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RANKING LIST AND ROADSIDE ENVIRONMENTAL TRAFFIC INSPECTIONS FOR TRANSPORT GREENERING IN HUNGARY

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Abstract: Air pollution is one of the most significant environmental concerns. It can cause adverse health effects like cancer, cardiovascular diseases and high levels of mortality. High population size is a key contributory factor to air pollution in industrial and metropolitan areas. This article focuses on pollution caused by vehicles, presents extensions to the current methods and future methodologies that are used to the decarbonisation of transport and to estimate the association between air pollution exposure and the risks to human health. This paper is centered around two specific topics, all of which focus on greening transport. First is about air quality problems in Hungary caused by transport and the possible environmental projects ranked by KTI expert group for decision makers to choose the appropriate one for solve current problems; the second is a practical one, presents a special Hungarian project for greening transport: a roadside inspection survey of the actual vehicles' technical condition and its emission in traffic, to explore the causes of high emissions, to look for ways to reduce emissions; to make feasibility studies for options of greening and to plan action projects based on these feasibility studies.

Keywords: Ranking list, roadside environmental traffic inspections, transport greening, Hungary

INTRODUCTION

Air pollution is a change in the composition of air, mainly due to smoke, dust, vapors, or toxic gases that cause climate change, adversely affect human health, or may damage the natural environment of many other species. Air pollutants may either be released into the atmosphere (primary air pollutants) or produced within the atmosphere (secondary air pollutants). The local, urban, regional and global air pollution range can be differentiated, mainly based on the atmospheric lifetime of different air components. Primary air pollutants include sulfur dioxide, nitrogen oxides, carbon monoxide, volatile organic compounds (VOCs) and particulate matter (PM₁₀). Secondary air pollutants are caused by chemical reactions of primary pollutants in the atmosphere and often include natural environmental components such as oxygen and water. Ozone, nitrogen oxides, is significant secondary pollutants in the air. The varieties of sources are identified, including transport, industry, combustion and natural sources.

Air pollutants kill an expected 7,000,000 individuals worldwide consistently [1]. World Health Organization

(WHO) data shows in which nine out of ten individuals inhale air containing significant levels of toxins. Air pollution raises the risk of stroke, neurasthenia, cardiovascular disease, cancer, and a series of respiratory diseases such as asthma, pneumonia, even lung cancer is increasing. People with heart or lung disease, elders and children are easy to be affected by air pollution, as vulnerable groups.

Explaining the root cause of this problem, according to experts, motor vehicles use gasoline and diesel as fuel, the process of leakage, evaporation, and burning of fuel also leads to many types of toxic gases such as VOC, Benzene, Toluene, etc. The emission of transportation is shown to depend heavily on the quality of vehicles, fuel, speed, drivers, congestion, and roads.

Transport takes place as Hungary's source of greenhouse gas emissions of 20% and rising since 2012. This trend needs to be reversed rapidly in the sense that it needs to be decarbonized in the mid-century under the Paris Agreement. The research focuses on reductions in pollution from road transport falling under the scope of the European Climate Action Regulation, which enforces a seven percent emission reduction goal for Hungary in 2030 compared to 2005 (including all sectors). Eventually, policy recommendations are brought out so that Hungary can achieve the most ambitious targets [2].

Emission of vehicles

Cars, light and heavy duty vehicles, and fossil-fuel-powered buses are major contributors to air pollution. Transportation currently emits more than half of our air's nitrogen oxides and is a significant source of global warming emissions. While this air pollution poses major risks for human health and the environment, we can dramatically reduce emissions from our cars and trucks through the clean vehicle and fuel technology and help transform transport. Throughout their life cycle, automobiles, trucks, and buses generate air pollution, including emissions generated during vehicle operation and fuel production. Additional emissions are correlated with fuel production and storage, and to a smaller extent, vehicle manufacturing and disposal.

Trucks and buses play a significant role in our lives, transporting goods every day from factories to stores, cleaning up our garbage, delivering parcels, and transporting thousands of people across cities. Yet such cars do have a significant effect on public health and global warming. Heavy-duty vehicles constitute just around five percent of all on-road vehicles, but they produce more than twenty-five percent of global warming emissions from the transport sector and large quantities of air pollution. The problem of reducing pollution from this sector will continue to rise as countries move more and more freight each year. Addressing pollution from heavy-duty vehicles is vital to improving air quality and reducing global warming emissions in communities around the world.

Problems of Hungary

In recent years, rapid urbanization and the growth of motor vehicles have had a serious impact on human life and its environment. Extremely high levels of urban air pollution affect most cities around the world, especially in the form of CO, SO₂, NO₂, PM (Particulate Matter), and RSPM (Respirable Suspended Particulate Matter). Transport sectors contribute dramatically (around seventy percent) to environmental emissions. One of these pollutants CO is the main pollutant from the transportation sector, contributing 90% of total emissions. Hydrocarbons are next to CO. It is interesting to note that the contribution of the transport sector to particulate pollution is as small as 3-5%, most of the SPM (Suspended Particulate Matter) is produced by the re-suspension of dust from which PM₁₀ is the most significant air pollutant. NO_x is yet another significant indicator of air quality. Both circumstances suggest that air pollution is becoming a major problem, and the need to create a safe environment and increasing the level of research around the world is important. The present study is an analysis of an evaluation model for pollutants released and effective strategies for reducing air pollution by road transports [3].

The expert group of KTI Institute for Transport Sciences Ltd. has gathered the most important problems that describe the harmful environmental effects of transport. There is also a correlation between some of the problems listed below. In evaluating the proposals for greening transport, we consider the solutions to these problems and the strength of their impact.

1. High emissions

The problem has several components. One is the unfavorable specific emissions of the outdated, high average age, inadequately maintained vehicle fleet, the other is high traffic, and especially congestion.

2. *The average age of vehicles is high*

The average age of passenger cars is 14 years. In the last few years, the import of used cars was at the level of 150 thousand units per year, and except for the year 2019, it significantly exceeded the sales of new cars. As a result of the complex economic situation caused by the crown virus, solvent demand, and thus new car sales will certainly fall significantly. In 2019 156 thousand used imported passenger cars were registered in the country, on average, 11 years old. 38 percent of used cars arriving in the country were between the ages of 11 and 15, and 22 percent were older than 16 years.

3. *Congestion of metropolitan road traffic*

This problematic point is also related to several of the following points. One of the serious problems with traffic in big cities is traffic jams, congestion, which no longer manifests itself not only in the morning and evening rush hour traffic but also extends to almost the entire daytime period in certain areas and periods. This causes significant excess emissions.

4. *Problems of public transport*

Local bus transport plays a significant role in urban air pollution. Unfortunately, in some large cities, e.g., the situation in Budapest has also deteriorated dramatically recently. Highly smoky blue buses in the capital provide a constant sight. It is the level of carcinogenic organic matter and soot that is emitted directly by walkers, especially young children sitting in prams or walking with low noses, as a vulnerable age group.

5. *Cycling problems*

The cycle path network in big cities is still more suitable for hobby cycling than for commuting to everyday work. The lack of bike paths in some places makes cycling almost completely impossible or dangerous.

6. *Deficiencies in traffic management*

This point includes a comprehensive package of measures. It is not the measures that require large investments in the future that need to be considered, but the relatively low-cost interventions that are possible in the current situation.

7. *Communication, public information*

Public information and the formation of environmental attitudes are extremely important not only in the field of transport but also in general. Attitude-building is the tool that can help with all transport-related problems because if the approach is appropriate, there is no need for excessive sanctions or incentives.

8. *Lack of vehicle maintenance*

A high average age would be accompanied by an increased need for maintenance. Parts and equipment that affect or reduce exhaust emissions are worn out and would need to be replaced in older cars.

9. *Air polluted, poor air quality (PM and NO_x)*

The air in our cities is often heavily polluted, especially about PM₁₀ and NO_x. According to expert estimates, premature deaths of the order of 10,000 can be attributed to air pollution in Hungary.

10. *Unfavorable CO₂ emissions*

Unfavorable CO₂ emissions are closely related to the high age of vehicles, and thus to higher petrol/diesel consumption. This includes the depletion of public transport fleets, but urban congestion also significantly increases consumption and thus CO₂ emissions.

Environmental projects for solution

The expert group of KTI calculated a ranking list of possible environmental projects for solution, based on the technique of Multi-criteria decision analysis (MCDA) [4]. Twenty transport greening projects were ranked and the result of first four places listed here as follows:

1. Conversion of public transport to electric vehicles Air pollution is most significant in large cities. The technical sophistication of electric buses has already reached the level that, apart from a few cases, they are suitable for satisfying the required daily running power. But trolleybuses are also a great alternative. According to government's intention, from 2020 onwards, in settlements with a population of more than 25,000, only electric buses can be put into operation in case of stock exchange or expansion.

2. Conversion of service vehicles (taxi, post office, courier services, service vehicles, etc.) to electric vehicles With the exception of passenger cars (e.g. taxis), there is currently no supply of electric vehicles in this area that would be desirable, but due to EU regulations, it is expected that there will be an adequate choice here in the next 2-3 years. In one part of the segment, the vehicles are operated by private companies, while in the other part by public companies. Public procurement companies also have an EU obligation to purchase clean and energy-efficient vehicles. The details are set out in Directive (EU) 2019/1161. In some cases, e.g. taxi, courier services, etc. obligations may be imposed, together with aid. The aid results in a direct, immediate reduction in air pollution [5],[6].

3. Restrictions on imports of outdated used vehicles It is well known that one of the most important problems of the Hungarian passenger car fleet and vehicle sales is the import of second-hand vehicles, which are used from the European Union, obsolete and thus environmentally unfavorable, highly polluting vehicles. This has recently been accompanied by the importation of first-generation rechargeable hybrids in the EU due to the green license plate, while these vehicles are barely suitable for electric operation due to battery wear.

4. Selective aid for the purchase of electric cars As price of all-electric cars has been significantly higher than a similar conventional car since their inception, support has been and will be needed for their proliferation. This will not change fundamentally in the medium term. The price of a family-sized electric car far exceeds the possibilities of an average Hungarian buyer, however lowered price makes it available for them. [7]

Measurement

“Measuring exhaust emissions from vehicles are a complex issue, and it’s a topic that has been extensively discussed in the media over the past months. This report explains in simple terms how vehicle emissions occur and how they are tested, and the reasons for the gap between tested and real-world driving emissions. - European Environment Agency (EEA) Executive Director Hans Bruyninckx”[8]
Pollutant emissions produced by road traffic have a major impact on air quality and are known to depend on traffic, road, and vehicle characteristics, on atmospheric conditions and on driving behavior.

Environmental review technology Environmental inspection shall verify that the environmental condition of the vehicle complies with the manufacturer’s specifications and its air pollution does not exceed the limit value specified by the manufacturer or specified in a separate legal act. Instruments designed, calibrated, and accurately checked in accordance with the applicable metrological regulations may be used for the environmental inspection. In addition to gas analyzers and smoke measurement instruments and other equipment capable of measuring characteristics, OBD readers capable of communicating with the on-board computer of vehicles must also be able to be connected to the IT system of the transport authority [9].
The classification of vehicles into environmental protection is regulated by Decree 6/1990. (IV. 12.) KÖHÉM on the technical conditions for the placing on the market and entry into service of road vehicles. Based on the design characteristics determining the pollutant content of the vehicle's exhaust gas and the fulfillment of the pollutant emission requirements set out in the annexes to the regulations of the Decree, vehicles are classified in the environmental classes [9].

XXIII. Road Transport Environmental Action, carried out by transport authority is an organic continuation of the previous work, for five days, inspections in 4 big cities and changing locations are basically events that form the basis of technical development, which provide an opportunity to:

- a roadside inspection survey of the actual emissions of motor vehicles in domestic traffic,
- to explore the causes of high emissions,
- look for ways to reduce emissions,
- feasibility studies for the options,
- planning action projects based on feasibility studies.

In Budapest, Győr, Szeged and Debrecen, between 23 and 27 September 2019, 517 vehicles were in the line of sight of professionals. The tool of the Action is the annual review of the environmental condition of vehicles. As a result of regular inspections and information, in ten years out of ten vehicles inspected, on average, experts found something objectionable.

The survey was implemented on a city-by-city basis, so we also address regional differences in the evaluation. Figure (1) shows the percentage of petrol and diesel vehicles, and the compliance by engine type and by city.

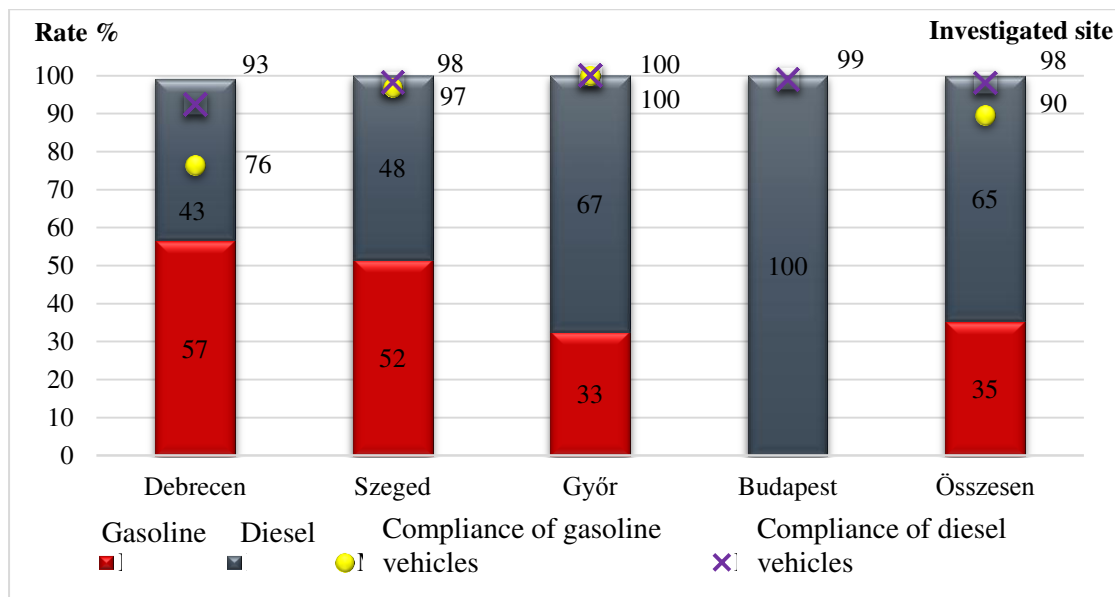


Figure (1) Distribution and compliance of the examined vehicles by category and engine type

In total, it can be said that during the roadside inspection of the vehicle fleet in Debrecen, 115 out of 127 vehicles passed the test (90%). 93% of diesel and only 76% of gasoline-powered cars met the requirements. In most cases, exceeding the limit value and leaking the exhaust system was the problem. The drivers of these vehicles received a warning. The 24 small trucks and one truck performed well in the inspection.

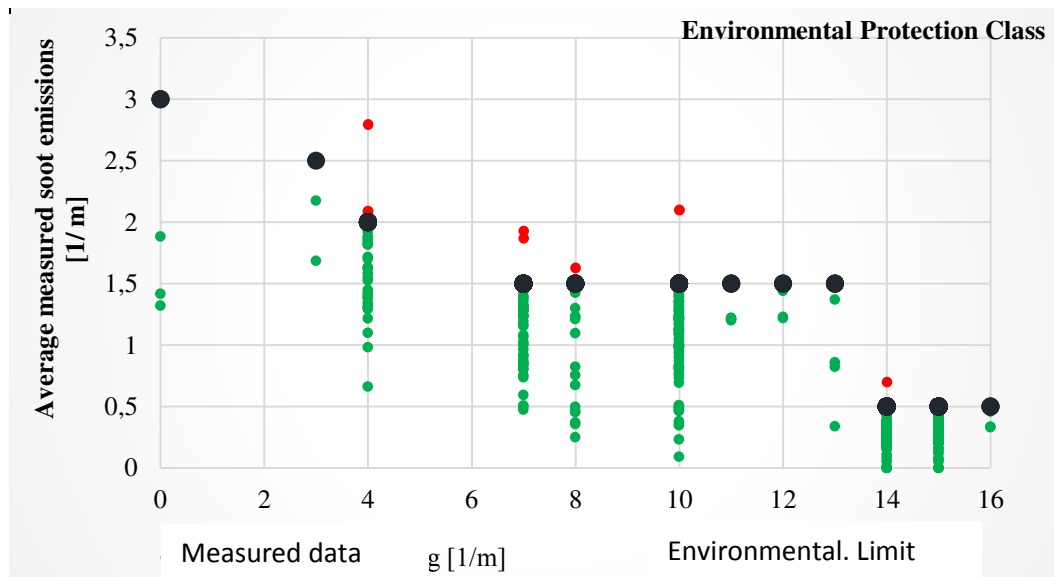


Figure (2) Carbon black emissions as a function of environmental protection class

Figure (2) presents the results of carbon black emission versus Environmental Protection Class and Figure (3) is for hydrocarbon emissions depending of the year of place on the market. These curves describe the inverse ration emission with the Euro class and proportional age of engines.

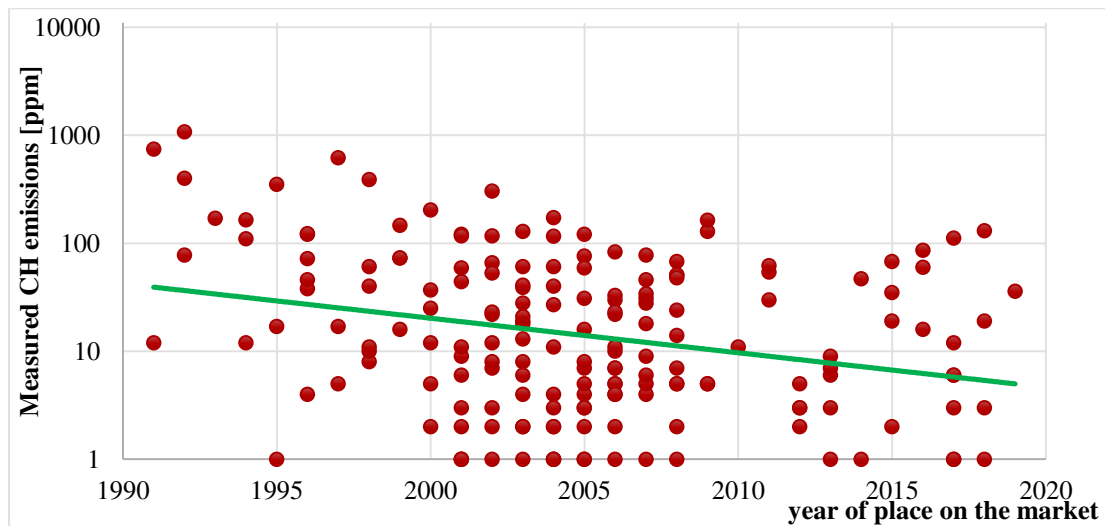


Figure (3) Age-related hydrocarbon emissions of the examined vehicles on a logarithmic scale

Assessing the condition and examining the emission values of the vehicles inspected during the Road Transport Environmental Action may draw attention to the problems mentioned earlier. As a result, environmentally conscious car owners can replace their older types of cars, reducing the number of high-emission vehicles or, if they do not have the financial means, pay more attention to maintenance, including their own safety and a cleaner environment.

Summary

Before, when it comes to air pollution, we often only think of developing countries and densely populated countries like China, India, etc. According to the latest WHO data, 97% of cities in low- and middle-income countries do not meet WHO air standards. For high-income countries, the rate drops to 49%. By all collected data in Measurement part, air pollution caused by transportation was found as the most serious problem to not only human beings but also the ecology and the worldwide economic.

That's why regular measurements of road and greening projects are needed; because the less air pollutant means the better air quality, the lower the number of people with health problems. Due to all of the researched information above, solutions for greening transport are identified. Some parts of them have been applied in several countries, including Hungary.

References

- [1] WHO, "Air pollution."
- [2] <https://www.eea.europa.eu/data-and-maps/indicators/transport-emissions-of-greenhouse-gases-7/assessment>
- [3] N. Saxena and G. Geeta, "AIR POLLUTION DUE TO ROAD TRANSPORTATION IN INDIA: A REVIEW OF ASSESSMENT AND REDUCTION STRATEGIES," vol. 8, Sep. 2013.
- [4] N. R. Khalili and S. Duecker, "Application of multi-criteria decision analysis in design of sustainable environmental management system framework," *J. Clean. Prod.*, vol. 47, pp. 188–198, 2013.
- [5] S. Roy and A. Baiker, "NO_x Storage–Reduction Catalysis: From Mechanism and Materials Properties to Storage–Reduction Performance," *Chem. Rev.*, vol. 109, no. 9, pp. 4054–4091, Sep. 2009, doi: 10.1021/cr800496f.
- [6] S. Miriam, "Difuse Lung Disorders: A comprehensive clinicalradiological overview," *Gt. Britain Springer-Verlag London Hmited*, vol. 42, 1999..
- [7] BRITANNICA, "Air pollution."
- [8] E. E. Agency, "Explaining vehicle emissions – why do laboratory and road measurements differ?"
- [9] NFM, "Környezetvédelmi felülvizsgálat."