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Article

Organizational and Economic Mechanisms of Environmental Management in Industrial Enterprises Under Sustainable Development

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Abstract: This article examines the improvement of organizational and economic mechanisms for environmental management in industrial enterprises under sustainable development. The close interrelationship of environmental management with corporate strategy, resource and energy efficiency, waste reduction, environmental risk management, and investment decision-making is substantiated. Within the organizational mechanism, the article considers environmental responsibility centers, internal environmental audits, digital monitoring, an environmental management system compliant with ISO 14001 requirements, and employee incentive mechanisms. Within the economic mechanism, the study proposes environmental cost accounting, the "polluter pays" principle, green investment, resource-efficient technologies, environmental KPIs, compensation payments, and economic incentive instruments. As a result of the study, an integrated organizational and economic mechanism model is developed to coordinate economic efficiency and environmental performance within a unified management framework in industrial enterprises.

Keywords: Sustainable Development, Industrial Enterprise, Environmental Management, Green Economy, Environmental Performance, Resource Efficiency, ISO 14001, Environmental Audit, Green Investment, Environmental KPI

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1. Introduction

Industrial production is an important source of economic growth, employment, and technological progress; at the same time, it has a significant impact on the consumption of natural resources and energy, atmospheric emissions, wastewater generation, and industrial waste [1]. Therefore, in modern industrial policy, increasing production volume alone is no longer regarded as a sufficient outcome. Reducing the environmental footprint of production, using resources efficiently, and aligning environmental risks with the economic interests of enterprises are becoming key conditions for sustainable development. UNIDO identifies resource efficiency, cleaner production, and circular economy approaches as key instruments of sustainable industrial development [2].

In Uzbekistan, the transition to a "green" economy is also emerging as one of the important directions of industrial development. The program for transition to a "green" economy and ensuring "green" growth by 2030 sets targets such as increasing energy efficiency in industry by at least 20 percent, reducing energy consumption per unit of gross domestic product by 30 percent, and expanding resource efficiency across all sectors of the

economy. The 2025 State Program identified the "green transformation" of sectors and industries, the enhancement of competitiveness and resource efficiency, the decarbonization of the economy, and the reduction of the "carbon footprint" as priority tasks. Since 2026, economic incentive mechanisms aimed at encouraging industrial enterprises to reduce their negative environmental impact have also been strengthened [3].

Sustainable development requires enterprises to consider economic, environmental, and social outcomes together. Resource conservation can reduce costs, recycling can recover value from waste, and energy efficiency can lower both expenditure and environmental impacts; however, these benefits depend on a management mechanism that connects authority, responsibility, information, financing, and incentives.

Environmental management is generally understood as the planning, regulation, monitoring, and continuous improvement of an enterprise's impact on the natural environment. ISO 14001 provides an institutional framework for managing environmental responsibilities, improving environmental performance, meeting applicable obligations, and pursuing environmental objectives [4].

Under these conditions, an environmental management system at the level of an industrial enterprise should evolve from an auxiliary function focused solely on compliance with environmental requirements into an element of strategic management. To achieve this, environmental objectives should be integrated into production, finance, investment, logistics, innovation, and human resource management processes, while environmental indicators should be evaluated jointly with economic results [5]. The purpose of this article is to systematize the organizational and economic mechanisms of environmental management in industrial enterprises and to propose an integrated mechanism consistent with sustainable development requirements.

2. Materials and Method

The study employs a systems approach, comparative analysis, logical generalization, institutional analysis, and organizational-economic modeling. The systems approach made it possible to consider environmental management within an enterprise not as the function of a separate department, but as a system interconnected with production, finance, investment, and strategic management. Comparative analysis was directed at comparing international environmental management approaches, particularly ISO 14001, resource efficiency, and cleaner production principles, with the institutional mechanisms of the "green economy" currently being formed in Uzbekistan.

In developing the organizational and economic mechanism, the sequence "objective – functions – instruments – indicators – incentives – control – improvement" was taken as the basic framework. Environmental objectives are not separated from economic efficiency. On the contrary, the impact of each environmental measure on resource consumption, operating costs, return on investment, risks, and market opportunities should be assessed. The effectiveness of the proposed mechanism is evaluated according to the criterion of simultaneous improvement in environmental and economic indicators.

3. Results

The organizational mechanism of environmental management in industrial enterprises should first clearly define the place of environmental responsibility within the enterprise's management structure. In practice, assigning environmental issues solely to the occupational health and safety or technical safety department reduces the strategic importance of environmental management [6]. Under sustainable development, environmental objectives should be incorporated into the enterprise development strategy and investment programs, responsibility for environmental outcomes should be established at senior management level, and this responsibility should be cascaded down to production units.

The first organizational direction is the distribution of authority and responsibility for environmental management. Enterprise management approves environmental policy, establishes environmental objectives and limits, and reviews investment projects against environmental criteria. The environmental management unit identifies environmental aspects, administers the monitoring program, oversees compliance with regulatory requirements, and reports to management [7]. Production units, in turn, assume operational responsibility for energy, water and raw material consumption, waste, emissions, and wastewater. Thus, the narrow approach that environmental issues are merely "the task of the environmental department" is replaced by the principle of "environmental responsibility of every unit."

The second direction is the digitalization of environmental information and monitoring systems. Under this approach, key environmental indicators are collected automatically or semi-automatically and consolidated in a unified database. Energy consumption, water use, consumption of major raw materials, waste volumes, atmospheric emissions, wastewater indicators, and the dynamics of environmental incidents are compared with production output. Digital monitoring enables management to see not only aggregate volumes but also the environmental load per unit of output. This is important for identifying hidden losses, detecting inefficient production areas, and determining investment priorities [7].

The third direction is the introduction of environmental auditing and a continuous improvement cycle. According to the ISO 14001:2026 approach, an environmental management system includes planning, implementation, performance evaluation, and improvement. A comprehensive internal environmental audit may be conducted at least once a year, while areas with high environmental risk may be audited more frequently. The audit should be organized not merely as a means of identifying violations, but also as a tool for detecting resource losses, technological inefficiencies, and reserves for modernization.

Table 1. Key elements of the organizational and economic mechanism of environmental management in industrial enterprises

Direction	Main instruments	Evaluation indicators	Expected outcome
Organizational management	Environmental policy, responsibility centers, internal audit	Achievement of objectives, number of nonconformities	Improved management discipline and accountability
Resource efficiency	Energy and water audits, RECP, technological modernization	Energy, water and raw material consumption / unit of output	Reduced production cost and environmental burden
Economic incentives	Environmental KPIs, bonuses, compensation payments, internal carbon price	Cost savings, return on environmental investment	Stronger economic motivation for environmental measures
Investment	Green CAPEX, life-cycle costs,	NPV, payback period, reduction in	Technological renewal and risk reduction

	environmental assessment	emissions and waste	
Monitoring	Digital accounting, sensors, environmental dashboard	Dynamics of emissions, waste, water and energy	Faster decision-making and transparent reporting

The first element of the economic mechanism is the comprehensive and accurate accounting of environmental costs. In traditional management accounting, a certain share of environmental costs remains "hidden" within general production overheads. As a result, management may not fully perceive the actual costs of waste disposal, water treatment, emission reduction, environmental monitoring, permits, fines, compensation payments, and resource losses [8], [9]. The introduction of environmental management accounting makes it possible to allocate these costs by process, product, or business unit and to assess the economic efficiency of environmental modernization more accurately.

The second element is the promotion of investment in resource-efficient and cleaner production. According to the UNIDO approach, production efficiency, environmental protection, and social outcomes should complement one another. The wider climate and industrial-development context is also discussed in the World Bank's country report and UNIDO's industrial-development analysis. The relationship between environmental improvement and competitiveness has also been discussed in the environmental-competitiveness literature, while the triple-bottom-line approach emphasizes the joint consideration of economic, environmental, and social performance. For example, introducing a closed-loop water circulation system can simultaneously reduce freshwater withdrawal, wastewater discharge, and the related payments. High-efficiency electric motors, heat recovery systems, and automated energy management systems can reduce energy costs as well as greenhouse gas emissions. Therefore, environmental projects should be assessed not merely as "mandatory expenditures," but as investments that take into account life-cycle costs and long-term risks.

The third element is the incorporation of environmental performance into the economic incentive system. For enterprise units, KPIs such as energy intensity, water intensity, waste intensity, and recycling rates may be established alongside production volume and unit cost. When achievement of these indicators is linked to a bonus system, environmental objectives become a tangible economic incentive for employees. To avoid creating inappropriate incentives, KPIs should not be one-sided but should be designed within a balanced performance indicator system. Natural-resource economics also highlights the importance of considering resource constraints and environmental costs, while the natural-resource-based view links environmental capabilities to organizational strategy [10].

The proposed integrated mechanism consists of five stages. At the first stage, the enterprise's environmental aspects and risks are inventoried. At the second stage, baseline values and target indicators are established. At the third stage, organizational responsibilities and a plan of technological and investment measures are formulated. At the fourth stage, implementation is controlled through digital monitoring, environmental management accounting, and KPIs. At the fifth stage, economic and environmental performance is reassessed based on audit results, and the next improvement cycle begins. This approach enables an enterprise to manage environmental objectives as a continuous management process rather than as a set of episodic measures [11].

To evaluate the effectiveness of the environmental management mechanism, relative indicators should be used in addition to absolute indicators. When production volume

increases, total energy or water consumption may also increase, even though consumption per unit of output may decline. Therefore, resource intensity and pollution intensity indicators are of particular importance in assessing environmental performance. Such intensity-based indicators are compatible with broader discussions of sustainable development and environmental economics and with indicator sets used to track green growth and sustainability performance.

4. Discussion

Accordingly, the organizational and economic mechanism of environmental management should begin with corporate strategy and extend to day-to-day operational decisions. In this framework, standards such as ISO 14001 provide the institutional foundation; resource efficiency and cleaner production form the technological and operational foundation; environmental management accounting and investment analysis constitute the economic foundation; and digital monitoring provides the information foundation. Integrating these elements makes it possible to transform environmental requirements from a factor constraining enterprise competitiveness into a source of efficiency and innovation.

The proposed mechanism is particularly relevant to Uzbekistan's industry because national policy is consistently strengthening instruments for energy and resource efficiency, decarbonization, and incentives for environmentally responsible production [12]. This process requires enterprises to measure environmental indicators regularly not only for government reporting but also for investment and strategic management decisions [13], [14]. As a result, the effective implementation of environmental management becomes a factor influencing internal efficiency, access to export markets, investment attractiveness, and the long-term sustainability of an enterprise [15].

5. Conclusion

Under sustainable development, environmental management in industrial enterprises should be formed not as a set of separate environmental measures, but as an integral component of economic and strategic management. Based on the study, an integrated organizational and economic mechanism is proposed that links environmental objectives with corporate strategy, production plans, investment decisions, and employee incentive systems. First, environmental responsibility centers and related powers should be clearly defined within enterprises, and environmental results should be reviewed regularly at senior management level. Second, a digital monitoring system should be established for energy, water, raw materials, waste, and emissions, and indicators should be analyzed per unit of output. Third, environmental costs and resource losses should be separately identified through environmental management accounting, while environmental projects should be evaluated on the basis of life-cycle costs and investment efficiency. Fourth, it is advisable to introduce an environmental management system based on ISO 14001:2026 requirements, or to update the existing system, and to establish internal environmental auditing and a continuous improvement cycle. Fifth, environmental KPIs should be integrated into incentive systems for managers and business units. Sixth, enterprises should systematically use the economic incentives, green financing opportunities, and investment support for resource-efficient technologies provided by the state. The practical implementation of the proposed mechanism can contribute to reducing resource and energy consumption in industrial enterprises, lowering environmental risks, optimizing production costs, improving compliance with environmental legislation, and strengthening long-term enterprise competitiveness. Future research should econometrically evaluate the mechanism using empirical data from specific industrial sectors or enterprises, determine the weights of an environmental performance index, and quantitatively assess the impact of environmental investments on financial results.

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