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Ecological and Economic Principles to Improve the Route Network of Urban Transport

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Abstract: The transport system of many Ukrainian cities does not meet the EU standards and requirements. There is a need to improve urban transport networks, to use transport potential efficiently on the basis of environmental logistics and to improve environmental safety as one of the principles of sustainable transport development. The systems model to create an ecologically safe logistics system of public transport determines the relationship between input parameters (transport system indicators), output parameters (ecological and economic indicators of the route network) and controlling parameters, restrictions, uncontrolled parameters and environmental impact assessment. To model the route network, linear programming (a transport task) has been used as a method with the criteria for optimizing the indicators of economic, ecological and social assessment. A target function is an additive function indicating economic costs, environmental and social losses in passenger and / or freight transportation with weight ratios. It describes the cost of the logistics system. The weight ratios of the importance of economic and ecological indicators are chosen for each route depending on the specifics of transportation. It enables to choose the scheme of transportation by the integration index. (Optimal or compromise plan is suggested according to economic or ecological indicators). The developed approach has been applied to improve the route network of public transport in Kyiv based on ecological and economic principles. Network optimization of only three routes has enabled to increase the income and reduce expenses for passenger transportation. Meanwhile, harmful emissions - CO, C_mH_n, NO_x, PM, CO_2 - have also decreased.
Keywords: Ecologically-Oriented Logistics System; Ecological and Economic Assessment, Green Logistics, Transport System, Route Network, Optimization
JEL Classification: K32, Q01, Q51, Q56

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1 - Introduction

The transport strategy of Ukraine for the period up to 2020 determines the key problems, goals, principles and priorities of developing the transport system in view of national needs and interests. It offers political, economic, organizational and legal measures. In 2020 the volume of cargo transportation is expected to increase by 43.1% and to make up 2.535 billion tons compared with 2008. Cargo handling at state sea ports is expected to increase by 43.2% and to make up 233.4 million tons. The volume of passenger transportation is expected to increase by 30.4% and to make up 10. 867 billion passengers.

The efficiency of transport activity depends on the efficiency of other industries, and hence the economic well-being of the country. However, the operation of motor vehicles results in a significant environmental pollution. Greenhouse gas emissions (CO_2, CH_4), ozone-depleting substances (fluorine, chlorinated hydrocarbons, i.e. carcinogens), harmful substances (NO_x, SO_2, CO, NH_3, solvents), dust are released into the atmosphere. As a result of intense movement due to asphalt coating wear, the amount of solid particles in the air increases, carcinogenic particles in particular. Considerable environmental damage is caused by sewage polluted by waste oils from transport enterprises. Materials used during vehicle repair, maintenance and refueling also pollute the environment. Lubricants (motor oils, transmission fluids, etc.), mineral-based liquids used for hydraulic systems, adhesives and sealants based on formaldehyde and epoxy resins and used for car repair and manufacture are all toxic. The amount of emissions from mobile sources in Ukraine is more than 1.7 million tons annually which accounts for more than one third of total emissions.

The impact of transport activity on human health is due to constant influence of air pollution, noise, water and soil pollution (especially in accidents when transporting dangerous goods and cargo) on mental health. The pollution of urban areas by motor transport emissions is one of the reasons for the increased morbidity rates among the population. This problem is particularly acute in large cities of Ukraine, such as Kyiv, Dnipro, Kharkiv, Odesa and others.

Kyiv is a large administrative center with a multimillion population. In order to meet the needs of its residents and ensure the functioning of all production and services industries, it requires regular passenger and cargo transportation. The implementation of the City Development Strategy until 2025 for transport and transport infrastructure depends on the effective policy of sustainable development and “ecologization” of the economy in order to reduce its energy and resource intensity and anthropogenic pressure. One of the global social, economic and environmental problems requiring urgent actions for Kyiv is the optimization of the route network of the city transport provided that the emission of pollutants from mobile sources is reduced. Reducing the impact on climate change through the implementation of the sustainable transport policy also provides a number of other benefits. They include air quality improvement, vehicle noise reduction, road safety improvement, and a range of social and economic benefits.

It is quite obvious that sustainable economic development of the city is not possible without the development of transport infrastructure and the city's

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transport network based on the business strategy of environmental logistics. The decisions of the functional level are mostly aimed at increasing the efficiency of fuel consumption in trucking, the optimization of vehicle routes and energy saving. Hence, an important direction in reducing the man-made environmental burden and public spending is the optimization of the route network of the city transport.

Thus, taking into account that the transport system of many Ukrainian cities still does not meet EU standards and requirements, there is a need to solve a range of problems. It is necessary to improve urban transport networks, to use transport potential efficiently on the basis of environmental logistics and to improve environmental safety as one of the principles of sustainable transport development.

Due to the above-mentioned problems, this study attempts to develop an approach to improve the route network of urban transport according to economic efficiency and environmental safety criteria. Thus, the following issues have been raised:

1. What parameters influence the "sustainable" development of the city transport system and route network?

2. What is the general criterion of environmental and economic efficiency enabling to assess the public transport route?

3. How to optimize the city's public transport routes according to ecological and economic indicators using the results of modeling?

2– Literature Review

Many problems and issues related to environmental impact of transport activity are tackled in modern scientific literature.

Ye.V. Krykavskiy (2006) investigates the evolution of the supply chain and its impact on a logistics operator. He describes the experience of logistics operators in Europe. He also justifies the development strategy of carriers or transport companies in the domestic market towards the logistics operator or integrator.

Alan McKinnon, Sharon Cullinane, Michael Browne and Anthony Whiteing, (2010) in a study entitled "Green Logistics. Improving the Environmental Sustainability of Logistics" says that the scientific analysis of approaches, methods and tools of environmental (green) logistics, logistics of resource conservation and waste forms environmentally oriented strategies of logistics entities' behavior.

Halyna Rodashchuk (2013) suggests the optimal route network for passenger transportation in rural areas. As a result of scientific research and calculations, a tree of minimum length has been created which is the network transport problem-solving. The task of covering the network, where the desired tree consists of a set of the shortest paths from the source to all nodes, has been performed after analyzing the methods of Dijkstra (determining the shortest path between two graph vertices) and Floyd (determining the shortest paths between all graph vertices).

Oksana Seroka-Stolka (2014) highlights the key factors that can influence the development of a green logistics concept in companies as an element of sustainable development.

Smeshek et al., (2014) in a study entitled "Environmental logistics as a factor of reducing the resource intensity of enterprises. Service market of integrated transport systems and applied problems of logistics" suggest that environmental impact of enterprises has been mostly investigated

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only for individual logistics processes, such as transportation, warehousing, or waste management processes.

Allen et al., (2016) in a study entitled "Analysis of road freight in London and Britain: traffic, activity and sustainability" state that last-mile urban freight contributes to its traffic congestion and poor air quality. They examine the development of road freight transport operations in London.

Lyshtva (2015) considers an integrated approach to optimizing the system of urban passenger transport (the case studied: transport problems of Kyiv).

Mateichyk (2016) in a study entitled "The peculiarities of Modeling the Indicators of Vehicle Environmental Safety in Motion in a Traffic Flow" examines the indicators of vehicle environmental safety under urban traffic conditions using mathematical modeling methods. He also considers the integration of ecological component in logistics processes.

However, the determined problem needs further research with regard to constant economic change and increasing environmental degradation from transport activity.

3 – Theoretical Background

The globalization of transport chains, high volatility of prices of fuel, energy and other resources, the regulation on greenhouse gas emissions result in environmental constraints taken into account when creating the logistics system. The ecological and economic approach based on the concept of sustainable development is an important way regulating all activities of transport enterprises. An important factor of a "sustainable" transport development model is the ecological optimization of end-to-end logistics flows. They involve the supply, production and sales sectors, including integration processes of suppliers of raw materials, semi-finished products, etc., with end consumers. The ecologization of transport logistics is based on the integration and coordination of environmental, social and economic aspects within the urban transport system aimed at ecologically-oriented logistics management of city development. In this case, to achieve the goal, the coordination of economic results, social and environmental effects should be based on the principles of multicriteria optimization (Politechnika Rzeszowska, 2015).

An efficient tool for adjusting economic, social and environmental requirements is the optimization of passenger and cargo flows of the city logistics system and the reduction of environmental impacts from the operation of certain spheres of logistics (Table 1).

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Table1. Environmental impact of certain spheres of logistics activities

Functional sphere of logistics	Environmental impact
Supply logistics	the increase of solid waste when storing physical resources
	touching ecologically dangerous ingredients when handling and loading goods
	loading on soils when storing physical resources and delivering them from suppliers
Information logistics	electromagnetic radiation when transmitting the information by means of communication
Sales logistics	the increase of solid waste when selling goods
	goods spilling, leakage, evaporation due to poor quality packaging
Production logistics	the increase of using manufacturing resources
	the use of land for manufacturing facilities and waste storage
	the increase of noise and vibration in the adjacent territory
Transport logistics	vehicles emissions into the atmosphere
	sewage from transport enterprises
	waste from transport activity
	the use of cheaper fuels processing products of which have a negative impact on the environment and human health
	noise and vibration pollution

When creating the route network of the city, the principle of environmental logistics involves forecasting the quantity and quality of environmental degradation effects from transport activity. In future it should take into account methods and ways to reduce the influence of anthropogenic factors on environmental pollution. The main tasks in this case are to reduce the harmful impact of transport logistics processes on the environment and to reduce the consumption of non-renewable or partially renewable energy resources in the logistics chain. Strategic goals of environmental logistics for the logistics chain are shown in Fig. 1.

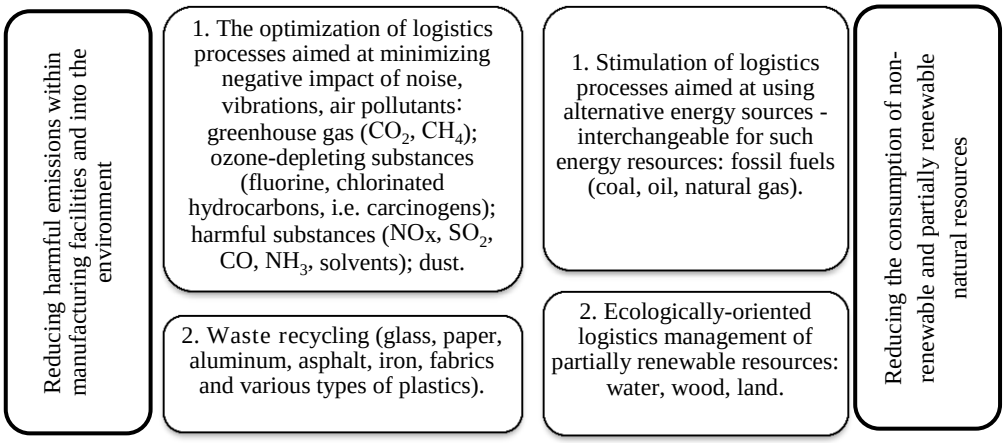

Fig1. Strategically-oriented goals of environmental logistics when creating the city's transport network (Kyiv, NTU, 2016)

The implementation of strategic and tactical goals of environmental logistics includes the following steps:

- the identification of environmental threats of logistics processes and the assessment of their implementation risks;
- forecasting the consequences from the implementation of environmental threats
- the development of organizational, technical, technological, scientific measures aimed at eliminating dangerous threats,

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reducing their risks and the impact of their implementation;

- including environmental costs in logistics processes.

In view of the above-mentioned, the creation of a route network, the development of a sustainable transport system in a city should be aimed at finding the optimal compromise. In this case, the economic and social benefits of transport would be maximized and the environmental and economic costs associated with it would be minimized.

4– Research Method

The basis of studying the mechanisms to improve the environmental performance of urban transport systems is systems analysis technique. It involves identifying the properties of the system to determine the structural relationships between its variables and elements. The first step is to create a "black box" model. It enables to show the inputs and outputs of the system necessary to study its functioning. This is a model of "input-output" type (Figure 2). When constructing such a model, the relation between these inputs and outputs is established. The model reflects the main properties of the system. It is integral and relatively isolated due to the connection with the environment.

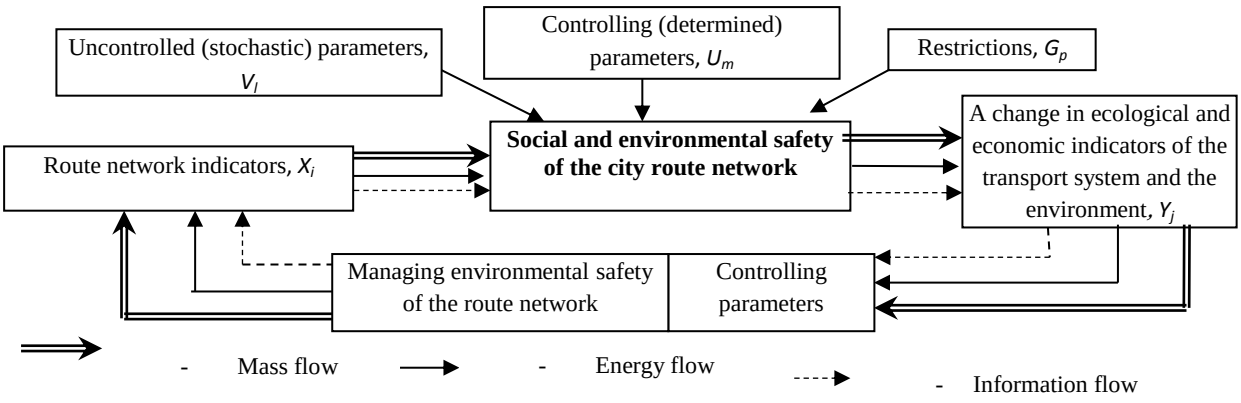

Fig2. A black box model to create environmentally safe route network of the city

The "input" of the system is such indicators of the transport system as the state of vehicles, vehicle technical characteristics, route characteristics, passenger / cargo flow, road conditions, skills and experience of employees. Ecological and economic indicators of the city route network - the level of environmental impacts, financial indicators of the logistics system - is the "output" of an environmentally safe logistics system in passenger and cargo transportation. External influences are formed by available determined controlling parameters, restrictions, uncontrolled stochastic parameters and the assessment of environmental impact of the logistics system. The main parameters of the systems model are shown in Table 2 (Zarządzanie i Marketing, 2012).

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Table2. Parameters of the systems model to create an e environmentally safe logistics system

Input parameters	$X_i = \{x_1, x_2, ..., x_n\}$, where $x_1, x_2, ..., x_n$ are indicators of the transport system - the state of vehicles, vehicle technical characteristics, route characteristics, passenger / cargo flow, road conditions, skills and experience of employees
Output parameters	$Y_j = \{y_1, y_2, ..., y_k\}$, where y_1, y_2 ,.., y_k are ecological and economic indicators of the city route network - the level of environmental impacts, financial indicators of the logistics system
Restrictions	$G_p = \{g_1, g_2, g_3\}$, where g_1 is the value of the maximum allowable concentration of hazardous substances, g_2 is restrictions determined by liability for violating traffic rules, g_3 is restrictions determined by liability for breaking environmental legislation
Controlling parameters	$U_m = \{u_1, u_2, u_3, u_4, u_5\}$, where u_1 is a regulatory framework for transport activities, u_2 is organizational, u_3 is technological, u_4 is financial and economic, u_5 is information support of the logistics system
Uncontrolled parameters	$V_l = \{v_1, v_2, v_3, v_4\}$, where v_1 is political influences, v_2 is social factors, v_3 is climate conditions, v_4 is traffic accidents (crashes, repairs, traffic jams, etc.)
The assessment of environmental impact of the logistics system	$IPE = \{ D, P^{el}, I, A, O, P^a \}$, where D is the time of action; P^{el} is the possibility to eliminate negative consequences; I is the way of influence; A is the scope; O is the origin; P^a is the possibility to accumulate effects.
Managing the result of the impact	$D \cap P^{el} \cap I \cap A \cap O \cap P^a$

The results of the systems analysis enabled to determine the mechanisms of reducing the level of anthropogenic pressure on the environment when creating the route network of urban transport. They involve three groups of interconnected means and measures aimed at minimizing environmental impacts through regulation and control of the corresponding activities:

1. Legislative measures include the adaptation of Ukrainian environmental legislation and transport law to European Union legislation. Ensuring the implementation of international environmental standards for vehicles and motor fuels.

2. Organizational and administrative measures include the establishment of institutions enabling to provide integrated management of urban and transport planning, development, the implementation and promotion of integrated plans for sustainable urban mobility, communication strategies, and others.

3. Technical and economic measures include timely vehicle inspection and maintenance, the use of environmentally friendly fuel, the timely restoration of a rolling stock by repairing trolleybuses, the reconstruction of traction substations and the replacement of worn-out equipment. They also include the elimination of the accident condition of contact systems; the renewal of a rolling stock with new trolleybuses domestically produced. The measures also include the optimization of the city traffic routes taking into account the environmental impact of transport activity based on the route network modeling.

A rational route network taking into account the requirements of passengers

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and enterprises should be planned by an integrated method. Its idea is to minimize costs according to the model of optimizing ecological and logistics flows of enterprises by the system of indicators - economic (costs for goods distribution and delivery), ecological (costs for reducing the anthropogenic pressure on the environment) and social (costs to meet the needs of service users).

To simulate the route network of urban public transport, linear programming (a transport task) should be applied. It uses the indicators of economic, ecological and social assessment as optimization criteria. A target function is an additive function indicating economic costs (Y_1^E), environmental (Y_2^D) and social (Y_3^S) losses in passenger and / or freight transportation with weight ratios. It describes the cost of the logistics system when creating the route network of urban transport.

$$\left.\begin{aligned} K &= \lambda_1 \cdot Y_1^E + \lambda_2 \cdot Y_2^D + \lambda_3 \cdot Y_3^S \to \min \\ \lambda_1 &+ \lambda_2 + \lambda_3 = 1 \\ Y_1^E &= h_i(x_1^{'}, \ldots, x_n^{'}) \le a_i, \quad i = \overline{1, l} \\ Y_2^D &= g_k(x_1^{''}, \ldots, x_n^{''}) \le b_k, \quad k = \overline{1, p} \\ Y_3^S &= \varphi_m(x_1^{'''}, \ldots\ldots, x_n^{'''}) \le c_m, \quad m = \overline{1, t} \end{aligned}\right\} \quad (1)$$

where $x_1^{'}$, ..., $x_n^{'}$, $x_1^{''}$, ..., $x_k^{''}$, $x_1^{'''}$, ..., $x_m^{'''}$ are valid variables (controlled parameters)

K is an integration index of the logistics system cost when creating the city route network;

$\lambda_1, \lambda_2, \lambda_3$ are weight ratios of the importance of each indicator.

The weight ratios of the importance of economic and ecological indicators (λ_1, λ_2) are chosen for each route depending on the specifics of transportation (Table 3). It enables to choose the scheme of transportation by the integration index. (Optimal or compromise plan is suggested according to economic or ecological indicators).

Table3. Recommendations for choosing an optimization plan of transportation route

Condition	λ_1	λ_2	Recommendation
$\lambda_1 > \lambda_2$	(0.6;1)	(0;0.4)	Optimal according to economic indicator
$\lambda_1 \approx \lambda_2$	[0.4;0.6]	[0.4;0.6]	Compromise plan
$\lambda_1 < \lambda_2$	(0;0.4)	(0.6;1)	Optimal according to ecological indicator

The optimal route as an optimal transportation plan is created by the results of performing the transport task.

Let us apply the developed approach to improve the route network of public transport in Kyiv based on the ecological and economic principles.

5– Results

The transport system of Kyiv includes dozens of buses, trolleybuses, trams, minibuses and a funicular. The total length of motorways located within the city, that is avenues, streets, boulevards, etc. is about 2000 km. Most of them were constructed in the last century. However, in current conditions of constant increase in the number of

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vehicles traffic throughput is insufficient. As a result, the congestions in Kyiv, especially in peak hours, have become an everyday phenomenon. With the current traffic management and bad driving habits, traffic jams regularly occur both on main motorways and on the nearest streets that drivers tend to use for a detour. The vast majority of roads have asphalt covering. Unfortunately, only on the main motorways and recently constructed or reconstructed roads such covering is in satisfactory condition.

Every day Kyiv residents are provided with transport services involving 2964 buses of different classes (361 of regular mode, 2603 of taxi service mode), 406 trolleybuses, 294 tram cars, 645 underground carriages (3 underground lines, 51 stations), 60 carriages of urban electric train. The transport network of the city covers 302 bus routes (of which: 70 of regular mode, 232 of taxi service mode), 37 trolleybus routes, 20 tram routes. The municipal enterprise Kyivpastrans combines 4 trolleybus depots, 3 tram depots and 8 bus depots. An important component of Kyiv transport system is the underground.

Expanding the capacity of transport services in Kyiv is closely connected with the problem of improving traffic flow management of the city. New principles of traffic management through the use of modern automated systems are being gradually introduced in Kyiv. Under these conditions, the problem of balanced and efficient use and development of urban passenger traffic flows is becoming extremely relevant. To solve this problem, it is necessary to develop and apply modern approaches and methods as well as to optimize the route network.

Meanwhile, transport costs when distributing the traffic flow in Kyiv route network according to ecological and economic indicators are minimized. The optimal route for passenger transportation will be created for economic (k_E) and ecological (k_D) indicators for specific routes of Kyiv route network. Three routes of passenger transportation of the city have been selected for the research, namely route A, route B and route C.

The length of route A in the straight direction is 23.3 km, in the opposite direction it is 24 km. The time for the return journey is 130 minutes. Routing time is 18 hours. It has 40 stops in the straight and 42 stops in the opposite direction. Most of stops are equipped with pavilions. The route does not intersect with railway crossings and tram tracks. It does not pass through complicated road conditions, bridges, with a narrow carriageway and with deteriorated road pavement. The transportation is carried out with constant frequency on this route.

The length of route B in the straight direction is 14.3 km, in the opposite direction it is 14.6 km. The time for the return journey is 90 minutes. There are 28 stops in the straight and 28 stops in the opposite direction.

The length of route C in the straight and opposite directions is 6.8 km. Routing time in each direction is 28 minutes. The entire length of the route has asphalt covering. Appropriate road signs are installed along the entire length of the route.

To carry out necessary calculations, experimental observations have been made on passenger traffic in selected routes. In order to carry out environmental assessment of the routes, mass emissions

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of harmful substances (CO, C_mH_n, NO_x, PM and CO_2) in the air have been calculated on the basis of emissions from every route (Table 4).

In order to create the optimal route, it is advisable to choose a transportation plan with balanced economic and ecological weight ratios. Using this plan, routes A, B and C have been optimized according to ecological and economic indicators. Economic indicators refer to the cost of passenger transportation on traditional and optimal routes. Ecological indicators determine the environmental damage caused by harmful emissions. Ecological and economic indicators of traditional and optimal routes are compared in Table 4 (K.: NTU, 2015).

Table4. Comparative characteristics of ecological and economic indicators of traditional and optimal routes

Economic indicators	Route					
	Route A		Route B		Route C	
	Traditional	Optimized	Traditional	Optimized	Traditional	Optimized
Economic indicators						
Income, *thousands of eq. units*	1 107.31	1 208.78	687.36	708.20	1 242.61	1 336.38
Expenses, *thousands of eq. units*	1 335.87	1 215.90	798.52	722.55	1 517.88	1 331.02
Profit, *thousands of eq. units*	- 228.56	- 7.11	- 111.16	- 14.35	- 275.27	5.37
Ecological indicators						
CO emissions, *kg*	435.7	106.9	183.0	39.5	428.4	92.6
C_mH_n, emissions, *kg*	435.7	160.4	183.0	59.3	428.4	138.9
NO_x,emissions, *kg*	448.9	187.1	188.5	69.2	441.4	162.0
PM emissions, *kg*	207.2	39.0	87.0	14.4	203.7	33.8
CO_2 emissions, *kg*	1280.7	802.0	537.0	296.5	1259.3	694.4

Thus, the results of the research show that the cost of passenger transportation has decreased significantly. The routes have become more profitable, route C in particular.

As a result of the comparative study, the following results have been obtained. The income has increased and costs have decreased for all routes. The harmful emissions have decreased - *CO* by 4-4.6 times, C_mH_n by 2.7-3.0 times; NO_x by 2.3-2.7 times, *PM* by 5.3-6.0 times and CO_2 by 1.5-1.8 times. Fig. 3 shows a comparative histogram of average mass emissions in traditional and optimized routes.

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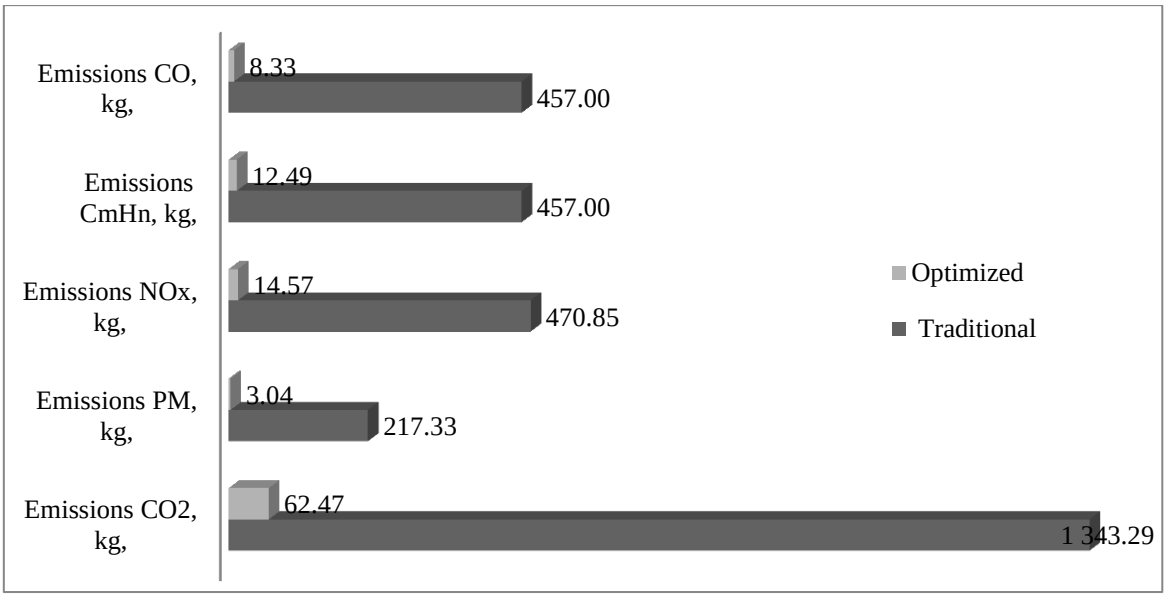

Fig3. Comparative histogram of pollutant emissions

The calculation of the total coefficient of ecological and economic efficiency for creating the logistics system of urban route network is given in Table 5.

Table5. The calculation of economic effect from transport route optimization, 2017, thousands of eq. units

Indicator	Route		
	Traditional	Optimized	
Expenses, thousands of eq. units	3652.28	3269.47	10.5%
Including transportation costs	1569.4	1467.5	6.5%
General environmental damage, eq. units	145.1	130.5	10.1%
An integration index of the route cost	5.5	1.6	70.9%

Thus, the total cost of passenger transportation after optimizing the three investigated routes has decreased by 10.5%, including transportation costs by 6.5%. Overall environmental damage has decreased by 10.1%. Fuel economy for one vehicle per one route is 23.2 liters. It results in savings on fuel costs by 4.3 eq. units, the reduction of transportation costs by 101.9 eq. units and the reduction of the removed environmental damage from emissions by 14.6 eq. units. The minimum value of the integration index of the route cost has reduced by 70.9%.

6– Conclusion and Discussion

According to the results of the study, it can be concluded that an efficient method of reducing the environmental impact of the urban transport system is the optimization of the route network of public transport.

Transport logistics activities resulting in harmful emission in the atmosphere, sewage from transport enterprises, noise and vibration pollution, waste from production processes have a significant impact on the environment. When using cheaper fuels, their processing products have a negative impact on the environment and human health.

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The implementation of strategic and tactical goals of environmental logistics implies: the identification of environmental threats of logistics processes and the assessment of their implementation risks; forecasting the consequences from the implementation of environmental threats; the development of organizational, technical, technological, scientific measures aimed at eliminating dangerous threats, reducing their risks and the impact of their implementation; including environmental costs in logistics processes.

The systems model to create an ecologically safe logistics system determines the relationship between input parameters (transport system indicators), output parameters (ecological and economic indicators of the city route network) and controlling parameters, restrictions, uncontrolled parameters and environmental impact assessment.

To model the route network of urban public transport, linear programming (a transport task) has been used as a method with the criteria for optimizing the indicators of economic, ecological and social assessment. A target function is an additive function indicating economic costs (Y_1^E), environmental (Y_2^D) and social (Y_3^S) losses in passenger and / or freight transportation with weight ratios. It describes the cost of the logistics system when creating the route network of urban transport. The weight ratios of the importance of economic and ecological indicators are chosen for each route depending on the specifics of transportation. It enables to choose the scheme of transportation by the integration index. (Optimal or compromise plan is suggested according to economic or ecological indicators).

The developed approach has been applied to improve the route network of public transport in Kyiv based on ecological and economic principles. Network optimization of only three routes has enabled to increase the income and reduce expenses for passenger transportation. The harmful emissions have decreased - *CO* by 4-4.6 times, C_mH_n by 2.7-3.0 times; NO_x by 2.3-2.7 times, *PM* by 5.3-6.0 times and CO_2 by 1.5-1.8 times. The total cost of passenger transportation after optimizing the three investigated routes has decreased by 10.5%, including transportation costs by 6.5%. Overall environmental damage has decreased by 10.1%. Fuel economy for one vehicle per one route is 23.2 liters. It results in savings on fuel costs by 4.3 eq. units, the reduction of transportation costs by 101.9 eq. units and the reduction of the removed environmental damage from emissions by 14.6 eq. units. The minimum value of the integration index of the route cost has reduced by 70.9%.

Thus, the optimization of the route network of urban transport is an important task of integrating the city into the European environment. Compliance, rationalization, economic feasibility and environmental safety of the city route network are ensured when using the criteria of environmental and economic efficiency. The developed ecological and economic model of urban logistics system efficiency enables to optimize traffic flows based on certain criteria of environmental and economic efficiency.

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