

# SUSTAINABLE TRANSPORT SYSTEM AS A BASIS IN THE FUNCTIONAL ASPECT OF SUSTAINABLE MOBILITY

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## ABSTRACT

In the conditions of modern development of cities and urban agglomerations, there is an increase in the level of motorization, which leads to problems of congestion, noise, an increase in greenhouse gas emissions into the atmosphere, as well as the need for additional urban space and an increase in road capacity. The analysis of studies and official sources made it possible to conclude that the environment, social well-being and economic development of cities and urban agglomerations are closely related to the development of sustainable mobility. In sustainable mobility, a large role is given to the functioning of sustainable transport systems that are focused on the individual needs of people, guarantee comfort, accessibility, safety and operate on the principles of environmental friendliness, taking into account the interests of future generations. Thus, a socio-ecological transformation of transport systems is necessary, as well as changes in the planning, organization and management of transport processes that will determine the quality of life of citizens, their comfort and safety. A sustainable transport system is considered by us as the main component in the functional aspect of sustainable mobility. A comparative assessment of the development of transport systems with the traditional approach and the development of sustainable transport systems has been carried out. It has been determined that sustainable transport systems focus on a human-centered approach, are based on the priority development of public transport, and also involve the use of urban space focused on the preferences and needs of residents.

## KEYWORDS

Sustainable Mobility, Sustainable Transport System, Climate Change, Greenhouse Gas, Urban Agglomeration, Transport

## 1. INTRODUCTION

The 2030 Agenda for Sustainable Development, which was adopted at the UN World Summit (United Nations, 2015), defines 17 sustainable development goals that require a rethinking of the worldview for the further development of society in the context of global problems and crises. To achieve Goal 11, it is necessary to ensure the access of the population to safe, inclusive and accessible, green and public spaces (paragraph 11.6), as well as to safe and sustainable transport systems (paragraph 11.2), in which priority development is focused on public transport, its suitability for people all categories.

The problem of climate change on Earth, which is associated with environmental pollution and the release of harmful substances into the atmosphere, is a global problem for mankind. The reduction of greenhouse gas emissions can contribute to the solution of the problem of climate change.

The Intergovernmental Panel on Climate Change (IPCC) report emphasized that «rethinking how cities and other urban areas function in future could help significantly in mitigating the worst effects of climate change. The right policies, infrastructure and technology...to enable changes to our lifestyles and behaviour, can result in a 40 to 70 per cent reduction in greenhouse gas emissions by 2050. “The evidence also shows that these lifestyle changes can improve our health and wellbeing.” (IPCC, 2022).

In order to achieve the strategic goals of sustainable development and mitigate the consequences of global problems, it is necessary to rethink the traditional approaches to planning, organizing and developing cities and urban agglomerations, as well as the transition to the formation of sustainable systems and the development of sustainable mobility, taking into account the changing preferences of people in the context of

the current level of digitalization and the development of information and communication technologies (Shramenko & Hupfer, 2023).

Urban mobility involves taking into account the individual needs of people in movement and is associated with the functioning of transport systems, so the article focuses on the development of sustainable transport systems and sustainable mobility.

The purpose of the study is to identify key aspects of the functioning of a sustainable transport system.

The theoretical and methodological basis of research are general scientific methods: a systematic approach, analogy, generalization, analysis and synthesis.

## 2. LITERATURE REVIEW

The Green Paper (1992) proposed the term "sustainable mobility" and assesses the overall impact of transport on the environment and presents a general strategy for "sustainable mobility" that should allow transport to fulfill its economic and social role while limiting its harmful impacts on the environment (European Commission, 1992).

The UN report (April 2022) notes that «an increasing share of emissions can be attributed to towns and cities» (United Nations, 2022). At the same time, urban resilience focuses not only on the resilience of metropolitan areas, but also includes cities and small residential areas (Meyer & Auriacombe, 2019).

The transport policy of the European Union is focused on the development of sustainable mobility, which involves taking into account the individual needs of people in movement and taking into account the interests of future generations.

In the EU, transport accounts for almost a quarter of greenhouse gas emissions and is the main cause of urban air pollution. Achieving climate neutrality by 2050 will require a 90% reduction in total greenhouse gas emissions from transport compared to 1990.

The largest CO<sub>2</sub> emissions in the world are in the energy sector 41.7% and transport 16.2% (Ritchie, n.d.). Among all modes of transport, the largest share of CO<sub>2</sub> emissions in the world is accounted for by road transport (11.9%), which includes all types of road transport (cars, trucks, motorcycles and buses). Thus, the transport sector is the largest consumer of energy and plays a significant role in global greenhouse gas emissions. In this regard, in order to reduce harmful emissions, significant attention should be paid to the development of sustainable transport systems.

The main transport policies implemented by the European Union and the United States, as well as an analysis of the concept of sustainable mobility, are presented in the study (Gallo & Marinelli, 2020). It is emphasized that strategies aimed at achieving the goal of sustainable mobility through the production/use of less polluting transport systems are of fundamental importance, but this should not be limited. Consideration should be given to environmental aspects, which are of paramount importance, as well as social and economic implications.

Socio-ecological transformation, which is aimed at improving the level and quality of life of the population, as well as the implementation of innovative processes in the development of sustainable mobility, is possible with comprehensive political support and decisive actions from administrative structures (Shramenko & Hupfer, 2023).

The experience, creative ideas and desires of citizens, as well as their involvement and participation in decisions to develop livable cities, can serve as the basis for making progress in changing the behavior of citizens when choosing a mode of movement (Häußler et al., 2019).

The results of the study (Brůhová et al., 2020) show that there is still a big gap between the theory of sustainable mobility and its implementation in practice. However, there can be significant differences among stakeholders on how to achieve sustainable urban mobility.

Based on the analysis of the concepts of sustainable development, the definition of "a sustainable transport system is formulated as a system in which fuel consumption, vehicle emissions, safety, congestion and social and economic accessibility are at such a level that they can be maintained in the indefinite future without compromising the ability to future generations of people around the world to meet their own transportation needs" (Gordon, 1995).

In implementing the concept of sustainable mobility, the main priority is given to the development of public transport, which involves the collective use (bus, tram, trolley bus, metro) (Hermelin & Henriksson

2022), as well as expanding the opportunities for sharing individual vehicles (rental of cars, scooters, scooters, bicycles etc.).

According to the expert assessment of the International Union of Public Transport (UITP, n.d.), the total return on funds invested in public transport is five times higher than the volume of these investments.

In 2012, an analysis was made of the travel trends of young people from Germany aged 18 to 29, who represented one of the most car-oriented age groups (Kuhnimhof et al., 2012). It is shown that until the 1990s, car use increased for all age groups in Germany, including youth. At the turn of the millennium, youth car use declined. Young people are using alternative modes of transport, indicating an increase in multimodal travel behavior.

The development of cycling is crucial to reduce energy consumption and the negative impact on the environment. In this regard, scientists are actively conducting research aimed at improving the overall safety, efficiency of movement and comfort of cyclists (Oskarbski et al., 2021). Increasing attention is paid to smart cities, which are part of urban development and rely on information and communication technologies (Telang et al., 2021). Smart cities contribute to the improvement of urban planning, integrate the work of urban resources and infrastructure elements and are focused on improving the quality of services in order to ensure safety (Husain et al., 2020), comfort, high level of service and sustainability. One of the basic components of a "smart city" is an intelligent transport system (ITS) - a communication infrastructure that is based on the wireless interaction of transport infrastructure objects and vehicles with each other, and is focused on improving the overall characteristics of transport, such as reliability, accessibility, integrity, efficiency, improving road safety (Husain et al., 2020; Fitah et al., 2018). Many external factors influence the efficiency and development of ITS. The study (Cuong et al., 2022) identifies 28 factors, which are divided into 5 main groups: lack of close attention from the government, financial constraints, inadequate/incomplete transport infrastructure, excessive urbanization, readiness and integration for ITS. However, a wide range of studies show that transport systems in most cities and urban areas are unsustainable and very often unbalanced in the context of environmental, social and economic aspects, which poses a threat to future generations (Bamwesigye & Hlavackova, 2019). Under the current conditions, changes in the development trends of transport systems are necessary, which requires the cooperation of various stakeholders at the regional, national and international levels.

Thus, the analysis of studies and official sources led to the conclusion that the environment, social well-being and economic development of cities and urban agglomerations are closely related to the development of sustainable mobility. In turn, the development of sustainable mobility is based on the functioning of sustainable transport systems. However, the concept of "sustainable transport system" requires systematization, definition of characteristic features and functional role in the urban context.

### **3. KEY ASPECTS OF THE FUNCTIONING OF A SUSTAINABLE TRANSPORT SYSTEM**

In sustainable mobility, a large role is given to the functioning of sustainable transport systems.

The transport systems of most modern cities traditionally develop based on the expansion of the road network and the use of additional urban space to increase road capacity in the face of an increase in the level of motorization. At the same time, social and environmental factors are often not taken into account, while these factors determine the quality of life of citizens, their comfort and safety.

A comparative assessment of the development of transport systems with the traditional approach and the development of sustainable transport systems was carried out (Table 1). So, a sustainable transport system should be focused on the individual needs of people, guarantee comfort, accessibility, and safety. At the same time, transport systems should function on the principles of environmental friendliness, taking into account the interests of future generations. The development of sustainable transport systems is based on the following main aspects: efficiency, safety, environmental friendliness, accessibility and comfort for all users. Essential in the functional aspect of sustainable mobility is the potential of sustainable transport systems in the urban context. With the development of a sustainable transport system, the main focus should shift to changing the consumption and mobility model, focused on a wide range of consumer preferences, objects and mobility services that are integrated into the transport and urban infrastructure based on information, communication, and innovative technologies.

Table 1. Comparative assessment of the development of transport systems in the traditional approach and sustainable transport systems. *Source: Created by the authors*

<b><i>Transport systems under the traditional approach</i></b>	<b><i>Sustainable transport systems</i></b>
Concentration of attention on vehicles when organizing traffic	Human-centered approach to the organization of movement
Urban space is focused on increasing the capacity of the city's road network	Urban space is focused on the preferences and needs of people in their pursuit of a comfortable life.
Inefficient use of urban space as a result of an increase in the level of motorization	Rational use of urban space and infrastructure through the priority use of public transport and public access to individual vehicles
Joint infrastructure for the movement of bicycles (scooters, scooters) when moving people and transporting small consignments	Separate infrastructure for the movement of bicycles (scooters, scooters) when moving people and transporting small consignments
The infrastructure of urban public electric transport is used primarily for the transport of passengers	Use of the infrastructure of urban public electric transport for the transportation of passengers and goods with a clear delimitation of time (to ensure safety)
Absence of massive restrictions on the movement of cars within the city	The presence of massive restrictions on the movement of cars within the city, which is supported by a list of motivational measures for the use of public transport
The transport system is considered as a set of modes of transport	The transport system is based on intermodality and interoperability of different modes of transport
Traffic regulation is carried out on the basis of preliminary monitoring of the traffic situation and analytical calculations	Adaptive traffic management based on continuous monitoring and expected forecasts using artificial intelligence
Information and telecommunication technologies are used as a basis for solving local problems of improving the efficiency of transport systems	Information and telecommunication technologies are used as the basis for the formation of an integrated platform for collecting, processing large amounts of data and making decisions on the sustainable functioning of the transport system as a whole
Separate payment systems for various types of movement	Development of a "smart payment system"; implementation of blockchain technologies; share economy development.

## 4. CONCLUSION

A sustainable transport system is considered as the main component of an integral system of sustainable mobility. The concept of "sustainable transport system", which is presented in official documents and scientific publications, does not fully reveal the key aspects of the functioning of such systems. In this regard, we have systematized and identified the characteristics of sustainable transport systems, as well as their functional role in the urban context.

A comparative assessment of the development of transport systems with the traditional approach and sustainable transport systems has been carried out. With the traditional approach, the focus is on the development of transport infrastructure and ways to increase the capacity of the city's road network. Sustainable transport systems involve the use of urban space based on the preferences and mobility needs of people of all categories, are based on the preferences and needs of residents, focus on the priority development of public transport and on public access to private transport, and also take into account the interests of future generations. Sustainable transport systems are based on a human-centered approach and are characterized by the following main aspects: efficiency, safety, environmental friendliness, accessibility and comfort for all users. Thus, a socio-ecological transformation of transport systems is necessary, as well as changes in the planning, organization and management of transport processes that will determine the quality of life of citizens, their comfort and safety.

Further research should be directed to the development and justification of technical and technological solutions for the development and management of sustainable mobility, and it is also necessary to focus on the methods and technologies used for decision-making.

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