Green Finance Instruments for Sustainable Infrastructure in Transition Economies

Maria Kldiashvili[1]

Received: 19.08.2024
Accepted: 06.11.2024
Published: 25.11.2024

Abstract. This study examines the impact of sustainable financing mechanisms on infrastructure renewal in transition economies, particularly the Shuatsevi Hydropower Plant in Georgia. The project was implemented using a complex multi-level financing model, supported by leading international financial institutions such as the European Bank for Reconstruction and Development (EBRD), the International Finance Corporation (IFC), and the Asian Development Bank (ADB). Shuatsevi Hydropower Plant is a pioneer in climate-friendly infrastructure investments in the South Caucasus, contributing to the development of the scientific literature on financing sustainable projects in post-Soviet countries. The study is methodologically based on a qualitative case study, using primary data as well as a wide range of secondary sources, including environmental and social impact assessments, financial contracts, and project participants' reports. A SWOT analysis was used to comprehensively assess the project implementation, identifying both strengths and weaknesses, as well as potential opportunities and threats. The results demonstrate significant environmental benefits, including significant reductions in CO_2 emissions and job creation, which will contribute to the country's energy independence. However, several challenges have been identified, including technical challenges related to geotechnical issues and a lack of local community engagement, which have negatively affected social support for the project. This study highlights the need for institutional alignment, regulatory coherence, and active stakeholder engagement for effective implementation of green infrastructure in the context of transition economies. The findings provide practical recommendations for policy development aimed at scaling up sustainable finance in Georgia and other post-Soviet countries with similar economic challenges, which will have a significant impact on enhancing environmental and economic sustainability in the region.

Keywords: green finance, hydropower, sustainable infrastructure, transition economy, Georgia, ESG risks.

INTRODUCTION

Green finance encompasses investment strategies that aim to channel funds into projects that support environmental sustainability, including reducing carbon emissions and preserving ecosystems (World Economic Forum, 2022). It includes a wide range of financial instruments and services, such as loans, debt facilities, and investments, that promote environmentally sustainable activities or reduce environmental risks inherent in traditional economies. Such instruments of actors play a key role in the development of sustainable infrastructure, through financing modernised energy systems, including hydroelectric power plants, transport networks, including electric transport, and water supply systems equipped with energy-efficient treatment technologies. Companies use green finance mechanisms to

[1] Maria Kldiashvili
Doctor of Business Administration, Associate Professor, Georgian National University SEU, Georgia, https://orcid.org/0009-0003-6839-2127

implement projects that have a positive impact on the environment, including the expansion of renewable energy sources, increasing energy efficiency, and developing infrastructure that can withstand the effects of climate risks. Analysis of global trends in sustainable financing of programs reveals that instruments within the ecofinance system fall into three main categories: debt instruments, equity investments, and risk reduction mechanisms. This classification corresponds to the financial reporting and balance sheet structure defined by national accounting standards (Barahona, Girón, & Tebrake, 2023). It is also consistent with the approaches used by international organisations such as the World Bank, the Climate Bonds Initiative, and the Global Environment Facility (GEF) (Table 1).

Table 1. Categorisation of Sustainable Financing Tools

CATEGORY	EXAMPLES OF INSTRUMENTS	PURPOSE	KEY FEATURES / NOTES
DEBT INSTRUMENTS	- Green bonds - Energy efficiency loans - Renewable energy project loans	To finance sustainable projects through debt obligations	Most common form; offers predictable returns to investors; widely used in infrastructure financing
EQUITY INSTRUMENTS	- Venture capital in green startups - Equity stakes in sustainability-focused companies	To obtain ownership in companies implementing environmentally responsible projects	Relevant for early-stage or high-risk ventures; supports innovation and growth in the green sector
CREDIT ENHANCEMENT AND RISK TRANSFER	- Guarantees by international institutions (e.g., IFC, GEF) - Green investment insurance - Blended finance mechanisms	To lower investment risk and reduce barriers to capital access	Increases bankability of projects; mobilizes private capital for green investments in emerging and transition economies

Source: created by the author based on Barahona, Girón, and Tebrake, 2023

The main instruments in the field of sustainable finance are debt mechanisms, in particular eco-bonds and loans related to sustainable development, which contribute to raising funds for environmentally responsible projects. Such financial instruments are widely used in international practice, as they allow accumulating significant amounts of resources for the implementation of large-scale infrastructure and environmental initiatives. They are flexible in terms of conditions and can adapt to the needs of both the public and private sectors, which makes it possible to combine the interests of investors and society effectively. The advantage of such instruments is the ability to provide investors with a predictable income while financing infrastructure and projects that meet climate and environmental goals. This makes debt mechanisms attractive to a wide range of market participants, including pension funds, banks and international financial institutions.

In contrast, equity instruments allow investors to acquire ownership stakes in companies or initiatives that adhere to the principles of environmental sustainability. Participation in equity capital involves not only financing but also the opportunity to influence the strategic decisions of the enterprise, directing its development towards greater environmental responsibility. This form of financing is significant for companies operating in the early stages of development in the field of clean technologies or renewable energy, where traditional debt instruments may be unavailable or insufficient. Investing in shares of such companies is associated with a higher level of risk, but at the same time opens up the prospect of obtaining significant profits in the event of successful implementation of innovative solutions (Alharbiv et al, 2023). Due to this, equity investments often act as a catalyst for technological breakthroughs in the field of environmental innovation.

The third group consists of credit enhancement and risk transfer mechanisms designed to reduce financial barriers and minimise the risks of green investments. They help remove obstacles that hinder the development of environmentally-oriented

projects, especially in regions with unstable economic environments. These include guarantees, insurance products and blended finance instruments that can reduce the cost of capital, increase the investment attractiveness of projects for banks and attract private investment in sectors or regions considered high-risk. Such instruments can be particularly effective in areas where there is a need for significant initial capital investments, but there is high uncertainty about future returns (Bhatnagar & Sharma, 2022). By reducing real or potential risks, these mechanisms expand the pool of interested investors and contribute to the faster implementation of environmental initiatives.

The division of sustainable finance instruments into these categories is a practical analytical approach for assessing their feasibility and effectiveness in different economic conditions. It allows financial analysts and policymakers to more clearly identify priority areas of development, based on available resources and the needs of the economy. This approach is of particular importance in transition economies, where capital markets are less developed, and the role of risk reduction mechanisms and concessional financing becomes crucial for accelerating the development of "green" infrastructure (Abdul Gafoor et al., 2024). In these conditions, effective coordination between government agencies, the private sector and international donors is the key to success. The need for sustainable finance is due to limited access to capital, environmental challenges, in particular dependence on imports of about 20% of energy, as well as the need for economic reforms to achieve international standards, such as the requirements of the Deep and Comprehensive Free Trade Agreement with the EU (SavvY, 2024; Monasterolo et al., 2022).

The transition to a sustainable economy is a global priority, and green financing plays a key role in this transformation. By directing investments towards environmentally responsible initiatives, businesses can reduce operating costs and greenhouse gas emissions while improving their reputation as socially responsible market participants. State incentives, including tax exemptions, funding for eco-friendly initiatives, and green bond issuance, encourage private sector investment in sustainable growth (Guo et al., 2024). Despite this, green financial markets in transition economies face several barriers: underdeveloped regulatory frameworks, low investor awareness, and limited participation of small and medium-sized enterprises (SMEs) in green projects (SavvY, 2024). In Georgia, only 58% of green loans in 2023 complied with the sustainable finance taxonomy of the National Bank of Georgia (2024), indicating issues with standardisation and the risk of "greenwashing" (SavvY, 2024). These challenges require a detailed analysis of specific cases to identify success factors and obstacles, which will contribute to improving green financing policies. This study focuses on analysing the Shuakhevi Hydropower Plant (Shuakhevi HPP) project located in Adjara, Georgia. This project is representative as it reflects typical challenges of transition economies: attracting international capital ($200 million from the EBRD and IFC), difficulties with environmental and social standards, as well as potential for energy diversification (EBRD, 2021). Shuakhevi HPP helps reduce dependence on energy imports and creates jobs, but it also causes social conflicts due to its impact on local communities.

Research objective:

To investigate how green financing instruments contribute to the development of sustainable infrastructure in Georgia using the example of the Shuakhevi Hydropower Plant (Shuakhevi HPP).

Research questions

- Which green financing instruments (loans, grants, technical assistance) were used in the Shuakhevi HPP project?
- What circumstances contributed to the implementation of this project, and which, on the contrary, complicated or hindered its successful implementation?
- What impact did the project have on the environmental aspect (reducing CO_2 emissions), the economic aspect (strengthening energy security, creating jobs), and the social aspect (improving community well-being) of sustainable infrastructure development in Georgia?

RESEARCH METHODOLOGY

This study uses a qualitative approach based on the case study method to explore the role of eco-financing instruments in the development of sustainable infrastructure in Georgia, with a particular focus on the Shuakhev Hydropower Plant. The chosen methodology is focused on achieving the objectives through a comprehensive review of the project's financial model, identification of the difficulties that accompanied its implementation, and assessment of socio-economic results. The study consistently justifies the choice of a specific case, describes data collection methods, analytical tools, and approaches to ethical compliance that meet the standards of scientific integrity established by the Law and Business Studies Herald.

Shuakhevskaya HPP, located in the Adjara region of Georgia, was selected as a case study for analysing the use of sustainable financing mechanisms in transition economies. Its installed capacity is 180 megawatts, and construction work was completed in 2020. The total investment budget reached about 420 million USD. The central part of the financing was provided by "green" loans provided by international financial institutions, including the European Bank for Reconstruction and Development (EBRD) — 87 million USD, the International Finance Corporation (IFC) — 93.5 million USD, and the Asian Development Bank (ADB). Additionally, the project was financed by contributions to the authorised capital of Adjaristsqali Georgia LLC (European Bank for Reconstruction and Development, n.d.). This financial model made it possible to combine resources from the private and public sectors, reduce risks for investors, and ensure a stable source of capital at all stages of implementation. Thanks to the participation of international financial institutions, the project received not only financial support but also expert support, which contributed to compliance with environmental standards and the implementation of best management practices. The implementation of the Shuakhevskaya HPP was an essential step in strengthening Georgia's energy security and developing renewable energy in the region.

Implemented over the period from 2011 to 2020, the initiative engaged a range of stakeholders, such as domestic financial institutions like TBC Bank, and various civil society actors. The scale and complexity of the project illustrate key characteristics of green finance deployment in transitional contexts—namely, limited availability of domestic capital (with green loans comprising just 1.8% of Georgia's loan portfolio in 2023), significant reliance on external funding sources, and the need to navigate socio-environmental trade-offs (SavvY, 2024; Monasterolo et al., 2022). The Shuakhevi HPP is exemplary as it contributes to Georgia's energy security by reducing dependence on energy imports. However, it has faced environmental risks and social conflicts, notably due to community resettlement and impacts on river ecosystems (Adjaristsqali Georgia LLC, 2023). These issues reflect broader challenges faced by post-Soviet countries transitioning toward sustainable development within global frameworks such as the Paris Agreement. This case study provides insights that can be applied in similar settings, which in turn contribute to the deepening of scientific knowledge and complement existing research on green finance in developing economies. Such analysis allows not only to identify key patterns and practical approaches, but also to outline promising directions for their application in other countries with similar economic challenges and financial market structures (Hua et al., 2024).

The study is based on the use of both primary and secondary data sources, which allows for obtaining a holistic view of the financing mechanisms and the impact of the Shuakhevskaya hydroelectric power plant. The primary information sources are official project materials, including the Environmental and Social Impact Assessment (ESIA) reports, financing agreements, and work progress reports prepared by the EBRD and IFC, which are of particular importance. All necessary information was obtained through official requests, which ensured its reliability and relevance. The specified documents contain detailed information on the financing structure, key stages of the project implementation, and implemented environmental protection measures, which allows for a comprehensive assessment of its significance for the region and the country as a whole.

In addition, the study used academic publications, reports from international organisations, and official Georgian sources.

Academic articles from journals such as Energy Policy and the Journal of Sustainable Development provide theoretical and empirical context for the analysis of green finance and hydropower in Georgia (Dzadzua, 2024). Reports from the EBRD (n.d.), IFC (2024), and Monasterolo et al. (2022) provide detailed information on the financial and environmental performance of the project. Statistics from the National Bank of Georgia (NBG) cover quantitative indicators, including the volume of green loans, which amounted to 313 million USD in 2023, as well as the reduction of CO_2 emissions by approximately 400 thousand tons per year (SavvY, 2024). Additionally, media materials and reports reflecting environmental issues and public opinion on this issue were taken into account. Using a variety of sources of information increases the reliability of the study by triangulating data and reducing possible bias (Lazaro et al., 2023). This comprehensive approach contributes to a comprehensive understanding of the topic and ensures a balance between theoretical provisions and practical results.

The analysis in the study combines qualitative and descriptive methods, which allows for a consistent and comprehensive response to the research questions. Qualitative analysis involves a thematic study of project documentation, which allows for a deeper understanding of the features of financing, implementation and impact of the project. For a comprehensive assessment, a SWOT analysis was conducted, which summarised the strengths of the project, such as attracting international financing and diversifying energy sources, and also identified weaknesses, including social conflicts. In addition, the analysis identified potential opportunities for expanding green initiatives and developing relevant infrastructure, and identified threats, in particular, the instability of the regulatory environment, which may complicate the further development of the project (Al Mamun et al., 2022). Such a systematic approach helped create a structured assessment of effectiveness, taking into account both internal and external factors, the impact of which should be carefully monitored during the implementation of such initiatives.

Descriptive analysis was applied to financial and environmental data to gain a more detailed understanding of the scale and performance of the project. Financial indicators, including the total loan volume of USD 420 million, the estimated interest rates in the range of 4–6% according to EBRD standards, and the allocation of funds between construction and environmental measures, were systematised to provide a clear picture of the green financing structure. In addition, a timeline of the project from 2011 to 2020 was developed, which helped to highlight key stages of its implementation, in particular, the delays caused by the protests in the period 2016–2018. This approach allowed not only to reflect the financial aspects, but also to take into account the socio-political context, which had a significant impact on the dynamics of the project (Ruggerio, 2021). Where quantitative data were available, including CO2 emission reductions and job creation (~500 during construction), comparative analysis was performed using Excel to calculate percentage changes and benchmark the Shuakhevi HPP against other projects such as Enguri HPP.

The study adheres to ethical principles by ensuring transparency in reporting and data reliability. Sensitive information, such as confidential financial details, is handled with anonymity and source protection. The research avoids conflicts of interest, maintaining independence from project financiers. All sources are cited following APA 7 standards, and the manuscript will be checked for plagiarism using Turnitin to ensure originality (<20% similarity). Social and environmental sensitivities, including community concerns regarding Shuakhevi HPP, are addressed objectively to avoid bias. The methodology acknowledges potential limitations. Access to confidential financial data or internal documents may be restricted, necessitating reliance on publicly available reports. Quantitative data on long-term effects, such as CO2 reductions post-2020, may be incomplete, limiting impact assessment. To mitigate these limitations, triangulation and cross-verification of sources were employed to enhance the reliability of the results. This methodology provides a rigorous and transparent analysis of the role of green financing in the development of Shuakhevi HPP, offering valuable insights for policy-making and research in transition economies.

RESULTS

Georgia is demonstrating further progress in the field of sustainable development, considering eco-financing as an essential tool for ensuring economic stability and environmental protection. In the face of global challenges such as climate change, depletion of natural resources and deterioration of the ecological state, the country is actively integrating its policies into the framework of sustainable development goals, proposing the concept of the so-called "green transition". The process provides for systemic changes in the economy aimed at reducing the negative impact on the environment and increasing the efficiency of resource use.

The National Bank of Georgia (2021) plays a key role in shaping and developing the eco-finance system. Since 2017, the NBG has implemented a comprehensive policy, including the creation of a Sustainable Finance Framework Agreement, a Roadmap and a Sustainable Finance Taxonomy, which standardise the approach to "green" investments. These measures are aimed at creating a stable regulatory environment that stimulates the flow of financial resources into environmentally friendly sectors. Thus, the National Bank has initiated the creation of a system that provides long-term financial and environmental benefits for the country, while simultaneously contributing to increasing investor and public confidence.

In April 2019, the National Bank presented the Sustainable Finance Roadmap, which outlines the main reforms to create a mature investment environment focused on sustainable development. The document contains four strategic directions: raising awareness and developing competencies, stimulating sustainable financing flows, managing risks related to environmental, social and governance (ESG) factors, as well as increasing transparency and discipline in the market. This initiative aims to create a predictable regulatory framework that will allow the financial sector to adapt to the requirements of sustainable development gradually. In 2023, the NBG published ESG Reporting and Disclosure Principles, specifying market participants' obligations under the third and fourth strategic directions. Together, these efforts establish an institutional foundation for transparent and accountable green financing, including the evaluation of the effectiveness of projects such as the Shuakhevi HPP (Table 2).

Table 2. Main Directions of the NBG Sustainable Finance Roadmap (2019)

NO.	DIRECTION	DESCRIPTION
1	Raising Awareness	Educational programs, consultations, and guides for banks
2	Sustainable Financial Flows	Searching for green capital instruments, integrating sustainability criteria
3	ESG Risk Management	Incorporating climate and social risks into banking models
4	Transparency and Market Discipline	Mandatory ESG-based reporting

Source: created by the author based on: National Bank of Georgia, 2023c

Georgia's European integration course is a key determinant for stabilising the business environment, increasing foreign direct investment inflows, and creating favourable conditions for infrastructure modernisation. An additional important factor is the possibility of gaining access to the financial instruments of the European Union, which are aimed at supporting measures to increase energy efficiency and develop sustainable energy sources. These instruments open up new prospects for the country to attract investments in the modernisation of energy infrastructure and the introduction of innovative technologies that meet the highest environmental standards. Through cooperation with European funds, Georgia receives additional opportunities for the implementation of ambitious projects aimed at reducing greenhouse gas emissions and ensuring the sustainable development of the energy sector.

Although the Georgian government has officially declared its intention to harmonise its energy policy with European Union regulations, the actual implementation of these commitments is often limited to a narrow range of measures. It is determined more by internal state priorities than by the desire for full

integration with the EU. This approach indicates that the country's national interests and current challenges prevail over the long-term strategic goals of European harmonisation. As a result, the process of adapting the regulatory framework and implementing EU standards is gradual and not always comprehensive, which hinders faster and deeper reform of the energy sector (Gabr & Elbannan, 2024). The 2020 update of the EU Eastern Partnership introduced new environmental goals, including procedural standards for hydropower development, aligned with the Renewable Energy Directive.

Georgia's initial motivation to adopt these frameworks stemmed from national energy security concerns—particularly its dependence on imported fossil fuels. After severing most energy ties with Russia following the 2008 war, Georgia became heavily reliant on gas imports from Azerbaijan, a dependency that persists today. Consequently, diversification of energy sources became a strategic priority, and large-scale hydropower projects were promoted to reduce natural gas use in electricity generation (Uche et al., 2024). Under President Saakashvili and successive Georgian Dream governments, several new HPPs were proposed—such as those along the Rioni River—with backing from the EU and international donors. EBRD financing supported both new initiatives and the rehabilitation of Soviet-era facilities like the Enguri HPP, which still produces around one-third of Georgia's electricity.

Although infrastructure projects are officially positioned as steps towards harmonisation with the European Union's energy policy, in practice their implementation is fragmented and inconsistent. As environmental NGOs point out, many legislative initiatives face challenges in terms of transparency, practical implementation, and insufficient institutional capacity. In particular, while a law on environmental impact assessment (EIA) was adopted in 2018 to comply with the provisions of the Association Agreement with the EU, it often fails to deliver real results in terms of control. It does not guarantee proper public participation and openness of the process.

Cooperation with international donors, especially the European Union, remains crucial for achieving the country's environmental goals. The effectiveness of state policies in the field of decarbonization depends largely on external technical and financial support. A striking example of such cooperation is the project to lay a high-voltage submarine cable in the Black Sea, which aims to integrate the energy systems of Georgia and the EU. This project plays a strategic role in strengthening the energy security of the South Caucasus and expanding the region's export potential in the field of renewable energy. It contributes not only to increasing the reliability of electricity supply but also to creating a more integrated and sustainable energy space that meets the modern challenges of the global energy sector (Qian, 2024). Such cooperation opens up new opportunities for the implementation of innovative technologies and strengthening international partnerships, which are key factors for sustainable development.

The Government of Georgia pays significant attention to measures aimed at raising awareness among state authorities and local communities about climate change adaptation tools. To ensure transparency in the implementation of climate projects, the Ministry of Economy and Sustainable Development (MESD) constantly monitors programs funded by donor organisations, in particular by assessing their contribution to achieving national sustainable development goals. This approach contributes not only to monitoring the efficiency of resource use but also to increasing trust among the public and international partners. In the area of green growth policy-making, the Ministry of Environmental Protection and Agriculture initiated the development of the National Green Growth Strategy and the Action Plan for 2025–2030. These strategic documents outline key areas for integrating the principles of the circular economy, decarbonization, introducing innovations and modernising energy-intensive sectors of the economy. The implementation of these documents aims to ensure the country's systematic transition to a low-carbon development model, which will contribute to reducing the negative impact on the environment and increasing economic sustainability (Sun et al., 2023). At the same time, the strategy provides for the active involvement of all stakeholders, including business, public organisations and international partners, which creates conditions for more effective implementation of the tasks set and achievement of ambitious environmental and economic goals.

Georgia is paying particular attention to the development of green hydrogen technologies, which are seen as a promising source of carbon-free energy for the future. In

cooperation with the German development bank KfW, a pilot project is being implemented to explore the possibilities of using green hydrogen in the transport system of the city of Batumi. The results of this project should become the foundation for the formation of a national action plan for the development of hydrogen energy, which opens up new prospects for the country's energy transformation and reducing its carbon footprint. In addition, digitalisation and innovation are actively integrated into Georgia's environmental policy (Tariq & Hassan, 2023). In particular, the Georgian Innovation and Technology Agency (GITA), together with the state program "Enterprise Georgia", promote the development of technologies focused on environmental protection, supports startups in the green energy sector and stimulates the implementation of digital solutions in energy consumption management processes.

In the long term, Georgia aims to implement inclusive mechanisms for implementing environmental policies, which include active community participation, access to green financing, and the development of educational programs to improve the environmental competence of specialists. The introduction of financial incentive systems should contribute to the gradual transformation of enterprises towards more sustainable production models. Such a comprehensive approach creates the prerequisites for balanced economic growth and environmental improvement in the country, responding to the current challenges of global ecology (Utomo et al., 2023). Therefore, for Georgia's climate policy to meet European standards, a comprehensive approach is needed, including active interaction between various state institutions, technological modernisation, enhanced international cooperation, and active participation of civil society in the processes of decarbonization and transition to new energy models. Such a multidimensional approach is key to the successful adaptation of national policy to the requirements of the modern environmental and energy paradigm.

In addition to national regulators, an essential role in the development of the "green" financing system is played by international financial institutions (IFIs), in particular the European Bank for Reconstruction and Development (EBRD), the Asian Development Bank (ADB), the International Finance Corporation (IFC), and others (Wang & Fan, 2023). They actively cooperate with local banks, government agencies, and the private sector, providing credit lines, facilitating the issuance of green bonds, and providing technical and advisory support. These efforts enable Georgian businesses to access long-term financing for energy efficiency, renewable energy, sustainable supply chains, and other environmentally friendly projects. In Georgia, green loans are typically provided through international financial institutions, which invest in local commercial banks while providing technical assistance to ensure projects meet environmental standards and international best practices. This mechanism helps to bridge local capacity gaps and reduce investment risks for private financial institutions, which significantly contributes to the development of the country's green finance sector. This process builds investor confidence and creates an enabling environment for sustainable economic development (Figure 1).

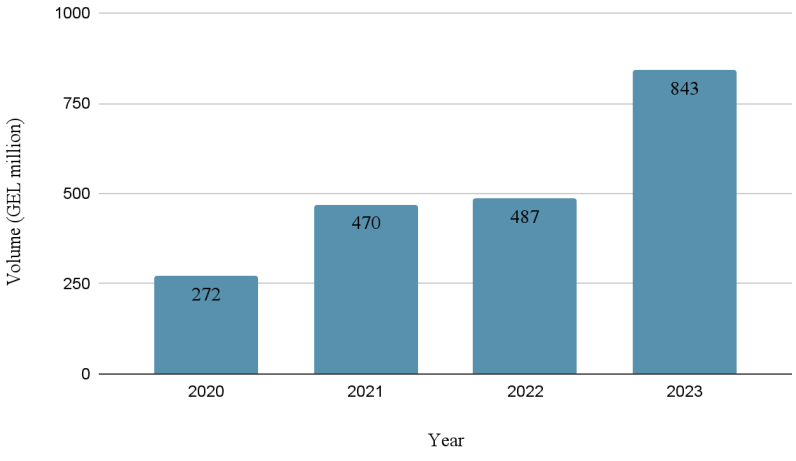

Figure 1. Total volume of issued green loans in 2020–2023 (excluding the impact of exchange rates)
Source: compiled by the author based on data from the National Bank of Georgia (2023b)

In 2020, the volume of green loans amounted to approximately 271.6 million Georgian lari (GEL). In the following year, 2021, this figure increased by 73% to 470 million GEL, indicating an initial dynamic development of the use of sustainable financing instruments in the country. In 2022, the growth rate slowed down somewhat, and the total volume of loans increased only slightly, to 487 million GEL. Such moderate dynamics likely reflect market adaptation, the gradual formation of the regulatory framework, and the level of readiness of institutions to implement new financial mechanisms (National Bank of Georgia, 2021). In 2023, there was a significant acceleration, when the volume of green loans issued increased sharply to 843 million GEL, which corresponds to a 58 per cent increase compared to the previous year. Such a significant jump can be explained by the growing attention of the international community to financing climate initiatives, the implementation of the National Taxonomy of Sustainable Finance of Georgia, as well as the more active involvement of commercial banks and international partners in the development of green financial instruments. These factors created favourable conditions for the expansion of "green" lending, which indicates the gradual strengthening of the position of sustainable finance in the country's economy.

Despite the impressive growth in green loans, in 2023, they accounted for only about 1.8% of the total volume of loans issued, which emphasises the initial stage of development of this market in Georgia. This indicator indicates that the green finance market is still relatively young and underdeveloped. At the same time, the steady trend towards an increase in the volume of "green" lending reflects the growing level of awareness of the importance of environmentally sustainable projects and the growing capacity of the country's financial sector to support such initiatives. This positive dynamic indicates significant potential for further expansion of the green finance ecosystem in Georgia. Of particular importance is the need to harmonise the regulatory framework, strengthen measures to develop professional competencies and expand access to preferential financing. The sectoral breakdown shows that 65% of such loans are directed towards renewable energy, of which 57% are allocated to hydropower projects. Another 14% goes to sustainable construction, and 10% to green transport. Overall, financing under this classification covered eight economic sectors (Figure 2).

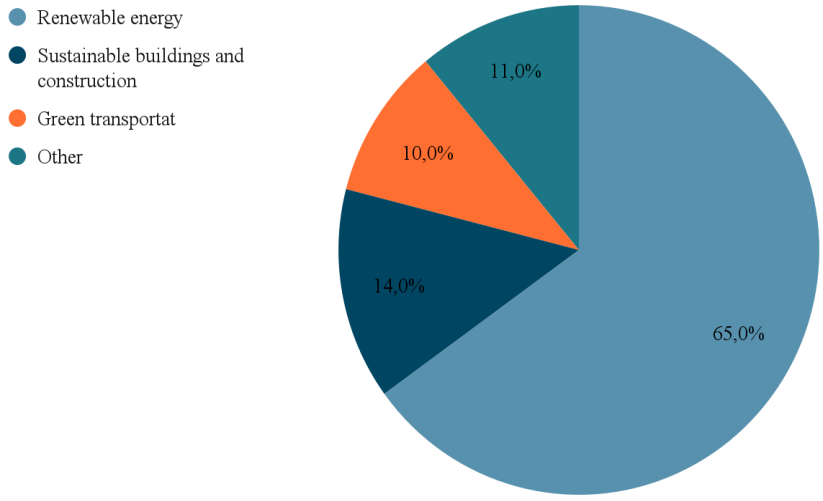

Figure 2. Distribution of Green Loans Issued in 2023 by Sectors
Source: compiled by the author according to the National Bank of Georgia

Another important channel for the distribution of sustainable capital is green bonds. In July 2024, Georgia Global Utilities (GGU), the country's largest private utility company, issued a landmark green bond worth USD 300 million, the largest issuance to date by a Georgian private company. The bond was partially subscribed by the International Finance Corporation (2024), which committed USD 40 million, along with participation from the EBRD, ADB, and Germany's DEG. The issuance was listed on the Euronext Dublin Stock Exchange and reflects growing international investor confidence in Georgia's

sustainable infrastructure sector.

The funds will be used to modernise the country's ageing water infrastructure, where water losses in some regions reach up to 70%, and to expand access to clean drinking water. The investment is expected to improve water supply for around 1.3 million people, or approximately 35% of Georgia's population, and connect 40,000 new customers to the water supply system by 2028. In addition, the project will contribute to reducing water losses and increasing energy efficiency in water treatment systems, which has a positive impact on the environmental status and economic sustainability of the sector. From a financial perspective, the green bond issue will allow Georgian Water and Power (GGU) to restructure its existing debt and build a more sustainable capital structure, which will strengthen the company's long-term operational sustainability. From a strategic perspective, this agreement strengthens Georgia's position in international capital markets, serves as an example for the implementation of corporate financing related to environmental sustainability, and demonstrates the great potential of "green" financial instruments to overcome infrastructure deficits in developing countries.

According to IFC (International Finance Corporation, 2024), the transaction aligns with its broader climate finance mandate and catalyses replicable public-private partnerships in the region. In a context where Georgia's domestic capital market remains shallow — with total corporate bond issuance at only USD 800 million in 2023, mostly from financial institutions — tapping into green finance instruments such as bonds is seen as essential for scaling up investments in climate-resilient infrastructure. Thus, Georgia's green financial sector is actively developing both in terms of establishing a regulatory framework and creating market mechanisms for capital access.

Shuatsevi Hydropower Plant is one of the key infrastructure projects in modern hydropower in Georgia. The financing of this large-scale facility was organised according to a complex model of environmental financing, with the support of three leading international institutions - the European Bank for Reconstruction and Development (EBRD), the International Finance Corporation (IFC) and the Asian Development Bank (ADB) (Wang et al., 2023). The sources of funds were formed by a combination of senior loans and equity shares, which allowed for the optimal distribution of financial risks by the principles of limited liability, where investors are liable only to the extent of their investments. The investments were aimed not only at the execution of engineering works and construction, but also at the development and implementation of comprehensive environmental and social protection mechanisms. Among them are the Environmental and Social Impact Assessment (ESIA), the Biodiversity Action Plan (BAP) and the Livelihood Restoration and Compensation Plan for Land Acquisition (LALRP) (Table 3).

Table 3. Funding Framework for Shuakhevi Hydropower Plant

Financial Institution	**Type of Instrument**	**(Amount (USD million)**	**Share of Total Financing (%)**
EBRD	Concessional Loan	86,5	20,7%
IFC	Loan + equity (20%)	90	21,6%
ADB	Syndicated Loan	90	21,6%
Equity (Clean Energy Invest + Tata Power)	Equity	~150	~36%
Total		417	100%

Source: created by the author based on: National Bank of Georgia, 2023a

Adjaristsqali Georgia LLC (AGL), a partnership of Clean Energy Invest (Norway), Tata Power (India), and the IFC, executed the project. This partnership enabled the combination of private resources with expertise in developing complex energy infrastructure in mountainous terrain, while ensuring compliance with international standards of transparency, sustainability, and stakeholder engagement. The Shuakhevi HPP, located in Adjara, Georgia, is a run-of-the-river hydropower plant. The project includes three tunnels: Chirukhistskali–Skhalta (5.8 km), Skhalta–Didachara (9.1 km), and the Shuakhevi headrace tunnel (17.8 km). The

reservoirs—Skhalta (19.4 ha) and Didachara (16.9 ha)—provide up to 12 hours of water storage, optimising energy supply during peak demand periods (Figure 3).

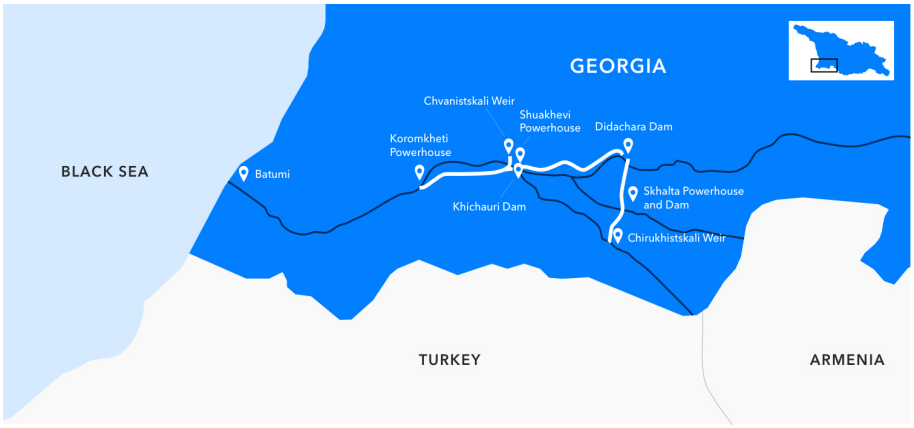

Figure 3. Map of the Shuakhevi HPP Project Area
Source: Clean Energy Invest AS, n.d.

At the implementation level, the project has demonstrated significant technological and organisational successes, demonstrating its high efficiency and modernity. The hydroelectric power plant has an installed capacity of 187 MW and produces over 450 GWh of electricity annually. In 2024, the volume of electricity generated increased to 481 GWh, which is about 5% of the total annual electricity production in the country. This level of production significantly reduces Georgia's dependence on electricity imports, especially in the winter period, when energy deficits are traditionally observed. By replacing fossil fuel-based electricity imports, the Shuatsevi hydroelectric power plant contributes to the reduction of carbon dioxide emissions by more than 200 thousand tons per year. This meets international standards for reducing the impact on climate change and contributes to the fulfilment of Georgia's commitments in the field of environmental sustainability. The high level of environmental compliance is confirmed by the project's certification within the framework of the mechanisms of the United Nations Framework Convention on Climate Change (UNFCCC).

From a socio-economic perspective, the construction of the plant generated more than 10,000 person-years of employment, involving over 700 Georgian professionals—around 90% of whom were young engineers and technical specialists. During the operational phase, the project provides approximately 70 permanent jobs. AGL's infrastructure investments in local communities include road network upgrades, development of communication infrastructure, and the launch of several social programs, such as the creation of an alpine botanical garden in the Goderdzi region, the opening of a sewing enterprise in Khulo, and support for educational initiatives. Overall, according to AGL, more than 10,000 residents have benefited from over 70 social projects (Table 4).

Table 4. Expected and Actual Impacts of the Project (Environmental and Social)

Indicator	Expected Value	Actual Result / Status
HPP Capacity	187 MW	Achieved
Electricity Generation	452 GWh/year	Partially achieved due to tunnel issues
CO_2 Emissions Reduction	>250,000 tons/year	Potentially achievable, but not verified
Natural Habitat Loss	≤10 ha (as per EIA)	93 ha (actual)
Biodiversity Compensation	Full	Partial / Unsatisfactory
Job Creation	500–700	Achieved
Local Community Involvement in Decision-Making	Planned	Limited, complaints submitted to IFIs

Source: created by the author based on: Adjaristsqali Georgia LLC, 2023

Despite significant international support and a generally positive impact, the implementation of the Shuatsevi hydroelectric power plant has faced several challenges. During commissioning, geotechnical problems in the tunnel system, including landslides, were identified, which required changes to the original engineering design documentation. In addition, social risks were not fully considered and minimised: some residents expressed concerns about changes in the groundwater regime, possible negative impacts on agricultural lands, and a lack of communication from the project company, especially in the initial stages (Halden & Cali, 2024). This led to complaints being filed through the grievance mechanisms provided for in EBRD and IFC policies. These difficulties highlight the importance of careful planning and transparent engagement with the community, as well as the need for ongoing monitoring of the environmental and social aspects of projects of this scale. At the same time, the experience of solving these problems became an essential lesson for improving future infrastructure initiatives and strengthening the responsibility of all participants in the process.

The Compliance Advisor Ombudsman (2021) investigation identified that construction activities had adversely affected local groundwater supplies and biodiversity. Specifically, the report states that residents experienced reduced groundwater flow impacting domestic and irrigation use, and that "several fish species, including an endangered one, have allegedly disappeared from the river since the Company began construction works". Thus, the Shuakhevi HPP represents a valuable case for analysing the impact of green financing instruments on the development of sustainable infrastructure in transition economies. The project illustrates both the strong potential for mobilising international capital and technology and the challenges of ensuring inclusivity, social responsibility, and long-term resilience.

The Shuatsevi Hydropower Plant was one of the first large-scale projects in Georgia to combine energy objectives with clear commitments to sustainable development and environmental protection. The project achieved "green" status through its focus on low-carbon electricity generation and the implementation of a range of adaptation measures, including environmental protection plans, systematic monitoring of rare flora and fauna species, and efforts to minimise impacts on river ecosystems. Although the construction phase has generated social resistance from some local communities, AGL has responded quickly by establishing information centres to improve communication with the population. Consultations were initiated with all stakeholders to address their concerns and suggestions. In addition, several compensatory measures were implemented to mitigate the negative impacts of the project, including road upgrades and technical assistance to families affected by construction (Dar et al., 2024). Such a comprehensive approach allowed not only to reduce social tension, but also to increase the level of trust in the project and promote its successful implementation, taking into account the interests of local communities and the environment.

The Shuatsevi Hydropower Project as a whole demonstrates not only the potential for large-scale green financing in a country undergoing economic transition, but also highlights the importance of an integrated approach to managing the social and environmental aspects of infrastructure development. The project is a compelling example of how to combine economic, environmental and social priorities to achieve sustainable development. The Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis provides a structured view of both internal and external factors affecting the Shuatsevi project (Table 5).

Table 5**.** SWOT Analysis of the Shuakhevi HPP Project

Strengths	**Weaknesses**
– International financing from EBRD, IFC, and ADB ensured credibility and low default risk. – High electricity output (450+ GWh/year), contributing to Georgia's energy security. – Integration of high environmental standards. – Implementation of a transparent project management system through a specialized company AGL.	– The occurrence of geotechnical problems, including collapses in tunnel systems. – Insufficient level of involvement of local communities in the initial stages of implementation. – Social tension resulting from changes in hydrological regimes and negative impacts on farms.

– Creation of new jobs and significant contribution to local budgets through tax revenues.	– Uneven perception of environmental compensation measures at the local level.
Opportunities	**Threats**
– Replication of project finance experience for other renewable energy projects. – Stimulating the development of Georgia's green finance market. – Using the case to improve legislation (taxonomy, audits, reporting). – Enhancing environmental literacy among communities and institutions.	– Climate risks (changes in water flow, floods) may reduce project efficiency. – Degradation of ecosystems and biodiversity loss due to landscape interventions. – Social resistance and negative perception of IFIs due to insufficient compensation. – Potential claims related to unfulfilled ESG commitments.

Source: author's elaboration based on case study findings

The Shuatsevi Hydropower Project as a whole demonstrates not only the potential for large-scale green finance in a country in economic transition, but also highlights the importance of an integrated approach to managing the social and environmental aspects of infrastructure development. The project is a compelling example of how to combine economic, environmental and social priorities to achieve sustainable development. The Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis provides a structured view of both internal and external factors affecting the Shuatsevi project. Key strengths include secure financing from leading international financial institutions, a significant electricity generation capacity that contributes to the country's energy independence, and compliance with global environmental and social standards, including an Environmental Impact Assessment (ESIA), a Biodiversity Action Plan (BAP) and a Livelihood Restoration Plan (LALRP). The project also introduced a transparent governance model through the specialist project company AGL and had a positive impact on the local economy, creating jobs and generating additional fiscal revenue.

However, some shortcomings were identified, including unresolved geotechnical issues such as tunnel collapses and initial communication gaps with stakeholders, particularly the local communities affected by the construction. These weaknesses have led to social tensions and criticism of the lack of environmental compensation measures. This experience highlights the need for greater public involvement and careful social planning in future large-scale sustainable development projects. In terms of opportunities, the Shuatsevi Hydropower Project serves as an example of a successful model that can be scaled up and applied to future investments in renewable infrastructure. It has the potential to become a catalyst for the development of the green finance market in Georgia, stimulating further capital investment in sustainable development. In addition, the implementation of this project opens up opportunities for improving public policy, especially in the areas of ESG (environmental, social and governance) criteria classification and reporting. It is also important to note the prospects for increasing environmental awareness at the local level, which will contribute to a more responsible attitude towards natural resources.

At the same time, the project faces several challenges and threats that may affect its long-term effectiveness. These include climate risks that may affect the productivity of the hydropower plant, environmental degradation due to changes in natural habitats, and persistent social discontent among local communities. There is also a reputational risk for international financial institutions if they are perceived to be failing to meet ESG commitments. These factors highlight the need for a comprehensive approach to implementing technical, environmental and social safeguards in infrastructure projects financed through green instruments, especially in countries undergoing economic transformation (Xioping & Yanqiu, 2024). Such an approach ensures not only economic benefits but also long-term sustainability and social acceptability of projects. Following the SWOT analysis of the Shuakhevi HPP case, it is essential to contextualise the broader environment in which sustainable infrastructure projects operate. While Georgia

demonstrates progress in green finance development, the sector still faces a range of structural, institutional, and market-level challenges that inhibit the dynamic scaling of investment flows into sustainable infrastructure.

The main barriers to the development of sustainable finance in Georgia, according to Dzadzua (2024), include low awareness and a fragmented understanding of climate finance among government agencies and financial institutions, which leads to ambiguous interpretations of sustainable development goals and instruments for their implementation. The discrepancy between Georgian national legislation and international green standards, in particular the European Taxonomy, complicates the process of classifying and monitoring environmentally sustainable projects. The temporal discrepancy between long-term environmental benefits and short-term profitability expectations negatively affects investment attractiveness for the private sector (Ahmad, 2024). High initial capital investments create a significant financial burden, especially in the context of high credit costs, which is typical for transition economies such as Georgia. The uncertainty of investment results, combined with long payback periods and uncertainty about the return on investment, discourages both domestic and foreign investors.

Institutional contradictions, manifested in banks' priorities for maximising short-term profits at the expense of sustainability goals, especially in the absence of appropriate incentives, complicate the development of "green" finance. The lack of ESG tools, quality data and relevant expertise among local financial institutions limits their ability to support green lending effectively. The perception of the risk of "greenwashing" contributes to increased caution and reluctance to invest in innovative projects that do not meet strict classification requirements. The absence of large-scale fiscal incentives, such as interest rate subsidies or tax breaks, reduces the financial motivation to invest in sustainable development (Bhutta et al., 2022). Administrative difficulties associated with the need to comply with ESG standards, including complex documentation and technical reporting, create additional barriers for small and medium-sized enterprises, as well as regional market participants.

The national environment is gradually transforming under the influence of growing public and political awareness of environmental risks, as well as regulatory initiatives of the National Bank of Georgia and government agencies. Demand for export products that meet ESG criteria, especially in sectors focused on the European market, is showing steady growth. International donors and financial institutions are increasing their support by providing green credit lines and technical assistance grants. The overall dynamics create favourable conditions for scaling up sustainable finance, provided that structural shortcomings are addressed and national institutional mechanisms are accelerated in integrating international green finance standards. Such developments can contribute to the formation of an environmentally oriented, economically sustainable and socially acceptable financial system in a transition economy.

DISCUSSION

Significance of the results obtained

The interpretation of the results suggests that specialised financing mechanisms, including concessional loans and investments from international financial institutions, played a key role in the implementation of the Shuatsi Hydropower Project. The participation of organisations such as the European Bank for Reconstruction and Development (EBRD), the International Finance Corporation (IFC), and the Asian Development Bank (ADB) not only provided the necessary capital inflow but also increased investor confidence through the reputation and guarantees they provide. Although this project did not directly use green bonds, similar financial instruments have shown effectiveness in attracting investment in other cases, especially when multilateral guarantees are available.

However, structural and regulatory barriers remain significant factors limiting the scaling up of green finance in Georgia. The lack of full compliance between national regulations and international standards, as well as the lack of developed internal classification systems for "green" projects, creates uncertainty for both investors and implementers. In addition, significant initial investments, lack of proper incentives and insufficient level of involvement of local communities negatively affect the

attractiveness and inclusiveness of such initiatives. Given this, the further development of sustainable finance requires systematic measures to harmonise the regulatory environment, create effective motivational mechanisms and strengthen communication with stakeholders.

Comparison with previously published studies

Several scientific studies on the development of green finance in transition economies, in particular in Poland and Ukraine, have revealed common patterns. Among them, it is worth noting the active participation of donor organisations, the presence of a fragmented regulatory environment, and the limited capacity of national institutions to implement and support sustainable financial instruments. These studies confirm that despite the differences in national contexts, transition economies face similar challenges in developing a green financial system. This situation emphasises the need for a comprehensive approach to reforming the regulatory framework, strengthening institutional capacity, and deepening international cooperation for the effective implementation of environmentally friendly financial practices.

In Ukraine, for example, the green bond market remains in its infancy, but holds notable potential. The country issued its first green bonds in 2021, amounting to USD 33 million, to finance solar energy projects and other renewable infrastructure. This was an essential step toward signalling Ukraine's readiness to attract sustainability-oriented capital. However, development in this area is constrained by several structural barriers, including a lack of standardised regulations for issuance and monitoring, insufficient transparency in reporting, and low awareness among investors and businesses regarding the benefits of green bonds (Sapozhnikov, Zhabak, & Sydorko, 2024). Poland stands out as a pioneer in the adoption of sovereign green bonds, issuing its first in December 2016 for €750 million—the earliest sovereign green debt in Europe—and following up in 2019 with a second €2 billion sovereign issue, reflecting robust investor appetite (bne IntelliNews, 2019; Reuters, 2016).

However, challenges remain similar to those in Georgia and Ukraine—such as high issuance costs, lack of standardised taxonomies, and risk of greenwashing—limiting broader domestic uptake. Practical examples of the development of a green finance system in Poland demonstrate both a significant level of maturity and some remaining obstacles in this sector. This experience is essential for Georgia, as it allows for considering key lessons and adapting them to its conditions. Although the Georgian context is different due to the dominance of hydropower and the complex mountainous terrain, the Šuātsevi case demonstrates that even in the absence of a developed green bond market, large-scale infrastructure projects using mixed sources of financing can be successfully implemented. This confirms the possibility of effectively implementing complex financial models in developing countries with similar economic and geographical characteristics, despite the limitations of the green instrument market.

Consequences for Georgia

The experience of the Shuatsevi Hydropower Plant provides valuable guidance for future green infrastructure projects in Georgia, especially in areas such as transport system modernisation, energy efficiency improvement of existing facilities, and water resources management. The analysis of this case highlights the importance of early stakeholder engagement, effective environmental protection measures, and integrated monitoring systems at all stages of project implementation. Interaction between financial regulatory institutions, environmental authorities, and local administrations is a necessary condition for aligning local development priorities with green financing opportunities. Such an interagency approach contributes to the formation of sustainable and socially responsible investment strategies that meet the national goals of ecological transformation.

Meaning for a broader context

This case study contributes to expanding theoretical and practical knowledge about green finance mechanisms in transition economies, demonstrating how external financial flows, combined with internal institutional capacity, can support the development of climate-friendly infrastructure. Compliance with environmental, social and corporate responsibility (ESG) principles is not only an element of reputational status, but also a functional requirement necessary to ensure the long-term sustainability and legitimacy of projects. The example of the

Shuatsevi hydroelectric power plant illustrates that successful implementation of initiatives requires comprehensive consideration of local characteristics — geographical conditions, social structure of communities and the level of development of institutional capacity — at the stages of financial planning and project design. Such an approach ensures the adaptability and effectiveness of green investments in the context of transition economies.

Research boundaries

This study, conducted as a single case study, does not aim to generalise the findings to all green infrastructure projects or across countries. The analysis of the Schuatze hydropower plant provides valuable information, but the results have limited applicability due to the specific institutional environment and geographical features of the region. Limited access to certain financial documents created difficulties in a complete analysis, and some long-term environmental impacts, in particular, absolute reductions in CO_2 emissions and restoration of biodiversity, remained unconfirmed due to a lack of data. Further research would benefit from applying a comparative analysis of several cases and conducting longitudinal assessments of the impact of similar projects over time, which would contribute to a deeper understanding of the effectiveness of green finance in different contexts.

CONCLUSIONS

Summary of main results

The study examined the role of green finance in supporting the construction of the Shuatsevi Hydropower Plant in Georgia, including the use of concessional loans, capital investments, and technical assistance. International financial institutions, effective governance mechanisms, and partial integration of environmental and social measures ensured the project's success. However, technical and social challenges highlight the complexity of developing green infrastructure in transition economies.

Solving research questions

Financing was provided through concessional loans from the EBRD, IFC, ADB and equity investments from Clean Energy Invest, Tata Power and IFC. Although no green bonds were issued, the structure met the criteria for green finance due to its focus on low-carbon targets and environmental measures. The project reduced CO_2 emissions by more than 200,000 tons annually, strengthened energy independence and created new jobs. Social impacts were manifested in the renewal of infrastructure, but also caused tensions due to the use of land and water resources.

Practical tips

Recommendations include harmonising the national taxonomy with international standards, introducing tax incentives and subsidies for green projects, and expanding grant support for environmental programs. Local banks should raise awareness of ESG and develop assessment tools.

4. Directions for future research

Further research should focus on comparative analysis of green infrastructure, long-term environmental and financial outcomes, and community participation in different institutional settings.

Acknowledgements

None.

Conflict of Interest

None.

Funding

The author received no specific funding for this work.

REFERENCES

Adjaristsqali Georgia LLC. (2023). About us. https://agl.com.ge/en/chven-shesaxeb

Ahmad, M., Pata, U. K., Ahmed, Z., & Zhao, R. (2024). Fintech, natural resources management, green energy transition, and ecological footprint: Empirical insights from EU

countries. Resources Policy, 92, Article 104972 https://doi.org/10.1016/j.resourpol.2024.104972

Alharbi, S. S., Al Mamun, M., Boubaker, S., & Rizvi, S. K. A. (2023). Green finance and renewable energy: A worldwide evidence. Energy Economics, 118, Article 106499. https://doi.org/10.1016/j.eneco.2022.106499

Barahona, S., Girón, C., & Tebrake, J. (2023, December 21). Issues note: Sustainable finance definitions in the 2025 SNA and Balance of Payments Manual 7 (SNA/M1.25/02). United Nations Statistics Division. https://unstats.un.org/unsd/nationalaccount/aeg/2024/M25/M25_2_Sustainable_Finance_Definitions.pdf

Bhatnagar, S., & Sharma, D. (2022). Evolution of green finance and its enablers: A bibliometric analysis. Renewable and Sustainable Energy Reviews, 162, Article 112405. https://doi.org/10.1016/j.rser.2022.112405

Bhutta, U. S., Tariq, A., Farrukh, M., Raza, A., & Iqbal, M. K. (2022). Green bonds for sustainable development: Review of literature on development and impact of green bonds. Technological Forecasting and Social Change, 175, Article 121378. https://doi.org/10.1016/j.techfore.2021.121378

Bne IntelliNews. (2019, March 3). Poland places €2bn worth of green bonds. https://www.intellinews.com/poland-places-2bn-worth-of-green-bonds-157278/

Clean Energy Invest AS. (n.d.). Projects. https://www.cleanenergyinvest.no/projects/

Compliance Advisor Ombudsman. (2021). Compliance appraisal report – Adjaristsqali Hydropower Cascade Project, Georgia. World Bank Group. https://www.cao-ombudsman.org/sites/default/files/downloads/CAO%20Compliance%20Appraisal%20Adjaristsqali%20Hydropower%20Cascade%20Project%20Georgia.pdf

Dar, B. I., Badwan, N., & Kumar, J. (2024). Investigating the role of Fintech innovations and green finance toward sustainable economic development: A bibliometric analysis. International Journal of Islamic and Middle Eastern Finance and Management, 17, 1175–1195. https://doi.org/10.1108/IMEFM-01-2024-0018

Dzadzua, M. (2025). Building a sustainable financial future: Exploring Georgia's path to green finance. Journal of Development Studies, 5(1(5)), 17–24. https://doi.org/10.52340/jds.2024.05.05.02

European Bank for Reconstruction and Development. (2021). Green Economy Transition (GET) and Paris alignment. Shuakhevi HPP (Project ID 45335). https://www.ebrd.com/home/who-we-are/ebrd-values/ebrd-environmental-social-sustainability/EBRD-green/Green-Economy-Transition-Paris-alignment.html

Gabr, D. H., & Elbannan, M. A. (2024). Green finance insights: Evolution of the green bonds market. Management & Sustainability: An Arab Review, 3(3), 274–297. https://doi.org/10.1108/MSAR-02-2023-0008

Abdul Gafoor, C. P., Perumbalath, S., Daimari, P., & Naheem, K. T. (2024). Trends and patterns in green finance research: A bibliometric study. Innovation and Green Development, 3(2), Article 100119. https://doi.org/10.1016/j.igd.2023.100119

Guo, M., Pang, D., & Dong, J. (2024). Promoting green growth: Resource management and resource efficiency in East Asian and Pacific economies. Resources Policy, 90, Article 104705. https://doi.org/10.1016/j.resourpol.2024.104705

Halden, U., & Cali, U. (2024). Exploiting green energy potential via FinTech: The role of DLT-based crowdfunding in PV and ESS investments. Renewable Energy, 228, Article 120528. https://doi.org/10.1016/j.renene.2024.120528

Hua, M., Li, Z., Zhang, Y., & Wei, X. (2024). Does green finance promote green transformation of the real economy? Research in International Business and Finance, 67, Article 102090. https://doi.org/10.1016/j.ribaf.2023.102090

International Finance Corporation. (2024, July 26). IFC anchors green bond issuance by Georgia Global Utilities to improve water services for 1.3 million people in Georgia. https://www.ifc.org/en/pressroom/2024/ifc-anchors-green-bond-issuance-by-georgia-global-utilities-to-improve-water-services-for-13-million-people-in-georgia

Lazaro, L. L. B., Grangeia, C. S., Santos, L., & Giatti, L. L. (2023). What is green finance, after all? – Exploring definitions and their implications under the Brazilian biofuel policy (RenovaBio). Journal of Climate Finance, 2, Article 100009. https://doi.org/10.1016/j.jclimf.2023.100009

Al Mamun, M., Boubaker, S., & Nguyen,

D. K. (2022). Green finance and decarbonization: Evidence from around the world. Finance Research Letters, 46, Article 102807. https://doi.org/10.1016/j.frl.2022.102807

National Bank of Georgia. (2021). Sustainable finance in Georgia: Status report 2021. https://nbg.gov.ge/fm/ფინანსური_სტაბილურობა/მდგრადი_დაფინანსების_ანგარიში/2021/sf-status-report-2021-eng.pdf?v=mtkav

National Bank of Georgia. (2022). Sustainable finance in Georgia: Status report 2022. https://nbg.gov.ge/fm/ფინანსური_სტაბილურობა/მდგრადი_დაფინანსების_ანგარიში/2022/sf-status-report-2022-eng.pdf?v=45k4v

National Bank of Georgia. (2023a). Principles on ESG disclosure. https://nbg.gov.ge/fm/ფინანსური_სტაბილურობა/მდგრადი_დაფინანსების_ანგარიში/esg_საკითხების_გამჟღავნება/nbg-principles-on-esg-disclosure-eng-6af93e3b.pdf

National Bank of Georgia. (2023b). Sustainable finance in Georgia: Status report 2023. https://nbg.gov.ge/fm/ფინანსური_სტაბილურობა/მდგრადი_დაფინანსების_ანგარიში/2023/sf-status-report-nbg-2023-eng.pdf?v=ko7ab

National Bank of Georgia. (2023c). Sustainable finance roadmap. https://nbg.gov.ge/fm/ფინანსური_სტაბილურობა/მდგრადი_დაფინანსების_ანგარიში/გზამკვლევი/sustainable-finance-roadmap-eng.pdf?v=xegrs

National Bank of Georgia. (2024). Sustainable finance in Georgia: Status report 2024. https://nbg.gov.ge/fm/ფინანსური_სტაბილურობა/მდგრადი_დაფინანსების_ანგარიში/2024/sf-report-2024-eng.pdf?v=g3ed8

Qian, S. (2024). The effect of ESG on enterprise value under the dual carbon goals: From the perspectives of financing constraints and green innovation. International Review of Economics & Finance, 93, 318–331. https://doi.org/10.1016/j.iref.2024.03.010

Reuters. (2016, December 5). Poland puts stake in the ground for first sovereign green bond. https://www.reuters.com/article/markets/poland-puts-stake-in-the-ground-for-first-sovereign-green-bond-idUSL5N1E04UD/

Ruggerio, C. A. (2021). Sustainability and sustainable development: A review of principles and definitions. Science of The Total Environment, 786, Article 147481. https://doi.org/10.1016/j.scitotenv.2021.147481

Sapozhnikov, V., Zhabak, A., & Sydorko, V. (2024). Development of green finance as a tool for sustainable development: Concepts, instruments, international experience, and prospects for Ukraine. Economic Analysis, 34(3), 598–612. https://doi.org/10.35774/econa2024.03.598

SavvY. (2024). Green finance landscape in Georgia and regional best practices. Swisscontact. https://www.swisscontact.org/_Resources/Persistent/9/7/b/2/97b2e19baed0f20c647e891315cbfd52dd9daad6/Green%20Finance%20Landscape.pdf

Sun, G., Li, G., Dilanchiev, A., & Kazimova, A. (2023). Promotion of green financing: Role of renewable energy and energy transition in China. Renewable Energy, 210, 769–775. https://doi.org/10.1016/j.renene.2023.04.044

Tariq, A., & Hassan, A. (2023). Role of green finance, environmental regulations, and economic development in the transition towards a sustainable environment. Journal of Cleaner Production, 413, Article 137425. https://doi.org/10.1016/j.jclepro.2023.137425

Uche, E., Ngepah, N., Das, N., & Dey, L. (2024). Dynamic interactions of green innovations, green transitions and ecological load capacity factor in BRICS. Renewable Energy, 231, Article 120905. https://doi.org/10.1016/j.renene.2024.120905

Utomo, C., Dwi Astarini, S., Fadhil, S. N., & Bintang Nurcahyo, C. (2023). Review of previous research methods of green finance for green building. Materials Today: Proceedings, 85, 104–107. https://doi.org/10.1016/j.matpr.2023.05.270

Wang, Q., & Fan, Z. (2023). Green finance and investment behaviour of renewable energy enterprises: A case study of China. International Review of Financial Analysis, 87, Article 102564. https://doi.org/10.1016/j.irfa.2023.102564

Wang, T., Umar, M., Li, M., & Shan, S. (2023). Green finance and clean taxes are the

ways to curb carbon emissions: An OECD experience. Energy Economics, 124, Article 106842. https://doi.org/10.1016/j.eneco.2023.106842

Monasterolo, I., Mandel, A., Battiston, S., Mazzocchetti, A., Oppermann, K., Coony, J., Stretton, S., Stewart, F., & Dunz, N. (2022). The role of green financial sector initiatives in the low-carbon transition: A theory of change (Policy Research Working Paper No. 10181). World Bank. https://openknowledge.worldbank.org/server/api/core/bitstreams/50b4b0d8-a194-597d-9a82-10fdd6d0c188/content

World Economic Forum. (2022, January 17). What is green finance? https://www.weforum.org/agenda/2022/01/what-is-green-finance/

Xiaoping, C., & Yanqiu, W. (2024). Cultivating green growth: The interplay of communication and resource efficiency in East Asia. Resources Policy, 90, Article 104776. https://doi.org/10.1016/j.resourpol.2024.104776