



MANAGING THE GREEN TRANSFORMATION OF LOGISTICS SYSTEMS THROUGH SUSTAINABLE FINANCE

Jurgita Martinkienė¹, Angele Lileikiene¹, Viktoriia Khaustova², Nataliia Trushkina², Olena Tur²

¹*Lithuania Business College*, ²*Research Center for Industrial Problems of Development of the NAS of Ukraine*

Abstract

The green transformation of logistics systems requires not only the introduction of low-carbon technologies, digital solutions, and circular economy principles, but also the coordination of financial, technological, and managerial decisions within an integrated system. The aim of this study is to develop an integrated management framework for sustainable finance supporting the green transformation of logistics systems in the European context. The methodological basis combines a structured search of scientific publications in Scopus, critical thematic analysis, examination of EU strategic, regulatory, and analytical documents, functional systematization of sustainable finance instruments, and conceptual synthesis of the findings. Five interrelated research approaches are identified: the finance–decarbonization approach; the ecosystem approach to sustainable supply chain finance and ESG; the resource–innovation and organizational–technological approach; the institutional–managerial and stakeholder approach; and the risk–resilience and integration approach. The study shows that current research provides substantial insights into individual aspects of green finance, green logistics, digitalization, ESG, and risk management, but does not yet offer a coherent management architecture linking financing with transformation targets, technological solutions, risks, and expected outcomes. Sustainable finance instruments are systematized according to their functional role in mobilizing long-term capital, financing technological and infrastructure modernization, reducing and sharing risks, supporting performance, and extending financial incentives across the supply chain. The principle of functional alignment is substantiated, according to which the financing structure should be determined with regard to the type of logistics asset, the scale of CAPEX, the payback period, projected cash flows, technological maturity, expected ESG effects, and the project risk profile. The key management mechanisms for integrating finance and green transformation are identified as strategic priority setting, project selection and assessment, financial structuring, stakeholder coordination, digital monitoring and ESG control, as well as risk, innovation, and digitalization management. On this basis, the Integrated Management Framework for Sustainable Finance and the Green Transformation of Logistics Systems is proposed. It combines the institutional and regulatory environment, sustainable finance instruments, management mechanisms, ESG criteria and risk management, green and digital transformation pathways, and transformation outcomes. An important element of the framework is the monitoring, learning and feedback mechanism, which enables the results achieved to be used to adjust investment priorities, the financing structure, and subsequent management decisions. The scientific novelty of the study lies in the shift from a fragmented analysis of individual financial and logistics instruments to a functional and managerial approach in which sustainable finance is considered an integral part of managing the trajectory of green transformation. The practical value of the proposed framework lies in its potential use by logistics companies to develop portfolios of transformation projects and select appropriate financing configurations; by financial institutions and investors to align capital allocation with technological maturity, ESG effects, and risks; and by public authorities to combine grant, guarantee, and private resources with priorities for the development of transport and logistics infrastructure.

KEY WORDS: sustainable finance, green logistics, green transformation, logistics systems, integrated management framework, ESG, circular economy.

JEL Classification: G32; L91; M10; Q56.

Introduction

The green transformation of logistics systems is increasingly moving beyond the greening of individual transport or warehousing operations. It involves changes in the principles of managing logistics infrastructure, flows, technologies, investments, and risks. For businesses and public institutions, the key challenge is not only to select environmentally sustainable technologies, but also to identify appropriate sources of financing, implementation mechanisms, and criteria for assessing performance. It is the interdependence of financial, technological, and managerial decisions that defines the contemporary transition towards low-carbon and resource-efficient logistics systems.

The scale of this challenge is particularly evident in the European Union. In 2023, transport, including international aviation and maritime transport, accounted for around 31% of total greenhouse gas emissions in the EU-27, while road transport was responsible for 72.9%

of transport emissions (European Environment Agency, 2025). These figures cannot be directly equated with emissions from the logistics sector, but they reflect the carbon intensity of the transport base on which modern logistics systems depend. According to the Sustainable and Smart Mobility Strategy, the EU aims to reduce greenhouse gas emissions from transport by 90% by 2050. This objective is associated with the decarbonization of freight transport, the development of multimodality, digitalization, infrastructure modernization, and the mobilization of public and private investment (European Commission, 2020).

At the same time, the financing base for green transformation is expanding. According to the Climate Bonds Initiative, by the end of 2024, the cumulative volume of green, social, sustainability, and sustainability-linked debt instruments aligned with the Climate Bonds methodology had reached USD 5.7 trillion. In 2024 alone, approximately USD 1.05 trillion of such instruments were issued through 10,331 deals, representing a 31% increase compared with the previous

year (Climate Bonds Initiative, 2025). This indicates the gradual integration of sustainability criteria into capital allocation mechanisms. However, the scale of the sustainable finance market alone does not guarantee an effective transformation of logistics systems. What becomes decisive is the extent to which the characteristics of a financial instrument correspond to the type of logistics asset, the technological solution, the investment horizon, the risk profile, and the expected environmental and economic outcomes.

Scientific research confirms the need to consider the financial and logistics dimensions in close interrelation. Starostka-Patyk et al. (2024) proposed the Green Logistics Performance Index, which combines indicators of logistics and environmental performance and enables comparison of development trajectories across EU countries. Using panel data for 26 EU countries, Ozekenci and Nur (2025) found that green logistics and green finance contribute to reducing transport-related CO₂ emissions, confirming their complementary role in the decarbonization process. Dai et al. (2025), in turn, showed that the integration of green finance and the logistics industry has a positive effect on the green transformation of logistics, although this effect is nonlinear and characterized by substantial regional heterogeneity.

At the same time, the existing findings do not provide a comprehensive explanation of how financial resources should be integrated into the management system of green logistics transformation. Research on sustainable finance, green logistics, ESG, digitalization, decarbonization, and risk management has largely developed as separate streams. Financial instruments are often examined from the perspective of capital mobilization and environmental impact, while technological and logistics studies tend to focus on operational efficiency and emissions reduction. As a result, the management architecture linking financing, strategic management, green and digital technologies, ESG criteria, risks, and expected transformation outcomes remains less developed. In the European context, this challenge is further intensified by the need to take into account both common EU decarbonization and regulatory priorities and significant differences in the financial, technological, and infrastructure capacities of individual countries and regions.

The scientific contribution of this study lies in moving from a fragmented consideration of financial, managerial, technological, and environmental components towards their systematic integration within an Integrated Management Framework. Unlike approaches in which sustainable finance is viewed mainly as a source of capital for individual green projects, this study proposes treating it as an integral element in managing the trajectory of the green transformation of logistics systems. The practical value of this approach lies in the possibility of aligning financial decisions with technological priorities, management capabilities, risks, and expected economic and environmental outcomes.

The aim of the study is to develop an integrated management framework for sustainable finance

supporting the green transformation of logistics systems in the European context. The framework combines sustainable finance instruments, management mechanisms, green and digital technologies, ESG criteria, risk management, and transformation outcomes. To achieve this aim, the following research questions are formulated:

RQ1. Which groups of sustainable finance instruments and which of their functions are most relevant to supporting the key areas of the green transformation of logistics systems?

RQ2. How can sustainable finance instruments be aligned with management mechanisms, green and digital technologies, ESG criteria, and the risk management system?

RQ3. What should be the structure and logic of relationships among the components of an integrated management framework for supporting the green transformation of logistics systems, taking into account the institutional characteristics of the European context?

Literature Review

The theoretical foundations of contemporary sustainable finance have developed at the intersection of the economics of externalities, the institutional approach, and the concept of sustainable development. The idea of correcting negative environmental externalities through economic instruments, together with the need to align the interests of economic actors through institutional mechanisms, created the basis for the gradual incorporation of environmental criteria into investment and financial decision-making (Pigou, 2013; Coase, 1960). In its contemporary interpretation, sustainable finance is no longer limited to financing individual environmental measures. It is increasingly viewed as a mechanism for directing capital towards low-carbon technologies, infrastructure modernization, changes in production and consumption patterns, and the structural transformation of economic systems.

The further development of this discussion makes it possible to distinguish a finance–decarbonization approach, within which green finance and green logistics are considered interrelated drivers of reduced environmental pressure. For EU countries, the development of green finance and green logistics practices has been associated with lower transport-related CO₂ emissions (Ozekenci & Nur, 2025). At the regional level, the integration of green finance and the logistics industry also has a positive impact on the green transformation of logistics; however, this relationship is nonlinear and depends on the level of regional development, the state of infrastructure, and the availability of financial resources (Dai et al., 2025). Global evidence further shows that the effects of supply chain logistics and green transportation are shaped by the financial environment, fluctuations in energy prices, and geopolitical risk (Kartal & Taşkın, 2026). The main strength of this approach lies in its ability to quantify the environmental outcomes of financial–logistics interactions. Its limitation is different: macroeconomic and regional models provide fairly convincing evidence as to whether green finance and green logistics contribute to decarbonization, but they explain much less clearly how

financial resources are transformed into managerial, technological, and infrastructure decisions.

The next stream can be defined as the ecosystem approach to sustainable supply chain finance and ESG. Unlike the previous approach, it shifts the focus from the macro level to the interaction among individual firms, financial institutions, and other participants in the supply chain. The systematization of research on supply chain finance, ESG, and value chains shows that financial decisions are increasingly viewed as part of value chain management rather than merely as a means of covering working capital shortages (Agrawal et al., 2024). A case-based approach to sustainable supply chain finance indicates that outcomes depend on the combination of financial incentives, digital technologies, and coordination among network participants (Zhou & Masi, 2025). Empirical studies also confirm the relationship between SCF and ESG: participation in supply chain finance can improve ESG performance by easing financial constraints and strengthening operational control (Wang et al., 2025), while supply chain synergy can serve as a channel for transmitting ESG effects across supply chain participants (Tian & Ye, 2026). A key strength of this approach is its attention to interorganizational relationships and the behavior of specific economic actors. At the same time, most such models remain focused on buyer–supplier relationships, working capital, access to finance, and ESG performance. As a result, long-term investment financing of transport, warehousing, energy, and digital logistics infrastructure is still insufficiently integrated into SSCF concepts.

A logical continuation of the ecosystem approach is the resource–innovation and organizational–technological approach. Within this perspective, financial resources are viewed not as an end result, but as one of the prerequisites for developing the technological and organizational capabilities of a firm. Research on the interaction among green finance, green logistics, and green technology confirms that the technological component can act as a mediating mechanism between financing, logistics practices, and green innovation (Wang et al., 2024). The development of digital supply chain finance extends this logic: digital platforms can reduce information asymmetry, ease financial constraints, improve disclosure, and support ESG performance (Gong et al., 2026). Blockchain performs a similar function by enhancing transparency, traceability, and interorganizational coordination, thereby strengthening the relationship among supply chain finance, green innovation, and ESG (Sun, 2026).

At the same time, technological solutions alone do not guarantee environmental performance. Tetteh et al. (2026) show that sustainable logistics practices generate results through a combination of operational, organizational, and human factors. Green transportation, sustainable waste management, green distribution and packaging, and green logistics information sharing can affect environmental performance both directly and through green competitive advantage, whereas the effect of green warehousing is mainly indirect. It is also important that green human resource management and energy efficiency alter the strength of particular relationships. Thus, the effectiveness of green transformation depends not only on technological

modernization, but also on the ability of firms to develop appropriate competencies, human resource practices, and resource capabilities. The strength of this approach lies in identifying the specific channels through which financial resources can be translated into technological and organizational change. At the same time, digitalization, green innovation, and individual green logistics practices are often examined as separate drivers, mediators, or moderators, while their alignment with financial instruments, corporate strategy, risk management, and regulatory requirements remains less developed.

This gap leads to the institutional–managerial and stakeholder approach. Its starting point is that the green transformation of logistics is shaped not only by financial resources and technological capabilities, but also by the quality of the regulatory environment, organizational capacity for change, transparency, coordination, and the motivation of participants. The analysis of ESG barriers in the logistics sector shows that legal and compliance, institutional, and economic barriers may act as root causes of limited adaptation, while weak technological capabilities, low stakeholder engagement, or governance problems are often consequences of broader institutional constraints (Phan et al., 2025). At the level of logistics companies, it has been shown that combining green logistics practices, ESG disclosure, and government support can also have a positive impact on financial efficiency, highlighting the importance of interaction between the private and public sectors (Kim et al., 2024).

Recent studies on green logistics governance further broaden this perspective: institutional reforms can stimulate green innovation by strengthening the institutional framework and reconfiguring interorganizational networks (Zhang et al., 2026). The European dimension is particularly important for this study. Research on supply chain stakeholders in Europe shows that sustainability priorities are generally not in conflict at the regional level, but differ noticeably across stakeholder groups: infrastructure managers and academia place greater emphasis on environmental goals, operators and cargo owners focus more on economic and social aspects, while public authorities assign greater importance to governance (Castaño-Herrera et al., 2026). This means that the green transformation of logistics systems requires not only financing and technologies, but also mechanisms for reconciling different interests. A major strength of this approach is its recognition of the multi-actor nature of transformation. Its main limitation is that financing is still largely treated as one of several supporting factors rather than as a fully integrated element of the management architecture.

Another stream that has gained increasing attention in recent literature can be defined as the risk–resilience and integration approach. Its development reflects the need to account for uncertainty, supply chain disruptions, financial shocks, and possible trade-offs between environmental and economic outcomes. Studies of connectedness between supply bottlenecks and segments of green finance show that these relationships are nonlinear, asymmetric, and dependent on market conditions; consequently, the financial system responds differently to logistics shocks under different market regimes (Yao et al., 2026). At the same time, green finance does not always produce

uniformly positive outcomes. In high-carbon supply chains, environmental gains may be accompanied by short-term economic losses, crowding out of R&D, or lower resource allocation efficiency, which makes it necessary to consider environmental outcomes, economic efficiency, and resilience simultaneously (Gao et al., 2026).

In response to this complexity, integrated decision-support frameworks have emerged that simultaneously consider costs, emissions, service reliability, forecasting, transparency, and stakeholder coordination (Nagy et al., 2026). Such models bring research closer to the practical realities of managerial decision-making, but they still remain largely focused on operational optimization and selected types of risk. The full range of sustainable finance instruments, strategic management mechanisms, ESG criteria, and technological solutions is still only partially represented within a single architecture.

Overall, the development of research reflects a gradual shift from a narrow understanding of green finance as a source of financial resources towards its interpretation as part of a broader mechanism of technological, organizational, institutional, and managerial change. However, the different strands of this discussion have developed unevenly. Green finance studies provide stronger explanations of capital mobilization and allocation; green logistics research focuses more on the operational and environmental dimensions of transformation; SSCF examines the interaction of financing with buyer–supplier relationships and ESG; governance studies emphasize the role of regulation and stakeholders; digital research explores technological mechanisms of transparency, coordination, and innovation; and risk-oriented research addresses uncertainty and external shocks. The insufficient integration of these research streams remains a major conceptual gap in the current literature.

The critical review makes it possible to identify five interrelated research gaps. First, there is still limited understanding of how specific sustainable finance instruments should be aligned with different stages, assets, and pathways of the green transformation of logistics systems. Second, sustainable supply chain finance remains largely focused on working capital and interfirm relationships, while long-term financing of transport, warehousing, energy, and digital logistics infrastructure is much less integrated into these models. Third, ESG, digital technologies, green innovation, human capabilities, and risk management are often examined as separate drivers, mediators, or moderators, but are rarely brought together within a unified management architecture. Fourth, governance- and stakeholder-oriented models convincingly demonstrate the importance of institutional coordination, yet financial mechanisms generally remain a supporting rather than a fully integrated component. Fifth, even in the European context, existing studies tend to address either the macroeconomic relationship between green finance and green logistics or selected aspects of governance and stakeholder priorities, without developing a comprehensive framework that simultaneously integrates sustainable finance instruments, management

mechanisms, green and digital technologies, ESG criteria, risk management, and transformation outcomes.

Thus, further development of this research area requires a shift from the analysis of separate financial, technological, or managerial instruments towards their systematic integration. This provides the conceptual basis for an integrated management framework in which sustainable finance is treated not as an external source of resources, but as an integral component of managing the trajectory of the green transformation of logistics systems.

Methodology and Research Methods

The research methodology reflects the conceptual nature of the study and is aimed at developing an integrated management framework for sustainable finance supporting the green transformation of logistics systems. The research design combines a structured review of the scientific literature, analysis of strategic and regulatory documents, thematic systematization of research approaches, grouping of sustainable finance instruments according to their functional purpose, and synthesis of the results obtained. This sequence makes it possible to consider financial, technological, managerial, and environmental components not in isolation, but as interrelated elements of the green transformation of logistics systems.

At the first stage, the scientific and information base of the study was developed. Relevant publications were searched in the Scopus database across four thematic areas: the relationship between sustainable/green finance and green and sustainable logistics; the integration of sustainable finance with logistics and supply chains; sustainable supply chain finance, green supply chain finance, and ESG; and green/sustainable logistics in the context of management frameworks, integrated management, governance, and strategic management. The main time horizon covered 2023–2026, with priority given to publications from 2025–2026. Earlier studies were used selectively as a theoretical basis for examining the evolution of sustainable finance and the institutional foundations of environmental transformation.

The analysis included mainly English-language research articles and review papers directly related to the research topic. The main selection criteria were the examination of the impact of green finance on decarbonization and green transformation; sustainable supply chain finance mechanisms; the role of ESG and governance in logistics and supply chain systems; the use of green and digital technologies; financial and non-financial risks; stakeholder interaction; management models; and integrated frameworks. Publications in which green finance or logistics were mentioned only marginally and had no direct relevance to the logic of the study were excluded from further analysis.

At the second stage, a critical thematic analysis of the selected literature was conducted. The studies were systematized into five conceptual approaches: the finance–decarbonization approach; the ecosystem approach to sustainable supply chain finance and ESG; the resource–innovation and organizational–technological approach; the institutional–managerial and stakeholder approach; and the risk–resilience and integration approach. For each approach, its content, main focus, strengths, and limitations

were identified. This made it possible not only to summarize current research directions, but also to identify issues that remain insufficiently explored.

At the third stage, strategic, regulatory, and analytical documents were examined. The information base for this stage included materials from the European Commission, the European Environment Agency, the Climate Bonds Initiative, and other international institutions relevant to the European context of transport decarbonization, sustainable finance development, and the green modernization of infrastructure. Their analysis made it possible to relate the findings of the scientific literature to current institutional and regulatory priorities of the European Union.

At the fourth stage, a functional systematization of sustainable finance instruments was carried out. The instruments were analysed not only by their form of financing, but also by their role in the green transformation process: mobilizing long-term capital; financing technological and infrastructure modernization; reducing and sharing investment risks; encouraging ESG-oriented decisions; and supporting innovative and digital technologies. This approach makes it possible to move beyond a simple list of green bonds, green loans, guarantees, or sustainability-linked instruments and to determine their place and functions within the management system of the green transformation of logistics.

At the final stage, the findings were conceptually synthesized. The analysis covered the relationships among institutional conditions, sustainable finance instruments, management mechanisms, green and digital technologies, risks, and expected transformation outcomes. On this basis, the Integrated Management Framework was developed.

The logic of the proposed framework is based on the alignment between financial instruments, financing objects, management mechanisms, technological solutions, risks, and expected economic and environmental outcomes. At the same time, the framework is conceptual in nature and is not intended to serve as a universal causal model statistically validated for all European countries. Its purpose is to systematize the main relationships and provide a basis for subsequent empirical testing.

To strengthen the validity of the conclusions, the results of the scientific literature analysis were compared with EU strategic and regulatory documents and analytical materials from international organizations. This made it possible to assess the extent to which the developed propositions correspond to current trends in sustainable finance, green logistics, and European decarbonization policy.

The overall sequence of the study, the methodological procedures applied, and the main results of each stage are summarized in Table 1.

Specialized software for bibliometric analysis was not used, as the study did not involve the construction of citation networks, co-authorship maps, or bibliometric mapping of the research field. Scopus was used as an information retrieval database, while the subsequent systematization and synthesis were based on the content analysis of the selected publications and documents.

Table 1. Logic of the Methodological Design of the Study

Stage	Methodological procedure	Main outcome
1	Structured search of publications in Scopus	Formation of an up-to-date body of scientific literature
2	Critical thematic analysis	Systematization of five conceptual approaches and identification of research gaps
3	Analysis of strategic and regulatory documents	Identification of the European institutional and regulatory context
4	Functional systematization	Grouping of sustainable finance instruments according to their role in the transformation process
5	Conceptual synthesis	Development of the Integrated Management Framework

Source: compiled by the authors.

Thus, the selected methodology provides a consistent transition from the analysis of current scientific research and the European regulatory context to the systematization of financial and management instruments. The results obtained provide a methodological basis for developing and substantiating the Integrated Management Framework presented in the following section.

Results and Discussion

The results of the study show that financing the green transformation of logistics systems is not simply a matter of expanding the range of available financial instruments. What is crucial is their alignment with the characteristics of a specific transformation project. Logistics assets differ substantially in terms of capital intensity, payback periods, technological maturity, cash flow structure, expected environmental effects, and risk levels. Therefore, a financing structure suitable for the modernization of a warehouse or vehicle fleet cannot automatically be applied to an intermodal terminal, charging/refuelling infrastructure, a large-scale digital platform, or supply chain transformation.

The European institutional environment provides a basis for such a differentiated approach. The EU Taxonomy establishes criteria for identifying environmentally sustainable economic activities; the European Green Bond Standard regulates the use of the European Green Bond designation and the related disclosure requirements; the Connecting Europe Facility and InvestEU provide mechanisms to support investment, while the Alternative Fuels Infrastructure Regulation sets requirements for the development of alternative fuels infrastructure. The Corporate Sustainability Reporting Directive, in turn, strengthens the importance of reliable ESG information for assessing investment decisions and transformation outcomes (European Parliament and Council, 2020; 2021a; 2021b; 2022; 2023a; 2023b). CEF Transport has a budget of approximately EUR 25.8 billion for 2021–2027 and supports, among other areas, the development of TEN-T, cross-border connections, innovation, energy efficiency,

and the reduction of the environmental impact of transport (European Commission, 2021b).

The research findings are presented in line with the three research questions formulated in the study. First, the functional role of sustainable finance instruments is identified; second, the management mechanisms for their integration are examined; and finally, these components are combined within the Integrated Management Framework.

Alignment

In response to RQ1, sustainable finance instruments were systematized not only by their form of financing, but primarily by the functions they can perform in the green transformation of logistics systems. This approach changes the logic of selection: from identifying an available source of funds to determining the financial solution that best matches the type of asset, the investment horizon, the expected ESG effect, and the risk profile. The main groups of instruments, their functional purpose, potential areas of application, and key management conditions are summarized in Table 2.

Sustainable Finance Instruments and Functional

Table 2. Sustainable Finance Instruments for the Green Transformation of Logistics Systems

Group of instruments	Main instruments	Function in the transformation process	Potential areas of application in logistics	Key management conditions
Targeted debt instruments	Green bonds, European Green Bonds, sustainability bonds	Mobilization of long-term capital for environmentally oriented assets and projects	Intermodal terminals, energy-efficient warehouses, charging infrastructure, modernization of transport assets	Compliance with eligibility criteria, transparent use of proceeds, verification of environmental effects
Performance-linked financing	Sustainability-linked bonds, sustainability-linked loans	Linking financing terms to the achievement of defined sustainability targets	Emissions reduction, improved energy efficiency, fleet renewal, ESG programmes	Well-defined KPIs and baseline, regular monitoring, reliability of reported results
Bank and leasing finance	Green loans, investment loans, green leasing	Financing of specific assets and technological modernization	Low-carbon transport, warehouse equipment, energy installations, digital systems	Creditworthiness, predictability of cash flows, alignment of the financing term with the asset life cycle
Public and EU financing	Grants, CEF, AFIF, other targeted EU programmes	Support for infrastructure projects with high initial costs and significant public benefits	TEN-T, multimodal hubs, railways, ports, charging/refuelling infrastructure, digitalization	Alignment with programme priorities, co-financing, transparency of project selection and implementation
Risk-sharing and blended finance instruments	Guarantees, InvestEU-supported instruments, public-private risk sharing, insurance	Risk reduction and enhancement of project investment attractiveness	New technologies, alternative fuels, innovative infrastructure, projects with long payback periods	Sound risk allocation, additionality of public support, control of financial commitments
Sustainable supply chain finance	Sustainable SCF, digital SCF, ESG-linked supplier finance	Extension of financial incentives for green transformation across supply chain participants	Supplier decarbonization, sustainable packaging, reverse logistics, traceability	Quality of ESG data, information interoperability, accessibility for SMEs
Investment funds and equity instruments	Green investment funds, infrastructure funds, private equity	Scaling up innovative technologies and new business models	Green logistics start-ups, digital platforms, circular logistics, innovative infrastructure	Investment readiness, a viable business model, risk control, and an exit strategy

Source: proposed and compiled by the authors based on (European Commission, 2021a; 2021b; European Parliament and Council, 2020; 2021a; 2021b; 2023a; 2023b; Climate Bonds Initiative, 2025; Zhou & Masi, 2025).

As shown in Table 2, the different groups of financial instruments perform different functions and therefore cannot be considered interchangeable. Targeted debt instruments are primarily intended to mobilize long-term capital; loans and leasing are more suitable for financing specific assets; and public and blended finance can support infrastructure or innovation projects with significant positive externalities or higher

levels of risk. Sustainable supply chain finance has a different functional focus, as it enables transformation incentives to extend beyond an individual company to suppliers and other participants in the value chain.

This finding broadens the existing understanding of SSCF. Zhou and Masi (2025) emphasize the role of digital technologies, financial incentives, and stakeholder engagement in sustainable supply chain finance, while

Agrawal et al. (2024) link SCF, ESG, and value chain management. The proposed systematization complements these approaches by incorporating long-term investment financing for logistics infrastructure, public and EU funding, and risk-sharing mechanisms, thereby extending beyond the predominant focus on interfirm relationships and working capital financing.

On this basis, the principle of functional alignment is formulated: the financing structure should be

determined after assessing the transformation object, required CAPEX, payback period, projected cash flows, technological maturity, ESG effects, alignment with the EU Taxonomy, and the level of risk. The relationship among these components is presented in Figure 1.

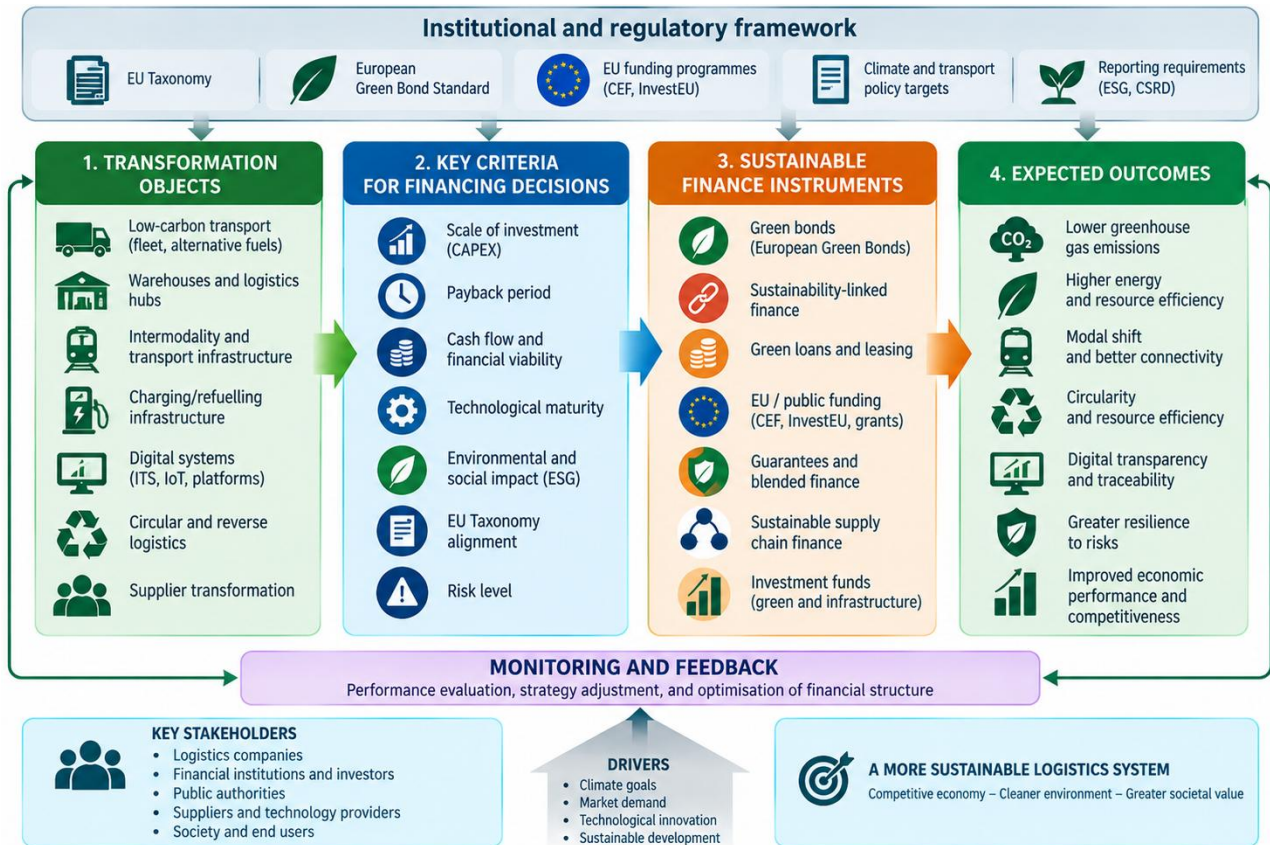


Figure 1. Functional alignment of financing with the green transformation of logistics systems

Source: developed by the authors based on the results of their own research (Dzwigol et al., 2021; Khaustova et al., 2022; Liashenko, Khaustova and Trushkina, 2022; Lileikiene et al., 2024; Ovchynnykova, Martinkienė and Navickas, 2024).

As shown in Figure 1, a separate set of financial decision-making criteria is positioned between the object of green transformation and the choice of a financial instrument. Financing is selected not simply because an instrument falls within the “green” category, but according to the economic, technological, environmental, and risk characteristics of the project. The institutional and regulatory environment defines the external conditions for this choice, while the involvement of key stakeholders and the influence of external factors shape the practical possibilities for its implementation.

Monitoring and feedback play a separate role in Figure 1. The assessment of achieved results makes it possible to review the financing structure, adjust investment priorities, and refine subsequent decisions. Thus, Figure 1 is not merely a classification scheme, but a model for substantiating financial decisions within

the green transformation of a logistics system.

This approach is consistent with the current logic of transition finance in the EU, according to which the financial system should support not only activities that already meet sustainability criteria, but also credible transition pathways for companies and assets moving towards more sustainable models of operation (European Commission, 2020; 2021a).

Management Mechanisms for Integrating Finance and Logistics Transformation

Matching a financial instrument to the characteristics of a project is a necessary, but not sufficient, condition for an effective transformation. This defines the logic of RQ2: the financial decision should be embedded in a system of strategic planning, project selection, stakeholder coordination, performance monitoring,

innovation management, and risk management.

Empirical studies confirm that the outcomes of green finance depend on the environment in which it is applied. For 26 EU countries, Ozekenci and Nur (2025) identified a relationship between green finance and green logistics and the reduction of transport-related CO₂ emissions. Dai et al. (2025) found a positive but nonlinear effect of the integration of green finance and the logistics industry on the green transformation of logistics, together with substantial regional heterogeneity in this effect. Thus, the availability of financial resources alone does not determine the outcome; what matters is the conditions under which these resources are translated into technological, organizational, and infrastructure changes.

This is also supported by firm-level studies. Wang et al. (2024) identified an interrelationship among green logistics, green finance, and green technology in fostering green innovation. Tetteh et al. (2026), in turn, showed that environmental performance depends not only on the implementation of sustainable logistics practices, but also on green competitive advantage, energy efficiency, and green human resource management. Therefore, financing should be considered together with the managerial, technological, and human resource capabilities of the firm.

The main mechanisms of such integration are systematized in Table 3.

Table 3. Management Mechanisms for Integrating Sustainable Finance and the Green Transformation of Logistic System

Management mechanism	Main content	Key participants	Expected outcome
Strategic priority setting	Definition of transformation goals, selection of priority assets, and sequencing of investments	Logistics companies, public authorities, infrastructure managers	Alignment of investments with long-term strategy
Project selection and assessment	Assessment of technical, financial, and environmental feasibility, EU Taxonomy alignment, and ESG criteria	Companies, banks, investors, public authorities	Development of a well-founded project portfolio
Financial structuring	Selection of a financial instrument or combination of instruments, financing terms, cost of capital, co-financing arrangements, and risk-sharing mechanisms	Project owners, banks, investors, financial institutions	Financial viability and bankability
Implementation coordination	Allocation of responsibilities, procurement, stakeholder coordination, and management of timelines and resources	Project owners, suppliers, authorities, technology providers	Coordinated actions and timely implementation
Digital monitoring and ESG control	Monitoring of emissions, energy use, logistics performance, financial KPIs, and sustainability indicators	Companies, financial institutions, auditors, regulators	Transparency in the use of funds and verification of results
Risk management and adjustment	Identification of financial, technological, regulatory, climate, logistics, and greenwashing risks; adjustment of project parameters	All key participants	Greater adaptability, reduced losses, and enhanced resilience
Innovation and digitalization management	Alignment of technological investments with the financing structure and transformation objectives	Logistics companies, technology providers, investors	Faster technological modernization and scaling of solutions

Source: proposed and compiled by the authors based on (Wang et al., 2024; Tetteh et al., 2026; Castaño-Herrera et al., 2026; Yao et al., 2026; Nagy et al., 2026).

An important element of Table 3 is stakeholder coordination. Castaño-Herrera et al. (2026) found that sustainability priorities are generally similar across European regions, but differ noticeably among stakeholder groups: infrastructure managers and the academic community place greater emphasis on environmental goals, cargo owners and operators focus more on economic and social aspects, while public authorities give greater priority to governance. Thus, even a financially viable and technologically well-founded project may face implementation challenges if the interests of its participants are not sufficiently aligned.

Equally important is continuous risk management throughout the transformation process. Yao et al. (2026) show that the relationship between supply chain bottlenecks and green finance markets is nonlinear, asymmetric, and dependent on market conditions. Gao et al. (2026) identify another dimension of the problem: positive environmental outcomes of green finance policies may be accompanied by short-term economic losses and constraints on innovation activity. Therefore, the assessment of transformation projects should take into account not only environmental performance, but also financial sustainability, innovation capacity, and resilience.

Integrated Management Framework for Sustainable Finance and Green Logistics Transformation

The functional systematization of financial instruments and the identification of management mechanisms for their application provided the basis for answering RQ3 and for developing the main conceptual outcome of the study – the Integrated Management Framework for Sustainable Finance and the Green Transformation of Logistics Systems, presented in Figure 2.

As shown in Figure 2, the Integrated Management

Framework is built around the interaction of six main components: the institutional and regulatory environment, sustainable finance instruments, management mechanisms, ESG criteria and risk management, green and digital transformation pathways, and transformation outcomes. An important element of the framework is the monitoring, learning and feedback mechanism, through which the results of implemented transformation decisions are used to refine strategic priorities, the financing structure, and subsequent management actions.

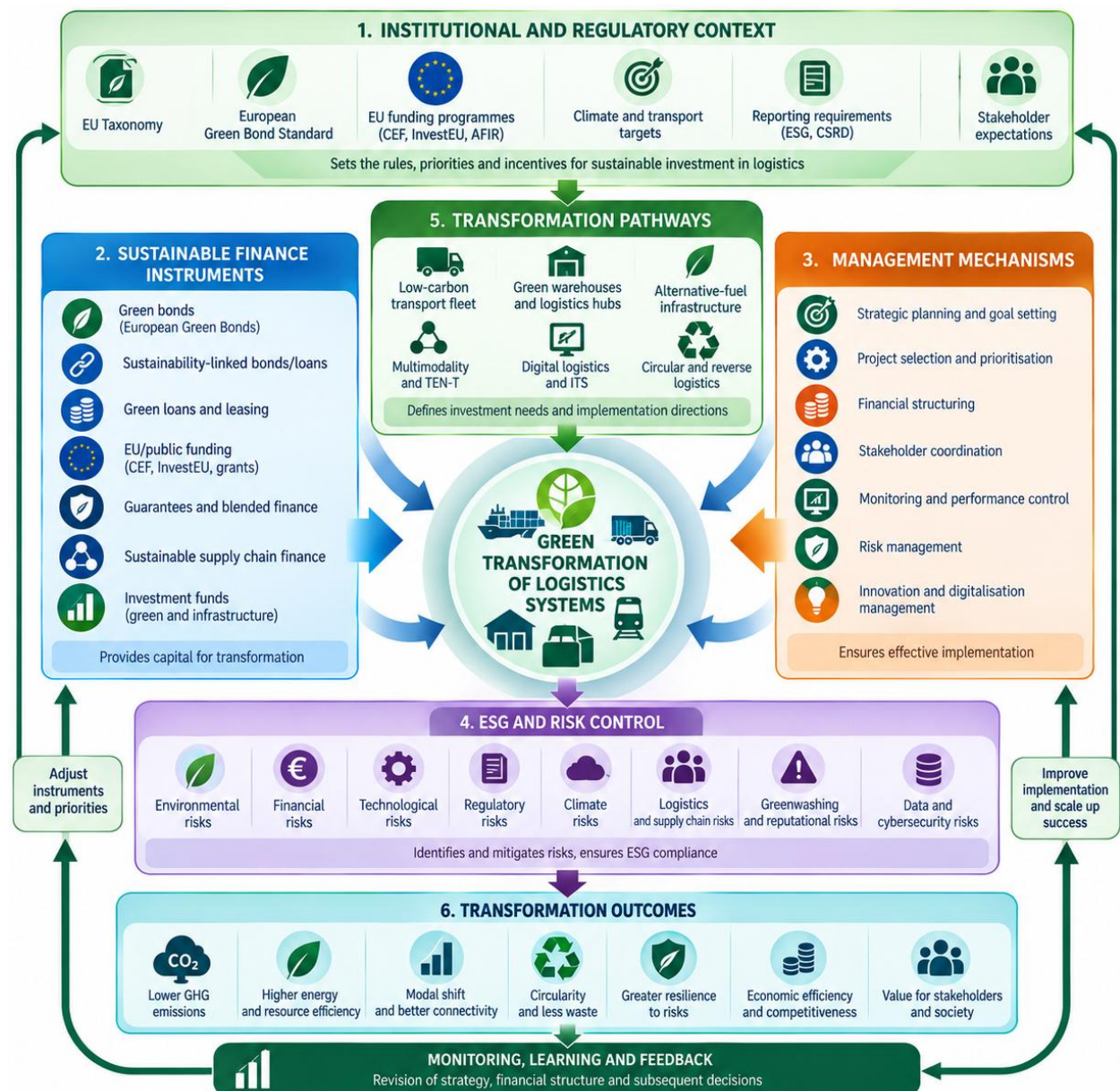


Figure 2. Integrated Management Framework for Sustainable Finance and the Green Transformation of Logistics Systems

Source: developed by the authors based on the results of their own research (Dzwigol et al., 2021; Khaustova et al., 2022; Liashenko, Khaustova & Trushkina, 2022; Lileikiene et al., 2024; Ovchynnykova, Martinkienė & Navickas, 2024).

A key feature of the proposed framework is its departure from a linear view of financing as an initial stage followed by project implementation. Sustainable finance instruments and management mechanisms interact throughout the entire transformation cycle; ESG and risk control accompany decision-making and implementation; and the results achieved provide an information base for the next cycle of planning and investment.

Within this system, the institutional and regulatory environment is not treated as an external background, but as one of the factors shaping financial and managerial decisions. The EU Taxonomy influences the assessment of the environmental eligibility of activities; the European Green Bond Standard affects the structure and disclosure requirements for relevant debt instruments; InvestEU and CEF shape opportunities for public support and the mobilization of private capital; AFIR establishes requirements for alternative-fuels infrastructure; and CSRD influences the sustainability reporting system (European Parliament and Council, 2020; 2021a; 2021b; 2022; 2023a; 2023b).

The practical operation of this combination can be illustrated by the example of alternative-fuels infrastructure. In 2025, the European Commission selected 39 projects for support under the Alternative Fuels Infrastructure Facility, with total funding of EUR 422 million. The support covered electric recharging, hydrogen refuelling, shore-side electricity, and other solutions for road, maritime, and air transport (European Commission, 2025). This demonstrates that the implementation of capital-intensive infrastructure changes may require a combination of public resources, private capital, and risk-sharing mechanisms.

For other assets, the financing configuration may differ substantially. The modernization of warehouses, vehicle fleets, or digital systems involves more clearly defined investment objects and more predictable economic benefits, creating opportunities for green loans, leasing, or sustainability-linked financing. By contrast, cross-border and intermodal projects are characterized by a larger scale, longer implementation periods, and significant public benefits, and therefore require greater use of public co-financing and infrastructure financing mechanisms. CEF Transport has a budget of approximately EUR 25.8 billion for 2021–2027 and supports TEN-T, cross-border connections, innovation, energy efficiency, and the reduction of the environmental impact of transport (European Commission, 2021).

Figures 1 and 2 perform different but complementary functions. Figure 1 presents the logic for substantiating a financing decision for a specific transformation object. Figure 2 extends this logic to the management of the transformation process as a whole by integrating financing, the institutional environment, management mechanisms, technological pathways, ESG, risks, and outcomes into a single cyclical process.

The scientific novelty of the findings lies, first, in the proposed functional and managerial approach to sustainable finance in logistics systems. Financial instruments are systematized not only by their form, but

also by their alignment with specific transformation objects, investment characteristics, technological solutions, management conditions, and risks.

Second, the Integrated Management Framework combines components that are largely examined separately in the existing literature: sustainable finance, strategic and operational management, green and digital technologies, ESG, stakeholder coordination, and risk management. In this respect, the proposed framework extends empirical findings on the interaction between green finance and logistics (Dai et al., 2025; Ozekenci & Nur, 2025) by moving from the identification of statistical relationships to the development of a management structure for transformation.

Third, the framework incorporates a monitoring, learning, and feedback mechanism through which transformation outcomes provide a basis for reviewing strategy, the financing structure, risk parameters, and subsequent investment decisions. This approach shares some features with the integrated decision-support framework proposed by Nagy et al. (2026), which combines forecasting, optimization, emissions accounting, and traceability; however, the framework developed in this study additionally integrates financial, institutional, and stakeholder dimensions.

The practical significance of the framework is evident at three levels. For logistics companies, it can be used to develop portfolios of green transformation projects and select appropriate financing structures. For financial institutions and investors, it provides a basis for aligning capital allocation with technological maturity, ESG effects, and project risk profiles. For public authorities, the framework can support the coordination of grant assistance, guarantee mechanisms, and private capital with long-term priorities for the development of transport and logistics infrastructure.

The findings provide consistent answers to the research questions posed in the study. RQ1 identifies the functional role of the main sustainable finance instruments; RQ2 systematizes the mechanisms for integrating these instruments with management, green and digital transformation, ESG, and risk management; and RQ3 develops the Integrated Management Framework, which brings these components together within a unified system for managerial decision-making, implementation, monitoring, and adjustment.

Research Limitations

The findings should be interpreted in light of several limitations. First, the Integrated Management Framework is conceptual in nature and was developed on the basis of an analysis of current scientific literature, strategic and regulatory documents, and their substantive synthesis. It has not been quantitatively validated using a sample of logistics companies or infrastructure projects. Therefore, the proposed relationships should be regarded as conceptually grounded rather than as statistically confirmed causal relationships.

The second limitation relates to the European focus of the study. Although EU countries operate within a common regulatory environment, they differ considerably in the development of financial markets, the

quality of transport infrastructure, access to capital, technological capabilities, and the pace of green and digital transformation. The practical application of the framework therefore requires the adaptation of financial and management mechanisms to national and regional conditions.

The third limitation concerns the dynamic nature of sustainable finance regulation and EU financial mechanisms. Changes in the EU Taxonomy, sustainability reporting requirements, the European Green Bond framework, CEF, InvestEU, and other instruments may affect particular parameters of the proposed framework.

Further research should focus on the empirical testing of the Integrated Management Framework with the involvement of logistics companies, financial institutions, and public authorities, as well as on comparing its application across different types of logistics assets, countries, and regions of the EU.

Conclusions

The study shows that financing the green transformation of logistics systems should be viewed not as the selection of a single “green” financial instrument, but as an integral part of a comprehensive transformation management system. The effectiveness of financing depends on how well it corresponds to the characteristics of a specific logistics asset or project, including capital intensity, payback period, cash flow structure, technological maturity, expected ESG effects, and risk level. On this basis, the principle of functional alignment is substantiated, according to which the financing structure should be designed with regard to the transformation object, its investment parameters, expected outcomes, and risk profile.

The systematization of sustainable finance instruments made it possible to identify their different functional purposes. Green bonds and other targeted debt instruments are primarily intended to mobilize long-term capital; green loans and leasing support the modernization of specific assets; sustainability-linked instruments connect financing terms with the achievement of measurable targets; public and EU funding supports infrastructure projects with high public value; guarantees and blended finance help reduce and share risks; and sustainable supply chain finance extends financial incentives for green transformation to suppliers and other participants in the value chain. Thus, there is no universal financing model for the green transformation of logistics: its configuration should depend on the type of asset, the scale and stage of the project, expected outcomes, and the level of risk.

The second result of the study is the identification of management mechanisms that enable financial resources to be converted into specific technological, organizational, and infrastructure changes. These mechanisms include strategic priority setting, project selection and assessment, financial structuring, stakeholder coordination, digital monitoring and ESG control, risk management, as well as innovation and digitalization management. This makes it possible to

view capital mobilization not as a final solution, but as one of the interrelated stages of the transformation process, whose effectiveness depends on the quality of management, technological capabilities, and continuous monitoring of achieved results.

The main conceptual outcome of the study is the Integrated Management Framework for Sustainable Finance and the Green Transformation of Logistics Systems. Its scientific novelty lies in bringing together within a single management architecture the institutional and regulatory environment, sustainable finance instruments, management mechanisms, ESG criteria and risk management, green and digital transformation pathways, and transformation outcomes. Unlike approaches in which financing, green logistics, ESG, digital technologies, and risks are largely considered separately, the proposed framework reflects their interdependence throughout the entire transformation project cycle. The inclusion of a monitoring, learning and feedback mechanism ensures that economic, environmental, and operational results are used to review investment priorities, the financing structure, risk parameters, and subsequent management decisions.

The practical value of the findings lies in their potential use by different groups of stakeholders when making specific strategic decisions. Logistics companies are encouraged to develop portfolios of green transformation projects based on the type of asset, required CAPEX, payback period, projected cash flows, expected emissions reductions, and risk level. For each project, an appropriate financing configuration, a system of measurable ESG and operational KPIs, and a procedure for monitoring actual results should be defined. For large supply chains, sustainability criteria should also be extended to suppliers through sustainable supply chain finance, common ESG data requirements, and financial incentives for technological and environmental modernization.

Financial institutions and investors should assess projects not only in terms of their formal classification as green, but also with regard to technological maturity, the asset life cycle, the ability to generate cash flows, expected ESG effects, and implementation risks. For capital-intensive and innovative logistics projects, combined financing structures may be appropriate, with lending complemented by guarantees, public co-financing, or blended finance. Sustainability-linked financing, in turn, requires clearly defined KPIs, a reliable baseline, regular monitoring, and independent verification of achieved results, which can reduce greenwashing risks and improve the quality of investment selection.

Public authorities and development institutions should move from fragmented support for individual environmental measures towards the formation of portfolios of priority logistics projects aligned with the development of TEN-T, multimodality, alternative-fuels infrastructure, energy efficiency, and digitalization. A key strategic direction should be the combination of grant funding, CEF, InvestEU, AFIF, and national mechanisms with private capital and guarantee instruments for projects that generate significant public benefits but have limited commercial attractiveness at the

initial stages. At the same time, transparent project selection criteria, preliminary assessment of financial and environmental viability, and digital monitoring of the use of public funds and achieved results are essential.

Thus, the proposed approach provides a basis for moving from fragmented financing of individual environmental measures towards systematic management of the green transformation of logistics systems. Its practical significance lies in the possibility of aligning sources of capital, characteristics of logistics assets, technological solutions, institutional conditions, risks, and management mechanisms with specific economic and environmental outcomes.

A promising direction for further research is the practical implementation of the proposed Integrated Management Framework in selected logistics companies and its application to infrastructure projects in EU countries. This would make it possible to assess how the framework performs in practice and to refine its individual elements in line with the specific features of different logistics systems and national conditions.

Author contributions: All authors contributed equally to this work.

Conflict of interest: The authors declare no conflict of interest.

Use of artificial intelligence: During the preparation of this manuscript, the authors used ChatGPT (OpenAI) as an auxiliary tool for language editing, stylistic refinement, improving the clarity and readability of the text, as well as for revising and restructuring selected passages. AI-based tools were also used to support the visual presentation of selected conceptual figures. The authors independently defined the research aim and research questions, designed the study and selected the research methods, identified and verified the scientific and regulatory sources, conducted the substantive analysis, interpreted the findings, and made all final scientific and conceptual decisions. The authors take full responsibility for the accuracy, integrity, originality, and final content of the manuscript.

References

- Agrawal, N., Modgil, S. and Gupta, S. (2024). ESG and supply chain finance to manage risk among value chains. *Journal of Cleaner Production*, 471, 143373. <https://doi.org/10.1016/j.jclepro.2024.143373>.
- Castano-Herrera, D., Sobrino, N. and Vassallo, J.M. (2026). Are sustainability priorities aligned across supply chain stakeholders in Europe? *Transportation Research Part D: Transport and Environment*, 157, 105390. <https://doi.org/10.1016/j.trd.2026.105390>.
- Climate Bonds Initiative (2025). *Sustainable Debt Global State of the Market 2024*. Climate Bonds Initiative, London. https://www.climatebonds.net/files/documents/publications/Climate-Bonds_Sustainable_Debt_2024_Global-State-of-the-Market_24-Sep-2025.pdf.
- Coase, R.H. (1960). The problem of social cost. *The Journal of Law and Economics*, 3, 1–44. <https://doi.org/10.1086/466560>.
- Dai, L., Tang, D., Atsi, E.R., Zhao, M., Zhang, H., Kong, Y. and Zhang, L. (2025). The integration of green finance and logistics: Implications for green industry transformation. *Frontiers in Environmental Science*, 13, 1556580. <https://doi.org/10.3389/fenvs.2025.1556580>.
- Dzwigol, H., Kwilinski, A. and Trushkina, N. (2021). The organizational and economic mechanism of implementing the concept of green logistics. *Virtual Economics*, 4(2), 74–108. [https://doi.org/10.34021/ve.2021.04.02\(3\)](https://doi.org/10.34021/ve.2021.04.02(3)).
- European Commission (2020). *Sustainable and Smart Mobility Strategy – Putting European Transport on Track for the Future: Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions*. COM(2020) 789 final, Brussels. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0789>.
- European Commission (2021a). *Strategy for Financing the Transition to a Sustainable Economy: Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions*. COM(2021) 390 final, Strasbourg. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021DC0390>.
- European Commission (2021b). *Connecting Europe Facility 2021–2027*. European Commission, Brussels. https://transport.ec.europa.eu/transport-themes/infrastructure-and-investment/connecting-europe-facility_en.
- European Commission (2025). EU mobilises €422 million to support the deployment of alternative fuels infrastructure in road, maritime and air transport. *Mobility and Transport*, 6 February 2025. https://transport.ec.europa.eu/news-events/news/eu-mobilises-eu422-million-support-deployment-alternative-fuels-infrastructure-road-maritime-and-air-2025-02-06_en.
- European Environment Agency (2025). *Sustainability of Europe's Mobility Systems 2025*. EEA Web Report No. 02/2025. European Environment Agency, Copenhagen. <https://doi.org/10.2800/4890019>.
- European Parliament and Council of the European Union (2020). Regulation (EU) 2020/852 of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088. *Official Journal of the European Union*, L 198, 13–43. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32020R0852>.
- European Parliament and Council of the European Union (2021a). Regulation (EU) 2021/523 of 24 March 2021 establishing the InvestEU Programme and amending Regulation (EU) 2015/1017. *Official Journal of the European Union*, L 107, 30–89. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32021R0523>.
- European Parliament and Council of the European Union (2021b). Regulation (EU) 2021/1153 of 7 July 2021 establishing the Connecting Europe Facility and repealing Regulations (EU) No 1316/2013 and (EU) No 283/2014. *Official Journal of the European Union*, L 249, 38–81. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32021R1153>.
- European Parliament and Council of the European Union (2022). Directive (EU) 2022/2464 of 14 December 2022 amending Regulation (EU) No 537/2014, Directive 2004/109/EC, Directive 2006/43/EC and Directive 2013/34/EU, as regards corporate sustainability reporting.

- Official Journal of the European Union*, L 322, 15–80. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32022L2464>.
- European Parliament and Council of the European Union (2023a). Regulation (EU) 2023/1804 of 13 September 2023 on the deployment of alternative fuels infrastructure, and repealing Directive 2014/94/EU. *Official Journal of the European Union*, L 234, 1–47. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32023R1804>.
- European Parliament and Council of the European Union (2023b). Regulation (EU) 2023/2631 of 22 November 2023 on European Green Bonds and optional disclosures for bonds marketed as environmentally sustainable and for sustainability-linked bonds. *Official Journal of the European Union*, L 2023/2631. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32023R2631>.
- Gao, J., Hua, G., Wang, K. and Huo, B. (2026). Green finance and brown firms along the chain: Environmental gains, economic pains, and supply-chain transmission. *Financial Innovation*, 12, 18. <https://doi.org/10.1186/s40854-025-00890-w>.
- Gong, B., Xu, S., Xu, Z. and Cheng, C. (2026). Digital supply chain finance, government-business relationship and ESG performance: Evidence from the ZARFS platform in China. *Journal of International Accounting, Auditing and Taxation*, 60, 100754. <https://doi.org/10.1016/j.intaccaudtax.2026.100754>.
- Kartal, M.T. and Taşkın, D. (2026). Impact of supply chain logistics and green transportation on green economics under green finance, oil price shocks, and geopolitical risk: Evidence from the globe via novel quantile methods. *Financial Innovation*, 12, 31. <https://doi.org/10.1186/s40854-025-00899-1>.
- Khaustova, V.Ye., Boiko, O.V. and Trushkina, N.V. (2022). Vectors of increasing the level of innovation and investment attractiveness of the transport and logistics infrastructure of the national economy of Ukraine. *The Problems of Economy*, 3, 84–97. <https://doi.org/10.32983/2222-0712-2022-3-84-97>.
- Kim, D., Na, J. and Ha, H.-K. (2024). Exploring the impact of green logistics practices and relevant government policy on the financial efficiency of logistics companies. *Heliyon*, 10(10), e30916. <https://doi.org/10.1016/j.heliyon.2024.e30916>.
- Liashenko, V., Khaustova, V. and Trushkina, N. (2022). Cross-border transport and logistics cluster as a tool for territorial development of Ukraine and Poland: Institutional basis. *Journal of European Economy*, 21(4/83), 503–521. <https://doi.org/10.35774/jee2022.04.503>.
- Lileikiene, A., Jonusas, J., Martinkienė, J. and Vaiksnoras, M. (2024). Promoting innovative activities through advanced management and fintech models. *Vadyba: Journal of Management*, 40(2), 9–17. <https://doi.org/10.38104/vadyba.2024.2.01>.
- Nagy, G., Umetaliev, A. and Szentesi, S. (2026). A simulation-based integrated decision-support framework for auditable green logistics. *Logistics*, 10(5), 98. <https://doi.org/10.3390/logistics10050098>.
- Ovchynnykova, O., Martinkienė, J. and Navickas, V. (2024). Enhancing global sustainability: The role of the blue economy in preserving natural capital. *Challenges in Sustainability*, 12(1), 65–79. <https://doi.org/10.56578/cis120105>.
- Ozekenci, S.Y. and Nur, T. (2025). Determining the role of green logistics and green finance to achieve carbon neutrality. *LogForum*, 21(1), 47–61. <https://doi.org/10.17270/J.LOG.001147>.
- Phan, Q.-H., Le, T.-N., Nguyen, P.-H., Thi Nguyen, L.-A. and Vu, T.-G. (2025). Toward sustainable logistics in emerging economies: Identifying ESG barriers using neutrosophic Delphi-DEMATEL model. *Journal of Open Innovation: Technology, Market, and Complexity*, 11(3), 100601. <https://doi.org/10.1016/j.joitmc.2025.100601>.
- Pigou, A. (2013). *The Economics of Welfare*. Palgrave Macmillan, London.
- Starostka-Patyk, M., Bajdor, P. and Białas, J. (2024). Green logistics performance index as a benchmarking tool for EU countries' environmental sustainability. *Ecological Indicators*, 158, 111396. <https://doi.org/10.1016/j.ecolind.2023.111396>.
- Sun, L. (2026). Blockchain, supply chain finance collaboration, and the ESG performance of cultural and tourism enterprises. *International Review of Economics & Finance*, 108, 105306. <https://doi.org/10.1016/j.iref.2026.105306>.
- Tetteh, F.K., Kwateng, K.O., Nuetey, D. and Mensah, J. (2026). Clarifying the sustainable logistics practice and environmental performance nexus: A 3-way interaction model. *Sustainable Futures*, 11, 101676. <https://doi.org/10.1016/j.sftr.2026.101676>.
- Tian, X. and Ye, X. (2026). How supply chain finance impacts ESG synergy across supply chains. *Finance Research Letters*, 87, 109032. <https://doi.org/10.1016/j.frl.2025.109032>.
- Wang, C., Rahman, M.M., Siddik, A.B., Wen, Z.G. and Sobhani, F.A. (2024). Exploring the synergy of logistics, finance, and technology on innovation. *Scientific Reports*, 14, 21918. <https://doi.org/10.1038/s41598-024-72409-9>.
- Wang, S., Hu, H. and Fan, H. (2025). Does supply chain finance improve firms' ESG performance? *Economics Letters*, 247, 112098. <https://doi.org/10.1016/j.econlet.2024.112098>.
- Yao, J., Wu, J., Feng, H. and Sun, J. (2026). Supply chain shocks and the reconfiguration of green finance markets: A quantile-on-quantile connectedness analysis. *Systems*, 14(6), 652. <https://doi.org/10.3390/systems14060652>.
- Zhang, Z., Zhu, Y. and Chen, S. (2026). Freight institutional reform and urban green innovation: Evidence from green logistics governance. *Research in Transportation Business & Management*, 68, 101771. <https://doi.org/10.1016/j.rtbm.2026.101771>.
- Zhou, W. and Masi, D. (2025). Sustainable supply chain finance: A multiple case study. *Sustainability*, 17(11), 4862. <https://doi.org/10.3390/su17114862>.

RECEIVED: 05 May 2026

ACCEPTED: 09 July 2026

PUBLISHED: 15 October 2026

Martinkienė Jurgita – Doctor of Sciences, Professor, Director, Participated in the Erasmus teaching and training exchange program in foreign higher schools: Bulgaria, Cyprus, Hungary, Latvia, Ukraine, Estonia, Jordan, North Macedonia, Poland. 22 scientific articles were published in international databases; 6 methodological tools were published together with co-authors. From 2021 Management / Journal of Management editorial board member and coordinator. Research directions: development of managerial competences, their assessment in business companies, higher education institutions, business simulation companies,

development of strategic and managerial competences of managers. Address: Turgaus St. 21, Klaipėda, +370 610 46728, jurgita.martinkene@ltvk.lt. ORCID ID: <http://orcid.org/0009-0007-5190-3508>.

Lileikiene Angele – Doctor of Social Sciences. Author of more than 88 scientific articles published in domestic and foreign scientific research journals, 8 scientific and methodological tools, expert in 6 international projects. Interned in the USA, Norway, Denmark, Portugal, Spain, Romania, Malta, Cyprus, Italy, Germany, Sweden. The direction of scientific research is the sustainability problems of the financial system. Address: Turgaus St. 21, Klaipėda LP- 91249, Lithuania, +37065792742, angele.lileikiene@ltvk.lt. ORCID ID: 0000-0002-8414-5906

Khaustova Viktoriia – Doctor of Sciences (Economics), Professor, Director of the Research Center for Industrial Problems of Development of NAS of Ukraine (2 floor 1a Inzhenernyi Ln., Kharkiv, 61166, Ukraine), E-mail: v.khaust@gmail.com, ORCID: <https://orcid.org/0000-0002-5895-9287>.

Trushkina Nataliia – Ph.D. (in Economics), Senior Researcher, Senior Research Officer of the Sector of Industrial Policy and Innovative Development of the Department of Industrial Policy and Energy Security, Research Center for Industrial Problems of Development of the NAS of Ukraine (2 floor 1a Inzhenernyi Ln., Kharkiv, 61166, Ukraine), E-mail: nata_tru@ukr.net, ORCID: <https://orcid.org/0000-0002-6741-7738>.

Tur Olena – Ph.D. (in Economics), Senior Research Fellow of the Sector of Problems of Regional Development and Decentralization of the Department of Macroeconomic Policy and Regional Development, Research Center for Industrial Problems of Development of NAS of Ukraine (2 floor 1a Inzhenernyi Ln., Kharkiv, 61166, Ukraine), E-mail: ellenn@ukr.net, ORCID: <https://orcid.org/0000-0001-6229-8605>.