PERIODICA POLYTECHNICA SER. CIV. ENG. VOL. 46, NO. 1, PP. 95–101 (2002)

ENVIRONMENTAL IMPACTS OF POLLUTANTS' EMISSION IN URBAN TRANSPORT

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Received: Sept. 20, 2000

Abstract

This paper is based on two research reports prepared at the Budapest University of Technology and Economics in 1994 and 2000, analysing the emission parameters of mostly used motor vehicles on working days. The research conclusions raised serious concerns about pollutants emission and pointed to fundamental problems of the greenhouse effect and its impact on the environment.

Keywords: climate change, global warming, emission, air pollution, greenhouse effect, environmental impact.

1. Emission of Pollutants in Urban Transport

Vehicles taking part in Budapest's urban transport can be categorized as follows: passenger cars (89.1%) and the rest, like emergency vehicles, semi-trailers, fire engines (10.9%), buses (urban transit of BKV), coaches (Volán), special cars, light and heavy trucks plus others. In 1993 the average age of the vehicle fleet in Hungary was 10.37 years for cars [1], 10.25 years for buses, 9.4 years for heavy trucks, and 9.7 years for trailers. The rates mentioned above are in close correlation with the pollutants' emission of a category or a certain vehicle type, and ageing vehicles' emission is generally much higher than that of a group of younger vehicles in the same category or of same type [8]. The passenger car fleet is composed of diesel and gasoline fuelled vehicles. Unfortunately, the number of cars running on alternative fuels is negligible for the given time. Since 1993, registered new cars are all equipped with catalyzer, which fact contributed considerably to the reduction of pollutant emission.

In 1999, the number of vehicles registered in Budapest was 535.520. *Fig. 1* shows the structure of passenger car fleet by manufacturers.

In the research report mentioned above (1994), the estimated emission values of passenger cars were published for 1995 (*Table 1*) and for 2000 (*Table 2*), which can be compared to the values actually measured in 2000. The differences between the estimated and the measured values can easily be observed. The difference is due – among others – to the uncertainties of forecast especially in engineering design [7]. Who could have imagined such a substantial change of the Hungarian vehicles'

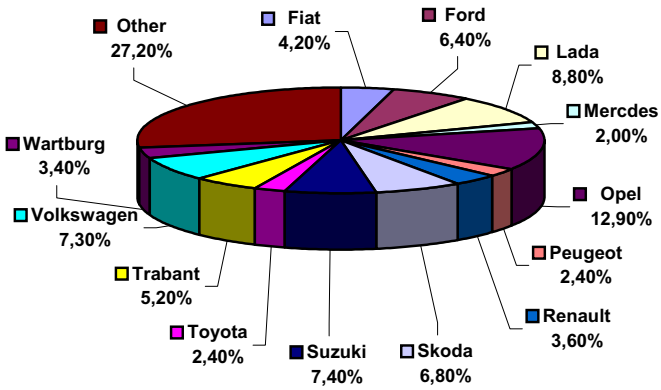

Fig. 1. The structure of Budapest passenger car fleet by manufacturers (2000)

fleet in 1990? However, in the field of engineering design it is common to think forward to 15 or 20 years! To face that challenge is almost unavoidable.

Table 1. Estimated emission values of passenger cars (1995)

Speed km/h	CO g/km	CH g/km	NO NOx g/km
10	53.2	5.22	1.47
20	34.2	4.12	1.41
30	25.0	3.42	1.43
40	20.7	2.74	1.45
50	**15.9**	**2.47**	**1.51**
60	11.2	2.34	1.66
70	8.1	2.19	1.91
80	7.3	2.13	2.15
90	7.7	2.14	2.36
100	9.1	2.18	2.58
110	11.8	2.27	2.79
120	15.4	2.38	3.03

CO pollution has slightly been reduced recently, due to the moderate modernization of the vehicles fleet. The widespread use of diesel engines, first of all in light trucks helped a lot too [6].

The reduction of the pollutants' emission is substantial, if the values estimated for 1994, or those estimated for 2000 – 4.9 g/km emission at 50 km/h speed (urban speed) – are compared to the real values measured in 2000 (*Table3*). The estimated emission is three times more than the measured one, which has to be considered as a very good result, even if part of it should be attributed to the pessimism of the

Table 2. Estimated emission values of passenger cars (2000)

Speed km/h	CO g/km	CH g/km	NO NOx g/km
10	21.8	2.58	1.08
20	12.1	1.64	1.09
30	8.4	1.24	1.13
40	6.3	1.03	1.20
50	**4.9**	**0.89**	**1.28**
60	4.3	0.70	1.38
70	3.7	0.56	1.51
80	3.7	0.53	1.63
90	3.8	0.53	1.74
100	3.9	0.55	1.90
110	4.0	0.57	20.8
120	4.1	0.59	2.32

forecasted. Besides the pollutants already mentioned, the problem of carbon dioxide emission has to be mentioned, since that is the dominant source of air pollution, and presumably mainly responsible for global warming and climate changes.

Table 3. Emission of different categories of vehicles in Budapest, 1999

Vehicles	CO emission g/km
Passenger car	1.53
Cab	1.36
Volán bus	3.78
BKV bus	3.0
Light truck	0.80
Heavy truck	3.47
Semi trailer	3.86
Special car	2.74

2. Global Warming and Climate Changes

Together with carbon monoxide, the climate changes are principally blamed on greenhouse gases, primarily on carbon dioxide (CO_2). It is assumed that water evaporation in the atmosphere and CO_2 emission increase the natural greenhouse effect. The carbon dioxide emission does not originate only in the transport sector [3]. The burning of fossil fuels for energy production, heating, manufacturing, land-use, transport and several other industrial activities are classified among the global

sources (*Fig. 2*). The transport sector is composed from road, rail and air transport as well as navigation all being sources of CO_2 emission; the most important one among these pollutants is, however, the road transport [7].

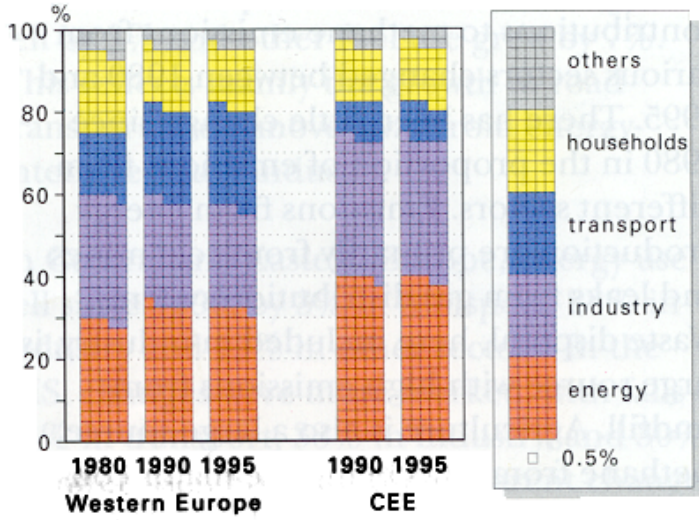

Fig. 2. Sectoral CO_2 emission

In the European Union carbon dioxide emission rose by 41% from 1985 to 1996, which is a considerable increase (*Fig. 3*) [5], and it was one of the key issues discussed at the Kyoto summit. The main topic of that meeting was to find measures to reduce carbon dioxide emission. The participating States have agreed to decrease CO_2 emission by 8%, back to the level of 1990, [4] which obligation means of course different values for different States. The road transport is responsible for 85% of the CO_2 emission of the transport sector, which rate could not be disregarded. On a global level, the most important CO_2 emission sources in the world are North America and Eastern Europe. Nevertheless, Third World and developing countries should not be forgotten either in this respect. In these countries the economic development, industrialization and urbanization is often explosion-like and this can produce serious environmental damages.

Future CO_2 emission depends entirely on traffic intensity (variation of traffic volume) and on the practical implementation of achievements of technological progress and research. In Western Europe several research programs are under way to develop new environmental-friendly fuels. Hydro-carburant, for instance is being tested in one of the bus lines in Paris. Maybe it can serve as a solution for the runout of non-renewable energy resources. Although some researches are in the initial stage yet, their results are already promising.

Global warming, caused by human activities, may have several unexpected and unforeseeable consequences, like the increase of sea level (a 10–25 cm increase

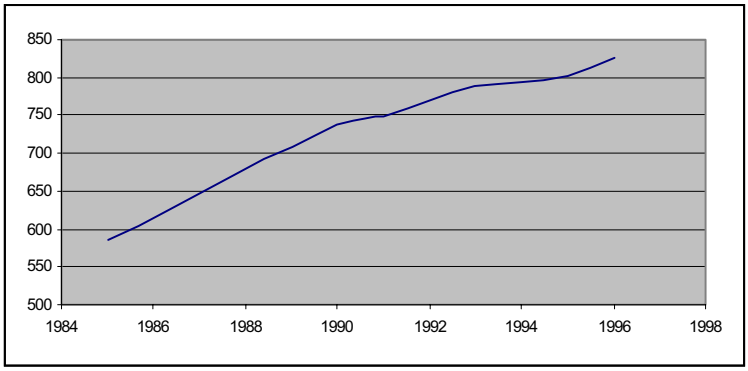

Fig. 3. CO_2 emission of EU transport sector (million ton/year)

has been observed in the past hundred years), melting glaciers and sea ice, augmenting temperature on the Earth, changing precipitation and the intensity of storms, and leading possibly to other changes, unknown at the moment. The environmental impacts on local, regional or global scale are uncertain and unpredictable. These effects of climate changes caused already not only meteorological disasters, but they had considerable impacts on fauna and flora, on the ecosystems, human health and last, but not least on the economy. What might be the social cost of the sea level rise on a global scale? In the Netherlands protection against a one meter increase of the sea level has an estimated cost of US$ 12.300 million. In Poland that cost would be US$ 1.400 million, while in Germany it equals US$ 23.500 (1995 US$) [3].

In our study CO_2 emission was analysed from two different aspects: emission per capita, and emission per GDP (*Fig. 4* and *Fig. 5*). A 3% reduction of CO_2 emission in Western Europe from 1990 to 1995 resulted from the economic reorganization in Germany and the switch from coal and natural gas to electricity in the industry and in the households. In Central and Eastern Europe, as well as in the Newly Independent States (Ukraine, Russian Federation etc.), the 20% drop of emission is caused mainly by the deep recession and the restructuring of the economy. The high CO_2 emission per capita in Luxembourg can be explained by the impacts of a huge steel industry compared to the small number of inhabitants, plus the relatively cheap fuel prices. In Central and Eastern Europe (3.3 tons/US$) and the NIS (2.4 tons/US$) the CO_2 emission per GDP is much higher than that in Western Europe (0.55 tons/US$) which is mainly due to the inefficient and improper use of energy [3].

3. Conclusions

Although Hungary is still in an early stage of conscious and justified investment in the protection of the environment, it can be stated, that the country is on the

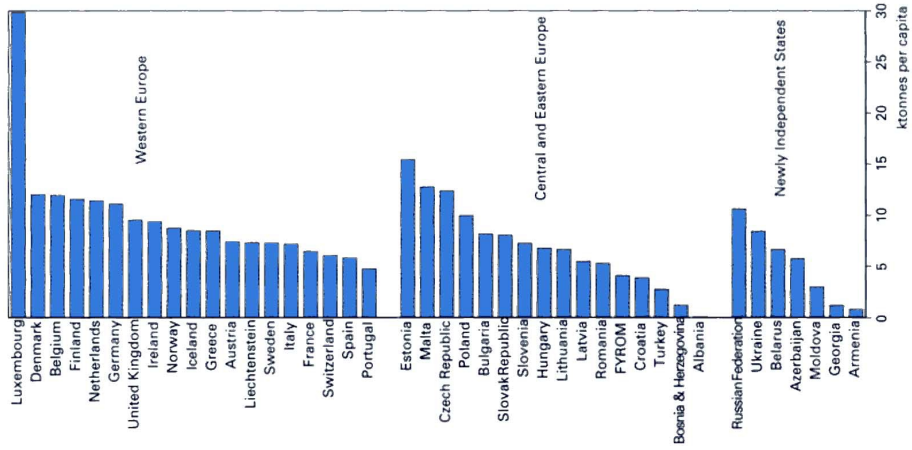

Fig. 4. CO_2 emissions per capita in Europe (1994)

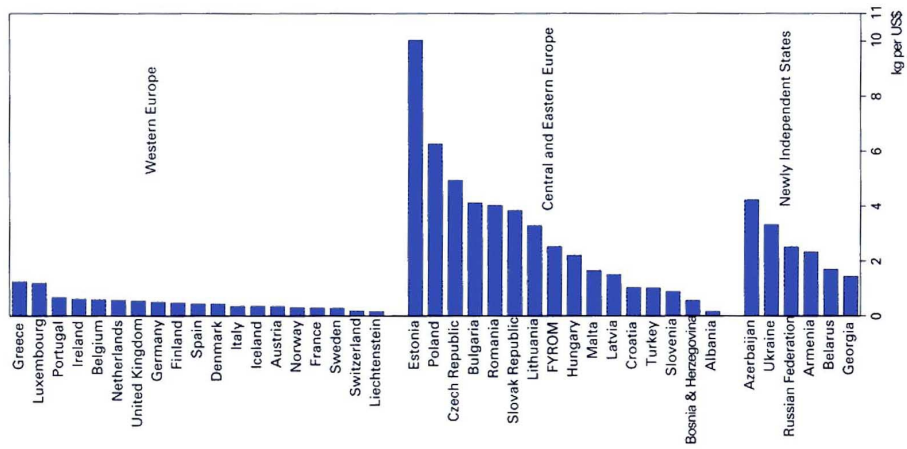

Fig. 5. CO_2 emissions per GDP (1994)

right track, contributing to a ‘cleaner air in Europe’. The outdated vehicle fleet is changing rapidly, there is already considerable progress achieved compared to the situation of the early nineties.

Joining the European Union requires to accelerate the replacement of the ageing road vehicles with new, less polluting ones, in compliance with the relevant EU Directives and strictly observing the critical level of the WHO guideline for protection of the environment and human health.

Humankind is deeply concerned about global warming and climate changes, so in road transport we have to do our best to decrease the air pollution to create a healthier environment.

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