

DOI: [10.26565/2311-2379-2024-106-12](https://doi.org/10.26565/2311-2379-2024-106-12)

УДК 316.422:338.504

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THE RELEVANCE OF THE TRANSITION TO A CIRCULAR ECONOMY FOR UKRAINE

The article deals with the problem of solid waste accumulation in the world and in Ukraine. The volumes of municipal solid waste and its distribution in different regions of the world are analyzed. The importance of efficient waste collection as a key aspect of waste management is emphasized, as well as the need for immediate measures to prevent further deterioration of the environmental situation. The article presents an analysis of the pre-war situation with waste management in Ukraine in terms of such indicators as the dynamics of waste generation and the share of its recycling, the number of operating business entities of various sizes in the field of waste processing. In addition, the article highlights the impact of military events on the environmental situation in the country and emphasizes the need for changes to build a sustainable economy, which may be possible through post-war recovery. In the context of finding solutions to reduce the negative impact of waste on the environment, the authors consider the concept of circular economy, which involves production aimed at reusing resources and reducing the volume of waste generation in order to ensure sustainable development. The basic principles of the circular economy and the hierarchy of waste management that has been formed in the EU are presented. In addition, the article presents the main program documents in Ukraine aimed at developing the circular economy, such as national strategies, plans and concepts. The article also examines the obstacles to the successful implementation of circular economy principles in Ukraine, such as imperfect regulatory framework, insufficient funding for environmental protection and waste management, and the lack of an integrated approach at various levels of the economy. Based on the analysis, the authors conclude that it is necessary to intensify efforts to implement the principles of the circular economy at Ukrainian enterprises. The authors emphasize the need to create incentives for innovation and investment in modern technologies to reduce the harmful effects of waste on the environment.

Keywords: **circular economy, waste management, closed-loop production, ecology.**

JEL Classification: *O20, Q56, P11, R11.*

Problem statement. With the onset of industrial revolutions around the world, the volume of production and consumption has been growing annually, which has created a problem of waste accumulation and difficulties in its management. Environmental issues are one of the most pressing global problems of humanity, as the level of welfare and life expectancy of future generations depend on the environment. In Ukraine, the problem of waste management has always been relevant and has become especially important with the beginning of the full-scale invasion in 2022, during which significant amounts of waste, discharges and emissions are generated daily and this, accordingly, has a negative impact on the environment.

Analysis of the latest research and publications. The general principles of the circular economy have been studied by several domestic and foreign researchers: Jiao W., Boons F. (2014), Korhonen J., Nuur C., Feldmann A. (2018). Zalunin M. M. (Залунін, 2019) studied the role of the circular economy in sustainable development, Zlotnik M. L. and Melnyk O. G. (Злотнік & Мельник, 2020) – the possibilities for adaptation of the circular economy by Ukrainian enterprises, Trushkina N. V. (Трушкіна, 2021) studied the concept of “circular economy” taking into account the



peculiarities of the development of the Ukrainian economy, (Пуда та ін., 2021) studied the problems of circular economy development in Ukraine and the possibility of adapting the European experience.

The purpose of the article is to determine the efficiency of waste management in Ukraine, to theoretically study the conceptual and categorical apparatus of the circular economy, to argue for the importance of its application in Ukraine, and to analyze the problems on the way to its implementation.

The analysis is based on statistical data concerning the levels of waste generation in the world and in Ukraine. The main research method is statistical data analysis, comparison and generalization.

The main results of the study. About 2.01 billion tons of municipal solid waste is generated annually in the world, of which at least 33% is not treated in an environmentally sound manner, and it is projected that in 30 years (by 2050) this figure will increase to 3.40 billion (an increase of 70%). Every day, every person in the world generates an average of 0.74 kg of waste, with a variation from 0.11 to 4.54 kg. High-income countries generate 34% or 683 million tons of global waste, despite having only 16% of the population (World Bank, 2024).

In high-income countries, waste generation per capita is projected to increase by 19 % by 2050, and in low- and middle-income countries – by 40% or more. A positive correlation has been established between the amount of waste generated and the income level of a country or region (World Bank, 2024), as waste generation first decreases at the lowest income level and then increases faster than at the highest. It is expected that by 2050, the amount of waste in low-income countries will be more than triple.

Fig. 1 shows the dynamics of the volumes of waste generated in different regions of the world in 2016 and the forecast for 2030 and 2050. The largest amount of waste is generated in East Asia and the Pacific (23% of the total), and the smallest amount is generated in the Middle East and North Africa (6%). The most rapid growth in waste generation by 2050 is projected in the Sahara region (3 times), the Middle East and North Africa (2 times), and South Asia (2 times). The growing amount of waste, which is currently predominantly (50%) disposed of in open landfills in these regions, has potentially negative consequences for the environment, health and economic prosperity, which requires immediate action to prevent further deterioration.

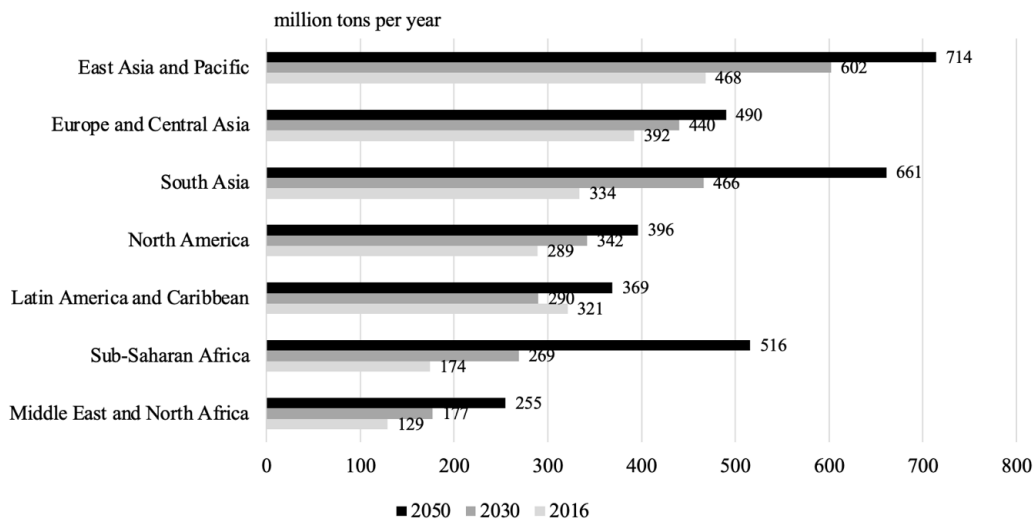


Fig.1. Projected waste generation, by regions (million tons/year)

Source: based on (World Bank, 2024)

Efficient waste collection is a key component of waste management, but the performance varies considerably depending on the income level of the country (fig. 2). In higher-income countries, waste collection is almost fully covered, while in developing regions, the share is higher in urban areas

(48%) but lower in rural areas (26%). For example, regions in South Africa collect about 44% of their waste, while in Europe, Central Asia and North America, the figure is at least 90%.

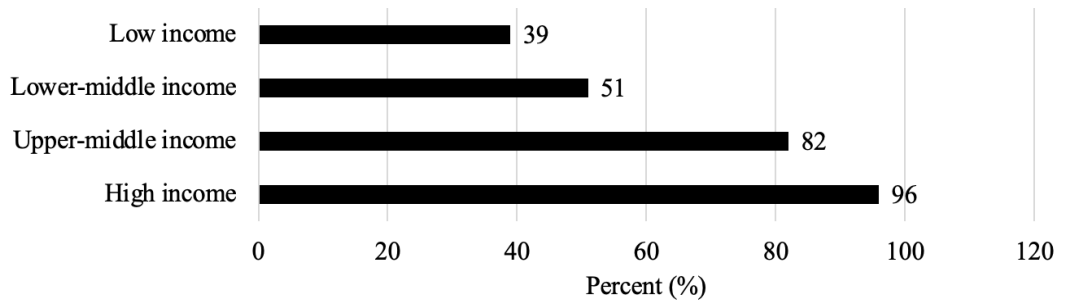


Fig. 2. Waste collection, by income country level (%)

Source: based on (World Bank, 2024)

Even before the full-scale invasion in 2022, Ukraine did not have a modern waste management system. The overall percentage of population coverage for waste collection was 75.86%. In 2020, only 3.2% of waste was recycled, which is the lowest rate in Europe, and 94.07% ended up in landfills, 35,000 of which are spontaneous, uncontrolled, and illegal, and therefore do not meet European standards. Part of the problem is that many of these waste disposal facilities are overloaded, which creates serious problems for human health and the environment (World Bank, 2024). As for municipal solid waste, about 16 million tons were generated annually, of which only 3% was recycled, while the rest remained in nature (Ecola, 2024).

In general, in recent years, there was a tendency for the volume of waste generated in Ukraine to increase annually, reaching 462 million tons in 2022, which is 9.4% more than in 2010, and 56% more than in 2016. The recycling rate for the study period ranges between 22% in 2022 and 35% in 2011, and has not exceeded 29% in the last 5 years (fig. 3). There is also a tendency that the share of recycling decreases with the growth of waste.

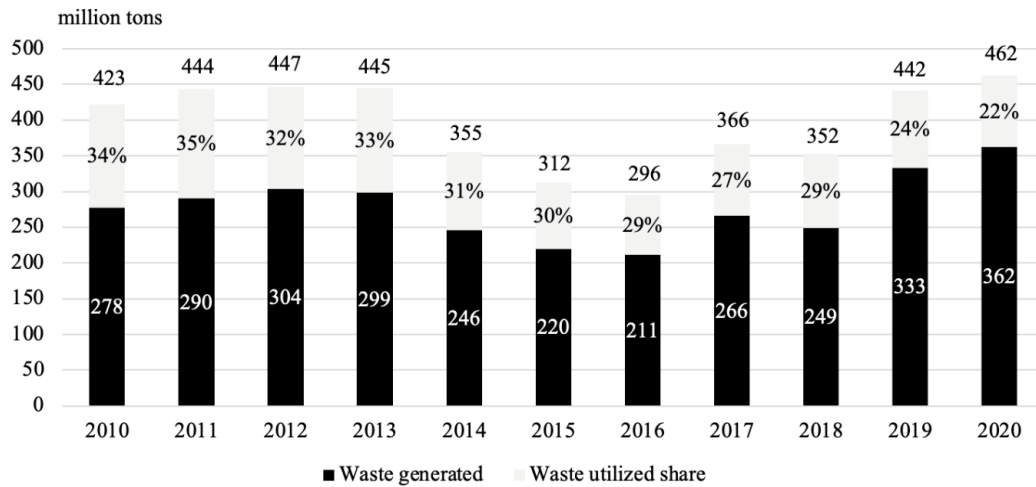


Fig. 3. Dynamics of waste generation and recycling rates

Source: based on (State Statistics Service of Ukraine, 2024)

Total waste management expenditures in 2020 amounted to UAH 14 million, which was 0.34% of Ukraine's nominal GDP in 2020, while in 2014 this figure was more than 2 times lower (0.12%). EU countries spend about 0.8% of GDP on environmental protection (Горбаль & Ломара, 2022).

The total number of operating large, medium, small, and micro enterprises in the waste management sector (collection, treatment, and disposal) is on a downward trend and in 2022 decreased by almost 40% compared to 2014. The structure of enterprises in this area has also changed: the share of microenterprises has increased from 77% to 81%, the share of small and medium-sized enterprises has decreased from 16% to 14% and from 7% to 6%, respectively, and the number of large enterprises occupies the same small share in the total number of waste management entities.

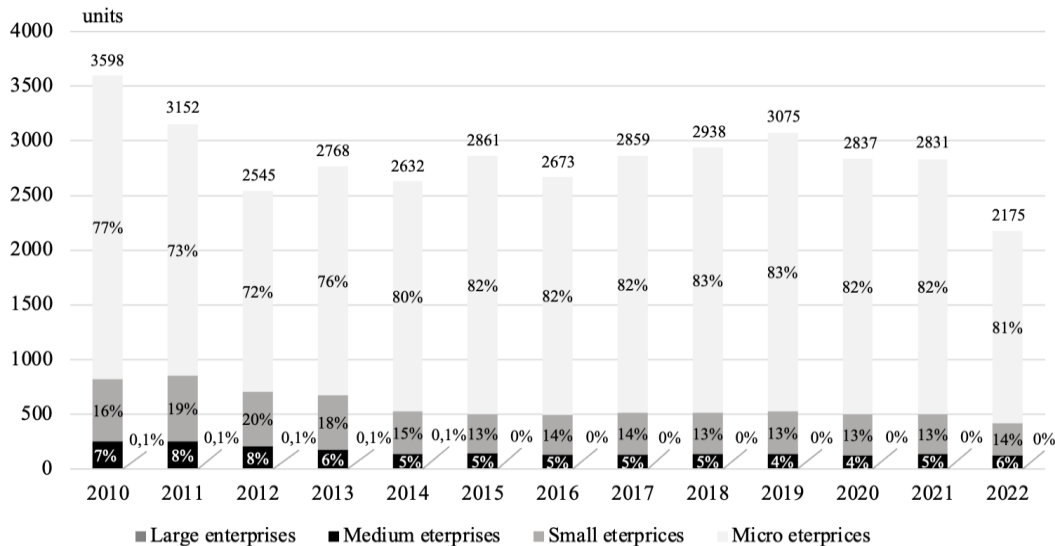


Fig. 4. Dynamics of the number of operating large, medium, small and micro-enterprises in the field of waste management, 2010-2022 (waste collection, treatment and disposal)

Source: based on (State Statistics Service of Ukraine, 2024)

Russia's full-scale invasion in 2022 resulted in significant losses, both human and material. In addition, the hostilities on the territory of Ukraine caused significant damage to the environment, which will have an impact on the state of the environment for a long time. As Denys Shmyhal noted in October 2023, total environmental damage has already reached 55.6 billion euros (Web portal of the executive branch of Ukraine, 2023), most of which was caused by air pollution from forest fires, missile attacks, and the burning of oil products (50%), and the rest – by land and water pollution.

The inefficient waste management before the full-scale invasion and the generation of waste in particularly large volumes during the war prompts the search for solutions to improve the situation. The post-war recovery will also be an opportunity to build a new economic system, introduce modern concepts, and launch a powerful process of building a sustainable economy.

The rapid increase in the volume of waste in the world is a concern for many countries and requires solutions and changes in the way they produce and manage waste. Thus, in the 60s of the XX century, the concept of a "circular economy" first appeared, based on resource-efficient production. Scientists W. Jiao and F. Boons define the concept of circular economy as a holistic concept that covers all stages of "reduction, reuse and recycling" in the process of production, circulation and consumption (Jiao & Boons, 2014). S. Sow, S. Bernard, and P. Sloan consider the circular economy as a model of production and consumption of goods through closed cycles of material flows, which involves the preservation of external environmental factors associated with the extraction of primary resources and waste generation (Sauve, Bernard, & Sloan, 2016). The European Parliament defines circular economy as a model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible (European Parliament, 2023). Other definitions of circular economy might mention "closed loops" stating that growth is not fuelled nor dependent on finite resources

(Haney, Krestyaninova, & Love, 2019; Deloitte, 2017). Thus, the circular economy is an innovative approach to closed-loop production aimed at reusing resources and waste from another production cycle, which aims to ensure sustainable development and preserve resources for future generations.

The basic principles of the circular economy have been expanded over the years and in 2018, the World Economic Forum defined them as the 10 R's: Refuse, Rethink, Reduce, Reuse, Repair, Refurbish, Remanufacture, Repurpose, Recycle, Recover (Morseletto, 2020). The strategy for each principle is shown in Table 1.

Table 1 – Circular economy strategies

Group	R	Name	Strategy
Smarter product use and manufacture	R0	Refuse	Make product redundant by abandoning its function or by offering the same function with a radically different product
	R1	Rethink	Make product use more intensive (e.g. through sharing products or by putting multi-functional products on market)
	R2	Reduce	Increase efficiency in product manufacture or use by consuming fewer resources
Extend lifespan of product and its parts	R3	Reuse	Reuse by another consumer of discarded product which is still in good condition and fulfils its original function
	R4	Repair	Repair and maintenance of defective product so it can be used with its original function
	R5	Refurbish	Restore an old product and bring it up to date
	R6	Remanufacture	Use parts of discarded product in a few product with the same function
	R7	Repurpose	Use discarded products or their parts in a new product with a different function
Useful application of materials	R8	Recycle	Process materials to obtain the same (high grade) or lower (low grade) quality
	R9	Recover	Incineration of material with energy recovery

Source: (Morseletto, 2020)

Based on the above-mentioned principles of the circular economy, the EU has formed a waste management hierarchy (fig. 5) based on the prevention of waste generation (reduction of waste), reuse is organized whenever possible, and residues that cannot be used should be disposed of in specially designated places.

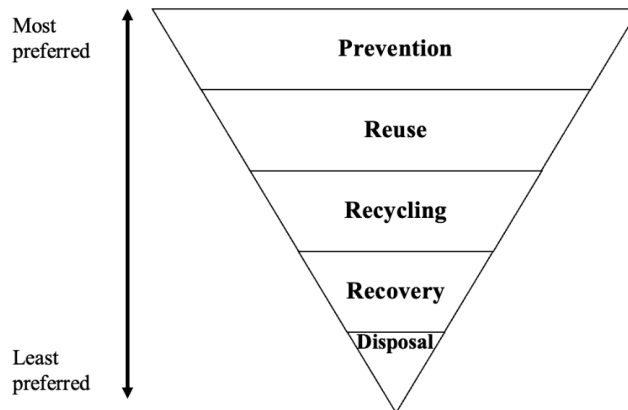


Fig. 5. Waste management hierarchy

Source: (Nogueira, 2023)

The EU countries are leaders in implementing these principles of the circular economy, and Ukraine should follow them as well, which will facilitate integration into the EU.

In 2015, the European Commission adopted the Circular Economy Action Plan, fully implementing it in 2019. And on March 11, 2020 a new Circular Economy Action Plan (CEAP) was approved as part of the European Green Deal. This course envisages a number of innovations and changes aimed at transforming Europe into a climate-neutral continent by 2050, improving the welfare and quality of life of citizens, greening the economy and protecting the environment. One of the key goals of the new EU strategy for the circular economy is to reduce consumption and increase the reuse of resources in the European Union, while promoting economic growth. (Ruda, Yaremchuk, & Bortnikova, 2021). It is expected that the implementation of CEAP will help increase EU GDP by an additional 0.5% by 2030, as well as create 700 thousand new jobs (European Commission, 2020). It is also worth noting that the EU has a Horizon program that supports innovative waste management projects, which contributes to business growth and job creation in this area.

In the post-war period, Ukraine will face the challenge of not only cleaning up the environment from military waste, but also of further reducing its generation. In addition, considering Ukraine's chosen direction of integration into the European Union, building a circular economy is a necessity. The positive factor is that movement in this direction is taking place, and currently the main program documents on the circular economy in Ukraine are the following:

- National Waste Management Strategy until 2030;
- National Waste Management Plan until 2030;
- Strategy of the State Environmental Policy of Ukraine until 2030;
- Concept of Implementation of the State Policy on Climate Change for the Period up to 2030 and its Implementation Plan;
- Low Carbon Development Strategy of Ukraine until 2050, etc. (Руда та ін., 2021).

These documents aim to protect the environment and transition to a sustainable economy by overcoming the consequences of environmental problems; eliminating the causes of environmental disasters; implementing best practices in the management of various types of waste; and drafting laws and other regulations in the field of climate and ecology. One of the drawbacks of these documents is the relatively low level of cooperation between the relevant agencies (Руда та ін., 2021).

The current development of Ukraine's economic sectors based on circular economy principles is relatively low, lagging far behind EU countries. At the same time, due to the inefficient use of the country's natural resources, their quantity is rapidly decreasing, which may become a serious threat in the future.

In our opinion, the main obstacles to the implementation of effective waste management and the application of circular economy principles in Ukraine are the imperfection of the regulatory framework (clear waste management policies for enterprises that would meet EU requirements) (Dixigroup, 2020); lack of an integrated approach at different levels of the economy (country, community and enterprise); insufficient funding for environmental protection and waste management (currently, environmental tax revenues in Ukraine are lower than the state's environmental expenditures). Also, at the enterprise level, it is necessary to encourage the reuse of raw materials, change of production methods to minimize waste, change of emphasis from labor productivity to efficient use of resources and investments in modern advanced technologies that will help to achieve the appropriate level of resource efficiency. Incentives can be provided through tax breaks, grant programs, interest-free loans, and international cooperation programs.

Conclusions. Transitioning to a circular economy should be a priority for Ukraine, as environmental pollution and resource depletion are pressing issues today. The post-war recovery will be a good time to make changes, rebuild infrastructure, and build the economy on a new basis. This period will also be characterized by the inflow of a significant amount of foreign investment, and green projects aimed at achieving environmental goals will be particularly attractive. However, we should not wait for the end of the war to start acting in this direction, as the successful transition from a linear to a circular economy requires effective legal and regulatory frameworks, which should be developed now.

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The article was received by the editors 29.04.2024
The article is recommended for printing 30.05.2024

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Стаття надійшла до редакції 29.04.2024

Стаття рекомендована до друку 30.05.2024

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АКТУАЛЬНІСТЬ ПЕРЕХОДУ ДО ЦИРКУЛЯРНОЇ ЕКОНОМІКИ ДЛЯ УКРАЇНИ

У статті розглянуто проблему накопичення твердих побутових відходів у світі та в Україні. Проаналізовано обсяг твердих побутових відходів та їх розподіл за різними регіонами світу. Підкреслено важливість ефективного збирання відходів як ключового аспекту в управлінні відходами, а також необхідність негайних заходів для запобігання подальшого загострення ситуації з довкіллям. У статті представлено аналіз довоєнної ситуації поводження з відходами в Україні за такими показниками, як динаміка обсягів утворення відходів та частка їх реалізації, кількість діючих суб'єктів господарювання різних розмірів у сфері переробки відходів. Крім того, у статті висвітлено вплив воєнних подій на екологічну ситуацію в країні та наголошено на необхідності проведення змін для побудови стійкої економіки, можливістю до чого може стати післявоєнне відновлення. В контексті пошуку рішень для зменшення негативного впливу відходів на довкілля, розглянуто концепцію циркулярної економіки, яка передбачає виробництво, спрямоване на повторне використання ресурсів і зменшення обсягу генерації відходів, з метою забезпечення сталого розвитку. Наведені основні принципи циркулярної економіки та ієрархія поводження з відходами, яку було сформовано в ЄС. В статті наведено основні програмні документи в Україні, які спрямовані на розвиток циркулярної економіки, такі як національні стратегії, плани та концепції. Також розглянуто перешкоди на шляху до успішного впровадження принципів циркулярної економіки в Україні, такі як недосконалість нормативно-законодавчої бази, недостатній рівень фінансування сфери охорони довкілля та поводження з відходами, а також відсутність комплексного підходу на різних рівнях економіки. На основі проведеного аналізу зроблено висновок про необхідність активізації зусиль для впровадження принципів циркулярної економіки на підприємствах України. Зазначено необхідність створення стимулів для інновацій та інвестицій у сучасні технології для зменшення шкідливого впливу відходів на навколишнє середовище.

Ключові слова: **циркулярна економіка, управління відходами, виробництво замкнутого циклу, екологія.**

JEL Classification: O20, Q56, P11, R11.

In cites: Voitko S., & Vyshnevskaa A. (2024). The relevance of the transition to a circular economy for Ukraine. *Bulletin of V. N. Karazin Kharkiv National University Economic Series*, (106), 122-130. <https://doi.org/10.26565/2311-2379-2024-106-12>