

Circular Economy as a Model of Achieving Sustainable Development

Gospodarka o obiegu zamkniętym jako model osiągnięcia zrównoważonego rozwoju

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Abstract

The essence of the concept of circular economy was determined. The processes of transition to a circular economy are analyzed, as a result of which three levels are distinguished: efficient use of materials; product life extension; smart production and use of products. The connection between the circular economy and sustainable development was implemented. The main business models of the circular economy are considered: Resources recovery, Sharing platforms, Product life extension, Product as a service, Circular suppliers. Strategies and tools of circular economy are developed. The world experience of waste utilization is considered.

Key words: circular economy, model, sustainability, sustainable development, Sustainable Development Goals

Słowa kluczowe: gospodarka o obiegu zamkniętym, model, zrównoważoność, rozwój zrównoważony, Cele zrównoważonego rozwoju

Introduction

The circular economy is a new economic and environment-oriented concept that harmonizes between economic growth and environmental sustainability, creates new opportunities for prosperity and is the main driver for achieving the goals of sustainable development of society.

The depletion of non-renewable resources, which has become a global problem for humanity, is accompanied by serious environmental and social consequences, and the irrational use of resources and products leads to significant economic losses. Therefore, it is advisable to move to a more sustainable economic model – the circular economy. The transition to a circular economy cannot take place quickly enough, as its implementation requires a thorough modernization of production and a certain rethinking of environmental problems. Based on the principles of resource recovery, prevention and reduction of waste and reuse of used products, it should be the basis for improving environmental and economic conditions and ensure sustainable development of the country.

Literature review

The idea of a circular economy is a relatively new concept, and therefore scientists express their own vision of the content and objectives of a circular economy. According to Carrez D., Van Leeuwen P. (2015), the closed-loop economy is designed to change the classical linear model of production, focusing on products and services that minimize waste and other types of pollution. Investigating the essence of the concept of circular economy, scientists Kirchherr J., Reike D., Hekkert M. (2017) found a large number of definitions that describe this concept. In his generalized researchers used R-typology and received ten R: recover, recycle, repurpose, remanufacture, refurbish, repair, reuse, reduce, rethink, refuse. They formulated their vision of the circular economy as an economy that provides a number of value creation mechanisms that are separate from the consumption of limited resources; in a circular economy, growth comes from within, which increases the value derived from existing economic structures, products and materials. It is noted that the philosophy of closed-loop economy seeks to return as much material as possible back into the production cycle, in contrast to the linear model, which always ends in waste.

Bastein T., Roelofs E., Rietveld E., Hoogendoorn A. (2013) define the circular economy as an economic and industrial system based on the reuse of products and raw materials and the renewable capacity of natural resources to minimize destruction of value in the whole system and maximize value creation in each link of the system. Zvarych I. Ya. (2017) believes that the circular economy distinguishes between economic growth and the use of natural resources and ecosystems, emphasizing the effective use of these resources.

Anisimova G.V. (2018) emphasizes the problem of the balance between economic growth and the use of resources through which such growth is provided. According to Deineko L.V. and Tsyplitskaya O. O. (2018) the introduction of a circular economy should be based on basic market laws – in the absence of demand for recycled waste and products, it loses its economic viability.

Suetnov E.P. and Lazebna A.V. (2020) indicate that in order to implement a circular economy in the context of the sustainable development goals it is advisable to be fully inclusive and to ensure that everyone has access to the benefits of such development. In a true circular economy, each entrepreneur is a separate link in a chain that forms a circle in which there are no redundancies (10 Key Indicators for Monitoring..., 2017).

Shkurenko O.V. (2021) believes that the circular economy as an innovative platform for sustainable development is focused on reducing the amount of resources used, the introduction of reuse or closed production cycle, modernization and renewal, recycling, visualization of products to ensure a long life cycle.

Zvarych I. Ya. (2019) proves that an inclusive circular economy solves two global problems: waste disposal and overcoming poverty, which are the consequences of human life. The scientist proves the existence of global recognition that the system in which we live was developed with a narrow economic approach, and its expansion through embedding other dimensions will encourage innovation. Vovk O. B., Voitsekhovskaya V. V., Zagoretskaya O. Ya., Lesyk L. I., Pashkevich V. Z., Simak A. V. (2019). consider the problems of the circular economy by studying the process of waste disposal and utilization.

We can note that the methodological approaches that form the basis of the circular economy are not new. The modern circular economy concept follows from the research of scientists in the field of ecological economy, which was studied by Costanza R., de Groot R., Sutton P., Ploeg S., Anderson S. J., Kubiszewski I., & et al. (2014), economy of nature management Cherevko G.V., Cherevko I.V., Vasylenko N.I. (2012) and others. Therefore, the main essence of the circular economy is the economic use of all types of resources. According to Geissdoerfer M., Savaget P., Bocken N., Hultink E. (2017) in a comprehensive inclusive circular economy, growth should be based on human capital and not instead of extracting natural resources.

The purpose of the research. The purpose of the article is to substantiate the theoretical, methodological foundations and develop conceptual approaches to the theoretical, methodological and practical support of the circular economy, considered as a model of achieving sustainable development goals.

Research methodology. In the article both general scientific and economic methods of cognition were used: logical, inductive, deductive, tabular methods of interpreting information, methods of analysis, due to which the essence of the concept of circular economy was determined, the connection between the circular economy and sustainable development was proved, conclusions were formulated.

Results. The concept of *circular economy* arose to address such important issues as lack of resources and environmental degradation. It emerged in the early 1990s with the implementation of the Sustainable Development Strategy. The circular economy is a component of the ecological economy and aims to maintain the value of products and resources for as long as possible by returning them to the production cycle while minimizing waste generation, while reducing the eco-destructive impact of man on the environment.

Ecological economics has a number of principles: environmentally friendly business; ensuring sustainable development; expediency of approval of ecological lifestyle; circularity, etc. The direction of the ecological economics should focus on achieving certain goals of sustainable development. By 2030, the world's countries aim to achieve 17 Sustainable Development Goals, some of which are closely linked to circular practices (table 1).

The transition to a closed-loop economy (circular economy) is global, according to experts from the Ellen

MacArthur Foundation (2015) in 2025, the circular economy can provide annual revenue growth of more than 1 trillion dollars. In addition, the transition to a circular economy will create huge opportunities for modernization of production and implementation of industrial innovations, providing an annual GDP growth of 7%. Three levels of transition processes to a circular economy can be divided: the efficient use of materials; product life extension; smart production and use of products (Figure 1).

Table 1. The relationship between sustainable development goals and circular practices, developed by the authors based on The Goals of Sustainable Development of Ukraine (2019) and UN Sustainable Development Goals (2015)

Sustainable Development Goals	Circular practices
Goal 6. Ensuring accessibility and sustainable management of water resources and sanitation	Fine water treatment, sustainable sanitation, wastewater treatment, water reuse and recycling, nutrient recovery, biogas systems, etc. can help increase access to safe drinking water and fair sanitation, reduce pollution and improve water quality
Goal 7. Providing access to low-cost, reliable, sustainable and modern energy sources for all	Renewable energy systems, including second generation low biomass and biofuel technologies, energy recovery (heat) and improved use in industrial systems
Goal 8. Promoting sustainable, inclusive and sustainable economic growth, full and productive employment and decent work for all	Circular business models are a major potential source of efficiency and resource efficiency, waste valorisation and green jobs
Goal 12. Ensuring the transition to rational models of consumption and production	The implementation of a circular economy is a separation of economic activity from the use of resources and related environmental impacts and society
Goal 15. Protecting and restoring terrestrial ecosystems and promoting their sustainable use, sustainable forest management, combating desertification, halting and reversing the land degradation process and halt the loss of biodiversity ecosystems.	The practice of circular economy is based on the restoration of natural capital, which involves the adoption of sustainable and restorative agricultural and agroforestry methods that cover and protect biodiversity and return biological material back to the soil as nutrients – practices that are essential for restoring terrestrial ecosystems.

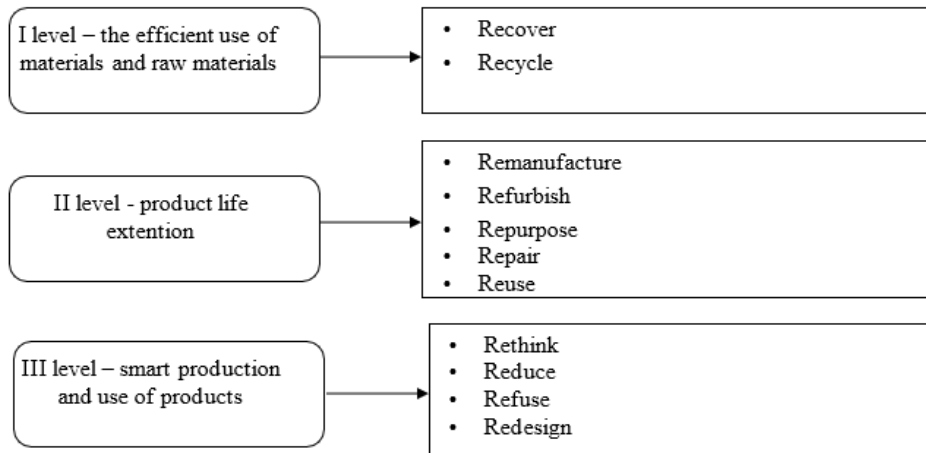


Figure 1. Analysis of processes at the levels of the circular economy, developed by the authors based on Ellen MacArthur Foundation (2015); Accenture (2015)

The circular economy proposes the use of business models that can increase the resource and energy efficiency of production and consumption of goods, as well as to reduce the negative impact on the environment.

The main tools of the circular economy model based on the principles of sustainable development are ecological innovations and *environmentally friendly* technologies. Companies can choose any business model. Consider the basis of business models classified by specialists of Accenture (Accenture Strategy, 2015).

Resources recovery model is based on the use of technological innovations to recover and reuse resources and helps to eliminate the loss of these resources by reducing waste and increasing the profitability of production from reverse flows. This model can be useful for companies that produce large amounts of by-products and have the ability to effectively recover and recycle waste.

Sharing platforms are designed to promote platforms for interaction between users of the product, which helps to increase the level of its use. This model is most suitable for companies that have not fully used capacity or low utilization of the product.

Product life extension model ensures the preservation or improvement of the product through repair, modernization, reconstruction or restoration. It is most suitable for industrial equipment manufacturers.

Product as a service is a model in which customers use the alternative of buying a product, providing it for use, for example, through a lease or lease agreement, and thus increases the incentive to create a product with a longer life cycle.

Circular suppliers – this model provides the supplier with delivery of resources that are completely recycled or biodegradable.

We will reveal in more detail the content of each of the approaches, as well as list some companies that use this approach (table 2).

Table 2. Business models of the circular economy at the micro level, developed by the authors based on Pakhomova N. V., Richter K. K., Vetrova M. A. (2017)

Approach	Description	List of companies
Circular Suppliers	Provides the supplier with fully recyclable or biodegradable resources that are at the heart of the circular production and consumption	Ford, Fairphone, 3D Hubs, Desso, Toyota, Cisco
Recovery Resources	Helps eliminate resource losses due to waste generation and increases the profitability of production from returned flows	Coca-Cola, Maersk, Michelin, Philips, Walt Disney World Resort
Sharing platforms	Used to promote platforms for interaction between product users, individuals or organizations	Patagonia, BlaBlaCar, Nearly NewCar, BMW, Drivy, Daimler, Lyft
Product life extension	Provides for the preservation or improvement of a used product through its repair, modernization, reconstruction or restoration	Bosch, Caterpillar, Volvo, Renault, Apple, BMA Ergonomics, Michelin
Product as a service	An alternative to buying a product, providing it for use, for example, through a lease, etc., which increases the incentives to create durable products, extend its life cycle	Rolls-Royce, Mud Jeans, De Kledingbibliotheek

The introduction of innovative business models can be aimed both at the modernization of the existing model of the company, and in the case of new startup projects, the development of a fundamentally new business model. Companies implement the common principles of the circular economy through different strategies and tools (Figure 2).

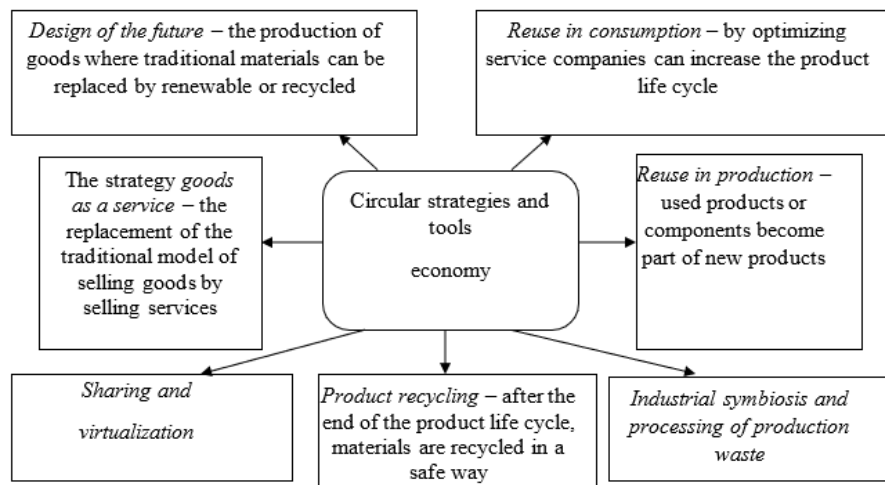


Figure 2. Strategies and tools of circular economy, developed by the authors

The circular economy involves not only responsible management of resources and the introduction of innovative technologies into production, but also the rational waste management. Solving waste management problems is the first step towards a circular economy, one of the tasks of which is to focus on the introduction of innovative technologies in the production, development and implementation of low-waste and non-waste technologies. The circular strategy and policy of enterprises should be based on the best practices of the EU and the world in the field of circular economy and bioeconomy. Research in recent years has shown the significant potential of the circular economy to improve the global climate. The circular economy model, where the value and life cycle of resources are maintained for as long as possible and waste generation is minimized, reduces the pressure on natural resources and thus stimulates the decarbonisation of the world economy.

In 2020, the European Commission adopted an Action Plan *Circular Economy Action Plan*, which aims to reduce consumption in the EU and double the reuse of resources in the coming decades, while contributing to economic

growth.

Today raw materials are becoming increasingly scarce, energy is becoming more expensive and, at the same time, the amount of waste is growing. In addition, pollution of soil, air and water poses a risk to sustainable development worldwide. Less than 10% of consumed materials are processed. Problems of waste disposal are exacerbated by changes in the structure of consumption, industrial development and urbanization. Many developing countries have faced the challenge of improving waste management.

Let's focus on the world experience of waste disposal. Based on the analysis of literature sources, we systematize the different approaches in table 3.

Table 3. World experience of waste disposal, systematized by the author on the basis of Recyclemag (2021)

Country	Disposal approaches
Germany	Germany is one of the world leaders in the volume of recycled waste. 66% of garbage is reused. The reason for such a large share of recycled waste is that Germany is one of the leaders in waste generation and already in the 80's all landfills were overcrowded. Therefore, the government of this country has obliged producers to label goods according to the category of waste. The introduction of collateral value of packaging, multi-colored containers for waste of different types contribute to waste disposal processes. Campaign work also played an important role. For Germans, it is a civic duty to help sort garbage.
USA	In the United States, one of the first interested in waste management – in 1895 in New York opened the world's first center for waste management. But full-fledged work with waste began only in the 2000s. The main prerogative of the government during these years was propaganda work. The Garbage Recycling Festival was introduced, on the day of which the results that most contribute to waste recycling are summed up and awarded. Extensive propaganda work is carried out in schools, there are special hours of volunteering. Also, the United States has introduced separate garbage disposal (waste that has been sorted by the owner is removed free of charge). As in Germany, there is a collateral cost of packaging. Innovative technologies of waste processing and disposal should be noted.
China	Waste recycling processes have also intensified in China in recent years. First of all, it should be noted the country's significant potential in this area – China has a large number of recycling plants. At this stage, the government promotes recycling by introducing a fee for separate waste. For example, for a couple of dozen bottles you can enter the subway for free. The government plans to impose fines for unsorted garbage. Also, waste recycling is facilitated by special garbage collectors, who buy it from ordinary people and resell it to special institutions. Campaigning work is implemented to a lesser extent.
Japan	In Japan, the problem of waste recycling is especially relevant given the area of the country. But the approaches used are quite unique. Extensive propaganda work is not necessary due to the peculiarities of religion (Shinto) and the worldview of the Japanese, for whom excessive waste of goods is a sin, because all earthly goods are given by heaven. The division of waste into 4 categories is quite unusual: suitable for incineration, unsuitable for incineration, suitable for recycling, large. Violations of recycling rules may be imposed on the entire housing cooperative. State-of-the-art technologies are used in processing and incineration. Unusual measures are also used, for example, in some cities garbage cans are intended only for certain categories of garbage and therefore have specific holes. In general, Japan is one of the world leaders in waste disposal.
United Kingdom	For a long time, the UK was an outsider in waste disposal. But in recent years the situation has improved significantly. Waste sorting system introduced. The government has chosen a slightly different strategy for campaigning. All violations of waste sorting rules are punishable by significant fines. To violations include even the excess weight of waste. All disposable polyethylene packages became paid. Food for which the expiration date has not yet expired is collected separately and sent to specialized dormitories, canteens for the poor and other similar establishments.

As we can see, different countries have different approaches to waste disposal. But we can identify several features that are common to the countries:

- waste sorting by different categories;
- special garbage collection points;
- collateral value of packaging;
- stimulating the extension of the service life of goods;
- educational and information campaigns.

So, it is important now to prevent waste from entering uncontrolled landfills and illegal dumps, burning in the open, as this leads to the release of greenhouse gases that deplete the ozone layer and damage the climate. In addition, it is necessary to suspend the entry of waste into waterways, because they cause significant damage to flora and fauna and enter the human food chain (Establishing Waste Management, 2021). According to the World Bank, 33% of the world's 25% of all waste is disposed of in illegal and official landfills, respectively. Only 13.5% of waste is recycled and 5.5% is composted, and 11% is incinerated (Figure 4).

Governments are increasingly recognizing the risks and costs of landfill disposal and sustainable waste management practices. The Slovak company Sensoneo, which offers smart waste management services, has

developed the Global Waste Index, which ranks 36 member countries of the Organization for Economic Co-operation and Development (OECD) according to the efficiency of their waste management. per capita through indicators such as waste generation, recycling, incineration, official and illegal landfills (Sensoneo Global Waste Index, 2019) (table 4).

According to The Global Waste Index 2019, the largest amount of waste was generated by such countries as the United States (5), Denmark (4.72), New Zealand (4.17), Canada (3.96), Switzerland (3.96).

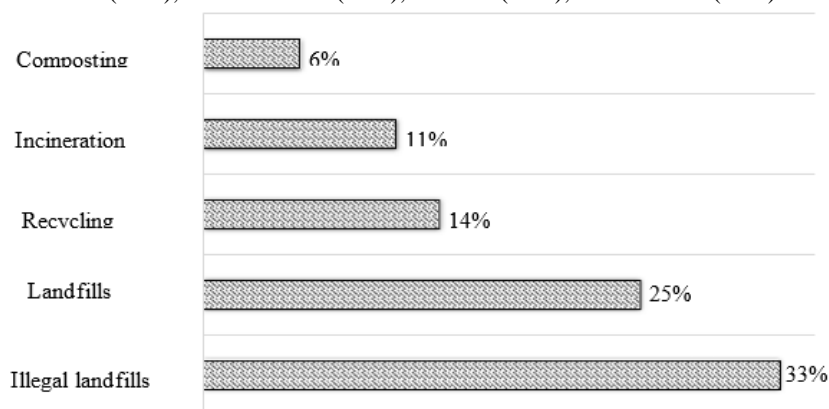


Figure 4. Share of waste disposal methods in 2019 (%), built by the author according to the World Bank Global Picture of Solid Waste Management 2020

Table 4. OECD ranking of the Global Waste Index in 2019, (points), compiled by the author based on data from The Global Waste Index 2019

No	Country	Volume of waste generated	Recycling of waste	Incineration of waste	Waste on landfills	Final index indicator
1	South Korea	0,45	3,79	0,36	0,40	100,00
2	Sweden	1,39	2,66	0,92	0,02	93,09
3	Japan	0,32	0,32	1,11	0,03	92,48
4	Switzerland	3,96	4,11	1,36	0,00	89,14
5	Netherlands	2,00	2,30	0,99	0,05	87,43
6	Germany	3,22	5,51	0,79	0,01	87,32
7	Finland	1,97	2,61	0,96	0,40	87,18
8	Belgium	0,96	2,56	0,73	0,03	85,44
9	Norway	1,08	2,01	0,89	0,10	84,97
10	Poland	0,00	0,00	0,15	0,87	84,74
11	Denmark	4,72	3,88	1,67	0,06	84,43
12	Czech Republic	0,29	1,60	0,22	1,15	82,22
13	Australia	2,48	4,29	0,22	1,88	80,85
14	Iceland	3,45	6,67	0,12	3,31	80,10
15	Luxemburg	2,96	3,14	0,85	0,76	80,01
16	Hungary	0,71	1,82	0,21	1,39	79,32
17	France	2,02	2,08	0,70	0,89	79,10
18	Portugal	0,73	1,14	0,38	1,53	75,48
19	Austria	2,58	2,66	0,85	0,11	73,77
20	Great Britain	1,55	2,32	0,61	0,75	72,60

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The ranking of countries for waste recycling is led by Iceland with a score of 6.67, and for waste incineration – Denmark (1.67), as shown in table 5.

Table 5. Rating of OECD countries on recycling and waste incineration compiled by the author according to The Global Waste Index 2019

Country	Recycling, (points)	Country	Incineration, (points)
Iceland	6,67	Denmark	1,67
Germany	5,51	Switzerland	1,36
USA	5,10	Japan	1,11
Australia	4,29	Netherlands	0,99
Switzerland	4,11	Finland	0,96

As a result, the final value of the Global Waste Index is the highest value for South Korea (100), 93.09 for Sweden, 92.48 for Japan, 89.14 for Switzerland and 87.43 for the Netherlands.

In its Environmental Performance Reviews, the OECD examines a number of policy instruments that are being introduced for waste and material management. Thus, the following policies can be used to develop waste management, such as:

1. Regulatory tools

- linking regulatory instruments to economic instruments and raising awareness to build strong policies (Prohibition of landfills in the Netherlands);
- standardization of goods and services aimed at recycling and the circular economy (EU Waste Vehicles Directive);
- Capacity building measures, where necessary to ensure the implementation of key bodies (municipal waste management reforms in Poland).

2. Economic instruments

- full reimbursement of waste management costs for the implementation of the polluter pays principle (Netherlands, Norway);
- ongoing improvement of prices for household waste management services to improve cost recovery and avoid detrimental incentives (Colombia);
- use of the income received from the provision of household waste management services to build the capacity of municipalities to perform their waste management functions (Poland);
- differentiation of disposal taxes depending on the environmental damage associated with different types of waste recycling (Norway);
- the use of the fee for non-organic products hinders the use of environmentally harmful products (Hungary).

3. Extended producer responsibility (further EPR) tools

- mechanisms of intermediary services for coordination of EPR;
- certification of EPR to ensure compliance with environmental standards (Norway);
- prepayment for the disposal of small waste streams for which the removal program will be too expensive (Korea);
- consultations with stakeholders during the development of schemes and their ongoing activities to ensure the involvement of industry and relevant authorities (Netherlands);
- landfill taxes for transformational changes in waste management.

4. Green public procurement

- use of eco-labels for public procurement (Korea);
- assistance to governments in reducing waste (Norway);
- use of procurement as a tool for the circular economy: support for secondary goods and *circular procurement* (Netherlands);
- monitoring of green public procurement in order to prosecute procurement agencies (Czech Republic).

5. Informing the public and raising awareness

- inclusion of waste reduction and recycling in environmental education programs (Colombia);
- encouraging and supporting the activities of non-governmental organizations to raise public awareness, such as cleaning activities (Estonia, Colombia).

6. Monitoring and reporting

- comprehensive monitoring and reporting on waste generation and recycling to support policy development and revision (Norway);
- introduction of modern information systems for tracking industrial and other waste (Korea);
- elimination of information gaps to improve the understanding of international flows of materials for the production of goods (Japan, the Netherlands).

7. Promoting the implementation of legislative acts

- coordination mechanisms between executive bodies (Israel, Poland);
- promoting compliance in order to ensure awareness among polluters and waste management entities (Norway); and
- specialized units for the investigation and prosecution of waste management violations (Colombia, Norway) (Environmental Performance Reviews, 2017).

Conclusions

Thus, achieving the goals of sustainable development is possible through the transition to a circular economy, which aims to restore and rational consumption of resources. Unlike the traditional model of economic development, the circular model is the best way to conserve resources and materials, as it is based not only on efficient waste disposal, but also global environmental principles, which include recycling and reducing resource

use. Waste management plays a fundamental role, especially in developed and developing countries. The larger the population and the more developed the economic activity, the greater the amount of waste due to the traditional linear economic model. Appropriate waste management policies reduce the negative impact of waste on the environment.

The circular economy is an economic development strategy with appropriate legal and economic instruments, and its implementation is based on innovation. The introduction of the circular economy will have a positive impact on companies, consumers and society, as its goal is to improve the quality of life without excessive use of waste and natural resources.

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