PERSPECTIVE MOST WIDESPREAD USED VEHICLE FUEL SYSTEMS IN LATVIA

Janis Mistris, Gints Birzietis
Latvia University of Agriculture
janis.mistris@llu, gints.birzietis@llu

Abstract. According to respective European Directive it is very important now to use biofuels in transport as much as possible. Despite that many studies about biofuels use in vehicles are done, the general increase of biofuels share in total fuel consumption mostly comes from compulsory admixture of biofuel to fossil fuel. In order to perform further studies on biofuels use in existing vehicle fleet in Latvia there is necessary to define more widespread vehicle fuel system. In previous studies there were clarified most widespread car and truck fuel systems in Latvia. The aim of this study is to forecast passenger car and trucks most widespread fuel supply systems in next ten years. In order to forecast most widespread car fuel systems in the next years there are analysed situation of first time registered vehicles in Latvia since 2004.

Keywords: fuel systems, most widespread fuel supply systems.

Introduction

Under the present economic conditions in Latvia, the production of domestic products became especially important. According to scientists, one of such products is biofuel, the production of which is potential. To make the use of biofuel more popular, it is important to find out the type of fuel systems that will dominate in the present vehicle fleet in Latvia after 5 and 10 years and the specifics of using biofuels in these fuel systems. It is important to ascertain the constructive specifics of presently exploited fuel systems for cars, trucks, and buses.

In vehicles, the engines of which consume petrol as fuel, a carburettor was designed for the first of fuel systems. From its first prototype, nowadays it became a complicated unit of engine. As next ones, mechanical fuel supply systems were introduced in vehicles, the engine of which uses petrol as fuel. Several modifications of these systems were developed. An imperfection of the mentioned systems is that they operate independently from an ignition system. Nowadays, both these systems are integrated, and electronic fuel systems are developed in which fuel supply and ignition is controlled by a single electronic control unit. Such systems are popular, and it is forecasted that they will be used in the nearest future for engines that run on petrol.

Several types of fuel supply systems are also developed for engines running on diesel fuel. As the first system, a multi-section high pressure fuel pump was developed in which fuel is supplied by an individual plunger to each cylinder at high pressure. Fuel is delivered to a nozzle of cylinder through an individual high pressure pipeline for each cylinder. In earlier years, such systems were popular on cars, but today they are installed on trucks, ships, agricultural machinery, and stationary engines. As the next fuel supply system, a single plunger high pressure fuel pump was developed. Only one plunger is used in such a high pressure fuel pump that delivers fuel to all cylinders. Such systems are widespread on cars. Today such fuel supply systems as Unit Injector and Common Rail are very popular for engines running on diesel fuel. In the unit-injector fuel supply system, each cylinder of engine is equipped with an individual high pressure fuel pump. In the common-rail fuel supply system, fuel is delivered to the nozzles of cylinders through a single fuel pipeline.

Nowadays, electronics plays a more and more important role in automobiles. It is exploited already for a long time to ensure the operation of fuel supply systems, but it still continues to evolve. More complicated systems and computer programs will allow use of new kinds of fuel in the future which were once regarded as inefficient.

Materials and methods

To carry out the study, available information on functional cars and light vehicles registered in Latvia and as well as information on cars and trucks registered in the country for the first time since 2004 were used. Such information can be obtained at the Road Traffic Safety Department (CSDD) [1].

The most popular fuel supply systems for cars and trucks were ascertained in the previous studies [2].

To forecast development scenarios for the market of cars and trucks, the forecast of gross domestic product (GDP) until 2016 that was published in the Latvian Ministry's of Economics Report on the Economic Development of Latvia was taken into account. According to a scenario of faster economic growth, a GDP growth of 3.5 %, compared to the previous year, will be observed in 2011, 4.0 % in 2012, and 4.8 % within the period of 2013-2016 [3].

According to a moderate scenario, the GDP will grow at a rate of 3.5 % in 2011, 2.4 % in 2012, and on average 2.7 % within the period of 2013-2016 [3].

An algorithm for processing the data gained is shown in Fig.1.

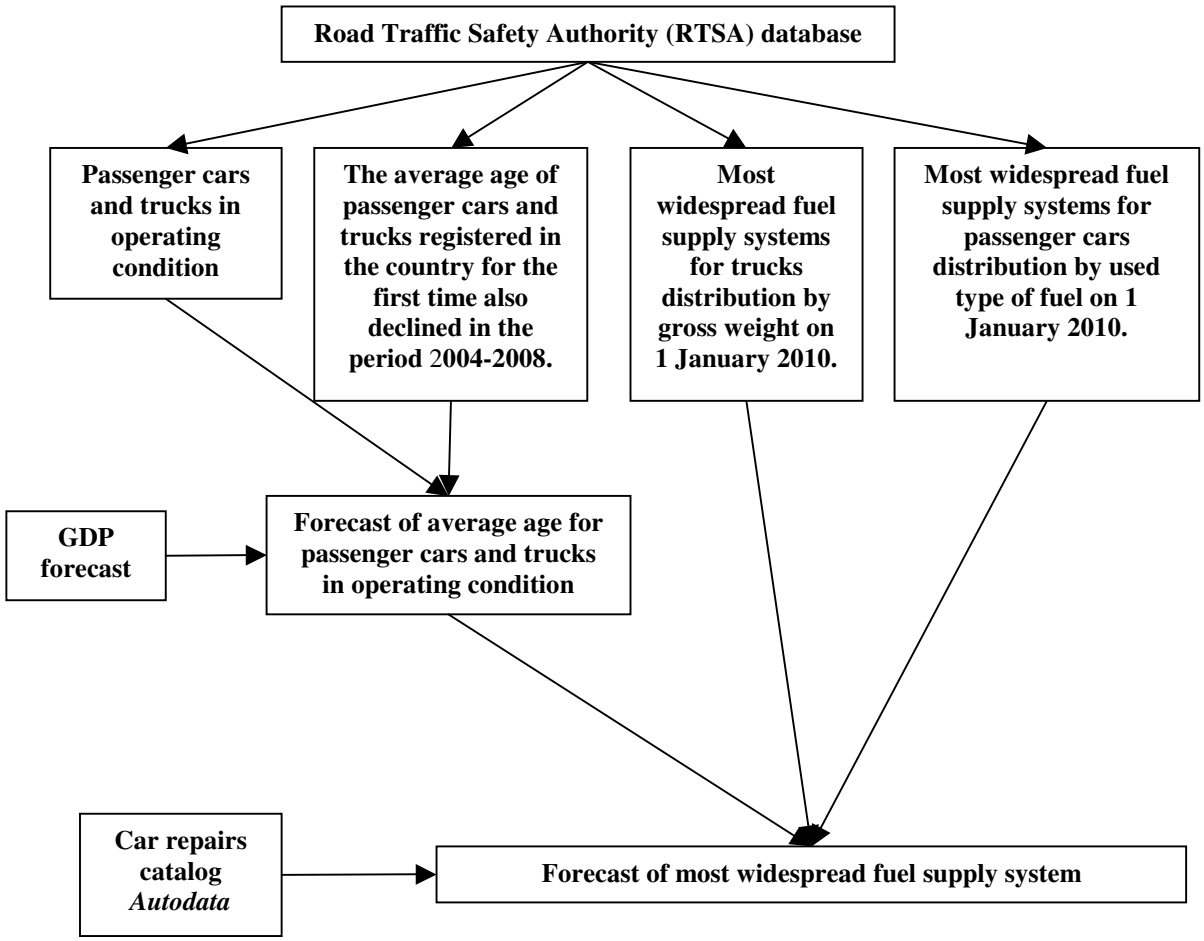

Fig. 1. **Data processing algorithm**

Results and discussion

The average age of cars registered in the country for the first time decreased in the period 2004-2008. It was 7.8 years in 2004 for cars, the engine of which use petrol, while cars running on diesel fuel were on average 7.7 years old. The average ages decreased annually on average by 0.6 years for cars running on petrol as well as for automobiles using diesel fuel, reaching an average age of 5.6 years for automobiles running on petrol and an average age of 5.4 years for automobiles running on diesel fuel in 2008 (see Fig 2). In 2009, a sharp increase in the average age was observed when the average age of petrol cars registered for the first time rose to 6.5 years, while the average age of automobiles running on diesel fuel increased to 7.6 years. In 2010, the average age of cars registered in the country for the first time continued to rise. It rose to 6.7 years for cars running on petrol, while automobiles running on diesel fuel were on average 7.8 years old. Over the analysed period, there is a strong correlation between annual changes in the average age of cars registered in the country for the first time and the GDP; the correlation coefficient proves it. The correlation coefficient for automobiles running on petrol R = -0.98, while for automobiles running on diesel fuel it is R = -0.74.

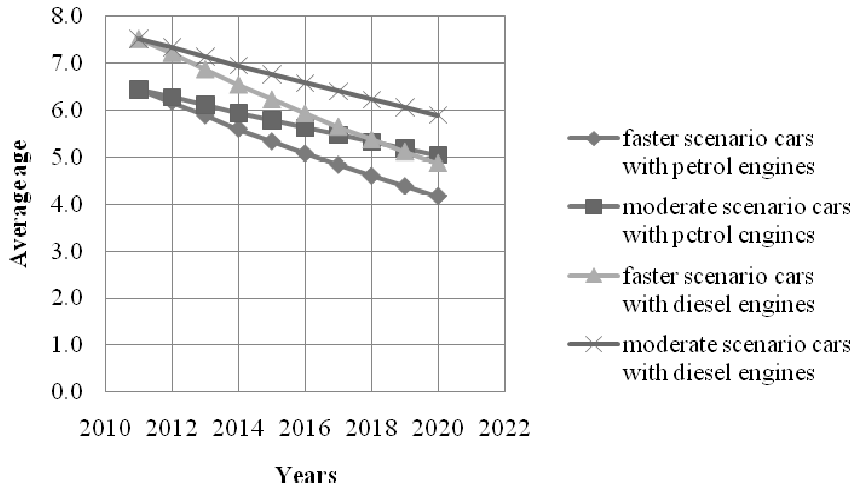

Fig. 2. **Forecast of passenger car average age in technical condition register in first time**

Given the correlation between these indicators, a decrease in the average age of cars registered in the country for the first time is forecasted as large as an increase in the GDP over the next years. According to a scenario of faster economic growth, the average age of petrol cars registered in the country for the first time will be 4.2 years in 2020, but according to a moderate development scenario, it will be 5.0 years. The average age of diesel fuel cars registered in the country for the first time, according to a faster growth scenario, will be 4.9 years, but according to a moderate development scenario, it will be 5.7 years by the year 2020.

Given the decrease in the average age of cars registered in the country for the first time, the average age of cars in working order will also decline until 2020. After forecasting a possible situation, it was found that the average age of cars in working order, according to a scenario of faster economic growth, will be 7.6 years in 2020, and 9.2 years – according to a moderate development scenario (see Fig. 3).

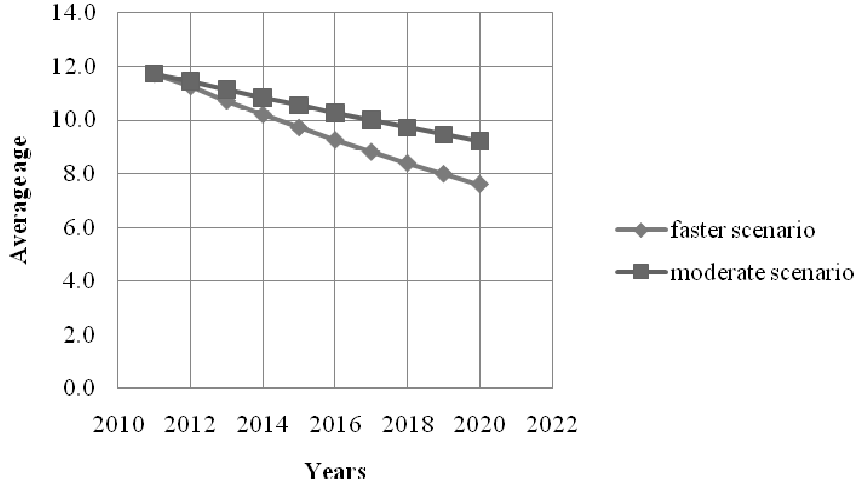

Fig. 3. **Forecast of passenger car average age in technical condition**

The average age of trucks registered in the country for the first time also declined in the period 2004-2008. It was 6.5 years for trucks with a gross weight of less than 3500 kg and 7.5 years for trucks with a gross weight of more than 16000 kg in 2004 (see Fig. 4). In 2008, it was 4.7 years for trucks with a gross weight of less than 3500 kg and 3.5 years for trucks with a gross weight of more than 16000 kg. In this period, its annual average decrease was 0.4 years for trucks with a gross weight of less than 3500 kg and 1 year for trucks with a gross weight of more than 16000 kg.

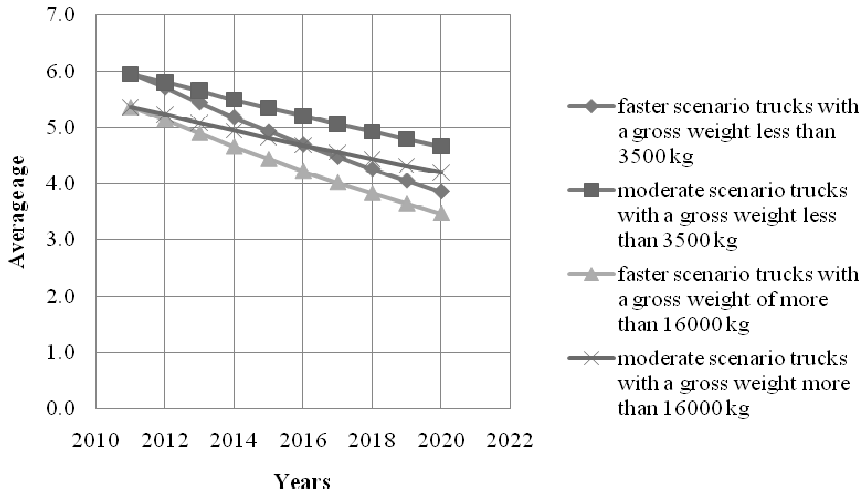

Fig. 4. **Forecast of trucks average age in technical condition register in first time**

There is a correlation, too, between the average age of trucks registered in the country for the first time and the GDP; the correlation coefficient for trucks with a gross weight of less than 3500 kg is R = -0.99 and R = -0.98 for trucks with a gross weight of more than 16000 kg.

By forecasting a possible situation, it was found that the average age of trucks, registered in the country for the first time, with a gross weight of less than 3500 kg will be 3.9 years according to a scenario of faster economic growth and 4.7 years according to a moderate development scenario in 2020. This indicator for trucks with a gross weight of more than 16000 kg will be respectively 3.5 and 4.2 years.

Given the decrease in the average age of trucks registered in the country for the first time, the average age of trucks in running order will also decline until 2020. After forecasting a possible situation, it was found that the average age of functional trucks with a gross weight of less than 3500 kg, according to a scenario of faster economic growth, will be 5.8 years in 2020, and 7 years – according to a moderate development scenario (see Fig. 5). For trucks with a gross weight of more than 16000 kg, this indicator will be respectively 3.5 and 4.2 years.

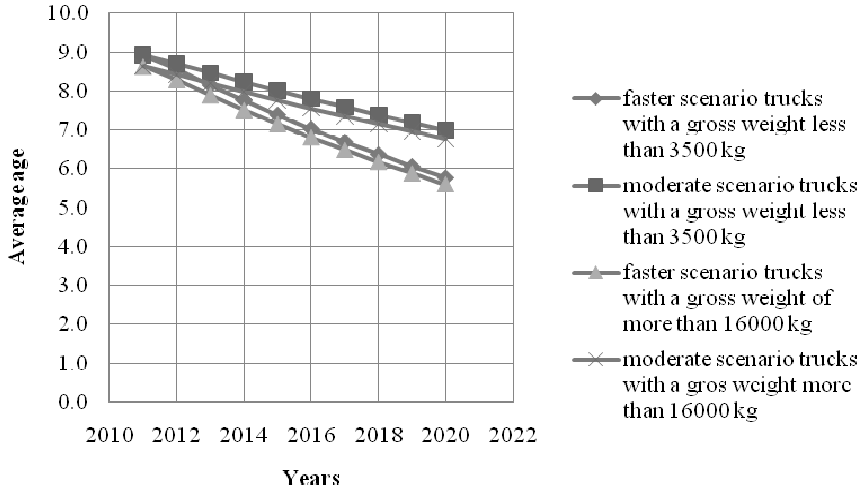

Fig. 5. **Forecast of truck average age in technical condition**

Figure 6 shows a potential distribution of the number of passenger cars in 2015 and 2020 years.

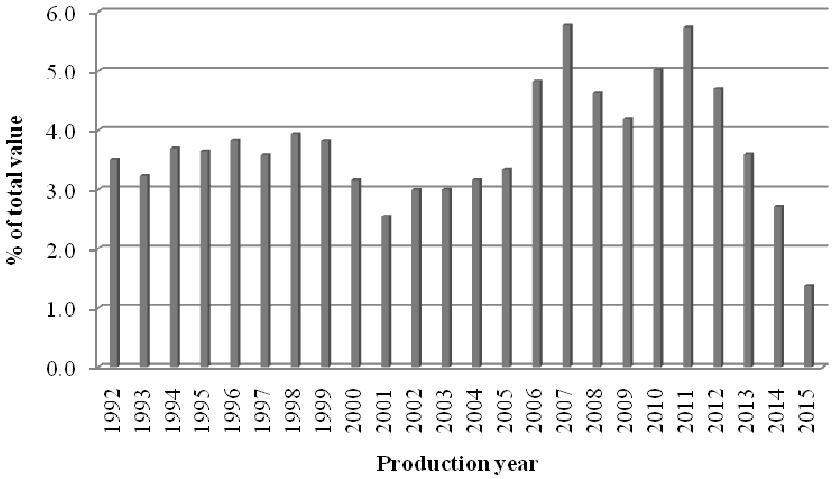

Fig. 6. **Breakdown of the number of passenger cars in technical condition by the production years in 2015**

Having regarded to forecast of the average age of cars in 2015 it will average 9.7 years in faster scenarios and 10.5 years in moderate scenario. Passenger cars whose engines as fuel used petrol widespread fuel systems in 2015 will be Bosch Motronic fuel supply system because this system very broadly using in cars which are produced in 2005 and the latest years [4]. Expected that by 2020, the most widespread fuel systems for passenger cars will be Motronic systems. From passenger cars whose engines as fuel used diesel, widespread fuel systems in 2015 will be Common rail and unit injector systems because these systems are broadly using all producers in newer diesel engines [4]. In 2020 widespread fuel system from engines that used diesel fuel will be system which develop very high pressure and will provide fuel dosing small portions to ensure better combustion.

Figure 7 shows a potential distribution of the number of trucks in technical condition with a gross weight of less than 3500 kg in 2015 and 2020 years.

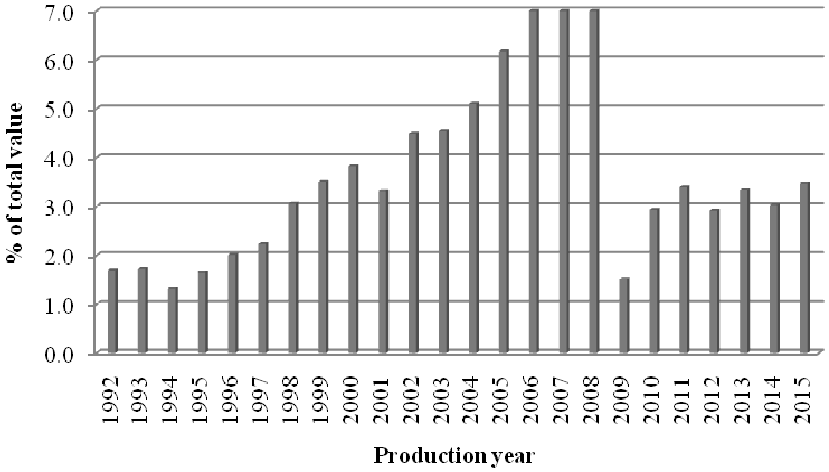

Fig. 7. **Breakdown of the number of trucks in technical condition with a gross weight of less than 3500 kg by the production years in 2015**

In this gross weight trucks category will be dominated Common rail fuel supply systems in engines that's as fuel used in diesel.

Figure 8 shows a potential distribution of the number of trucks in technical condition with a gross weight of more than 16000 kg in 2015 and 2020 years.

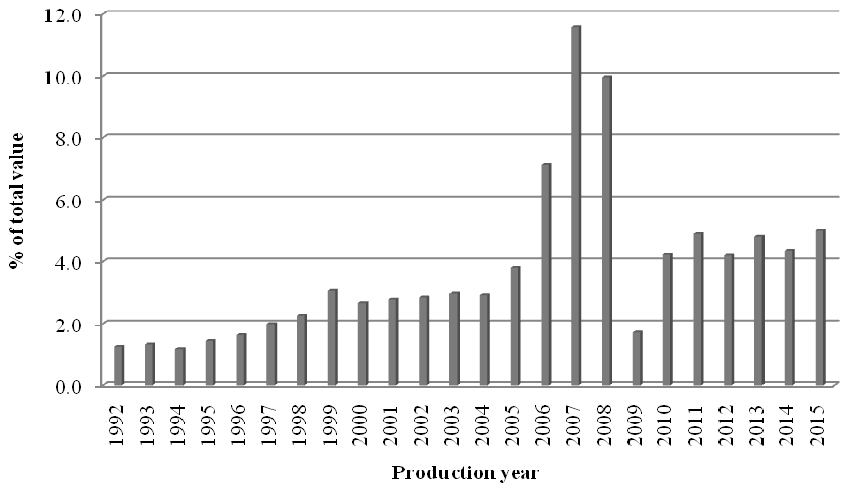

Fig. 8. **Breakdown of the number of trucks in technical condition with a gross weight of more than 16000 kg by the production years in 2015**

In this gross weight trucks category convincing the most widespread fuel supply system is unit injector system. In 2015 will be dominated this system but in 2020 most widespread system will be Common rail and Unit injector systems.

Conclusions

1. Between the GDP and the average age of the cars in technical condition from 2004 to 2008 there is a close correlation, that is 0.98 for the cars with petrol engines, 0.74 for the cars with diesel engines, 0.99 for the trucks with a gross weight of less than 3500 kg and 0.98 for the trucks with a gross weight of more than 16000 kg.
2. Perspective most widespread used vehicle fuel systems from passenger cars will be Motronic systems in cars who engines as fuel used petrol and Common rail system in cars who engines as fuel used diesel.
3. In perspective the most widespread used vehicle fuel systems for trucks will be the Common rail system for the trucks with a gross weight of less than 3500 kg and the Unit injector and Common rail system for the trucks with a gross weight of more than 16000 kg.

References

1. Cars and trucks registered in the country for the first time from 2004 to 2009. Data of the CSDD publicly unavailable database as of 1 January 2010.
2. Mistris J., Birzietis G. The most widespread car fuel systems in Latvia. Proceedings of 9th International Scientific Conference Engineering for Rural Development", May 27-28, 2010, Jelgava, Latvia, pp. 170-173.
3. Ministry of Economics of the Republic of Latvia [online] [10.03.2011]. Available at: http://www.em.gov.lv/images/modules/items/tsdep/zin_2010_2/2010_dec.pdf.
4. Vehicle e-catalog AUTODATA 2011. – Producer Autodata Limited.