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ENVIRONMENTALLY ORIENTED INNOVATIONS AS A TOOL FOR SUSTAINABLE DEVELOPMENT OF REGIONAL ENTERPRISES

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Abstract

In the article, modern economic trends affecting the development of innovative and active enterprises implementing environmental projects are identified. The following methods were used: formalization, dialectical, decomposition, generalization, comparative, and graphical. The interrelationship of environmentally oriented innovations with economic development of regions and the impact on the environment is considered and graphically presented. Ways to intensify implementation of ecologically oriented innovations as a tool for sustainable development of enterprises in the region are proposed. Advantages of implementing these innovations are revealed. Prospective directions for implementation of ecologically oriented innovations are reflected. The European experience regarding active development of ecologically oriented innovations is outlined, which involves formation of the systemic approach to the use of transformational aspects of ecologically oriented innovations and study of their impact on effective functioning of the sustainable management mechanism of natural resources. The unified strategic position of EU countries on formation of strategic vision of innovative and ecological development of enterprises, taking into account globalization processes, using complex multi-level approach to formation and implementation of the policy of ecologically oriented innovations, was studied. Modern trends in environmental orientation of enterprises in EU countries are analyzed.

Keywords: *environmental management, ecosystem, innovative development, innovative strategy, adaptive management, strategic management, business model, state and regional policy, state authorities, enterprises, innovative and intellectual regional development, digitalization.*

JEL Codes: *Q01, R10.*

Introduction

Digitalization and global environmental challenges make it necessary to implement new environmental regulations and increase tax obligations for those types of enterprises that do not direct their activities to reduce indicators of harmful effects on the environment and increase the risks of negative environmental consequences on the regional and national scale. Climate changes, environmental pollution, man-made emergencies and other environmental problems

require urgent solutions and are particularly relevant in modern conditions of management and economic development of Ukraine. Environmental innovations are an effective solution to these problems. This will ensure innovative development of enterprises and accelerate the growth of indicators of their effective innovative activities. It is the indicator of the implementation of environmental innovations in industrially developed countries that became the basis of long-term financial investments in the economy in a regional context and helped enterprises that implement various types of environmental innovations to reduce negative impact on the environment and preserve ecological environment for future generations. In the conditions of rapid dynamic changes in the ecological environment, it is important to highlight the leading role of ecologically oriented innovations as the main tool for sustainable development of enterprises in the region and to investigate their impact and implementation results from the point of view of the formed eco-innovation programs and measures of their implementation in development of enterprises.

Literature review

Theoretical and methodological foundations of ecologically oriented innovations are reflected in many studies of foreign and domestic scientists, theoreticians and practitioners.

The authors (Ji Huanyong et al., 2024) investigate specifics of the impact of digital technologies on development of environmental innovations in small and medium-sized enterprises. Within the framework of research (Panichakarn Boonsub et al., 2024; Abramova A. et al., 2021), the focus is on interaction of digital transformation, environment and innovative activities of modern enterprises. Article (Mingtao Zhao et al., 2024) analyzes ecological investment strategies by implementing ecological innovative technologies.

Scientists (Lyu Hengyu et al., 2024) investigate environmental innovations and carbon intensity of industrial enterprises. The purpose of article (Wang Xiaoyan et al., 2024) is to analyze environmental innovations of Chinese enterprises and to analyze feasibility of introducing the environmental protection tax (Wang H. et al., 2024; Marhasova V. et al., 2024) analyze features of state support for environment and green innovations of enterprises in the context of national security (Guancheng Wang et al., 2024) examine environmental regulation, environmental innovation, and enterprise's productivity. Article (Luo X. et al., 2024) discusses the innovative model of business development in the sustainable development context.

At the same time, much less attention is paid to problems of regional development of ecological innovations. Issues of defining the object and structure of environmental innovations, building complex mechanism for the functioning of ecological innovations and integrating them into the general economic model of development of the state and a separate branch of the economy, determining specifics and classification of territorial environmental problems that arose due to economic activity of enterprises and formation of regional innovative state programs for their solution, etc.

The purpose of this study is to develop a set of measures to determine the role of ecologically oriented innovations in achieving sustainable development of enterprises, from the point of view of the regional aspect.

Methodical approach

Within the scope of achieving the defined goal, the following methods were used in the article:

- formalization method - determination of modern economic trends affecting development of innovative and active enterprises directed to greening;
- dialectical method - relationship between ecologically oriented innovations and economic development of regions and impact on the environment is considered and graphically presented;
- decomposition method - systematization of ways to activate introduction of ecologically oriented innovations as a tool for sustainable development of enterprises in the region;
- generalizing method - outline of European experience regarding activation and development of ecologically oriented innovations at enterprises;

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- comparative method - disclosure and analysis of advantages of implementing environmentally oriented innovations as a tool for sustainable development of enterprises in the region;

- graphic method - reflection of modern trends in the development of enterprises based on environmental sustainability in EU countries and visualization of promising directions for implementation of ecologically oriented innovations.

Results

Modern economic trends on innovative and active environmental development of enterprises, which have become the basis of the world's leading economies, are increasingly oriented towards the sustainable development principles, which involves a balance between economic, social and environmental aspects. Adaptive innovative solutions, considering these aspects, are becoming important to endure competitiveness of enterprises. Consumers increasingly prefer environmentally friendly products and services, so enterprises that implement environmentally oriented innovations can satisfy these demands and strengthen their market position both in the regional market and in the national or global market. Many of the world's leading countries in innovative development are introducing new environmental standards and requirements. Businesses that actively innovate to reduce their environmental impact can avoid fines and receive benefits in the form of government subsidies, grant programs or benefits. In Ukraine, these trends on introduction of environmental innovations are a rare phenomenon for various reasons, the main of which is lack of visible economic benefits, since transfer of production and economic capacities to new environmental standards and requirements requires significant financial resources and not every enterprise wants to invest in future preservation of the territory in which it works. This problem is both regional and national in nature. Despite significant gains in global environmental innovations, almost all their aspects in domestic realities are insufficiently researched; there are still problems related to implementation of environmental innovations, their legislative consolidation, strategic reflection in programs of innovative and intellectual regional development, and market orientation for implementation of, first, innovative ecological products, environmental and social responsibility of business for introduction of the latest ecological technologies in its activities, etc.

Highly competitive enterprises of Ukraine are increasingly aware of their role in society and the economy, that is why introduction of ecologically oriented innovations demonstrates their responsibility and readiness to actively participate in the life of the state and solve global environmental problems related to their economic activities.

Research conducted in EU countries on ways to stimulate innovative activity of enterprises to reduce their negative impact on the environment dates back to the 1980s and was first presented to the general public in 1992 at the UN conference on innovative protection and development of the environment in Rio de Janeiro (https://sd4ua.org). Subsequently, in the early 2000s, the European Commission came up with a new initiative to support the launch of innovative environmental technologies, which are designed to become a tool for sustainable development for enterprises that comply with modern environmental standards. This marked the beginning of development of ecologically oriented innovations in the modern sense.

Currently, EU countries significantly support the environmental protection policy. According to the statistical reporting, it is possible to follow the results of enterprises directed to reducing the impact of digital transformation on the environment of EU countries. Thus, according to the results of the given data, the top 5 countries, which activities in 2022 were aimed at using measures aimed at reducing the impact on the environment when using ICT services/equipment or its disposal, are presented in (Fig. 1): Portugal (75.1% of enterprises), Italy (74.9% of enterprises), Cyprus (71.1% of enterprises), Romania (70.8% of enterprises), Slovakia (66.3% of enterprises).

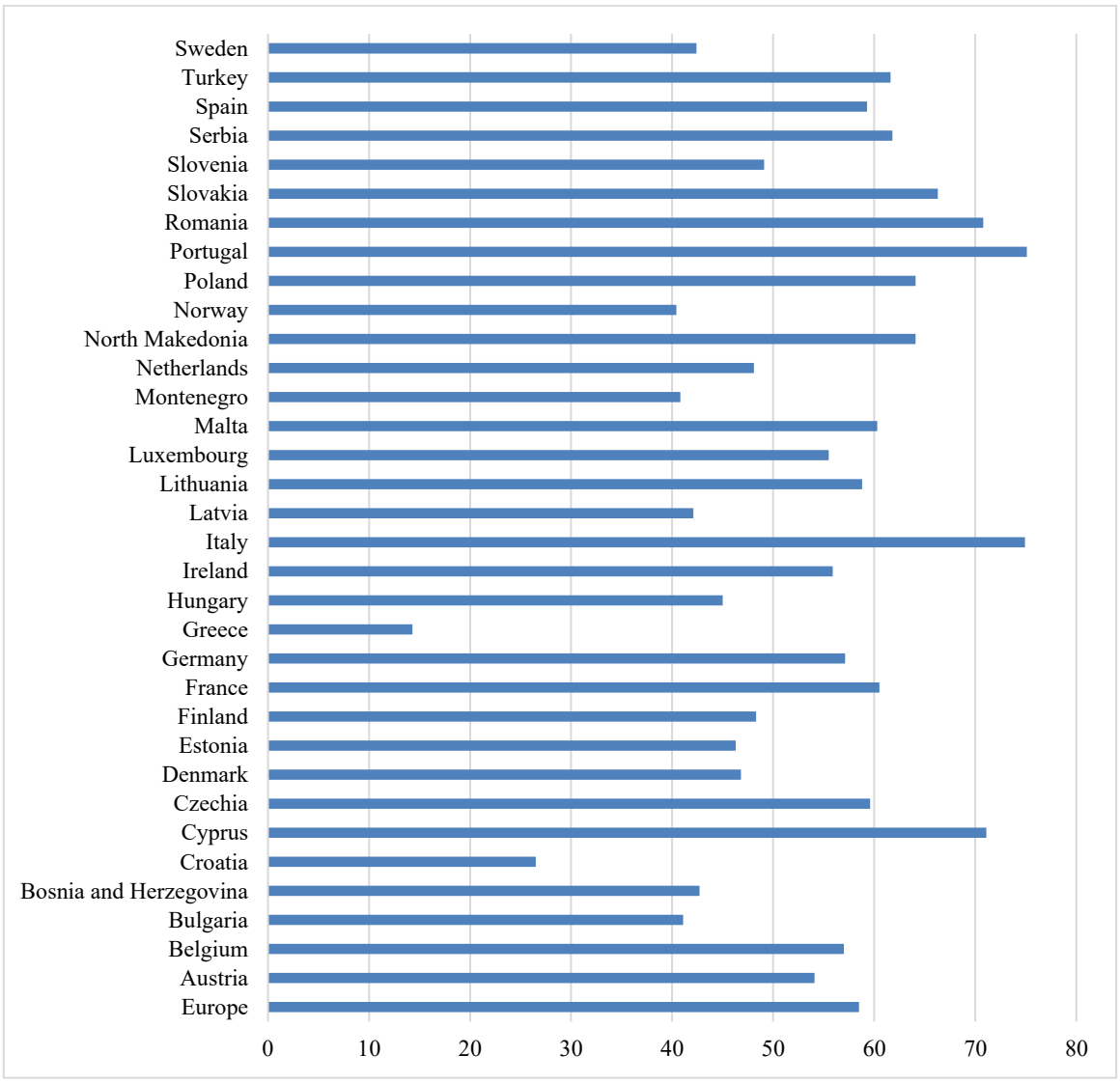

Figure 1. Enterprises in EU countries that consider the impact of digitalization aspects on the environment (% of enterprises), 2022

**Source: Eurostat (2024).*

Enterprises make maximum efforts to reduce the environmental load, including from the use of ICT equipment. According to results of the 2022 data analysis, 64.7% of small enterprises, 71.4% of medium-sized enterprises, 78.7% of large enterprises reported on applying measures to optimize the paper use in their activities; about the implementation of energy consumption optimization measures - 42.3% of small enterprises, 50.8% - medium-sized enterprises, 62.1% - large enterprises (Fig. 2).

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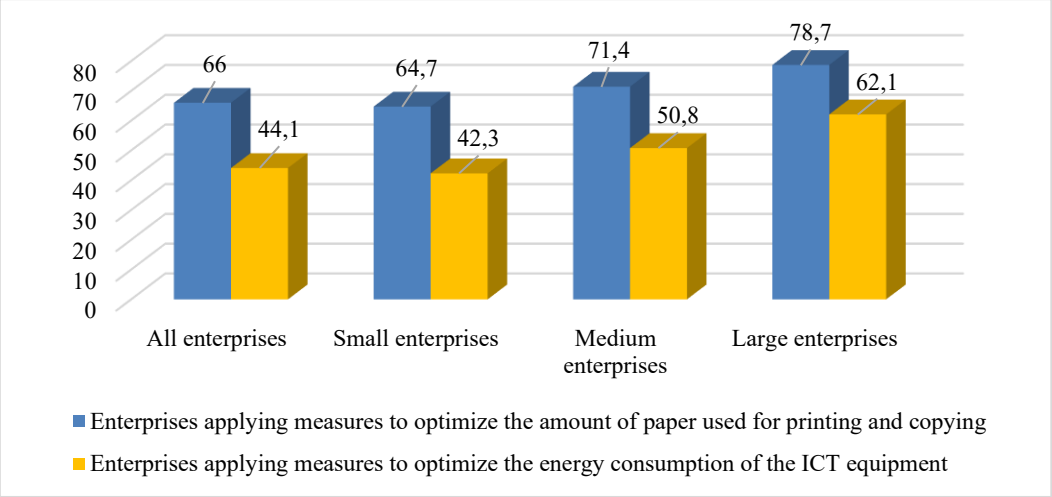

Figure 2. Enterprises of EU countries that apply measures to optimize the impact on the environment (% of enterprises), 2022

**Source: Eurostat (2024).*

Considering enterprises by type of economic activity (Fig. 3), which implemented measures to optimize the impact on the environment, the largest share of enterprises is concentrated in the sphere of professional, scientific and technical services (73.1%), in the field of information and communication (71.7%) and in supply of electricity, gas, steam and air conditioning (70.7%). The lowest indicators were characteristic of provision of accommodation and catering services (59.0%), processing industry (63.9%) and construction (65.2%).

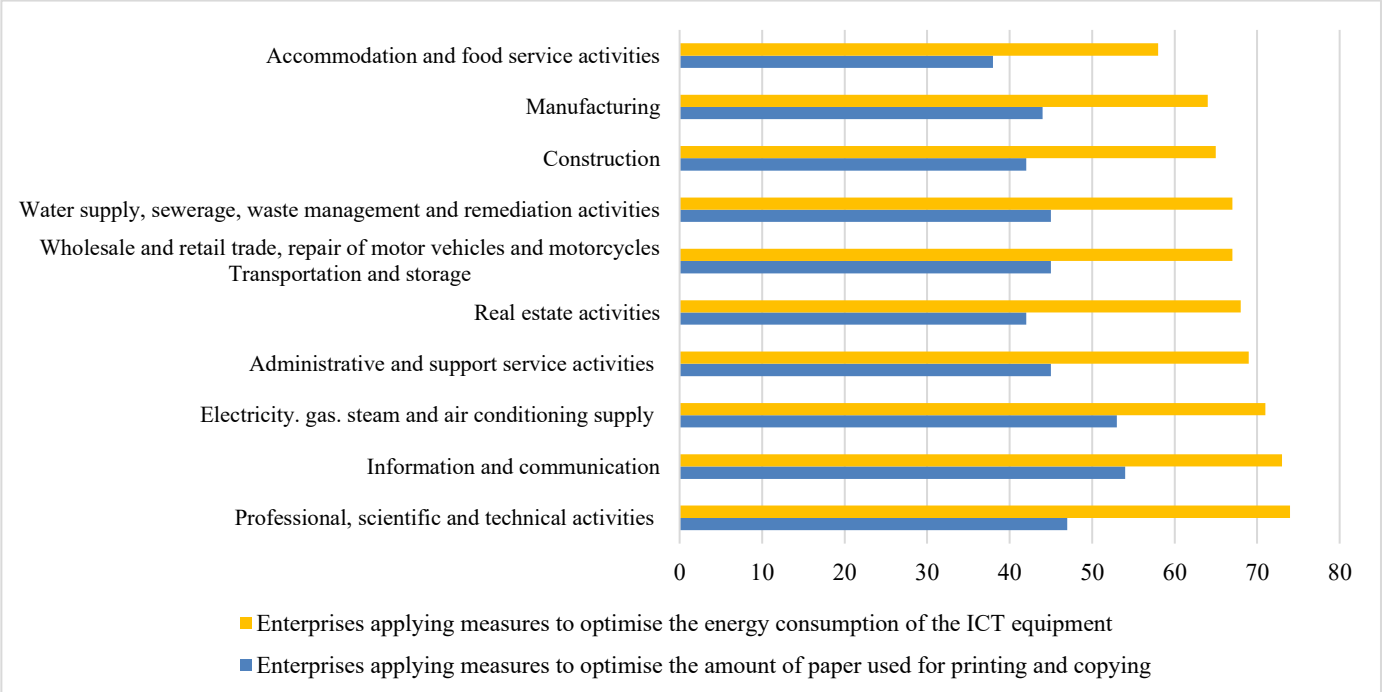

Figure 3. Enterprises of EU countries implementing measures to optimize the impact on the environment by type of economic activity (% of enterprises), 2022

**Source: Eurostat (2024).*

It is appropriate to consider in more detail interrelationship of ecologically oriented innovations with economic development of the region and the impact on the environment (Fig. 4). A significant advantage of ecologically oriented innovations is combination of innovative and ecological policies of enterprise development, which ensures their high-quality interaction and accelerates emergence of non-standard solutions that determine construction of innovation-orientated business models of regional enterprises for the use of new sources of value creation of their goods in conditions of resource and natural restrictions.

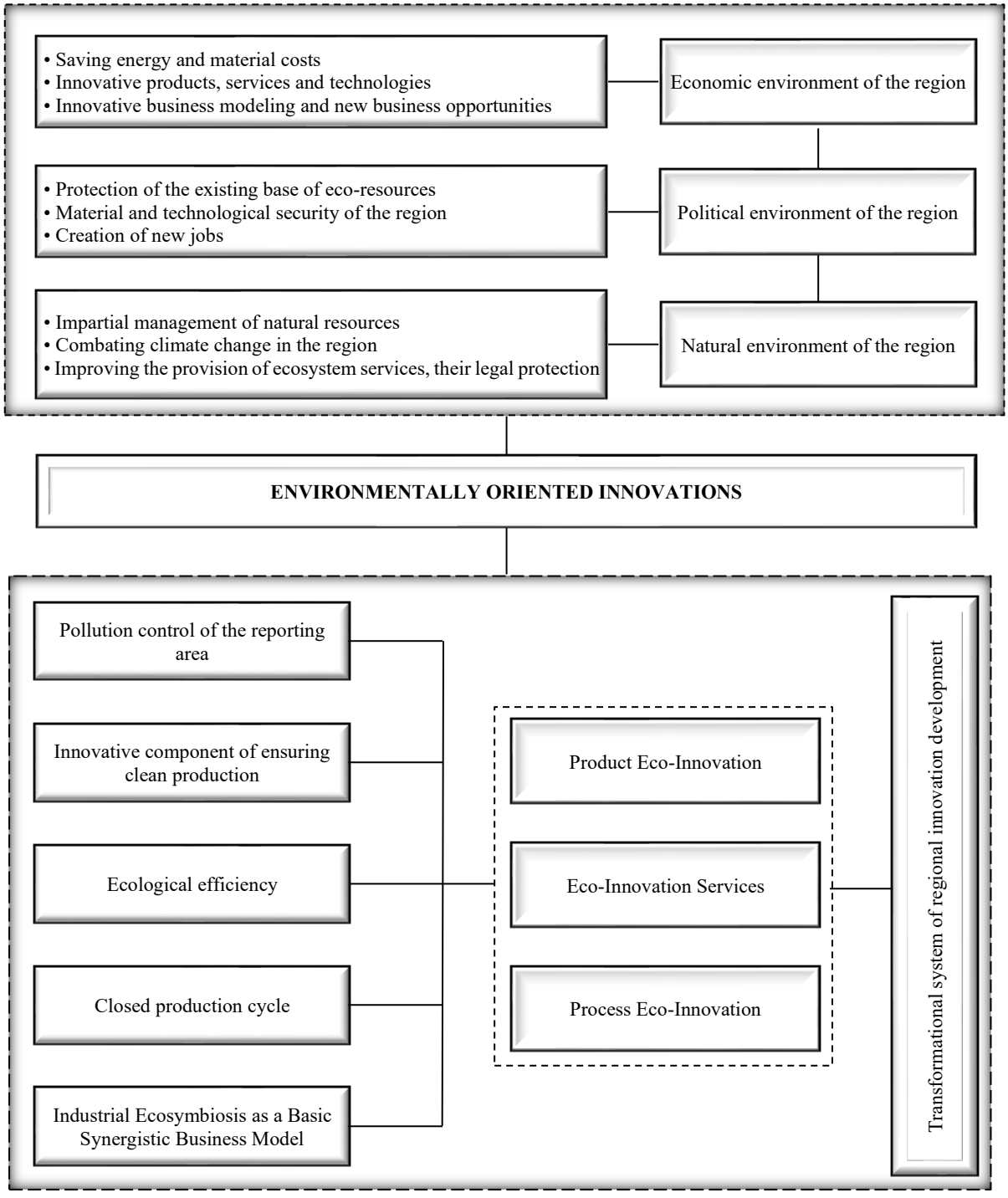

Figure 4. Influence of environmentally oriented innovations on the economy of the region and the environment

**Source: systematized by the authors.*

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The state and regional policy on promotion of environmentally oriented innovations covers important direction of transformational systemic shifts, and development of the long-term regional environmental program for enterprises "Sustainable ecological production and consumption" should be aimed at development of technical and technological innovations and become the main tool for effective operation of enterprises in the region. To intensify implementation of ecologically oriented innovations as a tool for sustainable development of enterprises in the region, a list of economic, financial and legislative conditions must be formed and provided, both by state authorities and a toolkit prepared by enterprises in the region, in particular:

– development and expansion of the nomenclature of insurance programs that would compensate for losses from development and implementation of ecologically oriented innovations, with the introduction of a corrective regional risk factor;

– provision of regional budgets, financing and development of interest-free credit programs for purchase of non-traditional energy sources, introduction of subsidizing enterprises that switched to such programs independently without participating in the relevant programs;

– creation of regional innovative and active eco-clusters, which would unite producers of innovative ecological products, using at least 60% of resource-saving ecological and environmentally safe technologies in their economic activity;

– increasing investment attractiveness of enterprises that use innovative ecological technologies in their economic and production activities to economize production and taking care of environmental safety of the region;

– formation of special regional investment funds for foreign investors and grant-makers, which funds can be directed to finance innovative developments of enterprises that develop and implement environmental innovations in the respective region.

Having studied directions of activation of environmentally oriented innovations as a tool for sustainable development of enterprises in the region, it is advisable to focus attention on advantages of implementing ecological innovations for such enterprises, namely:

– development of "environmentally friendly" production due to increased financing of interest-free state credit and grant programs in the field of eco-innovations, change in consumer behavior with the emphasis on increasing demand for environmentally friendly products;

– avoidance of additional tax barriers for creation and implementation of environmental innovations by enterprises, introduction of a preferential tax rate for these types of enterprises;

– additional benefits for various sectors of the economy of Ukraine and all participants in implementation of ecological innovations at the regional level, due to increase in the state order for these products and increase in the awareness level of ecological innovations among interested consumers, intermediaries and creation of unique innovative developments to expand sales markets of these products or innovative environmental technologies;

– increase in demand for ecological products, which will lead to change in the vector of development of many enterprises in various sectors of the economy in all regions of the state;

– increasing competitiveness and improving the marketing and market image of enterprises.

Guided by the directions of active implementation of ecologically oriented innovations and advantages of their implementation, we will graphically depict promising markets for introducing ecologically oriented innovations (Fig. 5). Modern innovation standards and methods of managing environmental innovations in the regional aspect emphasize extremely high importance of organizational and methodical support of innovative steps at the enterprise. Development of specialized innovative and ecological programs and implementation of relevant innovative solutions at the strategic level of enterprise management is an indicator of readiness to meet modern requirements and occupy high position in the regional market of

innovative and ecological goods and services. Modeling, forecasting and development of innovative greening processes is an important tool for implementation of ecological innovation projects in the relevant territory. Implementation of effective innovative and environmental management at the enterprise involves:

– implementation of innovative eco-technologies in production and economic activity;

– economic and ecological assessment of innovative eco-technologies and analysis of their payback indicators;

– analysis and construction of a detailed scheme for implementation of innovative production and technological processes, taking into account the environmental component.

Large-scale public-private investment and credit projects within the framework of regional environmental innovation programs require involvement of significant financial resources and can be implemented with funds accumulation from international institutions within the framework of environmental changes in the state. Economic efficiency of implementation of such large-scale innovative environmental regional projects is ensured by modern market needs and the increased level of demand for such products. Enterprises that cooperate within the framework of public-private partnership within the framework of such ecological development programs of the region receive significant material and financial benefits in the form of a reduction in the tax burden, free acquisition of technologies and equipment, and the opportunity to obtain additional financial resources. To determine environmental aspects of innovative activity of the enterprise, it is advisable to use a number of indicators for evaluating environmental friendliness of production and analyzing its impact on the environment.

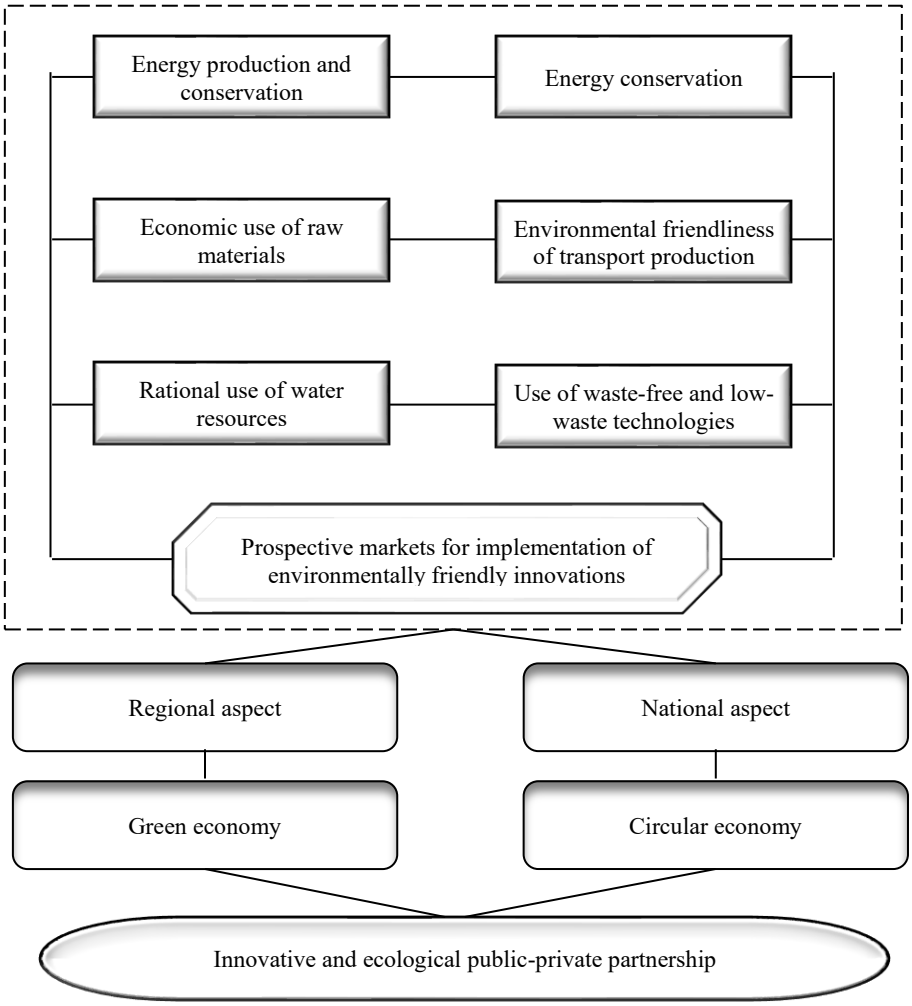

Figure 5. Prospective markets for introduction of ecologically oriented innovations
**Source: systematized by the authors.*

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Complex planning of regional greening programs will ensure efficient implementation of innovative measures. Such program measures include:

– regional aspect: implementation of green economy programs in the form of ready-made specific innovative environmental projects;

– national aspect: planning relevant innovative environmental projects and their implementation, within the framework of closed-loop economic initiatives, to increase competitiveness of the state's economic indicators and strengthen its position on the relevant world markets.

The European approach to activation and development of ecologically oriented innovations is characterized by:

– systematic approach to the use of transformational aspects of ecologically oriented innovations and their ability to influence efficient functioning of the innovation-economic mechanism of managing natural resources, water and the ecosystems at their disposal in the sustainable development context;

– unified strategic position of EU countries regarding formation of a long-term vision of ecologically oriented innovative development of enterprises, taking into account globalization processes and increased competitiveness of European enterprises, their ecological products and, as a result, maintaining leading positions in the global distribution of available ecological resources;

– use of a complex multi-level approach to formation and implementation of the policy of ecologically oriented innovations in the legislative support system of EU countries in strategic context.

The EU systematically approaches implementation of ecologically oriented innovations within the framework of individual countries and their regional characteristics. However, all of them are strictly regulated by single European legislation and standardized in their programs and approaches, which is lacking in domestic innovative environmental projects.

Conclusions

Ecologically oriented innovations as a tool for sustainable development of the region's enterprises are an important direction of strengthening the state's economy. Enterprises using environmentally oriented innovations reduce harmful impact on the environment by creating environmentally friendly products. Current state of domestic enterprises that pollute the environment is mainly characterized by low level of technological renewal of ecologically oriented innovations. These enterprises have high and ultra-high rates of emissions of harmful pollutants and a high degree of regional natural resource dependence. Under current economic, social, legislative, military and political conditions, sustainable development of these enterprises is possible only under the conditions of attracting additional financial and investment or credit resources to update relevant material and technical, production and economic base and create appropriate conditions for reaching new levels of environmentalization production. To ensure implementation of ecologically oriented innovations, as the main tool of sustainable development of the enterprise, appropriate long-term regional programs on introduction of eco-innovations with a minimum payback period of 10 years must be formed.

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