International Journal for Quality research
UDK – 006.35(4)CEN:621.43.068
Professional Paper (1.04)

Changes in GHG Emissions and Euro Standards

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Abstract: *An enormous price increase of crude oil, limited fossil resources and the impact of greenhouse gas (GHG) emissions on global warming have strengthened the efforts to develop alternatives- renewable to the classical-oil fuel. The world leading manufacturers of the motor vehicles have relatively easily satisfied increasingly more stringent EURO standards, ECE Regulations or EEC Directives. The vehiclemanufacturers of Serbia may satisfy EURO standards primarily by purchasing the appropriate foreign made engines. Based on the analysis presented in this paper, it is concluded that Florida model with diesel engine, is very environmentally friendly vehicle for our conditions.*

Keywords: *GHG, Environmental, Euro standard*

1. INTRODUCTION

In 21st century energy supply problems are standing for every man. Prices of oil, natural gas, coal are rising higher and higher. Governments of many states discuss using of renewed kinds of energy such as bioethanol, biodiesel, energy of water, wind, sun and so on.

Alteration and growth of fuel costs in the world market are often caused by war and political crisis in the regions abundant with raw oil and natural gas. When we also mention that the recorded stocks of oil according to certain authors are enough for the next 30 to 50 years of economical exploitation, it turns out that this is the right moment for broader introduction of alternative fuels. That task will not be easy given the adventages offered by fuels of fossil origin from the aspect of costs, available infrastructure and energetic value per unit of volume and consequently huge autonomy of mobility. Producers and distributers of petrol (gasoline) and diesel will use all the measures to try to maintain the achieved position on the market, where huge profits are made and a large number of workers employed. Producers of petrol and diesel will initiate large research and development activities to the end of improving the fuel quality, reducing bad ingredients in exhaust emissions such as sulphor, lead and their compounds and facilitating meeting severe environmental standards imposed on vehicle producers.

2. GREENHOUS GAS EMISSIONS

For over two decades politicians and ecologists have been imposing on automotive industry new and growingly rigid regulations on allowed exhaust emission. While doing so, they do not consider arguments of vehicle producers that automotive industry is not the biggest polluter of environment and the cause of greenhouse gas (GHG) emissions. The fact that the claims of automotive industry are argumented is best proven by an overview of world energy consumption by production resources of energy, as shown in Figure 1. From Figure 1 one can easily see oil based energy consumption amounting to 37% out of total energy consumption. Given that oil is used as driving energy for many industrial branches, one may conclude [1], that around 12 % belongs to automotive industry (passenger cars

and commercial vehicles). The main components of automobile exhaust are carbon dioxide (CO_2) and water vapor (H_2O). Carbon dioxide is the most important anthropogenic greenhouse gas (GHG).

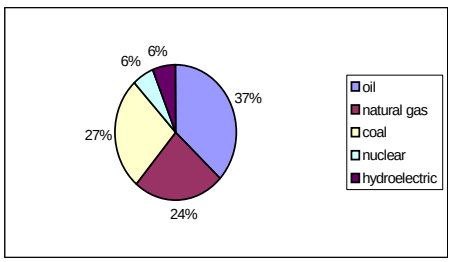

Figure 1.- World Energy Consumption

On the other hand, it is evident that huge quantities of CO_2 have been released into atmosphere while the largest polluters are energy plants. The most developed countries in the world are also polluters according to estimates measured in tons of CO_2 per 1 km^2 or per inhabitant, as you may see clearly from Table 1.

Measured through CO_2 emission, the biggest world polluter is USA with 1,616 million tons, the second biggest is China with 1,021 million tons followed by Western Europe with 955 million tons of CO_2. On the other hand, Japan with 894 tons has the biggest CO_2 emission per 1 km^2 of territory followed by Western Europe with 264 tons of CO_2.

The USA is currently the biggest consumer of energy in the world, although at current levels of growth, it is possible that in the future China could become the leading energy consumer. Energy usage in the transportation and residental sectors (about half of USA energy consumption), as it can be seen in Figure 2, is largely controlled by individual domestic consumers. Commercial and industrial energy expenditures are determined by businesses, government entities and other facility managers. National (USA) energy policy has a significant effect on energy usage across all four sectors.

Table 1

Country/ region	**CO_2 emission in millions of tons**	**CO_2 emission in tons per inhabitant**	**CO_2 emission in tons per 1 km^2**	**Number of vehicles per 1000 people**	**Percentual increase of CO_2 emission in the period from 1990 to 2004**
USA	1,616	5.5	172.6	782	19
WEST EUROPE	955	2.5	264	545	6
JAPAN	338	2.7	894	586	23
CHINA	1,021	0.8	106.4	21	67
INDIA	301	0.3	91.6	12	88

The Transportation sector includes all vehicles used for personal or freight transportation.

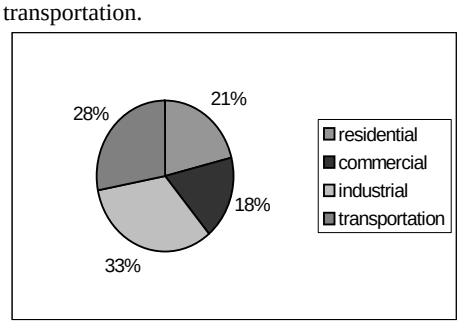

Figure 2. USA Energy Usage by Sector in 2004

Out of the energy used in this sector, approximately 65% are consumed by gasoline-powered vehicles, primarily personally owned.

Diesel- powered transport (heavy trucks, trains, merchant ships, etc.) consumes about 20%, and air traffic consumes most of the remaining 15%. On the other hand,during the past 20 years, world oil consumption has averaged approximately 70 million barrels a day. In 2005, consumption is expected to be just under 84 million barrels a day, 20 per cent up.

According to the protocol adopted in a Japanese town – Kyoto in 1997, which was signed by 150 countries, signees undertook to reduce the gas emission by 2012 by 5.2% at

least in reference to the level in atmosphere recorded in 1990. Because of such global requests for reduction of hazardous gas emission, the pressure made on automotive industry will not decrease, regardless of the fact that it has worked very hard to reduce hazardous gases and particles in the last 15 years and tried to highlight that other branches of industry were much bigger polluters on a global level. However, one should bear in mind that emission of hazardous gases and particles takes place in highly populated cities and along highways, which results in high concentration in these zones populated with large number of people. Therefore, broader application of alternative renewable fuels is one of solutions achieving double effect: environmental protection and saving of standard fuels of fossil origin whose reserves are limited.

3. THE LEVEL OF EURO STANDARDS FULFILLMENT

Currently in vehicle development, a reduction in fuel consumption is one of the key criteria on which a new vehicle is assessed. Engine and vehicle manufacturers, as they invest millions striving to meet current and future emissions legislation, dream of nearly infinitely abundent superclean alternative fuel that could be burned in an unmodified present-generation engine, either neat or blended with regular diesel (or gasoline).

According to the official data, there are in total 800 millions or so of registred motor vehicles, out of which over 600 millions are passenger cars. During the past few years over 65 millions of new vehicles have been produced out of which over 45 million passenger cars, as it can be seen in Figure 3, with the tendency of further growth [2]. Certain quantity of worn-out vehicles is withdrawn from exploitation every year.

If this kind of linear growth continues, by the year of 2025 there will be well over one billion vehicles on the world' s roads.

The quantity of CO2 in exhaust gases is in direct proportion with fuel consumption. However, many vehicle technologies are commercially available today to reduce GHG emissions. On the other hand [3], the European Union (EU) has its own set of emission standards that all new vehicles sold in EU member states must meet. Currently, emissions of NOx, HC, CO, and particulate matter (PM) are regulated for all road vehicles, trains, barges and "nonroad mobile machinery", but excluding seagoing ships and airplanes. For each vehicle type, different standards apply. European Emission standards for passenger cars and light commercial vehicles (Category M1) are summarized in the following Figure 4 (implementation dates) and Figure 5 (limits emissions).

In 1950. there were only 70 million cars, trucks, and buses on the world' s roads. By 2006. there were over eleven times that number, or about 800 million vehicles. This expansion has been accompanied by a similar growth in fuel consumption.

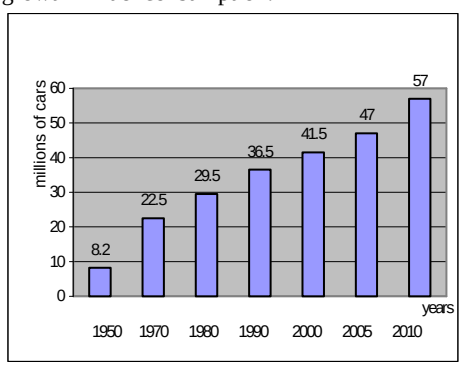

Figure 3. Passenger cars production in world by years (forecast for 2010)

Europe has come a long way in reducing exhaust emissions. With the latest EURO IV standards taking effect in 2005, emissions levels of carbon monoxide (CO) and combined emissions of hydrocarbons (CH) and nitrogen oxides (NOx) have been reduced by 97% since 1970, when emissions standards were first introduced. The most significant reductions will be achieved between 1992-2005, with CO emissions reduced by 82%, combined HC+NOx by 69% and particulate matter (PM-from diesel engines) by 82%.

The European automotive industry, which is assembled in the European Automobile Manufacturers Association (ACEA), bound itself to reduce the average carbon dioxide emission of their entirety of vehicles to 25% between the years 1995 and 2008, from averagely 186 gCO2/km (1995) to averagely 140 gCO2/km (2008) and new plans limit (European Commission) of 120 grams of CO_2 per kilometre by 2012.

Contamination	Environment policy (Legislation)		Year
			1990 1995 2000 2005 2010 2015
Air Pollution	Emission Reduction CO, HC, NO_x, particles	EURO 0 (1988) EURO 1 (1992) EURO 2 (1996) EURO 3 (2000) EURO 4 (2005) EURO 5 (2009?)	
Global Warming	CO_2 Reduction		
Energy Issues	Renewable Energy		

Figure 4.- Environment policy of the emission reduction-EURO standards in EU

Change in CO_2 emission from 1990 to 2003 for some countries, is illustrated in Figure 6. Comparing CO2 emission in 2003 to 1990 levels, the USA emissions were up by 5%, the USA emission were up by 5%, Japan 11%, Serbia 11% and India 50%. Based on calculations for diverse foreign car models and Zastava Florida car, levels of CO2 emission in tons per 10,000 travelled kilometers (45% highway and 55% city driving) are more clearly illustrated in Figure 7.

Fig. 7 clearly shows that Florida with diesel (EURO 4) engine and Honda Hybrid are environmentally friendly vehicles, because the quantity of CO_2 in exhaust gases is in direct proportion with fuel consumption. On the other hand, fuel economy is not a fixed number, it varies based on many other factors, can vary significantly: aggressive driving (speeding, rapid acceleration and braking), observing the speed limit, driving conditions, vehicle maintenance, variations in fuels etc.

The strong pressure on the automotive industry, especially on producers of passenger cars to reduce the exhaust gas emissions of their cars to a notably extent, has caused the automotive industry to detect the dimension of their contribution to the entire exhaust gas emissions.

In order to meet the requested standards, the vehicle manufacturers have to go on with continuous researches and innovations of the engine and its equipment, thus spending significant financial resources. The exhaust gases pollution level is highly effected by the fuel quality, so that the reseaches are focused towards that direction. The world leading manifacturers of motor vehicles, first or all due to the fact that they have had their representatives in the Committes where a new legislations have been passed and preliminary announced.

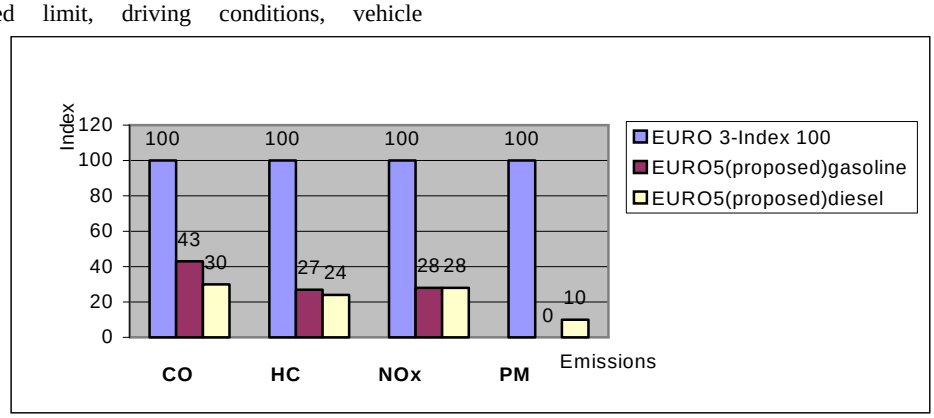

Figure 5. Limits for exhaust emission of new vehicles (Category M1) sold in EU

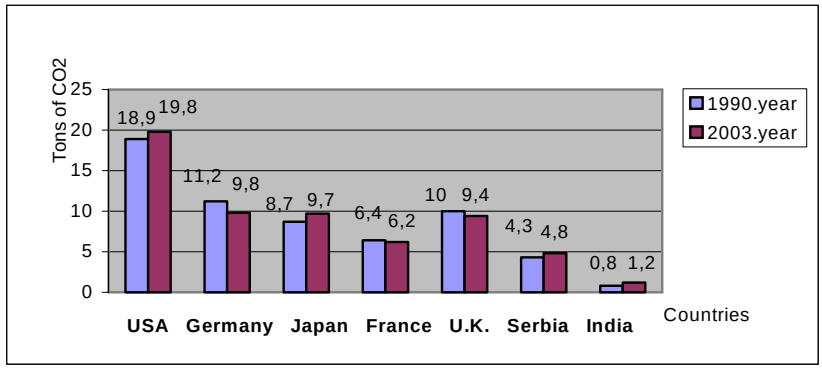

Figure 6 . Tons of CO_2 per capita per year

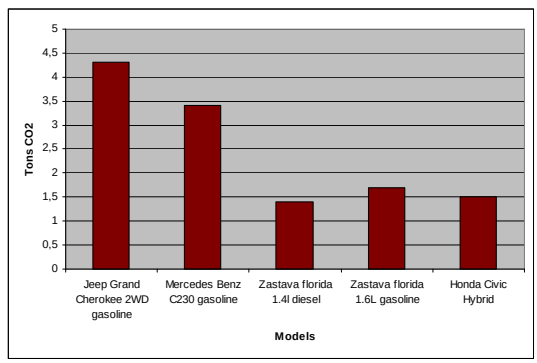

Figure 7 . GHG in CO2 equivalents (tons per 10.000 km) for divers car model

4. CONCLUSION

Limited fossil resources and the impact of greenhouse gas emissions on global warming have strengthened the efforts to develop alternatives to the classical fuel. Technical progress in the autoindustry is vital, that is rapidly changing in developing technology for other fuels. Based on presented calculations for Zastava Florida car with
diesel EURO 4 engine, this model is environmentally friendly car. The Serbian automakers may satisfy the EURO standards primarly by purchasing the appropriate foreign made engines. Otherwise, they will not be able to export their products, because the domestic engine producers currently do not fulfill the EURO 4 standards. On the other hand, as to the situation in Serbia and assuming the government development of stimulative measures and infrastructure, the prospects are that LPG, CNG, ethanol and biodiesel will be increasingly used and that expensive vehicles with electric and hybride drives will be rarity under our conditions. The worldwide oil crisis may also result in different strategies of further automotive industry development.

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Recived: 10.03.2007 Accepted: 25.04.2007 Open for discussion: 1 Year