INTERNATIONAL JOURNAL OF POLITICAL SCIENCES AND ECONOMICS
Impact Factor (research bib) - 9,78
https://ijmri.de/index.php/ijpse , German international journals company
ISSN 2751-9708

THE FORMATION OF THE GREEN BOND MARKET: GENESIS, TRENDS, AND DEVELOPMENT PROSPECTS

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Abstract. This article examines the key aspects of the formation and development of the global green bond market - one of the most dynamically growing segments of sustainable finance. The study traces the history of green bonds from the first issuance by the European Investment Bank in 2007, analyses the main stages of market development, its regulatory framework, leading issuers, and investors. Based on data from the Climate Bonds Initiative, the International Monetary Fund, and the International Finance Corporation, a quantitative analysis of issuance volume dynamics, geographical distribution, and sectoral structure of the market is conducted. The main barriers to growth are identified, including the problem of greenwashing, and promising directions for further market development are outlined.

Keywords: green bonds, sustainable finance, ESG investments, climate finance, greenwashing, Climate Bonds Initiative, Green Bond Principles.

Introduction. Global climate change and the need to transition to a low-carbon economy demand an enormous volume of investment. According to estimates by the International Energy Agency, achieving net-zero emissions by 2050 will require annual investments in excess of USD 4 trillion. In this context, green bonds have become one of the most significant instruments for attracting private capital into environmentally oriented projects.

Green bonds are debt securities whose proceeds are directed exclusively to the financing or refinancing of projects with positive environmental effects. This instrument combines the traditional characteristics of a bond loan with verification of the targeted use of the raised funds, thereby ensuring transparency and accountability for investors.

In less than two decades, the green bond market has evolved from isolated experimental issuances to a well-established global segment with cumulative issuance volume exceeding USD 3.4 trillion as of 2024 (Climate Bonds Initiative, 2024). This rapid growth has been driven by both the increasing awareness of climate risks and the large-scale transformation of the regulatory environment — in particular, the adoption of the Paris Agreement in 2015 and the introduction of the European Green Bond Standard (EU GBS) in 2024.

The relevance of this study is determined by the fact that green bonds are being increasingly used by governments, corporations, and supranational institutions as an instrument for financing the climate agenda. At the same time, the market faces a number of unresolved challenges: the heterogeneity of standards, greenwashing risks, and limited participation of developing countries.

The aim of this article is a comprehensive analysis of the process of green bond market formation: its historical background, institutional infrastructure, quantitative dynamics, and current challenges. To achieve this aim, the following objectives are set: (1) to systematise the history of the market's emergence; (2) to characterise the regulatory framework and issuance

standards; (3) to conduct an analysis of quantitative market indicators for the period 2007-2024; (4) to identify barriers to development and promising directions for growth.

Research methodology. The study is built on a combined methodological approach combining qualitative and quantitative analysis. The systemic approach serves as the methodological foundation, allowing the green bond market to be viewed as an integral ecosystem of interconnected elements: issuers, investors, regulators, and verifiers.

The empirical base of the study is drawn from several categories of sources. The primary sources of statistical data are reports from the Climate Bonds Initiative (CBI) - the leading independent analytical centre in the field of green finance, which publishes quarterly and annual market reviews. Additional data are drawn from the International Monetary Fund (IMF Working Paper WP/2024/120), the International Finance Corporation (IFC Emerging Market Green Bonds Reports 2023 and 2024), the World Bank, and the World Bank Group. The academic base includes publications in peer-reviewed journals of Springer Nature, Wiley Online Library, ScienceDirect, and PMC for the period 2019–2025.

The following methods are applied in the study: (1) the historical-genetic method - to examine the evolution of the market; (2) comparative analysis - to compare the regulatory regimes of different jurisdictions; (3) statistical time-series analysis - to identify trends in issuance volumes; (4) bibliometric analysis - to map the academic discourse in this field; (5) content analysis of normative documents - ICMA Green Bond Principles, EU Green Bond Standard, and Climate Bonds Initiative standards.

The temporal horizon of the study covers the period from 2007 to 2024 inclusive. The geographical scope is global, with a focus on leading jurisdictions: the European Union, the United States, China, and the largest emerging markets.

Literature Review. The academic study of green bonds as an independent research direction is relatively recent. According to a bibliometric analysis conducted by Azad et al. (2026) in the journal Business Strategy and the Environment, the first scholarly publications on this topic appeared in 2014, with a sharp surge in research interest following the adoption of the Paris Agreement in 2015: publication activity in the field of green bonds experienced a dramatic surge after 2015, driven by key policy milestones - the European Green Deal and growing investor attention to climate risks.

A systematic review by Springer Nature (2025), covering 80 published studies and working papers as of March 2025, identifies three central themes in the academic discourse on green debt: (i) sustainability premiums (greenium), (ii) stock market responses to green bond issuance, and (iii) improvements in issuers' ESG performance. The review also notes the emergence of new studies questioning whether green bonds truly finance new projects (Lam & Wurgler, 2024) and whether they meaningfully reduce emissions (Aswani & Rajgopal, 2024).

A significant body of literature is devoted to the phenomenon of the "green premium" – the systematic yield gap between green bonds and conventional bonds. The seminal work in this area is the study by Zerbib (2019), which established the existence of a small but statistically significant negative yield premium for green bonds. Subsequent studies - Gianfrate & Peri (2019), Su & Lin (2022), and research based on Chinese bond market data for 2016-2023 (ScienceDirect, 2024) - confirmed that green bonds carry lower financing costs compared to

conventional counterparts, although the magnitude of the premium varies significantly depending on jurisdiction and issuer type.

A prominent place in the literature is occupied by the problem of greenwashing. Research indicates that the absence of universal standards creates a risk of the green label being used without genuine environmental effect. Work by Bhagat & Yoon (2023) examines the market's response to green bond issuance announcements, pointing to the heterogeneity of market signals. A study of the Vietnamese market (Heliyon, 2024), employing a fuzzy multi-criteria decision-making methodology, found that regulatory uncertainty, information asymmetry, and limited expert capacity are the main barriers to green bond issuance in developing markets.

From the perspective of impact on corporate behaviour, research published in ScienceDirect (2025) demonstrates that green bond issuance acts as a signalling mechanism that incentivises green innovation in companies: green bonds as a financial instrument can significantly incentivise enterprises to pursue green innovation by channelling capital towards green projects through market mechanisms. The study by Flammer (2020) established that corporate green bond issuance is accompanied by improvements in companies' environmental performance and a positive response from the stock market.

The role of the institutional environment is studied in a Springer Nature (2025) paper examining the influence of institutional quality on green bond market development using US data for the period 2009-2021. The authors establish that higher institutional quality strengthens the relationship between the green economy and green bond market development. At the level of supranational organizations, key contributions come from IMF research: Working Paper WP/2024/120 analyses sovereign green bonds as a catalyst for sustainable debt market development.

Analysis And Results. The green bond market traces its history to 5 July 2007, when the European Investment Bank (EIB) issued the world's first green bond - the "Climate Awareness Bond" with a volume of EUR 600 million. This innovation was conceptually developed by the EIB team under the leadership of Aldo Romani: the idea was to allocate the funds raised exclusively to projects with a positive climate impact, while simultaneously allowing investors to monitor how the funds are used (EIB, 2022). The primary buyers of the first issuances were Scandinavian pension funds seeking instruments for climate-oriented investment.

In November 2008, the World Bank became the first institution to issue a bond with the official "green bond" label - in the format of a conventional "plain vanilla" structure. The impetus for this issuance came from a request by a group of Swedish pension funds who approached the World Bank to create an instrument linking investments to climate projects. This laid the conceptual foundation of the market: the "use of proceeds" principle, external auditing, monitoring, and impact verification.

The period 2013-2015 was marked by the market's transition to a qualitatively new level. In 2013, the International Finance Corporation (IFC) issued the first-ever green bonds in the format of US dollar benchmark bonds worth USD 1 billion each, setting a precedent for corporate issuers. In 2014, the International Capital Market Association (ICMA) published the Green Bond Principles (GBP) - the first voluntary set of issuance principles establishing standards for transparency and verification. In 2015, annual market volume exceeded USD 40 billion for the first time, and the Paris Agreement created a powerful political stimulus for further growth.

In 2016, Poland became the first sovereign state to issue green bonds, thereby opening a new market segment. In the same year, Apple became the first technology company to issue green bonds. In November 2017, the global market crossed the threshold of USD 100 billion in annual issuance. The period 2018-2021 was characterised by exponential growth: hundreds of corporate, municipal, and sovereign issuers joined the market, and annual issuance volumes reached a peak in 2021.

The green bond market operates within two main regulatory paradigms: voluntary and normative. The primary voluntary standard is the ICMA Green Bond Principles (GBP), which establish four key components: (1) use of proceeds; (2) project evaluation and selection processes; (3) management of the raised funds; and (4) reporting. Climate Bonds Initiative standards play a similar role in terms of taxonomy and criteria, specifying requirements for particular sectors in greater detail.

In 2024, the European Green Bond Standard (EU GBS, Regulation (EU) 2023/2631) entered into force, becoming the first legally binding regulatory act in this field. The Standard requires issuers to align the use of proceeds with the EU Taxonomy - a classification system for sustainable economic activities – as well as to engage an external verifier accredited by ESMA. In April 2025, the European Investment Bank issued the first large-scale green bond fully compliant with EU GBS, worth EUR 3 billion, which set a landmark precedent for the market.

In parallel, the sovereign segment is developing actively: by 2024, the number of sovereign green bond issuers reached 57, and the total volume of sovereign issuances exceeded USD 540 billion. Among the leaders are France (approximately EUR 70 billion), Germany, the United States, and Japan, which in 2024 developed its own Japan Climate Transition Bond Framework.

According to Climate Bonds Initiative data, the global volume of green bond issuance in 2024 amounted to USD 671.7 billion, an increase of 9% compared to 2023. This gives green bonds approximately two-thirds of the total volume of the sustainable debt instruments market (GSS+), which in 2024 exceeded USD 1 trillion in annual issuance for the first time. The cumulative volume of green bond issuance since the market's inception in 2007 exceeded USD 3.4 trillion by 2024.

The geographical distribution of issuance remains concentrated: Europe is the largest regional market with a share of 58% (USD 388.4 billion out of USD 671.7 billion in 2024). The Asia-Pacific region occupies second place (26%), and North America third (16%). By individual country, the United States (USD 49 billion), Germany (USD 47 billion), and France (USD 41 billion) rank among the three largest national issuers. China maintains a leading position by number of issuances, although its share of global volume has declined due to the slowdown in economic recovery.

The sectoral structure of issuance reflects a concentration of funds in the energy, transport, and construction sectors, which together account for more than 75% of placements. CBI analysts note severe underinvestment (less than 5% of total volume) in the waste management and agriculture sectors, despite their considerable potential for emission reduction. In terms of currency structure, the euro (39% of 2024 issuance) and the US dollar (30%) dominate, collectively covering approximately 70% of the market.

An important trend of 2024 was the growth in the number of issuances with external verification: the number of Second Party Opinions (SPO) increased by 10%, reflecting heightened investor demands for the quality of green labels and a reduction in greenwashing

risks. The number of green bond issuances in 2024 totalled 3,242, an increase of 7.5% year-on-year, though still below the peak level of 2021.

Emerging markets (EM) remain significantly underrepresented in the global green bond market. According to IFC (2025) data, the share of emerging markets in the total GSS+ bond volume is only approximately 16%, despite the fact that they bear the greatest burden of climate consequences and require large-scale investment in green infrastructure. Nevertheless, from 2018 to 2024, the annual volume of GSS+ bond issuance in emerging markets grew sixfold, reaching a cumulative total of approximately USD 800 billion over the period.

Among emerging economies, Chile stands out (USD 48 billion in total issuance by end-2024), followed by Thailand (USD 13.8 billion) and Mexico (USD 13.3 billion). Issuance in emerging markets has historically been denominated primarily in hard currencies - the dollar and the euro - but in recent years there has been growth in local-currency placements, particularly in the SLB segment. According to IFC and Amundi forecasts, a recovery in issuance growth rates for emerging markets outside China is expected at 10-14% in the medium term.

Despite impressive dynamics, the green bond market faces a number of structural constraints. The first and most debated is the problem of greenwashing - the formal assignment of a green label without ensuring genuine environmental impact. As noted in the research literature, the extensive criticism surrounding green bonds stems from the lack of uniform rules governing their issuance. The introduction of EU GBS is intended to reduce this risk in the European segment, but globally, standards remain fragmented.

The second significant barrier is the “additionality” of investments: a number of academic studies (Lam & Wurgler, 2024) indicate that green bonds often refinance already ongoing projects rather than financing new ones. The third problem relates to high transaction costs of issuance: expenses for verification, certification, and reporting create a disproportionately high burden for smaller issuers, limiting access to the market for small and medium-sized enterprises. In developing markets, additional barriers include weak institutional environments, a shortage of qualified personnel in the field of sustainable finance, and limited local investor demand.

Conclusion. The green bond market has undergone a remarkable development journey in less than two decades: from the single experimental EIB issuance of EUR 600 million in 2007 to a global market with cumulative volume exceeding USD 3.4 trillion and annual issuance of USD 671.7 billion in 2024. This process has been made possible through the synergy of several factors: the growing climate consensus and the adoption of the Paris Agreement, the formation of voluntary standards (GBP, CBI), the gradual evolution of the regulatory framework (EU GBS), and the diversification of the issuer base from supranational institutions to corporations and sovereign governments.

The analysis shows that green bonds are not a homogeneous asset class: they are significantly differentiated by issuer type, geography, currency structure, and sectoral orientation. The dominance of Europe (approximately 58% of global issuance) and the concentration in the energy, transport, and construction sectors point to the continuing potential for diversification. The participation of emerging markets, despite a sixfold increase over 2018-2024, remains disproportionately low relative to their climate needs and investment deficits.

The market faces key challenges: the problem of greenwashing, questions of investment additionality, high transaction costs, and the fragmentation of standards. The introduction of EU

GBS and the growth in the number of external verifications create the preconditions for raising quality standards, but their global convergence remains a long-term goal.

Looking ahead, the green bond market will be shaped by three main trends: (1) the further tightening of regulatory requirements and standardisation of reporting based on EU GBS and ISSB; (2) the expansion of emerging market participation - subject to targeted support from international financial institutions; (3) innovations in instrument structuring - including transition bonds linked to the climate targets of high-emission sectors. The achievement of USD 1 trillion in annual green bond issuance, projected by the Climate Bonds Initiative for 2024, may represent a symbolic milestone signifying the transition of green bonds from a niche instrument to a fully-fledged mainstream segment of the global debt capital market.

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