transparent, and reproducible process to identify, select, assess, and synthesize academic studies relevant to your research. Compared with traditional narrative reviews, the SLR method minimizes subjective bias and facilitates methodological rigor in mapping conceptual evolution, policy discourse, and empirical findings in the literature. This was conducted to trace the historical evolution of these arguments being conceptualised as green central banking through this review: (1) identification of main pillars; (2) prisms that considers climate and its interaction with monetary, macroprudential, and financial regulatory frameworks also discussed; (3) identification of major themes and debates within this literature; and (4) derive policy-relevant insights by studying different models for developed & developing economies including Indonesia.

Search Strategy (PRISMA Flow)

The search and selection process was performed in accordance with the PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. This review used the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework to ensure transparency, clarity, and replicability in how articles were identified, screened, assessed for eligibility, and included in the review. The search was conducted only in the Scopus database, which has broad coverage of high-quality, peer-reviewed international publications and provides consistent indexing and stable metadata retrieval.

A series of keywords specific to green central banking and green finance was used to search for: “green central banking,” “sustainable finance,” “green finance,” “monetary policy,” “central bank sustainability,” and “climate-related financial policy.” Boolean operators combined with the terms to increase search yield susceptibility. The primary search string utilized was: *(“green central banking” OR “green finance”) AND (“monetary policy” OR “central bank”) AND (“sustainable finance)*

For the identification stage, 287 records were obtained from Scopus. Subsequently, all records were exported, and reference management was performed in Mendeley, while duplicate checking was rechecked in RStudio using titles and DOIs. This method identified 12 duplicate records, culled them, and left 275 unique records to screen. The screening phase: Titles and abstracts were reviewed to assess relevance to the study's aims. At this point, 30 records were discarded for being unrelated to central banking and monetary policy, focusing exclusively on corporate ESG issues without context for the economic governance of money and finance, or not directly related to climate-related financial risks. Consequently, a total of 245 full-text articles were reviewed for eligibility.

Full-text articles were assessed for eligibility using specific inclusion and exclusion criteria. We removed articles that

Table 1. The Stage of the Article Selection Process

Stages	Total
Initial search results (Scopus)	287
Duplicates removed	(12)
After duplicate removal	275
Records excluded in title or abstract screening	(30)
Reports sought for retrieval or assessed for eligibility	245
Full-text articles excluded, with reasons	(160)
Final articles for analysis	85

were not directly related to green central banking, sustainable finance, financial stability, or climate-related monetary and macroprudential policy. After this assessment, 160 full-text articles were excluded for reasons related to insufficient conceptual relevance, lack of connectedness to issues central to changing formal institutional roles or capacities in relation to financial governance, or focusing on specific sectors outside the scope of this review. In total, 85 articles remained for the overall qualitative synthesis. Additionally, Figure 1 presents the PRISMA 2020 flowchart describing the search and selection process for the included studies from the selected literature.

Inclusion and Exclusion Criteria

This study used explicit inclusion and exclusion criteria to ensure consistency and analytical rigor. The following inclusion criteria are defined: (1) Publication in peer-reviewed journals; (2) Articles dealing with green central banking, sustainable finance, green finance and climate-related financial and monetary policy; (3) English language of publication; (4) Indexation of articles in Scopus;(5) Publications relevant to the topics covered by monetary policy, financial stability, macroprudential regulation or global sustainable financial governance. The review included only publications published between 2015 and 2026, as the year of adoption of the Paris Agreement and Sustainable Development Goals (SDGs) was a watershed moment in terms of global sustainable finance agenda-setting and opened up much greater academic and policy debate around climate-related financial risks with implications for financial sector governance relative to any time before.

Exclusion criteria included: (1) publications other than peer-review or

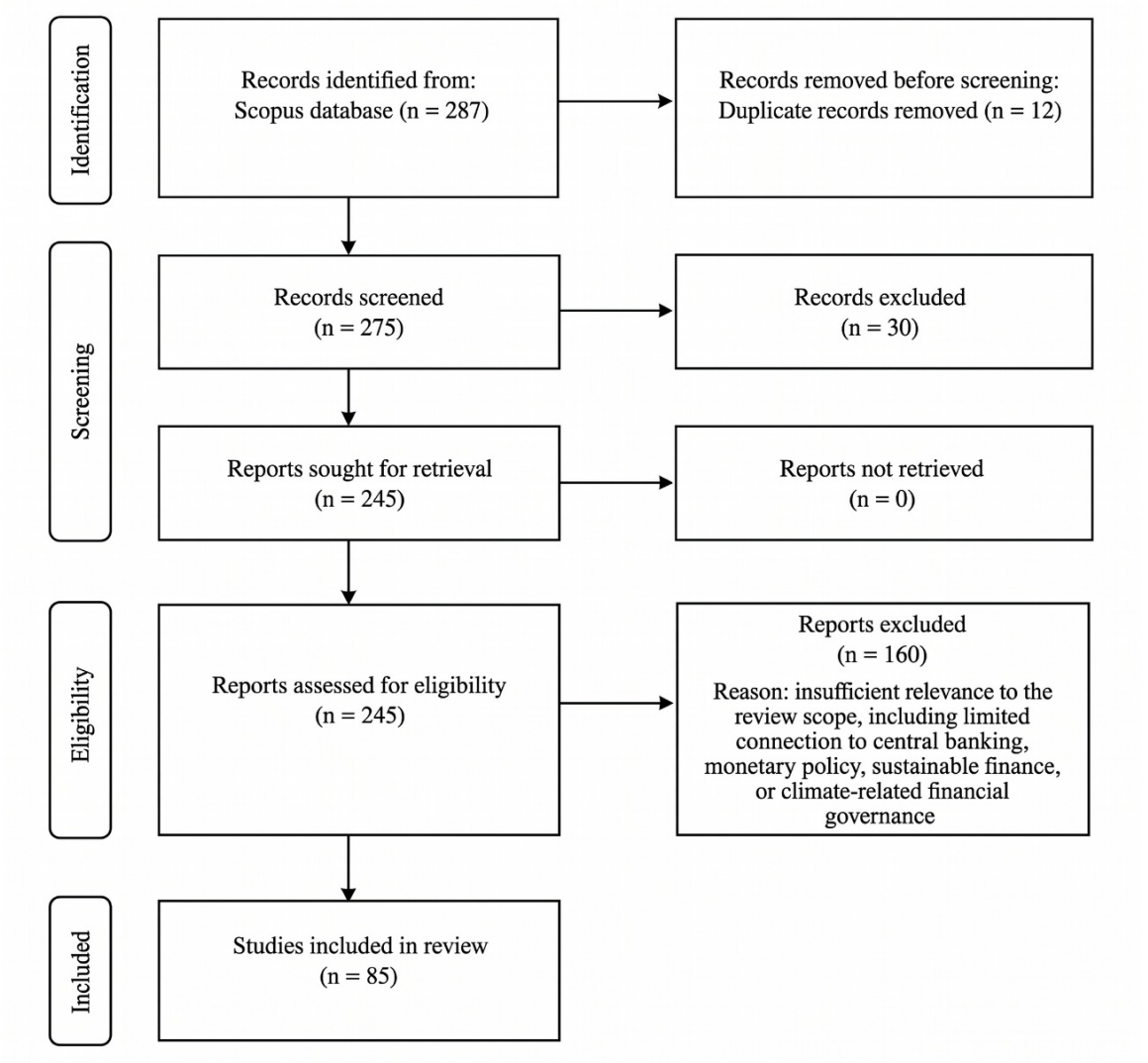


Figure 1. PRISMA 2020 Flow Diagram of the Literature Search and Selection Process

academic articles; (2) duplicate records; (3) records not directly related to central banking, monetary policy, or sustainable finance; and (4) articles that lack the necessary conceptual and/or empirical relevance to the objectives of the review.

Data Analysis

Articles were analyzed using thematic synthesis. This process was utilized to extract recurrent themes, to consolidate them into higher-order concepts, and ultimately develop a holistic understanding of the literature. The analysis was performed in four steps. To begin, we conducted open coding for each study to highlight salient concepts, arguments, and findings. Second, the data were categorized to group similar concepts into higher-level thematic clusters. Thirdly, thematic mapping was used to understand the interrelationships among themes, policy channels, and institutional dimensions, which this Part does. Fourth, an integrated analytical framework linking green central banking, climate-related financial risks, sustainable finance, and monetary policy was devised through conceptual synthesis.

The study incorporated three quality assurance strategies to bolster the credibility of this review: (i) use of an internationally recognized database, in this case Scopus; (ii) a PRISMA-based article selection process; and (iii) transparent descriptions of each step of the review process. Collectively, these procedures improve the reliability, transparency, and policy relevance of the synthesized literature.

■ RESULT AND DISCUSSION

Thematic Findings, Publication Trends, and Conceptual Mapping

Drawing on the PRISMA-based systematic literature review, an analysis of 85 selected articles provides recurrent conceptual patterns, theoretical developments, and policy implications for green central banking and sustainable finance. The results demonstrate a clear increase in scholarly interest over time, especially in the post-2023 era, with publication output peaking markedly in 2025. The literature grows from a minimal number of studies in 2021 and 2022 to a much larger number in the years through 2025, as seen in Table 3 and shown in Figure 3. This has triggered a growing academic and policy interest in integrating climate-related risks into monetary policy, financial supervision, and the governance of sustainable finance since around 2015. Furthermore, the literature remains largely concentrated on developed economies, cross-country analyses, and broader conversations about emerging markets, notwithstanding only a few studies that directly apply to Indonesia itself. This imbalance amplifies a contextual research void regarding the reception of green central banking within the institutional contexts of developing economies, particularly in Indonesia.

The thematic synthesis identifies five major themes, as summarised in Table 2. The largest share of the literature falls under Theme 3: Development of Sustainable Financial Instruments, with 25 articles, followed by Theme 2: Integration of Climate Risk into Monetary Policy Framework with 20 articles. Theme 1: Evolution of Green Central Banking Policy and Theme 4: Institutional and Policy Drivers of Green Finance Adoption each account for 15 articles, while Theme 5: Financial Stability and the Low-Carbon Transition comprises 10 articles. This distribution indicates that the literature has moved beyond purely conceptual discussions of green central banking toward a stronger focus on policy instruments, regulatory implementation, and practical channels for allocating low-carbon capital. In other words, while foundational debates on the changing role of central banks remain important, the dominant emphasis in the literature increasingly focuses on how sustainability objectives are operationalized through financial instruments and policy frameworks.

In Table 3 and Figure 3, a more refined temporal pattern reveals that the field has not expanded uniformly across themes. Meanwhile, the number of publications increased sharply in 2024, as a total of 11 articles focused on sustainable financial instruments (including green bonds and sustainable credit) and their combination with short-term financing mechanisms. On the other hand, Theme 2 (climate risk incorporation in monetary policy

Table 2. Article themes

No	Themes	Number of Articles
1.	Evolution of Green Central Banking Policy	15
2.	Integration of Climate Risk into Monetary Policy Framework	20
3.	Development of Sustainable Financial Instruments.	25
4.	Institutional and Policy Drivers of Green Finance Adoption	15
5.	Financial Stability and the Low-Carbon Transition	10

Table 3. Distribution of Articles by Themes

Year	Theme 1	Theme 2	Theme 3	Theme 4	Theme 5	Total
2021	1	0	0	0	0	1
2022	2	0	0	1	0	3
2023	3	2	4	3	1	13
2024	2	3	11	3	3	22
2025	7	11	4	6	5	33
2026	0	4	6	2	1	13
Total	15	20	25	15	10	85

frameworks) saw a bumper year in 2025, publishing a total of 11 articles, showcasing its increasing relevance as it is being recognized as a macro-financial stability threat normalized within central bank mandates. This increase is driven by a similarly defined Theme 1 (conceptual debates on the evolving role of central banks). While that topic peaked in 2025 as well, this suggests a systematic, deepening process of conceptual discussion taking place alongside more applied policy discussions. In comparison, Theme 5 was consistently smaller than the other themes during most of the review period (although it increased in 2025), suggesting that while green central banking is clearly evolving to be more established (especially as this relates to financial stability and low-carbon transition), this remains a less developed area of research than instruments and policy integration. In summary, these patterns suggest that the field has moved from more conceptual beginnings to a relatively policy-oriented and implementation-focused body of research.

Figures 2 and 3 further provide quantitative maps and descriptives of policy and financing flows (where relevant) weighted by concept frequencies across the literature to understand connections between policy, green finance instruments (sources), and low-carbon transition outcomes. Furthermore, Figure 4 shows a theoretical bibliometric thematic concept map constructed from the co-occurrence network of key terms in the reviewed literature. The visualization thus indicates that literature is structured around interrelated thematic clusters rather than isolated debates. Thus, together, Table 2, Table 3, Figure 2, Figure 3, and Figure 4 reveal how the literature on green central banking and sustainable finance has markedly broadened (in both scope and depth) since its earlier foundations in debates surrounding the changing role of central banks.

Evolution of Green Central Banking Policy

The role of the central bank is the first theme in a synthesis of key themes from the literature, and this has shown early interest in sustainability and climate-related financial governance, rather than a narrow focus on price stability. This shift can be interpreted through an Institutional Theory lens as institutional adaptation: the manner in which central banks respond to altered normative expectations, new systemic risks, and demands for policy legitimacy (Chamdani & Santoso, 2023). However, the literature suggests that this transformation remains hotly disputed. One line of argument in the scholarship also suggests that it is no longer possible for central banks to assume sectoral and environmental neutrality given climate change's emergence as a systemic macro-financial risk source affecting inflation expectations, asset prices, credit risk, and monetary policy transmission (Chamdani & Santoso, 2023; Handarumukti & Mori, 2026; Shirai, 2025). This perspective would lead to the conclusion that banks' integration of other types of environmental risk into banking supervision, sustainability disclosure frameworks, and green financial market development is an institutionally inevitable and natural response rather than a socially desirable one, given the evolving nature of capital and liabilities and the emergence of new sovereign-style systemic risk structures. By contrast, another line of the literature cautions that this kind of expansion may threaten established limits on central bank mandates, undermine institutional independence, and expose monetary authorities to political challenges masquerading as sustainability governance. Framed this way, green central banking may seem much like a species of mandate stretching wherein legitimacy is sought through the pursuit of broader policies but at the potential expense of role ambiguity and weakened accountability. Thus, the real question is not

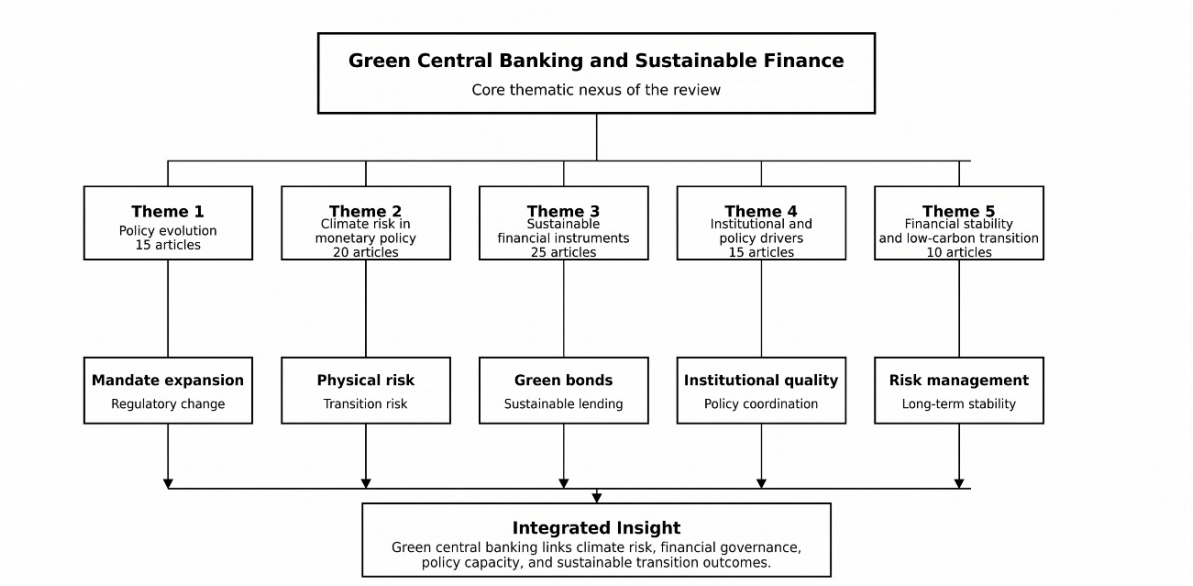


Figure 2. Concept Map of Thematic Findings

whether central banks should respond to climate risk but how this response is legitimized, carried out, and bounded within institutions. Therefore, green central banking should not be understood as a linear path of policy adjustment but rather as an iterative process of institutional renegotiation, in which the very meaning of normalcy regarding central bank legitimacy, neutrality, and accountability is being shaken to its foundations.

For this reason, the integration of environmental considerations is not an ethically normative imposition, but a functional adjustment to structural changes in global economic risk. This evolution represents a shift from an inflation-driven central banking model to a risk-integrated one, in which price stability and financial stability have become part of longterm ecological sustainability (Dikau & Volz, 2021). In this context, green central banking policy can be understood as a redefinition of macroeconomic stability. Moreover, stability is no longer simply about short-term inflation fighting, but about the capacity of our economic system to adapt to structural shocks such as the energy transition and the physical risks of climate change (R. Carè et al., 2024). This change makes the central bank not just a stabilizer of the market but an enabler of a transition, guiding capital flows through regulation, speech acts, and the design of monetary instruments. However, the literature also demonstrates a tension between this expanded mandate and the core principle of central bank independence, or the risk of the politicization of monetary policy, suggesting a gradual, incremental, rather than revolutionary evolution in policy (Babic, 2024; D'Orazio & Popoyan, 2023).

After all, the implications of this transition to green central banking in developing countries (such as Indonesia) are institutionally more differentiated than in advanced economies. In the case of Indonesia, this is not just about the relevance of global ideas about climate-responsive central banking for the country, but also about how these ideas are filtered through a domestically fragmented governance structure in which authority over sustainable finance is distributed across multiple institutions. According to the literature, Indonesia neither outright rejects nor uniformly or rapidly adopts the green central banking agenda. In contrast, its reception is mediated by the division of power between Bank Indonesia (which retains primary responsibility for monetary affairs, macroprudential stability, and payment systems) and OJK, now more responsible for sustainable finance regulation, ESG disclosure, and financial sector supervision (Putri et al., 2023). Such institutional arrangements imply that advocacy for green central banking in Indonesia generally thrives on price-oriented tasks where preexisting financial stability and supervisory mandates are already aligned, such as climate-risk monitoring, macroprudential oversight, green-lending surveillance, and policy coordination (Handarumukti & Mori, 2026). More interventionist proposals, such as widespread green monetary instruments or direct credit channeling through central bank balance sheet policies, encounter greater institutional opposition because they fall further

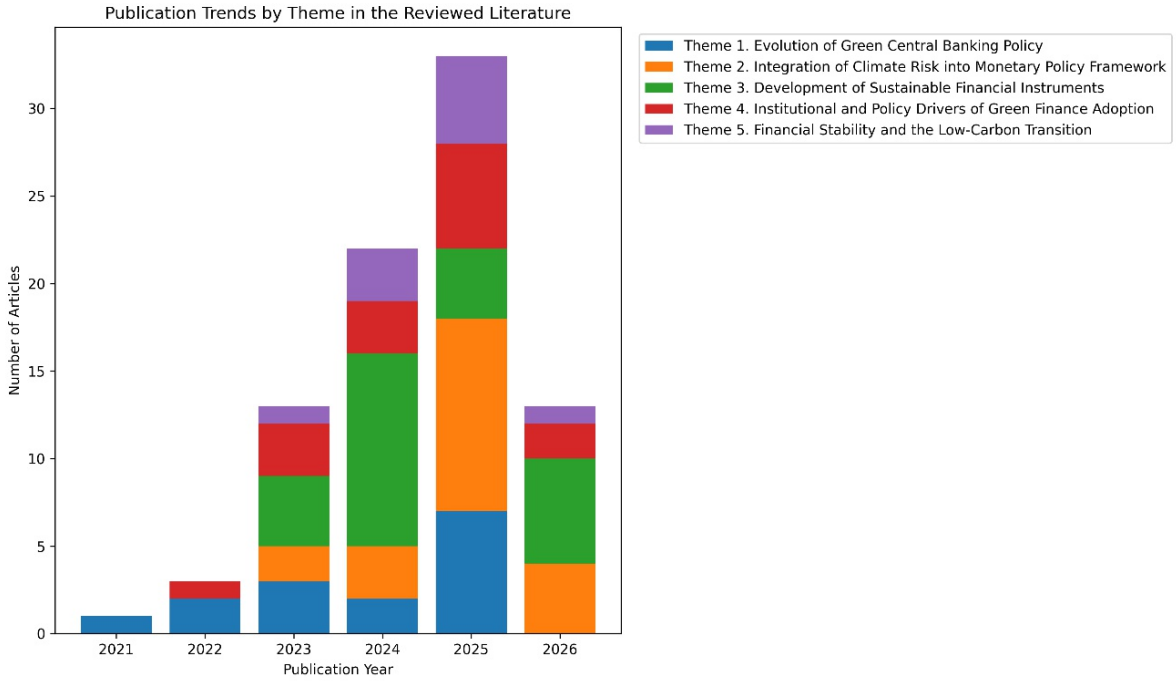


Figure 3. Publication Trends by Theme in the Reviewed Literature

outside the traditional scope of central banking (D'Orazio, 2022; Mertzanis, 2024).

Explaining this trend is further complicated, as it suggests an increasingly selective pattern of acceptance and rejection, which may help explain why green central banking in Indonesia seems more incremental than transformational. Across the Indonesian literature, there are overlapping development priorities, regulatory coordination challenges, varying levels of institutional capability, and a reliance on carbon-intensive and natural-resource-based sectors (D'Orazio, 2022). This, however, means that while these conditions provide incentives for climate-friendly financial governance, they also impose limits on both the pace and the scope of policy change. However, given Indonesia's intrinsic vulnerability to natural hazards and very large financing needs for an accelerated energy transition, this augmentation of the argument with climate risk nevertheless still does not translate into practice at the institutional level, which is primarily based on doing things in stages that are coordinated, versus policies that disrupt things rapidly. Further, evidence in banking shows that sustainability reporting, ESG governance, and the operationalization of 'green'– all reflect inconsistencies across financial actors or institutional variability– are limiting factors for policy effectiveness (Nursahla et al., 2023). Thus, Indonesia should not be considered only a local outpost of the global green central banking movement, but rather an institutional hybrid in which climate enters the stage to the extent it can be reconciled with bureaucratic mandates, inter-agency power dynamics, and development policy preferences. When viewed in this way, the Indonesian case shows that green central banking is not a universal policy transfer. Instead, it can be an institutional process of ideational acceptance and boundary-setting within the national financial governance apparatus.

Integration of Climate Risk into Monetary Policy Framework

The second theme focuses on incorporating climate change risks into the monetary policy framework. Nevertheless, in the Indonesian context, this integration cannot be conducted merely as a technical extension of central banking, nor as a single normatively coherent measure. From a political-economy angle, the critical problem is that climate-risk integration occurs within a fractured governance structure with dispersed authority, overlapping mandates, and institutional actors whose policy priorities are not necessarily aligned. Institutionally, Bank Indonesia maintains primary authority over monetary policy, macroprudential stability, and payment systems, and OJK, in terms of sustainable finance regulatory power, has broadened its scope to cover ESG disclosure and microprudential supervision. Consequently, the manner in which climate risk has been

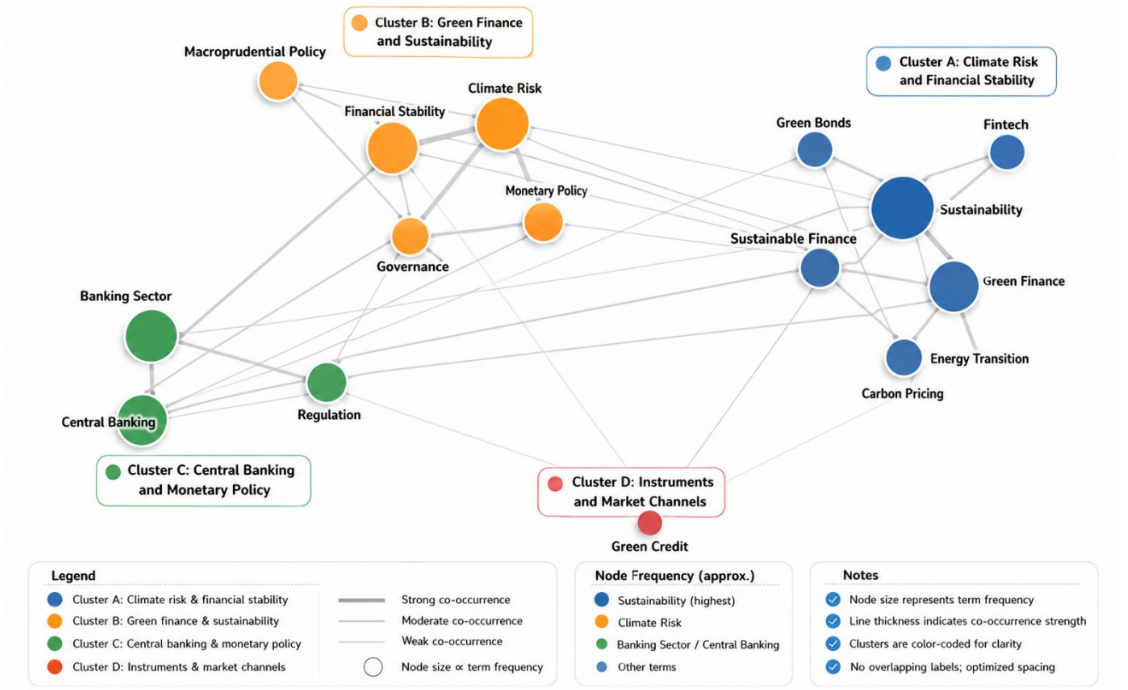


Figure 4. Bibliometric Keyword of Co-Occurrence Network Thematic Clusters in the Reviewed Literature

integrated is not the product of a comprehensive policy consensus but rather reflects ongoing negotiation over institutional boundaries (Setyowati, 2023; Putri et al., 2023).

Within this frame, the question is not whether climate-risk integration can be implemented without jeopardizing central bank independence, but under what institutional arrangements it remains complementary to it. Climate-related policy measures are more likely to maintain the Bank Indonesia's autonomy when they remain within the central bank's already established macroprudential and financial-stability functions, e.g., climate-risk monitoring, stress testing, supervisory data collection, and assessment of sectoral exposure (Handarumukti & Mori, 2026; Nursahla et al., 2023). In contrast, it is when climate objectives start justifying shielding effects with more proactive instruments, such as preferential liquidity, directed credit support, or green asset interventions, which are closer to allocative and quasi-fiscal functions that might risk entanglement between monetary authority and development policy (Chamdani & Santoso, 2023; Emam, 2025). From this perspective, climate risk integration must be compatible with central bank independence, but such compatibility is not prescriptive.

That is exactly why the issue of fiscal dominance arises. In an emerging economy like Indonesia, climate-related financial governance is part of broader state priorities, including financing for decarbonizing energy systems and industrial upgrading, as well as maintaining growth amid structural dependence on carbon-intensive sectors. These pressures can drive the government and other aligned regulatory players to nudge the central bank to take on a new role in supporting green transition objectives. However, this trend risks constraining Bank Indonesia's institutional independence, as monetary and macroprudential instruments are expected to serve broader fiscal and developmental purposes (Suphal & Adil, 2025; D'Orazio, 2022). Therefore, the problem is not that fiscal dominance has overtaken central bank independence, but rather that climate risk shades into a contested institutional space where it now stands out more sharply.

Furthermore, the coordination relationship between Bank Indonesia and OJK does not conform to a romanticized notion of flawless cooperation. The literature recognizes some overlap between the two institutions, but also suggests a division of regulatory labor that is likely to create frictions in terms of what counts as policy scope, who gets access to relevant data, and how responsibility for supervision is allocated, and what action or type of intervention climate-related issues can legitimately engage with (Putri et al., 2023; Setyowati, 2023). OJK is relatively stronger in sustainable finance regulation, so BI has a more

indirect, mediated climate role, which protects BI's formal independence but can also limit its policy scope. On the other hand, a more aggressive move by BI into climate-oriented monetary intervention would further conflict with institutional mandates and raise concerns about multiple mandates, political accountability, and the legitimacy of central banks (D'Orazio, 2022; Mertzanis, 2024). Thus, the Indonesian case state-sovereignty lens ought not to be seen or framed as evidence of coherent policies, but rather as one that is mediated and fraught with contestation, in which climate-risk integration is forever being (re)configured through inter-agency bargaining over development priorities and institutional boundary-setting. In conditions like these, meaningful climate-risk integration is less contingent on a formal green agenda than it is on whether institutional roles are negotiated adroitly to avoid tumbling back into policy paralysis or fiscal overreach. One interpretation, therefore, is that Indonesia either has a trajectory towards full regulatory harmonization or inevitable institutional conflict: it really has neither, but a managed tension. Climate-related considerations can fit within Bank Indonesia's policy framework, but only in a limited and harmonious way, while preserving its monetary credibility and allowing it to work hand in hand with OJK and other state actors. Therefore, we interpret the assimilation of climate risk into the monetary policy framework as a politically mediated and institutionally gated process where policy design per se is only part of what constitutes the principal challenge facing Indonesia: governance of competing mandates, overlapping jurisdictions, and development pressures in the country′s fragmented financial architecture (Setyowati, 2023; Putri et al., 2023; Handarumukti & Mori, 2026).

Development of Sustainable Financial Instruments

The second theme concerns the central bank's role in supporting the growth of sustainable financial platforms. Broadly, the literature points to the important role that regulatory policy and central bank signaling can play in supporting green bond and sustainable credit markets, as well as low-carbon investment by ceteris paribus directing capital to environmentally focused activities. However, this fact should not be taken too naively as signs of market efficiency. From an information-asymmetry perspective, sustainable financial instruments operate in a setting where issuers generally have more knowledge than investors and regulators about the true environmental quality, execution, and longer-term effects of capital projects funded by these instruments (Islahuddin et al., 2026). This imbalance creates the conditions for adverse selection, where products described as "green" (or something else to that effect: sustainable, ESG, climate-aligned) are not from truly sustainable activities (like a green SME), and moral hazard where issuers exploit weak monitoring and loose taxonomies to exaggerate their environmental performance. The rapid growth of green bonds and other sustainable finance instruments, in this sense, not only opens new avenues for financing the transition to low-carbon economies but may also risk ushering in a more sinister stage of their market development: institutionalizing the practice of greenwashing under the apparent guise of compliance with sustainability.

Thus, the success of these instruments does not rely solely on their function as capital allocation tools; they also depend on a solid regulatory and informational framework. Sustainable financial instruments aim to connect financial markets with environmental and social objectives in response to climate change and the Sustainable Development Goals. However, their integrity is undermined if green finance definitions are ambiguous, disclosure standards are unclear, and verification mechanisms are lax (Dev et al., 2025). While reporting requirements and sustainability labeling may enhance transparency, they do not by themselves eliminate strategic disclosure behavior or make environmental claims ex ante verifiable for stakeholders (Apata, 2024; Panait et al., 2023). Thus, a closer reading of the literature indicates that sustainable financial instruments need to be understood not just as neutral vehicles to direct green capital resources, but as contested financial products whose performance relies on clarity in taxonomies, third-party verification, regulatory enforcement, and the mitigation of information asymmetries between issuers, regulators, and investors.

Literature corroborates that the range of these instruments is broadening and now also includes green bonds, sustainability-linked loans, ESG-indexed ETFs, clean energy equity, carbon emissions trading mechanisms, and green securitizations like mortgage-backed obligations for green investments (Cusano et al., 2024; Ennin et al., 2025; Cai et al., 2025; Y. Zhang et al., 2024). These functions work through the following channels: (i) reallocation of capital towards environmentally friendly projects; (ii) creating market signals for emission reductions via carbon pricing; (iii), promoting innovation and development of

clean technologies, and(iv) enhancing risk management by considering ESG factors in the investment process and credit assessments (Ullah et al., 2023; X. Xu et al., 2025; Mouffok & Mouffok, 2026; Manasseh et al., 2026; D. Li, 2024). However, empirical literature on developed sustainable finance instruments shows that growth does not happen organically. Rather it occurs under a systemic mix of demand pressures (increasing awareness of climate risk and demand for sustainability from investors), regulatory pressures (policy frameworks and mandates or incentives to integrate sustainability components into products) as well as technology such as FinTech, blockchain, and AI that are accelerating the design, monitoring, and tracing processes of these instruments (Galeone et al., 2024; H. Xu et al., 2024; Musah et al., 2025). Conversely, some recurring complications include regulatory ambiguity regarding 'green' standards, a lack of data and transparency undermining investor confidence, and the risk of greenwashing when sustainability indicators are assigned without supporting evidence of measurable impact (Cusano et al., 2024; Saqib et al., 2024; Apata, 2024).

Indeed, as several studies have cautioned that the positive or negative effects of financial development on the environment depend on where capital is steered, the quality of governance, reporting integrity, and oversight capacity play large roles in determining the effectiveness of channeling (Ullah et al., 2023; Musah et al., 2025). However, over time, accumulated data indicate a coherent upside–sustainable instruments are helping to speed up the energy transition, shrink emissions, underpin economic activity, and improve market transparency – even at specific sector-level, such as housing with green mortgages (Cai et al., 2025; Manasseh et al., 2026; Mouffok & Mouffok, 2026; Ennin et al., 2025). Hence, the agenda to strengthen the future is of a more structural nature: regulatory and taxonomy harmonization; data quality & impact disclosure improvements; supporting products & technologies innovation; financial human resource capacity build-up; international collaboration on aligning standards and best practices; all to make sure that sustainable financial instruments do not remain pure symbols for compliance but actually become engines for capital allocation enabling low-carbon economic transformation.

Institutional and Policy Drivers of Green Finance Adoption

Interlinking with the earlier themes, the fourth is about institutional drivers that shape green finance policy. Instead of viewing these things as a nebulous constellation of external forces, one can analytically situate this literature within the institutional isomorphism framework, which posits that coercive, mimetic, or normative pressures explain policy diffusion. Most importantly, coercive isomorphism stems from formal regulatory demands, international policy commitments, and state-centric pressures that compel financial institutions and regulators to integrate sustainability into financial governance. Green finance adoption thus frequently occurs not so much due to domestic regulatory design as to international climate agendas, supervisory expectations, and the systemic risks posed by fossil-fuel exposure or climate vulnerability (Lu et al., 2023; Sun & Li, 2025). These coercive pressures are especially relevant in developing countries like Indonesia, where green finance policies are often embedded in broader state and regulatory efforts to balance financial stability, development priorities, and sustainability transitions (Setyowati, 2023).

Second, mimetic isomorphism arises in response to uncertainty, as policymakers and financial institutions imitate models deemed successful in other jurisdictions. This provides some rationale for why developing economies continue to adopt templates from global green finance efforts, such as sustainable finance frameworks or ESG disclosure and climate-risk supervision instruments, even against uneven domestic institutional capacity. Imitation in this context will be less a sign of profound institutional change than it is perhaps of opportunistic navigation of the new GFC-era environment of uncertainty and reputational pressure (Lu et al., 2023). Third, normative isomorphism operates through professional standards, expert networks, and transnational policy communities that define what counts as appropriate regulatory behavior. The growing involvement of central banks, regulators, and financial institutions in sustainable finance forums, technical working groups, and climate-related disclosure initiatives creates a shared normative expectation that green finance should become part of responsible financial governance (Carè, 2023). When seen through this lens, the green finance movement reflects a convergence of institutions that go beyond market responses and technical policy choices. As market dependence on fossil-fuel sectors raises perceptions of systemic risk, coercive pressures increase; as policy uncertainty fosters mimetic borrowing, normative compliance deepens (Sun & Li, 2025). Therefore, the structural and behavioral changes in developing countries towards green finance will not be

determined solely by their regulatory capacity; rather, they will result from an interplay among the three forms of isomorphic pressure within different domestic institutional settings.

In countries where climate awareness is less developed, government support for fossil fuels serves as a driver. In response to energy market distortions, these subsidies pave the way for green finance policies to serve as corrective instruments. Then the role of the financial industry is intentional in this process. Moreover, energy sector financing has implications for financial system stability. These markets can serve as new foundations for sustainable products such as green bonds, green loans, and ESG-based investments (Cojoianu et al., 2025). Additionally, governments and their regulatory policies are among the top factors driving the expansion of green finance within the economic system. Previous studies suggest that the successful implementation of green finance relies heavily on establishing regulatory clarity and assurance, policy incentives, and institutional legitimacy to align sustainable finance with genuine systemic change (Afeku-Amenyo et al., 2026). An excellent instance of this is China, where the Updating the Construction of Green Finance Policy Guidelines has signified the institutionalization of several green finance instruments, including green credit, eco-friendly bonds, eco-friendly funds, ecologically friendly insurance, and environmental rights marketplaces, supporting the economic transition to low-carbon development (Zou & Zhang, 2026; Chen & Wang, 2025). Green credit and innovation-based industrial policies have also been shown to reduce corporate carbon emissions through green innovation enhancement, green investment enrichment, and sustainability-oriented financing cost reduction (Y. Sun et al., 2022; Y. Li et al., 2025). However, the success of these policies is also determined by moderating factors such as uncertainty in public policy and the environmental background of company executives (Afeku-Amenyo et al., 2026).

The other important aspect concerns the quality of institutions and public governance, which are also key determinants of green finance implementation in each country. Countries with high regulatory quality, sound law enforcement capabilities, and government effectiveness can establish a solid institutional framework for sustainable finance (Zhu et al., 2025). The Nordic countries exemplify a more mature institutional system that has encouraged the routine integration of environmental policies and financial systems (Dong et al., 2025). In contrast, countries with weak institutions or uncertain regulations often struggle to create green finance markets. Besides these formal factors, stakeholder pressures from institutional investors, consumers, and the public also serve as informal mechanisms that enhance sustainable finance practices (Al Mamun et al., 2024). The impact of social pressure on financial institutions, especially in a digital financial ecosystem, has even become an important factor influencing the adoption of green credit (Grechyna & Ofori, 2025; Sharma & Rupeika-Apoga, 2026; W. Xu et al., 2023).

In addition, the rise in economic incentives and global market dynamics is accelerating the development of green finance to new levels. By October 2023, economic signals, such as policy instruments such as carbon pricing, green energy subsidies, and public-private partnership schemes, were steering investments toward eco-friendly sectors (Afeku-Amenyo et al., 2026). Sustainable financial products, technological development (particularly in fintech), and the incorporation of Environmental, Social & Governance factors into investment decision-making intensify momentum for the continued adoption of green finance across countries (Grechyna & Ofori, 2025). International trade and multilateral capital flows are also linking developing countries to the global environmental agenda and expanding their potential access to green finance (Pavesi et al., 2025). Thus, the interaction among government policies, the institutional framework, and macroeconomic conditions shapes green investment behavior within institutions in this context (Liew et al., 2025; Siddika et al., 2025). A more holistic approach to policy has also been shown to be more effective than deploying separate policy instruments. Different forms of green finance instruments, such as green credit, green insurance, and environmental rights mechanisms, can work together to create greater synergies that enhance energy efficiency and facilitate green development (F. Sun & Li, 2025). Green finance policy paths constitute a dynamical system with two active loop-in-law mechanisms: the technology innovation incentive mechanism and the carbon price feedback mechanism (Y. Li et al., 2025). The success of this strategy is generally greater in places with a high gross domestic product (GDP), a large industrial workforce, and technological innovation capabilities, as measured by the green technology patenting activities (Dong et al., 2025).

Last but not least, the political and social conditions are also crucial for where green

finance is headed. Derived from the Paris Agreement, global political appeals even apply normative pressure on countries to embed green finance in national development processes (Al Mamun et al., 2024). Political risks, however, can hinder the effectiveness of these policies by increasing regulatory uncertainty and undermining investor confidence (Xu et al., 2023). On the contrary, a relatively more advanced financial sector would support better green finance performance. In fact, studies indicate that women's political empowerment can enhance the enforcement of environmental laws by tightening regulations and imposing harsher penalties for damaging conduct. The social pressure from institutional investors and society contributes to this by providing incentives for companies and financial institutions to invest in green innovation and responsible business practices (Khan et al., 2024). Results depend on multiple interrelated components, including institutional quality, policy frameworks, market dynamics, stakeholder pressures, and wider political and economic context. Hence, an integrated policy design and sound institutional backing are pivotal to achieving the full potential of green finance as a strategic policy tool to advance sustainable development and expedite the transition to a low-carbon economy.

Financial Stability and Low-Carbon Transition

The third link between green central banking and financial system stability. However, it is also clear from the literature that this relationship varies tremendously across sectors and in developing economies with growth structures that remain tethered to extractive industries, and is complicated by rent-seeking and neo-liberal production (Mattick et al., 2020). The incorporation of environmental risks can, in theory, bolster financial resilience by enhancing risk awareness and appetite for portfolio diversification, while mitigating overexposure to carbon-intensive (and other economic) risks. However, in some developing countries (such as Indonesia), the low-carbon economy effect may be related to a more concrete structural danger: that is, the risk of coal-related assets becoming stranded assets; assets impaired from an economic perspective before they end their typically institged periods of operation or operational period because of tightening climate policy, technological substitution and external market demand through these emerging global environmental competition markets (Hu et al., 2025; C. Wang et al., 2024; W. Wang et al., 2025). This risk, of course, is not marginal in Indonesia. Current evidence also indicates that more than 80% of Indonesia's coal production is spatially concentrated in Kalimantan (Widiastuti et al., 2023), and around two-thirds of Indonesia's coal exports were directed to China and India, both countries extremely interconnected with fossil fuel decarbonization events globally (Global Energy Monitor, 2026). The analysis also highlights that Indonesia remains the coal-mining hotspot in Southeast Asia, which increases the risk of uneconomic and stranded assets if coal demand weakens.

This is important from a financial stability perspective because transition risk in Indonesia is embedded in domestic political economy dynamics, where coal mining, captive coal power, and carbon-intensive supply chains remain materially relevant to local output and regional development. A more recent analysis indicates that Indonesia already has operational and planned captive coal capacity of 31 GW, which presents lock-in risks that could jeopardize longer-term competitiveness and expose developers to stranded-asset risk. Moreover, a recent analysis of the decarbonization of Indonesia's power sector finds that coal phase-out would create some USD 9 billion in stranded assets in the power sector and major losses for the upstream coal sector, demonstrating that transition risk is not just a theoretical exercise but an ever-prevalent economic reality (Global Energy Monitor, 2026).

In this respect, the stability results of green central banking in Indonesia need to be examined not only in relation to physical and transition risks in general, but also with respect to the sectoral concentration of transition exposure. A carbon price above a certain threshold might cause stranded assets in mining and coal power, which could manifest as increased credit risk for those investments, lower collateral quality, tighter refinancing conditions for firms and utilities, or increased non-performing loans at banks with concentrated exposure to carbon-intensive sectors, which is why the actual capacity of local institutions is important. Sustainable finance governance in Indonesia continues to receive strong oversight from OJK. In contrast, Bank Indonesia's oversight is more indirect, through macroprudential oversight and green-lending supervision, but not through full-fledged, interventionist green monetary policy (Setyowati, 2023). Thus, incorporating climate risk into financial stability frameworks is necessary not only to comply with the global climate agenda but also to underpin sector-level

domestic vulnerabilities and limit their potential to become banking and macro-financial weaknesses.

The low-carbon transition can be systemic, but if it is disorderly or too rapid, and without sufficient preparation at the institutional and market levels, it will have wider economic impacts. A flight from fossil fuel industries could sharply devalue assets, lead to higher corporate default rates, and shrink bank credit in economies that depend on carbon-intensive industries as environmental policies change. These dynamics can cause sectoral or systemic financial crises in extreme cases (Magacho et al., 2026). Moreover, data indicate that, upon completing the transition process, bank credit exposure shifts from the traditional energy sector to the new and renewable energy sectors (Córdova et al., 2026). Nonetheless, the high credit concentration on carbon-intensive industries can already lead to systemic risk if their asset values decline simultaneously (Gourdel et al., 2025). Financial markets can also transmit transition risk by affecting asset valuations and corporate viability, as well as by triggering liquidity crises in fossil-fuel-dependent industrial sectors (Fevereiro & Lowe, 2025).

These risks have spurred the development of policies and regulations to enhance financial system resilience to climate-related shocks. Scenario analysis and climate stress testing are key regulatory tools for assessing how carbon policy, energy technologies, and extreme climate events could impact financial system stability (Zhao et al., 2025). The integration of climate risk into macroprudential supervision, capital planning, and banking oversight systems is a growing focus to make sure that financial institutions are prepared for potential losses stemming from the energy transition. Moreover, this approach prompts financial institutions to consider climate-risk-related pricing for long-term investment portfolios (Córdova et al., 2026). In addition to regulatory measures, green finance is a strategic tool for managing transition risks while accelerating investment in lower-carbon segments. This includes strengthening financing for clean energy projects and those involving environmentally sustainable technologies through policies such as green credit, green macroprudential policies, and public–private sector co-financing schemes (Xing et al., 2024). Both carbon tax policies and green finance interact to strengthen the effectiveness of emission reductions; these policies may also increase financial risks if corporate financing structures become overly debt-dependent (Monasterolo et al., 2024). It follows that good policy design is critical to achieving the desired financial incentives for green investment without compromising the financial system's overall stability. Subsidies for green loans and other selective government actions can accelerate the energy transition by increasing overall social welfare, provided that their macroeconomic and financial stability effects are taken into account (Dunz et al., 2021).

In particular, the impact of bilateral flows on financial stability during the low-carbon transition depends critically not just on economic fundamentals but also on market and investor behavior. Sustainable investment preferences may affect capital flows, corporate liquidity, and the cost of financing for companies with high sectoral carbon intensity. Positive investor expectations about the green transition enhance corporate cash flows and mitigate the impact of future liquidity crises (W. Wang et al., 2025). On the other hand, extreme investor expectations, such as being overly bullish or bearish, can lead to volatility in financing and increased market uncertainty. Thirdly, the transition to a low-carbon economy will bring external pressure on companies to provide greater transparency and higher-quality disclosure of climate risks and sustainability strategies. This provides greater transparency, which can reduce financing constraints, improve a corporation's financial stability, and shorten the gap between financing and investment maturities (Shu et al., 2025).

The energy transition has profound macroeconomic implications not only on a national scale but also for fossil fuel-exporting nations. Global declines in fossil fuel consumption can pose fiscal risks and economic instability through declining revenues and the condemnation of assets (Magacho et al., 2026). In addition, developed countries' green development strategies (green growth and degrowth) can spill over to developing countries through changes in international trade and foreign direct investment (Gourdel et al., 2025). This reinforces the necessity of international policy coordination and a just transition strategy to mitigate the potential moral hazard posed by global economic inequality accompanying national decarbonization (Fevereiro & Lowe, 2025). In general, the results from the SLR reveal that the literature is moving toward a different perception of central banks. They are being increasingly viewed as agents for a sustainable economic transition. A technical synthesis demonstrates that a green central banking policy bridges monetary policy and financial development towards sustainable. This is achieved through the integration of

environmental risks, enhanced regulation of green finance, and influence on investment allocation. However, even though the literature has gradually shifted toward national context-based analysis, there are still limitations, especially in Indonesia. As a consequence, there is a lack of research regarding green central banking policies and their specific operation in the Indonesian context. Thus, a multilevel conceptual framework that reflects the context of developing-country institutional settings is necessary to understand policy implementation dynamics in these countries.

■ CONCLUSION

This paper provides a systematic review of the emerging literature on green central banking policy and sustainable finance, and its relevance to the modern monetary framework. The study analyses a selected sample of 85 articles to identify five main themes: (1) the evolution of the central banking paradigm to embrace climate risk as a component of systemic risk; (2) adaptations to monetary and macroprudential policy frameworks which internalise physical and transition risks, respectively, (3) enhance sustainable finance instruments as channels for financing low-carbon capital allocation; (4) emphasise institutional factors and policy coordination for green finance adoption; (5) relate how green policies contribute towards effective long-term financial system stability. These results affirm that green central banking has transitioned from a peripheral extension of monetary governance to an increasingly prominent policy landscape through which central banks and financial regulators manage climate-related macro-financial risks.

The results point to the need for green central banking in Indonesia that starts with a gradual, operationally viable policy rather than an immediate increase in interventionist green monetary instruments. As such, some of the practical recommendations remain timely for Bank Indonesia. Bank Indonesia: Integrating climate- related risk indicators into the macroprudential surveillance framework. First, Bank Indonesia needs to identify sectors with possible structural exposures, such as mining and coal, and fossil-fuels-linked power generation. Second, Bank Indonesia should formulate and institutionalize climate stress testing and scenario analysis for the Banking Sector to assess the implications of physical and transition risks, as well as potential stranded assets, for financial system stability. Third, Bank Indonesia needs to improve the data it has on green loans and climate-risk exposure by ensuring its collection and dissemination are standardized; with this enhanced data, it can make more accurate supervisory decisions and base policymaking on evidence. Fourth, Bank Indonesia must optimize policy coordination with OJK and other government institutions to harmonize the sustainable finance taxonomy, disclosure standards, and regulatory incentives. Fifth, clear policy communication and market guidance from Bank Indonesia would support the gradual alignment of financial institutions with climate-related financial regulation.

Moreover, the implications of this research extend beyond Indonesia and can be adopted by central banks in other developing or emerging countries, as mentioned earlier. Central bank integration of climate-related financial risks into macroprudential surveillance and financial stability assessments as an initial and institutionally credible entry point in the evolving landscape for action by authorities in emerging markets. Second, they need to create a climate data infrastructure: this includes developing confidentiality facility maps, enabling green credit reports, and aligning taxonomies to bridge the information gap that undermines effective policy design. Third, they must conduct domestic-direct climate stress testing and scenario analysis, especially where banking systems remain directly tied to carbon-intensive sectors, fossil-fuel reliance, or production structures sensitive to climate shocks. 4) Central banks would greatly benefit from improved coordination with financial supervisors, finance ministries, and market regulators to prevent fragmented governance and misaligned incentives. Fifth, they should advocate for a sequenced market-development strategy in which sustainable financial instruments, disclosure standards, and regulatory certainty are advanced before reaching for more interventionist monetary tools. Sixth, they should uphold institutional credibility and policy independence by delineating a clear line between climate as a risk management function, macroprudential oversight, and (quasi-)fiscal intervention. From this perspective, the single most transferable lesson from the literature is that green central banking in emerging markets will be easier and more effective through gradual institutional embedding, regulatory coordination, and context-specific adaptation than through sudden policy transplantation.

In summary, this study contributes to the literature on green central banking not only by synthesizing and organizing the literature but also by illustrating policy relevance for developing countries, showing how climate risk will be institutionally or politically translated

into context-appropriate and actionable financial governance. For Indonesia, this suggests that Bank Indonesia's role is likely to be most effective when limited to macroprudential risk management (including supervisory data infrastructure and inter-institutional coordination). In practical terms, for other emerging markets, the research suggests that green central banking should not be thought of as a single technical solution but rather as a flexible governance framework appropriate to the scale of domestic institutional capacity, sectoral vulnerability, and the political economy of the low-carbon transition.

■ DECLARATION OF GENERATIVE AI IN THE WRITING PROCESS

The authors declare the use of AI-assisted tools in the preparation of this manuscript, limited to language refinement and literature identification. DeepL Translate was used to support translation and improve clarity of expression, while Grammarly was employed for proofreading, including grammar, spelling, and readability. The Scopus (AI Discover) feature was used to identify relevant scholarly articles and publications. In addition, VOSviewer was used for thematic mapping, and draw.io (online) was used for figure preparation. All content, interpretations, and citations have been carefully reviewed and verified by the authors, who take full responsibility for the accuracy, integrity, and originality of the manuscript.

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