

THE IMPACT OF CIRCULAR ECONOMY INNOVATION AND ENVIRONMENTAL SUSTAINABILITY ON ECONOMIC GROWTH

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Annotation. This article analyzes the impact of innovations and environmental sustainability based on the circular economy on national and global economic growth. The study compares the experience of advanced countries, the situation in Uzbekistan, and economic mechanisms, and proves the economic efficiency of the circular model. The scientific novelty of the article is that it provides a solid basis for real-world examples that serve to increase competitiveness and reduce environmental problems through innovative elements of the circular economy.

This article examines the impact of circular economy innovations and environmental sustainability on economic growth. The study analyzes the possibilities of achieving economic efficiency through recycling and efficient use of resources based on foreign experience. In particular, the experiences of Germany, the Netherlands and China are analyzed and the prospects for their implementation in the conditions of Uzbekistan are considered. The article develops sectoral proposals for the introduction of a circular economy in the economic system of Uzbekistan as a scientific innovation. The article is based on available statistical data, legislative documents and international reports.

Key Words: Circular economy, environmental sustainability, green innovation, economic growth, waste recycling, resource efficiency.

Introduction. Today, resource scarcity, waste problems, and climate change have become important environmental challenges in the world economy. In this context, the circular economy (CE) is being promoted as an alternative model that ensures waste-free production, resource recycling, and sustainable development. This article aims to analyze the impact of circular economy innovation and environmental sustainability on the process of economic growth. The relevance of the topic is that although Uzbekistan has initiated important reforms on the path to a “green economy,” the circular economy approach has not yet been fully implemented in practice.

The circular economy is an alternative to the “take–make–dispose” model, a closed-loop production and consumption system. It is based on the “Cradle to Cradle” model. The Ellen MacArthur Foundation defines the circular economy as a strategy that ensures economic growth while maximizing the value of resources. For example, according to the EU Circular Economy Action Plan (2020), the Full DI model could increase EU GDP by an additional 0. 5% by 2030.

The circular economy is implemented through innovative technologies in the following main areas: Waste recycling and use as a secondary resource; Use of biodegradable products; A product life cycle approach; Optimization of production and consumption

The impact of circular innovation on economic growth can be understood through three lenses (Figure 1).

| Area | Circular Impact | Economic Outcome |
|-----------------------|--|---|
| Industrial Efficiency | Resource-saving technologies and reuse | Reduced production costs, higher margins |
| Job Creation | Repair, recycling, and reverse logistics | New green jobs in all sectors |
| Innovation Incentives | Green R&D and eco-design | Patents, startups, global competitiveness |

Figure 1 - Relationship Between Circularity & GDP Growth

The link between the circular economy and economic growth. Empirical analyses show that DI provides not only environmental benefits, but also high economic efficiency. A study by Eglantina Hysa et al. (2020) found a positive correlation between circular economy indicators and GDP growth in European countries.

This study statistically substantiates the positive impact of waste recycling, the level of use of green technologies and environmental policies on economic growth in the case of 27 European Union countries. According to the OECD, eco-innovation has a positive impact on GDP and creates sustainable jobs. Waste-to-energy, water-saving technologies, and renewable energy play an important role in this. According to OECD (2021) analyses, eco-innovations produce the following economic results: Reducing resource consumption by 20–30%; Reducing production costs by 10–15%; Creating sustainable jobs.

In the case of China, in 2020, the economic benefits of converting waste into energy amounted to 1. 4 trillion yuan (about \$200 billion).

Prospects for introducing innovative mechanisms in countries:

1. Germany achieved up to 67% waste recycling through the Circular Economy Act (1996). More than 300,000 jobs have been created in this area.

2. The Netherlands has a strategy for transitioning to a fully circular economy by 2050. Waste is processed locally in each province.

3. More than 60,000 enterprises operate in China under the Circular Economy Promotion Law, which has been in effect since 2009. In 2020, this sector generated 1. 4 trillion yuan in revenue.

4. Uzbekistan has adopted the “Transition to a Green Economy” concept (2020–2030). Currently, projects are being implemented to separate waste, introduce biogas technologies, and reduce plastic consumption. The importance of the DI concept in the conditions of Uzbekistan

Since 2020, Uzbekistan has adopted a Concept for the transition to a "Green Economy", and DI elements are being gradually introduced. In particular, production efficiency is being increased based on DI through waste reduction in the food industry, the opening of processing enterprises, and the introduction of biotechnology. In this regard, expanding international cooperation, attracting environmental innovations, and directing investments remain important areas.

Challenges and Future Outlook. While the potential is clear, barriers include: Lack of harmonized global policy frameworks; High initial investment costs for SMEs; Limited consumer awareness

Outlook: By 2030, the circular economy could reduce global CO₂ emissions by 39% and create 700,000 net jobs in the EU alone (European Commission, 2023).

Conclusion. As discussed in the article, circular economy innovation is an effective way to ensure environmental sustainability and achieve economic growth. Foreign experience can serve as a practical lesson for Uzbekistan. For the development of this area, it is necessary to strengthen the system of institutional, tax and investment incentives. It is also necessary to develop scientifically based strategies for the introduction of the concept of CI in the sector.

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ПОДХОДЫ К ОЦЕНКЕ ЭКОНОМИЧЕСКОЙ ЭФФЕКТИВНОСТИ ИСПОЛЬЗОВАНИЯ БЕСПИЛОТНОЙ ТЕХНИКИ В СТРОИТЕЛЬСТВЕ

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Резюме. В статье рассматриваются актуальные вопросы цифровизации строительной отрасли Республики Беларусь с акцентом на внедрение беспилотной техники. Подчеркивается взаимосвязь цифровых решений и беспилотной техники, рассматриваемых как элементы единой цифровой экосистемы. Приведены подходы к оценке экономической эффективности использования беспилотных техники и технологий. Авторы выделяют ключевые критерии принятия решений о закупке беспилотной техники: уровень цифровой среды, срок окупаемости, снижение затрат на строительство и расчет экономического эффекта. Сделан вывод о высокой перспективности внедрения беспилотных технологий в строительстве Беларуси при условии методического сопровождения и повышения цифровой зрелости подрядных организаций.

Ключевые слова: цифровизация, беспилотная техника, беспилотные технологии, строительство, экономическая эффективность, цифровая зрелость.

Введение. В Республике Беларусь приняты стратегические документы, направленные на ускоренное внедрение цифровых технологий: Указ Президента № 381 «О цифровом развитии», Программа социально-экономического развития на 2021–2025 годы, Национальная стратегия устойчивого развития до 2035 года, а также Директива Президента № 8 «О приоритетных направлениях развития строительной отрасли». Все они направлены на стимулирование цифровизации экономики, в том числе строительной отрасли [1]. Беспилотная техника и цифровизация в современном строительстве, логистике и промышленности — это технологически взаимосвязанные направления, которые усиливают друг друга, так как беспилотная техника становится с одной стороны частью цифровой экосистемы, а с другой становится инструментом ее практической реализации, источником цифровых данных.

Использование беспилотных технологий в производстве создает конкурентные преимущества производителям развитых стран мира. Основные лидеры: США, Китай, Южная Корея и Сингапур. Согласно прогнозам к 2030 году 34 % задач будут выполняться машинами, 33 % - людьми и еще 33 % совместно. Для