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WPŁYW TRANSPORTU NA ŚRODOWISKO

Streszczenie: Niniejsze opracowanie skupia się na wpływie transportu autobusowego na środowisko. W odniesieniu do środowiska transport jest źródłem emisji, zarówno podstawowych zanieczyszczeń, jak i gazów cieplarnianych, hałasu i wibracji. Wywiera również presję na glebę i wpływa na układ przestrzenny, powodując zagrożenie dla zdrowia i bezpieczeństwa. Ekologiczny wpływ transportu na środowisko jest niekorzystny i często jest nieunikniony. Zużycie energii i produkcja gazów cieplarnianych stanowią coraz większy problem w dzisiejszym społeczeństwie. Dlatego efektywność transportu w zakresie zużycia energii i produkcji gazów cieplarnianych jest coraz częściej monitorowana.

Słowa kluczowe: transport, transport autobusowy, środowisko, powietrze, zanieczyszczenie powietrza

THE IMPACT OF TRANSPORT ON THE ENVIRONMENT

Summary: This study focuses on the impact of bus transport on the environment. In relation to the environment, transport is a source of emissions, whether basic pollutants or greenhouse gases, noise and vibration. It also puts pressure on the soil and affects the spatial arrangement, causing health and other safety risks. The ecological impacts of transport on the environment are unfavorable and are often inevitable. Energy consumption and greenhouse gas production are an increasing problem in today's society. Therefore, the efficiency of transport in energy consumption and greenhouse gas production is increasingly monitored.

Keywords: transport, environment, air, air pollution

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1. Introduction

However, the real impact of transport in terms of energy consumption and greenhouse gas production always depends to a large extent on the geographical conditions of the region, the available quality and quantity of transport infrastructure, the traction used, the type of transport and the transport technology used [1]. To global environmental issues such as climate change, for example, is air pollution by emissions. The transport sector, which is one of the major causes of energy and environmental problems, is also one of the largest consumers of fossil energy resources. The ecological impacts of transport on the environment are unfavorable and are often inevitable. Energy consumption and greenhouse gas production are an increasing problem in today's society. Therefore, the efficiency of transport in energy consumption and greenhouse gas production is increasingly monitored.At present, the development of transport service plans for cities and regions takes into account mainly the aspect of the public interest in the form of ensuring a certain level of mobility by public passenger transport for the population. Significant emphasis is also placed on the financial aspect in order to ensure the long-term sustainability of the entire transport system, also in terms of the demands on public finances [1,2].

2. Analysis of basic gases polluting the environment from bus transport

"The IPCC (International Panel on Climate Change), which was established in 1988 by two organizations, is the expert guarantor for defining methodologies for determining greenhouse gas emissions. WMO - World Meteorological Organization and UNEP - UN Environment Program. The mission of the IPCC is to assess scientific, technical and socio-economic information that is relevant to climate change impacts. It is also responsible for developing and publishing guidelines and manuals on GHG emission inventory methodologies for national experts." [4].

Nitrogen oxid (NO_x)

Combustion of hydrocarbon fuels at very high temperatures is required for nitrogen oxide to form. Only under these conditions is nitric oxide (NO) and also nitrogen dioxide (NO_2) actively formed, which 10-20% of the total exhaust emissions in diesel engines and approximately 2% in petrol engines in normal traffic.
Nitrous oxide, in the chemical abbreviation N_2O, is a gas whose excess in the air directly and actively depletes the ozone layer above the Earth. This gas is considered to have a greenhouse effect as well as CO_2 and methane [3].

Table 1. Development of nitrogen oxide from 2007 to 2017 (all values are given in tons)

Indicator	Nitrogen oxide
2007	9975.1
2008	8665
2009	8167.3
2010	9323.5
2011	7883

2012	8286.2
2013	8538.2
2014	8611.1
2015	7815.7
2016	6738.7
2017	6922.6

Figure 1 shows the annual emissions of nitrogen oxide from 2007 to 2017. We can see a declining trend in the production of this gas. This decrease may be due to the introduction of stricter standards for motor vehicles as well as bus vehicles.

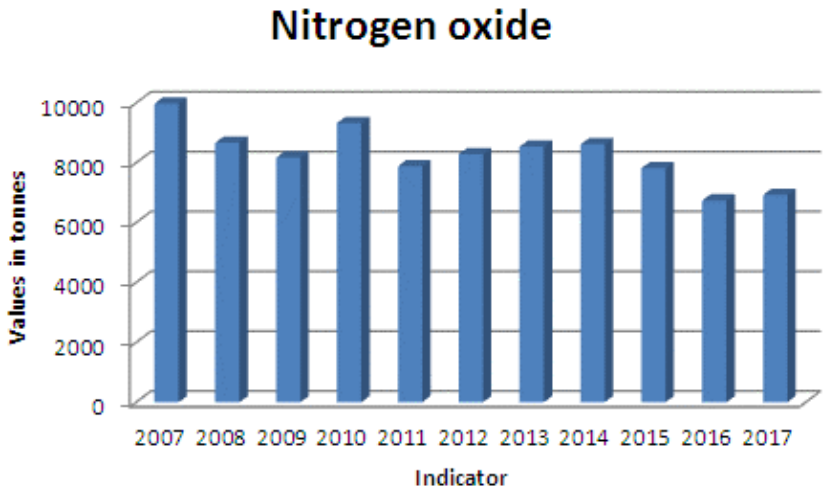

Figure 1. Annual emissions of nitrogen oxide from 2007 to 2017(all values are given in tonnes)

Carbon monoxide (CO)

Carbon monoxide is formed as a result of a chemical reaction with incomplete oxidation of carbon. Carbon monoxide has no odor, however, it is highly toxic. When inhaled into the lungs, when carbon monoxide binds to red blood cells and comes into contact with hemoglobin in the blood, it is approximately 240 times more effective than oxygen. This is exactly why the compound of carbon monoxide and hemoglobin in the blood remains stable and hemoglobin is suddenly unable to bind oxygen to itself, thereby oxygenating all the tissues and organs in the body [3]. A study published in the American Journal of Epidemiology suggests that carbon monoxide concentrations in tunnels (Brooklyn Battery Tunnel and Queens Midtown Tunnel) are considered to be the primary cause of excessive cardiovascular disease and death among transport workers [3].

Table 2. Development of carbon monoxide from 2007 to 2017 (all values are given in tons)

Indicator	Carbon monoxide
2007	102 662.80
2008	94 378.00
2009	68 477.10
2010	88 292.00
2011	101 052.70
2012	99 454.30
2013	100 635.40
2014	114 351.80
2015	113 059.30
2016	110 510.40
2017	114 313.40

Table 2 shows the development of carbon monoxide from 2007 to 2017. From 2007 to 2017, we can see a slight increase in the production of this gas.

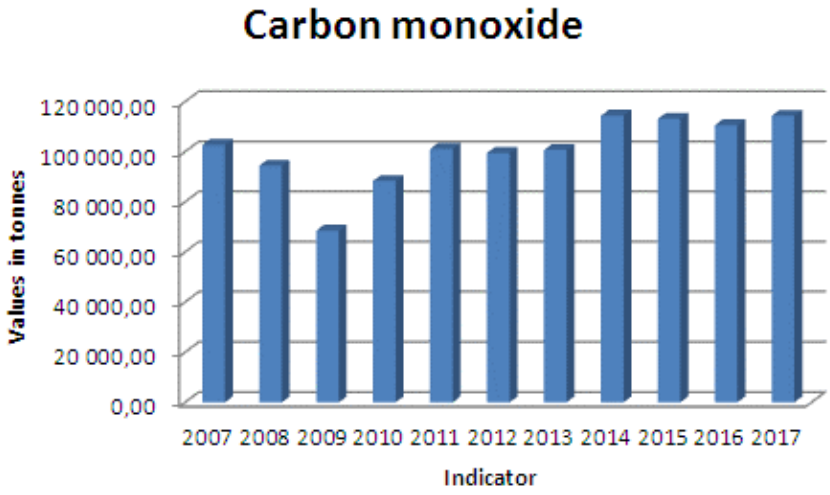

Figure 2. Annual emissions of carbon monoxide from 2007 to 2017 (all values are given in tonnes)

Reducing the adverse effects of transport is an important goal of EU policy. Within the main components of activity, transport is shifting to the least polluting and efficient modes of transport, using more sustainable transport technologies, fuels and infrastructure, and ensuring that transport prices take full account of adverse environmental and health impacts [5].

3. Comparison of diesel buses and electric buses

Suppose a bus in a city runs an average of 300km a day. The range of electric buses used today, designed for a low number of charges, is 110 to 200 km. In this case, there is visibly a significant difference between the values given by the manufacturer and the real reality [5]. An important factor influencing the range of buses is the number of passengers (vehicle load), the driver's driving style, vehicle lighting (outdoor and indoor), air conditioning or heating, the number of stops and starts, the terrain on which the line leads but also from outside temperature [4].
In real operation, the electric bus cannot run until it is completely discharged somewhere in the middle of the route, which is also reflected in the lower practical range. Therefore, the operation of electric buses must be adapted to the worst possible range, not the best. There are various ways in which this situation can be resolved, such as deploying electric buses on short routes or replacing one conventional diesel bus with two electric buses, which means greater investment. Another option is to charge them during the day [5].
There are several ways to charge, but they have in common that it is necessary to set aside a certain amount of time and space for charging. Where today a diesel or gas bus can turn around and serve another departure, the electric bus must stop and recharge. And then he has to be replaced by another bus.

Bus capacity

Diesel or gas buses are in large numbers, which are used in cities are articulated buses, while articulated electric buses appear only in small quantities. So far, such an articulated electric bus has been introduced in only 1 piece, and it was in the German city of Aachen, where another 201 articulated electric buses should be delivered in 2018. This would mean replacing diesel buses with electric buses in a 2: 1 ratio [8].

Price of buses

Electric buses are still an expensive product. Their purchase price is about 2.5 times higher than in the case of conventional buses and a third higher than in the case of trolleybuses. If the city was going to buy 90 diesel buses, it would buy only 36 electric buses for the same price [4].
The possibility of financing electric buses is offered through Eurofunds. The IROP program mentions the renewal of the bus fleet as one of the supported activities. However, all types of drive are supported, so electric buses are not more advantageous from the point of view of support through Eurofunds [5].

Ecological aspect

Electric cars and electric buses do not have to be as environmentally friendly as it is presented. As the results of the Swedish Institute for the Environment's analysis show, the ecological weakness of these vehicles is the production of batteries and their recycling [8].

In the production of lithium-ion batteries, 150 - 200 kg of CO_2 emissions are produced per 1 kWh of capacity. The SOR EBN electric buses used in Slovakia with a range of 110 to 160 km stated by the manufacturer have a battery capacity of 172 kWh. The production of batteries therefore produces around 30 tonnes of CO_2 emissions. The average diesel bus travels 60,000 kilometers a year, producing 6 tons of CO_2 emissions [7,8].

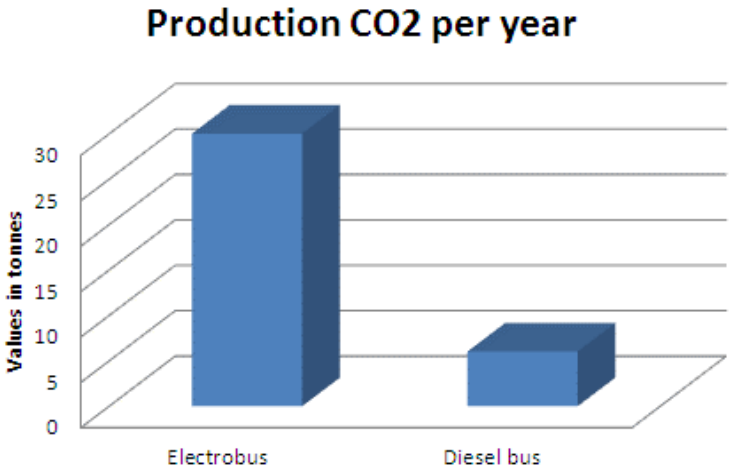

Figure 3. Comparison of the production of annual emissions from the electric bus and from the diesel bus (all values are given in tonnes)

The above comparison, which is shown in Figure 11, only applies to batteries and the production of the whole electric bus itself is not included in the emission calculations. The mentioned electric bus will thus start to be more environmentally friendly compared to a diesel bus only after 5 years of operation. And even if only as many outputs run as a diesel bus, which is at least debatable and, secondly, the production of electricity in Slovakia is associated with the production of carbon dioxide.
Another important piece of information is the battery life of SOR EBN electric buses, which are used in Slovakia, according to the manufacturer, it is stated to be 6 years. Only some of them are used in battery recycling, and further development will be needed to talk about environmental friendliness in this area as well [7].

Providing power to buses

It is not possible to build charging stations anywhere and it is necessary to have selected places where the distribution infrastructure can charge buses. It is also necessary to set aside suitable parking areas where electric buses could be recharged. Technical charging solutions are different, there is still no standard and there is no guarantee that a charging point built today will be suitable in the future [8].
Research by the Irish electricity distribution company ESB shows that if all vehicles in the EU were electric, electricity consumption would increase by 24%, which means that it will be necessary to prepare for such an increase in electricity consumption [8].

4. Conclusions

We know that transport plays a very important role in society and the economy. The very quality of our lives depends on its efficiency and availability. At the same time, it is a key source of environmental pressure in the European Union and contributes to climate change. Transport consumes one third of all final energy in the European Union. Most of this energy comes from oil. This means that transport is responsible for a large share of the EU's greenhouse gas emissions and makes a vital contribution to climate change. While in other sectors of the economy, such as energy production and industry, emissions have fallen since 1990, emissions from transport have increased. Cars, vans, trucks and buses produce more than 70% of total greenhouse gas emissions from transport. From the processed analyzes, where gas buses were compared with electric buses, it is clear that electric buses do not in fact belong to such suitable solutions for reducing the burden on the environment. Although the buses themselves do not produce any emissions, we have found that the production of lithium batteries, which are needed to power electric buses, produces much more CO_2 emissions than gas or diesel buses.

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