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RESEARCH ARTICLE

Modernization of Institutional and Economic Management Tools for Environmental Safety of Enterprises

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ABSTRACT

This study investigates the institutional and economic mechanisms employed for managing the environmental safety of enterprises in Ukraine and the European Union. Choosing Ukraine as the central focus of this study is deliberate and based on multiple considerations. Ukrainian businesses encounter distinct environmental obstacles due to the country's unique institutional and economic frameworks. Article enhancements to these mechanisms within the Ukrainian context, leveraging the EU's experience. The goal is to promote the development of more efficient systems for environmental safety management at enterprises, with an orientation towards sustainable development.

The research's methodological framework is meticulously constructed to be both exhaustive and multidimensional, facilitating a thorough and rigorous investigation of the research subject. This study also integrates synthesis, deduction, logical reasoning, and generalisation to augment the depth and scope of the research outcomes.

This study measures to enhance the effectiveness of environmental management systems. These measures include the formulation of an Environmental Safety Code and the Progressive Environmental Management System (PEMS), as well as the creation of an independent Environmental Impact Assessment Authority (EIAA). This study also investigates the potential application of AI in automating the analysis and evaluation of environmental impact scenarios. It proposes the establishment of an Intelligent Environmental Monitoring System (IEMS). Furthermore, the research discusses different types of taxes that could alleviate the adverse environmental effects of businesses. It recommends channelling funds from green bonds into the banking system for green loans or setting up a specialised green investment bank. These measures could incentivize businesses to adopt eco-friendly technologies. This study offers valuable insights for enhancing environmental safety management in businesses and provides practical suggestions for policymakers and business leaders.

Keywords: Security, State Security, Environmental Safety, Environmental Management, Environmental Impact Assessment, Artificial Intelligence (AI), Environmental Monitoring System (IEMS).
JEL Code: Q5, L5, M1

Introduction

The increasing global environmental challenges have made it clear that traditional methods of managing environmental safety at enterprises are no longer sufficient to meet the demands of the 21st century. As such, modernisation of existing regulations has become a key aspect of effective management and should be carried out alongside the development and implementation of institutional and economic tools.

Institutional and economic instruments not only involve more stakeholders but also contribute to the conservation of natural resources, reduction of pollution, and improvement of quality of life. Their modernisation allows for the adaptation of environmental safety management at enterprises to rapidly changing societal conditions and facilitates the exploration of new problem-solving approaches. The synergistic combination of old and new methods promotes positive shifts in sustainable development and aids in preserving our planet for future generations.

Numerous scholars have researched various aspects of theoretical, methodological, and practical tools for the institutional and economic management of environmental safety.

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Tomlinson and Atkinson (1987) conducted a literature review focussing on predictive technique audits, a type of audit with a significant role in improving environmental impact assessment practise (Tomlinson &Atkinson, 1987).

Sandle provides a practical approach to environmental monitoring by explaining the development of an environmental programme, the use of risk management, monitoring microbiology laboratories, microbial control strategies, and designing and implementing a control programme (Sandle, 2017).

Scotford discusses the challenges and importance of environmental legislation in Oxford Academic Journal (Scotford, 2021).

White et al. discussed how past experiments can improve environmental monitoring by illustrating non-random resampling in determining the optimal length and frequency of monitoring programmes to assess species trends (White et al., 2021).

Suprava et al. reviewed the evolution of environmental monitoring systems that incorporate IoT technology and sophisticated sensor modules (Suprava et al., 2022).

Brunelli discusses the current trends and challenges in the practical application of environmental audits in Central Asian countries (Brunelli, 2022).

The study has been conducted by M. Frey examined the impact of the carbon tax on Ukraine's economy. According to the results of this study, a tax rate of 3.46 US dollars per tonne of CO_2 will lead to a 22% reduction in GHG emissions. Furthermore, the use of funds generated from the carbon tax, combined with reductions in other taxes, will contribute to a 0.1% increase in GDP (Frey, 2015).

V. Kozyuk conducted a comparative analysis of the dynamics of the growth rates of gross environmental taxes (GET) and taxes on CO_2 and greenhouse gases in Europe. The analysis results revealed that the growth rates of GET significantly exceed the rates of reduction in harmful emissions. This indicates that environmental taxes primarily serve a fiscal function rather than a regulatory one (V. Kozyuk, 2019).

Kölbel et al. reviewed how sustainable investing contributes to societal goals. They distinguished three impact mechanisms: shareholder engagement, capital allocation, and indirect impacts. They concluded that the impact of shareholder engagement is well supported in the literature, the impact of capital allocation is only partially supported, and indirect impacts lack empirical support. Their results indicate that investors who seek impact should pursue shareholder engagement throughout their portfolio, allocate capital to sustainable companies whose growth is limited by external financing conditions, and screen out companies based on the absence of specific ESG practises that can be adopted at reasonable costs (Kölbel et al., 2019).

A. Zatti analyzes environmental taxes in Italy. The research revealed that although these taxes were expected to contribute to environmental improvement, this is not always the case in practise (Zatti, 2020).

Mok et al. conducted a multidisciplinary literature review on the green bond market, which is a financial product used to facilitate climate finance investments. They situate the green bond market within the development of climate finance by outlining the role of scientific research in developing green bond guidelines and standards. They examined this trend from an anthropological and economic-history approach, before delving into policy research emerging in the fields of climate finance and green bonds. This provided the context for an analysis of the rapidly growing body of legal research on the green bond market, including a reflection on the legal ramifications of a pricing difference between vanilla and green bonds (Mok et al., 2020).

Muhammad et al. conducted a systematic literature review that examined public acceptance of an environmental tax. Their analysis indicates that people are more supportive when they are well informed about a policy's effectiveness and the policy content, particularly the use of revenue; have high trust in the government; have a positive attitude towards protecting the environment; perceive the policy is fair in terms of cost distribution and social sharing; and are concerned about climate change (Muhammad et al., 2021).

Research conducted by a group of scientists under the leadership of Jules-Eric Tchapchet-Tchouto studies the impact of environmental taxes on economic growth in European countries. According to the findings of this study, increasing environmental taxes as part of any tax reform contributes to accelerated economic growth. However, it should be noted that low-income countries have a more significant negative impact than high- and middle-income countries (Tchapchet-Tchouto, 2021).

Bashir et al. conducted a bibliometric and systematic literature review of environmental tax publications. Their analysis of abstracts and keywords revealed that climate change, environmental taxes, double dividends, carbon tax, and environmental pollution are hotspots within the academic literature. They believe that research collaboration between developed and developing nations and further coordination among environmental agencies such as the IEA and IPCC will enhance the effectiveness of environmental reforms (Bashir et al., 2021).

Despite numerous studies in the field of institutional and economic instruments, many questions regarding the modernization

of instruments remain unresolved. Therefore, continued research in this direction is critically important for achieving a balance between economic development and environmental protection.

Presentation of the Main Research Material

After Ukraine declared its sovereignty and independence, a new stage of legislation began in the country, including the improvement of the legal framework for environmental protection, which had been developed over many years.

The foundational principles and objectives of Ukraine's state environmental policy are outlined in the fundamental legislative act – the Law of Ukraine "On Environmental Protection" (1991). This law establishes that the purpose of environmental legislation is to regulate relations in the field of conservation, use, and restoration of natural resources, ensure environmental safety, prevent and eliminate the negative impact of economic and other activities on the natural environment, and preserve natural resources, genetic resources of wildlife, landscapes, and other natural complexes, as well as unique territories and natural objects associated with historical and cultural heritage.

Based on the analysis of the Law of Ukraine "On Environmental Protection" (1991), the following classification of environmental safety management tools can be identified (Table 1):

Table 1. Classification of State Regulation Instruments for the Environmental Activities of Enterprises

Regulatory Tools	Basic Components
Legislative	Ukrainian laws in the field of environmental protection
	Ukrainian codes
	International agreements in the field of environmental protection
	National strategies in the field of environmental protection
	Resolutions and decisions in the field of environmental protection
Administrative	State Standards in the field of environmental protection
	Norms in the field of environmental protection
	Limits on the use of natural resources
	Limits on emissions of pollutants
	Monitoring, reporting, and verification of greenhouse gas emissions
	Environmental audit
	Environmental impact assessment
	Strategic environmental assessment
Fiscal	Environmental tax
	Rent for the use of natural resources
	Fines for environmental violations
Financial	Compensation for damage caused by violations of environmental laws
	State funding for environmental protection measures
	Environmental insurance

It is worth noting that the effectiveness of regulatory instruments for environmental conservation in enterprises is closely tied to complex socio-economic and socio-political processes within the state. Temporary loss of control over certain territories, armed conflicts, economic crises, and the loss of a significant number of mining, metallurgical, and chemical enterprises in Donbas and Crimea have shaped the development of environmental policy in unique ways. On the one hand, these events led to a significant

reduction in the emissions of harmful substances and industrial waste production. In addition, they constrained the budgetary resources available for implementing the planned measures under the National Environmental Protection Action Plan.

Regulatory and Legal Tools for Managing Environmental Safety of Enterprises

Regulatory and legal instruments establish the legal foundation for environmental quality management, establish normative connexions with various mechanisms within this system, and regulate societal relations while considering the optimal balance between environmental and economic interests in the socioeconomic development of society. Their strategic purpose lies in reducing the risk of harm to the environment and human health, limiting or discontinuing economic activities that harm ecosystems and the environment, and implementing the most effective methods of management and natural resource based on unified ecological-economic standards, indicators, norms, and requirements.

Ukraine's signing of the Association Agreement with the European Union on September 16, 2014, represents a significant milestone in the country's development and the establishment of close ties with the community of European nations. This historic moment underscores Ukraine unwavering commitment to reforms, modernisation, and alignment with EU standards, which contribute to the strengthening of democracy, human rights, and economic development.

According to Annexe XXX to the Association Agreement (2014), Ukraine is obligated to bring its legislation in the field of environmental protection in line with 26 directives and 3 EU regulations in the following areas:

- Environmental management and integration of environmental policies into other sectoral policies.
- Air quality.
- Waste and resource management.
- Water quality and water resource management, including marine environments.
- Nature conservation.
- Industrial pollution and technological hazards.
- Climate change and ozone layer protection.
- Genetically modified organisms.

As of 2023, according to the Reports on the Implementation of the Association Agreement between Ukraine and the European Union for the period from 2014 to 2022, Ukraine has achieved 77% of the commitments in the "Environment" sector outlined in Section V, "Economic and Sectoral Cooperation," of the Association Agreement.

Simultaneously, according to the analytical report of the European Commission on Ukraine's ability to fulfil the conditions for EU membership, as of February 2023, Ukraine has received a score of 1 in the harmonisation of environmental legislation, corresponding to the "initial level of preparedness." It is worth noting that this assessment applies not only to the 29 directives and regulations listed in Appendix XXX of the Association Agreement but also to the requirement of implementing all acts of the acquit communautaire in the field of environment and climate change for full EU membership, which includes approximately 200 acts, encompassing not only secondary legislation (directives and regulations) but also policies.

Analysing the environmental legislation of the European Union, it should be emphasized that it is built on the principle of codification, which allows for the unity and consistency of the legislation while simplifying its application and interpretation. For example, the Environmental Code of Sweden replaced 15 legal acts, and environmental quality standards define impact levels and should specify the following:

- Maximum or minimum presence of chemical products or biotechnical organisms in soil, surface waters, groundwater, air, or the surrounding environment.
- Maximum levels of noise, vibration, light, radiation, or similar impacts.
- Maximum or minimum levels or values of water level or flow in aquatic systems, watercourses, groundwater, or their components.

In Ukraine, these issues are regulated by legislative acts from various sectors, including the "Law of Ukraine on Chemical Safety and Chemical Product Management" (2022), the "State Building Norms of Ukraine on Protection against Noise and Vibration" (DBN V.1.2-10:2021), and the "State Sanitary Norms for Permissible Noise Levels in Residential and Public Buildings and on Residential Development Areas" (2019). This demonstrates that Ukraine's environmental legislation is multifaceted and requires coordination across different areas for effective implementation.

Unlike the Environmental Code of Sweden, the Environmental Code of France is structured according to the pandect system, as its provisions are grouped into General and Special Parts. The General Part includes provisions on the fundamental principles

underlying environmental legislation, the state authorities involved, and the objectives of the Environmental Code. The Special Part contains regulations related to the protection of water, forests, and air and governs activities related to waste management and hazardous substances. In addition, the Environmental Code of France contains provisions not typical of Western European countries' legal systems, such as the regulation of genetically modified organisms and environmental protection in Antarctica.

The Environmental Code of Italy regulates matters related to environmental impact assessment, integrated preventive pollution control, water and soil protection, air quality protection and emissions reduction, waste management, reclamation of contaminated areas, and claims for environmental damage.

Thus, the codified acts of France, Italy, and Sweden have similar content, including provisions regarding nature conservation, waste management, and penalties for legal violations. However, the most successful experience in this field still belongs to France, as its Code contains a greater number of significant norms and provisions that more effectively regulate the relevant legal relationships.

In the context of environmental governance, the public plays an integral role in France, Italy, and Sweden. The French Environmental Code requires public consultation for all industrial or urban development projects that could impact the environment and land. It also facilitates discourse on a broad spectrum of environmental issues. In Italy, environmental policy is predicated on principles such as sustainable development and prevention. The Italian legislation guarantees public access to environmental information, thereby promoting transparency. Sweden's Environmental Code, which is applicable to all activities that could potentially impact the environment, ensures public awareness through various databases and resources. This approach empowers citizens to express their views on environmental matters, thereby fostering a democratic society with an increased awareness of environmental issues.

Unlike EU countries, Ukraine does not have a single codified act that regulates environmental relationships within the country. However, the idea of creating a Ukrainian Environmental Code has been supported by many scientists, including Y. Shemshuchenko, G. Balyuk, S. Kuznetsova, O. Panchenko, and T. Proskura (Panchenko, 2017).

In Ukraine, active discussions are occurring regarding the content and structure of the codification act and the scope of codification. There are some theoretical developments and specific proposals for environmental code projects. One such project was introduced to the Verkhovna Rada as early as 2004, but it remained unexamined. The codification process is a complex and time-consuming endeavour that requires significant effort. It involves not only the creation of a new legislative act but also the review of existing laws, their analysis, and coordination among various government bodies.

The main drawback of Ukrainian legislation is the absence of legal consolidation of a systemic economic approach to environmental management. It should be noted that there are currently no effective economic incentives for the use of environmental business practices and environmentally responsible citizen behavior . Existing legal mechanisms are primarily fiscal and punitive and do not strike a balance between public and private interests. Meanwhile, a unified and balanced eco-economic mechanism for natural resource management that combines economic incentives, administrative promotion of positive environmental behavior, and comprehensive accountability for violations could create an effective system of interaction with the environment.

In general, the legislation of European countries is oriented towards promoting environmental safety. The preamble of the 6th Environmental Action Programme of the EU (2002) states that legislation is the cornerstone for addressing environmental issues, and the full and proper implementation of existing legislation is a priority.

Therefore, the creation of an Environmental Safety Code is evident since the current Law of Ukraine "On Environmental Protection" (1991) does not fulfil the role of a fundamental law in the field of environmental protection and ensuring environmental safety, under which natural resources and other specialised legislation should be developed. It is important to ensure that the new Code considers all the needs and interests of stakeholders and complies with international standards and norms. Therefore, this process should be transparent, inclusive, and collaborative, involving all interested parties, including government bodies, businesses, civil society, and scientists. Ultimately, its adoption will lead to the establishment of a more effective and integrated environmental legislation that can better protect the environment and promote sustainable development in Ukraine.

Administrative Tools for Managing Environmental Safety of Enterprises

The primary objective of administrative instruments within the mechanism of state eco-economic regulation is to involve natural resource users in the process of harmonizing relationships with the environment. The most important tools in this category include environmental standards and regulations, ecological limits, environmental monitoring, environmental auditing, environmental impact assessment, and strategic environmental assessment.

The need to implement environmental audits was recognised at the legislative level in Ukraine as early as the 1990s, particularly in the "Basic Directions of State Policy in the Sphere of Environmental Protection, Natural Resource Use, and Environmental

Safety," which were approved by the Verkhovna Rada of Ukraine on March 5, 1998, under Resolution No. 188/98-VR. The Law of Ukraine "On Environmental Audit" was adopted in 2004.

In Ukraine, an environmental audit is defined as a documented systematic independent process of assessing an environmental audit object. This process includes the collection and objective evaluation of evidence to establish compliance of identified types of activities, measures, conditions, environmental management systems, and related information with the requirements of Ukrainian legislation on environmental protection and other criteria of environmental audit.

In the European Union, environmental auditing is part of the EU Eco-Management and Audit Scheme (EMAS), which is a management tool developed by the European Commission for companies and other organisations to assess their activities, report on their environmental performance, and improve their environmental indicators. EMAS aims to create conditions for providing environmental information to the public. According to the official EMAS website data as of June 2023, there are 4,039 European organisations registered with a total of 12,847 sites.

Indeed, the primary difference lies in the fact that in Ukraine, environmental auditing was developed primarily for monitoring compliance with environmental legislation, whereas in the EU, it also aims to improve the environmental performance of businesses and organisations organizations.

The series of international standards for environmental management systems in businesses and organisations (ISO 14000) is one of the most recognised international instruments for environmental protection in Ukraine.

The State Standards of Ukraine (DSTU) ISO 14000:2015 have not gained widespread adoption in Ukraine. The main challenges of the limited implementation of ISO 14000 in Ukraine include the following:

- Economic instability in Ukraine.
- Contradictory and inadequate legislative, normative, and methodological framework.
- Insufficient resource allocation (financial, material, technical, human resources, etc.).
- Absence of state support for enterprises in environmental management system implementation.
- Insufficient levels of environmental awareness and knowledge among business owners and managers regarding the competitiveness of their products.
- Inconsistencies in terminology and definitions between the ISO system and Ukrainian legislation and within the DSTU ISO 14000 standards.

Thus, considering the EU's experience, Ukraine can expand its environmental audit system to include not only compliance with environmental legislation but also the improvement of companies' environmental performance. This can be achieved by implementing a national environmental management system similar to EMAS in the EU, which allows companies to assess, report on, and enhance their environmental indicators. For instance, the progressive environmental management system (PEMS)," which includes stages of assessment, planning, execution, monitoring, and improvement (integration with other management systems, use of digital technologies, and stakeholder engagement). Such an approach will not only promote legal compliance but also encourage companies to continuously improve their environmental practises.

Another important tool is environmental impact assessment (EIA). In the European Union, businesses provide relevant documentation to the competent authority before initiating any activity. Based on this documentation, the authority determines the need to conduct an EIA.

In Ukraine, unlike the European Union, an automatic screening model is implemented, where businesses independently determine whether they must conduct an EIA. This determination is based on Article 3 of the Law of Ukraine "On Environmental Impact Assessment".

Therefore, the main difference lies in who determines the need for conducting the EIA procedure: in the EU, it is done by the competent authority based on materials provided by the business entity, whereas in Ukraine, it is the business entity itself. This can be examined through the lens of the principle of separation of duties, which posits that no single entity should monopolise all aspects of a process. The compatibility of Ukraine's approach hinges on the presence of cheques and balances. In the absence of such mechanisms, the principle may not be fully actualised. Mechanisms such as independent audits or regulatory oversight are in place to ensure judicious decision-making by businesses, and the Ukrainian model could align with this principle. Therefore, the extent to which Ukraine's Environmental Impact Assessment (EIA) process aligns with the principle of separation of duties depends on the specific implementation of these cheques and balances.

Modernising the Environmental Impact Assessment (EIA) in Ukraine through the establishment of an independent EIA authority could lead to significant improvements in ensuring the environmental safety of enterprises. An independent EIA authority, free from political pressure or corporate interests, can objectively assess the potential impact of projects on the environment. This, in

turn, will strike a balance between economic development and environmental protection, promoting sustainable development and enhancing the transparency and openness of the EIA process, which will facilitate public oversight and citizen participation.

Strategic Environmental Assessment (SEA) in Ukraine and the European Union share similar objectives and principles. In both cases, SEA is a procedure for identifying, describing, and assessing the consequences of implementing documents of state planning for the environment, including for public health.

In Ukraine, the Strategic Environmental Assessment (SEA) is conducted in accordance with the Law of Ukraine "On Strategic Environmental Assessment" dated October 20, 2018. This law defines SEA as determining the scope of the strategic environmental assessment, preparing a report on the strategic environmental assessment, conducting public discussions and consultations (including transboundary consultations if necessary), considering the strategic environmental assessment report, the results of public discussions and consultations in the state planning document, and informing about the approval of the state planning document.

In the EU, strategic environmental assessment (SEA) is conducted in accordance with Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment. This directive defines SEA as a means of ensuring a high level of environmental protection and promoting the integration of environmental considerations into the preparation and adoption of plans and programmes to support sustainable development.

Thus, the difference between SEA in Ukraine and the EU lies in the specific legislative acts that regulate this process. However, both laws have a similar approach to SEA and emphasise the importance of integrating environmental considerations into the decision-making process.

To modernise the process of strategic environmental assessment (SEA), it is recommended to develop a digital platform. This platform provides interactive tools for simulating various long-term development scenarios and assessing their potential environmental impact. In addition, the platform can grant access to databases with the scientific and technical information necessary for conducting SEA.

As Ukraine already has the "EcoSystem" platform with an "e-SEA" section, for improvement and expansion of its functionality, it is advisable to add a module for the automated analysis and assessment of the potential environmental impact of various scenarios using artificial intelligence. Such an approach will streamline the SEA process and provide a more accurate and objective evaluation.

Environmental monitoring is an important tool for environmental protection and ecological safety. It allows for regular observations of the state of the natural environment and the level of pollution.

Ukraine operates a state environmental monitoring system that includes regulated periodic continuous, long-term observations, assessment, and forecasting of changes in the state of the natural environment. The main principles of the functioning of this system are a unified scientific-methodological framework for measuring parameters and determining indicators of the state of the environment, biota, and sources of anthropogenic impact on them.

However, environmental monitoring is not only a tool for control but also a vital means of planning and management. Monitoring results assist in the development of effective strategies and policies in the field of environmental protection.

However, Ukraine faces challenges with its environmental monitoring system, which does not fully meet its objectives and fails to meet modern requirements. In particular, there is insufficient effectiveness in the system concerning the interaction among environmental monitoring entities, their tasks, and the fundamental principles of the organisation. This also applies to the expansion of activities related to hydrocarbon extraction.

The European Union's environmental policy addresses the environmental needs of its member countries' populations, ensuring environmental safety, and promoting the sustainable use of natural resources. It also contributes to taking international measures to address regional or global environmental issues. In total, approximately 570 international standards in the field of environmental monitoring have been developed. The EU also collaborates with the governments of other countries to establish a methodological foundation for developing environmental regulations.

One of the innovative proposals for improving the environmental monitoring system in Ukraine could be the implementation of an intelligent environmental monitoring system (IEMS), developed on the basis of the experience of the European Union. The integration of Artificial Intelligence (AI) into environmental monitoring systems of the European Union has proven successful. The United Nations Environment Programme (UNEP) has emphasised the role of AI in addressing a spectrum of environmental challenges, from the creation of energy-efficient infrastructures to the surveillance of deforestation and the enhancement of renewable energy deployment. The World Environment Situation Room (WESR), a UNEP initiative, exemplifies the use of AI in the analysis of complex and diverse datasets. Moreover, the International Methane Emissions Observatory (IMEO) has adopted AI to innovate strategies for monitoring and mitigating methane emissions. The European Commission has also acknowledged the potential of AI in resolving several societal issues, including those related to the environment.

IEMS may include the following components:

- Data Integration: Automatic data collection from various sources such as satellites, air quality sensors, and monitoring stations. This allows for obtaining more accurate and up-to-date information about the state of the environment.
- Forecasting and Modelling: Using machine learning algorithms, IEMS can predict future trends and assess the impact of various factors on the environment. This helps in making timely decisions to prevent environmental issues.
- Interaction with the public: The IEMS will provide access to information about the state of the environment through a web portal or mobile application. This will increase awareness among citizens and their participation in environmental protection efforts.

Economic Tools for Managing Environmental Safety of Enterprises

The important place in the system of tools for state regulation of environmental aspects of entrepreneurial activity belongs to economic aspects. According to the Law of Ukraine "On Environmental Protection" (1991), the use of economic instruments is oriented towards the following:

- Establishing the correlation between enterprises' economic activities, rational use of natural resources, and effectiveness of environmental protection measures based on economic levers.
- Identifying sources of funding for environmental protection measures.
- Setting limits on the use of natural resources, emissions, discharges of pollutants into the environment, and waste disposal.
- Establish norms and rates of payment for the use of natural resources, emissions, pollution in the natural environment, and other harmful impacts.
- Providing economic entities with incentives to implement waste-reducing, energy-efficient technologies, and unconventional energy sources and to implement other effective measures for environmental protection.

Compensation for damages caused by violations of environmental protection legislation in accordance with established procedures.

The basic elements of the system of economic regulation of environmental activities of enterprises include fees/taxes for the special use of natural resources (mineral, water, land, forest, biological), fees for environmental pollution, and tax levers. On the one hand, they serve as incentives for environmentally friendly economic activities, while conversely, they serve as sources of environmental protection funds.

The main positive outcomes of the current economic mechanism for environmental regulation are, first, the establishment of the foundations of paid natural resource usage and, second, the inherent economic toolkit that serves as a means to ensure the availability of financial resources necessary for mitigating environmental pollution. However, certain subsystems and elements of this mechanism vary in terms of development and practical implementation.

The existing natural resource usage mechanism in Ukraine primarily relies on a set of regulators of environmental behaviour for manufacturers, compelling them to limit their environmentally harmful activities in accordance with regulatory acts, decrees, and laws. This mechanism does not incentivize them to adopt environmentally friendly business practises, constrains conservation efforts, and hampers the adoption of innovative environmentally oriented technologies, leading to the predictable deterioration of the environment.

When evaluating the effectiveness of the existing system of economic tools for natural resource usage based on ecological suitability and environmental quality improvement criteria, it is important to emphasise its ineffectiveness in addressing the preservation of the natural environment and its inability to ensure environmentally favourable conditions for economic activities. When assessing the effectiveness of the existing economic mechanism for natural resource usage based on the criterion of filling the state budget (profitability criterion), it is crucial to highlight its unquestionable effectiveness as an efficient means of meeting the significant national goal of satisfying the financial needs of the state.

Since 2000, Ukraine has been experiencing a stable trend of increasing budget revenues from fees/taxes for natural resource usage. The development of this trend primarily indicates the activation of the fiscal function of the current system of environmental taxation and the strengthening of its significance as a means of filling the state budget.

As of today, in Ukraine, according to the Budget Code, the environmental tax is distributed in a ratio of 45% to 55%, where 45% goes to the general fund of the State Budget (excluding the tax on carbon dioxide emissions and the tax on the formation and temporary storage of radioactive waste), and 55% of the environmental tax revenue belongs to the funds of local budgets (excluding the tax on carbon dioxide emissions and the tax on the formation and temporary storage of radioactive waste). Other taxes are paid and used based on the taxpayer's actual location.

In 2021, the Verkhovna Rada of Ukraine approved the draft law "On Amendments to the Tax Code of Ukraine and Certain Legislative Acts of Ukraine to Ensure Budget Revenue Balance No. 5600," under which the rates of the environmental tax for CO_2 emissions from stationary pollution sources were tripled, increasing from 10 UAH/t CO_2 to 30 UAH/t CO_2. However, even after this increase, the rate remains the lowest in Europe compared with other countries. According to the World Bank, "Carbon Pricing Dashboard", as of March 31, 2023, the highest rates are in Switzerland and Liechtenstein at \$130.81/t CO_2 and Sweden at \$125.56/t CO_2. The lowest rates are in Estonia at \$2.18/t CO_2 and in Ukraine at \$0.82/t CO_2 (see figure 1).

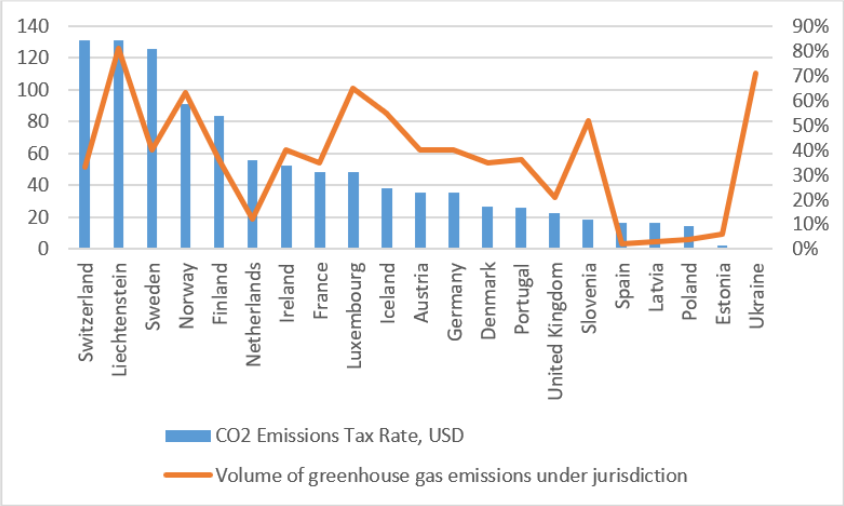

Figure 1. Emission Tax Rates

Carbon taxes can be established on various types of greenhouse gases, such as carbon dioxide, methane, nitrous oxide, and fluorinated gases. The magnitude of each country's carbon tax differs, leading to varying shares of greenhouse gas emissions covered by the tax.

Taxes should serve as a financial instrument that incentivizes businesses to modernise and implement environmental measures. However, in the legislation, the focus is once again on its fiscal function rather than its financial role, as is customary in European practise. Despite the provisions in draft law No. 5600 directing payments towards measures aimed at reducing CO_2 emissions in the manufacturing and electricity, gas, steam, and conditioned air supply sectors, to the extent of no less than 70% of the tax paid, the issue of how these funds will be used and which authority will oversee them remains unresolved.

Analysing European environmental taxation, it is worth noting that it is a complex system consisting of various types of tax payments, emissions trading mechanisms, and a variety of tax and non-tax incentives.

The Directorate-General for Taxation and Customs Union of the European Commission has allocated environmental taxes by usage area into seven main categories: energy taxes (on motor fuel, on energy products, on electricity); transport taxes (mileage taxes, excise duties on vehicle purchases, annual owner's tax); pollution charges (emissions of pollutants into the atmosphere and discharges into water bodies); waste disposal fees (fees for waste disposal in landfills, for their processing, and taxes on various specific products: packaging, batteries, tyres, oils, etc.); taxes on emissions of substances leading to global environmental changes (substances depleting the ozone layer and greenhouse gases); noise taxes; and charges for the use of natural resources.

According to their intended purpose, they are divided into three groups. The first group includes taxes with a fiscal function that increases revenues, directed not only towards covering the costs of environmental initiatives but also towards filling the budget. The second group consists of taxes aimed at cost recovery and directed towards environmental restoration (such as water abstraction fees, waste disposal charges, etc.). The third group encompasses incentive taxes designed to encourage environmentally responsible behaviour among economic entities (Shevchenko, 2014).

The EU is the first and only entity that obliges its member countries to pay energy taxes. Energy taxes constitute the largest share of environmental taxes in the EU. Transport taxes rank second, and pollution and resource taxes come third.

Considering the above distribution, it is necessary to analyse the environmental charges that operate within individual countries (see Table 2).

An analysis of existing taxes on a country-by-country basis has shown that Denmark, Sweden, and Ireland have the greatest diversity of environmental taxes. These countries appear to be leaders in the adoption of advanced technologies for environmental

Table 2. Types of environmental taxes in the EU

Tax	Country													
	UK	EST	SWE	FIN	DE	NL	DK	IE	CZ	PL	FR	LV	SI	UA
Energy Resource Tax		+	+	+	+	+	+	+						
Carbon Emission Tax				+			+	+			+		+	
Water Pollution Tax					+	+	+	+	+	+	+	+	+	+
Aviation Tax	+							+			+			
Air Pollution Tax								+	+	+	+			+
Vehicle emission tax			+		+			+						
Waste Tax	+		+	+	+	+		+		+	+			+
Packaging Tax			+		+						+			
Pesticides, Fertilisers, Chemicals Tax			+		+		+		+		+	+		
Environmental Protection Levy	+	+	+		+			+						

protection and have minimal anthropogenic impact on the environment. The leadership of these countries annually approves environmental development programmes and regularly reports to the public on completed and planned tasks.

As the issue of reducing pollution levels in the natural environment becomes increasingly important with each passing year, it is worth analysing the revenues accumulated by EU countries through environmental taxation.

According to Eurostat (see Figure 2) as of 2021, the total amount of environmental revenues amounted to 325.8 billion euros, whereas in 2000, the total amount of environmental payments was 123.8 billion euros less. It is worth noting that the largest share of EU environmental revenues comes from energy taxes, accounting for approximately 78.3% of the total as of 2021. In 2020, the share of such revenues was 77.4% although the value of the revenue from energy taxes decreased by 22.9 billion euros compared to 2021. This indicates an increase in the number of industrial enterprises and power plants in the EU.

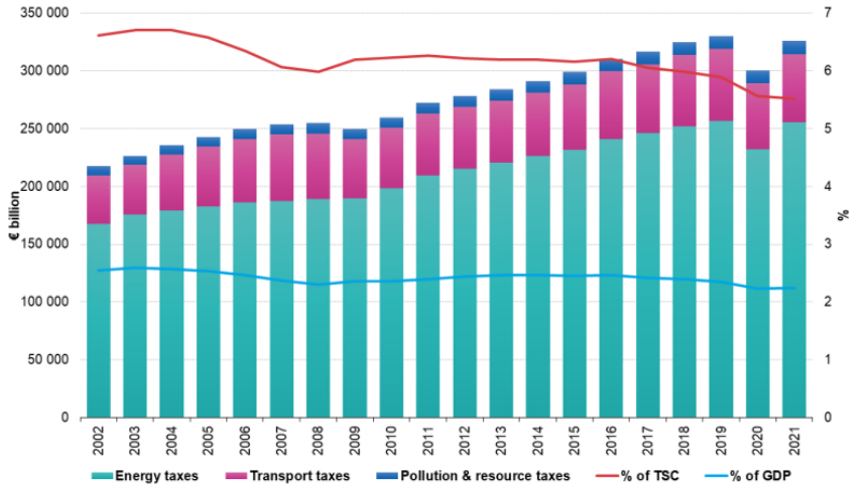

Figure 2. Receipts of Environmental Tax by Type and Total Environmental Taxes as a Percentage of GDP and GNI, EU-27, 2000–2021 (billion euros, %)

The average European factory pays most of its environmental taxes in the form of energy product prices and electricity used in its operations. Emissions are regulated through a quota trading system. In several cases, a factory may be eligible for tax incentives, typically linked to incentivize the adoption of "eco-friendly" technologies or processes. For example, in Italy, companies employing advanced technologies to reduce their negative environmental impact may qualify for what is known as "hyper-amortisation" of

these assets. In practise, a company can depreciate up to 270% of the asset's cost instead of 100%. In Belgium, the state can reimburse a significant portion of tax expenses (up to 80%) if the company participates in agreements to implement advanced energy-saving technologies (e.g., in accordance with ISO 50,001 standards).

A separate group of tax incentives can be highlighted, which are provided to taxpayers for their contribution to the development of new technologies, such as RD tax credits or patent boxes.

Because of this analysis, it can be concluded that the focus of European states is on taxing energy carriers. On the other hand, the legislative authority in Ukraine has been trying to control the level of environmental pollution for a long time, but this process is characterised by a certain degree of controversy. This leads to insufficient effectiveness in collecting environmental taxes.

In the context of exploring ways to improve the system of environmental taxation in Ukraine, considering the European experience, we propose considering the following directions:

- Energy taxation: introduction of taxes on energy products such as coal, oil gas, and electricity.
- Transport taxation: expanding transportation taxation, including the introduction of taxes on vehicle registration, road usage, congestion charges, and municipal fees.
- Pollution taxation: implementing taxes based on measured or estimated emissions into the atmosphere and discharges of pollutants into water bodies.
- Resource taxation: introducing taxes on the consumption of natural resources.

A critical component of the successful implementation of these proposals is a balanced increase in tax rates. This means that Ukraine should strive to strike a balance between effective environmental taxation and business stability.

The main expenditures for environmental protection are primarily funded through the State Budget of Ukraine. Additionally, the virtually sole source of financing for environmental measures carried out by local budgets is the respective funds for environmental conservation.

The domestic market for environmental services, including environmental insurance, has not achieved the necessary development that contributes to ensuring the "polluter pays" principle in the European Union. According to Directive 2004/35/EC on environmental liability, companies engaged in activities that could lead to environmental pollution must have environmental insurance.

In 2021, the government of Ukraine attempted to strengthen environmental regulation by considering the draft law "On Environmental Insurance and Guarantees of Compensation for Damage Caused by Activities that Pose Increased Environmental Risk," No. 6018-2 dated September 28, 2021. The main goal of this draft law was to establish new effective financial mechanisms for compensating damage caused to the environment, human life, health, and property, while also promoting the modernisation of polluting enterprises.

The Committee on European Integration of Ukraine states that this draft law does not contradict the goals of the Association Agreement with the EU. However, it raises concerns about the principle of legal certainty and therefore requires significant refinement.

To transition to a new level of development in the domestic economy, investments in natural resource management and resource conservation are essential. The quality of the environmental investment mechanism plays a crucial role in determining the country's socioeconomic development, the standard of living for the population, and the feasibility and completeness of implementing various modern environmental conservation measures, projects, and programmes.

The issue of funding environmental programmes and conservation measures is twofold. On the one hand, it presents itself as a problem related to the state and levels of funding for environmental protection, natural resource management, and ensuring environmental safety. On the other hand, it is a problem tied to the functioning of the financing mechanism for environmental conservation measures.

In shaping the "green" investment model in Ukraine, numerous obstacles are encountered:

- Significant macroeconomic imbalances and domestic economic disparities.
- Underestimation of the importance of technological progress leads to a technological lag.
- Ignoring the significance of innovation results in structural disparities in the economy.
- Low level of coordination among various government bodies in the field of state regulation.
- Substantial institutional weaknesses in the financial sector of the economy.
- Lack of a critical mass of investment projects for issuing green bonds and an underdeveloped capital market.
- Methodological issues in organising "green" investment related to the absence of a coordinated position among stakeholders.

In recent years, certain elements of the "green" investment mechanism have emerged and gained traction. Specifically, there have been positive developments in the use of green bonds as a financial instrument. In July 2021, the Law of Ukraine "On Capital Markets and Organised Commodity Markets" came into effect. This law introduced green bonds as a separate type of security and established rules for participants in the corresponding market.

The specificity of the functioning of the respective market remains diverse, even within Europe. For example, France issues sovereign green bonds to finance government-targeted projects, while Poland directs the proceeds from green sovereign bond issuance into the banking system to provide "green" loans. The United Kingdom stimulates the green bond market through a specially established Green Investment Bank, which assesses projects for compliance with green principles. In Germany, a state-backed bank that issues green bonds offers green loans at low interest rates.

Comparing the market for "green bonds" in Ukraine to European Union countries, it is worth noting that similar to France, "green bonds" in Ukraine can be used to finance government-targeted projects. However, unlike Poland and the United Kingdom, Ukraine currently lacks a mechanism to channel the proceeds from the issuance of "green bonds" into the banking system for providing green loans or stimulating the market through a specially established green investment bank.

Indeed, development and innovation in the Ukrainian green bond market could be a promising area for further growth. Implementing such a mechanism would contribute to increased investments in "green" energy and other environmentally friendly projects. This, in turn, would aid in achieving sustainable development goals and combating climate change.

According to the International Energy Agency, the energy sector will require $53 trillion in investments by 2035. Ransitioning to a decarbonised future will necessitate capital from both the public and private sectors because relying solely on government funds will not cover these expenses. Additionally, according to the International Finance Corporation (IFC), the potential of the Ukrainian energy efficiency and clean energy market is estimated at $73 billion by 2030. Half of this amount, $36 billion, can be raised through the issuance of "green bonds." This calls for the development of innovative financing mechanisms aimed at identifying potential investors who meet the green finance criteria and stimulating capital mobilisation to meet these goals. Some possible methods for attracting the necessary investments include using green equity funds, green securitisation and green leasing.

Taking into account the advanced experience of the European Union and the existing challenges in Ukraine, the modernisation of institutional and economic instruments should be developed and implemented with consideration for the principles of prevention and elimination of pollution sources, as well as the "polluter pays" principle, which forms the basis of EU environmental policy (see Table 3). Additionally, the goals of EU environmental policy, such as preserving, protecting, and improving environmental quality, safeguarding human health, rational use of natural resources, and promoting international actions to address regional or global environmental issues, should be considered.

Table 3. Modernisation of Institutional-Economic Management Tools for Environmental Safety in Enterprises

Regulatory Tools	Key Components	Purpose
Legal and Regulatory	Creation of the Environmental Safety Code	Regulation of environmental norms and standards
Administrative	Establishment of a Progressive Environmental Management System (PEMS)	Management of environmental processes and resources
	Establishment of an independent Environmental Impact Assessment Authority (EIAA)	Oversight of compliance with environmental norms
	Addition of a module for automated analysis and determination of the potential environmental impacts of different scenarios using artificial intelligence	Forecasting and analysis of environmental impacts
	Creation of an Intelligent Environmental Monitoring System (IEMS)	Monitoring the state of the environment
Fiscal	Implementation of energy taxation	Encouraging energy efficiency
	Implementation of transportation taxation	Reducing pollution from transportation
	Implementation of pollution taxation	Reducing polluting emissions
	Implementation of resource taxation	Encouraging rational resource use
Financial	Directing funds from emissions of "green" bonds to the banking system for the issuance of "green" loans	Financing "green" projects
	Government financing of conservation measures	Support for conservation initiatives
	Stimulating the market through the creation of a specialised Green Investment Bank	Attracting investments in "green" projects

Conclusion

The investigation, "Modernisation of Institutional and Economic Management Tools for Environmental Safety of Enterprises" accentuates the necessity of adjusting contemporary management mechanisms to assure environmental safety. This not only fortifies the resilience of enterprises to environmental challenges but also aids in the establishment of a more sustainable and eco-conscious business environment.

Despite numerous scholarly works spotlighting individual facets of enterprise environmental safety, a comprehensive approach to defining and implementing effective management mechanisms is lacking. Most researchers concentrate on examining individual issues. This investigation advocates a comprehensive strategy to modernise institutional and economic management mechanisms to augment the environmental safety of enterprises. This highlights the significance of a unified approach to environmental management and advocates for additional exploration in this domain.

Consequently, the modernisation of institutional and economic tools for managing environmental safety encompasses a series of pivotal innovations aimed at enhancing the efficiency of environmental safety management while maintaining equilibrium between economic productivity and environmental conservation. The suggestion for Ukraine to improve its institutional and economic tools for managing environmental safety involves legal, administrative, fiscal, and financial measures:

- the establishment of the Environmental Safety Code and the Progressive Environmental Management System (PEMS), as well as an independent Environmental Oversight Body (EOB), are important steps towards a more stable and effective environmental management system;
- the use of AI for automatic analysis and assessment of the potential impact of various scenarios on the environment, along with the creation of an intelligent environmental monitoring system (IEMS), represents promising directions for further development;
- the application of various forms of taxation, such as energy, transportation, pollution, and resource taxation, will contribute to reducing the negative impact of enterprises on the environment;
- directing the proceeds from the issuance of 'green bonds' into the banking system for providing green loans or stimulating the market through a specially established green investment bank will serve as an additional incentive for enterprises to adopt technologies.

The successful implementation of these regulatory tools could markedly enhance environmental management and sustainability not only in Ukraine also in other nations wrestling with similar environmental challenges. However, the effectiveness of these tools depends on the specific environmental context and the dedication of all stakeholders. Therefore, continuous monitoring, evaluation, and adjustment of these tools are essential to ensure their effectiveness and efficiency in achieving the desired environmental outcomes.

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