

Environmental and energy opportunities in the Arctic zone for the transition to a circular economy

Tatyana Golovina^{1,*}, *Irina Avdeeva*¹, *Vladislav Matveev*¹, *Aleksandr Adamenko*², and *Larisa Parakhina*¹

¹Central Russian Institute of Management, Branch of RANEPA, Orel, Russia

²Kuban State Agrarian University, Krasnodar, Russia

Abstract. The relevance of the study is determined by the need for scientifically-based approaches to the introduction of circular economy technologies in the Arctic zone based on accounting and assessment of the environmental and energy capabilities of this territory. Sustainable economic development with minimal negative impact on the environment is one of the biggest global challenges. Since today's linear economy increasingly contributes to the problems of sustainable development, it is important to work on creating a closed-cycle economy in which the cycle of resources-production-use-waste is closed. The purpose of the study is to study the concept of circular economy and the possibility of its use in the socio-ecological and economic development of the Arctic zone. The objectives of the research are the following: systematization of theoretical approaches to the study of the circular economy concept; identification of economic, energy opportunities, and problems in the Arctic zone of the Russian Federation for the transition to a circular economy; justification of the feasibility of using modern business models of the closed-cycle economy in the Arctic zone industries; development of state support directions for the circular economy development in the Arctic zone. The methodological and methodic basis of the research are the methods of systematic, comparative analysis, text mining, empirical verification. The results of the study are the substantiation of the possibility of introducing circular economy technologies in the national economy, considering the peculiarities of socio-ecological and economic development of the Arctic zone; the development of scientifically sound proposals for the transition to a closed-cycle economy based on the interaction of public authorities and business structures.

1 Introduction

A dynamically growing trend in the modern world is the preservation of nature and environment for future generations. Due to the unique geographical location and fragile ecology of the Arctic zone, which has undergone rapid environmental changes, the region is

* Corresponding author: golovina_t78@mail.ru

becoming the object of growing interests of various stakeholders from the perspective of achieving sustainable development goals.

The scientific problem is the need to study theoretical and practical approaches to identifying economic and energy opportunities in the Arctic zone of the Russian Federation for the transition to a circular economy in conditions of increasing intensity of flows and increasing load on environment.

The idea of a closed-loop economy originated in the United States in the 1960s. Buldin in 1966 first suggested that the circular economy is a kind of economic model of social production based on the recovery and processing of resources, characterized by "low pollution, low losses, and high efficiency" and the basic principles of "reduce, reuse, and recycle". Since then, the circular economy has been adopted in many countries of the world [1].

Circular economy is defined as an economic system aimed at minimizing waste and maximizing the use of resources through the longest possible use of materials and products.

Given the large number of studies in the field of circular economy, the existence of various approaches and their constant application is not sufficiently developed. At the same time, the economy needs driving changes and radical transformations in the aspect of innovative technologies and introduction of their components in a closed-cycle economy.

The transition of the Arctic zone to a circular economy is a complex and multi-stage process due to the presence of specific features of the functioning of each of the national economy branches.

2 Materials and Methods

The complexity of the problem of introducing circular economy technologies in the Arctic zone has predetermined the use of a combination of systemic and integrated approaches, phenomenological and computational-analytical methods, empirical verification, comparative analysis. The present study is also based on the use of such methods as induction, deduction, abstraction.

Identification of the directions of the circular economy development is presented in the works of domestic and foreign scientists I. Pustokhina, L. A. Sosunova, I. N. Omelchenko, V. D. Gerami, T. E. Evtodieva, A. S. Kocheshnov, N.P. Karpova, D. Kristof, S. Cosimato, D. Rogers, Hsiao-Min Ch., Tsai-Chi K., Ju-Long Ch., Bai X., Han J., Ma Yu., Zhang W., Aydoğmuş M., Gülay G., Ergun K., Beuren F., Ferreira M., Miquel P., Geissdoerfer, Martin, Paulo Savaget, Nancy M.P. Bocken, and Erik Jan Hultink, Platinina I., Teslyuk L., Dukmasova N., Pikalova E., Wiesmeth H. and others.

3 Results

Sustainable development is an important topic in connection with the numerous environmental problems that humanity is currently facing [2].

Responsible consumption and production is one of the 17 Sustainable Development Goals, but is marked as one of the four goals that is at greatest risk of non-fulfillment by 2030 (according to the 2018 UNEP report).

Responsible consumption and production are based on the idea of increasing efficiency with lower costs [3]. It is also about overcoming the failures of economic growth that cause environmental degradation, and establishing resource efficiency and sustainability instead [4].

The UN has identified 11 targets and 13 indicators to achieve progress in achieving responsible consumption and production. Many of these goals are scaled up for implementation by national governments, nevertheless, they are still can be used in business practice on a smaller scale.

The following are the most suitable business goals and indicators [5]:

- implementation of a 10-year framework for responsible consumption and production;
- sustainable management of natural resources and their effective use;
- responsible handling of chemicals and waste;
- significant reduction of waste generation;
- encouraging companies to implement sustainable practices and reporting in the field of sustainable development;
- promoting sustainable procurement practices.

Modern business structures are increasingly paying attention to the ESG concept in making management decisions. This approach is based on a triad of key postulates of careful nature management:

1. Environmental protection includes such measures as compliance with environmental laws, combating climate change, preserving biodiversity, waste management, reducing carbon emissions, rational use of resources, responsible consumption, and the use of alternative energy [6].

2. Social responsibility pays attention to equal opportunities, support for local communities, health and longevity, infrastructure development, occupational safety, and respect for human rights [7].

3. Corporate governance standards control objectivity and independence, risk management, responsible mutual settlements, transparency of procurement, fight against corruption, remuneration structure and policy [8].

Responsible production requires the production of goods and services in an ethical and sustainable manner that minimizes waste and pollution and supports the long-term sustainability of surrounding communities and their natural environment [9]. Often, initial investments in more sustainable processes lead to a higher return on investment in the long term [10].

Responsible consumption goes beyond buying better and more environmentally friendly products and greater awareness of where they are going [11]. This also includes consideration of the environmental, social, health, and economic impacts of the product and its services.

Companies should establish criteria for responsible consumption when developing their products and services. In other words, products and services should be created not only from environmentally friendly materials and sustainable production methods, but also developed considering the expanded environmental and social impact that they have when consumed [12].

The business also acts as a consumer of products and services. Production and consumption have a synergistic relationship in which producers are consumers, both in terms of acquiring the resources necessary for the production of their products and the materials used to conduct their business within the country [13]. They should also consider how to be ethical and responsible consumers within their internal activities.

A foreign consumer is significantly different from a Russian one - a company's commitment to a green economy for a Western consumer can become one of the decisive factors when making a purchase and cooperation decision [14]. According to Forbs research, 80% of Western consumers choose companies that support the solution of social and environmental problems, while sometimes they are even willing to overpay. Some enterprises have already achieved great success in introducing responsible consumption and production into their practice [15]. For example, the Icelandic clothing company Dimmbla

produces clothes using environmentally friendly methods and organic and innovative materials. The crops used to create textiles are less water-intensive and do not contain chemicals. In addition, the company aims to reduce production waste and create durable clothing, uses fabric scraps to make accessories and launches a campaign without the use of plastic [16]. Leaf'd is an online marketplace based in Los Angeles that offers ethical and environmentally friendly products of all kinds, including skin care products, clothing, home decor and pet products. Leaf'd conducts a strict verification process to ensure the reliability and integrity of suppliers who trade on the platform, make efforts to reflect their commitment to sustainability through transparency and encourage their suppliers and consumers to do the same [17].

Currently, due to the formation of a wide range of environmental problems, there is a gradual change of the usual linear economic model to a more environmentally friendly one, there is an active development of new modern concepts in the economy aimed at environmental friendliness, renewable resources, recycling, waste-free production.

The systematization of accumulated theoretical and practical experience in the field of circular economy allows to distinguish its three defining characteristics: the design of waste and pollution to ensure sustainability and recovery, rather than efficiency and waste in goods and processes to eliminate waste and pollution [18]; the preservation of products and materials in working condition (and not their disposal) by their repair, reuse, and recycling [19]; restoration and regeneration of natural systems such as streams and forests to ensure that future generations will have access to the resources of these systems [20].

Thus, the basic principle of the linear model is transformed into the "extract – produce – reuse" principle in the context of a phased transition to a circular economy (Figure 1).

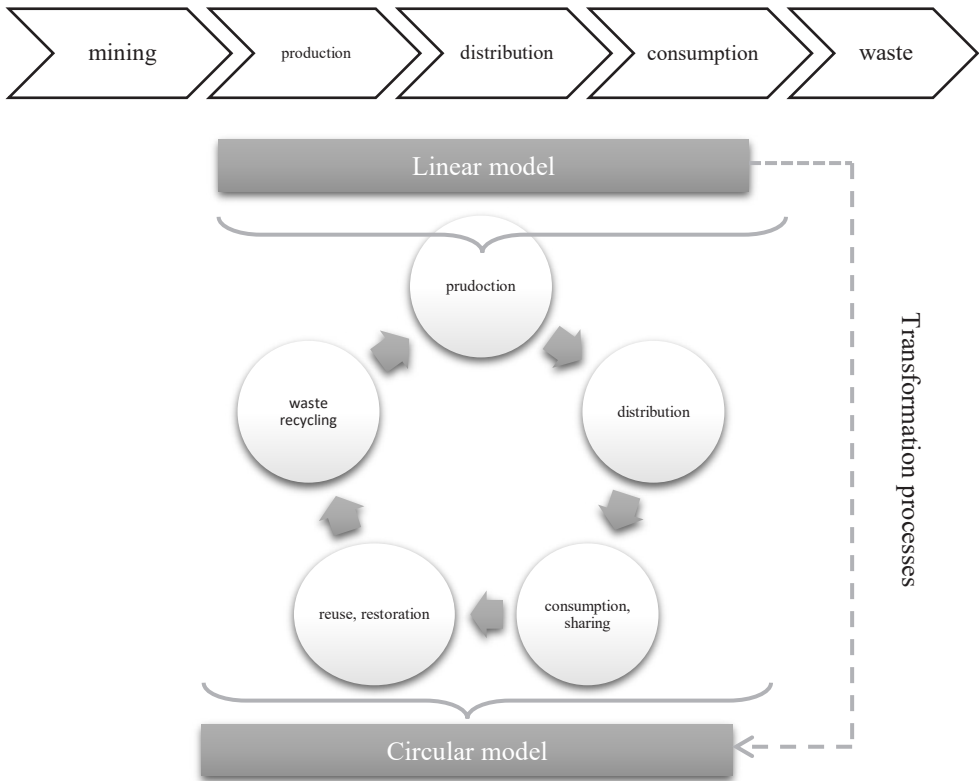


Fig. 1. Transformation of the basic principle of the linear model into the "extract – produce – reuse" principle of the circular model.

In Russia, in 2022, the federal project "Closed-loop Economy" was launched, which is designed to solve fundamental problems in the field of waste management. The implementation of the federal project will reduce the amount of waste and the growth of disposals and landfills in the country, because the maximum amount of waste will be converted into recyclable materials, and the extracted useful components will be returned to economic circulation. In addition, the creation of the infrastructure that will be needed for the transition to a cyclical economy will provide new workplaces.

The federal project provides for the approval of programs for the use of secondary resources in certain economy sectors and the creation of incentive mechanisms for involvement. This is part of a lot of work to be done at the first stage of the new federal project implementation. REO is engaged in the development of industry programs jointly with the Ministry of Industry and Trade, the Ministry of Agriculture, and the Ministry of Construction.

The current geopolitical situation in the world and the need for further socio-economic development force Russia to actively implement the Arctic policy. The Arctic region attracts attention because of its economic, political, and environmental significance against the background of global climate change.

The development of the circular economy concept on the territory of the Arctic zone is impossible without considering the peculiarities of this region (Figure 2).

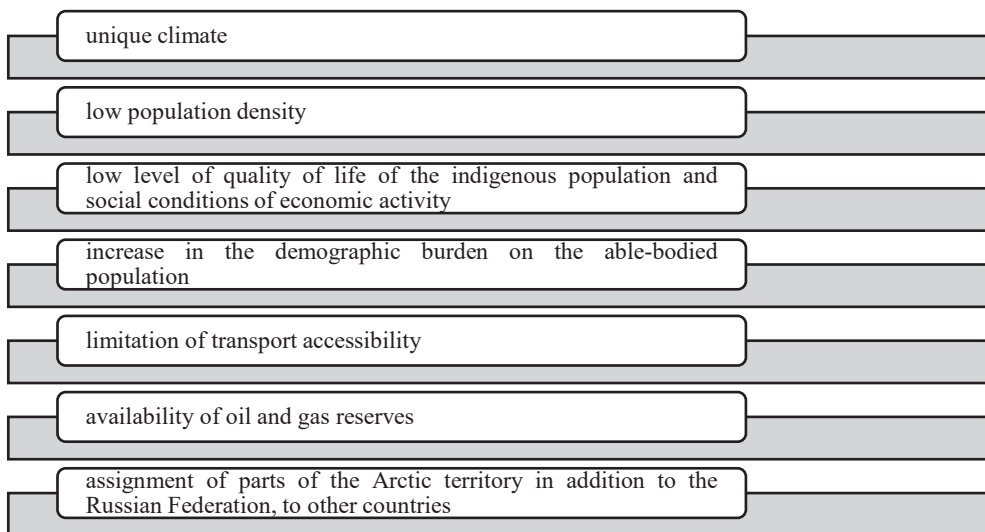


Fig. 2. Features of the Russian Arctic.

To study the economic, energy opportunities and problems in the Arctic zone of the Russian Federation for the transition to a circular economy, the authors constructed the BCG matrix (Figure 3).

Process of transition to a circular economy	CATCHING UP	<ul style="list-style-type: none"> ◆ shipbuilding ◆ fisheries complex ◆ housing and utilities infrastructure 	LEADERS	<ul style="list-style-type: none"> ◆ energy infrastructure ◆ oil production complex
	BEGINNERS	<ul style="list-style-type: none"> ◆ mining complex ◆ IT and software development ◆ timber industry complex ◆ transport and logistics complex ◆ manufacturing industries ◆ construction 	LAGGARDS	<ul style="list-style-type: none"> ◆ agricultural complex ◆ tourism

Circular transformation of economic systems

Fig. 3. A matrix of economic, energy opportunities and problems in the Arctic zone of the Russian Federation for the transition to a circular economy.

The results obtained indicate that the transformation of economic processes of industries in the Arctic zone into circular economy should be carried out in stages and consider the best practices of existing fundamental business models of the closed-cycle economy. In relation to the Arctic zone industries, the business models presented in Figure 4 are promising.

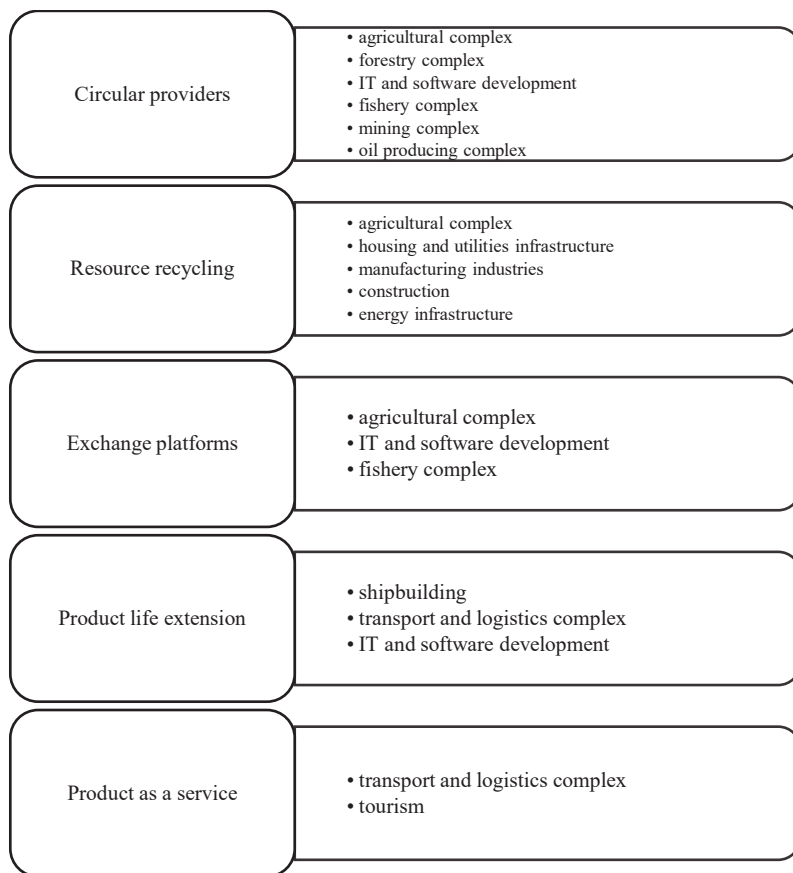


Fig. 4. Basic business models of the circular economy and prospects for their application in a number of Arctic zone sectors

The application of circular economy technologies in selected industries suggests that the sector can achieve greater sustainability and development by keeping more resources and materials in production as much as possible. This result can be achieved by reusing already manufactured products.

The study conducted a SWOT analysis of the process of using economic, energy opportunities and problems in the Arctic zone of the Russian Federation for the transition to a circular economy (Figure 5).

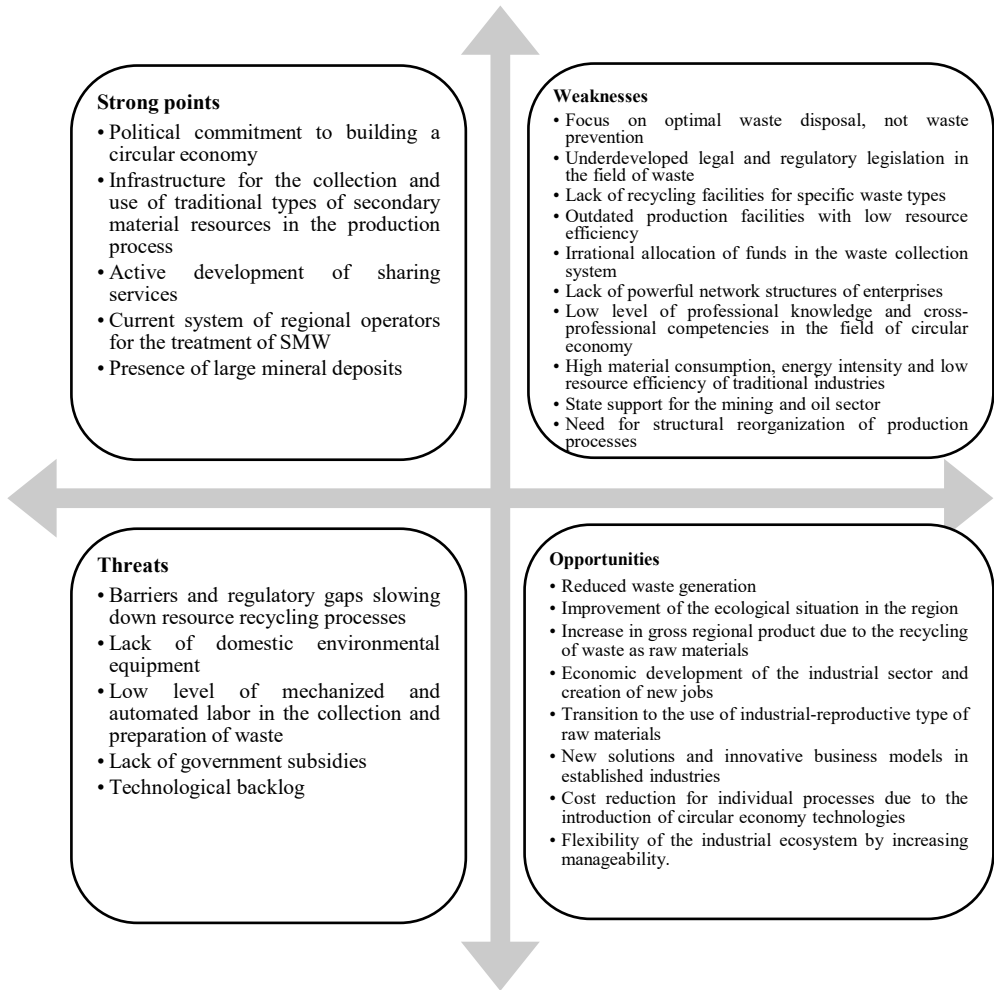


Fig. 5. The results of the SWOT analysis of the process of using environmental, energy opportunities and problems in the Arctic zone of the Russian Federation for the transition to circular economy.

The authors of this study identify the methods presented in Figure 6 to overcome barriers and problems in the transition to a circular economy of the Arctic zone industries.

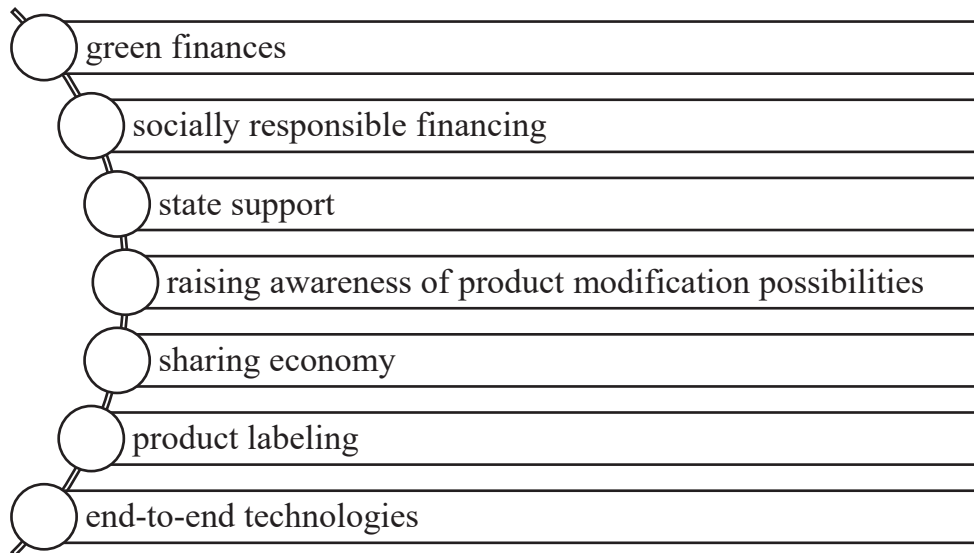


Fig. 6. Ways to overcome barriers preventing the circular economy introduction.

In the global economic space, despite the significant importance of innovations in demand in various sectors of the national economy, priorities are currently shifting towards greening, the predicted social effect, as well as ensuring sustainability in conditions of high uncertainty and risk (Figure 7).

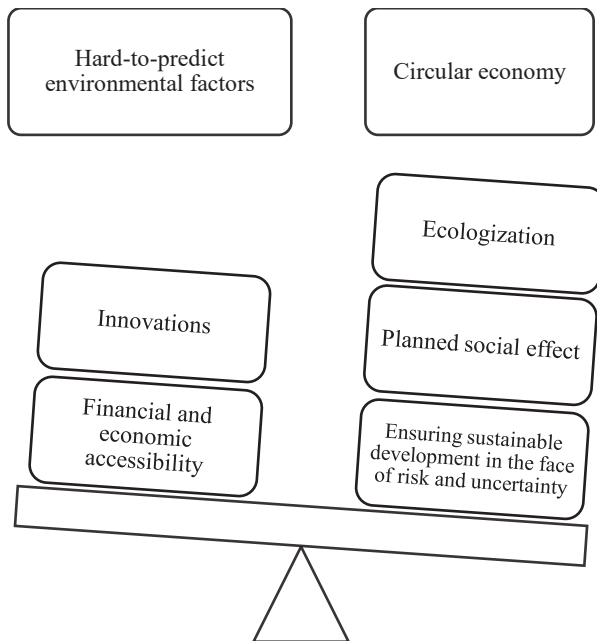


Fig. 7. Shifting priorities in the sectoral development of the Arctic zone based on circular economy technologies.

Currently, the choice of mechanisms for stimulating and supporting circular economy technologies in economic sectors is influenced by a complex of both external and internal factors (Figure 8).

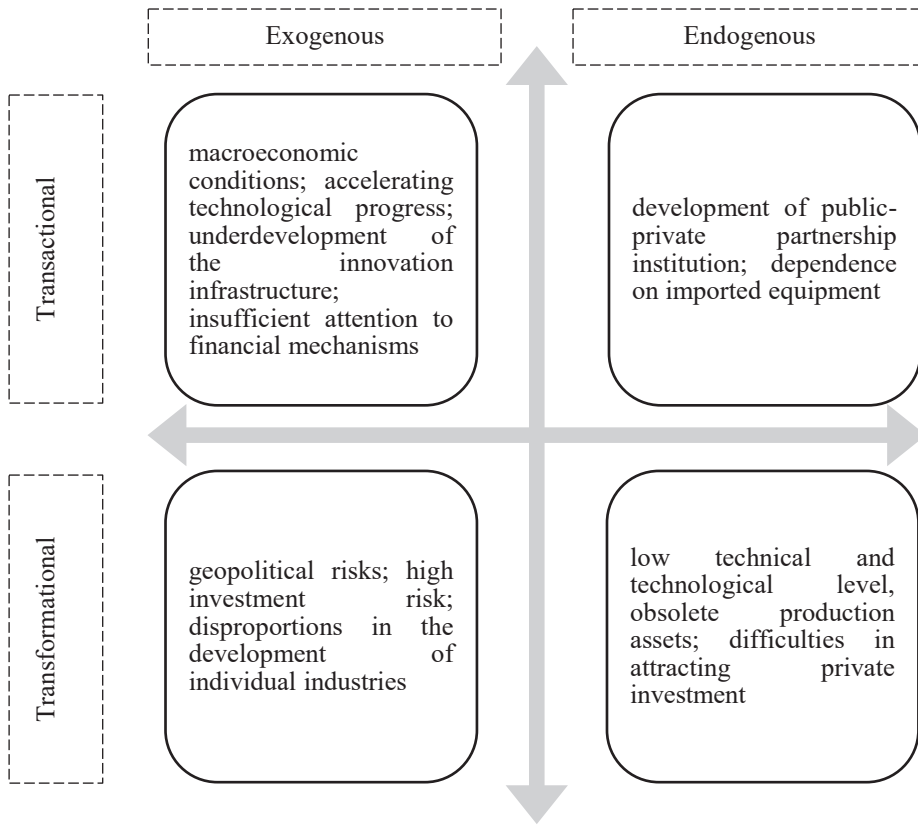


Fig. 8. A system of factors influencing the mechanisms of state support and stimulation of the introduction of circular economy technologies.

The most important elements for the circular economy development are institutional, financial, educational, and information infrastructures (Figure 9).

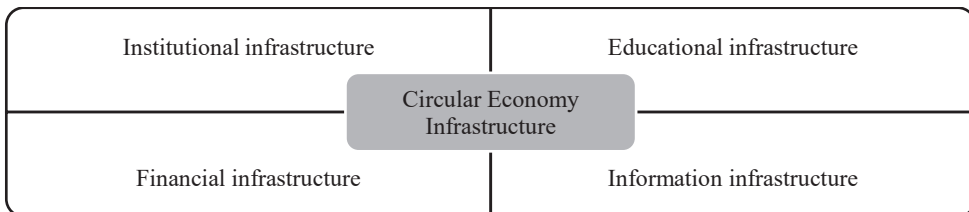


Fig. 9. Elements of the circular economy infrastructure.

For the introduction of circular economy technologies in the Arctic zone industry, a developed infrastructure is needed, as well as the transformation of the applied business models.

4 Discussion

According to the authors of this study, the transition to closed-loop economy will require a certain restructuring of existing processes. In particular, a new regulation of waste management processes is needed, fixing the priority of certain types of treatment: if

possible, first of all, reuse and recycle, and not dispose of and bury in landfills. It will also be necessary to create mechanisms that would encourage companies to switch to a "green" production model and allow more participants to be involved in the process of such a structural transformation. The directions and means of state support for the circular economy development in the Arctic zone of the Russian Federation are shown in Figure 10.

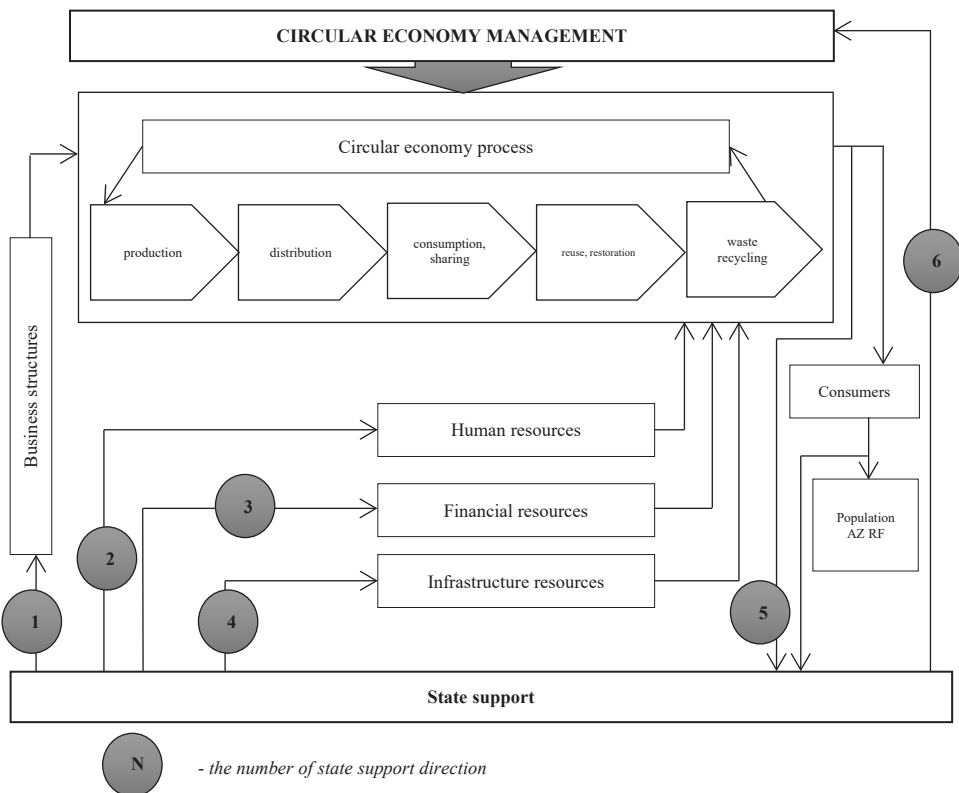


Fig. 10. Directions and means of state support for the circular economy development in the Arctic zone of the Russian Federation.

The transition to closed-loop economy should become an important part of the ESG strategy of companies, municipalities, regional and federal executive authorities.

In turn, it is important that business structures have the capabilities and resources to integrate the mechanisms of transition to closed-cycle economy into the main business processes. At the same time, such a transition should bring economic and social benefits.

Currently, projects based on circular economy technologies are being developed on the territory of the Arctic zone with the support of state authorities. Much attention is paid to improving the waste management efficiency.

Thus, the construction of an ecotechnopark for sorting, processing, and disposal of municipal solid waste will begin in the Kamchatka Krai in 2024. It is planned that the capacity of the new facility will be about 117 thousand tons of waste annually. Also, three waste transfer stations will be built for its operation. When choosing land plots for the placement of such waste transfer stations, both the seismicity of the site and the possibility of avalanches and mudslides are considered.

For the development of circular economy technologies in the Arctic zone within the framework of the current federal project "Closed-cycle Economy", it is necessary to provide compensation for processors for working with illiquid fractions that are currently

unprofitable to process, as, for example, in case of film plastics unclaimed so far. Then such fractions can be transferred for processing at a low cost. In this case, all waste processing complexes will choose illiquid components, the volume of disposal will actually decrease, and the processing industry will forget about the shortage of raw materials and will build new facilities to be able to accept the entire volume of incoming waste.

It is necessary not only to involve raw materials in secondary processing, but also to create sales markets for the resulting products.

5 Conclusion

Ensuring harmonization between economic growth and environmental sustainability, economical use of resources is the main prerequisite for the stability of the Arctic zone economy. The transition of the Arctic zone to a circular economy may be the beginning of a global process of reorientation of the national economy branches to the model of the circulating use of resources, which in the future will allow solving a large number of urgent environmental problems of this territory. The scientific significance lies in the expansion of theoretical ideas about the role of the circular economy in the socio-ecological and economic development of the Arctic zone. The practical significance lies in the formation of methodological foundations for the introduction of circular economy technologies, considering the environmental and energy capabilities of the Arctic zone, based on the interaction of public authorities and business structures.

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