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STRATEGIC MODEL FOR THE INTEGRATION OF GREEN TECHNOLOGIES INTO NATIONAL ECONOMIES

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Abstract: This article scientifically illuminates the strategic model of integrating green technologies into national economies. It analyzes such priority areas as increasing energy efficiency, rational use of resources, ensuring environmental safety, and achieving sustainable development. Stages and efficiency factors of the process of "greening" the national economy based on institutional reforms, green financing mechanisms, sectoral transformation, and monitoring systems will also be considered.

Keywords:green technologies, green economy, sustainable development, energy efficiency, resource conservation, ecology, transformation, innovation, green finance, renewable energy, strategy, monitoring, modernization, waste management, national economy.

Introduction

In recent decades, along with global economic development processes, the deepening of environmental problems, the sharp depletion of natural resources, and the intensification of climate change are posing new challenges for national economies. Since the traditional "brown economy" model cannot adapt to such challenges, a new paradigm based on the principles of harmonizing economic growth and environmental sustainability - the green economy and its main component - green technologies - is becoming increasingly important. As noted in the uploaded literature, green technologies strengthen the stability of the economic system by increasing energy efficiency, rational use of natural resources, reducing waste, and ensuring environmental safety. The "Green Economy Transition Strategy for 2019-2030" of the Republic of Uzbekistan has defined the institutional, economic, and technological foundation for this direction, which serves to accelerate the transformation processes in our country. The integration of green technologies into the national economy is crucial not only for improving the ecological environment but also for strengthening energy security, reducing production costs, creating new jobs, and building a modern, competitive economy. Therefore, strategically correct planning and effective management of this process is one of the priorities of national development. This article details the scientific foundations, institutional mechanisms, financing opportunities, sectoral transformation directions, and the strategic integration model developed based on the monitoring system for the introduction of green technologies into the national economy. The purpose of the article is to substantiate and develop a theoretical and practical approach that ensures the integrated introduction of green technologies into the economy.

Literature review

Analysis of scientific literature on green economy and green technologies allows for a deep understanding of the formation, theoretical views, and practical mechanisms of this area. Studies show that the concept of "green economy" has been formed since the end of the 20th century against the backdrop of increasing environmental threats, resource limitations, and the

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negative consequences of industrial development. Initially, this concept was based on the idea of reducing the impact of economic activity on the environment, but in subsequent years it began to be interpreted as an economic model of sustainable development.Green economy includes such principles as environmental protection, efficient use of resources, transition to renewable energy sources, and ensuring social justice. The authors assess "green technologies" as a strategic tool for increasing the energy independence of the economy, ensuring environmental security, and creating new economic opportunities. This resource also identifies technological modernization, innovative infrastructure, and government policy as important factors for the implementation of green technologies.

In the scientific work of Yormonqulova N. Ikromjon qizi, the historical development, principles, indicators, and financing mechanisms of the "green economy" concept are systematically covered. Based on the definition of "green economy" proposed by UNEP, the author defines it as an economic model aimed at reducing environmental risks and ensuring social equality. The study analyzes such priority areas as energy efficiency of the national economy, increasing the share of renewable energy, developing environmental transport, and modernizing the waste management system based on Uzbekistan's "Green Economy Transition Strategy for 2019-2030." In their opinion, natural resources should be considered as an economic asset, and environmental costs should be taken into account in economic policy. Also, the "low-carbon economy" model, developed by international economists, is considered an important stage in the environmental modernization of industrial processes. In scientific sources on green financing, green loans, green bonds, ESG investments, and global green funds are characterized as the main mechanisms supporting environmental projects. Yormonqulova noted that, unlike the traditional financial system, green finance takes into account environmental impact indicators and stimulates sustainable economic development.

Research Methodology

This research is carried out based on a comprehensive approach to scientifically illuminate the topic "Strategic Model for the Integration of Green Technologies into National Economies." The methodology includes modern methods of economic analysis, synthesis of international experience, review of regulatory legal acts, and principles of empirical assessment.Firstly, conceptual approaches to green economy, renewable energy, and environmental innovations developed by the UN Development Programme, the World Bank, the International Energy Agency, and the OECD are selected as the theoretical and methodological basis. These sources show the relationship between economic growth, resource efficiency, and environmental sustainability as an economic model, allowing for the identification of general principles for the integration of green technologies in national economies. Through this approach, the interaction of green technologies with all components of the national economic system - the energy sector, transport, industry, agriculture, and utilities - is studied. The level of technological modernization, the scale of environmental impact, and the contribution of each sector to economic efficiency are assessed individually. The experience of countries that have successfully implemented "green transformation," such as Germany, South Korea, China, Japan, and Finland, is analyzed in accordance with national conditions. In this case, the structural elements of state policy, the model of financial incentives, the role of technological clusters, and the formation of innovation infrastructure are studied separately. In this process, the correlation between the volume of investments in environmentally friendly technologies, the share of renewable energy, the dynamics of carbon emissions, the efficiency of green

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production, and economic growth indicators is assessed. Based on this data, indicators of the degree of integration and economic efficiency will be developed.

Analysis and Results

The analysis and results of this study show that the integration of green technologies creates a double benefit: on the one hand, it reduces the environmental burden, and on the other hand, it increases economic profitability through resource efficiency and technological modernization. The work of UNEP and Pearce et al. provides a theoretical basis for the main mechanisms of the green economy - the valuation of natural capital, internal accounting of environmental costs, and the direction of investments in green assets; based on these principles, a national model was developed. Empirical analysis (international and national statistics) confirms that the main channel of integration is the reduction of energy intensity through modernization and the development of renewable sources in the energy sector. International trends The IEA report notes that renewable capacity showed a sharp increase in 2023, and this growth will be the basis for reducing carbon intensity at the national level; at the same time, financing and regulatory restrictions in developing countries may slow growth. These factors also determine the main obstacles and opportunities in the conditions of Uzbekistan. The system of monitoring and indicators is a necessary condition for measuring the effectiveness of policy. OECD green-growth indicators allow for a systematic assessment of the results of policy measures; therefore, indicators (energy intensity, the share of recycled waste, the share of renewable energy, green jobs, the volume of green investments) were included in the national model as a mandatory element. This approach serves to compare the real result of policy in the international context. In the analysis of funding sources, the World Bank, EIB, and other institutions indicate green bonds, loan guarantees, and international grants as effective instruments; however, their effectiveness depends on national taxonomy, transparent project evaluation, and the availability of risk mitigation mechanisms. Therefore, the strategic model in the financing block emphasizes: a) the introduction of green investment taxonomy, b) the expansion of public-private partnership mechanisms, and c) targeted cooperation with international financial institutions. Sectoral and institutional results:

- Energy sector. The analysis shows that increasing energy efficiency and introducing renewable sources will reduce dependence on national energy imports and reduce production costs. The Uzbekistan Strategy (PQ-4477) emphasizes sectoral measures; however, in practice, the volume of investments and the shortage of technical personnel limit the full functioning of repositories. Therefore, the model proposes to stimulate energy modernization through phased (priority: solar and wind projects, digitalization of networks, integration of energy systems) and financial mechanisms.

- Industry and Manufacturing. The introduction of green technologies in industry will improve the price-quality index by reducing energy and raw material consumption, minimizing waste, and increasing product competitiveness. The literature recommends mechanisms of fiscal support (tax incentives, allocation of subsidies) and technology transfer to depreciate the initial costs of industrial modernization. In national practice, these mechanisms have been effective in pilot projects, but there is a lack of large-scale funding and standardization.

- Transport and urban infrastructure. Green transport (electricity transport, electrification of public transport systems, rational urban planning) reduces carbon emissions in cities and decreases economic losses associated with traffic. The analysis shows that the availability of a

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financing model (for example, green bonds and international loans) stimulates rapid modernization in this area; however, complex solutions integrated with infrastructure and tariff policy are required.

- Agriculture and water resources. Smart irrigation, resource conservation, and biotechnologies increase water and land efficiency in agriculture. The literature emphasizes the need for financial and technical support for small and medium-sized farms in this area, since the adoption of technologies often depends on the economic capabilities of small farmers. The National Strategy prioritizes improving irrigation efficiency and modernizing agricultural technologies.

- Waste management and circular economy. Waste processing and optimization of material flows create economic value and reduce waste. The analysis showed that the introduction of the principles of a circular economy creates a new raw material base for industry and transforms waste into an economic asset; at the same time, it is important to modernize the regulatory framework and create an investment stimulus.

Factors of integration effectiveness and barriers

Based on the analysis, it was established that the effectiveness of integration depends on the following factors: clear and current national taxonomy and accounting standards; availability and transparency of financial instruments; potential of institutions and personnel training; monitoring-indicator system; mechanisms for stimulating private sector participation. The main obstacles are financial gaps, technological transfer costs, regulatory and legal ambiguities, and a shortage of qualified personnel. The literature and empirical analysis show that the integration of green technologies is capable of simultaneously ensuring economic efficiency and environmental sustainability. Practical aspects for the National Strategic Model: priority investments in energy and industry; introduction of green financing instruments (tachonomy, bonds, loan guarantees); mandatory monitoring of indicators; strengthening cooperation with the private sector and international financial institutions; increasing personnel and institutional capacity. If these directions are implemented in the conditions of Uzbekistan based on PQ-4477 and international standards, adapted to local conditions, sustainable green transformation will give real results.

Conclusion

The integration of green technologies into the national economy is manifested today not only as an environmental requirement, but also as an economic necessity. The analysis showed that green technologies significantly strengthen the competitiveness of the national economy by increasing energy efficiency, rational use of resources, accelerating environmental modernization in industry and agriculture, and developing green infrastructure. The introduction of green transport, renewable energy sources, smart agriculture, and waste management technologies ensures a harmonious combination of economic efficiency and environmental sustainability.At the same time, the expansion of green financing mechanisms - in particular, green loans, bonds, and grants from international financial institutions - provides financial incentives for the implementation of these technologies. Institutional reforms carried out by the state, the improvement of the regulatory framework, and the formation of an innovative infrastructure are important factors ensuring the stability of the integration process. The experience of Uzbekistan shows that the scientifically based strategic model for implementing green transformation in the national economy serves to reduce environmental

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risks, stabilize economic growth, and increase competitiveness in the international arena. To further improve this process in the future, it is necessary to introduce innovative technologies, strengthen the participation of the private sector, develop a system for training green personnel, and further improve monitoring mechanisms.In general, the developed strategic model for the integration of green technologies into the national economy is an important direction that serves to bring Uzbekistan into the ranks of environmentally friendly, economically sustainable, and competitive countries.

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