

# LOGISTICAL SUPPORT FOR THE DEVELOPMENT OF THE CIRCULAR ECONOMY

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**Abstract.** The aggravation of ecological problems at the global level, as well as the need to solve the economic and social problems of humanity, require the implementation of important economic transformation measures. The circular economy (or closed-loop economy) is a form of production organization related to extending the life cycle of products and minimizing harmful disposal and waste. It is also about sharing, renting, reusing, repairing, refurbishing and recycling existing materials and products as much as possible. As with any type of economic model, the functioning of the circular economy requires a corresponding logistics system. In this context, together with the acceptance of the concept of ecological efficiency and "green" economy in many countries, the new approach of "green logistics" has emerged in international practice. *The purpose of this article* is to generalize theoretical approaches and to substantiate the conceptual provisions of logistical support for the development of the circular economy in the conditions of global transformations. *Methodology.* The methodological basis of the study is the scientific work of scientists on the problems of green economy, circular economy, environmental management, waste management, logistics management. The research was conducted using general scientific methods: analysis and synthesis – to summarize the existing conceptual approaches and regulations, scientific developments on the development of the circular economy, greening of logistics systems, green logistics, clarification of terminology; classifications – to systematize theoretical approaches to the definition of "green logistics" proposed by various scientific schools; structural and logical generalization – to determine the key logistics approaches to the development of the circular economy and the principles of green logistics for the implementation of circular business models. *Results.* In order to present the specific aspects of circular economy logistics, the opinions of researchers from different countries were studied to outline a related synthetic vision. After conducting the study, the current characteristics of the circular economy were identified. Then the current international trends in logistics development were identified. An important trend is the development of "green" logistics. It has been found that many conceptual approaches to the definition of the terms "green" logistics and environmental logistics are generally accepted and have a broader meaning, without taking into account the specifics of the functioning of different areas of economic activity, including the transport sector and logistics activities. Scientific views on the interpretation of the nature and content of the concept of "green" logistics are generalized. It is proposed to consider the concept of "green" logistics as a tool of circular economy. It offers companies a number of advantages and is based on certain principles. As a synergy effect, the massive implementation of the circular economy and green logistics can significantly contribute to solving the socio-economic problems of humanity. *Practical implications.* The practical significance of this study lies in the fact that the conceptual provisions can be used in practice when developing an organizational and economic mechanism for implementing the concept of green logistics. This mechanism should include such blocks as: management of supplies and purchases of material resources; production of products; warehousing and inventories; logistics flows; risks of logistics activities; logistics service processes; waste recycling; innovation and change. The introduction of the proposed organizational and economic mechanism will reduce the cost of managing the movement of logistics flows and increase the level of environmental safety. This is one of the most

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important requirements for the implementation of the concept of corporate social responsibility of business in a circular economy. Value/originality. The authors' approach to formulating the category "green logistics" is theoretically substantiated.

**Key words:** circular economy, green logistics, environmental logistics, greening of logistics activities, green technologies, logistics system, conceptual approach, organizational and economic mechanism, sustainable development, cost minimization, environmental safety, synergistic effect, globalization.

**JEL Classification:** G30, M14, M21, O31, Q21, Q56

## 1. Introduction

According to the World Business Council for Sustainable Development, the circular economy is critical to addressing today's biggest environmental priorities, including resource scarcity, pollution, climate change, biodiversity loss, land use change, and food loss and waste.

It is becoming increasingly clear that humanity is approaching the threshold of depletion of a wide range of natural resources. This requires an urgent abandonment of the practice of the linear model of production. In this context, experts V. Ganea and I. Birca (2020) mention: "This model has caused a huge deficit of energy resources, intensification of environmental pollution, increase in the area of industrial and household waste landfills, etc. The new challenges are to ensure a dignified quality of life for all the inhabitants of the planet, in the context of growing volumes of production and consumption, but at the same time in conditions of diminishing reserves of natural resources."

The circular economy model has become an alternative to the linear production model, which is seen as the only way to solve global problems related to rationalizing the use of exhaustible natural resources and minimizing the harmful impact of human activity on the environment.

In this regard, the nominated authors (Ganea, Birca, 2020) state: "This new type of economic activity aims to move away from the direct vector of economic growth based on the volume of resources used, gradually moving from depletion to the regenerative use of materials. This is made possible by optimizing the use of existing assets, stocks and materials, i.e., by reducing the amount of raw materials consumed and the volume of waste generated." The implementation of the circular economy has as its fundamental purpose the achievement of the synergy effect (environmental, economic and social). The circular economy is intended to offer acceptable solutions based on the principles of resource

efficiency, increasing the environmental and social responsibility of economic entities in combination with technological development and the transformation of social needs. (Ganea et al., 2022)

Acceptance of the circular economy model is part of the transition activity of many countries in the world to the "green" economy. (Caprian et al., 2023) As with any model of production organization, the success of the implementation and operation of the circular economy depends on the creation of an appropriate logistics system.

Leading scientists (Dzwigol, 2003, 2008, 2009; Karbownik et al., 2012; Kwilinski et al., 2021; Bezpartochnyi et al., 2022; Kuzior et al., 2022) are conducting scientific discussions on the implementation of the concept of green growth in order to preserve the environment and improve the economic activities of enterprises.

The desire of companies to create an ecological image among consumers has contributed to the development of a sustainable logistics concept (Boichuk, Kauf, 2019; Trushkina, Shyposha, 2021), which includes green components and takes into account economic, social and environmental activities in the context of logistics management.

It is precisely the greening of logistics activities that is a key vector for business development, since most consumers give priority to companies that carry out cargo transportation by "green" means and use technologies that save natural resources. (Trushkina et al., 2021) The use of "green" technologies in logistics has become as much a necessity as the implementation of a quality management system. As a result, according to the "Green Trends Survey" in the study "Towards Sustainable Logistics" (Christof, Ehrhart 2012), 59% of companies found that the green transportation of their products is recognized as a decisive factor in attracting consumers. Based on a survey conducted by PE International (UK) (McKinnon et al.

2010), the main benefits of implementing green logistics include reducing air emissions (33% of company directors and senior managers) and attracting new customers or developing new products (26% of respondents).

Thus, modern business conditions dictate new requirements for business development. The priority is green logistics as one of the most important components of the overall strategy of corporate social responsibility in the context of the development of a circular economy. (Dźwigoł et al., 2021; Trushkina, Prokopyshyn, 2021) It should be noted that the role and importance of green logistics as a tool to support environmental safety is becoming more relevant every year, as it has become a socially useful and profitable symbiosis of ecology and economy as part of corporate environmental governance policies.

Against this background, **the purpose of the paper** is to generalize theoretical approaches and to substantiate the conceptual provisions of logistical support for the development of the circular economy in the conditions of global transformations.

## 2. The circular economy from a modern point of view

There are several definitions of circular economy in the literature:

- The circular economy is an economic model that aims to use resources efficiently by minimizing waste, preserving long-term value, reducing primary resources and creating closed loops of products, product parts and materials within the limits of environmental protection and socio-economic benefits. (Morseletto, 2020)
- The circular economy is a production model that emphasizes the reuse of products, components, and materials; remanufacturing, reconditioning, repairing, and upgrading; and the use of energy derived from waste throughout the product value chain. (Korhonen et al., 2018)
- Circular ecology is a concept that contributes to the preservation of the environment by minimizing the extraction of resources and the generation of waste. Within this production model, the aim is to extend the life cycle of products and the materials from which they are made. Products that have reached the end of their use-by date must be reused or remanufactured as much as possible, avoiding

or postponing their incineration or storage. (Beames et al., 2021)

The circular economy concept is based on nine elements ("9Rs"): Rethink; Refuse; Reduce; Reuse; Re-Gift; Repair; Rent; Recycle; Rot. In the conditions of the emerging scarcity of resources, the circular economy can allow producers to reduce the cost of purchasing raw materials through repeated processing and ensure the optimal use of generated waste. The benefits of minimizing waste and environmental pollution are also remarkable. The circular economy is also related to the minimization of excessive consumption of resources due to the circularity of the production process. In particular, the use of components and materials with the highest utility throughout the entire technical and biological cycle is remarkable. (Ganea et al., 2022)

Within the circular economy, a distinction can be made between the biological cycle and the technical cycle. The biological cycle includes products made from materials derived from living organisms, but not from fossil resources. The technical cycle includes products made from metals and minerals that must first be extracted from the earth's interior. (Beames et al., 2021) Some experts have highlighted the basic principles of the circular economy: (Bugaian, Diaconu, 2020)

- The principle of ensuring the sustainability of resources provides for the use of renewable energy and renewable, recyclable and biodegradable materials in successive life cycles.
- The principle of transforming waste into raw materials proposes the total disappearance of waste and the rethinking of products so that they can be recycled and reused to obtain other consumer products.
- Recycling products, components and materials with the highest use and priority achieves the principle of optimizing resource yields.
- The principle of promoting the efficiency of the system is achieved by denouncing and combating the harmful effects of the current industrial economic system.
- The principle of ensuring the diversity and high adaptability of products is a priority for the circular economy, which seeks to create sustainable products over time that can be transformed into other products, creating a cycle of recycling without waste.

### 3. Modern approaches to logistics

Logistics is an economic category that has existed since ancient times. As a science, it has always been linked to the imperatives of the economy of the time.

Some experts define logistics as follows "Logistics is that part of supply chain management that plans, implements, and controls the efficient and effective flow and storage of goods, services, and related information from the point of origin to the point of consumption to meet customer requirements. It is about getting the right product, to the right customer, in the right quantity, in the right condition, at the right place, at the right time, and at the right cost." (Flex Logistics, 2021)

The Romanian expert G. E. Mocuța (2009) believes that since 2005 a new concept of logistics has been promoted as an activity related to "the delivery of a product, in good condition, at the right time, in the right place, in the right and necessary quantity, in the packaging of properly presented goods, preceded, accompanied and followed by correct and accurate information entered in legal documents, all under the best economic conditions".

This definition confirms the application of the 7 "Rights" in logistics: Right product; Right customer; Right cost; Right quantity; Right condition; Right time; Right place. (Flex Logistics, 2021) Some researchers believed that beginning in the 1990s, cooperative logistics is developing in global practice. (Akbari et al., 2002)

In this context, a complex concept of logistics is formulated: "The functions of planning, execution and control of the flow of goods and information for the acquisition, storage, movement and delivery of goods in full cooperation with the other members of the logistics chain in order to achieve the expected objectives of the logistics chain, in particular the reduction of the response time to the market." (Mocuța, 2009)

In the first decade of the 2000s, total production capacity for many products was much higher than the market's ability to absorb them. Competition is getting fiercer. Product life cycles are shortening, and the need for innovation is growing. All of this makes forecasting demand very difficult and creates important uncertainties in markets. Companies are required to produce their products in small quantities and deliver them in ever shorter periods of time. (Akbari et al., 2002)

In these conditions, modern companies have to solve the following tasks:

- search for new markets, market segments and niches;
- maintain high quality of products and services;
- minimize the cost of products;
- maintain marketing agility to respond quickly to unexpected consumer demands.

Modern logistics must solve a variety of problems in the following basic areas: organization of the transportation system throughout the logistics chain; strategic design of the supply chain in terms of size and location decisions; determination of demand and its satisfaction by supply and the formation of the resulting networks; detailed supply planning in the movement of products through supply chains.

Modern logistics focuses on the supply chain, which consists of all parties directly or indirectly involved in the flow and transformation of goods and services from the origin of the product to the consumer. Logistics encompasses the economic activities necessary to satisfy consumer demand for the products of companies with product offerings. These activities span the entire product supply chain, from the extraction of raw materials to the delivery of the final product. The collection and recycling of used products and rail waste is also logistics. (Beames et al., 2021)

Modern logistics is associated with the rapid development of logistics services and the outsourcing of logistics functions within manufacturing companies.

In the first decade of the 2000s, experts considered it a current trend among logistics providers to focus more on logistics operations than on transportation, which is increasingly outsourced after second-level subcontracting. In particular, following the development of new information and communication technologies, the competence of the logistics provider has evolved from 3 PL (third party logistics) to 4 PL (fourth party logistics). (Vasiliu et al., 2008)

3PL is the outsourcing of logistics functions (priority warehouse management and transportation procedures) to an external company that manages the company's supply chain and ensures its daily operations. The 4PL service is related to the management of the customer's entire supply chain and, upon request, the design and optimization of the customer's supply chain. SPL and 6PL level services are



currently offered. SPL is a fully integrated logistics solution that encompasses the entire supply chain through multiple outsourced service providers. This logistics service solution is created by applying IT technologies to provide full visibility of the entire supply chain in real time. 6PL is more theoretical with the alternative name "Artificial Intelligence-based Supply Chain Management". This is a fully integrated and partially automated supply chain solution that is monitored and controlled by artificial intelligence. With the development of self-driving vehicles, warehouse robots and delivery drones, some components are already in use today.

#### 4. Provision of logistics support for the circular economy

The establishment of the circular economy requires certain adjustments to logistics systems. In the circular economy, suppliers and other supply chain partners need to streamline information exchange and introduce new transportation services as infrastructure elements of the circular economy. In a circular economy, goods are in constant motion and do not become waste because they can always be reused. The most challenging logistics issues in a circular economy are the predictability of goods flows, the low cost of materials, and the wide variety of trading qualities.

Similarly, the implementation of the circular economy is closely linked to the development of reverse logistics. It refers to the supply chain process of returning products from end users back through the supply chain to the retailer or manufacturer.

From these positions, it is very important to solve problems related to repair, reuse, refurbishment, remanufacturing, recycling, waste-to-energy, and storage: (Beames et al., 2021)

First, it is important to examine the possibility of reusing, remanufacturing or recycling a product in the area of circular product design.

Second, for products that have a significant level of use, it is necessary to emphasize the optimal use of the product during its life cycle and the possible extension of this life cycle. In this context, maintenance or repair work is of great importance.

Third, all materials in products that are durable or recyclable must eventually be recycled.

The notion of a circular supply chain is also linked to the logistics of the circular economy, which ensures the operation of a cycle with the highest degree of product processing from finished products. This means generating value from end-of-life products, often leading to the recycling of their primary components.

In recent decades, the concept of "green" (ecological) logistics has been promoted. Wikipedia offers the following definition: "Green logistics describes all attempts to measure and minimize the environmental impact of logistics activities. It includes all activities related to the forward and reverse flows of products, information and services between the point of origin and the point of consumption. The goal is to create sustainable value for the company by balancing economic and environmental performance." Green (ecological) logistics is any business activity aimed at minimizing the impact of the logistics system and delivery on the environment. Green logistics offers high profits without compromising consumer satisfaction and the well-being of the planet.

Based on the analysis of literary sources (Janbo, Songxian 2008; Brdulak, Michniewska 2009; Sbihi, Eglese, 2009; Mesjasz-Lech, 2011; Ubeda et al., 2011; Lai, Wong 2012; Dekker et al., 2012; Ćirović et al., 2014; Harris et al., 2014; Jedliński, 2014; Seroka-Stolka, 2014; Zhang et al., 2015), scientific views on the interpretation of the essence and content of the concept of "green" logistics are generalized. As a rule, this term is understood by scholars as:

- a scientific field and one of the factors of environmental protection based on resource-saving and environmentally friendly technologies;
- a new direction that involves the use of advanced logistics technologies and modern equipment to minimize environmental pollution and increase the efficiency of logistics resources;
- from the theoretical and scientific-methodological point of view, the functionality of the "green" economy is subordinated;
- logistics based on resource-saving and environmentally friendly technologies;
- a type of logistics in which scientific and practical activities take into account environmental aspects at all stages of the movement of material and other flows that correspond to it in order to reduce the destructive impact on the environment and optimize resource consumption;

- an innovative method in logistics;
- part of the concept of sustainable economic development, an effective approach to managing resource and energy flows to reduce environmental and economic damage to the environment and ensure effective innovative development of production;
- a system of measures that involves the use of energy- and resource-saving logistics technologies and modern equipment in all parts of the supply chain to minimize the negative impact on the environment and increase the overall consumer value of products;
- an environmentally friendly and efficient transportation distribution system;
- a scientific and practical activity aimed at optimizing and efficiently managing direct and reverse material and related flows (information, financial, waste, emissions, various natural resources and energy) in order to minimize the negative impact on the environment;
- a scientific and practical activity that involves the formation of an effective mechanism for integrating environmental and socio-economic aspects at all stages of planning, designing and managing supply chains in order to minimize environmental and economic damage and increase the consumer value of products through the use of energy and resource-saving logistics technologies;
- an activity related to environmentally efficient management of logistics flows of products moving from the enterprise to the consumer, as well as reverse flows of goods in the supplier-consumer system;
- a set of actions related to the assessment and minimization of environmental impacts of logistics activities;
- coordination of logistics activities of market players with a focus on achieving economic, social and environmental benefits through the use of energy and resource-saving technologies;
- an increase in environmental responsibility in the transport and logistics sector.

As a result of research (Kwilinski et al., 2021; Ganea et al., 2022) it was established that green logistics is a tool of circular economy. The experience of some countries shows that the use of resource-saving technologies in logistics can reduce material stocks by 40-60%, speed up the turnover of working capital by 20-40%, reduce transportation costs by 7-20%, reduce the

costs of loading and unloading and warehouse work by 15-30%.

Ecological logistics should be based on the following principles:

- integrated approach to the management of logistics flows;
- rationalization of the use of various resources (production, financial, energy, information);
- minimizing the use of raw materials and non-recyclable packaging;
- economic and ecological rationalization of transportation and storage of material resources;
- maximizing the use of production waste, containers and packaging as secondary raw materials or their disposal in environmentally safe conditions;
- optimization of costs of organization of logistic activities;
- minimizing risks in the operation of transport and logistics systems;
- increasing the level of environmental education and responsibility of employees;
- implementation of innovative technologies to reduce the ecological burden on the environment;
- application of advanced information technologies in the field of environmental protection.

Using eco-friendly logistics has a number of advantages:

- increase the long-term profitability of first- and last-mile delivery by reducing waste, costs, and carbon footprint;
- create new partnerships or expand existing ones. When companies embrace sustainable supply chains and green logistics, they become more attractive to both customers and business partners;
- increase customer satisfaction and loyalty through fast delivery and flexibility, and simplify the returns process;
- enhance reputation by taking corporate responsibility to reduce local and global environmental impacts;
- simplified recruitment, as the company using green logistics is more attractive to young professionals.

## 5. Conclusions

The circular economy represents a global hope for the efficiency of production activities while minimizing their negative impact on the environment. It is linked to the renewal of resources and is an alternative to the linear

economy. The development of the circular economy is impossible without the implementation of ecological logistics and new forms of logistics services. The implementation of new forms of logistics services is of interest as an opportunity to continue the research carried out.

The study of successes in the development of green logistics also deserves attention. Green logistics is a powerful tool for transforming logistics systems. Based on the analysis and generalization of existing scientific approaches to the definition of the term "green" logistics, it was established that under it is considered a scientific direction; the factor of preserving the environment with the help of environmentally friendly technologies; component of the green economy; type of logistics; economic activity; scientific and practical activities; type of activity related to the eco-efficient management of the movement of logistics product flows; a tool for ensuring the ecological safety of the ecosystem; a set of logistical approaches to the optimization of waste and resource flows; environmentally friendly transport distribution system; coordination of logistics activities to achieve sustainable development.

At the same time, most scientists identify the concepts of "green" and "ecological logistics", which is understood as a scientific direction that includes the use of modern innovative logistics technologies; a set of actions aimed at minimizing the environmental impact of logistics activities; integrated management of logistics processes (production, storage, waste transportation); a subsystem for managing product flows from the supplier to the consumer with minimal impact on the environment.

As a result of the study, it was proposed to consider the term "green logistics" as a concept of sustainable development of logistics systems of different levels and a tool of circular economy. For the effective implementation of the concept

of green logistics, it is advisable to develop an organizational and economic mechanism, which is considered as a set of principles, tools, functions, methods and means aimed at reducing the level of greenhouse gas emissions and costs of organizing logistics activities and various logistics services (transport, warehousing, marketing, etc.).

The main principles of green logistics should be the application of an integrated approach to the management of logistics flows; rational use of resources (production, financial, energy, information); minimal use of raw materials and packaging that cannot be recycled; economically and environmentally sound transportation and storage of material resources; maximum use of production waste, containers and packaging as secondary raw materials or their environmentally sound disposal; optimization of costs of organization of logistic activities; minimization of risks in operation of transport and logistic systems; increase of the level of environmental education and responsibility of personnel; introduction of innovative technologies for reduction of environmental pollution; application of information systems and digital technologies in the field of environmental protection.

The implementation of the green logistics mechanism helps to minimize the costs of managing the movement of logistics flows while maintaining the required level of environmental safety, which is one of the important requirements for the implementation of the concept of corporate social responsibility of companies in a circular economy.

In further scientific research it is planned to carry out a SWOT analysis of the development of logistics systems taking into account the environmental component on the example of different countries of the world; to substantiate the conceptual provisions of green investment in the development of the circular economy in the context of the European Green Deal.

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