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ALIGNING PUBLIC FINANCE WITH GREEN ECONOMY GOALS: THE ROLE OF PERFORMANCE-BASED BUDGETING AND DIGITALIZATION IN POLICY IMPLEMENTATION (A CASE STUDY OF UZBEKISTAN)

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Abstract: Aligning public finance with green economy goals is hindered by a gap between strategic declarations and budgetary realities, which is rooted in systemic information and coordination failures. Although performance-based budgeting is a recognized reform, it is insufficient without a deep digital transformation, which creates a research gap regarding the technological prerequisites for its success. This study analyses the institutional architecture for green Public Financial Management that is being formed in Uzbekistan during the pilot implementation phase of performance-based budgeting. The analysis is based on a corpus of official documents, ranging from national strategies to operational acts that define the performance-based budgeting methodology and the national Green Taxonomy.

The findings show that Uzbekistan is laying the foundations for a data-driven system. Linking national strategy to the budget through performance-based budgeting and standardizing green activities via the Taxonomy create a machine-readable policy architecture to mitigate greenwashing risks. However, inter-departmental digital fragmentation remains a critical challenge. The research concludes that overcoming these information failures requires a genuine digital transformation, which entails creating a holistic digital ecosystem for green finance that utilizes advanced technologies and fosters a data-driven governance culture. The study's findings offer strategic guidance for decision-makers. As the work is a normative case study, it focuses on system design; future research should assess the practical impact on budgetary and environmental outcomes.

Keywords: *green budgeting, public financial management, digital transformation, performance-based budgeting, green taxonomy, data-driven governance, Uzbekistan.*

INTRODACTION

The transition to a green economy requires not only the declaration of long-term strategic goals but also the creation of effective financing mechanisms. The state budget is the primary instrument for this transformation, yet in practice, there is a widespread gap between long-term strategic priorities, including ambitious green goals, and real budgetary capabilities.

This problem is exacerbated by systemic weaknesses in state planning, which are a classic example of the information and coordination failures detailed in foundational works on public financial management (Allen, Hemming, & Potter, 2013). The challenges of aligning strategic priorities with budgetary constraints in practice have been confirmed by specific country case studies (Vinogradova, 2025). Modern research confirms that the gap between strategic goals and their implementation is largely due to the absence of a well-designed architecture for performance measurement systems, which should serve as a crucial link between planning and the use of data for decision-making (Johnsen, Solholm, & Tufte, 2024). Under these conditions, institutional reforms such as the introduction of performance-based budgeting (OECD, 2019) are a necessary but insufficient condition for success. The main challenge lies not merely in creating new budget programs but in managing their complexity, tracking multi-level data flows, and ensuring real-time inter-departmental coordination. This task cannot be solved by analogue methods and requires a profound digital transformation.

This universal problem is particularly relevant to Uzbekistan, which is at the pilot stage of implementing performance-based budgeting to achieve the goals of its "Uzbekistan-2030" Strategy.[1] Green economy objectives, such as improving the environmental situation or adapting to climate change, are a prime example of such complex tasks. They are inherently inter-departmental and long-term, and their results are difficult to measure with direct indicators, making them especially vulnerable to these very information and coordination failures. The launch of this process presents a unique opportunity but simultaneously reveals a key challenge: how to embed digital tools capable of overcoming traditional barriers into the public financial management system from the design stage. The absence of such tools increases the risk of "greenwashing," which is fundamentally a problem of unreliable and non-transparent data (de Grefte & de Bruin, 2025), and undermines trust in the entire green agenda.

[1] Decree of the President of the Republic of Uzbekistan, September 11, 2023, No. UP-158, On the "Uzbekistan-2030" Strategy", https://lex.uz/ru/docs/6600404.

RESEARCH QUESTION AND OBJECTIVE

This study poses the following research question: What institutional and technological prerequisites for the digital transformation of green public finance management are being formed in Uzbekistan during the pilot implementation of performance-based budgeting, and what are the key challenges to their realization?

The objective of the research is to analyse the emerging institutional architecture for aligning the budget process with green economy goals in Uzbekistan. The paper aims to identify and systematize the key components of this architecture (performance-based budgeting, green taxonomy, digital platforms), substantiate their synergistic effect, and identify the primary barriers (technological, human resource, institutional) hindering the transition to a full-fledged, data-driven governance model.

SUBJECT AND METHODOLOGY

The subject of this research is the processes, tools, and challenges of digitalizing public financial management to achieve green economy goals. The methodology is based on a systemic analysis of a corpus of key legal and strategic documents that form the architecture of green budgeting in Uzbekistan. The analysis covered documents at three levels: strategic (the "Uzbekistan-2030" Strategy, the Strategy for the Transition to a Green Economy); tactical (the Strategy for Improving Public Finance Management); and operational (decree approving the methodology for performance-based budgeting and annual budget parameters). This analysis was conducted through the lens of digital transformation theory to assess the readiness of the institutional environment for the implementation of data-driven approaches.

The performance-based budgeting method is viewed as the foundation for creating a machine-readable public policy architecture. It provides the necessary logical framework ("goal - objective - indicator"), which is then digitized using modern digital solutions, such as integrated financial management information systems, and directly linked to budget expenditures through program classifiers (del Paso et al., 2023). Furthermore, the concept of green budgeting (Bova, 2021; Sakrak et al., 2022; Vinogradova, 2023) was analysed from the perspective of the data and digital infrastructure requirements necessary for its full implementation (Vasconcelos et al., 2024). As a case study, an analysis of the regulatory requirements and strategic goals at the current pilot stage of the reform in Uzbekistan was conducted to identify key digital challenges and opportunities, including data standardization, inter-departmental integration, and the implementation of analytical tools.

RESEARCH FINDINGS

An analysis of Uzbekistan's official legal and strategic documents has revealed that the country is developing distinct elements of green budgeting and establishing consistent institutional prerequisites for its digital transformation. The findings demonstrate that a holistic architecture is being laid for the implementation of green performance-based budgeting, capable of operating on a data-driven basis and leveraging advanced technologies in the future.

1. The Foundation for a Machine-Readable Public Policy Architecture Has Been Created.

The research showed that a key achievement of the current reform stage is the formal establishment of a direct regulatory link between national strategic goals and the budget structure, which is a fundamental prerequisite for subsequent digitalization. This link is organized into a strict hierarchical structure. At the top level is the "Uzbekistan-2030" Strategy[1],which establishes comprehensive and measurable environmental goals. Key priorities include large-scale greening of the country under the "Yashil Makon" project (increasing the green coverage to 30%), a radical increase in water use efficiency (a 25% rise through the implementation of water-saving technologies on 2 million hectares), as well as systemic measures for climate change adaptation and biodiversity conservation, including the restoration of the Aral Sea ecosystem. Annually, these goals are specified in a state program for the year with defined priorities; for example, in 2025, the priority is "environmental protection."[2] At the middle, tactical level, documents such as the Public Finance Management Strategy (Resolution No. 210)[3] and Presidential Resolution No. PP-455[4] establish a direct requirement that the goals of the developed budget programs must correlate with the aforementioned long-term priorities. Finally, at the lower, operational level, is the pilot stage of developing budget programs for a number of ministries, including the Ministry of Ecology, Environmental Protection, and Climate Change of the Republic of Uzbekistan, which creates a unique opportunity to embed the correct mechanisms and indicators into their structure from the outset. Thus, a direct and traceable regu-

[1] Decree of the President of the Republic of Uzbekistan, No. UP-158 of September 11, 2023, On the "Uzbekistan - 2030" Strategy. https://lex.uz/ru/docs/6600404.

[2] Decree of the President of the Republic of Uzbekistan, No. UP-16 of January 30, 2025, On the State Program for the implementation of the "Uzbekistan-2030" Strategy in the "Year of Environmental Protection and the Green Economy". https://lex.uz/ru/docs/7369745.

[3] Resolution of the Cabinet of Ministers of the Republic of Uzbekistan, No. 210 of April 8, 2025, On the approval of the Strategy for improving the public financial management system for 2025-2030. https://www.lex.uz/uz/docs/7473280.

[4] Resolution of the President of the Republic of Uzbekistan, No. PP-455 of December 25, 2024, On measures to ensure the implementation of the Law of the Republic of Uzbekistan "On the State Budget of the Republic of Uzbekistan for 2025". https://lex.uz/uz/docs/7283137.

latory chain is established between a high-level policy goal, such as improving the environmental situation, and the specific mechanism for its financing through budget programs that are currently under development. This formalized "goal - objective - activity - resource" hierarchy is essentially the foundation for creating a "digital twin" of the public policy implementation process, where each element can be digitized and linked to others, which is a necessary condition for automating monitoring and analysis.

2. Data Standardization as the Foundation for Automation.

Digital transformation is impossible without unified standards and classifiers, and the analysis identified two key instruments that create this foundation in Uzbekistan. First, the implemented methodology of performance-based budgeting, according to the Resolution of the Cabinet of Ministers No. 4,[1] acts as a standardizer for the budget process itself. It requires a clear distinction between indicators of final results (outcomes), which reflect long-term socio-economic or environmental impact, and indicators of direct results (outputs), which measure the immediate product of an activity, such as the number of seedlings planted or kilometres of roads built. Second, the National "Green" Economy Taxonomy, approved by the Resolution of the Cabinet of Ministers No. 561,[2] serves as a standardizer for green activities themselves, acting as a practical guide for project verification. It translates general declarations into specific, technically measurable, and verifiable requirements. For example, for an energy efficiency project to be recognized as "green," it must ensure an energy consumption reduction of at least 20%, and water-saving projects must achieve savings of 20-40% depending on the sector. Such a taxonomy, as recommended by the World Bank (World Bank, 2024), is a central tool for mitigating the risks of greenwashing. The combined action of these two mechanisms creates the necessary synergy: the taxonomy defines *what* is considered "green," while the performance-based budgeting methodology standardizes *how* it is measured and financed. Without this dual standardization, it is impossible to automate the processes of climate budget tagging, apply artificial intelligence tools for analysis, and ensure data integrity across the entire public administration system.

3. The Challenge of Inter-Departmental Digital Integration has been Identified.

The principle of "greening" the economy, or mainstreaming the environmental agenda, involves integrating relevant metrics into the budgets of sectors not directly

[1] Resolution of the Cabinet of Ministers of the Republic of Uzbekistan, No. 4 of January 4, 2024, On the approval of the Regulation on the procedure for the development, monitoring, and evaluation of the effectiveness of budget programs of budget fund distributors during the implementation of the program budgeting system in the Republic of Uzbekistan. https://lex.uz/ru/docs/6728807

[2] Resolution of the Cabinet of Ministers of the Republic of Uzbekistan, No. 561 of October 25, 2023, On the approval of the National "Green" Taxonomy. https://lex.uz/ru/docs/6646012

related to ecology but having a significant impact on it, such as transport, energy, and agriculture (OECD, 2020; Sakrak et al., 2022). The analysis showed that the existing institutional structure in Uzbekistan creates the prerequisites for this. Since the Ministry of Ecology, Environmental Protection, and Climate Change also oversees the tourism sector, its pilot budget programs will inevitably have to align economic goals, such as increasing tourist flows, with its primary environmental mission. This creates an institutional requirement to apply green budgeting tools, for example, tagging expenditures based on the Taxonomy, to ensure that the development of related sectors contributes to sustainable development. In practice, however, this poses a formidable technical challenge of creating interoperable digital systems. Success depends on the ability of different ministries to exchange data in a unified format, which highlights the problem of lacking a single digital ecosystem for public administration. Climate policy, as emphasized in the UNDP report (UNDP, 2023), is inherently interdisciplinary and dispersed across various sectoral programs, which complicates monitoring. This confirms that without the creation of a unified information space that overcomes departmental fragmentation, the full implementation of green budgeting will be impossible.

4. Key Technologies for the Digital Ecosystem of Green Finance have been Identified.

Strategic documents, including the "Uzbekistan-2030" Strategy, define digitalization as a key factor in increasing the efficiency of public administration. However, in the context of green budgeting, its role extends beyond that of a simple tool; it becomes a necessary condition for the functioning of the entire system. To overcome the identified challenges, such as monitoring complexity, inter-departmental fragmentation, and the risks of greenwashing, the system requires the implementation of a set of modern technologies, transforming the "E-Budget" platform into an integrated analytical environment (Vinogradova, 2025). The automation of objective data collection can be ensured by Internet of Things (IoT) technologies, which will allow a shift from paper-based reporting to real-time information gathering. To support complex decision-making and forecast the consequences of various budget allocation options, artificial intelligence (AI) technologies can be used for scenario modelling. Meanwhile, the use of blockchain technology can guarantee the transparency and immutability of data on the targeted use of "green" funds, minimizing the risks of greenwashing. Thus, digitalization ceases to be an auxiliary function and becomes the foundation that provides the technical feasibility for implementing the reform.

5. Expenditure Analysis Revealed a Data Deficit for Predictive Analytics.

The quantitative analysis of Uzbekistan's public expenditures, presented in the CPEIR report (Ward et al., 2023), provides a crucial baseline for climate financing, reflecting the expenditure landscape prior to the pilot implementation of performance-based budgeting. The analysis showed that between 2020 and 2022, approximately 10-11% of the state budget was directed towards climate-related activities. However, this data also revealed a serious structural imbalance: about 95% of these funds were allocated to climate change adaptation, mainly in the water and agricultural sectors, and less than 5% to mitigation measures, i.e., direct emissions reduction. This finding not only highlights the current focus of public policy but also identifies a key problem with the existing data: its aggregated nature is unsuitable for dynamic forecasting and effective management. The available statistics do not allow for answering the question of which specific adaptation investments were the most effective. This demonstrates the need to transition to collecting more granular, real-time data at the level of specific projects and activities. Therefore, the identified imbalance justifies the need for launching pilot programs not only for a more balanced allocation of resources in the future but also for refining the mechanisms for collecting detailed data that will become the foundation for digital transformation.

DISCUSSION

The findings indicate that Uzbekistan is at a crucial stage, transitioning from the declarative adoption of green goals to their practical implementation through public financial management mechanisms. However, the research shows that the success of this transformation depends not so much on the presence of individual elements, such as a program budget or a green taxonomy, but on their synergy, which can only be ensured through a comprehensive digital transformation. The main challenge for Uzbekistan, as for many other countries, lies in moving from the simple digitization of existing bureaucratic procedures to their genuine digital transformation. Creating the "E-Budget" platform is only the first necessary step. The real complexity, identified during the analysis, is the fundamental restructuring of the decision-making processes themselves, which must become data-driven.

A central problem on this path is ensuring data integrity and reliability. As the research has shown, the National Green Taxonomy is a powerful tool against greenwashing. In a digital environment, it truly transforms from a static document into a dynamic, machine-readable classifier capable of automatically tagging budget expenditures. However, this immediately gives rise to a new, more complex challenge: how to ensure the verification that the data declared in a project (for example, a 20% reduction in energy consumption) corresponds to the actual state of affairs?

Successful automation depends on the quality of primary data, and this opens up the prospect of integrating technologies such as the Internet of Things (IoT) for objective monitoring and blockchain for creating an immutable ledger of transactions and results. Nevertheless, their full-scale integration into government information systems is not only a complex technical task but also a significant institutional one, requiring a revision of existing regulations for data collection and verification.

Another critical challenge arising from the findings is institutional and human resource inertia. The implementation of advanced tools proposed in this study, such as artificial intelligence for scenario modelling and forecasting, requires more than just purchasing software. It demands the development of a new generation of civil servants capable of setting correct tasks for data analysis, and critically evaluating and interpreting its results for managerial decision-making. The existing imbalance in climate financing, identified by the CPEIR report (Ward et al., 2023), can only be effectively corrected if the planning system allows for modelling the long-term effects of investments based on data. This, in turn, is impossible without specialists who possess the relevant competencies. Thus, overcoming the skills gap and potential resistance to change from a civil service accustomed to traditional planning methods is perhaps a more complex and long-term challenge than the technological implementation of the digital platform itself.

Finally, the research findings indicate that a state digital platform cannot and should not be a closed system. The identified challenge of inter-departmental integration is only part of the larger task of building a full-fledged digital ecosystem for green finance. For accurate and objective monitoring of the green transformation on a national scale, it is necessary to integrate data not only between ministries but also from external sources: the private sector, scientific institutions, and civil society. The taxonomy provides a common language not only for government bodies but also for private investors. Consequently, the digital platform must be architecturally open to aggregate data in the future from companies on their green projects, from banks on green loans issued, and from scientific institutions on the actual state of the environment. Only such a comprehensive ecosystem will make it possible to make truly informed decisions and effectively manage the country's transition to a green economy.

CONCLUSIONS

This study concludes that the fundamental barrier to effectively aligning green policy with budget financing is the systemic information and coordination failure inherent in traditional models of public administration. Institutional reforms, such as performance-based budgeting, create the necessary regulatory framework but are incapable of overcoming departmental fragmentation, information asymmetry, and reporting time lags on their own. This research demonstrates that the solution to this

problem lies in a profound digital transformation, which must become the core, rather than an auxiliary element, of public financial management reform.

The case of Uzbekistan has shown that the country has established the key institutional prerequisites for such a transformation, including an approved budgeting methodology and a National Green Taxonomy. These tools serve as the basis for data standardization and digitization. However, the study reveals that the main challenges are now shifting from the legal and regulatory sphere to the technical, organizational, and human resource domains. The success of the pilot phase will depend on the state's ability to design and implement not just IT systems, but a holistic digital architecture that ensures data interoperability between departments.

According to the analysis, a key success factor is the creation of a unified, integrated digital ecosystem for managing green finances. Unlike fragmented departmental IT solutions, such an ecosystem must consolidate data from various sources and use advanced technologies for its processing. The application of the Internet of Things (IoT) will enable a transition to the automatic collection of objective data on the state of the environment; artificial intelligence (AI) will allow for scenario modelling and forecasting the consequences of budgetary decisions; and blockchain can ensure an unprecedented level of transparency and trust in financial flows, which is critical for combating greenwashing and attracting private capital.

Ultimately, this research shows that the main challenge of digitalization is not so much technological as it is cultural and managerial. It lies in the need to transition from a traditional bureaucratic culture, focused on formal execution and the absorption of funds, to a data-driven management culture. This implies developing new competencies among civil servants and changing decision-making processes to be based on data analysis and forecasting, rather than intuition or departmental interests. It is this transformation that will turn green budgeting from a formal procedure into a real tool for achieving sustainable development.

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