

# TRAFFIC AND DRIVERS SYMBIOSIS: MANAGING BOTH FOR LOWER AIR POLLUTION

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**Abstract:** Air pollution problems in urban areas mainly can be connected with the high amounts of toxic exhaust emissions, generated from the growing use of vehicles that use fossil fuels [1]. Roads in urban areas are full with vehicles, and their management is important not just for smoothing traffic flows, but also for reduction of air pollution. Various ways could be considered in which traffic management can affect local air pollution [2]. But, is not just traffic management that should be considered solely. Attention should be given to the behavior of the drivers, which also has impact on air pollution levels. Therefore, the purpose of this paper is to show the importance that traffic control and management as well as drivers' behavior together have on exhaust emission pollution. In addition to that, measures with their effects in the both categories: traffic management and drivers' behavior are proposed.

**KEYWORDS:** TRAFFIC CONTROL AND MANAGEMENT, DRIVERS' BEHAVIOR, AIR POLLUTION

## 1. Introduction

Growth of the number of vehicles, as well as the expansion of traffic systems are characterized with continuous trend [1]. Although emissions from new vehicles are less harmful than before, the roads in urban areas have become full with vehicles more than ever, most frequently with vehicles which are major air polluters. This concentration of vehicles makes urban air quality unpleasant and often harmful for breathing.

The rising amounts of road traffic emissions are connected with the increase of the fuel consumption in traffic and increase of traffic demand. Road transport presents an energy-consumption sector with a highest growth [1]. In a combination with the continuous growth of fuel consumption and the mileage per vehicle, the vehicles remain in the center of air pollution problem. Therefore, traffic management is important not just from the aspect of improvement of traffic conditions, but also from the aspect of air quality protection.

Although road traffic is a main contributor to air pollution [3], traffic management and drivers' behavior are often analyzed separately from each other. This paper makes an effort to present a comprehensive approach including both components and to suggest measures that could be employed to secure environmental benefits.

## 2. Traffic and air pollution

### 2.1. The impact of traffic management and control on air pollution

An efficient road traffic system is of high importance to every society [3]. Many local authorities face a challenging situation with a steady increase in road traffic, leading to congestion and longer travel times. This is happening despite the measures to reduce congestion, e.g. by improving the traffic control, implementing road toll and stimulating use of public transport and other sustainable alternatives. As a result of congestion, fuel consumption increases together with emissions. In particular during peak hours, the emissions found in cities often exceed acceptable local, national and European limits [3].

Traffic management comprises both "supply side" measures (traffic system management to improve speeds of existing traffic volumes) and "demand side" measures (traffic demand management to improve speeds by reducing traffic volumes).

For example, traffic management may require some physical measures, usually referred to as traffic engineering [2]. Improvements in urban infrastructure can result with a decrease in vehicle emissions, even in the case when all other factors will stay unchanged. But, the improved conditions for traffic flows can offer

only a short-term improvement in urban traffic and only a short-term emission reduction [1]. Uncontrolled vehicle growth, following the road infrastructure improvements, is a negative result on the efforts regarding improvements of urban air quality.

Another way of traffic control is through traffic signals. If this is used not just for smoothing traffic flows, but also for their orientation towards open roads (from one or both sides) where natural ventilation contributes for emission dispersion, the benefits for urban air quality are bigger. Additionally, traffic signal control can successfully promote public transport as more attractive solution, giving a priority in crossroads.

Contribution in emission reduction can be achieved using variable message signs to inform the drivers for the speed limitations, available parking places, traffic calming zones etc. Variable message signs, supported by intelligent system which continuously monitors and forecasts local pollution and dynamically controls traffic signals, can be especially effective for emission reduction. In comparison with the unchangeable speed limitations or signs, variable message signs are changeable during the day, as a response of the change in road and traffic conditions and variations in air pollutions.

In fact, every technology or measure that encourages common usage of vehicles, change in the way of usage of passenger vehicles, promotion of public transport, walking and cycling can reduce exhaust emissions.

### 2.2. Measures for traffic control and management for air pollution reduction

Measures for traffic control and management, which have a positive influence on vehicle exhaust emissions appears in many forms. Most often, they have an impact on traffic operational characteristic, on the way that vehicles have been used, on promotion of sustainable alternatives (public transport, walking, cycling). Numerous measures for traffic control and management are defined, with a potential for exhaust emission reduction, including parking control, park&ride, urban logistics, massive transit systems and improvements in public transport.

However, this kind of measures is faced with the following obstacles [1]:

- problems with the range of the impact – measures focused in central urban zones will have only a small impact on emissions in the broader areas
- political problems – some of the measures, such as increase of the taxes for road toll, fuel taxes and taxes in public transport, politically is very difficult to be implemented.

The following measures are presented in the form of table and could be considered for traffic control and management in order to

decrease high pollution episodes from exhaust emissions.

**Table 1: Measures for traffic control and management**

Measure	Effect
road toll	stimulation of modal change, especially if taxes are 2-3 times higher during the peak hours
synchronization of traffic signal control systems	green waves and reduced idling time
priority for high occupancy vehicles during the peak hours	reduction of the number of vehicles on urban roads
parking payment	modal change and decreased usage of the vehicles
limited entrance for the passenger vehicles and high duty vehicles in the city center	minimization of traffic volumes in city center and increase of the traffic speed
programs for limited expansion of the road space for motorized vehicles	increase of the road space for sustainable modes
traffic calming zones	modal change
public transport priority	modal change
priority for cyclist and walkers; safe crossing	modal change
de-leveled separation of the crossing with major roads	network without signal control (in the long- term)

Source: Made by the authors

Apart of these measures, especially should be emphasized the programs for car-free journeys and programs for decreasing the need for individual journey with a car, as the most significant components in traffic planning and control. Their realization is highly conditioned by the development of all less-polluting traffic alternatives.

Critical to the successful implementation of traffic management measures is the establishment of a traffic management unit at the local level with the ability to plan and implement suitable traffic management schemes [2].

Presented measures for traffic control and management from the aspect of air pollution reduction have a suggestive nature. Before their implementation, a detailed technical studies and research are needed. In any case, modern vehicle technologies and intelligent traffic systems have a significant potential for the solution of air pollution problems in the urban environment and development of sustainable traffic in urban areas [4].

### 3. Drivers' behavior and air pollution

The style of driving the vehicle has high impact on the amount of released exhaust emissions. The most important influence on emission levels for a given vehicle is the driving cycle, with both fuel consumption and pollutant emissions many times higher per vehicle km during acceleration and deceleration than during cruise [2].

Eco-driving is a driving style aimed at preventing environmental degradation by reducing fuel consumption and greenhouse gas emissions, which in turn saves money [5]. Eco-driving offers benefits for drivers of private cars, company cars, lorries and busses, as well as fleet owners. Eco-driving can assist in effectively reducing fuel consumption thereby reducing harmful vehicle emissions and pollutants such as CO<sub>2</sub> which is one of the greenhouse gases that contributes to the climate change [5].

Before proposing several practical advices how to properly eco-drive a vehicle to reduce exhaust emissions, attention is given to other aspects that contribute to the change in drivers' behavior.

These aspects are: drivers' information during the journey and informed buying of new vehicle.

#### 3.1. Drivers' information system during the journey

Advanced information system for the drivers during the journey (GPS), for example by proposing optimal routes, reduces the necessary travelled mileage. In this way, indirectly contributes for the reduction in urban air pollution.

In-vehicles guidance systems provide real-time information for the location of the most congested and polluted places, advising the driver for the alternative routes. In most ideal case, drivers' information should include details for other travelling modes, for example by public transport, availability to the public transport and price, although drivers unwillingly accept public transport as an alternative for its own vehicle.

The use of these information systems imposes the need of more effective wide-range activities for data collection and their distribution to the drivers [1]. In-time and precise distribution of the collected data for air pollution are performed through networks for the surveillance of the level of polluted air and warning systems when the thresholds are exceeded, especially of particles, ozone, nitrogen oxides and sulfur oxides.

But, it must not be neglected that information system for the real situation with pollution levels, except that is helpful for the drivers, has another, even more important effect: contributes for the awareness of the broader public for the impact of traffic emissions on urban air quality. Hence, the system indirectly contributes for the increase of the pressure of the public for reduction of the vehicle emissions [1].

#### 3.2. Informed choice for buying a new vehicle

The best individual contribution from every driver for emission reduction at local and global level could be achieved in the process of buying a new vehicle when an informed choice should be made [1]. Today, when much more is known for the relation between vehicle exhaust emissions and environmental pollution, it is

important that buyers of new vehicle know the consequences of their choice. The best solution is buyers to have available specific information about the environmental performances of the vehicles, so that a decision could be made based on better information.

Information when buying a new vehicle shouldn't be deduced only to the vehicle basic price, registration and insurance costs, maintenance costs of the additional equipment, performances, durability, safety etc. When buying a new vehicle, buyers should be informed also for the fuel consumption and costs, i.e., the total approximate cost for the fuel during the vehicle exploitation period, for the emission amounts of carbon dioxide and other exhaust emissions.

The data, that should be available when buying, most often are obtained during the official tests done before the car model has been offered for sale [1]. Very helpful could be the advices of the official distributors when choosing the most suitable way for reduction of vehicle impact on the environment. Classification of the vehicles in categories according to the environmental performances provides important information about the vehicle impact on air quality and the greenhouse effect.

When the choice is deduced to one selected class of vehicles (as the best according to the needs and opportunities), a vehicle that has a best fuel efficacy should be chosen. Unnecessary vehicle size and weight increase fuel consumption. For example, fuel consumption at vehicles with similar size could vary up to 45% [6].

Most of the countries have fiscal measures (most often referring the fuels) to stimulate the buyers to choose the vehicle with higher fuel economy and to stimulate drivers for eco-driving. Besides that, vehicles that use cleaner fuels and alternative fuels have additional discount [7].

### 3.3. Practical advices for the drivers for exhaust emission reduction

Every driver individually, taking some simple measures and changing his own habits during the driving, could significantly

contribute for the improvement of air quality and pollution reduction [1]. Emissions from every individual vehicle are really small, but because of the total global number of vehicles, an effect in pollution reduction could be achieved if every driver is keeping himself to some simple preventive measures for eco-driving.

Driver behavior has influence on fuel consumption and exhaust emissions; hence, a higher self-responsibility is needed. Moderation in the driving style is useful not just for the environment, but also helps in the continuation of the exploitation period at every component in the vehicle. Frequent stops and starts, aggressive deceleration and acceleration, bad vehicle maintenance often lead to the higher consumption and higher exhaust emissions [1].

Vehicle occupancy rate by several passengers are low and total distances passed with the vehicles are rising [1]. This change causes higher emission concentrations with negative influences on the environment. Although innovation at passenger vehicles has brought higher personal mobility, presenting a flexible and comfort way of personal transit, the current level of usage of passenger vehicles aren't sustainable. Hence, efforts for stimulating of alternatives such as walking, cycling and public transit should be putted. However, it is unreal to expect that the vehicle owners would give up of them preferring other alternative ways of transit [1].

The fact that every driver contributes for increases of the emissions, clearly indicates that should not be expected that only authorities have an obligation for undertaking measures for pollution reduction. For their politics to be effective and to provide realization of the anticipated goals, it is necessary every driver to act individually in the form of eco-driving style [1].

Several simple advices for the drivers that can contribute for the decrease of the vehicle impact on environment and for less air pollution are presented in table 2.

**Table 2: Measures for drivers' behavior and eco-driving**

Measure	Effect
use of a vehicle with low fuel consumption	decrease of the amount of exhaust emissions
avoidance of usage of the vehicle at short journeys	decreased exhaust emission per kilometer
previous planning of the journeys	selection of the optimal routes with low congestion and shorter travel time
car-pooling (more passengers in one vehicle)	decrease of the total number of vehicles on the urban roads
driving with lower speed	decrease of the fuel consumption and emission reduction
driving with constant speed without frequent accelerations and decelerations	fuel savings
preservation of the vehicle gap	fuel savings
avoidance of the constant breaks usage	fuel savings
regular maintenance of the vehicle	fuel savings and emission reduction
keeping the suitable tire pressure	fuel savings
rare usage of the air-conditioner	fuel savings

Source: Made by the authors

Local, as well as global pollution would have been significantly improved if every driver is disposed to use its own vehicle for 30% less than usual, starting from now. Bigger European cities could achieve real results in the environmental protection, if in the next 3-5 years the traffic of passenger vehicles is reduced for 30% [8].

These and other measures that modify drivers' behavior have the biggest potential for reduction of the total vehicle emissions [1].

#### 4. Conclusion

Mobility needs in urban areas are constantly rising and most often the first choice for urban travel is passenger vehicle. The growth of the number of passenger vehicles on urban roads worsens the conditions of traffic flows, but also has very negative impact on urban air quality.

For dealing with this situation, a comprehensive approach is needed, taking into account traffic management and control and drivers' behavior. This means that from one side, a maximal effect in the traffic activities is necessary to be achieved. From the other side, special attention should be dedicated to the eco-driving style of the vehicles and changes in drivers' behavior in that direction. Eco-driving training is well-known as a feasible strategy to decrease fuel consumption and emissions [9].

Therefore, this analysis presents several measures together with their effects that can achieve reduction in air pollution during the congested traffic flowing on the road network, changing the drivers' behavior at the same time.

Traffic control and management is not a guaranteed, one-shot cure for traffic congestion. It needs constant adjustment and enforcement to be effective. Traffic management requires effective planning, implementation and enforcement skills [2].

Drivers' behavior has influence on fuel consumption and exhaust emissions; hence, a higher self-responsibility is needed. Following the eco-driving advices, every driver could contribute for decreasing of the local, as well as global emission levels.

Realization of the goal for significant reduction of emissions until 2030 it will be only possible by using an integrated approach which includes traffic management and control and changes in the way of driving (for reduction of the distances passed and fuel consumed). Also, the commitment of the authorities to maintain enforcement of proposed measures would be particularly critical [2].

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