



SUSTAINABLE DEVELOPMENT OF RAILWAY INFRASTRUCTURE: INTEGRATING GREEN ECONOMY PRINCIPLES WITH CSR, ESG AND PRI FRAMEWORKS

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Annotation

This article examines the theoretical and methodological aspects of implementing green economy principles in railway infrastructure, focusing on the formation of a sustainable development strategy through the integration of Corporate Social Responsibility (CSR), Environmental–Social–Governance (ESG) indicators, and the Principles for Responsible Investment (PRI). The study scientifically substantiates that the alignment of these components plays a crucial role in transforming the railway sector by reducing environmental impacts, enhancing energy efficiency, ensuring transparency in governance processes, and achieving financial stability.

Keywords: Transport systems, ecological innovations, ESG, environmental-economic indicators, logistics, sustainable development.

On a global scale, the innovative development of transport logistics and industrial infrastructure is increasingly recognized as one of the primary engines of economic growth. The railway sector, in particular, has become a central component of industrial supply chains and international trade networks. According to data from the International Union of Railways (UIC), more than 12.3 billion tons of freight and 25.1 billion [1] passengers were transported by rail worldwide in 2023. These figures represent increases of 14.7% and 9.2% respectively compared to 2015. More than 10 million individuals are employed in the transport sector, making it a significant source of stable employment and an essential segment of the economically active population.



In Uzbekistan, the railway network also serves as a critical pillar of the national transport system, exerting substantial influence on the efficiency and long-term stability of domestic and international logistics operations. However, several systemic challenges persist, including the absence of clearly defined government targets and economic incentive tools for promoting renewable energy technologies, energy-efficient solutions, and ESG-related standards. Limited public-private partnerships, insufficient regulatory requirements for reducing carbon emissions, and the lack of formal criteria for improving service quality further complicate the sector's development.

The existing regulatory framework remains largely conceptual and lacks specific strategic benchmarks, KPIs, and environmental-economic indicators necessary for sectoral advancement. State support and financing mechanisms are still primarily oriented toward basic infrastructure construction rather than the development of green initiatives, renewable energy integration, or energy-saving technologies. Considering contemporary global demands, establishing a comprehensive regulatory mechanism for railway sector development and defining its strategic priorities has become an urgent necessity.

Given the strategic role of the railway system in the national economy, Uzbekistan has intensified its efforts to modernize and expand this sector. The “New Uzbekistan Development Strategy for 2022–2026” sets forth clear goals, including raising the rate of railway electrification to 60%, expanding the market for transport and logistics services, strengthening foreign trade and transit capabilities, creating “green corridors,” and increasing transit freight volume to 15 million tons [2]. Achieving these targets requires establishing appropriate conditions to support the development of an efficient and globally competitive railway sector.

The tasks outlined in several key government documents—including the Presidential Decree of February 28, 2022, on the “Development Strategy of New Uzbekistan for 2022–2026,” the Decree No. PF-5647 of February 1, 2019 [3], on measures for fundamentally improving the public administration system in the



transport sector, the Decree No. PF-213 of December 14, 2023, approving the national program for the development and modernization of Uzbekistan's transport system, and the Resolution No. PQ-88 of February 15, 2024, on the digitalization of road transport and the implementation of eco-transport projects—together underscore the need to modernize the railway system in accordance with contemporary requirements [4]. These policy documents emphasize increasing the level of infrastructure electrification, expanding the use of renewable energy resources and energy-efficient technologies, enhancing sectoral competitiveness, promoting public–private partnership initiatives, and integrating green initiatives and ESG standards into national transport policy.

Literature Analysis

The reviewed literature provides a comprehensive foundation for understanding the dynamics of transport development, economic growth, and policy frameworks in Uzbekistan and the broader global context. International sources, such as the World Development Indicators, offer reliable macroeconomic and sectoral data that allow for comparative assessment and long-term trend analysis. These indicators serve as an objective benchmark for evaluating national performance in freight and passenger transport, infrastructure efficiency, and sustainability outcomes.

National regulatory documents, including presidential decrees and resolutions of the Cabinet of Ministers, form the legal and institutional basis for the transport sector's modernization. These sources highlight the government's strategic priorities, including digitalization, infrastructure improvement, safety enhancement, and alignment with global standards. Such policy documents are essential for understanding how legislative reforms influence operational practices and sectoral growth.

Sectoral reports published by the Ministry of Transport provide practical insights into implementation outcomes, annual achievements, and ongoing challenges. They complement the regulatory documents by presenting empirical





results, enabling a clearer evaluation of policy effectiveness and sectoral performance.

Academic sources contribute theoretical depth and methodological guidance. Local research works, such as studies published in scientific journals, offer analysis of economic mechanisms, innovation trends, and sector-specific development factors within the national context. In addition, internationally recognized strategic frameworks—such as Porter’s model of competitive forces—provide a theoretical lens for assessing the competitiveness of the transport sector and identifying external and internal factors shaping its evolution.

Overall, the literature collectively offers a well-structured interdisciplinary perspective. It integrates statistical evidence, policy analysis, sectoral reporting, and theoretical frameworks, thereby enabling a holistic understanding of transport sector dynamics and supporting well-informed analytical conclusions. As a strategic component of the country’s infrastructure, the railway system plays a dual role: it supports economic development while simultaneously influencing environmental sustainability. In the face of global challenges such as climate change, resource depletion, and ecological imbalance, the transport sector requires a reassessment of its development priorities. Consequently, the concepts of “green economy” and “ecological innovation” have begun to emerge not only as independent fields of policy but also as essential elements of the long-term development strategy for railway transport.

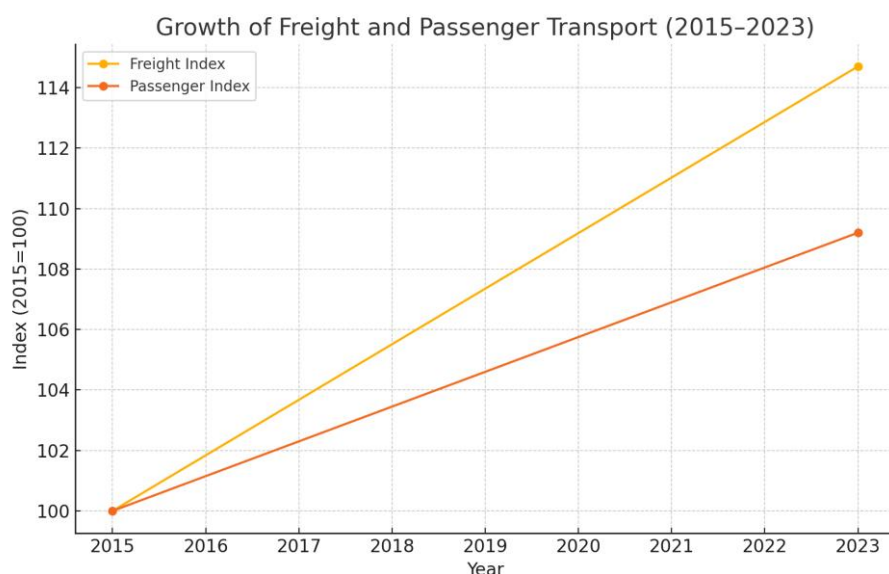
The concept of the “green economy” is not limited to environmental protection alone; rather, it represents a comprehensive framework aimed at ensuring economic growth and ecological sustainability simultaneously. Within this approach, transport infrastructure must be developed through mechanisms that enhance energy efficiency, reduce emissions, and promote the rational use of renewable resources. Railway transport is considered one of the most promising sectors in this regard, as it is inherently a low-carbon mode of transportation, and its transition toward greener practices can yield substantial economic and social benefits.



Ecological innovation extends far beyond technological advancements. It encompasses organizational reforms, management improvements, and financial instruments that collectively introduce long-term environmental efficiency into the sector. From this perspective, green modernization in railway transport involves not only the adoption of energy-efficient locomotives, but also the implementation of integrated energy management systems, ESG-based performance assessments, and life-cycle analysis (LCA) methodologies to evaluate the environmental impact of projects throughout their operational lifespan.

Within the broader framework of sustainable transport, railway systems are increasingly regarded as high-efficiency ecological networks. Principles such as energy conservation, waste minimization, and responsible resource use are becoming central to the sector's development agenda. However, achieving environmental efficiency is not limited to technological upgrades alone; it also requires strong strategic governance, political commitment, and a supportive investment environment. Drawing on Michael Porter's theory of the link between innovation and competitiveness [6], companies that embrace ecological modernization not only reduce their environmental footprint but also strengthen their competitive advantage in the marketplace.

1. Diagram: Growth of Freight and Passenger Transport (2015–2023)





The diagram illustrates the growth trends of freight transportation and passenger transportation by rail between 2015 and 2023, using 2015 as the baseline index value of 100.

1. Freight Transport Growth. The freight index increases steadily from 100 in 2015 to approximately 114.7 in 2023. This represents a 14.7% increase over the eight-year period. The sharper upward slope of the freight line indicates that freight transport experienced faster and more dynamic growth compared to passenger transport.

2. Passenger Transport Growth. The passenger transport index moves from 100 in 2015 to about 109.2 in 2023. This reflects a 9.2% increase, showing moderate but consistent growth. The smoother and less steep slope shows that passenger transport expanded, but at a slower pace than freight operations.

3. Overall Interpretation. Both segments demonstrate positive growth, meaning the railway sector has been expanding its operational capacity and service volume. The more rapid rise in freight transport suggests increasing demand for cargo movement, strengthened trade flows, and greater reliance on rail logistics.

Passenger growth, while positive, indicates a more stable and gradual expansion, potentially influenced by demographic trends, mobility patterns, or service modernization rates.

$$\text{Growth Rate (\%)} = \frac{\text{New Value} - \text{Old Value}}{\text{Old Value}} \times 100$$

Is one of the most commonly used formulas in economics, statistics, finance, and transport analysis. The growth rate shows how much a value has changed relative to where it started. It answers the question: “By what percentage did the value increase (or decrease) compared to its starting point?”

This formula:

- ✓ Allows comparison across years, countries, or companies;
- ✓ Helps analyze economic indicators (GDP, inflation, transport volumes);



- ✓ Shows performance changes (passenger flow, freight turnover, revenues);
- ✓ Provides a standardized measure of increase or decrease;
- ✓ Even if two values have different starting sizes, the percentage growth lets us compare them fairly.

Conclusion

The analysis of growth rates provides an essential framework for assessing the dynamics of economic and transport-sector performance. By comparing new indicators with their historical baselines, growth rate calculations reveal not only the magnitude of changes but also the relative efficiency and progress of operational activities. In the context of freight and passenger transportation, such indicators allow researchers and policymakers to identify underlying trends, evaluate improvements in service capacity, and understand the drivers of sectoral development. Moreover, growth metrics offer a standardized method that enhances comparability across different time periods and market conditions. A precise interpretation of these results is therefore critical for strengthening evidence-based decision-making and guiding long-term strategic planning within the transport industry.

Recommendations

Enhance data accuracy and periodic measurement

Regular and methodologically consistent data collection should be prioritized to ensure reliable growth assessments. High-quality datasets improve the validity of analytical outcomes and support more informed planning.

Integrate growth rate analysis into strategic transport management

Transport authorities and enterprises should routinely apply growth indicators when evaluating performance, forecasting demand, and allocating resources. This will help anticipate capacity needs and optimize operational efficiency.

Utilize comparative analysis for better policy formulation

Comparing growth rates across regions, transport modes, and time periods can reveal performance gaps and highlight areas requiring targeted intervention or investment.



Promote digital tools and analytical models

Adoption of modern analytical platforms can streamline growth calculations, enhance visualization, and facilitate rapid scenario analysis, ultimately strengthening managerial decision-making.

Align growth metrics with sustainable development goals

When assessing freight and passenger growth, environmental impacts and resource efficiency should be considered to ensure that sectoral expansion aligns with long-term sustainability objectives.

REFERENCES

1. The World Bank. World Development Indicators. Retrieved from <http://data.worldbank.org/indicator>
2. Decree of the President of the Republic of Uzbekistan. (January 28, 2022). PF-60.
3. Cabinet of Ministers of the Republic of Uzbekistan. (April 19, 2019). Resolution No. 336 “On the Approval of the Regulation on the Ministry of Transport of the Republic of Uzbekistan.” Retrieved from <https://lex.uz/uz/docs/-4300863>
4. Ministry of Transport of the Republic of Uzbekistan. (2023). Annual Activity Report for 2023. Retrieved from <https://mintrans.uz/2023hisobot>
5. Fayzullayev, J. (2021). Economics and Innovative Technologies. Scientific Electronic Journal, No. 2 (March–April).
6. Porter, M. E. (2008). “The Five Competitive Forces That Shape Strategy.” Harvard Business Review, 86(1), 78–93.
7. Нго, Т. (2015). Сравнительный анализ транспортных систем в странах ЕС и Азии: Проблемы и перспективы. Журнал транспортной экономики, 58(2), 45-60



8. Хиггинс, Д., & Джеймс, П. Экономическая эффективность инвестиций в транспортную инфраструктуру. Лондон: Cambridge University Press. 2012
9. Экономика транспорта: Учебное пособие / Терешина Н.П., Потапова Е.В.,
10. Терёшина Н.В., Епишкин И.А. – М.: РУТ (МИИТ), 2018. – 142 с
11. Rodrigue, J.-P., Notteboom, T. The Geography of Transport Systems. – New York: Routledge, 2020
12. OECD. Infrastructure Investment Outlook 2030. Paris: OECD Publishing, 2021.
13. UN ESCAP. Transport and Connectivity for Sustainable Development. United Nations, 2020