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EUROPEAN INTEGRATION DOMINANTS OF WASTE MANAGEMENT OF ROAD TRANSPORT INFRASTRUCTURE

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Abstract. In the modern conditions of the implementation of the European strategy of sustainable mobility and adaptation to climate change, the requirements for the responsible management of waste from motor vehicle infrastructure are growing. The subject of the study is the theoretical, methodological and practical bases of the formation of organizational and economic vectors of waste management of motor vehicle infrastructure objects. *Methodology*. The theoretical and methodological basis of the research are the basic regulations of foreign and domestic science in the field of responsible management of motor vehicle waste in relation to environmental protection, EU regulations, normative legal acts of Ukraine. The research methodology is based on the dialectical method. General scientific and empirical methods were used to solve the problems, namely: methods of analysis and synthesis when studying the conceptual provisions of the formation of the motor vehicle component of waste management and determining the European benchmarks for the development of the motor vehicle industry, system-structural methods – when determining the direction of transformation processes, observation methods – when applying environmental standards of motor vehicles, abstract-logical – when justifying directions for improving the environmental safety of a car at all stages of its life cycle, the SWOT analysis method – for forming strategic guidelines for the development of the motor vehicle industry with the leveling of negative impact on fishing, methods of comparison and analogy, methods of statistical analysis. *The purpose of the study* is to identify the priorities in the responsible management of waste from motorized transport infrastructure and the vectors of implementation of the European strategy for sustainable mobility. The realization of the goal determined the formulation and solution of the following tasks: analysis of the conceptual basis of the company's waste management; study of the problem of state regulation in the field of waste management; analysis of compliance with the company's waste management priorities to ensure the implementation of the European Strategy for Sustainable Mobility. *Results*. The unregulated standardization of motor vehicles and the lack of an effective state policy to stimulate the renewal of private and public transport have led to the fact that Ukraine is constantly turning into a reserve of used non-ecological motor vehicles from abroad, while its own auto industry is on the verge of extinction. Based on the results of the research, it is proven that today the motor transport system, based on the experience of the European Community and implementing the requirements of sustainable and intelligent mobility, can achieve its green and digital transformation and become more resistant to the current crisis. *Conclusions*. The set of received provisions forms a systematic approach to the analysis of known and synthesis of new ways of increasing the environmental safety of vehicles in the processes of European integration of design and operation, their evaluation and selection according to the criteria of fuel efficiency and the level of environmental pollution. Therefore, currently the main task in the field of environmental and road transport state policy should be to ensure a balance between the availability of vehicles and the observance of environmental rights of citizens in Ukraine. The conditions for improving the ecological situation in Ukraine and minimizing the environmental impact of the motor vehicle infrastructure have been established.

Key words: motor transport infrastructure, waste management, sustainable mobility, environmental safety, environmental standards, environmental protection.

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1. Introduction

The transition to climate neutrality also requires a special approach to waste management. The National Economic Strategy for the next decade envisages economic growth that takes into account the Sustainable Development Goals and the need to achieve climate neutrality by 2060. Climate neutrality can be achieved when emissions of greenhouse gases into the atmosphere as a result of human activities are balanced by the same amount of these gases being removed from the atmosphere by various methods. As a result of the operation of road transport, road equipment bases and other transport infrastructure objects, a lot of waste is generated.

The importance of solving this problem to ensure the fulfillment of the goals of sustainable development of Ukraine attracts the attention of leading scientists. In particular, when studying the problems of responsible waste management, the works of Burkinsky B.V., Kravtsiv B.C., Lysetskyi A.S., Melnyka L.G., Mishchenko B.C., Richter K.K., Rusnak P.P., Khachaturova B.C., Khvesyka M.A., Khlobistova E.V., Shchuryka M.V., Khumarova N.I., Shevchenko T.I., and other researchers.

The importance of the given problem is determined by the need to substantiate and find new opportunities for further sustainable mobility of the motor vehicle infrastructure and post-war reconstruction, which determines the relevance of the chosen research topic and forms the vectors of its structural definition.

The aim of the study is to identify the priorities in the responsible management of waste from motor transport infrastructure and the vectors of implementation of the European strategy for sustainable mobility.

The realization of the goal determined the formulation and solution of the following tasks: analysis of the conceptual basis of the waste management of the enterprise; study of the problem of state regulation in the field of waste management; analysis of compliance with the waste management priorities of the enterprise to ensure the implementation of the European strategy for sustainable mobility.

The object of the study is the processes of formation of the motor vehicle component of waste management, which generate the principles of functioning of the environmentally safe operation of the motor vehicle infrastructure.

The subject of the study is the theoretical and methodical bases of formation of organizational and economic principles of waste management of motor vehicle infrastructure objects.

The basis of research methodology is the dialectical method. General scientific and empirical methods were used to solve the problems, namely: methods of analysis and synthesis when studying the conceptual provisions of the formation of the motor vehicle component of waste management and determining the European guidelines for the development of the motor vehicle industry, system-structural methods – when determining the direction of transformation processes, observation methods – when applying environmental standards of motor vehicles, abstract-logical – when justifying directions for improving the environmental safety of a car at all stages of its life cycle, the SWOT analysis method – for forming strategic guidelines for the development of the motor vehicle industry with the leveling of negative impact on fishing, comparisons and analogies, methods of statistical analysis.

2. Conceptual provisions for the formation of the motor transport component of the waste management system

The interaction between human society and nature is one of the most important issues of our time. On the one hand, society's economic interests are aimed at achieving maximum economic efficiency from the use of natural resources. On the other hand, environmental interests are aimed at preserving natural resources and the environment in general. Human experience shows how important it is to find a reasonable compromise between economic and environmental interests. Ecological and economic concepts reflect the appropriate development of productive forces and the historical experience accumulated as a result of studying the impact of scientific and technical progress on the state of the natural environment. The problem of waste management is one of the most urgent, which is associated with a significant threat to human health and the natural environment.

At the same time, it should be noted that one of the main sources of air pollution is road traffic. Car emissions contain such harmful substances as carbon monoxide, nitrogen oxides, particulate

matter and volatile organic compounds. It should be noted that 90% of carbon dioxide emissions into the atmosphere are caused by road transport. At high levels in the air, this gas causes drowsiness and even death. The maximum number of emissions is recorded during peak hours, and the concentration of pollutants inside the car is the highest. Nitrogen dioxide is thought to irritate the lungs and aggravate asthma. Particulate matter that settles around (including on clothing and skin) is a component of vehicle pollution. The smallest of these (down to 10 micrometers, or one-hundredth of a millimeter) can penetrate deep into the lungs and aggravate respiratory diseases. A significant amount of these particles are emitted into the air by diesel-powered cars and large trucks.

Exhaust gases contribute to the greenhouse effect, which causes global warming. Volatile organic compounds, such as polyaromatic hydrocarbons and benzene, lead to the formation of smog. Hydrocarbon emissions are the result of incomplete fuel combustion. They can be gases or solid particles. Benzene (which enters the atmosphere with exhaust and fumes from gas tanks and service stations when cars are refueled) can cause lung cancer and respiratory disease.

When burning 1 kg of gasoline, each car consumes 15 kg of air, especially 5.5 kg of oxygen. Burning 1 ton of fuel releases 200 kg of carbon monoxide into the atmosphere. Motor vehicles are responsible for about 55% of total harmful emissions, which include more than 200 different compounds, including: carbon oxides, lead, nitrogen, formaldehyde, especially aromatic hydrocarbon impurities, benzapyrene, carcinogens, including surfactants, among which there are many mutagens. It is possible to solve this problem by production and introduction of new (alternative) types of environmentally friendly fuel, for example, hydrogen. Photochemical smog (a nebula of corrosive gases visible to the naked eye, characteristic of large cities) is formed as a result of the action of the sun's ultraviolet radiation on hydrocarbons and nitrogen oxides. Due to temperature inversions, the smog hangs over the city and does not dissipate. (Current problems of atmospheric pollution; Cars in modern environmental policy)

As a result of the analysis of the conceptual connections between the field of waste management and the economic, as well as the related social, ecological and indeed ethical content of waste management (see Table 1), it can be stated that the conceptual foundations of the study of the waste problem include, firstly, the theoretical provisions of environmental economics, waste economics, secondary resource economics and, secondly, the political component (environmental, social, regulatory policy – in those aspects that intersect with the generation and management of motor vehicle waste. (Study of the Impact on Emissions of Harmful Substances into the Atmospheric Air of Types of Paper, 24-Hour Waste Disposal Facilities in Ukraine; Kodzhebash, 2019)

However, it should be emphasized that cooperation and integration of Ukrainian companies into global networks of environmentally responsible business will help to organize closed supply chains in Ukraine, obtain more accurate information about suppliers, reduce potential economic risks, and share costs among all participants of the newly organized closed circle. (Naboka, 2021) Reducing the consump-

Table 1
Comparison of innovative approaches to waste management

Conceptual approach	Comparison criteria			
	Integration into the enterprise management system	Direct connection to the waste management industry	Focus on taking into account the interests of third parties	Environmental focus
Corporate social responsibility	Average level	Low level	High level	Average level
Extended liability manufacturer	Average level	High level	Average level	Average level
Integrated management of waste	High level	Average level	Average level	Average level
Environmentally extended motivated responsibility	Average level	High level	Average level	High level

Source: (Kodzhebash, 2019)

tion of resources and, consequently, the demand for them, will lead to an understanding that the current economic model will no longer be able to support economic growth, improve well-being in the long term, and the transport infrastructure will begin to diversify its activities and apply environmental standards.

3. Transformation of the motor vehicle industry

In Ukraine, the processes of European integration of transport and logistics systems, characterized by production cooperation, inter- and intra-industry connections, are gaining special importance. Taking into account the resource potential of Ukraine, the impact of the motor vehicle complex on the environment is characterized by the dominance of integration business processes in the motor vehicle complex and the introduction of process innovations in the production of vehicles and their operation. At the same time, the issue of stabilization and development of the industry should be solved comprehensively, considering production, consumption and related material flows in connection with the movement of waste based on the principles of the circular economy.

With this in mind, it should be emphasized that the automatic transmission system is one of the main means of environmental protection. Full air pollution with oxides of nitrogen and carbon, lead and other harmful substances and most of the large amount, according to the data of the Guide of Ukraine, acetic acid is significantly increasing (see Table 2).

On the other hand, about one third of the total amount of harmful substances emitted into the atmosphere comes from highways, and in megacities this amount reaches 85-90%, which creates serious problems for the purpose of environmental monitoring. This is connected with the tendency of intensive increase in the number of vehicles, which is irrevocably connected with the increase in the number of destinations on Earth and the increase in its life span. According to IAG AUTO Consulting, the car fleet of Ukraine, as of January 1, 2021, is about 14,269,268 cars. At the same time, the average age of cars in Ukraine is about 21.5 years. The current level of environmental safety of the automotive transport sector as a whole and its main elements is determined by the level of energy and resource consumption, environmental pollution by emissions and waste in the process of vehicle use and recovery of productivity. (Kodzhebash, 2019)

Transportation and logistics occupy a special place among them: starting with the timely removal of waste, especially the first three hazard

Table 2
Air emissions of some pollutants from motor vehicles

Designation	2010	2015	2018	2019	2020
Sulfur dioxide, thsd. tons	19,8	16,3	18,6	19,8	20,9
Carbon monoxide, thsd. tons	1782,7	1092,0	1974,9	1255,2	1358,4
Nitrogen dioxide, thsd. tons	206,1	152,9	170,4	178,8	189,9
Nitric oxide, thsd. tons	1,3	0,8	0,8	0,8	0,9
Non-methane volatile organic compounds, thsd. tons	272,4	157,6	162,8	162,6	175,3
Ammonia, thsd. tons	0,018	0,009	0,007	0,006	0,007
Methane, thsd. tons	7,6	4,7	5,0	5,1	5,6
Carbon, thsd. tons	23,8	21,6	24,7	26,5	27,7
In % to the previous year					
Sulfur dioxide	105,9	86,2	102,2	106,5	105,5
Carbon monoxide	100,9	80,0	99,4	63,6	108,2
Nitrogen dioxide	104,2	84,6	100,9	104,9	106,2
Nitric oxide	100,0	72,7	100,0	100,0	112,5
Non-methane volatile organic compounds	100,5	78,6	95,5	99,9	107,8
Ammonia	100,0	75,0	87,5	85,7	116,6
Methane	100,0	79,7	98,0	102,0	109,8
Carbon	107,7	88,2	103,8	107,3	104,5

Source: Ministry of Environmental Protection and Natural Resources of Ukraine

classes, and the way it is transported to storage and processing facilities, the level of potential environmental damage depends on the level of environmental damage. At the same time, it should be noted that the issues of stabilization and development of the industry should be addressed comprehensively when production, consumption and related material flows are considered in connection with the movement of waste according to the principles of a circular economy. The operation of road transport, road equipment bases and other transport infrastructure facilities generates a lot of waste (Final Report of the Heavy Vehicle Fuel Efficiency Standard Evaluation Group, Heavy Vehicle Standards Evaluation Subcommittee, Energy Efficiency Standards Subcommittee of the Advisory Committee on Natural Resources and Energy; Study of the Impact on Emissions of Harmful Substances into the Atmospheric Air of Types of Paper, 24-Hour Waste Disposal Facilities in Ukraine).

The difference between the waste situation in Ukraine and other developed countries is the large volume of waste generation and the lack of waste management infrastructure. In general, the waste management system in Ukraine is characterized by accumulation tendencies. In turn, the fulfillment of the requirements for the adaptation of Ukrainian legislation to the EU requirements and the Recovery Plan of Ukraine provides opportunities to solve this problem (see Table 3). The strategic directions of state regulation in the field of waste management in the coming decades, taking into account the European approaches to waste management, are based on the provisions of EU directives.

Ukraine is currently in the second stage of implementation of the National Strategy for Waste Management. The first stage of implementation of the strategy fell on 2017–2018, the second – for 2019–2023, and the third – for 2024–2030.

In recent decades, the requirements of national laws and regulations on environmental protection have increased in almost all countries. At the same time, the issue of the environmental friendliness of cars, one of the main sources of harmful emissions into the atmosphere, has become a priority. As early as 1988, a regulation (so-called "Euro-0") came into force in Europe, which required a reduction in the level of emissions of carbon monoxide, nitrogen oxides and other substances from cars. The "Euro" ecological standard has become one of the main tools for controlling the level of emissions of toxic substances in car exhaust gases. There are also similar regulations in the U.S. and Japan.

For comparison, the average age of cars in the EU is 10.5 years, in Germany – 9.3 years, and in Poland – 13.6 years. 53.4% of the car fleet in Ukraine was produced before 1991. In 1991 for the first time in Europe the Euro-0 environmental standards were introduced, which began to regulate the level of emission of hazardous substances from cars. In the future, approximately every 5 years, the requirements for environmental standards of vehicles were strengthened, until Euro-6 was adopted in 2014.

Half of the Ukrainian car fleet are EURO-0 cars. The share of cars meeting the EURO-5 standard and higher is no more than 5-6%. As for electric cars, as of January 1, 2020, there are only 18,066 units.

Ecological classes of vehicles are expressed by a coefficient of conformity with the EU standards (according to Table 4), which is determined on the basis of the comparison of emission standards for means of transport of the k-th cluster of the EURO with the EURO-0 emission standards and experimental studies on the toxicity of exhaust gases. (Weigang, 2014)

With the acquisition of full membership in the WTO, Ukraine obtained additional rights to use a number of measures to protect the internal market. However, these rights have not been fully utilized with respect to the national automobile industry. It should be noted that Article 361 of the Ukraine-EU Free Trade Area Agreement provides that cooperation shall be aimed at preserving, protecting, improving and restoring the quality of the environment, protecting public health, prudent and rational use of natural resources and promoting activities at the international level aimed at solving regional and global environmental problems, including in the following areas: a) climate change; b) environmental management and related issues, in particular education and training, access to information on environmental issues and the decision-making process; c) atmospheric air quality. Article 363 of the EU-Ukraine Association Agreement provides that "Gradual approximation of Ukrainian legislation

Table 3
Adaptive directions of waste management system development

Problems of the waste management system in Ukraine	Fundamentals of European approaches to waste management	Problem solving
– accumulation of waste in both the industrial and domestic sectors, which negatively affects the environment and human health; – improper utilization and disposal of hazardous waste; – disposal of household waste without taking into account possible dangerous consequences; – improper use of waste as a secondary raw material.	– Framework Directive No. 2008/98/EC of the European Parliament and of the Council of November 19, 2008 " On Waste and the Repeal of Certain Directives"; – Council Directive No. 1999/31/EC of April 26, 1999 "On Waste Disposal"; – Directive No. 2006/21/EC of the European Parliament and of the Council of March 15, 2006 "On Waste Management of Mining Enterprises and Amending Directive 2004/35/EC"; – Directive 94/62/EU of the European Parliament and of the Council of December 20, 1994 "On Packaging and Packaging Waste"; – Directive 2012/19/EU of the European Parliament and of the Council of July 4, 2012 "On Waste Electrical and Electronic Equipment (WEEE)"; – Directive 2006/66/EC of the European Parliament and of the Council of September 2006 "On Batteries and Accumulators and Spent Batteries and Accumulators".	– The installation of catalytic converters on gasoline car engines makes it possible to reduce the amount of nitrogen oxides, carbon monoxide and hydrocarbons emitted into the atmosphere by more than 75%. To solve a problem, it needs to be implemented: – The use of special motor oils, additives to them and fuel, modifiers of car kinematic units, introduction of catalytic fuel converters, etc. on motor vehicles, which will lead to a decrease in fuel consumption, decrease in pollutant emissions and increase the motor resources of engines; – Strict control over the quality of fuel supplied and sold by gas stations, its compliance with state standards.

Table 4
Values of vehicle emission reduction factors in nom. EURO

Polluting substances	Ecological classes of vehicles					
	EURO-0	EURO-1	EURO-2	EURO-3	EURO-4	EURO-5
CO	1	0,4	0,32	0,17	0,12	0,12
NO_X	1	0,55	0,49	0,34	0,24	0,13
C_mH_n	1	0,46	0,46	0,28	0,2	0,2
TM	1	0,51	0,21	0,14	0,03	0,03

Source: (Weigang, 2014)

to EU environmental law and policy shall be carried out in accordance with Annex XXX to the Agreement." At the time of the Agreement's entry into force, the import and initial registration in Ukraine of cars and buses that did not meet the EURO 5 environmental standard was prohibited. Over the past two years, amendments to the legislation have been made that allow similar operations for used cars at the level of environmental class EURO 2. (Kovalchuk, Mazur, Overkovska, 2019)

At the same time, based on these requirements, the necessary changes were made in the customs legislation. And despite the fact that the state mechanisms for solving this problem were and are insufficient, since 2017 there have been constant changes in the customs and tax codes, which have further liberalized the requirements for used cars with low environmental standards, which largely became the reason why the domestic car fleet became the oldest in Europe and one of the oldest in the world.

A civilized environmental policy of Ukraine is one of the integral components of the European integration process. In Ukraine, the gradual tightening of requirements for environmental parameters of vehicles imported into Ukraine is being introduced in accordance with the Law of Ukraine "On Amendments to the Law of Ukraine "On Certain Issues of Importation into the Customs Territory of Ukraine and Registration of Vehicles" regarding wheeled vehicles" No. 5177 of 2012. Thus, from January 1, 2016, the Euro-5 environmental standard for motor vehicles came into force in Ukraine. In addition, from January 1, 2018, the norms on the

introduction of Euro-6 should come into force. The introduction of new standards significantly limits the import of old cars that have already been in use and belong to a lower class of environmental safety. However, Ukraine postponed the introduction of Euro-6 environmental standards for two years, until January 1, 2020. Environmental standards for harmful emissions of light vehicles are shown in Table 5. (Pymytskyi, 2014, p. 43–49)

Emission standards are established and periodically revised for various categories of vehicles, depending on the make and type of vehicle. It should be noted that the implementation of European standards in Ukraine is delayed by 8-10 days.

Currently there are more than 10 million cars in Ukraine, the average age of which is 21.5 years. Approximately half of these cars meet the EURO-0 environmental standard, while the share of cars meeting the above EURO-5 standard is 5-6%. The share of electric cars in the Ukrainian fleet does not exceed 0.15%. In order to reduce the emission of polluting substances into the atmosphere from mobile sources by 30%, it is necessary that the share of cars meeting the EURO-4 environmental standard and higher in the car fleet should be at least 20-25%.

As the legislation emphasizes, the main goal of such an initiative is to increase the level of environmental friendliness of the car fleet of Ukraine by stimulating the development of the market of motor vehicles of the Euro-5 environmental standard. The main improvement of the situation in the infrastructure sector is the opportunity to adjust the production and market of vehicles to the gradual introduction in Ukraine of environmental safety requirements that meet the international environmental standards for wheeled vehicles.

It should be noted that the transition to stricter environmental standards is a necessary step that allows reducing the amount of harmful emissions into the atmosphere. However, the transition to high Euro standards should not be separated from the development of the system as a whole. In particular, the introduction of Euro-6 should be accompanied by an adjustment of fuel production, since the standards for the latter are far behind the environmental requirements for motor vehicles. The vehicle's compliance with the standards for the content of pollutants in exhaust gases is directly dependent on the compliance of the fuel used with the environmental standards (Study of the Impact on Emissions of Harmful Substances into the Atmospheric Air of Types of Paper, 24-Hour Waste Disposal Facilities in Ukraine).

It should be noted, however, that the Euro 6 environmental regulation left the emission standards for gasoline engines unchanged, while significantly tightening the standards for diesel engines. First of all, the level of nitrogen oxides, which according to scientists is 10 times more harmful than carbon monoxide. Diesel engines are no longer considered clean in Europe and are causing increasing dissatisfaction among environmentalists, and the authorities are taking

Table 5

Environmental standards for light motor vehicles in terms of emissions of harmful substances

Eco-friendly standard	*CO*	C_mH_n	NO_X	*ТЧ*
For a diesel engine				
EURO-1	2,72 (3,16)	–	–	0,14 (0,18)
EURO-2	1,0	–	–	0,08
EURO-3	0,64	–	0,50	0,05
EURO-4	0,50	–	0,25	0,025
EURO-5	0,50	–	0,18	0,005
EURO-6	0,50	–	0,08	0,005
For a gasoline engine				
EURO-1	2,72 (3,16)	–	–	–
EURO-2	2,2	–	–	–
EURO-3	2,3	0,20	0,15	–
EURO-4	1,0	0,10	0,08	–
EURO-5	1,0	0,10	0,06	0,005
EURO-6	1,0	0,10	0,06	0,005

Source: Cars in modern environmental policy, Actual issues of atmospheric air pollution

steps to reduce their number on the roads. At the same time, the diesel ban is no longer an isolated case. In Ukraine, however, the environmental pressure on the automobile infrastructure is based on the commitments between the governments of the countries to reduce harmful emissions.

4. European recommendations for the development of the motor transport industry

As special studies of the EU experience show, the development of motor vehicles and the initiatives of the European Green Deal are reflected in detail in the EU Sustainable and Intelligent Mobility Strategy, which was published in December 2020. This is a strategic document of the European Union that aims to transform the European transport system to reduce emissions from transport by 90% by 2050 and make cities more resilient to future crises. The strategy includes initiatives and incentives to accelerate the use of zero-emission transport (not only electric transport, but also cycling and micro-mobility), the use of renewable energy to power transport, the transfer of freight transport to rail and water, the acceleration of the market entry of electric trucks, aircraft and ships, stricter taxation of carbon emissions and air pollutants (application of the polluter-pays principle).

In view of this, the problem of introducing fast multimodal cargo and passenger transport systems is becoming extremely urgent. The Sustainable and Smart Mobility Strategy of the EU (Sustainable and Smart Mobility Strategy) notes that the digitalization of transport services should contribute to reducing emissions from transport (Sustainable and Smart Mobility Strategy).

In this context, it is appropriate to emphasize that the European Court of Justice has approved the main directions of EU policy in the field of climate and energy until 2030. One of the main goals is to reduce greenhouse gas emissions by 40% by 2030 compared to 1990 levels. To date, according to the International Energy Agency (IEA), the European Union has managed to reduce CO_2 emissions from fuel combustion by 21% compared to the level of 1990, despite the fact that in the USA the volume of such emissions increased by 8%, and in China – by 333%. It should be noted that the IEA only calculates emissions from fuel combustion, but these data allow us to see the general picture, as emissions from the energy sector account for about 2/3 of global greenhouse gas emissions (Actual issues of atmospheric air pollution).

The EU Sustainable and Smart Mobility Strategy ensures the achievement of the objectives of the European Green Deal in the field of transport and mobility. It should be noted that the European Green Course defines 10 main objectives, which are detailed in the Sustainable and Smart Mobility Strategy, as shown in Table 6.

It should be noted that the integration of Ukraine's transport network into the Trans-European Transport Network TEN-T, which is a significant part of the EU Mobility Strategy, requires the development of Sustainable Urban Mobility Plans in Ukrainian cities. It is known that Ukraine plans to become climate neutral by 2060, and therefore the transportation infrastructure needs much needed transformations. As of 2021, the financing program "Ukraine Indicative TEN-T Investment Action Plan Projects" includes 39 projects with a total cost of 4,378.9 million EUR. The majority of these projects are long-term (14 projects, 5% of the cost) with a deadline of 2030; three other

Table 6
Vectors of implementation of the European Green Deal in the motor transport infrastructure

Vectors for the implementation of the European Green Deal	
By 2030	By 2050
At least 30 million zero-emission vehicles will be used on European roads;	Almost all cars, trucks, buses and other heavy vehicles will be zero-emission;
At least 100 European cities will become climate neutral	Freight transportation by rail will double;
The number of trips by high-speed rail will double;	Travel by high-speed rail will triple
Planned trips (by intercity public transport) of up to 500 km within the European Union will be climate-neutral (not by plane);	–
Maximum automation of mobility	

automotive and two rail and aviation projects worth 1.3 billion EUR (30%) are currently being implemented. 18 short-term projects (14% of the cost of the TEN-T investment program) are being prepared for implementation in the near future.

With this in mind, the Ministry of Environment, in its analytical review of the Second Nationally Determined Contribution, predicts an increase in the share of electric vehicles in the passenger car fleet to 3%. However, the growth of the fleet of electric vehicles by 3% in 10 years is a natural course of things, and most likely this indicator will be exceeded by 2030 anyway. According to the Transport&Environment study, in 2026 the price of electric cars will be equal to the price of cars with internal combustion engines and will become cheaper in the future, which will lead to an increase in their number in the car fleet. Therefore, Ukraine can set a higher share of electric vehicles as the main vector for achieving the goals of sustainable development (Emissions from transport and how to deal with them).

In the field of road transport, the EU-Ukraine Association Agreement (in particular Annex 32) requires Ukraine to implement 14 mandatory and directly related EU regulations and directives. In order to bring Ukrainian legislation into line with EU legislation in the field of road transport, the draft Law of Ukraine "On Amendments to Certain Legislative Acts of Ukraine on the Regulation of the Market of Road Transport Services in Ukraine in order to Bring Them into Line with the Act of the European Union" was developed, which proposes the implementation of Regulation (EC) No. 1071/2009 laying down common rules on the conditions for authorization of road transport operators and repealing Council Directive No. 96/26/EC, in accordance with Annex 32.

In the light of the above, the Association Agreement sets the deadline for the implementation of Directives 92/b/EEC and 2009/40/EC for all vehicles used for the international carriage of goods within one year after the entry into force of the Agreement (in accordance with Article 486 of the Agreement, it is provisionally applied from November 1, 2014 until the entry into force of the Agreement). At the same time, the use of tachographs in vehicles is directly regulated by two regulations: Council Regulation (EEC) No. 3821/85 and Regulation (EEC) No. 561/2006, which, unlike directives, do not leave any room for flexibility. Considering the above issues in detail, it should be emphasized that the Order of the Ministry of Transport and Communications of Ukraine dated 07.0b.2010 No. 340, in particular the provisions on the equipment of buses used for irregular and regular special passenger transport, for regular passenger transport on intercity bus routes with a length of more than 50 km, and trucks with a gross vehicle weight exceeding 3.5 tons, cannot be considered as a proper implementation of the above-mentioned regulations and fulfillment of Ukraine's obligations. Since a number of amendments to laws and the Code (penalties, relevant powers of the Ministry of Infrastructure and Ukrtranssafety in relation to an effective mechanism of state control and supervision), which are necessary to ensure the implementation of the regulations, are possible only at the level of law. As for the above comments made during the consideration of the draft Law No. 4683, most of them have been taken into account in its new version.

In particular, when the Anti-Corruption Committee issued its conclusion that the requirements for approval of the conditions for production of vehicles and component parts create conditions for corruption and corruption-related relations and do not comply with the Law "On Accession of Ukraine to the Agreement Concerning the Adoption of Uniform Technical Prescriptions for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or Used on Wheeled Vehicles and on the Conditions for Mutual Recognition of Approvals Issued in No. 1448-III of February 10, 2000" did not take into account the provisions of Directive 2007/46/EC regulating the production and approval of vehicle designs. Also, the Committee's remark about "returning to mandatory technical inspection of civilian vehicles", which contained a corruption component, is not entirely true. At the legislative level, a new system of roadworthiness testing of vehicles is envisaged, a completely new mechanism that has been tested in European countries and is regulated by a number of directives (2009/40/EC, 2014/45/EC) and is important for increasing/improving road safety and is not a "revival" of the old inspection system.

By signing and ratifying the Association Agreement, Ukraine has committed itself to aligning its national legislation with that of the EU and to implementing European standards, norms and requirements. In the field of transport, Ukraine has to implement about 49 EU directives and regulations, which is an extremely ambitious and complex agenda (European integration in transport: joint work and responsibility; Transport).

5. Adaptive directions of implementation of European experience

Taking into account previous studies, it is appropriate to emphasize that the sector of waste management of the motor vehicle complex in Ukraine is actually under significant stress due to a number of interrelated aspects that hinder its effectiveness and lead to undermining the health of the population and the environment. There are a number of reasons for this, ranging from a weak and incoherent regulatory and organizational framework, lack of financial resources, and inadequate monitoring and evaluation.

It should be emphasized that the motor vehicle complex is a source of serious environmental problems. Therefore, it is extremely important to objectively assess the level of environmental hazard of a motor vehicle facility. Improvement of methods of maintenance, operation and repair of automobiles with the purpose of reduction of concentration of toxic components in exhaust gases, noise level and reduction of environmental pollution caused by operating materials, use in technological process of maintenance and repair of equipment that reduces the level of environmental pollution and observance of labor protection requirements and safety techniques when performing work in technical service facilities along international highways will allow to improve the environmental situation in the region. At the global level, the introduction of regulatory documents limiting the use of certain types of fuel, especially those containing lead, as well as the introduction of requirements for the reduction of carbon oxides, nitrogen and hydrocarbons in the exhaust gases of automobile engines, is of great importance for the environmental safety of motor vehicles. Compliance with the requirements for standardization and certification of the motor transport infrastructure (see Table 7) has a certain impact on the maintenance of the balance with the environment.

The environmental impact of road transport infrastructure is that soil contamination is possible in the event of oil spills from vehicles and construction machinery. In addition, there is a possibility of contamination of the territory with construction waste and garbage; to prevent negative impact on land resources, the company plans to equip workplaces and the construction site with containers for household and construction waste and then transport them to the city landfill.

There is no direct negative impact on the land, flora and fauna during the operation of the object, as the limit of influence is limited to the territory of the company. Solving the problem of monitoring the environmental safety of the road transport network is an extremely difficult task and requires, first of all, a final conceptual

Table 7
Implementation of standardization and certification

Name	Implementation measures
Standardization	Implementation of a unified scientific and technical policy for the production, operation, repair, maintenance and disposal of vehicles; To increase the reliability, comfort and safety of vehicles, the quality of work and services in accordance with the development of science and technology, the needs of the population and the national economy; Saving of all kinds of resources, improvement of technical and economic indicators of activity; Safety of facilities, taking into account the risk of natural and man-made disasters and other emergency situations.
Certification	Preventing the use of vehicles, works and services dangerous to life, health of people and the environment; To help consumers to make a conscious choice of vehicles, works and services; Creation of conditions for participation of business entities in international economic, scientific and technical cooperation.

Source: Methods of improving environmental safety at motor transport enterprises

definition. In addition, environmental safety and protection of the population from the long-term effects of environmental pollution caused by vehicle emissions require increased control over the implementation of sanitary and hygienic rules and standards at all levels of sanitary and epidemiological services (Methods of improving environmental safety at motor transport enterprises).

In 2021, the Cabinet of Ministers of Ukraine approved the Order "On Approval of the Plan of Measures for Implementation of the National Transport Strategy of Ukraine for the Period up to 2030". The national transport strategy Drive Ukraine 2030 is the main program document that determines the development of the transport industry for 10 years. The Strategy Implementation Plan, approved by the Government, defines specific stages and deadlines for the implementation of measures necessary to ensure effective activity and comprehensive development of the industry as a whole. The document was developed with the support of the European Union Representation in Ukraine and reflects the implementation of the European integration obligations of Ukraine in the field of transport. These are the implementation of the European "green course" and the replacement of public transport with a more modern and ecological one, as well as the improvement of passenger transport services and the development of bicycle infrastructure. The action plan provides for the development, implementation and execution of specific actions to ensure the fulfillment of tasks aimed at achieving competitiveness and efficiency of the transport system of Ukraine, creating conditions for innovative development of the transport industry and global investments, safe for society, environmentally friendly and energy-efficient transport, as well as unimpeded mobility and interregional integration. Regulatory policy instruments for reducing emissions can be divided into those that apply to the producer and those that apply to the user. (Ganoshenko, Golik, 2021, p. 40–45; Chernyshova, Petrenko, Vyshebaba, 2020)

Technological means of emission management are divided according to the stage of production and according to the main source of pollution or excessive energy consumption: Well-to-tank – from the well to the tank (cost of extraction, processing, fuel delivery to the tank of the machine); Well-to-wheel – from the well to the wheel (cost of all previous processes + fuel cost in test conditions); Tank-to-wheel – from the tank to the wheel (fuel consumption in test conditions); Real Driving Consumption (RDC) – fuel consumption in real driving conditions. Vehicle certification takes into account the emissions determined for the last two stages. In different regions of the world, the permissible emission levels are regulated by different legal standards (EU5, EU6, ULEV, LEVII, LEVII, etc.).

Legislative standards define the allowable emission levels, which are evaluated with different test approaches, which can be divided into 3 main clusters: the United States and some countries in Central and South America, which fully or partially use the US Federal Test Procedure (FTP); Europe and countries based on EU legislation, which use the new World Light-Duty Vehicle Test Procedure (WLTP) and Real Driving Emissions (RDE) test from 2017; Japan has its own test procedure, but will also move to the new WLTP and is considering the possibility of introducing RDE; China, which combines elements of Europe (now NEDC – New European Driving Cycle, but moving to WLTP and RDE) and elements of US legislation.

All regulations limit the maximum emissions in mg/km for each car sold. This means that any vehicle that needs to be certified, whether it's a premium car or a small city car, has to meet a certain level of emissions. Currently, the strictest emissions regulations are in the United States, and from 2023, China will have stricter requirements than Europe.

Ukraine is one of the countries that rely on the European emissions classification system in its regulatory policy. Since 2017, the European Commission has required car manufacturers to use the Worldwide Harmonized Light Vehicle Test Procedure (WLTP) (Chernyshova, Petrenko, Vyshebaba, 2020). Unlike the NEDC system, which was developed in 1980 and used theoretical driving profiles, WLTP uses real driving profile data collected from around the world. According to WLTP, the driving cycle is divided into four parts with different average speeds: low, medium, high and ultra-high. Each part includes different phases of movement, stopping, acceleration and braking.

For a given vehicle type, the WLTP tests each powertrain configuration for the lightest (most fuel efficient) and heaviest (least fuel efficient) versions of the vehicle. As a result, corresponding values of fuel consumption are measured, which directly affect the volume of CO_2 emissions.

From September 2018, the values of CO_2 emissions according to WLTP must be indicated for all new cars registered in the EU. Since Ukraine as a producer is not competitive enough in the market of car sales today, the vast majority of new cars that hit the roads of Ukraine are foreign-made and meet international standards. From the ecological point of view, the greatest threat is posed by used cars that do not meet modern environmental standards, both those that are already in the country and those that are actively imported from Europe. (Gutarevich, Zerkalov, Govorun, 2008; Chernyshova, Petrenko, Vyshebaba, 2020)

Therefore, in order to increase the level of environmental friendliness of the car fleet, countries stimulate the renewal of rolling stock. The policy applied to the user can be centralized, for example, extended to all owners of motor vehicles with a certain level of emissions, or local, that is, limited to the territory where a restriction on the use of vehicles with certain indicators is introduced.

6. Ensuring sustainable mobility of motor transport infrastructure

In accordance with the National Transport Strategy of Ukraine for the period up to 2030, three-year action plans will be developed, which will include the definition of: key tasks and actions; responsible body; term of execution; main stages; assessment of resources and costs (The Government approved the plan of measures for the implementation of the National Transport Strategy of Ukraine until 2030).

Continued harmonization of Ukrainian legislation with the norms of the EU legal system in the field of transport in accordance with the Association Agreement between Ukraine, on the one hand, and the European Union, the European Atomic Energy Community and their member states, on the other hand, will bring the industry to a new level. In particular, the national transport strategy "Drive Ukraine 2030" provides measures for the responsible management of waste from motor vehicle infrastructure, which are presented in Table 8.

Logically, the issue of ensuring the implementation of measures with specifically defined steps for the implementation of the tasks and priorities of the transport policy, the formation of an effective state administration and the determination of the direction of development of the industry arises. For the implementation of the Action

Table 8
Measures for responsible waste management of road transport infrastructure "Drive Ukraine 2030"

	Activities	Ways of execution
1	Transportation infrastructure development projects, both regional and interstate, whose implementation aims to improve the safety, quality and availability of transportation services;	Strengthening the institutional capacity of state authorities that directly or indirectly regulate the transport services market and carry out measures of state supervision (control) of transport safety: implementation of a new approach to the licensing of transport operators, including in particular requirements for good reputation, financial capacity, professional competence of personnel;
2	Inclusion of innovative technologies and introduction of benefits to support national producers proposed by professional associations;	Creation of a new organizational, legal and economic model for the management of the motor vehicle industry, in particular the creation of a central executive body that will perform the functions of a regulatory body in the motor vehicle sector; completion of the transformation of the motor vehicle component by introducing a vertically integrated management system with proper planning of resources in the short term, while ensuring the separation of the infrastructure operator, freight and passenger carriers;
3	Improvement of the quality of transport services, their environmental friendliness and compliance with world standards, integration of the Ukrainian transport system into the European network, etc.	Improvement of the state vehicle safety management system in accordance with international standards; road management reforms to be implemented through the decentralization of state road management, the structure of effective management and the distribution of powers and responsibilities in the field of road management; ensuring equal, open and transparent access to transport infrastructure for operators.

Source: National Transport Strategy of Ukraine for the period up to 2030

Plan, infrastructure projects, regulatory changes, responsible bodies, implementation deadlines, expected results and the relationship between key tasks have been determined, and an assessment of resources has been provided.

The effective implementation of the action plan will be ensured through the use of appropriate tools for monitoring key performance indicators and strengthening the institutional capacity of the Ministry of Infrastructure of Ukraine and other central executive authorities. As part of the monitoring of the implementation of the Action Plan, a monitoring committee will be formed, which will include representatives of interested authorities, public organizations, businesses and mass media, and it is expected that an annual report on the state of implementation of the action plan will be prepared and published. Based on the results of the evaluation of the implementation of the action plan and the analysis of the transportation model, it is possible to make changes to the list of infrastructure projects (On Approval of the "National Waste Management Plan until 2030" Resolution of the Cabinet of Ministers of Ukraine). Therefore, it is important to highlight the priority areas for improving the environmental safety of a car at all stages of its life cycle (see Table 9).

For the implementation of the measures of responsible waste management of the infrastructure projects of the automobile industry, certain sources of financing will be used (own funds of the enterprises, funds from the state and municipal budgets, participating private investments and investments of international financial organizations). The strategic environmental assessment and the assessment of the impact on the environment, including the health of the population, have been carried out taking into account the specified features.

As a result of the conducted research, adaptive goals of rational functioning and progressive development of the waste management sphere in Ukraine, including its automotive component, were formulated in accordance with the Global Goals of Sustainable Development (Table 10).

Summarizing the results of the SWOT analysis, the strengths and weaknesses of responsible waste management will be highlighted. A SWOT analysis of waste management in the road transport infrastructure provides a clear understanding of the situation and indicates the direction of the industry's development. It also allows to develop an effective business strategy by utilizing strengths and knowing weaknesses.

It should be noted that the SWOT analysis of road transport infrastructure waste management can be used to develop a strategy for individual communities and regions (see Table 11). SWOT analysis helps to minimize the risks of responsible management of road transport infrastructure waste.

Nowadays, SWOT analysis is used in a promising direction: when starting a new business

Table 9

Priority directions for improving the environmental performance of the vehicle at all stages of its life cycle

	Ways to improve the environmental safety of the car
1	Various methods to reduce the emission of toxic components into the environment;
2	Installation of special indicators on nodes and parts subject to the most rapid wear, indicating the need for their replacement;
3	Design and manufacture of new vehicles capable of rapid disassembly, reuse of used working mechanisms and units and their disposal;
4	Constant increase in the number of environmentally friendly materials used in production and implementation of control over the use of materials with harmful substances in the construction of cars;
5	The use of harmful materials and special fluids should be minimized at all stages of the vehicle's life cycle;
6	Timely maintenance and precise adjustment of the ignition system and power supply of internal combustion engines;
7	Reducing the harmful effects of toxic substances on the environment during operation by introducing the latest systems for neutralizing harmful emissions;
8	Widespread use of liquefied natural gas, alternative fuels, new vehicles – electric cars;
9	Improving the ecology of large cities by complying with the requirements of environmental legislation, banning the construction of parking lots in the city center, controlling the construction of gas stations within the city limits, building bypass roads, stopping the mass cutting of trees and parks, developing noise protection, and promoting environmentally friendly transportation.

Table 10
The relationship between some of the Sustainable Development Goals and waste management in Ukraine

Goal	The task of permanent development	Waste treatment tasks	Tasks of the motor transport component
9	Development of high-quality and accessible infrastructure	Development of high-quality and accessible infrastructure, primarily transportation, in the field of waste management	
12	Reduce waste generation and increase recycling	Ensure full coverage and rationalization of waste collection and sorting	Coordination of transport logistics processes; rationalization of waste transportation routes

Source: compiled by the author based on materials from the (Strategy for Sustainable Development of Ukraine until 2030)

Table 11
SWOT analysis of responsible waste management in road transport infrastructure

S (strengths)	**W (weaknesses)**
Development of the region's transportation network. Development of cooperation with domestic investors. Interest of the regional leadership in the development of the waste management system. The possibility of obtaining additional income. Development of the industry, which can be the basis for the development of the infrastructure of processing and disposal of waste. The possibility of using waste to obtain "green" energy. Availability of active regional waste management programs and plans.	Lack of statistical data on the state of the industry, lack of systematic collection and analysis of information. Lack of a proper system of accounting and registration of indicators characterizing the state of waste management. Insufficient control in the field of waste management, non-transparency of activities. Lack of a clear vision for solving the problem of waste collection and disposal. Lack of sufficient number of qualified personnel. Lack of motivation to collect and properly dispose of waste. Low profitability of business units. Presence of a significant part of the waste management market in the "shadow sector" of the economy. Non-compliance of waste management facilities with safety requirements, overcrowding of landfills. Low level of inter-municipal and inter-regional cooperation. Lack of local political focus on environmental safety issues. Insufficiently developed industrial infrastructure. Insufficient coverage of the territory with waste disposal services.
O (opportunities)	**T (threats)**
Access to MFI grant and loan funds for MFI infrastructure development, cooperation with foreign investors. Increased environmental awareness among the population. Significant potential for waste recycling and reuse. Development of innovative technologies and equipment for waste management. Creation of new jobs. Ensuring compliance with sanitary, hygienic and environmental standards in settlements. Potential for business development in the processing of secondary raw materials.	Low level of awareness, unwillingness to pay for services, and lack of responsibility among the population and businesses regarding solid waste management. Weak financing of programs and projects in the field of waste management. Gaps in the legislative regulation of the industry, lack of an effective mechanism for the implementation of legislative provisions. Lack of a single center coordinating the solution of problems in the waste management system. The effect of "other people's garbage", social rejection when determining the locations of regional waste management facilities.

Source: summarized by the author

or a new line of business, when considering the options of business restructuring, when analyzing the market for a better understanding of the situation, when checking the correctness of the given course of development of territorial communities, etc. This type of analysis is carried out with the aim of more detailed definition and clarification of the list of factors that can influence the development of the approval and further implementation of the Regional Waste Management Program and Recovery Plan of Ukraine. As a result, external and internal factors were selected and classified into positive (strengths) and negative (weaknesses).

On the basis of the conducted researches it is possible to fully confirm the necessity to create an industrial system for the disposal of vehicles with the produced resource. At the same time, it

should be noted that the implementation of the recycling system is not limited only to the creation of the appropriate legal basis in this area. In particular, in the future it is necessary to pay attention to the economic and innovative issues related to this process, namely: to determine the income and costs of implementation, to establish existing in the state technologies for processing, disposal and reuse of materials and parts of vehicles with the produced resource, and to develop new ones, similar to those already used in the EU member states, to explore available innovations in this area.

Therefore, the network of motor vehicle complexes contributes to the formation of background pollution, to the increase in the content of pollutants at a considerable distance from the sources of pollution, and to global changes in the composition of the atmosphere, which can lead to many undesirable consequences, including climate change. The directions of adaptation to the Paris Agreement (Second National Defined Contribution, SNDC) require that emissions in the transport sector are effectively reduced, the following targets must be set (provided that electric transport is powered by renewable energy sources), see Table 12.

These targets can help achieve climate neutrality by 2050. In addition, all new infrastructure must be built with the inevitability of climate change and the need to adapt to it in mind. The action plan of the National Transport Strategy 2030 is a complex document, because the project was discussed for more than 2 years not only with the central bodies of executive power, regional state administrations – it was also discussed with IFIs (EBRD, EIB, World Bank) and, given the cross-border impact, with the neighboring countries of the EU (Bondarenko, 2021; Action plan for the implementation of the National Transport Strategy of Ukraine until 2030; On Approval of the National Waste Management Strategy in Ukraine until 2030). During the development of the action plan project, a balanced approach was introduced, which responds to the future growth and changes in the demand for transport services, contributes to economic development, improves the quality of life of the population and efficient use of resources. The result of the implementation of the action plan should be the formation of a unified transport space of Ukraine, in which the transport infrastructure of the national and regional levels, the transport infrastructure of cargo owners will be effectively integrated, and a single information environment for the interaction of different types of transport will be created.

7. Conclusions

Thus, at present the main task of state policy in the field of environment and motor transport should be to ensure a balance between availability of vehicles and observance of environmental rights of citizens in Ukraine. Undoubtedly, the protection of the health of citizens should be a primary component of state policy. In this connection, it is also worth remembering the

Table 12
Adaptive directions of adaptation to the Paris Agreement (SNDC)

№	Directions of adaptation to the Paris Agreement (SNDC)
1	Increase the share of urban travel by public transport to more than 50% (and where it is already 50%, maintain it) and do not allow it to fall below 35%. This means electric public transport: trams, trolleybuses (including autonomous ones) and electric buses. Diesel minibuses and similar vehicles must be phased out.
2	Reduce the share of passenger trips made by private cars in cities to 10%, while encouraging their replacement by electric cars. Increase the share of passenger trips made by bicycles, scooters, and other forms of micro-mobility to 10-20%, depending on the size of the city.
3	To increase the popularity and possibility of walking (pedestrian crossings, lowered curbs, urban planning "center near the house", development of multifunctional neighborhoods).
4	Transfer 75% of land freight transport from road to rail. Currently, this indicator in Ukraine has fallen from 60% in 2010 to 51.6% in 2018. Provided that the tracks are electrified, rail has every chance of becoming the least carbon-intensive means of transporting goods.
5	Increase of rail electrification to 70% by 2030. This indicator is now at 47.2%.
6	Refuse to heat passenger cars with coal.
7	Increase the share of passenger transportation by rail to 15%.

Association Agreement between Ukraine and the European Union, within the framework of which Ukraine undertook to adapt to EU legislation a number of legal acts related to motor vehicles as mobile sources of environmental pollution.

There are prerequisites for improving the environmental situation in Ukraine and minimizing environmental damage from cars:

1) State programs and measures are aimed at rejuvenating the automobile fleet of Ukraine by stimulating the purchase of new cars with an environmental standard not lower than EURO-4 and electric vehicles. In order to stimulate the purchase of electric vehicles by Ukrainians, it is necessary to maintain zero customs duties, excise taxes and VAT on the import of such vehicles. In addition, in order to stimulate the production of electric cars in Ukraine, it is necessary to attract investors capable of setting up production, which at present seems unlikely due to the fact that imported and domestic cars are found on unequal terms. It is also worth expanding the list of goods "for industrial assembly of motor vehicles" in the Customs Tariff of Ukraine and extending their use to the production of electric vehicles. The decision of the Cabinet of Ministers of Ukraine to encourage ministries to purchase electric cars instead of vehicles with internal combustion engines is positive in the context of promoting ecological cars.

It is worth noting that the Vehicle Fleet Renewal Program can be made not only environmentally friendly but also more inclusive, in particular by adding a social component to it. For example, it is possible to launch a program with the conditional name "My first car" that could be used by those who buy a car for the first time. The program will provide a 10% discount (state subsidy), but the initial price of the car should not exceed, for example, 500-600 thousand UAH, the car should at least meet the EURO-4 environmental standard, it is also worth setting a limit on the total weight of the car. It is also possible to establish as a mandatory condition, which will contribute to the restoration of car production in Ukraine, that the car must be assembled in Ukraine. This model can also support young families, for example by introducing the state program "Cars for the Family".

2) Encourage the phase-out of old vehicles with low environmental standards (mainly EURO-0). At the regulatory and legislative level.

3) The measures are aimed at limiting the import of used cars with low environmental standards.

In order to adapt the transport infrastructure of Ukraine to the strategy of sustainable mobility of the EU, it is necessary to: develop and implement a transparent and automatic system for calculating carbon footprints; collect and publish carbon footprint data from different modes of transport; implement taxation systems for the purchase, ownership and use of cars according to the polluter-pays principle: more expensive for cars with high emissions, cheaper for cars with low and zero emissions; restore state technical inspection of cars; develop and implement a system for recycling old cars; resume and improve the collection of data on emissions from mobile sources of pollution by region (at the local level, at the level of settlements) in order to monitor emission indicators; create a network for charging and refueling zero-emission vehicles; propose and initiate research and innovation in the field of connectivity and automation of transport, especially multimodal, and road safety (through universities, scientific institutes); create multimodal options for passengers to travel between cities, for example by offering tickets for the route (including transfers) rather than for each individual train or bus, and offering free use of public transport on the day of departure/arrival of the train or plane for which the passenger has a ticket; promote the development of zero-emission freight transport and actively participate in EU activities in this direction; develop and implement a system of state support and co-financing for the creation of bicycle infrastructure in cities; abolish taxation on spare parts/elements for the production and repair of permanent means of transport (e.g., bicycles).

Therefore, a comprehensive solution of environmental and transportation problems requires concerted actions of legislators and various state institutions. The focus of their actions should be primarily on environmental safety, protection of life and health of Ukrainian citizens, ensuring adaptation to climate change. The implementation of these provisions in the country's regional recovery plans is the subject of further research.

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