

IMPROVING FINANCIAL MECHANISMS FOR DECARBONIZATION OF GAS INFRASTRUCTURE IN THE TRANSITION TO A GREEN ECONOMY

Qulliyev Ulug'bek Mirzayevich

Leading Specialist at the Ministry of Economy and Finance of the Republic of
Uzbekistan

Abstract. This study proposes a performance-based financial mechanism for decarbonizing Uzbekistan's gas transport infrastructure. Using the Mubarek Compressor Station case, the model combines grant financing, verified gas savings, escrow accumulation, and reinvestment. Findings show that targeted methane reduction measures can generate rapid economic returns and support green transition goals.

Keywords. Green economy; decarbonization; gas infrastructure; methane; finance; reinvestment; Uzbekistan; UTG.

1. Introduction

The accelerating consequences of climate change, growing pressure to reduce greenhouse gas emissions, and the global transition toward sustainable development have made the green economy **one of the central priorities** of modern economic policy. Countries are increasingly **redesigning** industrial systems, energy markets, and investment models to achieve environmental sustainability while maintaining **economic growth**. In this context, decarbonization has become a strategic objective for both developed and emerging economies.

Although natural gas is often considered a transitional fuel due to its lower carbon intensity compared to coal and oil, gas infrastructure remains associated with significant **environmental risks**. One of the most serious challenges is methane leakage across transmission **pipelines, compressor stations, storage facilities, and distribution** networks. Methane has a substantially higher global warming potential than carbon dioxide over the short and medium term, making uncontrolled emissions from gas systems a major obstacle to climate targets.

Therefore, reducing methane leakage and modernizing gas infrastructure are not only technical or environmental tasks, but also **financial** and **institutional** challenges. In many developing economies, including Uzbekistan, aging infrastructure, insufficient

investment resources, tariff constraints, and limited access to long-term capital reduce the ability of gas operators to implement large-scale decarbonization measures.

Natural gas remains the principal component of Uzbekistan's energy structure, accounting for approximately **83 percent of total primary** energy consumption, while renewable sources, mainly hydropower, represent only a limited share of around 1 percent. A similar pattern is observed in the power sector, where nearly **82 percent** of electricity generation is based on natural gas, whereas hydropower contributes about **9 percent**. In 2022, the industrial and residential sectors were the largest consumers of both energy and electricity, indicating substantial potential for improving energy efficiency and expanding the use of renewable energy sources (UNECE, 2024).

For Uzbekistan, where the gas sector plays a critical role in national energy security and industrial development, improvement of financial mechanisms for methane abatement and infrastructure decarbonization has strategic significance. Effective reforms in this sphere can simultaneously reduce environmental damage, lower resource losses, strengthen financial sustainability of sector enterprises, and accelerate fulfillment of national climate commitments.

This paper examines modern approaches to financing gas infrastructure decarbonization and proposes practical mechanisms for improving investment efficiency during the transition to a green economy.

2. Literature Review and Conceptual Background

The concept of the green economy has become a major analytical framework for aligning economic growth with environmental sustainability. According to the United Nations Environment Programme (UNEP), a green economy is defined as an economic system that improves human well-being and social equity while reducing environmental risks and resource scarcity. This approach places particular emphasis on transforming energy systems, since the energy sector remains one of the largest contributors to global greenhouse gas emissions (UNEP, 2011).

For economies with a high dependence on hydrocarbons, the transition to a green economy requires gradual decarbonization rather than abrupt fuel substitution. In Uzbekistan, natural gas continues to dominate the national energy balance, accounting for approximately **83% of total energy supply** and around **82% of electricity generation**, while renewable energy sources remain comparatively limited. These indicators demonstrate that gas infrastructure modernization is not only an

environmental priority, but also a strategic requirement for energy security and economic stability (IEA, 2025).

From an analytical perspective, this structure indicates that immediate elimination of natural gas is economically unrealistic in the short term. Therefore, reducing emissions within the gas value chain becomes a more practical policy direction than rapid fuel displacement. Methane emissions from oil and gas systems have received increasing attention in recent academic and policy literature. According to the International Energy Agency (IEA), the global energy sector emitted approximately **135 million tonnes of methane** in **2023**, with oil, natural gas, and coal operations representing the main sources (IEA, 2025).

The same report notes that around 70% of methane emissions from fossil fuel operations could be reduced with existing technologies. Moreover, a substantial share of these reductions can be achieved at low net cost because captured methane can be sold as commercial gas. This finding is especially important for Uzbekistan. It suggests that methane mitigation should not be treated solely as an environmental expense, but rather as an investment opportunity capable of generating both ecological and financial returns (Climate Policy Initiative , 2023).

Financial barriers remain one of the principal constraints to infrastructure decarbonization. The Climate Policy Initiative estimated that global climate finance flows reached approximately **USD 1.3 trillion in 2021/2022**; however, developing economies continue to face significant shortages of affordable **long-term capital** for infrastructure modernization (Climate Policy Initiative , 2023).

This **financing gap** is relevant for state-owned gas enterprises, where **tariff regulation**, social pricing pressures, and legacy infrastructure often limit internal investment capacity. Academic and policy studies increasingly recommend revolving financing mechanisms, under which savings generated through efficiency improvements are reinvested into subsequent projects. The World Bank and other multilateral institutions have used similar models in municipal energy efficiency and utility modernization programs. Such mechanisms are especially effective where budget resources are constrained but measurable operational savings can be captured (World Bank, 2024).

For gas infrastructure, this means that financial savings created through leakage reduction may be accumulated in dedicated accounts and redirected toward future repairs, monitoring technologies, and modernization investments. This creates a self-sustaining financing cycle. Another emerging area is carbon monetization. The World

Bank's *State and Trends of Carbon Pricing 2024* reports that carbon pricing instruments now cover nearly one quarter of global greenhouse gas emissions (World Bank, 2024).

Overall, descriptive international data show three important conclusions. First, methane reduction in gas systems is among the most cost-effective short-term climate measures. Second, many developing countries lack sufficient capital for rapid modernization. Third, hybrid financing systems that combine grants, savings reinvestment, and carbon value creation are becoming the most practical policy solution. Therefore, designing such a mechanism for Uzbekistan's gas sector represents both a relevant academic issue and a necessary policy priority.

3. Methodology and Research Framework

This study applies a case-study based methodology to develop a practical financial mechanism for decarbonizing Uzbekistan's gas transport infrastructure through JSC O'ztransgaz (UTG). The research combines institutional analysis, descriptive statistics, and policy evaluation.

Institutional analysis is used to assess the roles of key stakeholders, including the Ministry of Economy and Finance, the Ministry of Energy, tariff authorities, and UTG. Descriptive analysis helps explain the economic importance of reducing methane leakage in a gas-dependent energy system. Policy evaluation is applied to examine how the proposed draft resolution can support long-term infrastructure modernization.

The study focuses on a pilot financial facility for UTG based on three core elements: initial grant financing, verification of gas loss reductions, and reinvestment of achieved savings through a dedicated escrow account. Under this model, funds generated from reduced gas losses are redirected toward future leak repair and modernization projects.

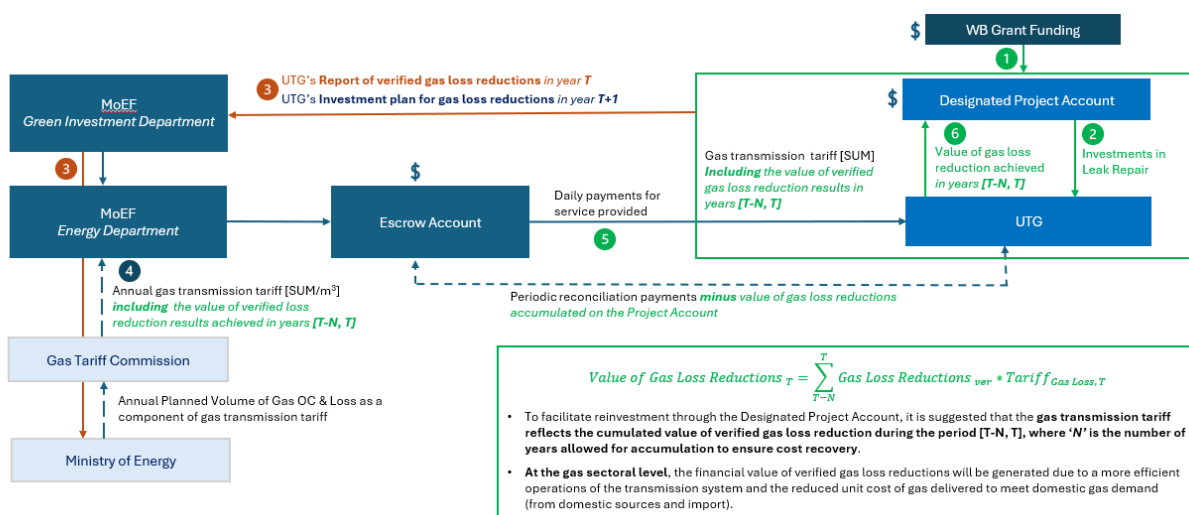
The research framework evaluates the mechanism through four stages: financing, implementation, verification, and reinvestment. This approach allows assessment of both financial sustainability and environmental effectiveness.

Overall, the methodology is designed to test whether a revolving investment model can become an effective instrument for decarbonizing gas transport infrastructure during Uzbekistan's transition to a green economy.

4. Results and Discussion: *Pilot Financial Mechanism for UTG*

The principal result of this study is the formulation of a targeted financial mechanism for decarbonizing Uzbekistan’s gas transport infrastructure through JSC O‘ztransgaz (UTG). The proposed model is designed as a pilot facility for the gas transmission segment, where methane leakage reductions can generate measurable environmental benefits together with direct economic returns. Unlike conventional financing approaches that depend mainly on budget allocations, the mechanism converts operational efficiency gains into a continuous source of reinvestment capital.

The structure of the facility is based on four interconnected stages. First, initial capital is provided through external grant resources and transferred to a designated project account. Second, these resources are used to finance leak detection, repair works, equipment replacement, and modernization activities at selected UTG facilities. Third, achieved gas loss reductions are independently verified and translated into monetary value based on the applicable gas transmission tariff. Fourth, the verified value of saved gas is accumulated through a dedicated escrow arrangement and redirected toward future repair and decarbonization investments. This creates a revolving financing cycle capable of sustaining modernization over time.



Picture 1. Piloting of the re-investment mechanism with UTG

From an environmental perspective, repairing prioritized leaks at high-emission facilities can significantly reduce methane releases in the short term. Since methane has a high short-term warming potential, such reductions provide faster climate benefits than many longer-horizon carbon reduction measures. In addition, verified reductions

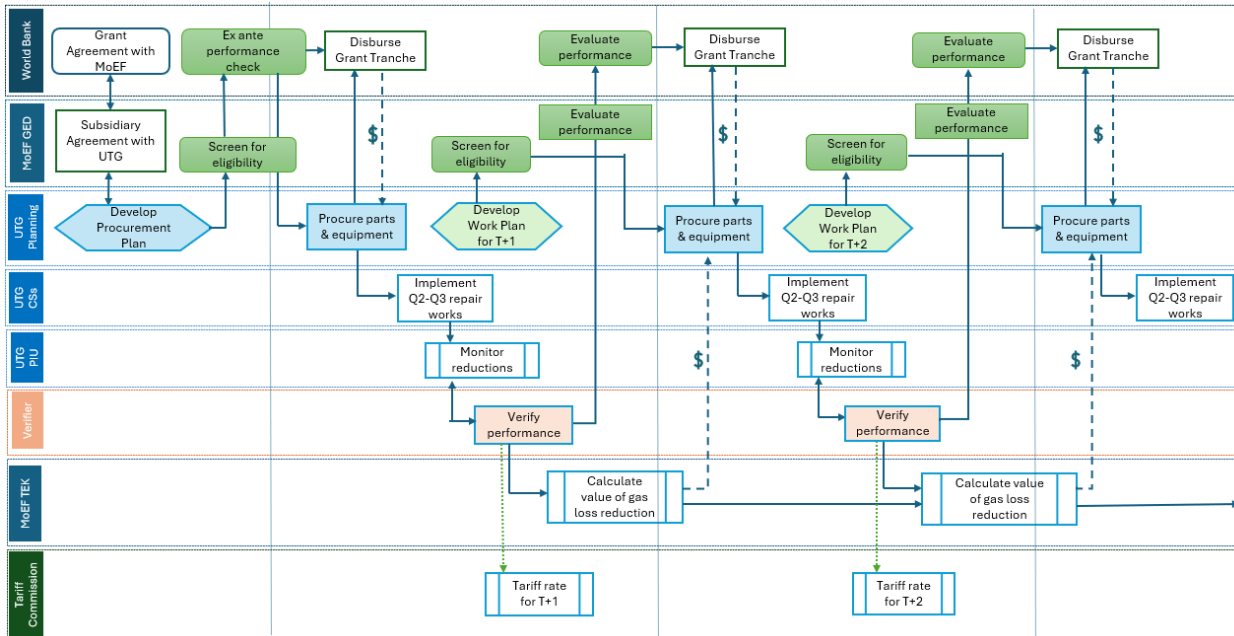
may strengthen Uzbekistan's progress toward national climate commitments and create future carbon monetization opportunities.

The discussion also suggests that the Mubarek pilot can serve as a scalable prototype for broader application across UTG's network. Once the methodology for leak valuation, payback ranking, verification, and reinvestment is institutionalized, the same model may be replicated at other compressor stations and strategic transmission nodes. Over time, this would allow Uzbekistan to build a portfolio-based decarbonization finance system within the gas transport sector.

Overall, the results indicate that the proposed financial mechanism is not only environmentally justified but also commercially rational. By selecting station-specific, high-return repair measures and recycling the resulting savings into future investments, the model provides a practical pathway for decarbonizing gas transport infrastructure during the transition to a green economy.

A key operational feature of the model is that compressor stations are assessed individually rather than applying uniform investment distribution across the network. Each facility is screened according to technical conditions, methane leakage volumes, repair costs, operational feasibility, and expected payback period. As a result, financial resources are directed first to the most economically efficient interventions. This improves capital productivity and ensures that limited resources generate the highest immediate return.

The pilot case of **Mubarek Compressor Station** provides strong empirical support for this approach. According to the technical assessment, initial detection identified **210 leaks** with estimated methane losses of approximately **4.78 million** cubic meters per year. UTG repaired **100 leaks** using its own internal resources, reducing losses by around **1.17 million** cubic meters annually. The remaining leaks were then subjected to cost-benefit prioritization for inclusion under the proposed financial facility.



Picture 1. Operational Cycle of the Reinvestment Mechanism for UTG Gas Transmission Assets

Following economic screening, **56 leaks** were selected as the most efficient package of interventions. The total estimated repair cost for these measures amounted to **USD 117,758**, while expected methane loss reductions reached approximately **2.92 million cubic meters per year**. The cumulative payback period was estimated at only **0.27 years**, or roughly **three months**. This indicates exceptionally high financial efficiency and demonstrates that methane abatement in gas transport infrastructure can produce rapid returns when investments are properly targeted.

The Mubarek case also illustrates the importance of marginal selection logic. According to the assessment, adding the next leak beyond the selected package would increase cumulative cost by **2 percent** while raising methane savings by only **1 percent**, making the additional intervention economically suboptimal. This confirms that the mechanism should prioritize not the largest number of repairs, but the highest-value repairs.

From a financial perspective, the proposed mechanism offers several advantages for UTG. First, it reduces dependence on direct fiscal support by generating internal reinvestment resources from verified efficiency gains. Second, it enables phased modernization across compressor stations and transmission assets. Third, it creates transparent and auditable financial flows through designated project and escrow accounts. Fourth, it aligns managerial incentives with measurable performance outcomes.

5. Conclusion and Policy Recommendations

The transition to a green economy requires not only expansion of renewable energy sources, but also modernization and decarbonization of existing hydrocarbon-based infrastructure. For Uzbekistan, where natural gas continues to play a dominant role in electricity generation, industrial production, and household energy supply, improving the environmental and operational efficiency of gas transport systems remains a strategic priority.

This study demonstrates that methane leakage reduction within the gas transmission network should be approached as both an environmental objective and an economic opportunity. Losses in compressor stations, pipelines, and associated equipment represent not only greenhouse gas emissions, but also forgone commercial resources and additional financial pressure on sector enterprises. Therefore, targeted leak repair and modernization programs can generate dual benefits: emission reduction and measurable financial savings.

The main contribution of the research is the proposed financial mechanism for JSC O‘ztransgaz (UTG), based on grant-supported initial financing, independent verification of gas savings, accumulation of monetized benefits in a dedicated escrow account, and reinvestment into future modernization projects. This model transforms one-time efficiency gains into a revolving source of capital for long-term decarbonization.

The empirical case of Mubarek Compressor Station confirms the practical viability of the approach. Selection of economically efficient repairs with a short cumulative payback period demonstrates that methane abatement in gas transport infrastructure can produce rapid and measurable returns when investments are properly prioritized.

Overall, the findings indicate that the proposed mechanism can strengthen financial sustainability, reduce dependence on direct budget support, improve operational efficiency, and accelerate fulfillment of national climate commitments. It also provides an institutional basis for integrating environmental performance into infrastructure finance policy.

Policy Recommendations

First, the pilot mechanism should be gradually expanded from Mubarek Compressor Station to other compressor stations and priority transmission facilities within the UTG network.

Second, a unified measurement, reporting, and verification (MRV) system should be introduced to ensure transparent accounting of gas loss reductions and financial savings.

Third, the legal and operational framework for dedicated escrow and reinvestment accounts should be formalized to guarantee continuity of funding flows.

Fourth, tariff regulation should incorporate incentive elements that reward verified efficiency improvements and methane reduction measures.

Fifth, Uzbekistan should explore carbon monetization opportunities by integrating verified methane reductions into national climate finance strategies and future carbon market instruments.

In conclusion, a performance-based financial mechanism for gas transport infrastructure can become an effective policy tool for supporting Uzbekistan's green transition. By linking technical efficiency gains with continuous reinvestment, the model offers a realistic and scalable pathway toward cleaner, more sustainable, and financially resilient energy infrastructure.

Reference list

1. Climate Policy Initiative. (2023). Global Landscape of Climate Finance 2023. San Francisco: Climate Policy Initiative.
2. International Energy Agency (IEA). (2025). Global Methane Tracker 2025. Paris: IEA.
3. United Nations Economic Commission for Europe (UNECE). (2024). Energy Policy Brief: Uzbekistan. Geneva: UNECE.
4. United Nations Environment Programme (UNEP). (2011). Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication. Nairobi: UNEP.
5. World Bank. (2024). State and Trends of Carbon Pricing 2024. Washington, DC: World Bank.