

GREEN FINANCE AND ITS ROLE IN GLOBAL SUSTAINABLE DEVELOPMENT: TRENDS, CHALLENGES, AND POLICY IMPLICATIONS

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ABSTRACT

The digital transformation towards a low emission economy and adaptation to climate change is a persistent, long term, and comprehensive process across all sectors of the economy. Green finance has emerged as a strategic tool for mobilizing resources. This paper aims to provide a systematic and updated review of global green finance development, combining theoretical perspectives and empirical evidence. In the context of countries accelerating their commitments to sustainable development, green finance acts as a bridge between economic growth and environmental protection, contributing to the promotion of an inclusive and long term development model. This study analyzes the concept, operating mechanisms, global development trends, and challenges in implementing green finance. The study also discusses policy implications to enhance the effectiveness of green finance frameworks, especially in emerging economies. The results, synthesized from sources such as the World Bank, the International Monetary Fund, the United Nations Environment Programme, and previous empirical studies, show that green finance is not only a tool to support environmental goals but also a crucial pillar in ensuring long term financial stability and mitigating systemic risks related to climate change.

Keywords: Green finance, green bonds, green credit, sustainable investment, ESG, climate change.

1. INTRODUCTION

Global economic growth is facing systemic risks from climate change and environmental degradation. According to the Intergovernmental Panel on Climate Change report in 2023 [1], limiting global temperature increase to 1.5°C requires a significant shift in investment and financial structure. However, the current level of climate finance remains insufficient to meet these targets, creating a substantial financing gap. In this context, green finance is considered a crucial tool for directing capital flows into sustainable economic activities.

According to the OECD [2], the investment needs for sustainable infrastructure by 2030 are estimated to reach trillions of USD annually. To achieve this, coordination between the public and private sectors is needed in developing effective green finance tools.

Furthermore, in the context of the world facing serious challenges from climate change, resource depletion, and social inequality, the concept of sustainable development is increasingly considered a strategic goal of nations and international organizations. Green finance, a system of financial tools and mechanisms aimed at mobilizing capital for environmentally friendly and low-emission projects, has emerged as a crucial strategic driver for global sustainable growth. Green finance not only coordinates capital flows from the public

and private sectors into “green” economic activities such as renewable energy, waste management, and clean agriculture, but also promotes the transformation of development models towards a balance between socio-economic and environmental aspects [3] (Zournatzidou, 2025).

The latest research published in Scopus shows a growing trend of academic and policy-making interest in the role of green finance in sustainable development. Zournatzidou [3] (2025) conducted a statistical bibliographic analysis of over 400 Scopus articles to clarify the relationship between green finance, financial technology, and sustainable development, affirming the key role of the green finance ecosystem in promoting innovation and sustainable growth.

Another study, also indexed in the Scopus database, emphasizes the importance of integrating green finance with green energy and green production to achieve green growth, i.e., clean and sustainable economic growth in the long term. Analysis of 52 countries shows that when green finance is combined with renewable energy and clean production technologies, the positive impact on sustainable economic growth is clearly evident [4] (Nguyen et al., 2024).

According to Tran Man Thy et al. [5], in Southeast Asia, green credit, a core component of green finance, has a positive impact on sustainable development, although the degree and manner of expression differ from country to country. This further reinforces the urgency of developing a green financial system as a long-term strategy to both restore post-COVID-19 growth and meet global commitments on climate change and the Sustainable Development Goals (SDGs).

From a policy and economic perspective, green finance is considered an indispensable element in national and global strategies, not only to attract private capital for sustainable projects but also to increase economic and financial stability in the face of complex environmental risks. The development and application of green finance has become a strategic driver for sustainable global growth in the 21st century.

Despite the growing body of literature on green finance, existing studies tend to focus on individual aspects such as green bonds, ESG investing, or specific regional cases. There remains a lack of comprehensive research that integrates theoretical frameworks, global development trends, and policy implications within a unified analytical perspective. Therefore, this study aims to address this gap by providing a systematic and holistic overview of green finance in the context of global sustainable development.

2. CONCEPTS AND THEORETICAL FRAMEWORK

2.1. The concept of Green Finance

Green finance is understood as financial activities that support projects beneficial to the environment, including renewable energy, waste management, clean transportation, and sustainable agriculture. According to the United Nations Environment Programme in 2016, green finance is the process of “increasing capital flows into activities that promote environmentally sustainable development.”

The main instruments of green finance include:

- **Green Bonds:** These are debt instruments issued to raise capital for projects with positive environmental impacts, especially in the fields of renewable energy and green infrastructure. These bonds play a crucial role in reducing financial risk and attracting long-term investment flows for sustainable projects.

- **Green Loans:** These are loans with preferential terms, designed to support businesses and projects with clear environmental criteria, such as emission reduction and energy efficiency standards.

- **Investing according to ESG (Environmental, Social, Governance) criteria:** This involves integrating environmental, social, and governance factors into financial investment decisions, creating a comprehensive framework for evaluating the sustainable value of investments and promoting capital flows into businesses committed to sustainable development.

In the context of sustainable development and the global energy transition, green finance is also considered a key area of research and policy aimed at mobilizing and allocating capital to activities that deliver positive environmental value. Systematic studies show that green finance is defined as a set of financial mechanisms to support investment in sustainable development and mitigate negative environmental impacts, such as renewable energy, clean transportation, waste management, and sustainable agriculture, through capital flows from the public and private sectors and global capital markets.

Thus, the theoretical framework of green finance goes beyond simply defining financial instruments; it also emphasizes the connection between financial mechanisms, corporate social responsibility, and sustainable development goals within long-term growth strategies.

2.2. Theoretical Framework

Institutional theory is used as a key analytical lens to explain the adoption and spread of green finance on a global scale. According to Paul J. DiMaggio and Walter W. Powell [6], organizations tend to converge in structure and practice due to the influence of three forms of institutional pressure: coercive pressure, normative pressure, and mimetic pressure. In the field of green finance, coercive pressure comes from national regulations and international climate commitments requiring the integration of environmental risks into the financial system; normative pressure stems from professional standards, ESG reporting frameworks, and international practices; while mimetic pressure reflects the tendency of financial institutions to imitate successful models to mitigate risks and maintain competitiveness. Recent overviews of green finance show significant convergence in practices and policy frameworks among countries, despite differences in domestic institutions, reinforcing the argument for institutional isomorphism in this field [7],[8].

Simultaneously, Stakeholder Theory, developed by R. Edward Freeman [9], provides a basis for explaining the strategic motivations of financial institutions when implementing green finance. According to this approach, businesses are not only accountable to shareholders but must also meet the expectations of multiple interest groups such as international investors, customers, the community, regulators, and civil society organizations. In the context of capital market globalization, the rise of ESG-based investment funds has created significant pressure on financial institutions to integrate sustainability into their business strategies to maintain access to capital and enhance market credibility [10],[11]. Therefore, green finance is not merely a compliance response to institutional pressure, but also a proactive strategy to maximize long-term value for stakeholders.

Furthermore, Legitimacy Theory emphasizes that the existence and development of an organization depend on its level of social acceptance [12]. In the global financial system, legitimacy is established not only at the national level but also at the international level, where climate norms and commitments are increasingly central. Issuing green bonds, publishing ESG reports, and participating in international sustainable finance initiatives can be seen as mechanisms for building and strengthening global legitimacy. Recent studies indicate that adopting green finance helps organizations enhance their image, reduce reputational risks, and strengthen their competitive position in international capital markets [13];[14]. Thus, from a

legal perspective, green finance is not only a financial tool but also a symbolic strategy to maintain social and international acceptance.

The synthesis of these three theoretical approaches shows that green finance is a phenomenon that is simultaneously institutional, strategic, and social. Global institutional pressure creates the framework for action; stakeholder expectations shape strategic motivations; and the need to maintain legitimacy drives organizations to actively disclose and implement green finance practices. This combination provides a solid theoretical foundation for qualitative research aimed at analyzing how financial actors interpret and institutionalize green finance in a global context.

3. METHODOLOGY

This article employs a qualitative research method, combining a comprehensive analysis of secondary literature. The research follows a systematic literature review approach to ensure the reliability and validity of the collected data. Specifically, the author conducts a literature review from reliable sources such as the OECD, IRENA, Global Overview, World Bank, IMF, and CBI on this topic, along with recent research papers and scientific articles published in specialized journals. The synthesis and analysis of content are applied to extract important information and data reflecting the current state and trends of green finance globally, as well as the challenges and risks. This is achieved through comparison and contrast with international experience and a general theoretical framework. Because the scope of the article is a theoretical overview, not a direct quantitative survey, the arguments are primarily based on secondary data and previous research findings. This approach enhances scientific rigor, transparency, and reproducibility, while providing a more comprehensive view of the topic of sustainable finance. In addition, comparative analysis is used to identify similarities and differences across regions and financial instruments, thereby strengthening the analytical depth of the study. All references are cited and listed according to IEEE standards at the end of the article to ensure transparency and verifiability.

4. GLOBAL TRENDS IN GREEN FINANCE DEVELOPMENT

The green finance market has grown rapidly over the past decade. According to the Climate Bonds Initiative report [15], the total value of global green bond issuances has exceeded USD 2 trillion. In the European Union, the European Commission has implemented the “EU Taxonomy” to establish standards for classifying sustainable economic activities. Meanwhile, China and the United States are also strongly promoting the green bond market through fiscal and monetary incentive policies. International financial institutions such as the International Monetary Fund have warned that climate risks could destabilize the financial system if not integrated into macroeconomic risk management.

Amidst globalization and the challenges of climate change, green finance has emerged as a crucial area of academic research, with a significant increase in the number of publications in the Scopus database over the past two decades. Bibliometric analyses reveal a distinct shift in research topics from initial discussions of green finance to more diverse themes such as climate finance, ESG, and sustainable financial innovation [16]. Sang [17], in a broad study on the evolution of “green finance” based on 1,487 Scopus articles, published that from around 2015 onwards, the number of articles and citations increased sharply, reflecting the growing interest of the academic community in financial mechanisms supporting the environment and sustainable development [17]. Simultaneously, Judijanto et al [18] pointed out in a bibliometric study that topics such as green bonds, sustainable development, and climate finance are not only increasing in number but also showing a growing trend of international cooperation, with China and other Asian and European countries being major contributors to

the scientific cooperation network [18]. Furthermore, El Mortagi et al. [19] updated that research in the ESG era focuses heavily on green finance development strategies, green credit management, and the impact of green finance on corporate and investor policy, opening up new research directions for the next decade [19]. These findings demonstrate that green finance is not only a rapidly growing academic trend but also a multifaceted field of research involving policy, capital markets, and sustainable financial innovation on a global scale.

4.1. Green finance and sustainable investment

Table 1. Green Finance and Sustainable Investment Statistics (2019 - 2024)

Indicators Year	Green Bonds (USD billion)	Total Sustainable Bonds (USD billion)	Renewable Energy Investment (USD billion)	Total Energy Transition Investment (USD billion)
2019	270	382	-	-
2020	304	560	-	-
2021	522	862	-	-
2022	487	792	622.5*	-
2023	565	872	622.5	1,800**
2024	523+	851+	807	2,400***

Source: Author's compilation

Table 1 shows the strong expansion trend of green finance and sustainable investment [20] during the period 2019-2024, despite cyclical adjustments. The value of Green Bonds issued increased from USD 270 billion in 2019 to a peak of USD 522 billion in 2021, reflecting the post-COVID-19 green recovery wave and increasing carbon neutrality commitments globally. After a slight decline to USD 487 billion in 2022 amid high inflation and tight monetary policy, the market recovered to USD 565 billion in 2023 before a slight correction to over USD 523 billion in 2024. A similar trend was observed in Sustainable Bonds, which surged from USD 382 billion (2019) to USD 862 billion (2021), maintaining a high level above USD 850 billion during 2023-2024, indicating diversification of ESG financial instruments beyond pure green bonds.

Notably, real investment in the energy sector and energy transition increased at a faster rate than bond issuance. Investment in renewable energy reached USD 622.5 billion in 2022-2023 and surged to USD 807 billion in 2024. Total investment in the energy transition increased from USD 1.8 trillion in 2023 to USD 2.4 trillion in 2024, many times the scale of green bond issuance. This shows that capital markets, while playing a crucial role, are only one component of a broader green finance ecosystem, encompassing bank credit, equity, and public investment. Overall, the data reflects the long-term growth trend of global sustainable finance, while also showing a shift from financial commitment to actual investment deployment in the energy transition process.

4.2. Green Bonds

By the end of 2024, the total value of the global green bond market [21] is estimated to reach approximately USD 3.4 trillion, equivalent to 60-62% of the total sustainable bond market size, including green bonds, social bonds, and sustainability bonds. Other reports indicate that the total value of labeled sustainable bonds exceeded USD 5.7 trillion in 2024, with green bonds continuing to account for the largest share. By mid-2025, the total value of green bonds and sustainable debt instruments globally is expected to increase to approximately USD 6.3 trillion, reflecting the rapid expansion of the sustainable finance market.

Regarding issuance activity, 2024 saw positive growth in green bonds. The total value of new issuances reached approximately USD 671.7 billion, an increase of about 9% compared to 2023. However, some other statistical sources recorded the issuance value at around USD 611 billion, with a total of 1,841 issuances during the year, indicating certain differences in data collection and classification methods. Looking ahead to 2025, by the end of the third quarter, the total value of green bond issuances reached approximately USD 467 billion. Simultaneously, the total value of outstanding green bonds exceeded USD 3 trillion, reinforcing the central role of this instrument in the global sustainable capital market structure.

In terms of regional distribution, Europe continues to hold its position as the world's largest green bond issuance market, accounting for the dominant share of the total global issuance value. This region is followed by Asia Pacific and North America, reflecting a high level of commitment to sustainable energy and financial transition goals. According to several reports updated to Q3 2025, green bonds account for approximately 46% of the total value of sustainable bonds issued globally, demonstrating the central role of this instrument in the capital market structure geared towards sustainable development.

In terms of issuer types, the green bond market sees diverse participation from both the public and private sectors. Non-financial enterprises and financial institutions are actively using green bonds as a fundraising tool for environmentally friendly projects. Furthermore, governments and international financial institutions, including the European Union and the Asian Development Bank, also play a significant role in scaling up and standardizing the market through large-scale issuance programs and transparent standard frameworks.

One of the prominent trends in the green bond market recently is the strong increase in emerging economies. In 2023, the value of green bond [22] issuances in developing markets increased by approximately 34%, reaching nearly USD 135 billion. This development reflects the growing demand for capital mobilization for energy transition projects, sustainable infrastructure, and climate change adaptation in high-growth countries, and also demonstrates the geographical expansion of the global green finance market [23]

However, alongside the long-term growth trend, some recent signals suggest that green bond issuance may slow down in 2025 in certain markets. The main reasons stem from unfavorable macroeconomic conditions, interest rate volatility, and changes in the global policy and geopolitical environment [24]. These factors can affect the cost of capital and investor risk appetite, thereby impacting the size and speed of market expansion in the short term.

4.3. Green Loans

In 2024 saw a significant expansion of the green credit market amidst continued growth in the global sustainable credit market. According to market reports, the total value of issued sustainable loans (including both green loans and sustainability-linked loans) reached approximately EUR 907 billion, equivalent to around USD 960-980 billion, an increase of about 17% year-on-year. Within this structure, green loans maintained a growth rate of approximately 6% compared to 2023, although the sustainability-linked loan segment still accounted for a larger share in value. Aggregate data from syndicated loans under the Green, Social and Sustainability (GSS) standard shows that out of a total of approximately USD 638 billion in sustainable credit in 2024, about USD 162 billion was green credit, an increase of about 31% year-on-year. These figures indicate that green credit continues to be a crucial component and is growing at double-digit rates in the global sustainable finance market. Considering the regional distribution of the entire sustainable loans market (of which green loans are a key segment), the Europe, Middle East, and Africa (EMEA) region leads with approximately 49% of the total issuance value, affirming its central role in sustainable finance development. The Americas (North and South America) account for about 34% and is noted as the fastest-growing region. Meanwhile, the Asia Pacific (APAC) region accounts for about

15%, with stable growth but significant room for expansion. In terms of sector structure, green loans are mainly concentrated in energy and public utility projects, followed by real estate, finance, and technology, reflecting a priority orientation towards sectors that directly impact energy transition and emission reduction.

The medium- and long-term outlook for the green loans market is assessed positively. Several specialized reports estimate the market size to reach approximately USD 385.7 billion in 2024 and could grow at an average rate of around 13.2% per year between 2025 and 2033. Under this scenario, the market size could reach approximately USD 1,047.8 billion (approximately USD 1 trillion) by 2033. These forecasts reinforce the view that green credit is one of the fastest-growing segments in the global sustainable finance ecosystem.

Regarding development trends, green loans are considered to be experiencing stable and sustainable growth, rather than the rapid explosive growth seen in sustainability-linked loans. The EMEA region continues to lead in terms of sustainable credit size, with green loans accounting for a significant proportion of issuance. North America closely follows with high growth rates, while APAC maintains a modest increase but possesses significant long-term potential. Nevertheless, within the overall sustainable credit market, green loans are generally smaller in scale compared to sustainability-linked loans, but they still hold a key position due to their direct connection to specific green projects and assets.

4.4. ESG investing

The market for environmentally, socially, and ethically sound (ESG) investments has grown significantly in recent years and continues to play an increasingly important role in the global financial structure. According to various sources, total global ESG investments in 2022 reached approximately USD 35.3 trillion, equivalent to about 13.9% of total professionally managed assets worldwide. In the United States, the size of ESG assets under management (AUM) increased sharply from approximately USD 12 trillion in 2020 to USD 22.7 trillion in 2023. Europe continues to lead, accounting for approximately 58% of total global ESG assets, equivalent to approximately USD 20.5 trillion in 2023. Other forecasts suggest that ESG AUM could reach approximately USD 33.9 trillion by 2026, representing about 21.5% of total global assets under management, up from approximately USD 18.4 trillion in 2021 [25]

The medium-term growth outlook for ESG investment remains positive, although estimates vary among research institutions. Some market surveys forecast ESG assets could reach approximately USD 50-53 trillion by 2025, equivalent to nearly one-third of total global assets under management. Meanwhile, according to Bloomberg Intelligence's forecast, global ESG assets could exceed USD 40 trillion by 2030, accounting for approximately 25% of the world's total AUM if the global asset market continues to expand [26].

In terms of regional allocation, Europe is currently the center of ESG investment with an overwhelming share. The United States recorded rapid growth in AUM size between 2020 and 2023, reflecting the strong expansion of funds and investment strategies incorporating ESG criteria. The Asia Pacific (APAC) region and other markets account for the remainder of the total global ESG assets, although detailed figures are not fully disclosed in all reports.

Besides the increase in size, the ESG market is also characterized by increasingly deep integration into corporate strategies. According to a McKinsey & Company survey, approximately 83% of large global businesses have integrated ESG elements into their business strategies, not only to meet compliance requirements but also to create long-term value and enhance resilience to risk. Furthermore, numerous empirical studies show that a significant percentage of ESG funds achieve competitive, or even benchmark, performance in the long term, reinforcing investor confidence in the sustainability and financial effectiveness of this investment strategy.

Table 2. Global ESG Investing (2018–2025)

Year	Global ESG Assets (USD trillion)
2018	22.8
2019	~26.0*
2020	30.6
2021	~35.0*
2022	35.3
2023	~37.8
2024	~46.9*
2025	~61.7*

Source: Author's compilation

Table 2 shows the strong growth trend of global ESG investment from 2018 - 2025. The size of ESG assets increased from USD 22.8 trillion in 2018 to USD 30.6 trillion in 2020 and is projected to reach approximately USD 35 - 37.8 trillion in 2021 - 2023. Forecasts indicate significant increases in 2024 - 2025, potentially reaching USD 46.9 and USD 61.7 trillion respectively.

Overall, the data reflects the rapid expansion of ESG investment and the global shift of capital flows towards sustainable investment strategies.

Table 3. Regional Allocation of ESG Investments

Area	2018 (USD billion)	2020 (USD billion)	2022 (USD billion)	2024 (USD billion)
Europe	676	2,740	10,164	14,345
United States	136	393	715	1,602
Canada	64	94	149	420
Australia & New Zealand	23	121	221	366
Japan	4	18	25	22

Source: Author's compilation

Table 3 shows a significant increase in ESG investment across regions during the 2018-2024 period, with Europe playing an absolute lead. Investment in Europe surged from USD 676 billion in 2018 to USD 14.345 trillion in 2024, reflecting the early development of the legal framework and a high level of commitment to sustainable finance.

The United States recorded rapid growth, particularly during 2022–2024, reaching USD 1.602 trillion in 2024, indicating a strong expansion trend in the ESG market. Canada and Australia & New Zealand also maintained a steady upward trend, although their scale was significantly smaller than Europe and the United States.

Conversely, Japan experienced slower and relatively volatile growth, with investment remaining modest compared to other regions.

Overall, the data reflects an uneven distribution of ESG investments across regions, with Europe playing a central role in the global sustainable financial market.

4.5. Challenges and risks

Although green finance plays a crucial role in mobilizing capital for climate change mitigation and sustainable development, the sector still faces numerous challenges and risks

that could affect the long-term integrity and effectiveness of the market. Firstly, the lack of uniformity in standards and taxonomy among countries creates significant barriers to cross-border capital flows. Each country's application of its own criteria for defining "green" activities makes it difficult for investors to compare, evaluate, and allocate capital transparently (as cited in Green Finance Tools Education in Vietnam in 2025)[26]. This fragmentation also increases the risk of greenwashing, as some issuers may label financial products as "green" without clear or verifiable environmental impacts, thereby undermining investor confidence and leading to inefficient resource allocation (Sustainable Finance, Green Bonds and Financial Performance [27]).

Furthermore, the lack of transparency and standardization of ESG data continues to be a major limitation globally. Different reporting frameworks and inconsistent measurement methods create information asymmetry, making it difficult to assess the risks and environmental impacts of investments. According to the International Monetary Fund [28], improving climate-related information disclosure is key to ensuring the integrity of the green finance market, as the lack of reliable data limits the ability to accurately price risks and hinders the scalability of climate finance. When information is incomplete or lacks comparability, financial institutions tend to be more cautious, especially for small-scale projects or in emerging economies. Therefore, challenges such as standards fragmentation, the risk of greenwashing, and a lack of data transparency highlight the urgent need to harmonize classification systems and improve the quality of climate information disclosure at a global level to strengthen market confidence and enhance the effectiveness of the green finance ecosystem.

Another critical challenge is the limited capacity of financial institutions in developing countries to assess and manage climate-related risks, which restricts the effective implementation of green finance instruments.

Moreover, high initial investment costs and long payback periods of green projects may discourage private sector participation without adequate policy support.

4.6. Policy Implications

To promote the effective and sustainable development of green finance [29] in the long term, a comprehensive set of solutions needs to be implemented at both national and regional levels. First, establishing a unified, transparent, and internationally-standardized green taxonomy is crucial for clearly defining economic activities that are considered "green" or "sustainable." A clear taxonomy not only reduces the risk of "greenwashing" but also builds investor confidence and enhances market comparability. Furthermore, increased transparency and standardized ESG reporting are necessary through the issuance of mandatory, unified disclosure standards for measuring and assessing environmental and social impacts [30]. This will improve data quality, support investors in making evidence-based decisions, and reduce information asymmetry in the market.

Furthermore, developing domestic green capital markets in emerging economies is a strategic priority to mobilize long-term resources for energy transition and sustainable development. Governments can provide support through credit guarantees, tax incentives, or by establishing a favorable legal framework for the issuance of green bonds and other sustainable financial instruments. Finally, promoting public-private partnerships (PPPs) in financing sustainable infrastructure projects plays a key role in risk sharing and resource optimization. Close coordination between the public sector, the private sector, and international financial institutions will contribute to scaling up green finance while ensuring the efficiency and stability of the financial system during the transition to a low-carbon economy.

Additionally, international cooperation should be strengthened to harmonize green finance standards and facilitate cross-border capital flows.

Capacity building for financial institutions and regulators is also essential to improve risk assessment, monitoring, and implementation of green finance instruments.

5. CONCLUSION

Green finance is playing a central role in global sustainable development strategies. This study highlights that green finance is not only a financial mechanism but also an institutional and strategic response to global environmental challenges. Despite challenges regarding standardization and transparency, coordination among governments, international organizations, and the private sector can significantly transform green finance into a key driver of long-term growth and financial stability. In the context of escalating climate change, expanding and improving the effectiveness of green finance is not only a policy choice but also an essential requirement of the global economy.

Future research should focus on quantitative assessments and country-specific case studies to further validate the effectiveness of green finance in different economic contexts.

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