

Green Growth Transformation and Entrepreneurial Ecosystem Development in Post-Conflict Karabakh: Drivers, Mechanisms, and Policy Implications

Rasul Yusibov

Ph.D. Research Fellow, Head, Global Affairs Office, International Cooperation Department, Azerbaijan State University of Economics (UNEC), Ganja State University (GSU)

rasul.yusibov@unec.edu.az

ORCID: <https://orcid.org/0009-0007-1270-6544>

Abstract: This paper explores the prospects of green growth transformation and entrepreneurial ecosystem development in post-conflict Karabakh, focusing on structural drivers, institutional mechanisms, and policy implications. Following the end of armed conflict, Karabakh presents a unique case for sustainable reconstruction, where economic revitalization can be aligned with environmental sustainability and innovation-led growth. The study identifies key drivers such as infrastructure rebuilding, renewable energy potential, digital transformation, and international investment flows. It also analyzes mechanisms including public-private partnerships, regulatory reforms, and entrepreneurial support systems. The research adopts a qualitative and conceptual methodology, drawing on secondary data and comparative case studies from other post-conflict regions. The findings highlight that green growth strategies can enhance long-term resilience, support inclusive development, and position Karabakh as a regional model for sustainable post-conflict recovery. Policy implications emphasize the importance of integrated planning, institutional capacity-building, and fostering innovation ecosystems.

Keywords: green growth, post-conflict development, Karabakh, entrepreneurship, sustainability, economic reconstruction

1 Introduction

Post-conflict regions often face complex challenges related to economic recovery, institutional rebuilding, and social cohesion. In recent years, scholars have increasingly emphasized the importance of integrating sustainability into post-conflict reconstruction strategies. The concept of green growth, which promotes

economic development while ensuring environmental sustainability, has emerged as a promising framework in this regard [2]. In the context of Karabakh, a region undergoing large-scale reconstruction following decades of conflict, the opportunity to embed green growth principles into development strategies is particularly significant.

The literature on post-conflict economic development highlights the role of entrepreneurship as a critical driver of recovery, resilience, and poverty reduction in fragile environments [1, 3]. Entrepreneurial ecosystems, defined as interconnected networks of institutions, policies, and actors that support business creation and innovation, are essential for fostering sustainable economic growth [4]. In parallel, green entrepreneurship has gained increasing attention as a mechanism for aligning economic activity with environmental objectives and facilitating sustainable sociotechnical transitions [5]. Together, these approaches provide a valuable framework for understanding how post-conflict regions can pursue economic revitalization while advancing long-term sustainability goals.

Despite the growing body of research, there remains a gap in understanding how green growth and entrepreneurial ecosystems can be effectively integrated in post-conflict settings, particularly in the South Caucasus region. This paper addresses this gap by focusing on Karabakh as a case study. The rationale for selecting this topic lies in the region's strategic importance, its untapped renewable energy potential, and the ongoing efforts to rebuild infrastructure and institutions. Furthermore, Azerbaijan's national development agenda increasingly emphasizes sustainability and innovation, making Karabakh a relevant and timely case for analysis.

The main problem of the research is the lack of a coherent framework for integrating green growth principles with entrepreneurial ecosystem development in post-conflict environments. The research aims to identify the key drivers and mechanisms that can facilitate such integration and to derive policy implications for sustainable reconstruction. The under-researched nature of Karabakh in academic literature further justifies the contribution of this study. This study employs a qualitative methodology based on secondary data analysis, including policy reports, academic literature, and international case studies. The approach is intentionally simple and conceptual, focusing on synthesizing existing knowledge to generate insights applicable to Karabakh. The remainder of the paper is structured as follows: Section 2 reviews the theoretical foundations of green growth and entrepreneurial ecosystems; Section 3 analyzes the drivers and mechanisms in the context of Karabakh; and Section 4 discusses policy implications.

2 Materials and Methods

This study adopts a qualitative, conceptual, and exploratory research design aimed at understanding the dynamics of green growth transformation and entrepreneurial ecosystem development in post-conflict Karabakh. Given the early stage of reconstruction and the limited availability of primary empirical data, the research relies on secondary data sources and comparative analytical methods. The materials used in this research include policy documents from the Government of Azerbaijan, international organization reports (World Bank, OECD, UNDP), academic journal articles on post-conflict reconstruction and green growth, and case studies from comparable regions such as Rwanda, Bosnia and Herzegovina, and Kosovo. These cases were selected due to their relevance in demonstrating how post-conflict economies can integrate sustainability and entrepreneurship into recovery strategies. The methodology is intentionally simple and structured around three main components. First, a systematic literature review was conducted to identify theoretical frameworks related to green growth, entrepreneurial ecosystems, and post-conflict development. Second, a comparative analysis approach was applied to extract transferable lessons from international cases. Third, a conceptual synthesis was developed to adapt these insights to the Karabakh context. To operationalize the analysis, the study identifies key variables such as infrastructure development, renewable energy capacity, institutional quality, access to finance, and human capital [11, 12, 15]

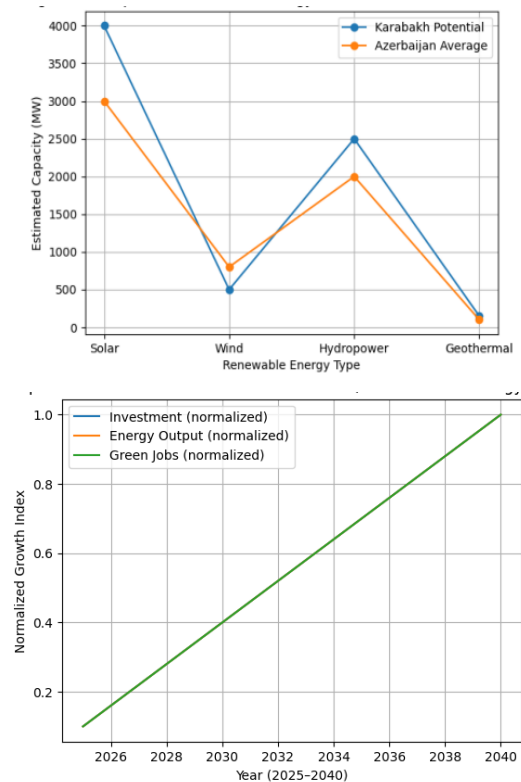
A conceptual model is proposed to explain the interaction between these elements. The model consists of three interconnected layers: (1) Structural Drivers (infrastructure, natural resources, policy environment), (2) Enabling Mechanisms (institutions, financial systems, innovation platforms), and (3) Outcomes (green entrepreneurship, sustainable growth, regional competitiveness). The model assumes a feedback loop, where successful entrepreneurial activities reinforce institutional development and attract further investment.

3 Drivers and Mechanisms of Green Growth in Karabakh

The transformation of Karabakh into a sustainable and innovation-driven economic zone depends on a combination of structural drivers and enabling mechanisms. One of the most significant drivers is the large-scale reconstruction of infrastructure. The rebuilding of transport networks, smart cities, and digital infrastructure creates a foundation for modern economic activity and supports the integration of green technologies.

Another critical driver is the region’s substantial renewable energy potential, particularly in solar, wind, and hydropower. The concept of “green energy zones,” already promoted by the Azerbaijani government, positions Karabakh as a hub for clean energy production. This creates opportunities for green entrepreneurship in areas such as energy services, sustainable agriculture, and eco-tourism. The effective management of natural resources and renewable energy assets is increasingly recognized as an important component of sustainable development and long-term economic transformation [6].

Human capital development also plays a crucial role. The return of displaced populations and the attraction of skilled professionals can contribute to the creation of a dynamic entrepreneurial ecosystem. Education and training programs focused on sustainability and innovation are essential in this regard, as human capital remains a key determinant of economic diversification, entrepreneurship, and sustainable regional development [6].

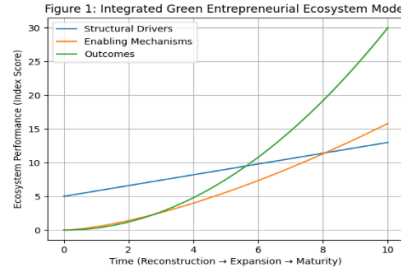


Graph 1.
Comparative Renewable Energy Potential (Karabakh)
Source: State Statistical Committee of Azerbaijan, 2024

In terms of mechanisms, institutional frameworks are central. Effective governance, transparent regulations, and investment-friendly policies are necessary to attract both domestic and foreign investors. Public-private partnerships (PPPs) can facilitate large-scale infrastructure and energy projects, while also supporting small and medium-sized enterprises (SMEs). Access to finance is another key mechanism. The establishment of green finance instruments, such as green bonds and sustainability funds, can provide capital for environmentally friendly projects. International financial institutions can also play a role by offering technical assistance and funding. Innovation platforms, including technology parks and startup incubators, are essential for fostering entrepreneurship. The interaction between these drivers and mechanisms creates a virtuous cycle. For example, improved infrastructure attracts investment, which in turn supports entrepreneurial activity, leading to economic growth and further development.

4 Conceptual Model of Green Entrepreneurial Ecosystem in Post-Conflict Karabakh

The figure illustrates three ascending curves: (i) Structural Drivers (INF, REN), (ii) Enabling Mechanisms (INST, FIN, INN), and (iii) Outcomes (Green Startups, Investment, Competitiveness). The model shows that while infrastructure and energy investments rise first, institutional and financial mechanisms accelerate growth in the mid-phase, leading to exponential outcomes in later stages. The proposed model conceptualizes Karabakh's transformation as a multi-layered system. At the base level, structural drivers provide the necessary conditions for development. These include physical infrastructure, natural resource endowments, and macroeconomic stability. The second layer consists of enabling mechanisms, which translate these conditions into actionable opportunities. Institutions, financial systems, and innovation networks play a mediating role by facilitating interactions between stakeholders.



X-axis: Time (Reconstruction → Expansion → Maturity)
Y-axis: Ecosystem Performance (Index Score: 0–100)

Figure 1.

Integrated Green Entrepreneurial Ecosystem Model

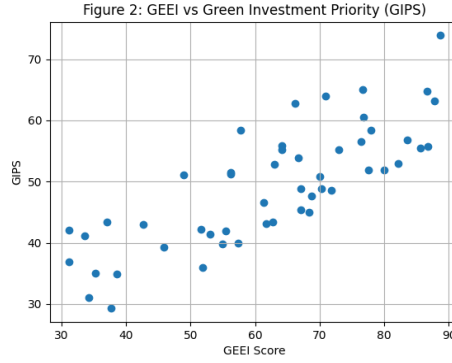
Source: Author's conceptualization based on OECD (2011) and Isenberg (2010).

The third layer represents outcomes, including the emergence of green startups, increased investment in sustainable industries, and enhanced regional competitiveness. These outcomes contribute to long-term resilience and inclusive growth. A key feature of the model is its dynamic nature. Feedback loops ensure that successful outcomes reinforce the underlying drivers and mechanisms. For instance, the success of green enterprises can lead to policy improvements, increased investor confidence, and further infrastructure development.

5 Quantitative Application Model for Green Growth–Entrepreneurship Nexus

The scatter plot demonstrates a positive linear relationship between ecosystem readiness and investment prioritization. Projects located in the upper-right quadrant ($GEEI > 70$, $GIPS > 70$) represent high-impact, investment-ready initiatives suitable for fast-track funding. Lower-left quadrant projects require institutional strengthening and capacity-building interventions.

$$GEEI = w1 \cdot INF + w2 \cdot REN + w3 \cdot INST + w4 \cdot FIN + w5 \cdot HC + w6 \cdot INN$$



GEEI Score vs Green Investment Priority (GIPS)
X-axis: GEEI Score (0–100)
Y-axis: GIPS (0–100)

Figure 2.

GEEI vs Green Investment Priority (GIPS)

Source: Author's calculation model.

To complement the conceptual framework, this study proposes a simple composite index model to operationalize and compare green entrepreneurial ecosystem readiness in post-conflict Karabakh. The Green Entrepreneurial Ecosystem Index (GEEI) is defined as:

$$GEEI = w1 \cdot INF + w2 \cdot REN + w3 \cdot INST + w4 \cdot FIN + w5 \cdot HC + w6 \cdot INN$$

where: INF (infrastructure quality), REN (renewable energy capacity/utilization), INST (institutional quality), FIN (access to finance), HC (human capital), and INN (innovation capacity). Weights ($w1$ – $w6$) sum to 1 and can be set equally ($1/6$) for simplicity or adjusted via expert scoring (Delphi-lite). Each component is normalized on a 0–100 scale using min–max normalization based on regional benchmarks.

For policy application, a Green Investment Priority Score (GIPS) is derived:

$$GIPS = 0.5 \cdot GEEI + 0.5 \cdot (\text{Policy Readiness Score, PRS})$$

PRS aggregates regulatory clarity, PPP frameworks, and incentives for green sectors. Projects/municipalities with higher GIPS receive priority in funding allocation. Sensitivity checks can be performed by varying weights $\pm 10\%$. This parsimonious model enables rapid diagnostics and comparability without complex econometrics. The GEEI–GIPS framework is intended as a practical tool for assessing the readiness of post-conflict regions to support green entrepreneurial

development. The six dimensions included in the model—Infrastructure (INF), Renewable Energy Capacity (REN), Institutional Quality (INST), Access to Finance (FIN), Human Capital (HC), and Innovation Capacity (INN)—capture the key factors commonly identified in the entrepreneurship ecosystem and sustainable development literature.

Each variable reflects a distinct aspect of ecosystem performance. Infrastructure and renewable energy provide the physical foundation for economic activity, while institutions and finance create enabling conditions for investment and business formation. Human capital and innovation capacity determine the ability of the region to generate knowledge, adopt new technologies, and sustain entrepreneurial growth. Standardizing indicators on a 0–100 scale enables comparison across projects, sectors, and municipalities. The practical value of the model lies in its ability to support investment prioritization. For example, a municipality with strong renewable energy resources but weak innovation capacity may require targeted support for business incubators and skills development, whereas areas with stronger institutional readiness may be better positioned to attract private investment. By combining ecosystem readiness (GEEI) with policy readiness (PRS), the GIPS indicator helps identify projects that can generate the greatest economic and sustainability impact under limited reconstruction resources.

Consequently, the framework serves as a decision-support mechanism for governments, development agencies, and investors by facilitating evidence-based allocation of resources and monitoring progress toward sustainable post-conflict recovery.

6 Case-Based Validation and Eligibility Criteria

The radar chart compares post-conflict performance across selected cases. Rwanda shows strong institutional and innovation capacity, Bosnia demonstrates strength in finance and infrastructure due to donor support, while Kosovo exhibits higher human capital and entrepreneurial dynamism. This visualization supports the adaptability of the GEEI model across contexts.

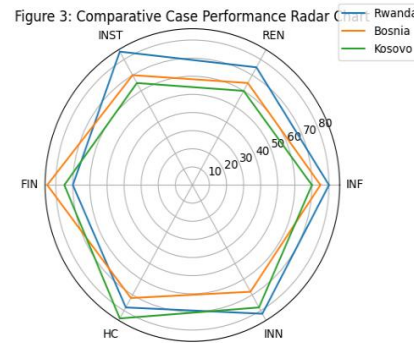


Figure 3.
Comparative Case Performance Radar Chart (Rwanda, Bosnia, Kosovo)
Axes: INF, REN, INST, FIN, HC, INN
Source: Adapted from World Bank (2013) and OECD datasets.

Comparative cases inform parameter selection and eligibility thresholds. In Rwanda, post-conflict recovery integrated green city planning (Kigali), where strong institutions (INST) and innovation platforms (INN) lifted SME participation in green services. Bosnia and Herzegovina illustrates the role of donor-backed finance (FIN) and PPPs in renewable micro-hydro projects, improving REN and INF. Kosovo demonstrates diaspora-driven entrepreneurship (HC, FIN) and regulatory simplification (INST) as catalysts for startup formation. Eligibility for applying the GEEI/GIPS model in Karabakh requires: (i) minimum baseline data availability for all six indicators; (ii) existence of a designated green policy framework (e.g., “green energy zones”); (iii) operational PPP or investment facilitation mechanisms; and (iv) stakeholder coordination platforms (incubators, agencies). Projects qualify for prioritization if $GIPS \geq 60$, with strategic projects (≥ 75) fast-tracked for blended finance instruments (green bonds, IFI co-financing) [14, 15]

7 Discussion

The integration of green growth and entrepreneurial ecosystem development in post-conflict settings has been increasingly recognized as a pathway to resilient and inclusive recovery. Prior studies emphasize that rebuilding alone is insufficient; the quality and direction of reconstruction determine long-term economic, social, and environmental outcomes [2, 5]. In this context, the development of renewable energy infrastructure and the promotion of sustainable economic activities can

support both economic diversification and environmental sustainability. Azerbaijan's growing focus on renewable energy development, particularly through the establishment of green energy zones, reflects this strategic approach and provides a foundation for green entrepreneurship and innovation-driven growth in Karabakh [7, 10, 11, 12]. This paper advances that debate by operationalizing a dual-layer approach that combines structural drivers with enabling mechanisms and introduces a pragmatic index (GEEI) to guide allocation decisions. Evidence from Rwanda, Bosnia and Herzegovina, and Kosovo suggests that sequencing matters. Institutional stabilization (INST) and regulatory clarity often precede successful mobilization of finance (FIN) and innovation (INN). Brück et al. (2013) highlight that entrepreneurship in conflict-affected contexts is highly sensitive to uncertainty; therefore, predictable policy environments reduce risk premiums and unlock private investment. In Rwanda, coordinated urban planning and green infrastructure investments created demand for green SMEs, demonstrating a demand-pull dynamic consistent with OECD (2011) green growth principles. Similarly, Bosnia's reliance on donor finance underscores the catalytic role of blended finance in environments with shallow capital markets, aligning with findings on green finance effectiveness in transitional economies.

The proposed GEEI/GIPS framework contributes methodologically by offering a transparent and adaptable tool for policymakers who often lack granular data or advanced modeling capacity in early reconstruction phases. Unlike complex CGE or DSGE models, the composite index approach allows for rapid iteration, stakeholder engagement, and scenario testing. This aligns with Isenberg's (2010) emphasis on ecosystem orchestration rather than isolated policy instruments. By incorporating feedback loops, where improved outcomes reinforce institutions and attract further capital, the model captures the dynamic nature of ecosystem evolution highlighted in the entrepreneurship literature.

For Karabakh, the salience of renewable energy (REN) as a driver is particularly pronounced due to the region's substantial solar, wind, and hydropower potential, as well as the government's strategic commitment to developing green energy zones [8, 9]. This creates a unique opportunity to leapfrog carbon-intensive development paths and embed sustainability from the outset, echoing Gibbs and O'Neill's argument on the transformative potential of green entrepreneurship [5]. Recent assessments further suggest that Karabakh can become a regional hub for renewable energy production and green investment, strengthening its long-term economic competitiveness [10, 11, 12].

Moreover, the return of displaced populations can expand human capital (HC) and social networks, which, when coupled with digital platforms, can accelerate knowledge diffusion and firm creation. From a scientific perspective, the paper contributes by bridging two literatures that are often treated separately: post-conflict reconstruction and green entrepreneurial ecosystems. It provides a testable

framework that can be applied comparatively across regions, enabling cumulative knowledge building. Practically, it offers a decision-support tool for prioritizing investments and coordinating actors in resource-constrained settings [13, 14, 15]

Despite its practical value, the GEEI–GIPS framework has several limitations. The model relies on indicator selection and weighting procedures that may introduce subjective judgments. Furthermore, data availability in post-conflict regions is often constrained, potentially affecting measurement accuracy. Future research could apply expert-based weighting methods, such as Delphi or Analytic Hierarchy Process (AHP), and test the framework using longitudinal data to improve robustness and predictive validity.

Conclusions

This study demonstrates that integrating green growth principles with entrepreneurial ecosystem development offers a viable and strategic pathway for post-conflict reconstruction in Karabakh. By leveraging its substantial renewable energy potential, particularly in solar and hydropower, the region can transition toward a sustainable and innovation-driven economic model. The proposed conceptual and quantitative frameworks, including the GEEI and GIPS models, provide practical tools for policymakers to prioritize investments, strengthen institutional capacity, and support green entrepreneurship. The findings highlight that successful transformation depends on the alignment of structural drivers with enabling mechanisms such as effective governance, access to finance, and innovation platforms. Comparative case analysis further confirms that coordinated policies and targeted interventions can accelerate recovery and enhance long-term resilience. Overall, this research contributes to both theory and practice by bridging post-conflict development and green economy approaches. It underscores Karabakh's potential to emerge as a regional model for sustainable reconstruction and inclusive economic growth in the South Caucasus.

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