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TRENDS IN A GLOBAL CIRCULAR ECONOMY

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Abstract
The article analyzes the indicators and dynamics in a global circular economy. The methodological bases of the study are the fundamental provisions of the closed-loop economy model. Structural-functional method, historical and logical method, comparative analysis, intuitive forecasting, graphical and tabular, method of induction and deduction are used in the article. It is revealed that the development of the circular economy model is characterized by such trends as the responsibility of packaging companies for the final life of materials; development of chemical processing on a commercial scale; material footprint reduction by reducing the level of household, enterprises and the other economic agents' consumption. It is proved that the introduction of the circular economy model will help to increase GDP and average employment and to reduce greenhouse gas emissions. It has been established that the European Union's Ecodesign Directive, the Environmental Management and Audit Scheme (EMAS), the Environmental Choice Program, the TCO Certified, etc. play an important role in encouraging business and the public to take environmental issues into account.

Keywords: *circular economy model, extended producer responsibility, greenhouse gas emissions, material footprint, trends.*
JEL Codes: *E21; F63.*

Introduction

The modern economic system "produce - use – utilize" has functioned for a long time at the expense of cheap and affordable raw materials to create conditions for growth and stability. However, by 2030, the number of middle-class consumers is expected to increase by 3 billion people. Such an unprecedented increase in demand for limited supply of resources calls into question the continued functioning of the traditional linear economic system. Thus, the cost of recycling equipment can be reduced by about 50% if companies produce products that are easy to disassemble, introduce reverse logistics processes and offer incentives to return unnecessary equipment. Also, the distribution of leasing services among households will save about a third per cycle of use, while producers would earn about a third more profit. The economic benefit of saving materials alone is estimated at more than 1 trillion dollars per year. The transition to innovative reuse, overproduction and recycling of products can lead to significant job creation. In the EU alone, recycling creates 500,000 job places. The transition to a closed-loop economy will have a positive economic impact on companies and consumers in both industrialized and developing countries. According to the International Trade Union Confederation, such a transition will allow governments around the world to overcome a global job shortage of 600 million people. The circular economy will allow countries to conserve resources, increase their

efficiency, reduce pressure on the environment, promote economic growth, innovate, and more (Roleders, 2021).

Trends in the development of a closed-cycle economy are constantly expanding. Some of them are rethinking of the old ideas, others stem from the introduction of the new technologies (Ellenmacarthurfoundation, 2021).

2020 has become a challenge for all countries of the world. All business models have been changed: from the ordinary communication to the global value chains. Tough measures to combat the COVID–19 pandemic, related to the introduction of a regime of total isolation, led to the closure of borders, disruption of the labor migration flows, increased security requirements, and the introduction of additional control measures. The President of the European Central Bank, C. Lagarde, emphasizes that the pandemic will accelerate the existing digitalization and automation movement; will lead to a reduction in supply chains and the development of environmentally friendly industries (Horobin, Rajbhandari, 2020). All this strengthens society's demands for the government instruments to support, seek and implement their own resources and the opportunities for economic development in a limited environment. Overcoming the challenges of the COVID–19 pandemic depends on justifying and implementing new approaches to the further industrial development, including finding opportunities for successful integration into the global value chains.

The research aim and object

The purpose of the article is to analyze both the indicators and the dynamics of the current state and trends in a global circular economy.

The object of research is a set of relations between the world economy agents concerning the implementation of the circular economy model. The subject of the research is the peculiarities of the development of the global circular economy model.

Analysis of recent researches and publications

The study of the formation and development of a circular model of the economy is extremely relevant.

J. Korhonen, A. Honkasalo, J. Seppala (2018) consider the conceptual foundations of the circular economy and the problems of its implementation in modern conditions, while B. Lin Chi-ang (2020) studies the circular economy in the context of sustainable development, emphasizing the need for active cooperation between consumers, producers and the state. The impact of COVID–19 on the global ecosystem is analyzed by T. Ibn-Mohhamed, K. B. Mustapha et al. (2020), emphasizing that the sustainable development of the world economy requires decisive structural changes not only in the economic model, but also in lifestyle and thinking.

Zvarych (2019) explores the prospects for the implementation of the EU Action Plan in Ukraine, offers concrete steps to include Ukrainian industry in the circular process. T. Oriekhova (2019) conceptualizes the idea of a circular economy as a basic transformative, integrative philosophy, which is the basis of environmental and economic policy of public-private partnership.

Updating the approach to evaluate the contribution of demographic factors to economic growth, M. Pasichnyi and A. Nepytaliuk (2021) propose the institutional framework based on the ideas of caring for the environment and the circular economy, in particular. The aforementioned concept could be regarded to achieve favorable public performance.

V. Gurochkina and M. Budzynska (2020) substantiate the theoretical aspects of the closed-loop economy, the process of its formation, give the main proposals for its development in Ukraine. On the example of the EU countries, researchers substantiate the possibilities of formation and development of circular business models in Ukraine.

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M. Varfolomeev and O. Churikanova (2020) consider the problems and main aspects of the circular economy in different countries, as well as assess the prospects of Ukraine's transition to a circular economy.

The circular economy model is an economy based on the renewal of resources, an alternative to the traditional linear economy. Other names for this approach are circular economy, closed-loop economy, green economy, nature management economy and waste-free economy.

The first mention of a circular economy came more than half a century ago. In 1962, the American marine biologist R. Carson published a book Silent Spring, which drew attention to the environment, especially some of the problems she thought were caused by synthetic pesticides, said: "I do not claim that chemical insecticides. I claim that we have passed toxic and biologically active chemicals into the hands of people who for the most part know nothing about their potential danger. We have exposed a significant number of people to these poisons without informing them or asking for their consent". The above-mentioned book provoked changes in national pesticide policy, and later led to the creation of the US Environmental Protection Agency. After all, at that time the main indicator of industrial development was progress and no matter at what cost it was achieved, and ecology was not considered a science at all. However, despite the scale of criticism at the time, the publication of R. Carson's book "Silent Spring" ("Silent Spring") is considered the beginning of the war for the preservation of the environment.

The next no less significant mention in 1966 was an essay by K. Boulding entitled "The Economics of the Coming Spaces Earth". Essays are often called the first expression of "closed-loop economy", although Boulding does not use this phrase, instead the author notes that the main problem is that humanity has increased its activities to a level where environmental pollution and resource extraction can no longer be insignificant. We cannot move to another place to avoid our waste or find new resources. As a result, businesses based on increasing consumption rates using technologies that burn fossil fuels and destroy ores without worrying about recycling or reuse are short-lived and wasteful. Thus, K. Boulding for the first time raises the issue of reuse of goods.

The closed-loop economy was further modeled by British environmental economists D. Pierce and R. Turner in 1989. At work "Economics of natural resources and the environment" they pointed out that the traditional open economy developed without any constructions in the tendency to recycling, which is reflected in the treatment of the environment as a reservoir for waste.

In the early 1990s, T. Jackson began to gather the scientific basis for this new approach to industrial production in his edited collection "Strategies for clean production", which includes chapters from prominent authors in this field, such as W.Stachel, B. Rice and B. Costanzo. While still known as "preventive environmental management," his next book, Material Problems - Pollution, Profits, and Quality of Life, synthesized these discoveries in a manifesto for change, shifting industrial production from an extractive linear system to a more closed economy.

The main interpretations of the circular economy are summarized in table 1.

Table 1. Interpretation of the circular economy model

Year	Author	Interpretation
2015	Haas W. et al.	A simple but compelling strategy that aims to reduce both the cost of primary materials and the production of waste by closing the economic and environmental cycles of resource flows.
2015	Tukker A.	A mutually beneficial philosophy is that a thriving economy and a healthy environment can coexist.
2016	Lieder M., Rashid A.	Addressing a number of issues, such as waste generation, resource scarcity and sustainable economic benefits.
2016	Pilyugina M.A	An economy that increases people's well-being and ensures social justice, significantly reducing risks to the environment.
2017	Alexandrova V.D., Yesipova O.V.	Economic activity aimed at energy saving, regenerative environmentally friendly production, circulation and consumption. The circular model is the most successful way to save resources and materials, and constant economic growth.
2017	Kirchherr J., Reike D., Hekkert M.	An economic system based on business models that replace the concept of “end of life” with reduction, alternative reuse, recycling and recovery of materials in the processes of production / distribution and consumption, thus functioning at the micro level (products, companies, consumers), meso-levels (eco-industrial parks) and macro-levels (city, region, nation and beyond) in order to achieve sustainable development, which means creating the quality of the environment, economic prosperity and social justice in the interests of present and future generations.
2018	Mashukova B.S.	The philosophy of reusing and profiting from what was previously considered unnecessary and was scrapped within the triad of the traditional linear economy.
2019	Zvarych I.Ya.	A relatively new system of operation, which aims to "close the cycle" and project waste from the system, which means the transition from the outdated linear operating model "take, make, dispose", which is very costly and harmful to the environment, to a more responsible comprehensive management system resources.

**Source: Compiled by the author based on the analysis of literature sources on the research topic*.

The economy of the closed cycle is a model where the used materials are processed or released into the biosphere without harmful effects.

The tendency to perceive waste not as garbage but as useful resources is a key feature of the circular economy. The importance of this approach is also due to the fact that there is a high risk of depletion of many natural resources.

Materials and methods

Structural-functional method - in revealing the essence of the concept of circular economy; historical and logical method - in the analysis of the transformation of processes from traditional to circular economy; comparative analysis - in identifying the peculiarities of the global circular economy; synthesis - in determining the ways of introduction of the circular economy in the business model; intuitive forecasting - when substantiating the prospects for the development of the global circular economy; graphical and tabular - in the disclosure of trends in the circular economy at the international level; method of induction and deduction - in formulating the general conclusions of the article.

The theoretical basis of the article was the research of domestic and foreign scientists. The factual and statistical basis was the data of the Ellen MacArthur Foundation

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and the Club of Rome, the European Commission, New Plastics Economy Global Commitment Progress Report 2019, OECD. Stat.

Results

Extended producer responsibility (EPR), a model in which packaging companies are responsible for the final life of materials, is extremely important for the circular economy policies to promote sustainable material management, recycling and reduction in the environmental impact. Manufacturers can influence change by making products and packaging more durable so that materials can be reused, recycled or reintegrated into the new product design. The use of EPR in the circular economy is expanding worldwide, especially in the EU (table 2).

Table 2. Activities to implement a circular economy with the help of EPR in the particular countries

Country	Activities
The Netherlands	The goal of implementing a complete circular economy model by 2050 and reducing consumption of natural resources by 50 percent by 2030 has been set.
Scotland, United Kingdom	Three priority areas for supporting the circular economy have been identified: reducing carbon emissions in the food and beverage sector; encouraging the reconstruction of production goods; reduction of construction waste.
Germany	Product Innovation Cycles Initiative Launched, which offers grants to zero-waste products development projects and encourages repairs and upgrades products to promote the development of a circular economy.
Canada	In 2018, the Zero Plastic Waste Strategy was adopted, which contained 10 priority areas to promote the development of a circular economy, including the durability of plastic products, support for reuse and processing.
USA (California)	The bill on the creation of a comprehensive regulatory scheme for the manufacturers, retailers and wholesalers of disposable packaging and other disposable products and the reduction of such waste by 75 percent to 2030.

**Source: Compiled by the author according to the City of Ottawa*.

In December 2015, the European Commission presented its Circular Economy Action Plan, which included 54 measures to close product cycles. The focus was on the design of more durable and recyclable products. In the European Union, EPR is mandatory for batteries and electronics, and the EU countries have their own mandatory or voluntary EPR programs for goods such as medicines, plastic bags, and light bulbs (Waste Management, 2021).

According to the research by the Ellen MacArthur Foundation and the Club of Rome, providing government support for the circular economy model will help to increase GDP and average employment, reduce greenhouse gas emissions.

Thus, for the EU as a whole from the

introduction of the circular economy model, GDP growth is projected at 6.7%, and separately for Sweden, the Netherlands and Finland – 3%, 1.4% and 0.8% respectively. The introduction of the circular economy model contributes to the growth of average employment by creating new jobs in connection with the development of reuse, processing, restructuring of production, certification (transition to the provision of services along with the production of goods), and will be 3% in Sweden, 1% in the European Union, 0.6% in the Netherlands, 0.3% in the United Kingdom and Canada (Ellenmacarthurfoundation, 2021).

Greenhouse gas emissions are also projected to be reduced by 25% in the European Union, including 70% in Sweden and 8% in the Netherlands due to improved waste management and recycling.

The European Commission has launched the SWITCH to Green initiative, which promoted green business through awareness-raising activities, mapping green economy opportunities, economic modeling, capacity building of public institutions, and support for private sector initiatives, inter-company dialogue and more. It focuses on the key sectors in value creation, such as food and light industry, building materials production, tourism, in order to create a new platform for cooperation within the circular economy model. The initiative is implemented in partnership with international organizations, such as the United Nations Environment Program and the United Nations Industrial Development Program, partner governments and civil society organizations (Stellamccartney, 2021). The main current activities supported by the EU in the context of this initiative include assistance in Africa and Asia, in the field of medicine and green economy development, etc. (table 3).

Table 3. Activities within the EU initiative SWITCH to Green

Activities	EU commitments as of 2020 (euro)
SWITCH Asia	280 000 000
SWITCH Med	39 400 000
SWITCH Africa	39 000 000
SWITCH to Circular Economy Value Chains	19 000 000
Partnership for Action on Green Economy (PAGE)	17 500 000
Green Economy Coalition	5 000 000
SWITCH to Green Facility	5 300 000

**Source: Compiled by the author according to the European Commission.*

Another trend in the development of the circular economy is to bring chemical processing closer to the commercial scale. Progress in this area is facilitated by the large companies such as Unilever, Walmart and Nestle. The essence of chemical processing is to break the polymer structure into simpler blocks, for example, by chemical or enzymatic processes, which are then re-integrated into the new materials for the production of the new products (Progress Report, 2019).

The development of chemical processing requires gradual steps and significant investments. In 2020, Neste Corp. and the constantly oriented investment company Mirova have announced a joint investment of € 10 million in Recycling Technologies Ltd., a specialized supplier of plastics processing technologies to accelerate the development of chemicals and facilitate the transition to a circular plastics economy (Waste Management, 2021).

Japan's Yokogawa Electric has also

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announced an investment and partnership agreement with Jeplan, a polyester recycling company with innovative chemical processing technology. In 2019, Mars, Inc. launched a working group on chemical processing to assess the viability of scale technology, along with environmental, social and financial impacts, and food safety considerations.

Schneider Electric intends to use only high-quality chemically recycled plastic for its electrical products. Indorama Ventures has started production of PET using chemically processed monomers from consumer goods, with an initial annual volume of 10,000 tons. Recycling Technologies uses the Beta Plant research facility in the UK for R&D, training and testing of chemical processing of mixed plastic waste to separate raw materials for new products. Finally, in a joint project, with the assistance of the Ellen MacArthur Foundation, the signatories of Schneider Electric and UPM Raflatac Global Commitment, along with other companies, began to set out the principles of a mass balance system for accounting for chemically processed content development of clear, generally accepted standards (Progress Report, 2019).

According to the Report of the Global Commitment of the New Economy on Plastics Management in 2019, as of 2018, among the top 10 global companies producing consumer goods (FMCG), the largest number of packaging that can be recycled, manufactured and used have been associated with the Coca-Cola Company (99%), PepsiCo (77%) and Nestlé (65%), which have set a goal to shift those figures to 100% by 2025.

Packaging reuse rates are much lower at 5% at L'Oréal, 3% at PepsiCo and 2% at Nestlé. However, the goal was to increase the use of recycled plastic to 40% in L'Oréal, to 25% in PepsiCo and to 15% in Nestlé.

The next trend in the development of the circular economy model is the material footprint reduction by reducing the level of household, enterprises and the other economic entities consumption.

Material footprint is the ratio of global material extraction to domestic demand. The total material footprint is the sum of the material footprint indicators for biomass, fossil fuels, metallic and non-metallic minerals. This indicator can be interpreted as the value of the material standard of living in the country and the level of the economy's capitalization. Material should be considered in conjunction with the indicator of domestic consumption of material (total number of resources directly used in the economy), as they cover two aspects of the economy: production and consumption (Unstats, 2021).

Since 2005, the material footprint has increased to 27 billion tons or by 30% and amounted to almost 92 billion tons in 2017.

According to the UN Environment Program, without concerted policy action, the figure is projected to increase to 190 billion tons by 2060. Moreover, the global material footprint is growing faster than population and production (Progress Report, 2019). As of 2017, the level of domestic consumption of materials in the world amounted to almost 92 billion tons, which was 17% more than in 2010.

This growth was due to the following reasons:

- building new infrastructure in emerging market economies as a model to be followed in the future;
- outsourcing of material-intensive and energy-intensive stages of production from high-income to less resource-efficient countries, which means the need for more resources than in developed ones (Unstats, 2022).

According to the OECD report on environmental policy and individual choice, the government plays an important role in encouraging business and the public to take environmental issues in consumption and production into account. The examples are:

- a decision of the European Parliament banning certain disposable plastics, such as plastic cotton swabs, straws, plates and cutlery;
- the European Union Ecodesign Directive, which sets the basis for setting

mandatory environmental requirements for energy-using and energy-related products sold in all the member-states. Its sphere of influence covers more than 40 product groups (boilers, light bulbs, TVs and refrigerators), which are responsible for about 40% of all greenhouse gas emissions in the EU (Directive 2009/125/EC);

- the Environmental Management and Audit Scheme (EMAS) is a voluntary environmental management tool developed in 1993 by the European Commission that allowed companies to assess, manage and continuously improve their environmental performance (Regulation (EC) No 1221/2009);
- eco-labels and green stickers are the systems for labeling food and consumer goods. Eco-labels are voluntary, while green stickers are required by the law. For example, in North America, large appliances and cars use the so-called Energy Star, which is a form of consumer sustainability measurement that should make it easier to consider environmental issues when shopping. Some labels quantify pollution or energy consumption using indices or units of measurement, while others indicate compliance with minimum requirements for sustainability or environmental damage reduction (Waste Management);
- the TCO Certified – a certificate created by the Swedish Confederation of Professionals to ensure that computer products purchased by employers meet environmental standards and are ergonomic enough to prevent the long-term health problems (Waste Management and circular economy, 2021);
- the Environmental Choice Program is an environmental label created by the Canadian Ministry of the Environment in 1988 for more than 300 product categories to help consumers distinguish between services and products that are less harmful to the environment (Ellenmacarthurfoundation, 2021); and
- the Fairtrade brand was developed by the Dutch Development Agency in collaboration with Mexican farmers, which aimed to empower small producers and improve their access to global markets. The most distinctive feature of the Fairtrade is the guarantee of a minimum price and a social premium that comes to the cooperative, not the producers. Recently, environmental targets have also been adopted as part of the certification system (Varfolomieiev, Churikanova, 2020).

Conclusions

The planet is under a lot of stress caused, in majority, by the reckless consumerism with little regard for long-term effects. Adopting circular economy trends can change this. By rethinking and redesigning the way we interact with and consume nature, a harmless model can be established. Of all sustainable efforts, creating a circular economy must be the principle goal.

It was proved that extended producer responsibility was extremely important for circular economy policies to promote sustainable material management, recycling and reduce environmental impact.

Providing government support for the circular economy model will help to increase GDP and average employment, reduce greenhouse gas emissions.

The other trends in the development of the circular economy should be focused on the efforts to bring chemical processing closer to commercial scale and to reduce the level of the household, enterprises and other economic agents' consumption.

References

Chi-ang B. Lin. Sustainable growth: a circular economy perspective (2020). Retrieved from: https://www.tandfonline.com/doi/abs/10.1080/00213624.2020.1752542?journalCode=mjei20. [2022 02 11].

Directive (2009) 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products. OJ L 285, 31.10.2009: 10–35

Fairtrade Mark (2022). Retrieved from: https://www.fairtrade.net [2022 02 11].

Furkan Sariatli (2017). Linear Economy vs Circular Economy: A comparative and analyzer study for

eISSN 2345-0355. 2022. Vol. 44. No. 2: 176-184
Article DOI: https://doi.org/10.15544/mts.2022.18

Optimization of Economy for Sustainability. Visegrad Journal on Bioeconomy and Sustainable Development : 31-34.

Horobin W., Rajbhandari A. ECB's lagarde expects disinflation as crisis transforms economy (2020). Retrieved from: https://www.bloomberg.com/news/articles/2020-07-04/ecb-s-lagarde-expectsdisinflation-as-crisis-transforms-economy

Hurochkina V., Budzyns'ka M. (2020) Circular economy: Ukrainian realities and opportunities for industrial enterprises. *Economic Bulletin*. Series: finance, accounting, taxation, vol. 5 : 52–64. DOI: 10.33244/2617-5932.5.2020.52-64 [2022 02 26].

Ibn-Mohhamed T., Mustapha K.B. and others. A critical analysis of the impacts of COVID-19 on the global economy and ecosystems and opportunities for circular economy strategies, resources, conservation and recycling (2021). Retrieved from: https://www.sciencedirect.com/science/article/abs/pii/S0921 344920304869. [2021 11 12].

Indicator 8.4.1: Material Footprint, material footprint per capita, and material footprint per GDP (2022). Retrieved from: https://unstats.un.org. [2022 02 12].

Institutions, governments & cities (2021). Retrieved from: https://www.ellenmacarthurfoundation.org/our-work/approach/government-and-cities. [2021 12 18].

Korhonen, J., Honkasalo, A. & Seppala, J. (2018). Circular Economy: The Concept and its Limitations Retrieved from: https://www.sciencedirect.com/science/article/abs/pii/ S0921800916300325? Via % 3 Dihub. [2021 12 18].

Oriekhova Tetyana (2019). Circular economy as a global imperative. *Journal of European Economy*. Vol. 18, No 4 : 360–371.

Pasichnyi M., Nepytaliuk A.(2021) The Contributions of Demographic Factors to Economic Growth. *Problemy Ekorozwoju – Problems of Sustainable Development*, *16*(1), 219–229. DOI: 10.35784/pe.2021.1.24

Progress Report (2019). The New Plastics Economy Global Commitment. Ellen MacArthur Foundation. 48 p.

Regulation (EC) (2009) No 1221/2009 of the European Parliament and of the Council of 25 November 2009 on the voluntary participation by organizations in a Community eco-management and audit scheme (EMAS), repealing Regulation (EC) No 761/2001 and Commission Decisions 2001/681/EC and 2006/193/EC.

Roleders V. V. Characteristic differences of functioning of linear and circular models of economy. Economics and organization of management. 2021. Issue №4 (44) : 235–242. DOI 10.31558/2307-2318.2021.4.21 [2022 02 27].

Stella McCartney's Circular initiatives and partnerships (2021). Retrieved from: https://www.stellamccartney.com. [2021 12 02].

Varfolomieiev, M. and Churikanova, O. (2020), Circular economy as an integral way of Ukraine's future in the aspect of globalization, *Efektyvna ekonomika*, vol. 5, retrieved from: http://www.economy.nayka.com.ua/?op=1&z=7929. DOI: 10.32702/2307-2105-2020.5.200 [2022 02 26].

Waste Management and circular economy – conserving resources (2021). Retrieved from: https://www.giz.de. [2021 12 20].

Waste Management: the Base for Circular Economy (2021). Retrieved from: https://www.ennomotive.com/waste-management/ [2021 12 21].

Zvarych I. Ya (2019), "Cowboy Economy" vs "Spaceship Economy", *The Fourth Industrial Revolution: a Change in the Direction of International Investment Flows*, ed. Krysovaty A, I, Sokhatska O.M.,Ternopil, Osadtsa Yu.V.: 111-119.