# INNOVATIVE RENEWAL OF ECONOMIC RESOURCES AS AN ADVANCED TECHNOLOGY FOR SUSTAINABLE DEVELOPMENT

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*The article, which is of a review nature, reveals the conceptual principles of innovative renewal of economic resources as a key technology for ensuring sustainable development of an enterprise and identifying its practical forms and mechanisms of influence. The focus is on the triune nature of sustainable development – economic, environmental, and social – within which economic resources provide a system-forming role. The modern innovative technologies that form the resource base for sustainable development, including digitization, green technologies, circular economy principles and innovative energy solutions, are studied. It is substantiated that innovative renewal involves a qualitative renewal of material, labour, financial, information and technological resources through the introduction of the latest technical, managerial and social solutions. The forms and mechanisms of influence of innovative renewal on sustainable development are analyzed, including technological modernization, financial innovations, digital transformation, organizational and social innovations. It is emphasized that this form of renewal allows enterprises to reduce resource dependence, increase efficiency, strengthen competitiveness and ensure environmental safety. It is concluded that it is necessary to integrate innovative renewal into the strategic management of enterprise as a prerequisite for its long-term sustainability. Adopting a descriptive analysis method, this paper are outlined for further research are determined, in particular in the field of methodological assessment of the effectiveness of innovation renewal in the context of combining business profitability with responsibility to society and the environment and adaptation to Ukrainian realities.*

*Keywords: innovative renewal, sustainable development, economic resources, digitization, green economy*

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## Introduction

In modern business conditions, when global challenges such as resource constraints, environmental risks and growing competition form new guidelines for business operations, economic resources and the process of their renewal are of key importance for ensuring the sustainable development of an enterprise (Porter and Kramer, 2011). Economic resources are a set of material, labor, financial, information and technological components that are used by an enterprise to produce products, provide services and achieve strategic goals (Melnyk, 2019). Within the framework of the concept of sustainable development, these resources should not only ensure economic efficiency, but also meet the requirements of social justice and environmental safety (European Commission, 2020). In the triune structure of sustainable development (economic, environmental, social component),

economic resources perform the function of an infrastructural basis, without which long-term growth of an enterprise is impossible. The issue of ensuring sustainable development of enterprises in conditions of a dynamic external environment and resource constraints is becoming particularly relevant. Traditional approaches to the renewal of economic resources are gradually exhausting their potential, which necessitates the development of innovative mechanisms for resource modernization. This involves updating the resource base of an enterprise through the introduction of the latest technologies, management practices, and organizational models, and entails not only replenishing lost or consumed resources, but also a qualitative transformation of their structure, functional capacity, and strategic suitability. In this context, innovative renewal acts not only as a tool for improving the efficiency of resource use, but also as the latest technology for building the internal sustainability of an enterprise.

The purpose of the article is to scientifically substantiate the innovative renewal of economic resources as advanced technology for ensuring the sustainable development of the enterprise and to identify its practical forms and mechanisms of influence.

**Modern technologies for sustainable enterprise development: scientific analysis**

Sustainable enterprise development is based on the principles of resource efficiency, environmental responsibility and innovation dynamics (Kashchena and Chmil, 2022). These three key principles form the strategic basis for long-term competitiveness and adaptability of enterprises to global challenges (Hanchuk, 2024).

The principle of resource efficiency is to achieve maximum results with minimal use of resources (material, energy, labor, etc.). Resource efficiency involves optimizing production processes, reducing losses, reusing resources (recycling) and increasing productivity. Resource efficiency allows you to reduce the cost of products, increase competitiveness and reduce the environmental footprint of the enterprise. For example, the introduction of energy-saving equipment that reduces electricity consumption, or the use of zero-waste technologies in the food or textile industry to reuse by-products.

The principle of environmental responsibility means awareness and consideration of the environmental consequences of on enterprise's activities, including minimizing environmental damage and implementing environmental protection measures. The enterprise must minimize emissions, effectively manage waste, use environmentally friendly materials, and comply with international environmental standards (ISO 14001, etc.).

The principle of innovative dynamics means the constant orientation of the enterprise towards the introduction of a advanced technologies, products, management processes and business models. This is the ability of the enterprise to constantly generate, implement and adapt innovations (product, process, organizational) in order to increase efficiency, environmental sustainability and resilience to change. For example, the implementation of a «digital twin» system for monitoring production processes in real time and predicting failures, or the use of artificial intelligence to optimize logistics routes, which reduces $CO_2$ emissions and reduces transport costs.

The implementation of these principles in the practice of enterprises allows not only to achieve environmental and social responsibility, but also to increase economic efficiency, thus ensuring a balance between current needs and long-term development. The coordinated implementation of these three principles is not only an ethical or environmental requirement, but a real tool for increasing

business efficiency. They allow the enterprise to become resistant to risks, flexible to changes and open to the future.

Leading technologies in the field of sustainable development are: digitalization of production and management processes; green technologies; circular economy technologies and innovative energy solutions.

Digitalization of the enterprise's production and management processes is a key factor in the modernization of its activities in the context of the new industrial revolution (Industry 4.0; Tatarintseva and Strokov, 2023). This involves the systematic introduction of digital technologies, such as the Internet of Things (IoT), artificial intelligence (AI), big data (BigData), cloud computing, blockchain, «digital twins», etc., into all areas of the enterprise's functioning – from production and logistics to strategic management and decision-making (Sukachova, Gorodianska et al., 2025).

Digitalization as a technology for sustainable development ensures the achievement of three main components of sustainable development:

– Economic component – through automation, cost optimization, reduction of production losses and increased resource efficiency.

– Environmental component – through the implementation of «smart» energy management, reduction of emissions of harmful substances, real-time monitoring of environmental impact.

– Social component – digital technologies improve working conditions, promote the development of human capital through digital education and ensure greater transparency of management processes.

For the sustainable development of an enterprise, digitalization facilitates: the innovative renewal of the enterprise's resource base; enhanced competitiveness in both domestic and international markets; improved adaptability to global challenges, including climate risks, energy instability, and regulatory changes; and increased transparency and accountability in line with ESG (environment, social responsibility, corporate governance) reporting requirements.

Therefore, digitalization is not just a technical improvement, but a transformational technology that ensures the transition of an enterprise to an innovative model of sustainable development, where efficiency, environmental friendliness and social responsibility are interrelated components of the economic growth strategy.

Green technology is a set of scientifically sound solutions, technical means and organizational and management practices aimed at minimizing the negative impact of human activities on the environment, conserving natural resources and creating a safe and healthy environment for current and future generations (Zairi, 2017). It is a key tool for achieving the sustainable development goals set by the UN (European Commission, 2020).

The systemic essence of green technology is that it encompasses a wide range of innovative solutions that allow for: rational use of natural resources; reduction of harmful emissions and waste; use of renewable energy sources; development of a circular economy (closed-loop economy); waste-free or low-waste production; greening of logistics, transport, packaging and recycling.

Green technology contributes to the harmonization of three dimensions of sustainable development:

– Economic – by increasing production efficiency through energy and resource conservation.

– Environmental – by reducing anthropogenic load on the environment.

– Social – by improving the quality of life, creating «green» jobs, ensuring environmental safety.

The basis of sustainable development of enterprises is green technologies, which ensure: reduction of the ecological footprint of the enterprise; reduction of energy and raw material costs; improvement of the image and investment attractiveness; compliance with international environmental standards and requirements; stimulation of innovative development and transformation of the enterprise's business model. Therefore, green technology is not only an environmental initiative, but a strategic management tool that ensures the long-term competitiveness of the enterprise in the context of global challenges of sustainable development (post-pandemic recovery, digital transformation). Its implementation forms a new business paradigm based on the principles of environmental responsibility, resource efficiency, innovation and circular economy.

Circular economy is a modern economic model aimed at radically changing approaches to production and consumption, based on the principles of renewal, reuse, recycling and waste minimization (Kyfyak, 2024). It is not just an environmental practice, but a strategic technology for sustainable development, which allows for balanced economic growth while preserving the environment and resources.

The basic idea of the circular economy is to transform the linear model of «take – produce – use – throw away» into a closed cycle of «take – produce – use – recycle – reuse». The key tools and mechanisms are: recycling and upcycling (recycling with increased value); product-as-a-service models; the introduction of digital technologies for monitoring material flows; blockchain and artificial intelligence for tracking supply chains in real time; digital product passports - documents that contain complete information about materials, composition and disposal methods.

Thus, the circular economy is the technological and conceptual basis for the transition to sustainable development, as it transforms not only the methods of production, but also the worldview of enterprises and consumers. It is an innovative response to global challenges that combines economic efficiency, environmental responsibility and social justice. Its integration into the practice of the enterprise is the key to resource-efficient, environmentally safe and strategically promising development (Taranych and Burkivska, 2024).

Innovative energy solutions are a set of new technologies, approaches and management models that ensure efficient, environmentally safe and socially responsible production, distribution and consumption of energy. In the context of sustainable development, they play a fundamental role, as they solve several critically important tasks at once: reducing greenhouse gas emissions, reducing energy dependence, rational use of resources and ensuring access to clean energy for all (Department of Economic..., 2015).

Key areas of innovation in energy cover a wide range of technologies, such as: renewable energy (solar, wind, bioenergy, hydro- and geothermal energy); smart energy networks (smartgrids) integrated into a single digital management system; energy-efficient technologies; innovative energy sources (hydrogen energy, thermonuclear fusion, organic photovoltaics, etc.); energy storage technologies (new generation lithium-ion batteries, hydrogen-based batteries, superconducting systems, etc.).

Innovation in energy plays a leading role in ensuring the basic components of sustainable development. In particular, the economic component is ensured by: reducing energy consumption of enterprises through the implementation of energy-efficient solutions; creating new markets and sectors of the economy (green startups, production of energy equipment); attracting investments in

green projects through financial instruments for sustainable development (green bonds, ESG financing). The environmental component is ensured by: reducing $CO_2$ emissions through reduced dependence on fossil fuels; reducing air, water and soil pollution; supporting climate neutrality and achieving the goals of the Paris Climate Agreement. The social component is access to energy sources in energy-deficient regions; creating new «green» jobs; improving the quality of life through stable and secure energy supply.

Thus, innovative energy solutions are a modern driver of sustainable development, which allows combining energy security, economic benefit and environmental responsibility. They transform not only the technical base of energy, but also the very philosophy of its consumption: from excessive use of resources to energy awareness and responsible management of energy flows (Ogienko, 2024). Their active implementation is a prerequisite for a sustainable future for both the enterprise and society as a whole.

The use of these technologies creates the basis for sustainable development, but requires a qualitative renewal of resource potential through innovative renewal.

**Integrating resource renewal technology into a enterprise sustainable development strategy**

Economic resources (material, labor, financial, information, technological) are the basis of the functioning of the enterprise (Melnyk, 2019). Their effective use and timely renewal determine the competitiveness, innovative capacity and sustainability of the business entity (Pylypenko, 2020). Resource renewal is carried out in the following forms: simple, extended and innovative reconstitution. Simple renewal is characterized by maintaining the volume and quality of resources at the previous level. Extended renewal contributes to the quantitative and qualitative growth of resource potential. Innovative renewal ensures the transformation of the qualitative state of resources through innovation (Gorodianska, 2024). It is innovative renewal that creates the conditions for the enterprise to transition to a qualitatively new level of development, capable of providing opportunities for adapting its sustainable development strategy to global challenges.

The process of renewal of economic resources means their constant reconstitution, modernization, rational use and expansion in accordance with changes in the external environment. Effective renewal makes it possible to avoid the degradation of the resource base of the enterprise, ensure high productivity and reduce costs. In particular:

– Reconstitution of material resources allows the introduction of energy-saving and environmentally friendly technologies.

– Renewal of labor resources involves investing in the development of human capital, the creation of safe and decent working conditions.

– Financial resources ensure investment activity and the ability of the enterprise to adapt to challenges.

– Information resources form the basis for digital transformation, innovative management and transparent interaction with stakeholders.

– Technological resources determine the ability of the enterprise to modernize production and adapt to a european environmental standards.

Scientific literature mainly considers separately the problems of innovative development of enterprises, issues of renewal of certain types of resources, as well as aspects of environmental and social responsibility. At the same time, there is a deep systemic connection between these categories.

The lack of an integrated approach to the study of innovative renewal as a mechanism for ensuring sustainable development leads to fragmentation of scientific and practical solutions.

In general considers separately the problems of innovative development of enterprises, the issues of renewal of individual types of resources, and aspects of environmental and social responsibility. However, there is a deep systemic connection between these categories. The lack of an integrative approach in the study of innovative renewal as a mechanism of sustainable development leads to fragmented solutions. In modern scientific discourse (Gorodianska, 2024; Hanchuk, 2024; Kyfyak, 2024; Ogienko, 2024; Taranych and Burkivska, 2024; et al.), there is an increase in research on the relationship between innovations, processes of renewal of economic resources and achieving sustainable development of enterprises. This interest is due to the need to transform traditional business models towards greater efficiency, environmental responsibility andsocial orientation.

Despite a significant amount of research, there are a number of gaps, namely:

– due to the fragmentation of innovation approaches, renewal and sustainable development are mostly studied separately, without proper synergy;

– an insufficient number of empirical studies leads to a lack of specific examples from domestic practice regarding the implementation of innovative strategies for resource renewal;

– the limited use of economic and mathematical modeling is not always supported by a quantitative analysis of the relationships between investments in innovation, the efficiency of resource renewal and the level of sustainability.

At the same time, new trends and research directions are observed, which allow us to assert that:

– a new scientific field is being formed – innovative resource renewal, which combines the categories of innovation, resource renewal and sustainable development;

– the use of integrated approaches is spreading: ESG concepts, principles of the circular economy, industry 4.0, which strengthen the relationship between technological changes and the resource policy of the enterprise;

– there is a growing interest in strategic management of sustainable development, which involves harmonizing innovative, financial and environmental solutions within a single renewable paradigm.

We believe that innovative renewal is a purposeful process of updating and modernizing economic resources based on the use of innovative technologies (Gorodianska, 2024). It involves technological modernization, digital transformation of labor resources, development of financial instruments for sustainable investment, automation of knowledge management, creation of adaptive structures. Innovative renewal, integrated into the enterprise strategy, allows to ensure not only economic profitability, but also environmental and social sustainability of its development. We believe that innovative, balanced renewal of economic resources is critically important for the implementation of enterprises sustainable development strategy. It allows to: reduce resource intensity and increase energy efficiency; minimize environmental impact; ensure stable growth of labor productivity; maintain competitiveness; promote social responsibility of the enterprise. Thus, the innovative renewal of economic resources is not only a production necessity, but also a strategic condition for the transition to sustainable development. The role of economic resources in the sustainable development of an enterprise is system-forming, and their renewal is a guarantee of long-term efficiency, innovative potential and environmental responsibility of business. The ability of the

enterprise to organize continuous, efficient and environmentally friendly renewal of resources is a determining factor of its sustainability in the conditions of modern challenges.

**Forms and mechanisms of influence of innovative renewal of resources on sustainable development of the enterprise**

In modern conditions of growing technological competition, globalization of markets and environmental challenges, innovative renewal of economic resources is gaining special importance as a factor of sustainable development of enterprises. It is not only about updating the resource base, but also about transforming management approaches aimed at achieving long-term sustainability of the enterprise in the economic, social and environmental spheres. In this context, it is advisable to highlight the key forms and mechanisms of the impact of innovative resource renewal on sustainable development.

Considering the above, it can be argued that the main forms of the impact of innovative resource renewal on the sustainable development of an enterprise are as follows:

Technological renewal of resources, since innovative renewal of material, labor and technological resources is based on the introduction of modern technologies, automated systems and means of production, which contributes to increasing productivity, reducing energy intensity, material intensity of production processes and, in turn, has a positive effect on the environmental and economic indicators of the enterprise.

Greening the resource cycle, as evidenced by the fact that modern enterprises are increasingly implementing resources that meet the principles of environmental safety and sustainable nature management. Replacing traditional energy- and resource-intensive technologies with «green» innovations ensures reduced emissions, more efficient waste management, and an increase in the environmental reputation of the enterprise.

Digitalization of renewal processes, accompanied by the integration of digital technologies into the resource management system – in particular, the use of ERP systems, IoT solutions, artificial intelligence – allows you to significantly increase the accuracy, transparency, and adaptability of management decisions regarding resource provision and its innovative renewal.

Intellectualization of labor resources, according to which innovative renewal of personnel is based on increasing the educational and qualification level of employees, developing soft skills, stimulating creative thinking, and increasing motivation for innovative activity. This forms a socially sustainable environment of the enterprise and creates the prerequisites for increasing its innovative activity.

Financial and investment transformation, according to which new financial mechanisms are formed, in particular investments in innovative projects with a long-term effect. The use of sustainable financing instruments (for example, ESG criteria, «green» bonds) contributes to the formation of a positive investment image of the enterprise and the attraction of external resources for innovative development.

The mechanisms of influence of innovative resource renewal on the sustainable development of the enterprise should be considered as follows:

The mechanism of synergy between innovation and resources. Innovative technologies make it possible to increase the return on existing resources through their structural and technological modernization. Thus, in the context of Ukraine, examples of the application of additive (3D) technologies demonstrate the possibility of local manufacturing of components and spare parts,

reduction of logistics chains, and rapid restoration of equipment operability in conditions of limited resources. The practice of using metal 3D printing in military-industrial and repair tasks demonstrates an increase in repair efficiency and a reduction in dependence on imported components. These results illustrate the synergistic effect of innovative implementation – a simultaneous increase in productivity and reduction in material and energy costs.

Mechanism of adaptability to the external environment. Innovative renewal forms modular and flexible production solutions that allow for the rapid redistribution of production capacities when demand or supply conditions change. In the European food industry, the introduction of modular production lines has shown that enterprises can quickly reconfigure production for new product ranges and changing order volumes, which increases the resilience of the value chain during crises (pandemic, supply chain disruptions). Such flexibility is an example of how innovative resource renewal enhances enterprises operational adaptation to external shocks.

Mechanism for improving resource efficiency. Innovative technologies and process solutions make it possible to reduce resource consumption per unit of output and cut emissions. For example, in metallurgy, the transition from the traditional BF-BOF process to direct iron reduction (DRI) technologies, particularly in projects focused on the use of low-carbon or hydrogen reducing agents, demonstrates a significant reduction in the carbon intensity of production and improved energy efficiency. This changes the resource structure of production – less raw materials/energy per unit of steel while maintaining or improving product quality.

Mechanism of environmental modernization. Innovative renewal includes the introduction of closed-loop systems, energy-efficient technologies, and technologies for the utilization of by-products. An example is industrial investments by large manufacturers of building materials and industrial groups that implement heat recovery, waste recycling, and water reuse systems, which significantly reduce the environmental footprint of production and comply with international environmental standards. Such practices confirm that innovative investments in the renewal of material and energy resources have a direct impact on the environmental sustainability of an enterprise.

The mechanism of cyclical innovation activity. This mechanism describes a continuous innovation cycle – from fundamental research and applied development to large-scale implementation and evaluation of results – as a way to systematically update the resource base. Examples from the pharmaceutical industry show that an organized R&D process, supported by quality management systems and control scenarios (QRM, GMP), allows for regular updating of production technologies, optimization of raw material use, and reduction of production losses while simultaneously improving product quality. Cyclical innovation activity transforms resource planning from reactive to proactive – that is, resource renewal occurs not only «as needed» but as part of a sustainable development strategy.

Therefore, the forms and mechanisms of influence of innovative resource renewal serve as a practical tool for implementing the concept of sustainable development at the enterprise level (Susidenko and Susidenko, 2020). They allow not only to renew resources, but also to change the logic of their management – from traditional exploitation to strategic and responsible use (Tarasyuk, 2025). The focus of these forms and mechanisms on reducing costs, optimizing production processes, improving social conditions and ecological balance makes them critically important in the context of modern challenges.

**Conclusions**

Innovative renewal of economic resources is a key factor in the transition of an enterprise to a sustainable development trajectory (Porter and Kramer, 2011). It creates a basis for increasing business efficiency, ensuring environmental safety and social responsibility of enterprise. The integrated use of forms and mechanisms of innovative renewal allows an enterprise not only to stay on the market, but also to develop in accordance with the principles of sustainability, which highlights the need for further research in this area.

Innovative renewal of economic resources is a promising and necessary technology for sustainable development of an enterprises. Its implementation allows adapting to the challenges of the modern economy, strengthening competitive positions, and creating the prerequisites for long-term growth (Gorodianska, 2024). The scientific substantiation of the interrelationship of innovations, renewal of resources and sustainable development of the enterprise is at the stage of active formation of an interdisciplinary platform. Future research should focus on synthesizing relevant concepts, developing methodological approaches for evaluating the effectiveness of innovative renewal, and adapting global models to the specific needs of Ukrainian enterprises operating under crisis conditions.

**Conflict of interest**

The author states no conflict of interest.

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