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## ЕКОНОМІЧНІ НАУКИ

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### INTRODUCTION OF THE CLOSED-LOOP ECONOMIC MODEL IN THE MYKOLAYIV REGION

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*The article deals with the concepts of the closed-loop economic model realization and its popularisation in foreign countries. The main problems that have arisen in the Mykolayiv region concerning the introduction of the closed-loop economy are defined and the directions of their overcoming are proposed.*

**Keywords:** closed-loop economy, resources, waste, model of economy.

**Problem setting.** Taking into consideration influences of the climate change, wide inefficient extraction of resources and global population growth, experts agree that our current economic model is no longer sustainable.

The closed-loop economy is an alternative economic model for exchange and manufacturing, which want to release economic growth from material dependency. The idea is to increase resource efficiency and reduce environmental impact at all stages of the life cycle of a product (goods and services), reduce costs of the resources, ensure decreasing of an impact on the environment, at the same time allowing our needs to be met within the planet and improve people's well-being. According to the European Commission, a closed-loop economy encourages support of the cost of products, materials and resources for as long as possible, returning them back to the production cycle at the end of their use, and minimizing waste generation. Based on system-wide innovations, it is focused on recycling product's life cycle waste and providing services for minimization of the negative impacts.

**Recent research and publications analysis.** The problems of the processes, which balance economic and environmental interests harmonizing, minimizing of the negative impact of economic activity, became particularly acute in the second half

of the 20th century, when the threats of global ecological crises became obvious to society. Particularly in this period questions of ecologization of the economy, harmonious coexistence of human and nature are actively included in scientific research. Fundamental and applied concepts of ecologization are presented and grounded in the classical and modern works of domestic and foreign scientists in the field of preservation and use of the natural environment, in particular I. Martusenko, A. Tabachuk, V. Gryshchenko, L. Grinov, B. Danylyshyn, K. Dergachova, V. Kravtsiv.

The concept of a closed-loop economy was first proposed by British economists D. W. Pearce and R. K. Turner who dealt with environmental issues in 1990. They pointed out that the traditional economy was developed without a trend towards recycling, and was environmentally oriented as a waste reservoir. However, it is necessary to consider the Earth as a closed economic system: a system in which the economy and the environment are characterized not by linear interconnections but by circular relations. In order to achieve a win-win situation for the economy and the environment, they have proposed a closed cycle of materials in the economy [3]. So far, the processes of introducing closed-cycle economy at Ukrainian enterprises are fragmented, due to the lack of a systematic policy and effective mechanisms for

its implementation, therefore, there is a need for further research.

**Paper objective** is to identify the main concepts of closed-loop economics, to study its distribution in foreign countries, as well as to identify barriers that prevent the use of such models in the Mykolayiv region and provide recommendations for their implementation by domestic enterprises.

**Paper main body.** At the base of the closed-loop economy, the so-called circular economy, is the 3R-Reduce, Reuse, and Recycle principle (reduction, reuse and recycling).

In a modern economy under the economy of a closed cycle scientists understand a model where the waste are processed or allocated to the biosphere without harmful effects. The tendency to perceive waste not as a waste, but as a useful resource is a key feature of the circular economy. The importance of this approach is also due to the fact that there is a great danger of exhaustion of many natural resources.

In a closed cycle model, the economic cycle has the same stages as in the linear model, but this cycle is not interrupted. After the goods are consumed, the waste is not throwing, but sent to special recycling centers, where they are processed and become a resource for the further production of goods.

The main task of closed-loop economics is to change the linear model of the economy and its principles. To do this, you need to consume natural resources and energy sources as little as possible and, as much as possible, use them rationally. Thus, waste should transform to new resources to create a closed loop [4,5].

Then you need to create the maximum number of closed loops using the new principles and tools of the closed-loop economy model. First, use the theory of "4 R": Réutiliser-Réparer-Réhabiliter-Recycler), reduction-re-utilization-rehabilitation-processing, at all levels of production and consumption. Secondly, it is necessary to provide as short as possible chains between producers and consumers and to create common networks and a system for data exchange between different participants in the economic process. Finally, according to these processes, it is necessary to adapt the normative base, system of financing and support of the state [5].

At the base of the implementation of the closed-loop economy are four main concepts that can also be seen as tools for achieving the objectives of the closed-loop economy:

1. Ecodesign is a direction in design and architecture that focuses on protecting the environment throughout the life cycle of a product and the harmonious existence of a person in the environment. A good example is the experience of Interface (Interface, Inc.), the world's largest designer and manufacturer of carpet tiles [6]. After analyzing

the "life cycle" of the products, it was discovered that too much nylon was used in this type of activity to increase the duration of the product. Consequently, it was necessary to reduce the consumption of nylon and to find new materials. As a result, the company began to use 50% less nylon. In addition, it began to use recycled nylon, mixed with new fibers such as "biosphere", created by "Interface". Now the carpet has been made from the recycled used fishing nets which are purchased in developing countries. This step, in particular, helps fight poverty, as well as pollution of the oceans, as fishermen usually throw away old nets that accumulate at the bottom of the oceans. Such a policy also prevents the disappearance of living creatures in the underwater world that are entangled and killed in these neglected nets. In addition, the company no longer uses rolls of carpet, replacing them with tiles. In this case, the design of the carpet is created in such a way that it would be possible to cut these tiles in any necessary place. Herewith, allowed to reduce the loss of resources from 12% to 3-4% [6].

2. Functional economy (Service economy) is a part of the economy that focuses on the sale of a limited set of property rights to goods (for example, rent) and the provision of services instead of the full transfer of property rights to material goods. This new economic concept is based on two basic principles: the search of new ways to optimize the usage of resources and sales of services. In order to increase the wealth of society, it is not necessary to stimulate production growth. An optimization of the long-term use of goods will maximize profits and reduce the dependence on the increase of the production of new goods [7].

3. Industrial symbiosis is a voluntary cooperation of enterprises in order to optimize production costs by using by-products and wastes of some enterprises as raw materials for others, as well as joint consumption of information, energy, water and other resources. The most famous example is the industrial symbiosis created in Caloundborg, Denmark. Since 1961 and for 30 years, a network of material and energy flows between enterprises, residential houses and agricultural farms has been formed in a small area on the shore of the sea. The initial motive for organizing such a system was the desire of entrepreneurs to reduce the cost of production by using waste and gaining more profit.

Gradually, business leaders and the municipality realized that together with the increase of the profit of enterprises, they reduced the damage from environmental pollution [6].

4. "Green" economy is an economy aimed at preserving the goodwill of society by the most effective use of natural resources, primarily due to the sparing consumption of those resources that are

currently prone to exhaustion, and the rational use of inexhaustible resources.

Finland is one of the leading countries, which has been the first in the world in creating a national roadmap for the circular economy model which was adopted for 2016-2025. Both large companies and startups are actively moving under the chosen direction and take into account the circular economy in the base of development of their business [8].

Finnish forest industry is among the most active representatives of the closed-loop economy solutions users. According to Metsä Fiber, the forest industry is based on cyclic solutions. Water, chemical and other resources circulate in different processes, and all external directions can be used quite effectively. Their new factory in Äänekoski produces bioproducts such as, for example, food gas, sulfuric acid, biogas and biofuel granules.

In China, the transition from a linear economy to a closed-loop economy is seen as a natural stage of the development of the economy. This country can be an example for developing economies, including Ukraine. Taking into consideration the fact that China and Ukraine are developing economies, one can consider this case as an example of the possible use of closed-loop economy models based on state support and state regulation.

Similar is also the fact, that, an active industrial development began almost in the same moment in this two countries. In addition, the case of China can be seen as an example of tight control of industrial enterprises by state.

It is known that currently the ecology of China is in very poor condition - pollution of water, soil and air has reached enormous proportions. This was due to the rapid industrial development of the country, which caused a huge amount of harmful emissions from industrial enterprises.

In two thirds of cities, the maximum permissible level of air pollution has been exceeded in five times. The need of economic and environmental harmonization has been highlighted in the preparatory document of the 2014 Central Economic Research Conference, according to which China "achieves the upper limit of its environmental bandwidth."

In 2009, China became the third country in the world, which adopted a law which was connected with promoting of the circular economy after Germany and Japan. In 2013 the strategy of China was further refined with "circular strategies for

economic development and action plan," in which three levels of circular economy were described in detail: within the company, in industrial parks, at the city / region level.

The state council appointed 10 industrial sectors to initiate a circular economy: coal, energy, steel, non-ferrous metals, oil and petroleum products, chemicals, building materials, paper, food and textiles [9].

Tianjin Economic and Technological Development Area (TEDA) is a convincing example of both serious problems and innovative solutions. One of the largest industrial zones in China, it faces both the lack of freshwater resources (lack of water, limited groundwater and seawater intrusion) and the problem of excessive wastewater discharge. With proper coordination between the various offices, the zone managed to initiate corrective measures: quotas and progressive tariffs for freshwater resources, preferential prices for disposed water, the obligation to install and operate water utilization systems for new large-scale enterprises, common infrastructures such as wastewater treatment facilities, cogeneration installation, network of steam pipes and water pipes, certification of ISO 14001, disclosure of information, exchange of experience and so on. Achievements are significant: the level of reuse of industrial water became higher than 87%. Fresh water consumption and wastewater discharge per unit of industrial value added were reduced by 21% and 33% respectively for three years (2009-2013). In addition, the level of COC (chemical oxygen consumption) is three to four times lower than necessary.

In Mykolayiv region, in accordance to the main principles of state policy in the field of waste management, the overall management strategy is based on solving the following main tasks: minimizing the amount of generated waste; maximum possible attraction of waste to economic circulation, their material and energy utilization as man-made raw materials; search of environmentally safe methods of waste treatment with the least economic costs; the organization of the registration of the formation, processing, recycling and disposal of waste, their certification, creation and maintenance of a register of objects of formation, treatment of waste, a register of waste disposal sites (WDS). Indicators of waste management of I-IV hazard classes waste in the Mykolayiv region are presented in Table 1.

**Table 1**

**The main indicators of waste management with the waste of I-IV classes of hazard, thousand tons (under the form of statistical reporting № 1-waste) in the Mykolaiv region**

№	Ratios	Years		
		2015	2016	2017
1	Formed	2306,1	2366,4	2336,7
2	Received from other enterprises	980,4	472,3	401,5
3	Burned	26,0	25,5	35,5
3.1	including for the purpose of obtaining energy	26,0	25,4	35,4
4	Used (disposed of)	77,0	81,8	61,1
5	Directed to storage facilities of organized storage (burial)	1949,6	1819,3	1969,8
6	Transmitted to other companies	823,4	513,2	393,8
7	Loss of waste due to leakage, evaporation, fires, theft	-	-	-
8	Availability at the end of the accounting year in warehouses and warehouses in the territory of enterprises	49087,5	50926,0	52968,1

According to Table 1, despite a small reduction in waste generation and some increase in their combustion for energy purposes, significant accumulation in storage and warehousing continues on the territory of enterprises.

Therefore, the introduction of a closed loop economy, when materials do not become waste, but are distributed between different supply chains and are often transformed, is particularly relevant. There are quite severe barriers for closed-loop economy models implementing in regional businesses. The logistics of the circular economy faces several problems, such as poor predictability of material flows, small batches, low financial cost of the material, variety of material and its quality. For example, it is necessary to solve the problem of how companies can economically, ecologically and at the right time transport inexpensive materials to a plant that produces products from secondary raw materials. Logistics will also grow as companies and consumers move from ownership to service use.

Economic and environmental management of supply chains will be the main requirement of the circular economy. According to the information of the companies, which operate in the circular economy, the logistics costs of the circular economy, often, are too high. There are no services and operators in the supply chain. Collaboration between companies and segments is still low. In many cases, these disadvantages are an obstacle to new business

in the circular economy or significantly impair its profitability.

Also, to implement a closed-loop economy, it is necessary to change the structure of production, purchase equipment, change the strategies of companies and review the activities of companies in general. Perhaps companies are scared to make changes because they are not sure in the financial impact of such changes, both in the long-term and in the short-term perspectives.

However, there is also a psychological barrier in the minds of the population of the country. The habit of throwing garbage, not a lot of concern with the problems of nature and others. For the successful implementation of the closed-loop economy, it is also necessary that not only the company, but also the population of the country monitor the waste and give it for recycling.

A very serious barrier is the lack of awareness of companies about the benefits (which can be attributed to insufficient understanding of the topic) that may give the use of closed-loop economy models. Many organizations simply do not see the need to introduce more closed-loop economic initiatives, limited themselves by existing ones.

Following the analysis of enterprises in the Mykolaiv region and the study of waste management materials, the groups of barriers for the implementation of closed-loop economy models were introduced and they are presented in Figure 1.

Technologies	Market	Culture	Regulation
Lack of technology	The need for large investments	Non-acquaintance of the population and companies	Lack of systematic work of the government
Lack of infrastructure	Increase the cost of logistics	Lack of the understanding of the benefits of implementing closed-loop economy models	Imperfection of normative-legal provision
-	-	Lack of knowledge and experience	Lack of incentives

**Figure 1 - Barriers during the process of the closed-loop economy models implementing**

Thus, the barriers for closed-loop economy models introducing can be divided into such groups

as: Technological. The lack of technologies which are required for the processing of waste from

enterprises, as well as the lack of infrastructure, which is necessary for the transportation of waste both to the place of processing and its transportation after processing to consumers.

**Market.** The necessity of very large investments. Many companies do not have the opportunity to rebuild a business model, business processes, purchase new equipment in order to close one or more production cycles. In addition to the reorganization of the organization, the closed-loop economy models require revision of transportation operations, as there is a need to transport waste to both the place of their processing and end users. This increases the cost of logistics.

Also, the consequence of this may be lack of understanding of best practices, lack of knowledge and experience.

**Cultural barriers** lie in the non-acquaintance of both society as a whole and companies about the closed loop economy and misunderstanding, as well as the underestimation of the benefits it can provide. In addition, one can highlight the little concern of people about ecology, compared with other countries.

**Regulatory issues.** The lack of government support is also a serious barrier, since many initiatives require large investments that companies can not attract on their own.

**Conclusions of the research.** Implementation of the closed-loop economy models have many perspectives.

Besides the direct benefits, which such models could give to the companies, there is also a positive influence on the nature, environment, ecology in general and consumption culture. Despite the large number of benefits provided by the closed-cycle economy model, at the enterprises of the Mykolayiv region, this model has not yet become widely used. In foreign companies, closed-loop economy models are much more common. The comparatively small interest of domestic companies is due to both psychological factors and little awareness of the advantages of such models. In addition, there is a number of obstacles for the introduction of closed-loop economy models.

It is necessary to accelerate innovations and attract companies for which sustainable development is a priority. It is important to develop the possibilities of information exchange in supply chains and to introduce new transport services that will bring infrastructure closer to the needs of the circular economy, therefore the use of digital technologies in distribution circuits is a field for further research.

It is also necessary to raise the awareness of companies about the benefits of the circular economy, public awareness of the problems of nature and the negative effects of the impact of waste on the environment.

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**І. В. Гончаренко, О. Є. Кузьмін, Є. Б. Нерознак, Н. О. Скибінський. Запровадження економічної моделі замкнутого циклу у Миколаївській області**

*У статті розглядаються поняття реалізації замкнутої економічної моделі та її популяризація у зарубіжних країнах. Визначено основні проблеми, що виникли у Миколаївській області щодо впровадження замкнутого циклу економіки, запропоновано напрями їх подолання.*

**Ключові слова:** економіка замкнутого циклу, ресурси, відходи, модель економіки.

**И. В. Гончаренко, О. Е. Кузьмин, Е. Б. Нерознак, Н. А. Скибинский. Внедрение экономической модели замкнутого цикла в Николаевской области**

*В статье рассматриваются понятия реализации замкнутой экономической модели и ее популяризация в зарубежных странах. Определены основные проблемы, возникшие в Николаевской области по внедрению замкнутого цикла экономики, предложены направления их преодоления.*

**Ключевые слова:** экономика замкнутого цикла, ресурсы, отходы, модель экономики.