

UDC 69+502/504

Key aspects of implementing the concept of closed-loop economy in the construction industry

The paper considers the environmental situation in the country and the implementation of the concept of a closed-loop economy in the construction sector. The focus is on the sustainable use of resources, waste minimization and the use of secondary materials. The main types and volumes of world waste that have the greatest impact on the environment are presented, and it is noted that the construction sector occupies a leading position in terms of annual volumes, which proves the relevance of this study. The closed-loop economy helps to rethink existing approaches to the design, construction and operation of real estate. The paper presents key aspects of the approach to the formation of a closed-loop economy at various stages of the implementation of an investment and construction project, such as planning and design, preparation for construction, construction, operation and end of the life cycle. Particular attention is paid to the use of recyclable and environmentally friendly materials, as well as the application of technologies that make it possible to reuse construction waste. The paper also considers examples of successful practices and innovative approaches used in Russian and international projects aimed at increasing sustainability and reducing the environmental burden. Examples of the implementation of closed-loop economy projects in Russia, such as eco-industrial parks, which include a new approach to the implementation of recycling and waste disposal, are considered. The problems that the construction industry faces during implementation are emphasized, the main ones being the lack of a legal framework, the creation of incentive programmes for stimulation and the need to improve the skills of personnel. In conclusion, the importance of the closed-loop economy programme and the effectiveness of its implementation are highlighted.

Keywords: closed-loop economy, secondary raw materials, environmental situation, federal project, construction

The issue of the environmental situation in Russia is becoming more and more relevant every year. Measures are being taken at the state level to support environmental protection and sustainable development of the country. For example, the national project "Ecology" is currently being implemented¹ [1], which is aimed at radically improving the environmental movement and stimulating the health improvement of Russians. In addition, the goals and objectives in the field of environmental protection fixed at the legislative level by the Decree of the President² [2] are taken into account. As part of the implementation of environmentally friendly projects, it is also necessary to note the importance of following the concept of closed-loop economy.

The project of closed-loop economy implies the application of a fundamentally new approach to production, consumption and economic activity on the basis of renewable solutions and environmentally sustainable business models. Closed-cycle economy approaches are especially relevant in the context of the implementation of the national project "Ecology"¹, the goals and targets of which are presented in Fig. 1 [1].

The goals set by the national project are oriented towards improving the quality of water supply and the health of water bodies, ensuring a balance between the loss and recovery of flora, and reducing pollution, including through effective waste management.

Approximately 33 billion tonnes of waste are generated annually in the world [2]. For clarity, let us

present five main types of waste that have the maximum impact on the environment and note their approximate volume (Fig. 2).

Thus, it can be concluded that construction and demolition account for the maximum share of waste, accounting for 30 per cent of the world's waste. The construction and demolition of buildings consumes about 1/3 of all materials consumed in the world and generates about 40 % of harmful CO₂ emissions due to inefficient energy saving of resources [3]. Consequently, the construction industry as a whole has an enormous environmental responsibility. If we consider in more detail the types of wastes of IV–V hazard classes in the field of construction, the most common ones include concrete waste, soil during construction works and scrap of asphalt and concrete pavements [4]. In order to reduce the indicators of harmful impact on the environment, managers of the world's enterprises strive to use more rational management methods, as well as to implement new environmentally friendly technologies. As a consequence, there is a growing tendency to reorient production towards the use of secondary resources and raw materials, particularly in the construction industry, which confirms the relevance and necessity of this study.

The concept of the circular economy is a model based on the principles of sustainable development, aimed at minimizing waste and maximizing the use of resources. The basic idea is that instead of the traditional linear model "extraction – production – consumption – utilization", the closed-loop economy

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1 Federal media outlet "Ecology of Russia". URL: <https://ecologyofrussia.ru/> (Accessed on 11.11.2024).
2 National goals and strategic objectives for the development of the Russian Federation through 2024 : Decree of the President of the Russian Federation dated 05/07/2018 No. 204.

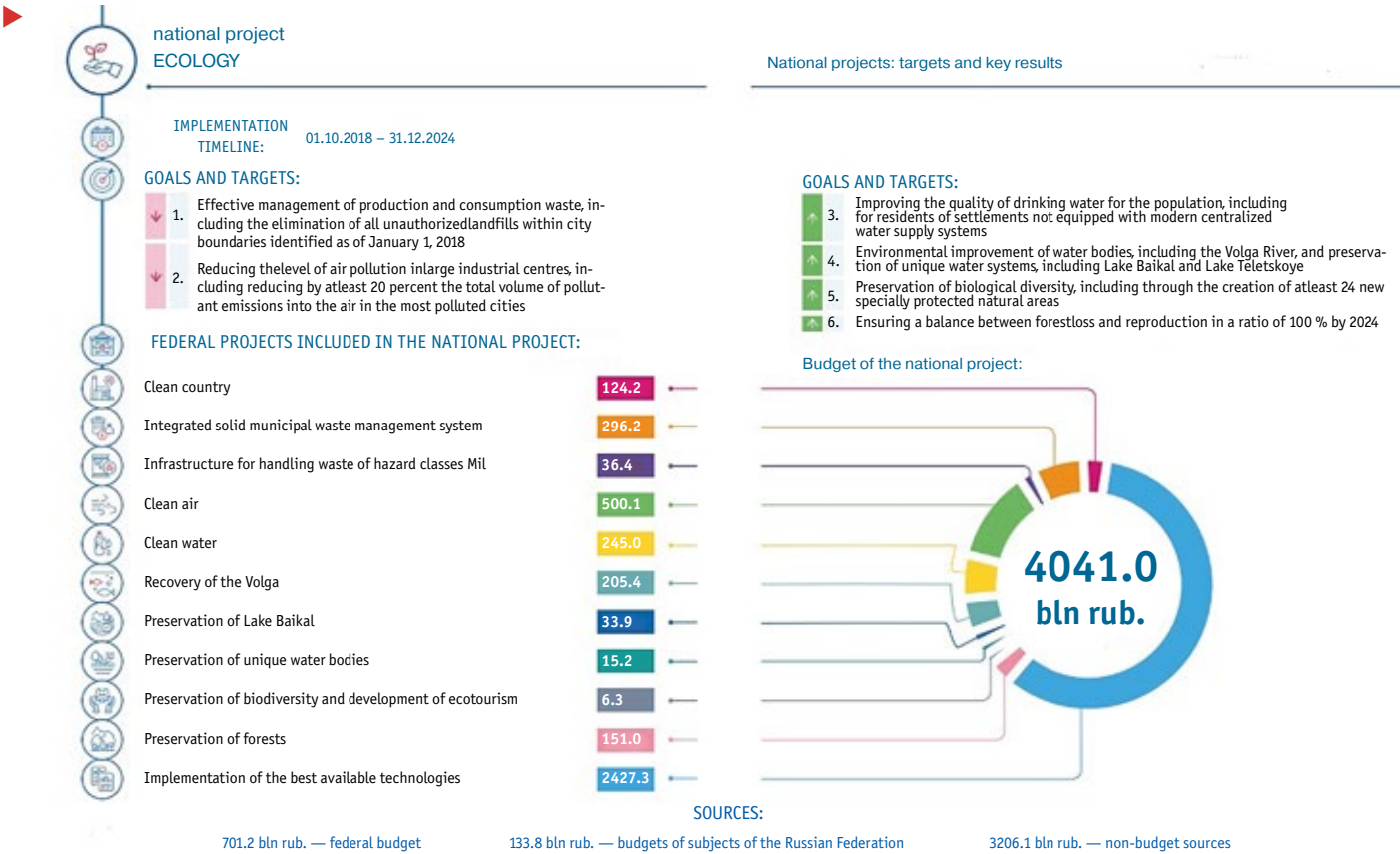


Fig. 1. National Project "Ecology"

focuses on the creation of so-called "closed" cycles where products, materials and resources are reused, recycled or recovered [5]. For the construction sector, especially important is the measure of using non-toxic, modern, durable, renewable materials (as construction waste belongs to the 4th and 5th class of hazard); improving the energy efficiency of buildings; recycling of materials after dismantling; use of modular structures suitable for assembly and disassembly (Fig. 3) [6].

One example of an architectural initiative inspired by the concept of the circular economy is the construction of the CNAD National Art, Crafts and Design Centre³. This centre is located on the island of Cape Verde in the city of Mindelo. Because of the island location, all goods were brought into the country using containers and barrels. The architects, inspired by the ideas, decided to take the lids from the containers as a basis and use them as industrial parts in the construction. The lids became a colourful facade in the project (Fig. 4, 5) [7]. As a result of using all kinds of colours, they create not only a unique external appearance, but also act as a double ventilated facade (Fig. 6), which provides passive control of the internal temperature and does not require air conditioning. They can be rotated, which allows the indoor light and airflow to be regulated.

One of the examples of the implementation of closed-loop economy projects in Russia can be called eco-industrial parks. Ecoprom-parks are a new approach to the implementation of waste recycling and utilization⁴. Such sites will house resident companies, and production will be carried out in a closed system. Waste and other

by-products will be realized in a new production cycle. Ecoprom-parks will become a place where the full cycle of waste utilization and production of products from secondary raw materials will be implemented. Glavgosexpertiza in the report for 2023 indicated that 7 positive conclusions on eco-industrial parks were issued [8]. In 2024, the construction of such parks began in the Moscow, Chelyabinsk, Leningrad, Novosibirsk regions and Stavropol Krai. It is planned that in total the enterprises will be able to process over 850 tonnes of waste per year [9]. The construction of eco-industrial parks will provide an opportunity to reduce emissions into the atmosphere and reduce the burden on the environment, as well as become a promising investment in the economy of the regions.

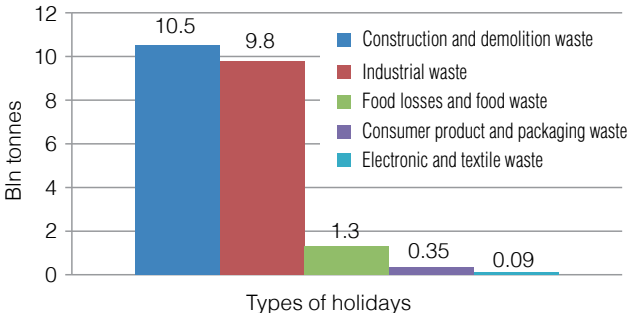


Fig. 2. Annual volume of major waste streams in the world

3 Official website of the National Centre for Handicraft, Art and Design (CNAD National Art, Crafts and Design Centre). URL: <https://cnad.cv/en/> (Accessed 12.11.2024).

4 Circular economy: how the project for the construction of eco-industrial parks is being implemented in Russia | FAU "Glavgosexpertiza of Russia". URL: <https://gge.ru/press-center/news/ekonomika-zamknutogo-tsikla-kak-v-rossii-realizuyetsya-proekt-po-stroitelstvu-ekopromparkov/?ysclid=m3h4fw7d1y821595962> (Accessed 11.11.2024).

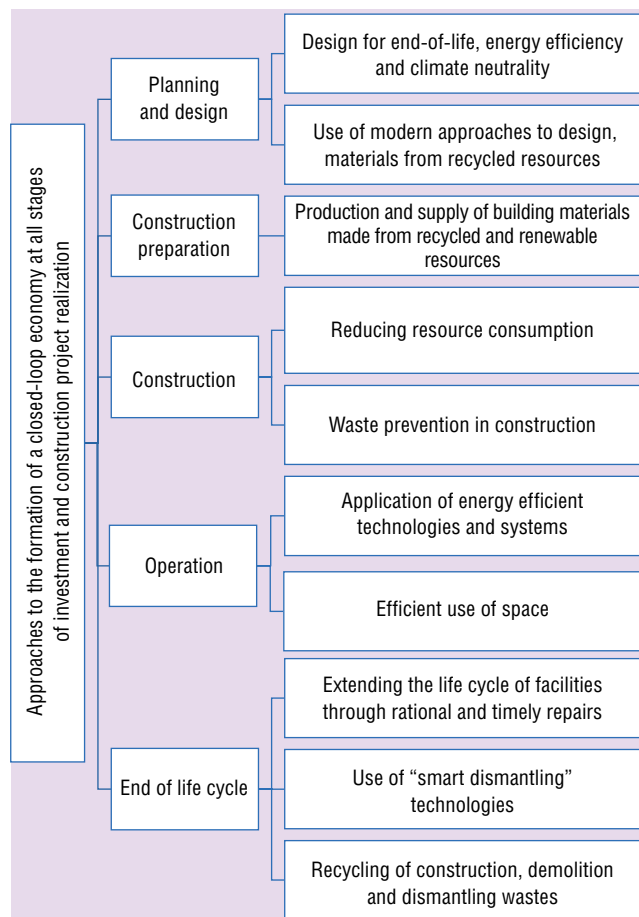


Fig. 3. Approaches to the formation of a closed-loop economy

At the moment, the transition to a closed-loop economy is hampered by a number of problems. For example, the legislation of the Russian Federation has no normative regulation of construction waste, which leads to the lack of a system of standards and certification of materials from secondary resources. In this regard, it is the state that can become the main initiator of the introduction of measures to stimulate the use of new construction materials [10]. Economic incentives and state support measures will make it possible to implement construction projects using secondary resources and raw materials. In addition, it is important to develop a monitoring system for waste management, thanks to which it will be possible to increase the level of control over the formation, transport and disposal of construction waste. Implementation of the described approach has many positive effects not only for companies in the construction industry, but also for the environment. Thus, it will be possible to provide recycling of up to 85 % of construction waste of all types and reduce up to 20 % of the share of waste sent to landfills [11]. These improvements will also affect the partial substitution of investments in traditional production methods for new technologies for the use of recycled materials, which will potentially lead to the stimulation of research and development in the field of secondary production, as well as the emergence of new recyclable products.

In conclusion, we would like to note the obvious advantages of the closed loop programme, which justify the expediency of its application. The use of secondary resources and raw materials in the construction industry will allow to significantly reduce the volume of waste, increase the efficiency of materials use, and will also have a positive impact on business development in this area.

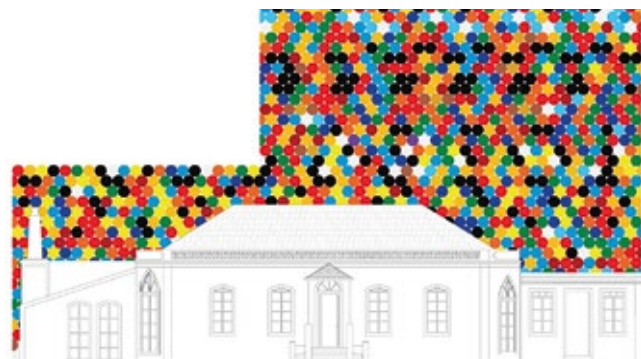


Fig. 4. Project visualization



Fig. 5. Visualization of the project. Addendum



Fig. 6. Exterior view of the building facade

An integrated approach to the implementation of the closed-loop economy programme will make it a means of achieving sustainable development and environmental protection on a planet-wide scale.

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Ключевые аспекты реализации концепции экономики замкнутого цикла в сфере строительства

В статье рассмотрены вопросы экологической ситуации в стране и реализация концепции экономики замкнутого цикла в сфере строительства. Акцентируется внимание на устойчивом использовании ресурсов, минимизации отходов и использовании вторичных материалов. Представлены основные виды и объемы мировых отходов, оказывающие максимальное влияние на экологию, и отмечено, что по количеству годовых объемов лидирующую позицию занимает сфера строительства, что доказывает актуальность данного исследования. Экономика замкнутого цикла помогает переосмыслить существующие подходы к проектированию, строительству и эксплуатации объектов недвижимости. В статье представлены ключевые аспекты подхода к формированию экономики замкнутого цикла на различных стадиях реализации инвестиционно-строительного проекта, таких как планирование и проектирование, подготовка к строительству, строительство, эксплуатация и окончание жизненного цикла. Особое внимание уделяется использованию перерабатываемых и экологически чистых материалов, а также применению технологий, благодаря которым становится возможным повторное использование строительных отходов. Также в статье рассматриваются примеры успешных практик и инновационных подходов, применяемых в российских и международных проектах, направленных на повышение устойчивости и снижение экологической нагрузки. Рассмотрены такие примеры реализации проектов экономики замкнутого цикла в России, как экопромпарки, включающие новый подход в реализации оборотки и утилизации мусора. Подчеркиваются проблемы, с которыми сталкивается строительная отрасль при реализации, основными из которых можно отметить: недостаток правовой базы, создание льготных программ для стимулирования и необходимость повышения квалификации кадров. В заключении отмечается важность программы экономики замкнутого цикла и эффективность ее реализации.

Ключевые слова: экономика замкнутого цикла, вторичное сырье, экологическая ситуация, федеральный проект, строительство

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For citation: Khromykh V.D., Chubarkina I.Y. Key aspects of implementing the concept of closed-loop economy in the construction industry. Real Estate: Economics, Management. 2025; 1:59-62.

Для цитирования: **Хромых В.Д., Чубаркина И.Ю.** Key aspects of implementing the concept of closed-loop economy in the construction industry // Недвижимость: экономика, управление. 2025. № 1. С. 59–62.