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CIRCULAR ECONOMY BUSINESS MODEL IN THE CHEMICAL INDUSTRY OF UZBEKISTAN

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Abstract

This thesis explores the development and implementation of circular economy business models within the chemical industry of Uzbekistan. It examines the theoretical foundations of circular economy principles, including resource efficiency, waste minimization, recycling, reuse, and closed-loop production systems. The research aims to identify the key challenges and opportunities associated with integrating circular strategies into existing industrial frameworks and evaluates the potential economic, environmental, and social benefits of such transformation. The results of this research provide policy recommendations and strategic guidelines for industry stakeholders and decision-makers to facilitate sustainable growth and enhance environmental performance.

Key words: circular, chemical, economy, business, recycling, resource, industry, model, waste, utilize, strategies, investment, reduce, carbon economy, future outlook.

Аннотация

В настоящей статье исследуются вопросы разработки и внедрения бизнес-моделей циркулярной экономики в химической промышленности Узбекистана. В работе рассматриваются теоретические основы принципов циркулярной экономики, включая эффективность использования ресурсов, минимизацию отходов, вторичную переработку, повторное использование и производственные системы замкнутого цикла. Цель исследования - выявить ключевые проблемы и возможности, связанные с интеграцией циркулярных стратегий в существующую промышленную структуру, а также оценить потенциальные экономические, экологические и социальные выгоды такой трансформации. Результаты исследования содержат рекомендации по вопросам политики и стратегические ориентиры для заинтересованных сторон отрасли и лиц, принимающих решения, с целью содействия устойчивому росту и улучшения экологических показателей.

Ключевые слова: циркулярная, химическая, экономика, бизнес, переработка, ресурс, промышленность, модель, отходы, использовать, стратегии, инвестиции, сокращать, углеродная экономика, перспективы.

Annotasiya

Ushbu maqolada O'zbekiston kimyo sanoatida sirkulyar (aylanma) iqtisodiyot biznes-modellarini ishlab chiqish va joriy etish masalalari tadqiq qilinadi. Maqolada sirkulyar iqtisodiyot tamoyillarining nazariy asoslari, jumladan, resurslardan samarali foydalanish, chiqindilarni kamaytirish, ikkilamchi qayta ishlash, takroriy foydalanish va yopiq siklli ishlab chiqarish tizimlari ko'rib chiqilgan.

Tadqiqotning maqsadi — sirkulyar strategiyalarni mavjud sanoat tuzilmasiga integratsiya qilish bilan bog‘liq asosiy muammolar va imkoniyatlarni aniqlash hamda bunday transformatsiyaning potensial iqtisodiy, ekologik va ijtimoiy afzalliklarini baholashdan iborat. Tadqiqot natijalari barqaror o‘shishni ta’minlash va ekologik ko‘rsatkichlarni yaxshilash maqsadida sohaning manfaatdor tomonlari hamda qaror qabul qiluvchi shaxslar uchun siyosiy masalalar yuzasidan tavsiyalar va strategik yo‘nalishlarni o‘z ichiga oladi.

Kalit so‘zlar: aylanma, kimyoviy, iqtisodiyot, biznes, qayta ishlash, resurs, sanoat, model, chiqindilar, foydalanish, strategiyalar, investitsiyalar, qisqartirish, uglerod iqtisodiyoti, istiqbollar.

Introduction

The transition from a traditional linear economic model to a circular economy has become a critical priority in ensuring sustainable industrial development, particularly in resource-intensive sectors such as the chemical industry. The chemical sector plays a significant role in the economic structure of Uzbekistan, contributing substantially to industrial output, employment, and export potential. However, conventional production practices in this industry are associated with high levels of resource consumption, environmental degradation, and waste generation, necessitating the adoption of innovative and sustainable business approaches.

Circular economy business models (CEBM) in the chemical industry focus on transitioning from linear "take-make-dispose" systems to circularity through reduction, reuse, and recycling of materials. Key strategies include developing sustainable feedstocks, implementing chemical leasing, and fostering industrial symbiosis to enhance resource efficiency and minimize environmental impact.

Literature review

The chemical industry plays a central role in global manufacturing, providing essential inputs for plastics, pharmaceuticals, fertilizers, and specialty materials. However, linear production dominates due to reliance on fossil-based feedstocks, intensive energy use, and complex product value chains (Zeng et al., 2017). Research highlights several areas where CE principles can reshape this sector:

- **Resource Efficiency and Green Chemistry:** Scholars advocate adopting green chemistry principles—such as safer solvent use, catalysis, and atom economy—to minimize environmental impact while maintaining performance (Anastas & Warner, 1998; Sheldon, 2012).
- **Renewable Feedstocks:** Transitioning from petrochemical feedstocks to bio-based alternatives and recycled materials can reduce carbon intensity and resource depletion (Jamieson et al., 2019).
- **Waste Valorization and Industrial Symbiosis:** Inter-firm collaboration allows by-products from one plant to serve as inputs for another, fostering closed-loop systems (Chertow, 2000; Niero & Hauschild, 2017).
- **Technological Innovations:** Emerging technologies—such as chemical recycling of polymers, catalytic depolymerization, and digital tracking—enhance circularity potential (Hopewell et al., 2009; Vollmer et al., 2020).

Despite this progress, the complexity of chemical products, regulatory barriers, and high capital requirements present significant challenges to widespread adoption of CE business models (Korhonen et al., 2018).

Similarly, Kamoliddin Nuriddinov has investigated the integration of circular economy principles into urban-industrial systems, highlighting the importance of sustainable resource management and industrial symbiosis in supporting national development objectives. At Tashkent State Technical University, Salima Khashimova has contributed to the theoretical understanding of circular economy formation and its potential application within Uzbekistan’s industrial sectors. In addition, studies carried out at Gulistan State University by researchers such as Gayrat Berdiev and Sevinch Malikova explore the application of circular economy principles for improving natural resource efficiency. Their work highlights the relevance of circular strategies in reducing environmental degradation and optimizing material flows within resource-intensive industries.

Research Methodology

This study employs a mixed-methods research design, combining qualitative and quantitative approaches to develop a holistic understanding of circular economy (CE) business models within the chemical industry of Uzbekistan. The use of mixed methods enables triangulation—enhancing validity and depth of findings by integrating numerical data trends with contextual insights from experts and industry stakeholders.

Analysis and results

Today, one can encounter various concepts and understandings of circular economy. The basis of this model is the "principle of three R" - to reduce, reuse, and recycle (from English reduce, reuse, recycle). It should be noted that the circular economy is fundamentally opposite to the currently prevailing linear economic model (Figure 1). The linear model is based on the assumption that all natural resources are readily available, available, and easy to utilize [1].

Resource Extraction → Production → Distribution → Consumption → Waste

Let's illustrate a simplified circular economy model, whose key idea is that waste generation and material consumption decrease when using eco-design, waste recycling, and product reuse. This implies both ecological and economic benefits simultaneously.

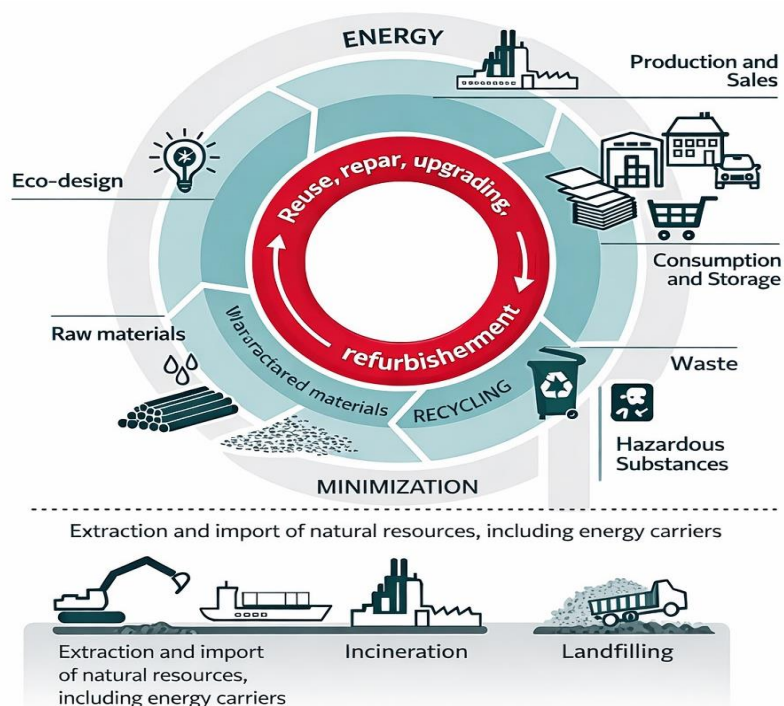


Figure 1. The concept of circular economy [2].

In the context of the transformation of modern society, caused by the spread and implementation of the internet, digital data, robotization, and artificial intelligence, all spheres of human life are changing [3]. Building a circular economy involves global changes at all stages of the production process: from the production and sales chain to the introduction of new business models, the preservation and extension of product life (preservation of natural resources), the processing of waste into a resource, and the introduction of new forms of conscious consumer behavior.

Circular models of economic development involve a more detailed study of data on the use of secondary resources, rational use of waste, and the impact of food components on the environment [4].

A significant factor that allows for significant development of the context of cyclical development models is the control over the use of resources and waste utilization capabilities. The key aspect in a circular economy is resources, that is, increasing resource security and reducing dependence on imports. For a favorable ecological future, the cycle of material and energy consumption must be directed towards optimal resource utilization [5]. The closed-loop economy influences the distribution system, where secondary resources are priority resources [6].

The concept of a circular economy in current conditions must be considered as a relationship between three aspects: social, economic, and environmental.

When transitioning to a cyclical economy, experts highlight three fundamental advantages: 1. Reduction of production costs when producing products due to a decrease in the amount of primary resources used. 2. The emergence of new markets leads to the creation of additional jobs. 3. Due to the reduction in resource utilization in the production process, the negative environmental impact is reduced.

The transition to a circular economy will bring undisputed benefits in three areas: 1. Environmental aspect: reducing the environmental burden. 2. Economic aspect: the potential of economic growth and innovation. 3. Social aspect: rational consumption and growth potential is occupied.

Table 1. Advantages and disadvantages of the circular economy model

Group of factors	Consequences
POSITIVE EFFECTS	
Economic	Reduction of material and raw material costs Sustainable demand for secondary material resources Rational use of products Formation of new industrial sectors Reduction of costs for utilization, maintenance of warehouses and lands
Ecological	Reduction of consumption of natural raw materials and materials, use of renewable materials Reduction of waste burden on the environment Reduction of exhaustible mineral extraction Reduction of pollutant emissions
Social	Production and consumption of environmentally friendly products Creation of additional jobs in the field of waste processing and recycling services, repair and reverse logistics Increasing the level of social responsibility for the careful use of material resources

NEGATIVE EFFECTS	
Economic	Reduction of resource-producing countries' incomes Additional energy and resource consumption during waste and product recycling
Ecological	Increasing storage areas for secondary resources
Social	Job reduction

Source: compiled by the author using materials [7]

In Table 1, we will examine the advantages of the circular model and the negative effects in more detail.

From an economic point of view, the recycling and restoration of resources is necessary to reduce waste and provide an additional source of materials in the market. Recycling of materials (secondary use) reduces waste and harmful emissions into the atmosphere, as well as reduces the consumption of primary raw materials, water, and energy. When re-processing and reusing products, it is necessary to arrange the operation of the enterprise to facilitate dismantling and accelerate restoration processes [8].

Key Findings on CEBM in the Chemical Industry:

- Core Components: CEBMs require integrating circular principles into value propositions, key activities, and partnerships. This involves shifting from selling products to providing service-based models like chemical leasing.
- Strategic Drivers: The transition is driven by the need to minimize waste and resource depletion, often requiring collaboration across supply chains.
- Transition Challenges: The chemical sector faces barriers, including a lack of consistent, scalable circular feedstocks, complex existing infrastructure, and the need for stronger policy frameworks.
- Systemic Approach: A successful transition depends on a "4R" approach (reduce, reuse, recycle, remove) to close material loops.

Common Circular Business Models Identified [9]:

- Chemical Leasing: A service-oriented model where the producer sells the function of the chemical (e.g., cleaning, coating) rather than the volume, promoting reduced consumption.
- Industrial Symbiosis: Companies within industrial parks share resources, waste heat, and by-products to improve efficiency.
- Circular Carbon Economy: Utilizing carbon capture and utilization (CCU) technologies to turn emissions back into raw materials [10].

Uzbekistan's chemical industry is shifting from a linear to a circular economy model, focusing on resource efficiency, waste reduction, and industrial symbiosis to enhance sustainability and economic growth. Key initiatives include recycling plastic and hazardous waste, implementing Extended Producer Responsibility (EPR) for oils, and utilizing mining waste. Uzkimyosanoat is actively seeking technological and investment partners to modernize facilities, aiming to turn waste into valuable secondary resources.

Key Circular Economy Strategies in Uzbekistan's Chemical Industry [11]

- Waste Valorization & Recycling: Active projects focus on recycling plastic waste, neutralizing mercury-containing waste, and converting construction debris into usable materials.
- Industrial Symbiosis: Efforts are being made to connect different industrial sectors to use waste from one process as raw material for another, promoting a zero-waste approach.
- Modernization & Technology Transfer: Uzkimyosanoat is collaborating with international partners (e.g., from Malaysia) to bring in advanced technologies for specialized chemical production and to modernize aging, resource-intensive infrastructure.
- Regulatory Framework: Introduction of Extended Producer Responsibility (EPR) systems to manage industrial and technical oil waste, alongside developing regulations for handling hazardous chemical waste.
- Sustainable Sourcing: A focus on combining Uzbekistan’s natural and agricultural resources with green technologies to develop sustainable, bio-based, and eco-friendly products.

Challenges and Opportunities [12]

- Financing Large Projects: A significant challenge is securing funding for major sustainable projects, which Uzkimyosanoat is addressing by seeking foreign investment partners.
- Infrastructure Investment: Developing proper waste management, sorting, and recycling infrastructure is a key, long-term requirement.
- Innovation & Education: The need for innovative technologies to replace "take-make-dispose" models is driving investment in new, sustainable production methods.

The transition is supported by the government’s efforts to align with the Sustainable Development Goals (SDGs), focusing on reducing environmental harm and fostering a green economy.

Conclusion

The future of circular economy business models in the chemical industry of Uzbekistan is marked by significant potential for innovation, sustainable growth, and alignment with global environmental trends. As international markets increasingly favor eco-efficient products and low-emission supply chains, Uzbekistan’s chemical sector stands to benefit strategically by embracing circular principles that enhance competitiveness and reduce environmental risks.

In the coming decade, technological advancements—such as industrial biotechnology, green chemistry, and advanced recycling systems—are expected to transform production processes. These innovations will enable chemical manufacturers to reduce reliance on virgin raw materials, minimize hazardous outputs, and optimize energy and water use. Digitalization and Industry 4.0 tools (e.g., IoT, AI, blockchain) will play a vital role in enabling material traceability, efficiency tracking, and real-time optimization of circular systems.

Institutional support and policy reform will be central to shaping this transition. The development of regulatory frameworks, incentives for eco-design and waste valorization, and support mechanisms for small and medium enterprises will stimulate investments and adoption of circular business practices. Public-private partnerships and international

collaborations will further accelerate capacity building and technology transfer, enabling local firms to leapfrog traditional production models.

Furthermore, consumer awareness and demand for environmentally responsible products are anticipated to increase within both domestic and export markets. This shift in market preferences will drive companies to adopt transparent sustainability reporting and pursue certifications that demonstrate circular performance.

Nonetheless, the road ahead involves overcoming structural barriers, such as financing gaps, limited technical expertise, and entrenched linear production norms. Targeted education and workforce development programs will be essential to equip professionals with the skills needed for circular innovation and systems thinking.

Overall, the integration of circular economy business models promises to enhance the resilience and long-term viability of Uzbekistan’s chemical industry. By fostering economic diversification, reducing environmental impact, and creating new forms of value from previously discarded resources, this transition aligns with national sustainable development priorities and global climate commitments. As these dynamics continue to evolve, Uzbekistan could emerge as a regional leader in sustainable chemical production.

The chemical industry's shift is currently incremental due to high investment needs, but it is supported by growing demand for sustainable, circular products. Future research emphasizes the need for better metrics to measure circularity, such as the Circular Economy Index (CEI).

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