

XIII International Conference on Transport Infrastructure: Territory Development and Sustainability

# Impact of Urban Transport on City Development in the Context of Sustainable Development

Sergey Besspalyy<sup>a\*</sup>, Alexandr Petrenko<sup>b</sup>

<sup>a</sup>*Innovative University of Eurasia 1, Pavlodar, Kazakhstan*

<sup>b</sup>*Toraighyrov University 2, Pavlodar, Kazakhstan*

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## Abstract

The article examines the impact of urban transport systems on the development of urban areas in the context of compliance with the goals of sustainable development (SDG 11). The problem of developing ecological transport both in Kazakhstan and in other countries is relevant due to the constant expansion of cities and the unavailability of existing transport systems to provide all citizens with access to quality living conditions. The authors studied the world experience and, on its basis, developed a concept for the introduction of ecological transport in Kazakhstan.

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Peer-review under responsibility of the scientific committee of the Transport Infrastructure: Territory Development Sustainability

**Keywords:** Urban and public transport; sustainable development of the city; quality of life.

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## 1. Introduction

Over the past few decades, humanity has been striving for such development that will improve the quality of life of people without negative consequences for the lives of future generations. Cities play an important role in sustainable development. Thus, ensuring openness, security, resilience and environmental sustainability of cities and towns is a separate goal of sustainable development (Goal 11: Make cities inclusive, safe, resilient and sustainable, 2022).

One of the main pollutants of the urban environment is transport. To date, there are more than 4 million private cars in Kazakhstan, and more than 70% of them have been in operation for over 15 years and are made according to

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\* Corresponding author. Tel.: +7-701-605-5864.

E-mail address: [sergeybespalyy74@gmail.com](mailto:sergeybespalyy74@gmail.com)

extremely outdated standards (UN in Kazakhstan Annual Report, 2020). Transport is at the center of many economic and social development challenges, accounting for about 64% of global oil consumption, 27% of all energy consumption and 23% of global energy-related carbon dioxide emissions. Rethinking public transport in the post-COVID era by implementing structural changes would go a long way towards amplifying some of the positive impacts on emissions levels and air quality brought about by efforts to contain the pandemic.

## 2. Materials and Methods

The article examines the problems of environmental pollution by urban transport and proposes a system of standards that ensure the development of sustainable transport, taking into account the needs of people and their quality of life. This study used scientific literature, databases including Scopus, Web of Science, Google Scholars, and published scientific articles. To study the impact of the urban transport system on the sustainable development of the city, statistical and economic methods were applied. To study the impact of transport on the ecological state of the city, a comparative analysis was used, which made it possible to assess the types of urban transport and key indicators of emissions of harmful substances that affect the state of the urban living environment. Analytical methods were used to consider the factors influencing the development of urban public transport, given that the reduction of environmental problems depends on the policy implementation of the Sustainable Development Goals.

## 3. Results

Transport mobility is an integral part of modern society, ensuring its prosperity and well-being. According to most projections, the coming decades will see continued growth in the world's population, rising levels of prosperity, and further changes in mobility and transport patterns. The world of transportation is changing and mobility will continue to rise as people and goods move more and more between cities and around the world (Crozet, 2020).

Mobility in urban areas can roughly be divided into three categories: travel by private transport, travel by public transport, and the share of walking/cycling mobility.

Figure 1 shows the ratio of the shares of transport modes in 8 urban agglomerations by the number of trips made. Most walking and cycling take place in the inner city, and most of the trips using personal vehicles - in the peripheral areas and suburbs.

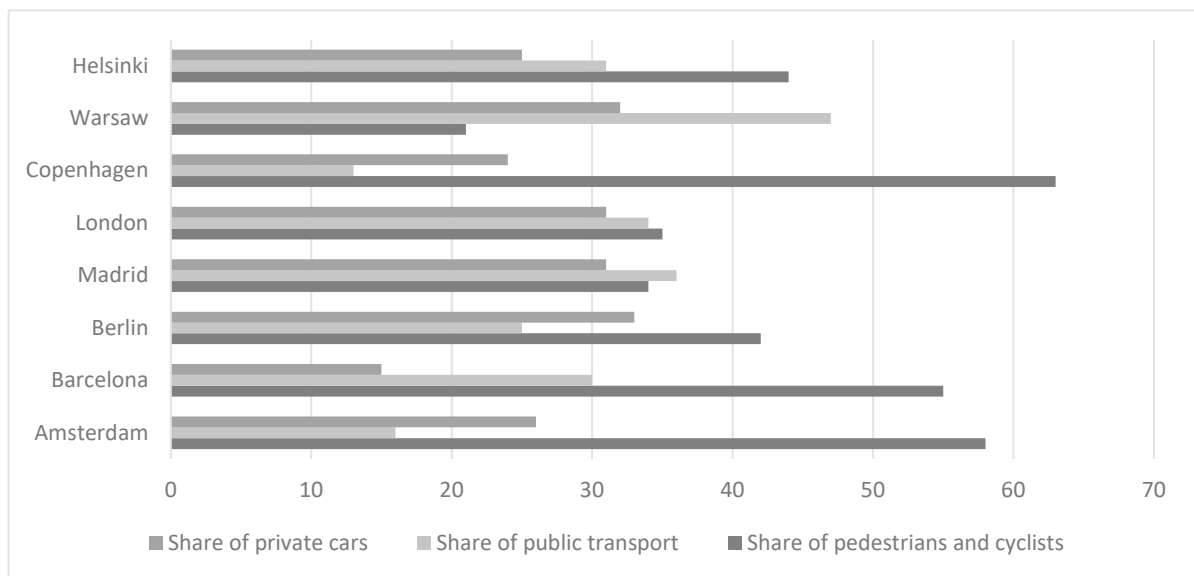


Fig. 1. Use of different modes of transport in major European cities.

The path to zero emissions began with the introduction of electric vehicles and the realization of the strong electrification potential in public transport, rail freight, motorcycles and bicycles. This is an important watershed that has brought us closer to moving away from fossil fuels for transportation (Sustainable transport: Internalization of transport costs, 2021).

At the same time, the use of new technologies affects urban planning, public health and the environment in new ways. Switching to electric vehicles does not bring the same health benefits as switching to active forms of mobility.

In order to maximize the benefits of building a truly sustainable system, the indirect effects of the introduction of electric vehicles must be considered at an early stage (for example, the composition of battery fuel cells, the working conditions of the people who produce them, and the type of energy sources used in their production should be taken into account).

Therefore, the introduction of electric vehicles should ideally be combined with policy decisions that regulate the well-to-wheel chain (resources), the circular economy (production and processing methods), energy conservation (energy sources, energy efficiency) and active mobility. The latest statistics on charging stations provide insight into the emerging market for electric vehicles. All automakers are now offering electric vehicles to customers, and countries are encouraging the deployment of the necessary charging infrastructure. The number of electric vehicle models is growing every year. So, today 214 models of electric vehicles are sold in Europe, and in 2019 - only 98 (UNECE Statistical Database, 2022). The variety of models also affects the availability of electric vehicles for different segments of the population.

One of the main negative impacts of transport is environmental pollution by emissions of harmful substances. Air pollution is one of the main causes of premature death and disease and represents the biggest environmental hazard to human health.

The most common causes of premature death due to air pollution are heart disease and stroke. They are followed by lung diseases and lung cancer. The burden of exposure to high concentrations of pollutants is unevenly distributed among different social groups. The International Agency for Research on Cancer has classified air pollution in general, as well as particulate matter emissions, which are a major component of air pollutant mixtures, as carcinogenic.

Impact and consequences for ecosystems. Transport continues to be a significant source of harmful air pollution, especially through emissions of nitrogen dioxide and particulate matter in the ground layer of the atmosphere.

Emissions from transport in the world have been reduced, but the volume of passenger and freight traffic is gradually increasing. In 2018, a significant proportion of agricultural areas and natural ecosystems were affected by air pollution in Europe (Table 1) (Emission Standards, 2022).

The main air pollutants that currently cause the most damage to ecosystems are ozone, ammonia and nitrogen oxides (NOx). Ground-level ozone damages crops, forests and other vegetation, impairs their growth and affects biodiversity.

Table 1. Health effects of air pollution in 2022.

In EU countries	Approximate number of premature deaths	Lost years of life (YLL)
PM 2,5	379 000	4 381 000
NO2	54 000	610 000
O3	19 400	232 000

#### 4. Discussion

External costs associated with road transport are not reflected in current market prices. Traffic congestion, pollution and traffic accidents cause huge costs. For example, for the countries of the European Union alone, the corresponding annual costs are estimated at about 502 billion euros. The benefits of moving towards more active mobility and public transport are mainly due to increased life expectancy, higher productivity and reduced health care costs associated with noncommunicable diseases. This is a strong argument for investing in walking and cycling in cities and beyond.

At the first stage of the study, we conducted a comparative analysis of popular types of urban transport in Kazakhstan in terms of compliance with modern world standards, primarily EURO5 / 6 (Table 2).

Table 2. Comparative analysis of urban transport in Kazakhstan. Source – Authors.

Kind of transport	Quantity in Kazakhstan	Fuel consumption per 100 km	Average CO2 emissions	Compliance with modern world standards
Petrol vehicles	4 000 000	7-10 liters of gasoline	1 – 2.5 g/km	No
Cars on gas	313 000	10-12 liters of gas	0.5 – 1.2 g/km	No
Diesel buses	17 000	25 l diesel	2.5 - 3 g/km	No
Hybrid buses	100	10-12 l diesel	1.2 – 1.7 g/km	Yes
Buses on gas	200	25-28 liters of gas	2.0 – 2.5 g/km	Yes
Electric buses	300	3 - 4.5 l diesel	0.8 – 1.2 g/km	Yes

Based on the indicators of emissions of harmful substances, it can be seen that most of the standard modes of transport in Kazakhstan do not comply with the emission limits that exist in European countries (EURO5/6). However, hybrid cars and buses meet such standards.

A hybrid refers to a vehicle that uses a combination of an internal combustion engine (ICE) and an electric motor, i.e. a hybrid of a standard car and an electric vehicle.

Hybrids are extremely relevant and applicable in the climate of Central Asia and its northern regions. Due to the fact that the internal combustion engine reaches its maximum efficiency only in a narrow interval of its power, the maximum efficiency of such an engine does not exceed 20-30%, while a hybrid car eliminates this problem due to the fact that the engine is operated only in a narrow interval, in which its efficiency reaches 70-30%. 80%.

On diesel buses, the efficiency is even lower due to the need to constantly stop and start moving. The hybrid power plant does not experience stress when it needs to increase power, because at the moment of increased load, the entire load falls on the batteries, which accumulate energy during the shutdown process. Unlike electric buses, a hybrid car does not need recharging, huge hard-to-recycle batteries, and maintenance infrastructure.

In Europe, the number of hybrid buses is growing every year, and the leader in this indicator is Germany (50% of all hybrids in the EU). In general, hybrid buses can be seen on the roads of cities such as Madrid, Paris, Milan, Vienna, etc.

For Kazakhstan, it is relevant and necessary to introduce a standard that will limit the negative impact of transport on the urban environment. The basis of the new standard should be a system of indicators for the maximum allowable emissions of harmful substances (Bespalyy, 2021b).

Based on the current environmental situation in Kazakhstan, we propose the following emission standards (Table 3).

Table 3. Emission Guidelines. Source – Authors.

Group name	Group number	Emission, g/km			
		CO	NO	HC	Soot
Cars	I	1.2	0.4	0.15	0.01
Minibuses up to 3.5 t	II	1.7	0.5	0.25	0.03
Buses over 3.5 t	III	2.2	0.6	0.35	0.08

It is necessary to install modern catalysts on cars (metal, magnetic-striction, etc.), which must be serviced in a timely manner every 50,000 km, because. have a certain resource of operation. The use of devices that reduce the effectiveness of emission control systems should be prohibited. Also, modern sensors of harmful substances should be installed on all cars.

Regular inspections and tests are necessary to monitor compliance with emission standards. We suggest a compliance test to be carried out every 2 years or every 50,000 km or 5,000 hours, whichever comes first. A separate test for the durability and quality of pollution control sensors must be carried out in conjunction with the emission compliance test.

Conducting a technical examination of vehicles for compliance with the environmental standard should be carried out by state authorities at the time of passing the technical inspection of the vehicle.

Also, the level of development of urban public transport is very important for the sustainable development of the city, since only with its help it is possible to unload roads and reduce environmental problems (Gerlofs-Neyland et al., 2021). It is simply impossible to create a city in which everyone will be comfortable using personal, even environmentally friendly, transport, which is proved by world experience, primarily from US cities.

For a number of reasons, the most beneficial for the city is the development of the tram system. So, the carrying capacity of a tram is 2 times higher than that of a bus, and when building a light rail (LRT), it is 6 times higher. The tram is more durable, uses less energy than buses and does not produce harmful emissions. Therefore, it is necessary to focus on the development of the tram as the main mode of transport in order to transfer people to a roomy, convenient and comfortable transport, reducing the load on the roads and improving the environmental component. Also, the use of tram systems is possible in close relationship with the expansion of the use of renewable energy sources, which is one of the priority goals of Kazakhstan according to the concept of transition to a green economy (Bespalyy, 2021a).

## 5. Conclusions

Urban transport systems have a significant impact on sustainable development in general. To achieve sustainable development goals, a number of changes are needed in the urban transport system, the main of which are:

- Implementation of modern standards for emissions of harmful substances.
- Mandatory use of sensors and regular monitoring of compliance.
- Changing the approach to urban public transport, increasing its importance and status, developing an environmentally friendly type of public transport - the tram.

All this together will make cities more environmentally friendly, comfortable and convenient for all residents, solve the problem of motorization and urban traffic jams and make cities “greener” and more sustainable.

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