Recycling construction waste in real estate reproduction in the Russian Federation

Inara Shakhbanova, Zaira Ibragimova, Zemfira Radjabova, Jamilya Sungieva, and Jafar Magomedov

1 Dagestan State Technical University, 70, Imama Shamilya Avenue, Makhachkala, 367015, Russia
2 Department of the Federal Treasury for the Republic of Dagestan, 93, M. Yaragskogo Street, Makhachkala, 367015, Russia

Abstract. This article discusses the main problematic aspects of the processing of construction waste, due to the growth in the volume of real estate. The purpose of the article is to analyze the efficiency indicators of the use of construction waste processing in the production of real estate objects. Based on this goal, the following tasks were set: identifying the main factors hindering the development of construction waste recycling and developing a general model of environmental and economic efficiency at the stage of recycling and processing.

Research methods. The composition of the methods that ensured the conduct of this work included: methods of economic and mathematical modeling, analysis of expert estimates and initial retrospective analysis.

Conclusions. The article presents the results of a study on the use of technologies for processing waste from the construction industry and shows the effectiveness of the economic and environmental provision of real estate. The authors proposed a scenario model for forecasting the development of the construction waste processing industry.

1 Introduction

Today one of the priority concerns of the government is to provide residents of Russia with the most comfortable and affordable housing. This goal includes a wide range of measures having program- and goal-oriented and financing instrument nature. Unfortunately, negative scenarios for the development of the macro- and microeconomics affect the execution of tasks set. As the result, the Russian Federation ranks 5th in the international ranking of states with the most unaffordable residential housing.

Referring to both domestic and foreign experience, it is worth saying that the use of construction waste processing technologies helps saving energy and financial resources, thereby reducing the cost of products. These technologies are used in demolition, repair, renovation and reconstruction of real estate. Studies have shown that annual steady growth trend makes recycling effective in terms of economics and environmental friendliness, besides solving the problem of disposal of construction waste itself. Generation of this type of waste in this case amounts up to 25%.

* Corresponding author: djami_ramazanova@mail.ru

© The Authors, published by EDP Sciences. This is an open access article distributed under the terms of the Creative Commons Attribution License 4.0 (http://creativecommons.org/licenses/by/4.0/).
It should be noted that some issues of the use and development of recycling technologies with subsequent processing of secondary products remain unresolved [8]. This problem stems from the lack of legal regulation and evaluation of economic efficiency of using such technologies in order to improve the reproduction of residential real estate in the country.

To date, most of performance indicators of building material recycling can be considered. For example, A.V. Abramov [9] suggests using an indicator to characterize the economic efficiency of resources when preventing pollution in the territories under consideration.

Other authors [10] propose to evaluate the performance of construction waste processing based on a comprehensive accounting of environmental, economic, energy-saving, and social efficiency. Unfortunately, this method is not always effective. For example, all this can be feasibly accounted in reference to statistical recording system by comparing the economic effect of saving resources and eliminating negative environmental impacts in accordance with the given costs. However, with the introduction of direct accounting of economic and social efficiency, certain difficulties arise, for instance: lack of necessary accounting details; subject variability of participants receiving and sending effects; synergistic effects, etc.

The aim of this article is to develop a general model of environmental, economic, and social efficiency in the disposal of waste from the construction of real estate.

2 Methods

Information sources for the present paper are official statistics, research papers from domestic and foreign journals and analytical reviews. The main research methods were the following: methods of system analysis of expert assessments, retrospective analysis, economic-mathematical and functional-strategic modeling, as well as econometrics.

With regard to heterogeneity of the infrastructure for the generation and disposal of construction waste, we can highlight the following features:

- high degree of uncertainty and instability of the organizational structure;
- spatial heterogeneity and hierarchy;
- diversification of raw materials and underdevelopment of regulatory institutions, etc.

Considering the multidimensionality of factors influencing the development and structure of the industry, we came to the conclusion that it is inappropriate to use inertial forecasting methods. Therefore, scenario modeling methods are more acceptable for designing a concept for the long-term development of construction waste management.

These are several important factors and sources of environmental variability:

- investments: the availability and composition of investment programs for the development of waste processing enterprises;
- macroeconomics: the speed and degree of fluctuations in the main development parameters of the world and domestic economy;
- technological: substitution of building materials, consolidation of energy and resource saving concepts;
- technical: quick and large-scale changing of technical parameters of technological equipment for waste processing;
- organizational;
- legal.
3 Results

The study has revealed factors that hinder the development of a low-rise real estate cluster in Russia (Figure 1) and indicate the underdevelopment of production capacities of low-rise construction, including those that use recycling technologies for producing secondary raw materials for building structures [11].

It should be noted that waste recycling is a top priority for the world's leading economies [11] (Figure 2).

---

Fig. 1. Factors hindering low-rise housing development (green low-rise construction)

- Increase in taxes (based on the cadastral value, ch. 32 of the Tax Code of the Russian Federation)
- Underdevelopment of the industrial base for low-rise construction
- Low motivation of consumers
  - Focus on the price of construction
  - Higher cost of construction (10-15% more expensive than traditional construction)
  - Low awareness of consumers about the economic efficiency of the operational stage of the full life cycle of a building
  - Lower cost of operation (due to reducing energy and water consumption by 25% and 30% respectively)

Source: authors' calculations.
But still foreign countries have some disadvantages. For instance, most of developed economies still use traditional waste disposal technologies, which are quite controversial in terms of environmental safety. At the same time, government policies in those countries are aimed at recycling and reuse of waste.
In Russia, disposal of inert construction waste is the prevailing way of waste treatment (Figure 3), which inevitably leads to occupation of new areas by landfills and a significant degradation of the biosphere.

Fig. 3. Dynamic pattern of waste generation in the Russian Federation, including construction waste (million tons). Source: Federal State Statistics Service; authors' calculations.

Thus, according to the analysis, we can see that the total landfill area in Russia is about 4 million hectares, which is approximately equal to the area of a small European state [12]. Moreover, there are a plenty of spontaneous dumps, the aggregate area of which increased 12 times over the period from 2016 to 2020.

4 Elaboration of a general model for the disposal of construction waste

In the construction industry, when using products of waste recycling, the efficiency of the final product is largely increased by reducing the cost of basic building materials. The market of Russian companies that work in the field of waste processing and recycling is quite small despite the obvious environmental and economic efficiency of waste recycling technologies. Based on the analysis of the construction industry, the following framework conditions for the development of the sphere of construction waste processing (recycling) can be specified:

- overproportionate volumes of waste recycling and waste generation;
- low demand for secondary materials in construction (the exception is metal elements);
- underdevelopment of the legislative base in the field of waste disposal and processing;
- technological difficulties of processing due to the diversity of waste types;
- the significance of costs of collecting, processing and recycling secondary raw materials.

Today, the top market share of Russian waste processing companies accounts for the Moscow region and the city of Moscow. This is because problematic issues of waste disposal are being worked out by local authorities. In Moscow and the Moscow Region programs for construction waste and demolition waste treatment are being implemented, investment programs in this area are being elaborated. Moreover, the industry is subsidized from the city budget, and preferential credit and tax policies are pursued.
Innovations introduced in the Moscow Region includes the one that is also worth noting: the banks of information on the amount of waste and the need for secondary raw materials. It should be noted that the reuse of waste when applying building materials minimizes the load on the biosphere, increasing the competitiveness of regional investment and construction complexes, and contributes to durability and environmental friendliness of materials and structures [13].

Therefore, the following organizational factors and trends were chosen for the scenario modeling in construction waste disposal:

- creation of the necessary mechanisms for the functioning of a sustainable economy;
- structural changes in the world market of raw materials due to the negative impact of the instability of the world financial and economic situation;
- transformation of the mechanisms for creating a recycling collection fund;
- innovative transformation of the final scenarios of state development management based on reindustrialization and modernization of the economy.

As part of the study, the parameters of the forced scenario according to the adjusted forecast of the socio-economic development of Russia until 2028 (data from the Ministry of Economic Development of the Russian Federation) were taken as the basis for the assessment.

Variability in assessment of a probable pivot point in the development of the waste processing industry was ensured by making a list of scenario parameters that characterize the "internal" uncertainties of the potential risk:

- composition, terms of approving a recycling fee and positive transformation of environmental responsibility of citizens;
- adoption of technological regulations.

The "external" parameters were:

- implementation of targeted programs for the development of basic industries and the speed of resource replacement at the state and regional levels.

With the help of the above requirements, we obtained a general scheme for the prospects of the waste processing industry development (Figure 4).
Fig. 4. General scheme of the scenario model for forecasting the development of recycling in the construction industry. Source: authors' calculations.

A general model of environmental and economic efficiency at the stage of waste disposal and processing is shown in Figure 5.
5 Discussion

Today the growth of waste volumes induces the necessity to use waste processing technologies that can reduce man-caused impacts on the biosphere. These technologies should be focused on a comprehensive solution of key issues of economic sustainability of the construction industry and of the growth of assimilation potential of the biosphere.

In Russia, the factors hindering the development and implementation of recycling technologies in the reproduction of residential real estate are the lack of a regulatory framework and methods for assessing the economy [14]. However, construction waste generated during the demolition of buildings can be reused without the use of additional processing technologies. Such waste treatment will undoubtedly increase the efficiency of building elements and buildings during demolition.

Fig. 5. General model of environmental, economic and social efficiency at the stage of building materials recycling. Source: authors' calculations.
6 Conclusion

Thus, the key direction in real estate reproduction at all stages of the life cycle is the implementation of the concept of energy efficiency, resource efficiency, and environmental sustainability. The key point is to introduce the technologies for construction waste processing, which enables ensuring the environmental and economic efficiency of secondary construction products and reduce the "locked" energy costs of the production of raw materials and building materials.

Fragmentary nature of the concept of waste management in the Russian Federation necessitated the development of a comprehensive strategy for development of the industry. A scheme of the scenario model, which was worked out as part of the study on forecasting the evolution of the waste processing industry, and the industry analysis carried out on the basis of the study prove the need to prepare a long-term strategy based on program-targeted planning of the waste processing industry.

References

14. V. Gorin, Kontentus 12, 1-7 (2017)