Modern Trends in the Development of Environmentally-oriented Innovative Processes in Construction

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Keywords: Ecologization of the economy, environmental audit, secondary raw materials, recycling, technology, construction.

Abstract: The article discusses the main stages of the selection of innovative production technologies that are adapted to the environmental and economic constraints in force in accordance with national and international regulations on the state of the environment, and also take into account the social component as one of the components of sustainable development. An algorithm for the step-by-step selection and evaluation of optimal solutions is presented in compliance with environmental, economic and social imperatives based on the principles of sustainable development. The ways of transition of the construction industry to a new conceptual development framework are proposed, within which the priority is the cascade involvement of natural resources in the production process and minimizing the volume of residual products. Analyzed and proposed promising areas of application of information and environmentally-oriented technologies for predicting the life cycle of an object with the possibility of its increase.

1 INTRODUCTION

Since the 70s of the last century, mankind has realized that information about the state of the environment, coordination of efforts to collect, store and process and analyze it are a necessity for further existence. In 1970, under the auspices of the UN, the Stockholm Conference on Environmental Protection was held, where the Environmental Program (UNEP) was adopted. It developed the basic concept of monitoring and assessment of the state of the environment, as well as common terminology (Agenda…). Since then, economic entities can be legally liable for environmental damage. This led to significant additional financial losses that enterprises began to experience. Financial and fiscal instruments caused a shift in business philosophy towards compliance with environmental legislation in their activities. Outwardly, such measures are very reminiscent of a financial audit. Therefore, the environmental review procedure is called environmental audit (State…).

The first companies to develop and implement their own environmental review programs were US Steel, Allied Chemical, and Occidental Petroleum. Industrially developed countries were initially leaders in environmental auditing. The environmental audit procedure is used to resolve conflicts between carrier companies and national environmental authorities. The most common is a specialized environmental audit on accounting for production waste, etc. It should be noted that a modern environmental audit is not only a check of the state of an enterprise for compliance with the requirements of environmental legislation, but also the basis for developing a set of measures to prevent its possible violations (Directive…). Thus, environmental audit is transformed from an ordinary administrative tool for monitoring compliance with the law into an economic and legal tool for stimulating the environmental activities of an enterprise.

Another type of non-state environmental audit can be considered voluntary rating certification in the

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Shakhgiraev, I., Aliyev, S. and Gasanova, N.
Modern Trends in the Development of Environmentally-oriented Innovative Processes in Construction.
DOI: 10.5220/0011568200003524
In *Proceedings of the 1st International Conference on Methods, Models, Technologies for Sustainable Development (MMTGE 2022) - Agroclimatic Projects and Carbon Neutrality*, pages 183-188
ISBN: 978-989-758-608-8

manufacturing industry. Modern world standards on the regulation of environmental parameters of the architectural and construction industry concern mainly the environmental, energy and economic efficiency of the so-called "green buildings" (green building) and are developed as systems. The best known of these are BREEAM (building environmental performance assessment method) and LEED (leadership in energy and environmental design) (Maliene, 2010). Today, more than 50 international agreements are in force abroad, which directly relate to the issues of environmental monitoring and auditing the state of enterprises and adjacent territories. Special working groups have been created, whose task is to develop recommendations and action plans on environmental monitoring for the countries of the world.

Environmental international policy is based on the task of preventing the generation of waste, promoting reuse, recycling and processing of waste into biologically safe substances. The priority goal is to turn waste into resources and reduce their generation. Domestic legislation in this area, despite a fairly developed regulatory framework, does not fully comply with such requirements. So, the implementation of these requirements is associated with significant changes and additions in the legal field. First of all, our country faces the necessity of transition to a new conceptual basis of economic development. Most sectors of the national economy, which are resource-intensive due to direct dependence on the raw material base, are built on a linear model of the economy. The linear model assumes an increase in resource costs in direct proportion to production volumes, which contradicts the problem of preserving valuable natural resources. In contrast to the linear model of the circular economy, it is focused on the continuous or cascade turnover of technical and biological materials during production and minimizing the volume of residual products. This approach coincides with the biosphere-compatible economic orientation and environmental imperatives (Dedicoat, 2016).

The purpose of this work is to develop a mechanism for managing the construction complex, which ensures the transition of the construction industry to a new conceptual development framework, within which the priority is the cascade involvement of natural resources in the production process and minimizing the volume of residual products. The mechanisms of greening the economy and their success will depend on the correlation of specific programs in each sector of the national economy. The strategy of modernization of the construction industry, as one of the resource-intensive, is one of the serious problems of the modern economy.

The methodological basis of the study is the regulatory legal acts regulating the investment and construction sphere, statistical data, methodological developments and other literature on the study of the innovative construction complex and ecological construction.

2 RESEARCH METHODS

In Russia, the main component of the environmental assessment system is an environmental review, which is organized and carried out by the Federal Service for Supervision of Natural Resources. “Environmental expertise in our country is the establishment of compliance of documents and (or) documentation substantiating the economic and other activities planned in connection with the implementation of the object of environmental expertise, with environmental requirements established by technical regulations and legislation in the field of environmental protection, in order to prevent negative impact such activities on the environment” (Federal…). Directive 2008/98/EC of 2008 on waste introduced measures to protect the environment and human health by preventing or reducing the negative impacts of production and waste management, as well as reducing the overall consequences of the use of resources and increasing the efficiency of such use. This document is based on the ambitious goal of moving closer to the “recycling society”. It prioritizes recycling measures, encourages separate collection of waste and reuse of products. The directive sets out the criteria for classifying waste as a by-product and the procedures by which the status of waste ends, when the waste is no longer considered waste, but a potential resource. Advantages are given to technologies based on energy resources from renewable sources and secondary raw materials. But such a condition is a limitation not only in the use of primary environmental resources (as a cause), but also in economic development (as a consequence). The concept of limitedness in relation to the natural environment has several vectors: limitedness of the main natural resources and energy sources necessary to continue the process of development and economic growth; limitation of the main components of the environment, characterizing its qualitative parameters, assessment of the state, which is derived, on the one hand, from the amount of emitted pollution, on the other hand, from the ability of

various ecosystems to self-regulate; limitation in the socio-economic dimension, which is associated with the demand (demand) for a clean environment, that is, the limitation in meeting the needs of a psychological, aesthetic recreational nature by various elements of the natural environment; limited functions of terrestrial ecological systems as the natural capital of the planet.

All over the world, the ecological concept of the development of the construction industry, called "Green Building", is becoming more widespread. Ecological construction is aimed at solving the issues of the qualitative component of construction through the use of environmental technologies in the planning, design, construction, operation and disposal of buildings. The use of such technologies allows minimizing the harmful effects of the construction industry on the environment and humans. Thanks to the use of "green" technologies, the reduction of atmospheric and water pollution, the conservation of natural resources, and the improvement of comfort and safety of indoor premises are achieved.

The tool for the examination of a construction project for compliance with the presence of "green" technologies in it, determining its level of quality, is the Certification System for "green" buildings (Sukhinina, 2013). “The idea of sustainable development has evolved significantly from the principle of “greening” the economy, that is, from the relationship between man and nature, to the principle of a stable economy without increasing the capacity to use irreplaceable natural resources” (Shakhgiraev, 2019). The main problem at the microeconomic level, where environmental and economic problems are localized, is the need to make a difficult choice between economically exalted and biosphere-compatible technical progress. Not every new production technology that is beneficial in terms of labor and capital productivity is environmentally sound. This means that the technology must be assessed against an environmental standard, in terms of emitted pollution and/or in terms of the use of original natural resources. Thus, the choice that enterprises make in connection with the greening of new technologies and products will depend not only on economic factors (economic calculation), but also on mandatory legal regulation and environmental expertise - especially in the case of productive innovations - on knowledge and environmental awareness of consumers and the economic benefits they produce.

That is, the assessment of a new technology by a business entity is to determine the balance between choice and limitations. It is difficult to make a choice in favor of a cost-effective technology that would meet environmental standards and could be implemented in a certain region, based on material, technical and human resources, without a qualitatively new methodology and tools for environmental and economic analysis. Figure 1 shows the allocation of a biosphere-compatible production technology, taking into account the limitations of the environmental and economic aspects of development.

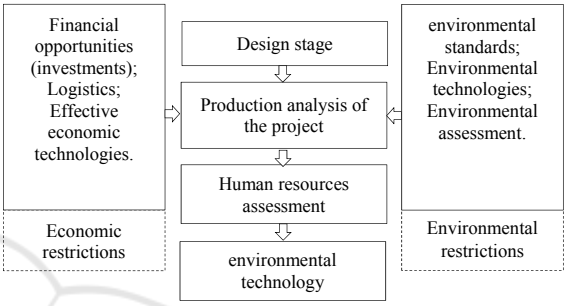

Figure 1: The choice of innovative technology under environmental and economic constraints.

The complexity of the choice is also predetermined by the multi-vector nature of environmental policy, that is, a kind of excess of goals that, in conditions of limited financial, material and labor resources, cannot be simultaneously implemented. Therefore, it is necessary to evaluate a promising technology according to such a cumulative indicator that takes into account environmental and economic constraints, the financial possibilities of the present and is capable of transformation over time in accordance with changes in the legal and technological environment. The sequence of selection and evaluation of rational production technology is shown in Figure 2.

The algorithm can be adapted to any industry with the addition of specific blocks of restrictions and variable blocks that characterize the features and stages of the choice of technological solutions. The base of environmental technologies for the construction industry should be formed according to the fundamental principle of world standards in the field of waste management, namely, reducing the amount of waste that is sent to the final disposal. To do this, all technologies related specifically to construction (design of buildings and structures, production of building materials, semi-finished products, structures and products) should be aimed at

applying a clear waste management hierarchy. The priority is the principle of preventing the formation of construction waste, minimizing (or no) recycling.

Despite the fact that the contribution of human capital to the dynamics of economic indicators is increasing every year, the growth in the use of primary natural resources continues to grow. It should be taken into account that the depletion of mineral reserves and the degradation of the environment that accompanies the extraction of raw materials reduces public welfare, i.e. statistically, these processes should reduce the rate of economic growth. This circumstance makes us take a different look at the recycling of materials, since the recycling of resources can be considered as a new, largely hidden source of economic growth without negative consequences for the environment.

It is believed that recycling can significantly reduce the use of natural resources. The launch in 2018 of the Circular Economy Initiative in Germany, one of the pioneering activities in this area, included discussions in the scientific community about the potential of recycling for the country's economy, as well as the development of a roadmap for political action, as important tasks. Calculations showed that recycling, service life extension and energy efficiency will reduce the consumption of primary raw materials by 68% by 2050. It is expected that the accelerated development of the recycling market and green technologies will make a significant contribution to this process. The Circular Economy Roadmap for Germany 2021 notes that only about 13% of the resources consumed in the country are currently derived from recycled materials (taking into account

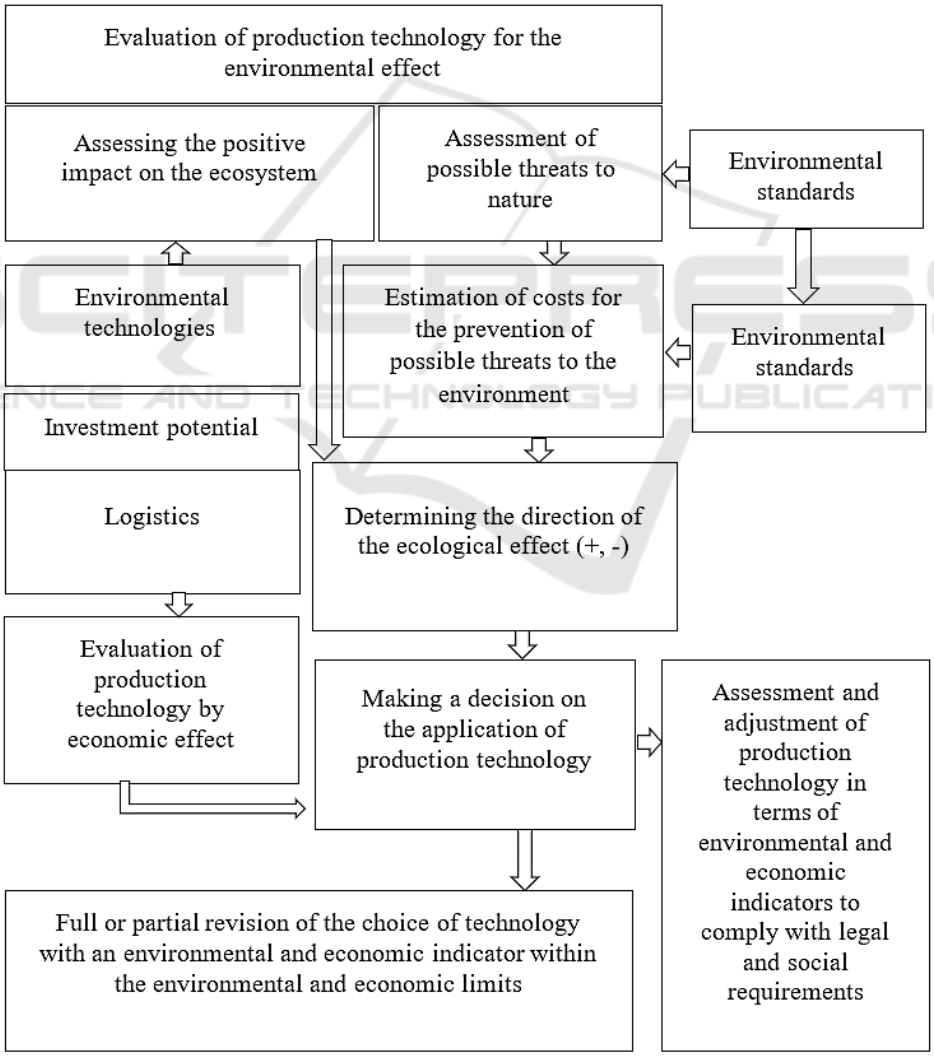

Figure 2: Algorithm for selecting and evaluating rational technology within the scope of environmental and economic restrictions.

intermediate consumption, this figure increases to 18%) (Kadner, 2021), in general In the European Union, 11.9% of the raw materials and materials used in 2019 were obtained by recycling waste (Sustainable…).

The process of reuse of waste for the same purpose after their processing - recycling of building materials and structures - is one of the areas of greening building technologies. Today in our country there is no single cost estimate for a project using recycled construction waste, and the lack of a regulatory framework does not contribute to the mass dissemination of environmental solutions. It should also be noted that the cost of processing secondary raw materials is too high, primarily due to the lack of proper initial sorting; secondly, there is no effective system of control and punishment for non-compliance with environmental standards; thirdly, the collective socio-ecological consciousness of the community, aimed at maintaining non-material values, has not been formed. The way to overcome it is the centralized introduction of a system of mandatory processing of construction waste and its recycling, the subordination of design technological and economic solutions to environmental restrictions and the principle of balanced nature management; technological re-equipment of construction production under environmental control by the state. At the same time, IT technologies should be more widely introduced into the process of the entire life cycle of an object - from the stage of conceptual development, design through the stages of construction and operation to dismantling. This makes it possible to implement many aspects of environmental and economic development, namely: timely assessment of the state of a construction object in order to ensure a warranty and post-warranty period of operation to extend the life cycle; designing the timing and scope of modernization, reconstruction, disposal of a construction site to predict the production capacities of construction and processing enterprises; introduction of new concepts in the approach to the design of buildings and structures that would take into account changes in the functional feasibility of objects in the real estate market - the concept of functional transformation.

3 CONCLUSIONS

Domestic legislation requires revision in order to harmonize the conceptual apparatus, in particular, the provision of definitions for the concepts of "separate collection", "prevention of education", "reuse", "best available technologies".

But for the effective implementation of world standards, it is not enough just to harmonize the legal aspects. For the construction industry, it would be appropriate to stimulate processing production, recycling, the introduction of new design concepts aimed at increasing the life cycle of an object by universalizing primary architectural and design solutions based on the biosphere compatibility paradigm. In this regard, it requires the development and adjustment of building codes that would regulate the boundaries of the use of construction scrap as a structural material. This would lead to the expansion of the use of recycling and products from secondary raw materials without the introduction of fiscal mechanisms for environmental audit. Technology is a necessary factor for economic development and growth. There is no doubt that new technologies provide an advantage in economic development. But in the context of environmental restrictions imposed on economic growth, it would be wrong not to take into account the social component of sustainable development. Ecologization of the economy is accompanied by a shift in the center of economic analysis from costs and intermediate results to the final results of economic activity and further to predicted development trends in accordance with the principles of social responsibility. Therefore, the achievement of balanced socio-ecological and economic solutions should be based on a change in the ecological and economic orientation of the structure of human needs and standards of well-being in the direction of rejecting the dictates of supply and artificially stimulating secondary needs.

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