



## RELATION BETWEEN ROAD TRAFFIC AND ENVIRONMENT

Ivo Jakovljević<sup>1</sup>, Marinko Jakovljević<sup>2</sup>

*1 Croatian Academy of Arts and Sciences – Scientific Council for Traffic, Croatia*

*2 HIVIA d.o.o. – Zagreb, Croatia*

### Abstract

The paper analyses and indicates the problems in road traffic due to air pollution, especially emissions of CO<sub>2</sub>, the main greenhouse gas responsible for climatic changes. Almost 20 per cent of total air pollution is generated by road motor vehicles. By the year 2020, the international documents on air protection against climatic changes plan a reduction of fossil fuels in favour of alternative bio-fuels, natural gas and hydrogen. Constant growth and development of population result in increasing volume of traffic and energy consumption, everyday social components of the modern society. The history of humans up to now, and especially in the last two centuries was a history of satisfying the increasing material needs at the account of other living beings, at the account of healthy environment, and as today's situation shows, at the account of the future generations. This would bring the quantity of CO<sub>2</sub> emission, the main greenhouse gas that impacts the climatic changes, to a harmless human measure. This is precisely the reason, with the aim of necessary prevention, that the problem of global impact of traffic – primarily road and rail traffic – on the environment needs to be highlighted.

*Keywords: emission, CO, traffic*

### 1 Introductory considerations

The annual increase in the number of vehicles is the main reason for an increase in the emission of greenhouse gases in urban environments. In bigger urban environments there is greater impact of road vehicles on air pollution, health of the population and traffic safety. Finally the architects also came to the conclusion that the construction of big million-sized cities should be avoided. In million-sized cities there is a much larger number of vehicles, and the citizens travel over greater distances, and there is also greater loss of travel time, even up to ten times. The distances between the place of residence and the workplace are greater, and this also disturbs the safety of traffic participants.

Thus, for instance, in Croatia, 80 per cent of traffic accidents occur in the cities and inhabited areas, according to the analyses from the Police Bulletin – No. 25 for the year 2008. A special EU Fund gives incentives and assists all those programs and projects that contribute to the establishment of cleaner traffic, by implementing the technical and organisational measures in passenger and cargo transport. This refers especially to the introduction of alternative fuels, hydrogen, liquefied petroleum, compressed natural gas, bio-gas, bio-diesel, and bio-ethanol, and also plants equipped with batteries and fuel cells.

Although the entire today's traffic, including also air and maritime traffic, have their share in pollution, it seems that only road transport can do most for the reduction of the greenhouse gas emissions. A large amount of combustion of petrol and diesel in vehicles has brought to the greenhouse effect and ozone layer cracking. When one adds here acid rains, that have destroyed the forests due to sulphur in fuel – undesired component of crude petroleum, the result is endangered health of humans and survival of pure nature.

Therefore, intensive search is performed for alternative sources, and many see the best and cleanest solution in electrical energy. The analyses show that in the period from 2005 and 2030, the consumption of energy sources in the world will mark an increase of as much as 50 per cent. Strong economic development and growth of population in the developing countries are, namely, the main argument of these energy forecasts. An analogue forecast is that the percentage of share of liquid fuel will be reduced by the year 2030 from the current 37 to 33 per cent. In this field of air and environment protection the Croatian Government has brought several necessary legal standards. The future lies in gas, electricity and hydrogen.

Up to now, the greatest success in replacing petrol and diesel belongs to liquid petroleum gas, known under designation LPG – which consists of propane and butane. The equipment for use onboard vehicle can be simply installed in any car with a petrol engine. However, this still fails to be a long-term solution since LPG is produced using the process of petroleum distillation, and therefore a more rational solution is the usage of natural gas - CNG. This environmentally-friendly operator, primarily consisting of methane, still exists in abundance, and it will disappear when there will be no petroleum.

The biggest problem is that the equipment for usage is extremely demanding, more expensive and heavier than LPG, and the installation of equipment for the CNG propulsion of vehicles reduces the vehicle capacity, i.e. in case of passenger cars one to two seating places in the vehicle are lost. Besides, it is necessary to compress it to more than 200 bar and carries the designation: CNG (compressed natural gas).

**Table 1** Comparison of emissions of LPG propelled vehicles in relation to petrol and diesel:

Comparison with petrol	Comparison with diesel
75% less CO (carbon monoxide)	90% less hard particles
85% less hydrocarbons	90% less NO (nitrogen oxide)
40% less NO (nitrogen oxide)	70% less impact on ozone formation
87% less impact on ozone formation	60% less CO (carbon monoxide)
10% less CO <sub>2</sub> (carbon dioxide)	

## 1.1 Biological fuels

At the end of 1930s the production of synthetic petrol out of stone coal using the hydration process under high pressure started in Germany. Today, alternative petrol and diesel fuel is produced mainly from biological raw materials and waste. The majority of manufacturers offer models propelled by E85 fuel, which consists of 85% bio-ethanol and 15% petrol. Such mainly naturally obtained fuel is not only replacement for fossil fuel, but rather enables improvement of running performance and reduction of harmful gases. Bio-diesel that is produced mainly out of rape and sunflower oil can be used in diesel cars without any additional refurbishing of motor vehicles.

## 1.2 Compressed natural gas

Natural gas has great expectations in the future, since only the part that is burnt and released into the atmosphere on oil fields could be sufficient to propel all the cars in Europe. This would solve a large part of ecological problems, since combustion generates 50 per cent less harmful elements. The engine power is reduced by about 5 per cent, but the engine becomes more flexible and quieter. Besides, lower peak temperatures prolong the engine service life, especially the catalyst. Therefore, an increasing number of vehicle manufacturers offer on the market models that use natural gas, designated: CNG.

The problem lies in the demanding gas tanks in the passenger car bodies. Thus, to store an energy equivalent of 10-litre petrol, 40 litres of natural gas have to be compressed to a pressure of 250 bar. Besides, when filling a high-pressure tank 1kWh of electrical energy is used per kilogram of filled gas.

### 1.3 Fuel cells

Since 2003 buses produced by Mercedes, type Citaro propelled by fuel cells have operated in the European metropolis, and soon the fuel cells will be used in passenger cars as well. These are through batteries, which generate electricity by reaction between hydrogen and air. There are several types, and today the most used ones are the simplest, membrane fuel cells. The main advantages include higher level of energy efficiency compared to conventional engine and completely clean operation, since they release water vapour.

In tanks located in the floor of the vehicle there are 20 to 30 litres of hydrogen, compressed to 700 bar. They consist of membrane, electrode and separator plate and they are quite simple, but at the same time very expensive. The price is higher due to the membranes out of phluoro-nitrated polymer and platinum that serve as catalyst. Approximately one gram of platinum per kilowatt of the engine power is needed.

It is still the opinion that long-term high possibilities are offered by hydrogen and the work is done on several concepts of electric cars supplied by the current from the hydrogen fuel cells. Due to the resulting problems regarding price and reliability, all this has been prolonged to the year 2010. BMW went farthest. They have been preparing series production of Hydrogen 7, that is, limousine type: 760-i, hydrogen-propelled.

### 1.4 Engines as commercial vehicles

In vehicle homologation CO<sub>2</sub> emissions are limited as well. The testing method and the limit values are given in the ECE Regulations R101 – Measuring of carbon dioxide emissions and fuel consumption of motor vehicles, i.e. in the EC 80/1268 Directive - Annex 2004/3. The permitted limits of exhaust gas emissions for CO, HC and NOx are also being reduced.

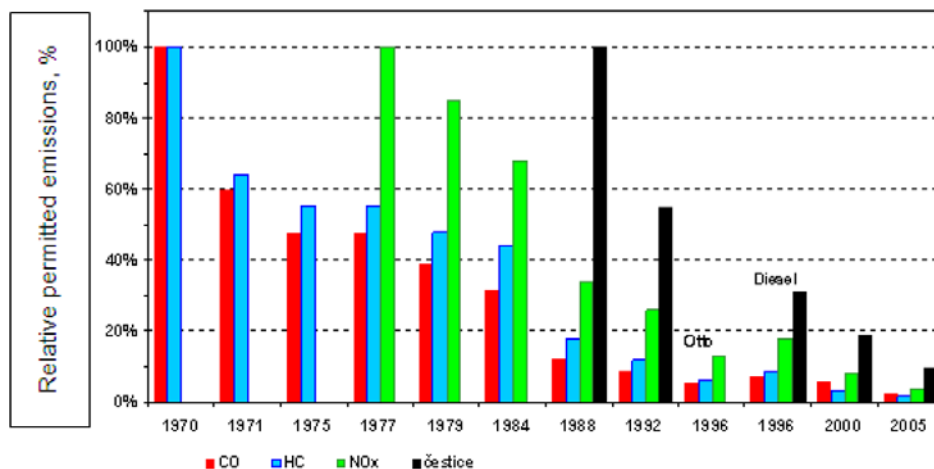


Figure 1 Reduction of harmful emissions in the EU countries for M1 and N1 category vehicles

## 2 Influence of greenhouse gases of modern transport

In the troposphere there is a layer of natural greenhouse gases: mostly water vapour, less carbon monoxide and dioxide, as well as other compounds in smaller quantities. They let the Sun rays pass through and they warm up the surfaces on the Earth. Thermal infrared rays are reflected from the Earth back to the layer of the greenhouse gases, but this layer stops them and prevents their further penetration into the higher layers of the atmosphere. Therefore, the most favourable temperature of about +15°C is maintained on the Earth, since without this the temperature would be: -18°C.

In this way the greenhouse gases act like glass which in agricultural greenhouses maintains in winter the temperature which is favourable for the growing of vegetables. The combustion of fossil fuels at thermal electric plants, industrial plants, automobile engines, households, and by setting fire to big areas of tropical forests produce above-average levels and big amounts of carbon dioxide - CO<sub>2</sub>, which unnaturally increases the concentration of greenhouse gases in the troposphere, and therefore increasing heat is reflected to the Earth. Therefore, the majority of scientists think that this is the reason why the Earth is getting increasingly warm. In order to prevent the catastrophic warming of earth climate, the international scientists in the Japanese city KYOTO accepted a Protocol which obligates the United Nations governments to implement the measures for the reduction of CO<sub>2</sub> emissions.

Consequently, the scientists warn that, for instance, the ice climate of the Antarctic will become subtropical, and because of the Earth's rotation around the Sun it is becoming elliptical, and this is linked to the occurrence of raising the sea level and to flooding of the coastal regions and lower islands. This is related also to the occurrence of drying-up of arable land, as well as the appearance of climatic disturbances, with fatal hurricane storms, etc.

In the formation of the anthropogenic greenhouse effect CO<sub>2</sub> accounts for 50 per cent, CH<sub>4</sub> for 21 per cent, the newly formed chlorofluorohydrogens account for 17 per cent, and O<sub>3</sub> for 7 per cent, then N<sub>3</sub> (bi-nitrogen oxide) and other gases account for 5 per cent.

The greenhouse effect is one of the biggest problems of the present time. It causes irreversible changes in individual eco-systems, because plant and animal species are becoming extinct – due to rise in temperature on the road. It is obvious that humans are changing the chemical composition of the atmosphere, including physical and chemical processes that occur in it. The fact is that the CO<sub>2</sub> emissions from road traffic most pollute the atmosphere, and technological innovations are used to reduce CO<sub>2</sub>. The tendency is to improve the technology of combustion of the fuel - air mixture in engine cylinders to achieve reduction to 10 grams per kilometre. Therefore, bio-fuel for engines is used, and the construction of vehicles with electric propulsion, and then usage of combined transport by railways, etc.



Table 2 Values of CO<sub>2</sub> emission in passenger cars

The UN Commission for Europe estimated that total ecological damages caused by road traffic range around 154 million euro, i.e. on the average about 2.5 per cent of domestic product of these countries for every year. The recommendation is to use bicycles as much as possible,

especially for younger persons, since the bicycle consumes least energy per travelled kilometre (27kJ) compared to 560 kilojoules per passenger by train or even to 2850 kilojoules per passenger by car with petrol engine.

What is interesting is the contribution of CO<sub>2</sub> emission values in world manufacturer of passenger cars for 2008 and 2009. The presented graph shows record CO<sub>2</sub> emission reduction made by TOYOTA, which is followed by the factories Honda, Ford, Audi and Mercedes.

### 3 Instead of a conclusion

The usage of alternative fuels today is applied also in public transport of the City of Zagreb as part of the “Intelligent Energy for Europe” Programme. Already since June 2007 the City of Zagreb has been carrying out a pilot project of operating eleven city buses using biodiesel as fuel. This has proven successful, and the activities of purchasing green vehicles using environmentally-friendly fuels have continued. In order to reduce the CO<sub>2</sub> emissions in road traffic, one can see today in coastal part of Croatia and on the islands the constructed windmills that provide electricity so as to reduce the usage of thermal electric plants and for the sake of ecologically healthier environment.

Apart from harmful emissions of exhaust gases from motor vehicles, there is also asphalt wear and tear of the carriageway layer, tyres, brake disks and linings, as well as loss of lubricants from the engine and vehicle transmission mechanisms.

The recommendation, therefore, in road construction is for the road designers to take care about the road geometry, and to construct the roads with as few ascents and dangerous curves as possible, because this also contributes to ecology, as well as greater road traffic safety. Today’s technology of construction and the existing specialised construction machinery allow the building of tunnels and overpasses in overcoming natural barriers.

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