Waste Management of Production and Consumption as an Element of on the Circular Economy

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Abstract. Practical aspects of the functioning of the Russian economy in the field of production and consumption waste management are considered. The main problems inherent in the sphere of production and consumption waste management in Russia are identified. The principle of waste management of production and consumption, defined in foreign practice in the theory of management as 3R, is considered. The difference between the traditional «linear» model of economy and the closed-loop economy is shown. Some business strategies that can be supported by a closed-loop economy have been studied, namely, the «product as a service» strategy, which can be applied independently or combined with other technological solutions, and the «sharing» strategy. The conclusion is made about the need to develop digital solutions in the industry for processing production and consumption waste.

1. Introduction

Effective management of production and consumption waste is an integral task of every state at any point of economic development. The economy is not a static system and is dynamic, regardless of whether it implements an industrial or innovative scenario for further development.

In the Russian Federation, the current system of waste management of production and consumption certainly requires better management methods. However, full copying of foreign practices will not bring the desired result, no matter how effectively they work in other countries. This is due to both the scale of the territorial division and regional management features. In those regions where mining is carried out, the level of pollution of the surrounding territory and the level of generated waste is significantly higher than in the territories that originally had the status of the capital, or in the territories that have historical and cultural significance. Accordingly, the measures taken to optimize the sphere of waste management of production and consumption will differ for these territories.

However, approaches to the organization of the functioning of the General economic system based on the principles of introducing a closed-loop economy, widely used in foreign countries, can be very organically integrated into existing legal acts and administrative and organizational-economic methods of managing enterprises and industries.
2. Study methodology
The purpose of this publication is to analyze the scientific literature, the regulatory framework and the results of research on the development of methods for managing production and consumption waste based on the concept of closed-loop Economics. The following Russian scientists contributed to the study of this area: E. M. Belovodskikh, Yu. N. Zhuzhoma, A.V. Nikolaev, Yu. V. Nikulichev, M. A. Shakhramanyan, and others. D. the following methods were used in the study: system approach, comparative analysis, retrospective analysis, analysis of official statistics, and document analysis method.

Much attention is currently paid to the methods of using digital technologies and artificial intelligence in the field of waste management of production and consumption. These are advanced technologies that meet modern requirements for environmentally friendly collection and processing of production and consumption waste, which in the concept of a closed-cycle economy act not as waste, but as resources suitable for subsequent use.

3. Assessment and results
In modern economic conditions, the sphere of waste management of production and consumption in Russia is undergoing significant changes, both at the state and regional levels, as a result of which it is expected to create a comprehensive system that ensures the effective functioning of the industry on a national scale [1].

However, the practical aspects of the functioning of the Russian economy indicate that in most cases the processing of resources is carried out on the basis of a "linear model". Waste disposal in the environment currently remains one of the main elements of the waste management system, which is confirmed by the creation of a large number of high-capacity landfills for waste disposal in the territories of individual regions. At the same time, the construction of waste processing plants is carried out at a significantly lower rate, as evidenced by the almost complete lack of information about projects of a similar scale.

The total amount of waste by Federal districts of the Russian Federation for 2017-2018 is shown in table 1 [2].

Table 1 Total amount of waste by Federal districts of the Russian Federation for 2017-2018 (million tons).

| Federal district              | 2017                  | 2018                  |
|------------------------------|-----------------------|-----------------------|
| Russian Federation           | At the beginning of the year | For a year | At the beginning of the year | For a year |
| Far Eastern Federal district | 1 672,2               | 632,3                 | 1 810,2               | 893,5       |
| Volga federal district       | 2 756,1               | 153,6                 | 2 760,0               | 168,9       |
| North-Western Federal district | 1 859,7          | 464,7                 | 1 910,0               | 490,5       |
| North Caucasus Federal district | 1,9                  | 3,7                   | 1,8                  | 3,2         |
| Siberian Federal district    | 22 380,3              | 4 417,6               | 25 549,1              | 5 145,9     |
| Ural Federal district        | 7 202,7               | 281,1                 | 7 498,5               | 291,1       |
| Central Federal district     | 274,0                 | 248,9                 | 396,7                 | 245,3       |
| Southern Federal district    | 128,5                 | 18,7                  | 107,4                 | 27,7        |
| IN TOTAL                     | 36 275,4              | 6 220,6               | 40 033,8              | 7 266,1     |

The dynamics of changes in the total amount of production and consumption waste for these periods shows a tendency to increase this amount in almost all Federal districts.

The leader of this anti-rating is the Siberian Federal district, which is associated with coal mining in the Kemerovo region and the formation of a large number of overburden rocks.

Among the main problems inherent in the sphere of production and consumption waste management in Russia, the following can be identified:
1. the formation of industrial waste is more typical for the mining industry, whose fixed assets are characterized by outdated equipment and lack of innovative technological solutions;
2. the greatest threat to the population and the environment is caused by the problem of unauthorized landfills, which remains unsolved in Russia today;
3. it is necessary to update the information and technological base of production and consumption waste management, which will be built on the basis of modern digital solutions and will be aimed at effective coordination of the activities of all participants in the waste management process.

In addition, there is no clear orientation of the Russian economy to the implementation of the "3R" principle, which has proven itself positively in the formation of a system for managing production and consumption waste in developed countries.

The principle of waste management of production and consumption in foreign practice in the theory of management is defined as 3R. The 3R initiative belongs to Zuintiro Koizumi, Prime Minister of Japan [3] and includes the main components of an effective waste management system:

- **reduce** - reduce the level of waste;
- **reuse** - re-use;
- **recycle** - use of secondary resources.

The goal of a policy based on these principles is to create a society in which all resources will be used as efficiently as possible, and the amount of waste will be minimized. In this aspect, an important role is assigned to innovative technologies that ensure the safety of waste disposal of production and consumption. The regulatory legal document regulating these issues, for example in the United States, is the resource conservation and restoration Act (RCRA), adopted in 1976 [4]. The United States is concerned about preserving the ecological balance due to the presence of a significant number of landfills, the number of which, for example, in the Western region of the country, is 186 thousand [5]. This leads to air and ground water pollution, as well as global warming due to uncontrolled emissions of CO2 and CH4 [6, 7].

Currently, this concept is being transformed into the concept of 5R or Zero Waste ("zero waste", "zero loss"), which is based on reducing the amount of garbage produced by the population.

To build an effective waste management system for production and consumption, we can use the experience of foreign countries that have managed to practically implement the concepts of waste management based on the principles of a closed-cycle economy. Issues of financial security, efficiency of administrative resources, tighter control over the activities of industrial enterprises and promotion of a healthy attitude to this process among the population and private business are of fundamental importance.

The traditional "linear" model of the economy, for which the process of producing economic goods is the main process, differs from the closed-loop economy, where the broader context of the life cycle of products and services is considered.

The idea of recycling economy is based on the fact that people in their operation produces a linear flow of materials on which input are the resources and produce wastes of production and consumption, the linear flow can be converted to cyclic. In a cyclical flow, waste, the formation of which is inevitable at each stage, can be considered as resources for the production of processed products [8, 9].

The introduction of closed-loop economy approaches used in foreign countries is based on the consideration of activities to reduce the total volume of waste generated (reduce), reuse (reuse) and recycling of materials (recycle), as an integral element of production processes, distribution and consumption processes; it is necessary for effective waste management, according to which the most preferred method is the prevention of waste formation, the least preferred – their placement in the external environment [10].

The efficiency of resource use can be increased by including methods of secondary use of used materials or their processing in production processes, which will affect the formation of costs in the direction of their reduction and ultimately reduce the resource dependence of producers [11].

The existing model of production companies operates with the concept of "waste" and considers the method of "waste disposal" as the main method of their management. The closed-loop economy is
characterized by a change in the fundamental approach to these concepts, since "waste" should be replaced with "resources", and other waste management technologies should be used instead of "waste disposal" [12]. At all stages of the product life cycle, certain waste management technologies should be provided, in contrast to the linear model, where the evidence of their application is clear only at the final stage of production. Solving the problem of waste generation at the initial stages forms the value chain of products, taking into account secondary resources that can be converted into emerging waste, which gives certain opportunities for the formation of a business model of waste-free production [13].

A closed-loop economy can support a large number of business strategies, including the "product as a service" strategy, which is characterized by the retention of ownership rights to the product from its manufacturer. The function of the consumer is that payment is made only for the actual benefit derived from the product. The seller's responsibility is to maintain the product during its full life cycle, and to carry out recycling processes for the product and its components.

In particular, Ricoh sells more than 60% of its equipment under life-cycle contracts that allow for supply and demand planning, as well as resource recycling [14].

The application of the "product as a service" strategy is that Ricoh has developed a "click-contract" product that provides for payment by the client for printed works that were actually performed. The cost of the print includes expenses related to the consumption of materials, spare parts necessary for smooth operation, as well as preventive inspections, the work of engineers and consultations with technical specialists. In particular, according to this principle, the company serves the Moscow metro, for which the resource saving of printed works was 21%.

The "product as a service" strategy can be applied independently or combined with other technological solutions. An example of such strategic and technological integration is the company Phillips, which introduced the product "Circular Lighting" to the market, which increases the efficiency of lighting systems. The technology used in the production of the product "Circular Lighting" allows you to reuse and recycle not only lighting devices, but also their elements. The "product as a service" strategy in this case assumes, in particular, that all functions for installation, maintenance, modernization and disposal of lighting devices are assumed by the manufacturer.

Philips has considerable experience in collecting and disposing of lamps. For example, in the EU, Philips' share in the mercury lamp collection and recycling industry is 22%, with a utilization rate of 95% for mercury contained in them.

The product "Circular Lighting" is a further development of this approach, which involves ensuring complete recycling of lighting devices. For the production of "Circular Lighting", the main stages of the product life cycle were reformed. The production of lighting devices is based on the modular principle, which makes it relatively easy to upgrade and maintain elements that have a longer useful life, and has the ability to combine elements. Comprehensive life cycle contracts include maintenance, upgrades, and disposal of consumer-installed appliances. In the process of ensuring the operation of the manufacturer, reverse logistics methods are widely used to ensure the reuse of modules, their components and materials. As a result, it is possible to upgrade lighting systems after the end of the contract for their maintenance, reuse lighting systems, return all its components and materials to the manufacturer for use in the production process or recycling. The economic and environmental effectiveness of this approach is ensured by minimizing production and consumption waste and reducing environmental damage [15, 16].

The consumer does not bear the initial cost of investing in the purchase and installation of a lighting system and does not have the final cost of its disposal at the end of its service life, which makes it cost-effective to use such lighting systems.

As innovative business strategies, the "sharing economy" model can be used, in which the main factor determining the economic, social and environmental value of the resources available to consumers is an increase in the intensity of their use.

The above-mentioned models or their elements can be used as a basis for building a system for efficient management of production and consumption waste based on a closed-cycle economy [17].
It is also necessary to develop digital solutions in the industry for processing industrial and consumer waste in terms of production of smart systems for waste collection ("smart containers"), optimization of logistics chains ("smart garbage collectors"), production and implementation of intelligent systems for processing and recycling of MSW, development and application of cloud technologies and user interfaces [18, 19, 20]. Government policy in this area should be aimed at encouraging IT professionals to develop digital solutions in this industry by providing financial, informational, organizational and consulting support.

4. Conclusions
The intensive increase in the amount and variety of human waste released into the environment has led to negative consequences in the following areas: violation of the ecological balance, increased environmental risks, reduced quality of life, and negative impact on the economy.

The main vector of functioning of the domestic waste management industry should be aimed at reducing the negative impact of production and consumption waste on the environment, including on humans, which requires the introduction of environmental management systems and standards at enterprises operating in this industry, based on the concept of a closed-loop economy.

The implementation of the global waste management principle "3R" should be expanded by using the principles of closed-loop Economics to the principles" 5R "and" 9R ", widely used in foreign practice of waste management of production and consumption.

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