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Analysis of the motor vehicle fleet as a way to reduce air pollution in the Republic of Kosovo

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ABSTRACT

Transport has been considered a basic activity in social and economic life. Motorized traffic is the most massive activity within any country. The Republic of Kosovo remains the place where cars have been used in almost every destination and purpose of travel. The environmental and health effects of car use are already known throughout the globe, so monitoring and analysis in order to minimize their impact is a necessary and scientific requirement. The composition of the road vehicle inventory will serve as the main input for building the model for fleet renewal as a targeted approach to reducing harmful substances emitted into the atmosphere. The most harmful substance from the combustion of hydrocarbon fuels is CO_2, therefore the same serves as an instrument for the necessary reform with the rate of vehicle taxation in the Republic of Kosovo.

Keywords: Transport, CO_2 emissions, road vehicle, negative externality, air pollution, vehicle emission, particular matter, environmental impact.

1. INTRODUCTION

Motor transport of passengers and goods affect the individual life of each citizen of the country in both positive and negative ways. Numerous studies have proven that transport raises the standard of living of the population and contributes to the economic development of market economies [1, 2]. At the same time, motor transport produces a wide range of environmental pollutants with the largest component being carbon dioxide (CO_2) emissions which is one of the negative externalities of motor road transport [3-6]. Other negative aspects have been identified in relation to the motor of the road transport by including traffic jams, noise, local pollution and climate change which were typically negative externalities that require state-approved remedial measures. It has been based into the fact that older are the motor vehicles used in road traffic the more harmful emissions it produced.

The environmental impact of the fleet's age and composition has been historically proven by scientific studies [7-11]. In addition to these, the average annual kilometers of movement of vehicles at the same category as well as the specific emission rate expressed in [g/km] are other equally important factors in pollution calculations. Also, fuel type, engine volume, driving mode have been other factors to take into account. Combustion of hydrocarbons as fuel produces two types of basic emissions:

- Directly emitted substances: Carbon monoxide (CO), non-combustible hydrocarbons (HC), nitrogen oxides (NO_x), particular matter (PM) particles; Compressed combustion

engines also emit soot (like carbon black) as well as liquid components that attach to dust in the atmosphere;

- Indirectly emitted substances: Carbon dioxide (CO_2), Sulfur oxides (SO_x).

EU legal standards define the amounts of harmful substances emitted by transport. These pollutants are also limited by Regulation (EC) no. 443/2009, which provides for the establishment of standards for reducing emissions from new vehicles to 130 g CO_2 / km by 2015 and 95 g CO_2/km by 2020 In addition, the Kyoto Protocol aims to reduce greenhouse gases through tax assessments regarding the amount of CO_2 emissions. Our research work will be focused on analysis of the motor vehicle fleet situations to reduce the air pollution in Republic of Kosovo.

2. METHODS

The volume of harmful emissions generated by road motor traffic are greatly influenced by the composition of the fleet. The main purpose of this paper is to provide a description and analysis of the current state of the fleet in the Republic of Kosovo. Particularly under consideration will be the composition, participation, Euro rate, average age, and annual kilometres of the vehicle fleet in the Republic of Kosovo. Based on the statistics of the mentioned description and analysis we will discuss the possibilities that lead to the renewal of the fleet in the Republic of Kosovo using the aspects of setting environmental taxes as motivation.

To achieve the goal, it was necessary to study a number of specialized sources, especially national statistical data covering this topic. This research is based on the analytical method as an approach that uses the decomposition of a whole, into elementary units. The purpose of the analysis is to identify the essential and necessary properties of the elementary units of the whole, the nature and similar characteristics between them. The process consists in decomposing the phenomenon in this case fleet, see Table 1, into smaller parts or groups with properties and similarities between them. The paper also uses description to mediate the characteristics of a particular phenomenon or process. Then, the decomposition and synthesis methods are applied to formulate conclusions and recommendations. Basic mathematical and arithmetic methods will be used to calculate certain numerical data (e.g. emission volume).

Table 1. Composition, classification, presence rate and definitions of the constituent categories of the road vehicle fleet [2].

ECE Class	No. Vehicles	Presence rate %	Definitions
L	2427	0.6%	Motorcycles
M_1	**308387**	**80.64%**	Passenger vehicles up to 8 + 1 seats (cars)
M_2	778	0.20%	Passenger vehicles more than 8 + 1 seats, less than 5 ton
M_3	1638	0.43%	Passenger vehicles more than 8 + 1 seats and more than 5 ton
N_1	**51076**	**13.36%**	Freight transport vehicles up to 3.5 ton (vans, pickup)
N_2	4935	1.29%	Freight transport vehicles from 3.5 ton to 12 ton
N_3	8613	2.25%	Freight transport vehicles over 12 ton
O	3634	0.93%	Trailer weighing over 10 ton
T	890	0.23%	Agricultural vehicles
OT	52	0.01%	Agricultural trailers
Total	**∑382430**	**∑ 100 %**	

In the Figure 1 it has been seen that within the totality of motor vehicles the dominant were those of class M_1 = 82% and N_1 = 14% which include cars and light means of transport of

goods. Since 96% of the motor vehicle fleet consists of classes M_1 and N_1, then it is considered that it is enough to decompose them and further to carry out the relevant calculations.

Other categories include motorcycles, agricultural tractors, trucks, minibuses and buses where all together make up approximately 5% of the fleet, therefore in this paper have been avoided from further analysis due to the almost negligible presence in the total fleet of road vehicles

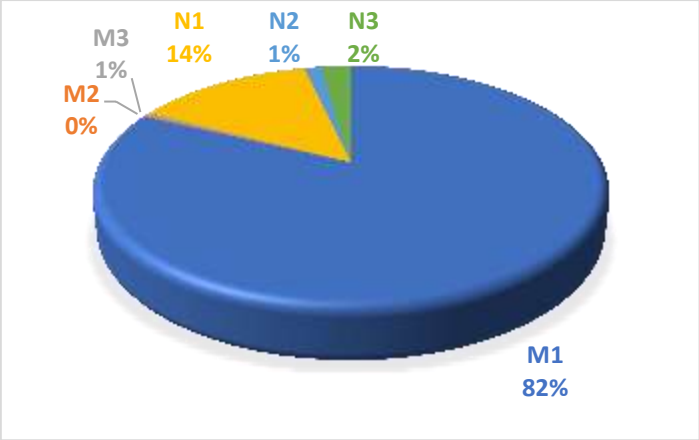

Figure 1. Presence rate of motor vehicles in %.

Emission limits for pollutants from vehicles, which adversely affect health and the environment, are set in European emission standards (EURO standards). EURO standards are used in the Republic of Kosovo for the purpose of gaining the right to import but not for the calculation of the environmental tariff. EURO standards are classified according to the type of vehicle (car, truck, bus) and the type of engine (petrol, diesel) and determine the maximum amount of combustion products that can be discharged into the atmosphere from a vehicle. The implementation of EURO emission standards is the most widely used method to consider the environmental aspect especially in the case of trucks. EURO emission standards set permissible emission limits. Higher EURO numbers mean stricter limits, demanding a reduction in emissions. The standards limit the volume of carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NOx) and particulate matter (PM) and consequently indirectly limit CO_2 when passenger vehicles are considered.

Most EU countries apply regular road tax to passenger motor vehicles, the basis of which is formed by engine volume, number of axles, maximum mass and also carbon dioxide (CO_2) emission values. It is CO_2 emissions that play an ever-increasing role in collecting the regular tax on the use of motor vehicles. Most EU countries base their road tax assessment only on the level of CO2 emissions, others combine this feature with other criteria. The Republic of Kosovo does not apply CO_2 based tax but uniform annual tax for all vehicles based on Law no. 04 / L-117 on the road and ecological tax of vehicles [12]. This law specifies that the road tax for each vehicle with a maximum amount of up to 3.5 [ton] is paid 10 Euros upon registration.

The vehicle fleet in the Republic of Kosovo is categorized according to Euro standards, but not a few in use are also older vehicles, which we are calling "Euro 0" instead of 'before Euro 1', see Table 2.

The results of the Table 2 have shown the presence of Euro 0 vehicles in 11%, Euro 1 was 3.7%, Euro 2 was 11.9% and Euro 3 was 29.4%, respectively together they constitute 56% of the total.

Table 2. Classification and participation according to the Euro norm [2]

Euro Standard	$M_1 + N_1$				KM annual average
	Diesel		Gasoline		
	$N_{vehicles}$	%	$N_{vehicles}$	%	
Euro 6	**18270**	5.1%	**2800**	0.8%	18200
Euro 5	**54173**	15.1%	**4573**	1.3%	11400
Euro 4	**67830**	18.9%	**10560**	2.9%	10200
Euro 3	**91964**	25.6%	**13674**	3.8%	9600
Euro 2	**31207**	8.7%	**11529**	3.2%	6800
Euro 1	**9432**	2.6%	**3898**	1.1%	3300
'Euro 0'	**28625**	8.0%	**10928**	3.0%	2200
∑	**301501**	**83.9%**	**57962**	**16.1%**	**8814**

Table 3. Annual imports (2020) according to EURO standards

Euro standard	2020 Import of $M_1 + N_1$			
	Diesel		Gasoline	
	$N_{vehicles}$	%	$N_{vehicles}$	%
Euro 6	**6003**	21%	**1385**	4.8%
Euro 5	**13034**	45.4%	**1024**	3.7%
Euro 4	**3855**	14%	**290**	1.0%
Euro 3	**2153**	8%	**28**	0.1%
Euro 2	**625**	2%	**11**	0%
Euro 1	**0**	0.0%	**0**	0%
∑	**25670**	**90.4%**	**2741**	**9.60%**

According to the calculation of annual pollutant quantities emitted by the vehicle fleet [2] it results that approximately 4150 tons of CO_2 have been emitted into the atmosphere by the vehicle fleet in the Republic of Kosovo. Considering that 56% of the vehicles were those from EURO 0, up to EURO 3, then at least 56% of this amount (2324 tons of CO_2 / year) has been released from vehicles of these categories.

3. ANALYSIS

Based on data from the Kosovo Vehicle Centre [2], 382430 vehicles from all categories have been registered in the Republic of Kosovo. The average age of the fleet was approximately 16 years. The average annual import was approximately 30,000 vehicles at Table 3 or 12% of the fleet size while the number of vehicles excluded from circulation was approximately 5% of the fleet size. The annual average of kilometres travelled for all vehicle categories have been shown in the above Table 2 was 8814 [km / year]. The annual emission in tons for CO_2 was 4150 [t / year] where almost 2324 [tons of CO_2 / year] contribute to the old vehicles EURO 0, EURO 1, EURO 2 and EURO 3. On the other hand, monitoring of CO_2 emissions and consumption of fuel for new passenger vehicles dates back to Directive 1999/94/EC but the values in g / km for new vehicles were introduced by Regulation (EC) 443/2009 as an integrated approach of the European Community to reduce emissions of CO_2 from light vehicles [13, 14]. This regulation obliges member countries from 2020 the average emissions from cars (class M1) not to exceed 95g CO_2 / km. Regulation (EC) 510/2011 which sets emission standards for commercial light vehicles (class N1 <2610kg empty) not to exceed 147 g CO_2 / km from 2020 [15].

Republic of Kosovo thanks to the technical advantages and the database that Kosovo possesses Vehicle Centre for the fleet of vehicles in circulation and those imported is able to

adapt to European practices of vehicle targeting regarding CO_2 emissions. Another advantage which gradually leads to the renewal of the average age of the fleet and in this case to the presence of more ecological means is the legal restriction for import based on Law no.05/L-132 On vehicles which does not allow import of used vehicles that do not meet at least the standard EURO 4 [16].

4. DISCUSSION AND CONCLUSIONS

Based on our analysis and the annual results of the amount of substances originating from the vehicle fleet of the Republic of Kosovo we have to take into account the measures to minimize them. Within the implementation of the most priority measures should be the harmonization and implementation of European legislation and respectively the directives that set objectives for reducing CO_2 emissions. Due to this, there is a need that CO_2 to be the indicator according to which the size of the tax for the motor vehicle is determined. The application of the so-called 'Pigovian tax' is recommended which means the application of the 'polluter pays' principle. Based on it the vehicle that emits more g CO_2 / km will have the highest tax compared to the other that emits less. Consequently, it is no coincidence that most EU countries apply this principle to reduce negative externalities related to the use of motor vehicles with the effect of stimulating fleet renewal.

Furthermore, the legal strengthening of the measurement of exhaust gases as part of the technical control would postpone the exclusion from traffic of many vehicles, especially the old ones (EURO 0, EURO 1, EURO 2, EURO3) and unmaintained for which the investment and repair would be costlier which would encourage the import of newer tools. In parallel with these recommendations, the Republic of Kosovo should maintain as a criterion for the import of used vehicles the EURO 4 standard, in addition to the EURO 6 standard, which applies to new vehicles (M1), and also restrict the right to import commercial light vehicles (N1) at a higher level of the EURO standard (EURO 3). The import restrictions give their result, as the annual renewal rate of the fleet is approximately 12%, which is reduced in numerical value by the number of vehicles (5%) that complete the life cycle.

Finally, it is concluded that Law 04 / L-117 fails to motivate users of these old vehicles to abandon them and replace them with newer which does not facilitate ecological means from non-ecological ones but creates equal treatment in a useless and unreasonable way. Another incentive measure that would be effective is to minimize taxes on environmentally friendly vehicles (electric, hybrids and battery vehicles).

CONFLICT OF INTEREST

The authors confirm that there is no conflict of interests associated with this publication and there is no financial fund for this work that can affect the research outcomes.

REFERENCES

[1]. Dorri A. Prediction of Pollutant Formation in Diesel Engine Through Numerical Simulation. *Journal of the Faculty of Engineering and Architecture of Gazi University*; 2013; 28(1); 167-172.

[2]. Shala K. and Dorri A. Impact of motor vehicle fleet on air pollution in the Republic of Kosovo. *International Journal of Ecosystems and Ecology Science*, 2021; 11(3); 373-388.

[3]. Dimitrov V. and Dimitrovski D. Analysis of Emissions from Diesel Passenger Cars in North Macedonia. *International Journal of Ecosystems and Ecology Science*, 2019; 9(2); 245-250;

[4]. European Commission (EC) (2007). Directive 2007/46/EC of the European Parliament and of the Council of 5 September 2007 establishing a framework for the approval of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles. https://ec.europa.eu/growth/sectors/automotive/legislation/motor-vehicles-trailers/directive-2007-46-ec_en

[5]. European Commission (EC), (2015). European Commission welcomes Member States' agreement on robust testing of air pollution emissions by cars. https://ec.europa.eu/commission/presscorner/detail/en/IP_15_5945

[6]. European Commission (EC), (2020). Road transport: Reducing CO_2 emissions from vehicles. https://ec.europa.eu/clima/policies/transport/vehicles_en

[7]. Mamalis A. G., Spentzas K. N., Mamali A. A. The impact of automotive industry and its supply chain to climate change, *European Transport Research Review*, 2013; 5; 1-10.

[8]. Buysse C., Miller J., Díaz S., Sen A., Braun C. The role of the European Union's vehicle CO_2 standards in achieving the European Green Deal, *International Council on Clean Transportation*, 2021; 1; 1-22.

[9]. Benöhr M. and Gebremedhin A. Photovoltaic systems for road networks. *International Journal of Innovative Technology and Interdisciplinary Sciences*, 2021; 4(2); 672-684.

[10]. Gebremedhin A. and Zhuri M. Power system analysis: The case of Albania. *International Journal of Innovative Technology and Interdisciplinary Sciences*, 2020; 3(4), 501–512.

[11]. Andrlík B. Taxation of passenger motor vehicles with environmental aspect. *Acta Univ. Agric. et Silvic. Mendel. Brun.*, 2012; 60(7), 9-18.

[12]. Kosovo Law no. 04/L-117. http://www.mei-ks.net/repository/docs/ANNEX_A_-_Laws_published_in_official_gazette.pdf

[13]. Directive 1999/94/EC https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:01999L0094-20081211

[14]. EU Regulation 443/2009. https://www.buildup.eu/en/practices/publications/eu-regulation-4432009-emission-performance-standards-new-passenger-cars

[15]. EU Regulation 443/2009. https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2011:145:0001:0018:EN:PDF

[16]. Kosovo Law no. 05/L-132. http://www.mei-ks.net/repository/docs/ANNEX_A_-_Laws_published_in_official_gazette.pdf