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## **CONCEPTUAL PRINCIPLES OF THE "GREEN" TECHNOLOGIES INTRODUCTION IN THE LOGISTICS ACTIVITIES OF UKRAINIAN COMPANIES IN THE CONTEXT OF THE IMPLEMENTATION OF EUROPEAN ENVIRONMENTAL PROGRAMS**

**Sergiy Grytsenko, Lidiia Savchenko, Serhii Kryshstal.** *"Conceptual principles of the "green" technologies introduction in the logistics activities of Ukrainian companies in the context of the implementation of European environmental programs". The article reveals the essence of the conceptual approach to "green" technologies in the logistics activities of enterprises. The concept of "green" technologies has been clarified as technologies that use environmentally safe production processes and supply chains in comparison with the production methods traditionally used at enterprises.*

*The role and opportunities of Ukrainian environmental logistics in the European Green Deal have been studied. It has been established that the European Green Deal is a program of the European Union aimed at protecting the climate and the environment. This program is aimed at making the economies of the European Union countries more resource-efficient, canceling greenhouse gas emissions by 2050 and separating economic growth from the use of natural resources.*

*Currently, Ukraine is only planning to join the European Green Deal, declaring in the National Economic Strategy the intention to achieve climate neutrality by 2060.*

*The state and general trends of the development of strategic logistics infrastructure projects of Ukraine in the context of the implementation of the Green Deal and Digital Europe programs are analyzed. The European Green Deal is a dynamic instrument that is at the stage of formation.*

*The purpose of the article is the development of theoretical and methodological foundations, applied recommendations regarding the prospects of "green" technologies in the logistics activities of Ukrainian enterprises: their concepts and features of implementation within the framework of the European Green Deal and Digital Europe programs, "European Union for the Environment" (EU4Environment), development of sustainable logistics in Ukraine, features of application in specific logistics processes, problems and prospects, logistics strategy of Ukrainian enterprises.*

*The process of applying "green" technologies in supply chain management is analyzed. In the logistics chain, processes related to supply, production, warehousing, transportation and distribution are involved, therefore, logistics activities are focused not only on the internal business processes of the enterprise, but also have a significant impact on the environment and contribute to the emergence of negative environmental consequences.*

*In connection with the above, the concept of "green" (sustainable) supply chains, which provides for a minimal harmful impact on the environment during the implementation of logistics business processes, has recently become widespread.*

**Keywords:** ecology, supply chains, logistics activity, environmental strategy, European Green Deal, transport logistics, decarbonization.

**Сергій Гриценко, Лідія Савченко, Сергій Кришталь. «Концептуальні засади впровадження «зелених» технологій в логістичну діяльність підприємств України в контексті реалізації європейських екологічних програм».** У статті розкрито сутність концептуального підходу до «зелених» технологій в логістичній діяльності підприємств. Уточнено поняття «зелених» технологій як технологій, що використовують екологічно безпечні виробничі процеси та ланцюги постачання у порівнянні зі способами виробництва, що використовуються на підприємствах традиційно.

Досліджено роль і можливості української екологістики в Європейському зеленому курсі. Встановлено, що Європейський зелений курс – це програма Європейського Союзу, яка направлена на захист клімату та навколишнього середовища. Дана програма націлена зробити економіку країн Європейського Союзу більш ресурсоефективною, анулювавши до 2050 року викиди парникових газів та відокремивши економічне зростання від застосування природних ресурсів.

На сьогодні Україна тільки планує приєднатися до Європейського зеленого курсу, проголосивши в Національній економічній стратегії намір досягти кліматичної нейтральності до 2060 року.

Проаналізовано стан та загальні тенденції розвитку стратегічних логістичних інфраструктурних проєктів України в контексті реалізації програм Green Deal і Digital Europe. European Green Deal - динамічний інструмент, що перебуває на стадії формування.

Метою статті є розробка теоретико-методичних основ, прикладних рекомендацій щодо перспектив «зелених» технологій в логістичній діяльності підприємств України: їх поняття та особливості впровадження в рамках Європейського зеленого курсу та програм Green Deal і Digital Europe, «Європейський Союз для довкілля» (EU4Environment), розвиток «зеленої» логістики в Україні, особливості застосування в конкретних логістичних процесах, проблеми та перспективи, логістична стратегія українських підприємств.

Проаналізовано процес застосування «зелених» технологій в управлінні ланцюгами постачань. В логістичному ланцюзі задіяні процеси, пов'язані з постачанням, виробництвом, складуванням, транспортуванням та розподілом, отже, логістична діяльність зосереджена не лише на внутрішніх

бізнес-процесах підприємства, але й здійснює значний вплив на навколишнє середовище та сприяє виникненню негативних екологічних наслідків.

У зв'язку з вищенаведеним останнім часом набуває поширення концепція «зелених» ланцюгів постачань, що передбачає мінімальний шкідливий вплив на зовнішнє середовище при здійсненні логістичних бізнес-процесів.

**Ключові слова:** екологістика, ланцюги постачань, логістична діяльність, екологічна стратегія, Європейський зелений курс, транспортна логістика, декарбонізація.

**Сергей Гриценко, Лидия Савченко, Сергей Крышталь.** «Концептуальные основы внедрения «зеленых» технологий в логистическую деятельность предприятий Украины в контексте реализации европейских экологических программ». В статье раскрыта сущность концептуального подхода к «зеленым» технологиям в логистической деятельности предприятий. Уточнено понятие «зеленых» технологий как технологий, использующих экологически безопасные производственные процессы и цепи поставок по сравнению со способами производства, используемыми на предприятиях традиционно.

Исследованы роль и возможности украинской экологистики в Европейском зеленом курсе. Установлено, что Европейский зеленый курс – это программа Европейского Союза, направленная на защиту климата и окружающей среды. Данная программа нацелена сделать экономику стран Европейского Союза более ресурсоэффективной, аннулировав к 2050 г. выбросы парниковых газов и отделив экономический рост от применения природных ресурсов.

Сегодня Украина только планирует присоединиться к Европейскому зеленому курсу, провозгласив в Национальной экономической стратегии намерение достичь климатической нейтральности к 2060 году.

Проанализированы состояние и общие тенденции развития стратегических логистических инфраструктурных проектов Украины в контексте реализации программ Green Deal и Digital Europe. European Green Deal – динамичный инструмент, находящийся на стадии формирования.

Целью статьи является разработка теоретико-методических основ, прикладных рекомендаций по перспективам «зеленых» технологий в логистической деятельности предприятий Украины: их понятия и особенности внедрения в рамках Европейского зеленого курса и программ Green Deal и Digital Europe, Европейский Союз для окружающей среды (EU4Environment), развитие «зеленой» логистики в Украине, особенности применения в конкретных логистических процессах, проблемы и перспективы, логистическая стратегия украинских предприятий.

Проанализирован процесс применения «зеленых» технологий в управлении цепями поставок. В логистической цепи задействованы процессы, связанные с снабжением, производством, складированием, транспортировкой и распределением, следовательно, логистическая деятельность сосредоточена не только на внутренних бизнес-процессах предприятия, но и оказывает значительное влияние на окружающую среду и способствует возникновению негативных экологических последствий.

В связи с вышеприведенным в последнее время получает распространение концепция «зеленых» цепей поставок, предусматривающая минимальное вредное влияние на внешнюю среду при осуществлении логистических бизнес-процессов.

**Ключевые слова:** экологистика, цепи поставок, логистическая деятельность, экологическая стратегия, Европейский зеленый курс, транспортная логистика, декарбонизация.

**Introduction.** At the current stage of development, the consideration of logistics as one of the factors of environmental

protection is gaining relevance, because logistics deals with the supply of raw materials to the enterprise, the movement of

semi-finished products within the enterprise, the transportation of finished products to warehouses and the delivery of goods to customers. With the appearance in science of the concept of "green" logistics, which is based on resource-saving and environmentally safe processes and technologies, it began to be called ecological logistics (ecologistics) [1, p. 8].

As a result of the definition of the concept of "green" logistics (ecologistics), the concept of "green" technologies becomes clearer. Thus, green technologies can be called such technologies that use environmentally safe production processes and supply chains in comparison with the production methods used at enterprises traditionally.

Today, "green" technologies are used in the environmental, economic, technological and innovative spheres of state policy. They are applied when solving the issue of processing and disposal of waste, the implementation of alternative sources of electrical energy [2].

Environmentalism takes a leading place and plays an important role in the European Green Deal. The European Green Deal is a program of the European Union aimed at protecting the climate and the environment. The program is aimed at making the economy of the European Union countries more resource-efficient by canceling greenhouse gas emissions by 2050 and separating economic growth from the use of natural resources [3].

The European Union seeks to motivate other states by its own example. That is, by developing a "green" economy and "green" logistics in particular, the European Union will achieve stable economic growth and make the entire planet cleaner and safer. Today, Ukraine also seeks to develop "green" logistics, as it seeks to gain economic benefits from the global movement towards climate neutrality and to clean up the environment of the planet.

Therefore, the main task of environmental logistics is to ensure the minimization of damage to the environment

due to restrictive conditions regarding the use of natural resources in the sphere of supply, production and sales.

For the development of "green" logistics at Ukrainian logistics enterprises, the enterprise itself must actively cooperate with state and local authorities, other enterprises and citizens who are final consumers of logistics services.

"Green" technologies must be implemented at each company taking into account the needs of customers of logistics services, their wishes and needs.

Today, the majority of Ukrainian logistics enterprises have joined the policy of decarbonization and implementation of the European Green Deal.

**Analysis of recent research and publications.** In the economic literature, a lot of attention is paid to the issue of "environmentalization" of logistics activities of enterprises [4-16].

Research also revealed ways to reduce the impact of logistics systems of enterprises on the environment.

However, the highlighted approaches to improving the greening of logistics activities of enterprises do not include prospects for the introduction of "green" technologies in the work of logistics companies of Ukraine, which requires further research.

**The aim and task of the research:** development of theoretical and methodological foundations, applied recommendations regarding the prospects of "green" technologies in the logistics activities of Ukrainian enterprises: their concepts and features of implementation within the framework of the European Green Course, Green Deal, Digital Europe and European Union for the Environment (EU4Environment), development of "green" logistics in Ukraine, features of application in specific logistics processes, problems and prospects, logistics strategy of Ukrainian enterprises.

**Main material and research results.**

Deterioration of the environment is a consequence of the intensive globalization



process in international business. In order to survive, the economy must be reorganized in such a way that the industry is fully integrated with an efficient sustainable infrastructure and the introduction of "green" technologies into the logistics activities of enterprises [16].

The use of "green" technologies at enterprises is currently considered a new business philosophy based on a resource-saving concept, the implementation of which in the economy helps:

- reduce damage to the environment by means of restrictive conditions for the use of natural raw resources in the sphere of supply, production and sales;
- choose a rational vector of business development using "green" energy and its combination with traditional energy sources;
- activate creative development, strategic thinking of managers at various levels;
- carry out "green" restructuring of the enterprise and its meaningful functional support;
- optimize transport flows to meet the material and technological needs of production;
- alleviate the environmental crisis thanks to waste recycling;
- reduce costs from "freezing" of capital in the form of inventory due to environmentally-oriented business plans and coordination of business partnerships;
- activate innovative activities of enterprises during the implementation of environmental standards for production, packaging, storage and transportation;
- strengthen the competitiveness of business processes thanks to the use of environmentally friendly "green" technologies and energy- and resource-saving equipment;
- involvement of alternative energy sources to perform functions in the field of supply, production and sale of finished products;
- enrich the marketing information system of enterprises thanks to the formation

of environmental information and environmental monitoring of logistics marketing networks;

- multiply the economic and social effect by applying a reduction in the cost of resources per unit of manufactured products or services, as well as to increase labor productivity in the logistics chain of creating added value;

- increase the investment attractiveness of Ukrainian entrepreneurship.

The problem of efficient processing of waste and its reuse requires special attention in Ukraine. An important aspect is also the improvement of the efficiency of the use of partially renewable energy resources (wood, water, land resources) and the gradual transition to "clean" energy sources.

The main environmental measures implemented in Ukraine include:

- reuse of containers, which reduces packaging costs;
- thermal insulation of warehouses, which increases the heat output of warehouses, reduces energy costs for heating;
- rejection of paper document circulation, which saves costs for paper, cartridges, electricity, printers, document archiving, and also stimulates the introduction of modern management systems;
- planning of optimal routes for transportation of finished products, reduction of idle time and reduction of fuel consumption, freight consolidation and use of railway transport [17, p. 284].

Thus, domestic enterprises should implement effective environmental methods and tools, taking as an example of transnational corporations such as Toyota, Xerox, Johnson & Johnson, Honda, Volkswagen, Hewlett-Packard, Casio, Sony, for which the key incentive is the desire to form socially responsible image of the company.

Taking into account the foreign experience of countries that also implement the Green Deal and Digital Europe programs in their own business activities will contribute

to the effective integration of environmentalism at domestic enterprises of many industries. Therefore, logistics department specialists should:

- introduce "green" innovations into supply chains;
- ensure waste recycling;
- introduce energy and resource saving at the enterprise;
- choose suppliers focused on environmental strategy;
- to ensure the production of eco-goods and the provision of services that are not harmful to the environment;
- use ecological packaging and containers reduced in size and materials;
- control indicators of harmful emissions into the atmosphere [18, p. 213].

It is interesting to note that modern products of the IT industry, for example, ERP systems, which are actively and effectively used to manage internal and external resources of the enterprise, can solve the problems of logistics companies in terms of reducing a significant amount of paper waste, transport downtime, personnel costs, etc.

Thus, the development of strategic logistics infrastructure projects in the context of the implementation of the Green Deal and Digital Europe programs is a promising direction of activity for Ukraine today and should ensure a balance between the economy and environment.

The application of "green" technologies in supply chain management is implemented as follows:

1. Supply. Interaction with suppliers, which involves reducing iterations in supply chains, the possibility of supplying environmentally-friendly and safe materials, implementing recycling, reducing anthropogenic load on the soil during the storage of material resources and their transportation from suppliers.

2. Production. Minimization of the use of non-recyclable raw materials and packaging, use of energy-saving technologies, maximum reuse of production waste, recycling of waste,

application of the latest technologies for the use of secondary raw materials.

3. Storage. Provision of environmentally safe storage technologies, thermal insulation of warehouses, which contributes to reducing energy costs for heating and reducing the overall burden on the environment.

4. Transportation. Planning of optimal routes, reduction of idle time in congested flows and reduction of fuel consumption, use of multimodal technologies, which will contribute to the reduction of harmful emissions into the atmosphere.

5. Distribution. Reduction of the volume of solid waste in the process of finished goods delivery, use of "green" packaging materials, selection of sales channels according to the criterion of impact on the environment.

In recent years, "green" technologies have become a newfangled trend among Ukrainian logistics enterprises, that is, such enterprises are increasingly using technologies that do not cause or minimize damage to the environment. The negative aspects of this process are associated with the increase in logistics costs due to the use of "green" technologies. However, despite this, in today's competitive market conditions, logistics enterprises have no other way out than to switch to "green" logistics in order to reach the international level, meeting European standards, to consolidate their own positions in the international market, in which the use of "green" technologies will soon become mandatory.

In order to save money, Ukrainian logistics companies, in particular Nova Poshta, Meest Express, Ukrposhta, Ukrkuryer and others, use the following "green" logistics measures:

- returnable packaging, which significantly saves costs for packing parcels and other shipments, especially large ones;
- thermal insulation of warehouses, which helps to save electricity for heating, and at the same time to pay less utility bills;
- rejection of paper document circulation, which leads to reductions in costs for paper, printers and electricity;

– rational planning of transportation routes, freight consolidation, use of rail transport for transportation, which leads to reduction of CO<sub>2</sub> emissions into the air.

The Meest Express company has introduced a program for the absorption of greenhouse gases, which consists in financing the planting of forests and their care from funds in the amount of UAH 1 for each parcel paid by the client. The Nova Poshta company is expanding its own fleet of electric cars and plans to purchase electric cargo vans for transportation in order to reduce CO<sub>2</sub> emissions. The Ukrposhta company is testing the delivery of parcels using drones.

Logistics companies of Ukraine have proven that reducing pollution and negative impact on the environment increases the company's competitiveness. Environmental pollution is currently considered an economic waste, as it is a consequence of the company's inefficient use of resources and irrational management.

One of the key signs of the modern development of the world economy is the tendency to expand the scale, intensifying the exchange and movement of goods, capital, raw materials, financial and labor resources. The increase in the pace of import and export operations, together with other forms of international cooperation, became possible thanks to the intensive development of the transport and logistics infrastructure, which is accompanied by an increase in the number of vehicles not only in the regional, but also in the global transport fleet.

The functioning of transport logistics is connected with the growth of consumption of material and energy resources and emissions of harmful substances, in particular greenhouse gases. The process of carbonization leads to a decrease in the content of hydrogen and oxygen and an increase in carbon in the atmospheric air. This leads to an increase in anthropogenic burden on the environment.

Therefore, the issues of "greening" of transport and decarbonization in order to increase environmental safety and reduce harmful ecological and economic consequences for the environment and human health are in the center of attention of the world community, demanding an urgent solution.

The analysis of economic, social and environmental relations in the "transport - environment" system allows to identify the factors of indirect negative impact at the following levels: legal, economic, environmental and social (Table 1).

Transport companies are forced to develop and apply effective approaches to resource and energy flow management, decarbonization of their activities in order to reduce ecological and economic damage caused to the environment, and ensure effective innovative development of transport activities in general.

Table 1 - Characteristics of the impact of transport logistics on the global ecosystem by groups of factors

Group of factors	Impact characteristics
Normative and legal	1. Weakness, imperfection of the environmental policy of the country, enterprise. 2. Outdated environmental requirements, regulations, standards that require revision for vehicles and transportation organization, etc.
Economical	1. Traffic congestion. 2. Excessive expenditure of material and energy resources.

End of Table 1

Group of factors	Impact characteristics
Ecological	1. Emissions of pollutants, including greenhouse gases. Global warming and climate change. 2. Consumption of non-renewable material and energy resources. 3. Generation of waste (tires, packaging, used lubricant). 4. Noise pollution. 5. Destructive impact on ecosystems, reduction of biodiversity, disappearance of certain species of plants and animals.
Social	1. Impact of pollution on human health and living conditions. 2. Increasing the danger on the roads (accidents). 3. Congestion of roads, which hinders passenger flow. 4. Destruction of green spaces and development of open space (logistics warehouses, hubs, etc.). 5. Accelerated moral and physical wear and tear of transport infrastructure facilities.

*Source: compiled by the authors based on [19, p. 165, 20].*

So, the set of indisputable facts about the negative effects of transport logistics on the environment, as well as additional economic advantages for transport companies, confirm the need for greening transport logistics. On the other hand, a detailed analysis of existing "green" practices, approaches and technologies has shown their contradictory nature regarding safety for the environment and human health. The assessment of the basic characteristics of logistics systems in the context of compatibility with environmental protection measures showed some discrepancy between economic and environmental results, which is commonly called the paradoxes of greening, including the decarbonization of logistics (Table 2).

The analysis of the existing negative effects of transport logistics on the environment and the economic advantages of greening transport activities explain the growing interest of manufacturers and society in the use and development of "green" technologies in transport logistics, its decarbonization.

However, some issues have not been studied yet due to the complexity and unpredictability of the consequences of their practical solution (paradoxes of "green" logistics). All this determines the need for a detailed study and further deepening of theoretical and practical provisions regarding

the management of transport activities based on the principles of ecologistics and sustainable economic development.

The environmental strategy of logistics enterprises of Ukraine within the framework of the international program "European Union for the Environment" (EU4Environment) [22] is continuously developing through the use of environmentally safe materials for packing parcels, sorting garbage at branches, re-equipping the fleet, introducing electronic document flow, using modern and effective technologies for measurement of CO2 emissions of harmful substances into the air and other.

According to the goals of the international program "European Union for the Environment" Ukraine provides:

- increase national responsibility and speed up the greening of the economy of its state;
- increase environmental awareness of the population and its environmental education;
- implement the transition to "green" logistics and "green" economy, influence the recognition of this strategy by the population;
- implement resource-efficient and clean production methods at Ukrainian industrial enterprises;

Table 2 - Paradoxes of logistics greening

Indicator	Approach to achieving results	Paradox
Costs	<ul style="list-style-type: none"> <li>- renewal of vehicles;</li> <li>- reducing the consumption of energy resources and/or their replacement (for example, replacing gasoline with gas fuel);</li> <li>- improvement and/or reduction of packaging material;</li> <li>- reduction of waste volumes</li> </ul>	Environmental costs are mainly external, i.e. costs are incurred by third parties who are not involved in transport and logistics activities
Time/Flexibility	<ul style="list-style-type: none"> <li>- integrated supply chains;</li> <li>- "Just-in-time" and "Door-to-Door" logistics concepts</li> </ul>	The expansion of warehouse networks and/or the increase of areas for warehouse premises lead to the removal of additional land plots from general or agricultural turnover, an increase in the consumption of energy resources, and, as a result, an increase in the volume of emissions of harmful substances (CO <sub>2</sub> , NO, etc.)
Warehouse networks	<ul style="list-style-type: none"> <li>- development of transport and logistics networks (warehouses, hubs, etc.);</li> <li>- reducing the need for private warehouses</li> </ul>	Localization of environmental impact around transshipment points. Increasing pressure on local communities

Source: compiled by the authors based on [21, p. 339-350].

- implement strategic approaches to the waste management process;
- support "green" reform in the economy;
- acquaint Ukraine and its population with the united market of "green" products and conduct its wide demonstration.

Regarding the practice of applying an environmental strategy within the international program "European Union for the Environment", it is worth noting that this program is most actively implemented by the Ukrainian company Meest Express, which began cooperation with the European Bank for Reconstruction and Development (EBRD) in the field of implementing a comprehensive system of environmental initiatives [23].

Interest in the development of ecology among companies, the government and the public is growing rapidly, especially because traditional logistics cannot meet the demands

of modern society, but has a huge impact on the environment.

There are barriers to the implementation of environmental science, which are related to the environment: lack of necessary skills and technologies; lack of professional consultations; uncertainty of the result; participation of certifiers/verifiers; lack of resources; implementation and maintenance costs.

These barriers are also characteristic of Ukrainian enterprises. In particular, the low quality of Ukraine's transport infrastructure, which is present in all its components, becomes a significant obstacle to the use of more environmentally-friendly transport. The situation is complicated by insufficient interaction between different branches of the transport sector, low investment inflow, an outdated regulatory system and a high degree of wear and tear of fixed assets [24, p. 86].

Ukraine has an advantageous geographical location in Europe, as it is a transit country, and therefore it is obliged to have a high logistics potential with the introduction of "green" logistics measures, which is especially important in wartime.

**Conclusions.** The concept of "green" logistics includes: environmentally safe transportation and storage; resource conservation; personnel responsibility; introduction of IT technologies; waste minimization; waste recycling.

"Green" logistics is aimed at managing supply chains in order to minimize environmental, social, and economic damage and create additional value for the consumer through the use of resource- and energy-saving technologies.

In general, the implementation of "green" technologies in the work of logistics companies is completely economically justified, it increases the competitiveness of the enterprise, opens the way to international markets, attracts a larger number of consumers.

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