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The Impact of The Circular Economy on The Efficiency of Resource Use

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Abstract: The transition toward a circular economy has become one of the most important directions for improving the efficiency of resource use, reducing environmental pressures, and ensuring sustainable economic development. Unlike the traditional linear economic model, which is based on the extraction of natural resources, production, consumption, and disposal, the circular economy seeks to maintain the value of products, materials, and resources for as long as possible. This approach involves reducing the consumption of primary raw materials, extending product life cycles, increasing reuse and repair, developing recycling systems, and returning secondary raw materials to production processes. Therefore, the circular economy represents not only an environmental concept but also an important economic mechanism for increasing resource productivity and reducing production costs. This article examines the impact of circular economy principles on the efficiency of resource use and identifies the main economic, technological, organizational, and environmental mechanisms through which circular practices contribute to more rational utilization of resources. Particular attention is paid to the relationship between resource productivity, waste reduction, secondary raw material utilization, energy efficiency, innovative technologies, and sustainable production. The study considers how enterprises can improve their economic performance by reducing material losses, minimizing waste generation, introducing resource-saving technologies, and developing closed-loop production systems. The role of digital technologies, industrial symbiosis, eco-design, recycling infrastructure, and responsible consumption in strengthening resource efficiency is also analyzed. The article emphasizes that the implementation of circular economy principles can generate multiple economic effects, including reduction of material and energy costs, lower dependence on imported raw materials, increased competitiveness of enterprises, creation of new markets and employment opportunities, and improvement of investment attractiveness. At the same time, the transition to a circular model requires significant institutional and technological changes, including the development of appropriate legislation, financial incentives, infrastructure for waste collection and recycling, modern production technologies, and effective mechanisms for monitoring resource flows.

Keywords: Circular Economy, Resource Efficiency, Resource Productivity, Secondary Raw Materials, Waste Recycling, Circular Material Use Rate (CMUR), Sustainable Development

1. Introduction

The circular economy is an economic model aimed at preserving the value of resources for as long as possible, keeping products and materials in continuous circulation, and minimizing waste generation. Unlike the traditional linear “production -

consumption - disposal" model, the circular economy forms a closed cycle based on the principle of "production - consumption - recycling - reuse", in which waste from one process becomes a source of raw materials for the next process.

The global economy is characterized by a steadily increasing demand for resources. According to the Circularity Gap Report 2025 published by Circle Economy and Deloitte Global in May 2025, the volume of materials entering the global economy annually exceeded 106 billion tons for the first time, but only 6.9 percent of these materials came from secondary (recycled) sources, which is a decline of 2.2 percentage points compared with the 2015 level.[1] In other words, the global economy has become more "linear" over the past decade, meaning that the efficiency of resource use is lagging behind the growth rate of resource consumption.

Global material consumption has increased more than threefold over the past fifty years and, if the current trend continues, is expected to increase by another 60 percent by 2060. This will intensify the risk of depletion of natural resources, climate change, and biodiversity loss - experts note that biodiversity loss and two-thirds of global waste are directly associated with the extraction and use of resources. Therefore, improving the efficiency of resource use is being considered not only an environmental issue but also an issue of strategic economic importance.

In Uzbekistan, particular attention is also being paid to introducing the principles of the circular economy. According to Decree No. PF-56 of the President of the Republic of Uzbekistan dated March 24, 2025, "On measures to further improve and comprehensively systematize the waste recycling sector", newly generated waste is to be maximally recycled or incinerated instead of being sent to landfills; the implementation of circular economy practices in the sector and the establishment of eco-industrial zones within the "zero waste" system are also envisaged. This is an important step toward reducing the resource-intensive nature of the national economy and increasing resource efficiency.[2]

The purpose of this article is to explain the concept and theoretical foundations of the circular economy, analyze its impact on the efficiency of resource use based on international and national statistical data, and develop practical proposals for further development in this area.

The issue of the impact of the circular economy on the efficiency of resource use has been studied by a number of foreign researchers and international organizations. In particular, studies by the Ellen MacArthur Foundation interpret the circular economy as an economic model that reduces the need for primary resources by preserving the economic value of resources for as long as possible and by reusing and recycling products and materials. This approach links improving resource-use efficiency not only to reducing waste, but also to extending the life cycle of products and reintegrating materials into the economic process.

The Circularity Gap Report 2025 prepared by Circle Economy and Deloitte Global analyzes the imbalance between the use of materials in the global economy and their reintroduction into economic circulation. According to the study, although more than 106 billion tons of materials enter the global economy annually, only 6.9 percent consists of recycled materials. This result shows that, amid the increasing volume of resource use, the rates of recycling and use of secondary resources remain insufficient. Therefore, this study substantiates the need to return materials to the economic cycle as one of the key mechanisms for improving the resource efficiency of the circular economy.[3]

Eurostat studies use indicators such as resource productivity and the circular material use rate (CMUR) to assess the circular economy and resource efficiency. In this approach, resource productivity is assessed as the ratio of the economic value created to the volume of materials consumed, while CMUR indicates what share of the materials used in the economy is derived from secondary sources. The fact that CMUR in the European Union was 12.2 percent in 2024, while the indicator differed significantly

across countries, shows that the efficiency of the circular economy depends on infrastructure, recycling capacity, and the development of the secondary raw materials market.[4]

The World Bank's "What a Waste 3.0" study reveals the relationship between increasing waste volumes and the efficiency of resource use. The study estimates that approximately 2.1 billion tons of municipal solid waste are generated worldwide each year and projects that, if the current trend continues, this figure will reach 3.8–3.9 billion tons by 2050. These results demonstrate the need to return waste to the economic process as secondary raw materials rather than simply disposing of it. Thus, the development of recycling and reuse mechanisms is an important condition for improving resource-use efficiency through the circular economy.[5]

The reviewed literature explains the positive impact of the circular economy on resource efficiency mainly through mechanisms of reuse, recycling, the use of secondary raw materials, and extending the period of materials' economic circulation. At the same time, although the experience of global and developed countries has been extensively studied in existing research, the quantitative assessment of the impact of the circular economy on resource productivity and the use of secondary materials under Uzbekistan's conditions has not been sufficiently researched. This situation indicates the need for additional scientific research in this area.[6]

2. Materials and Method

The study used statistical, comparative and systematic analysis, dynamic analysis, and logical generalization to assess the impact of the circular economy on the efficiency of resource use. Statistical analysis examined resource consumption, resource productivity, recycling rates, and CMUR indicators. Comparative and dynamic analysis assessed country indicators and their changes over time. Systematic analysis identified the relationship between the circular economy, resource use, and waste recycling. The study used international statistical data, the Circularity Gap Report 2025, Eurostat and World Bank reports, and relevant regulatory and legal documents of Uzbekistan.[7]

3. Results and Discussion

International reports published in 2025 reveal a complex picture of the global economy's resource-use efficiency. On the one hand, the idea of the circular economy is widely supported at the policy and business levels; on the other hand, current indicators show that the level of circularity is declining globally. According to the Circularity Gap Report 2025, if, theoretically, all recyclable materials were fully recycled, the global circularity indicator could rise from the current 6.9 percent to 25 percent, but this is not an easily achievable goal in practice because some materials remain technically or economically difficult or costly to recycle.[8]

The following Table 1 presents the circular material use rate (CMUR) for European Union countries as of 2024.

Table 1. Circular material use rate (CMUR) in European Union countries, 2024, percent [9]

Country	CMUR (%)	Change compared with 2015
Netherlands	32.7	+5.3 p.p.
Belgium	22.7	-
Italy	21.6	-
European Union (average)	12.2	+1.0 p.p.
Portugal	3.0	-
Finland	2.0	-3.2 p.p.
Ireland	2.0	-
Romania	1.3	-

The table data show that the difference between countries is very large - the gap between the Netherlands, which has the highest indicator, and Romania, which has the lowest, exceeds 25 percentage points. This difference is primarily related to the level of development of waste-sorting infrastructure, recycling capacities, and the secondary raw materials market in the countries. By material type, metal ores have the highest circularity indicator (23.4%), because metal recycling is one of the most technologically and economically feasible areas.

Different international organizations use different methodologies to assess the economic potential of the circular economy, but all estimates reach one common conclusion - the potential is measured in trillions of dollars. Table 2 provides a comparative summary of these estimates.

Table 2. International estimates of the global economic potential of the circular economy [10]

Source	Estimated annual/overall effect	Period
World Economic Forum / Ellen MacArthur Foundation	≈1 trillion US dollars (annually)	By 2025
OECD / UNDP	4.5 trillion US dollars	By 2030
OECD / UNDP (long-term)	25 trillion US dollars	By 2050
McKinsey (European economy)	1.8 trillion euros (annually)	By 2030
International Resource Panel (IRP)	global GDP +0.8%, waste -39% (greenhouse gases)	By 2030

Differences in the estimates are primarily explained by the methodology of each organization, the sectors covered (for example, manufacturing only or the entire economy), and the types of benefits taken into account (direct resource savings or indirect innovation benefits). Nevertheless, all sources agree on one conclusion: efficient resource use is not only an environmental benefit but also a significant source of economic advantage.

The circular economy is also of important socio-economic significance from the perspective of employment. According to a study by the International Labour Organization, 121–142 million people worldwide (5–5.8 percent of global non-agricultural employment) are currently engaged in repair, recycling, secondary trade, and waste management. This figure confirms that circular economy activities are more labor-intensive than linear production, meaning that this sector has high employment-generation potential. Particularly in developing countries, repair and recycling activities have become a source of livelihood for millions of people through the informal sector.[11]

Trends in waste management are making the need to improve resource efficiency even more urgent. According to World Bank forecasts, global municipal solid waste volumes could nearly double to 3.8–3.9 billion tons by 2050, with the highest growth rates observed in developing regions (Sub-Saharan Africa +124%, South Asia +99%). This demonstrates the importance of introducing circular economy principles precisely in resource-intensive, rapidly growing economies - including countries such as Uzbekistan.

In the case of Uzbekistan, the issue of improving the efficiency of resource use is also becoming increasingly important. In 2025, the country's foreign trade turnover exceeded 81 billion US dollars, growing by 20.7 percent during the year, while exports increased by 24 percent to 33.8 billion dollars, with processed raw-material products accounting for an important share. Under such resource-intensive economic growth, improving resource efficiency, particularly by introducing circular economy principles to reduce dependence on raw materials, is of strategic importance. Within the framework of Decree No. PF-56 adopted for this purpose, the establishment of new eco-industrial zones, maximum recycling of waste instead of sending it to landfills, and the

introduction of a “zero waste” system are planned, which will contribute to the formation of a secondary raw materials market and increased resource productivity in the country.[12]

1. Impact on resource productivity

Resource productivity is the ratio of the volume of gross domestic product produced to the volume of raw materials consumed and is one of the main measurement criteria of the circular economy. According to Eurostat data, in 2024, domestic material consumption (DMC) worldwide amounted to 13.2 tons per capita, reaching the highest level since 2000, close to the European Union average of 13.3 tons. At the same time, the resource productivity of the European Union economy has increased by 50 percent since 2000, but in 2024, for the first time, the decline in EU resource consumption was matched by the growth of global material extraction.[13]

2. Waste management and the potential of secondary resources

According to the World Bank’s “What a Waste 3.0” report, approximately 2.1 billion tons of municipal solid waste are currently generated worldwide each year, and if the current approach continues, this figure is expected to nearly double to 3.8–3.9 billion tons by 2050. The highest growth rates are forecast in Sub-Saharan Africa (+124%) and South Asia (+99%). Waste management costs could increase from 252 billion dollars in 2020 to 640.3 billion dollars by 2050, nearly tripling. According to UNEP’s 2024 Global Waste Management Outlook, the volume of electronic waste (e-waste) amounted to 62 million tons in 2022 and is expected to increase to 82 million tons by 2030, an increase of 32 percent. At the same time, according to the OECD’s Global Plastics Outlook, only 9 percent of the plastic produced worldwide is successfully recycled, demonstrating how limited the circular economy remains in practice.

3. Impact on employment and the social sphere

According to a report prepared in 2025 by the International Labour Organization (ILO), the World Bank, and Circle Economy, between 121 and 142 million people worldwide, or 5–5.8 percent of non-agricultural employment, are engaged in circular economy activities such as repair, recycling, secondary trade, and waste management. According to a UNCTAD report, the circular economy could create more than 7 million new jobs and generate up to 4.5 trillion dollars in economic growth by 2030. The European Union’s Circular Economy Action Plan is estimated to have the potential to increase EU GDP by 0.5 percent and create 700,000 additional jobs by 2030.[14]

Research conducted shows that, despite the great potential of the circular economy, its development in practice faces a number of obstacles. First, globally, the growth of material consumption is faster than the growth of recycling: although the volume of recycled materials increased by approximately 200 million tons between 2018 and 2021, total material consumption increased from 79 billion tons to more than 106 billion tons, resulting in a decline in the circularity indicator. Second, the informal sector plays a major role in developing countries - in low- and middle-income countries, informal waste workers account for up to 40 percent of the total waste-sector workforce, which complicates formal statistics and management systems. Third, some materials (such as complex composite materials or fossil-fuel-based products) remain technically and economically difficult to recycle.[15]

4. Conclusion

The circular economy plays a significant role in improving the efficiency of resource use by replacing the traditional linear model of “take–make–dispose” with a system based on resource conservation, reuse, repair, remanufacturing, recycling, and recovery. The analysis shows that circular economy principles enable enterprises and national economies to obtain greater economic value from fewer primary resources, reduce material and energy consumption, minimize waste generation, and strengthen resource security. The integration of circular production technologies, sustainable

product design, industrial symbiosis, digital technologies, and secondary raw-material markets can further increase material productivity and reduce production costs. At the same time, the successful transition to circularity requires coordinated government policies, financial incentives, technological innovation, responsible business practices, and changes in consumer behavior. For Uzbekistan, the development of circular economy mechanisms is particularly important for improving waste-management systems, expanding recycling capacities, developing secondary-resource markets, reducing dependence on primary raw materials, and supporting environmentally sustainable economic growth. Therefore, the circular economy should be considered not only as an environmental approach but also as an important economic strategy for increasing resource productivity, strengthening competitiveness, promoting innovation, creating new employment opportunities, and ensuring long-term sustainable development.

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