PHYSICAL AND TECHNICAL ENERGY PROBLEMS

FACTORS OF GREENHOUSE GAS EMISSIONS REDUCTION
IN THE ROAD TRANSPORT OF LATVIA

L. Grackova, G. Klavs

Laboratory of Energy System Analyses and Optimisation,
Institute of Physical Energetics,
21 Aizkraukles Str., Riga, LV-1006, LATVIA
e-mail: energy@edi.lv

The admissible scenarios are considered as related to reduction in the greenhouse gas emissions from the road transport in Latvia by 2020. All of the scenarios are analysed, and the proofs are presented for the possibility to reduce such emissions as well as the energy consumption through a more extensive use of efficient cars and biofuel.

Key words: *biofuel consumption, efficient cars, greenhouse gas emissions reduction, modelling scenarios.*

1. INTRODUCTION

Energy use in the transport sector – in particular, the consumption of fossil fuel – is an important component of the energy- and environment-related policy of the state, which is closely connected with its energy supply security as well as with generation of greenhouse gases (GHG) and other air polluting emissions. The main consumer of fossil fuel in the transport sector is road transport. On the average, in the 27 European countries the road transport consumes about 80% of the total in this sector. The share of fossil fuel consumption by the road transport of Latvia is even higher: almost 92%.

Fig. 1. GHG emissions from road transport in Latvia (2000–2010).

In Fig. 1, which refers to the time from 2000 to 2010, a rise is seen in the consumption of fossil fuel by the road transport (55%) and, respectively, in the amount of GHG emissions (53%). Approximately 99% of them are CO₂ emissions.

Relative to the year of 2005, in 2007 the GHG emissions in the road transport sector increased by 27.4%. Succeeding years were marked by a decline in the economic activity, which resulted in a decreased number of cars and, consequently, in reduced fuel consumption and emissions. In 2010, a 7.9% increase in the greenhouse gas emissions was observed.

In the decade under consideration the increase was noticed in:

- the number of passenger cars – 63.3% (the total mileage – 79.6%);
- the number of trucks – 26.3% (the total mileage – 45.9%);
- the number of buses – 25.8% (the total mileage – 89.6%).

To counteract the global climate changes, in 2009 the climate and energy related package of European Legal Acts came into force, which stipulates that by the year of 2020 the following is to be achieved:

- in the branches covered by the EU's emissions trading scheme (ETS) the planned reduction of emissions by 2020 is 21% from the 2005 level;
- in the branches not covered by the emissions trading scheme (non-ETS) such as transport (except aviation, which in 2012 is included in the ETS system), households, agriculture, small businesses, waste management, etc., the reduction is to be 10% from the 2005 level.

In the EU member states the mandatory targets have been set for the non-ETS sectors (transport included). In Latvia, up to 2020 a non-ETS sector is allowed 17% more GHG emissions as compared with the 2005 level.

Efficient tools for reducing the fuel consumption and exhausts from the road transport are:

- appropriate organisation of the road traffic providing a secure, optimal, and uninterrupted process of transporting the passengers and cargos over the road network;
- creation of forbidden zones for the private transport, with a wider use of public transport;
- introduction of a reduced tax on small engine cars, hybrid cars, and electric cars;
- exploitation of the updated vehicles with a reduced consumption of fossil fuel which would be equipped with additional emission-control systems;
- the use of bioethanol and biodiesel.

In the paper, from the listed factors only the last two are considered, i.e. the exploitation of new more efficient cars with a reduced consumption of fossil fuel and the use of bioethanol and biodiesel.

2. APPROACH

The calculation of road traffic emissions was performed based on COPERT IV – the European model for estimation of the road traffic emissions. The elaboration and perfection of the COPERT IV software is coordinated by the European Environment Agency (EEA) in the framework of the activities of European Topic Centre on Air Pollution and Climate Change Mitigation (ETC/ACM).

The software for COPERT IV has been worked out with the aim to calculate the annual national emissions from road traffic based on the registered statistical data. This allows the following to be done: to introduce a typical for the country motor transport group taking into account the type of fuel consumed (e.g. the cargo transport on liquefied gas); to calculate additional emissions stemmed from the operation of conditioning systems; to compute emissions and fuel consumption up to 2030 taking into consideration the updated technologies to be introduced.

For COPERT IV computation of emissions the following input data have been taken:

- distribution of passenger cars, light and heavy duty vehicles, buses, and motorcycles according to the corresponding legislation classes (“ECE”, “EURO”), with account for the engine size;
- average annual mileage, with differentiation by groups, engine size, and type of fuel consumed;
- speed and traffic conditions (urban, rural, highway) for each group by the type of fuel consumed;
- average monthly air temperature during the whole year.

Since the fuel consumption and road traffic emissions correlate with the economic processes in a country, the expected recovery of its economy in the nearest years would most probably lead to increased fuel consumption, and, respectively, to increased emissions. Therefore, a necessity arises to apply appropriate measures to control the consumption of fossil fuel and greenhouse gas emissions; it is also necessary to estimate the potential impact of these factors.

The consumption of fuel by the road transport is determined – first of all – by changes in the characteristic mobility parameters of passenger conveyance and cargo traffic, and, the second, by the level of technological provision.

Based on the GDP (gross domestic product) forecast and changes in the private consumption dynamics, the parameters used for calculating the fuel consumption and emissions in the road transport sector using the COPERT IV model have been determined as follows.

- The total passenger kilometres (Pkm) by transport type.
- The total volume of cargo traffic (ton-kilometres (Tkm)) by transport type.
- The average annual mileage of passenger cars and heavy duty vehicles (km/year).
- The total number of cars.

Using the above listed parameters and taking into account the characteristic elasticity of their interaction, a medium-term forecast up to 2020 has been made, which implies that relative to 2010 the car fleet growth will be:

- 18% for passenger cars (total mileage 25.5%);
- 7.2% for heavy duty vehicles (total mileage 15%);
- 17.2 for motorcycle transport (total mileage 25.5).

3. MODELLING SCENARIOS

Based on the tendencies of previous years and suggestions as to further development of the Latvian car fleet the road transport distribution in fuel types has been modelled for 2020 (Fig. 2).

Fig. 2. Distribution of the road transport in fuel type, % (2020).

To assess the influence of the measures intended for control of GHG emissions from road transport the following three scenarios have been elaborated:

- Scenario 1: the basic scenario, in which the fuel is consumed in compliance with the existing normative acts, i.e., the fuel mix is determined by 5% bioethanol content of the total petrol volume (E5) and 5% biodiesel content of the total diesel fuel volume (B5).
- Scenario 2: the basic scenario is supplemented by considering the vehicles with updated technologies, such as Euro-5 (2011), Euro-6 (2016).
- Scenario 3: presents Scenario 2 supplemented by considering the hybrid cars and electric cars as well as consumption of fuel mix consisting of 10% 5% bioethanol content of the total petrol volume (E10) and 7% biodiesel content of the total diesel fuel volume (B7).

4. RESULTS AND DISCUSSION

The results obtained by COPERT IV software calculation of greenhouse gas emissions for the three scenarios are shown in Fig. 3.

Fig. 3. The greenhouse gas emissions calculated for three scenarios.

In 2020 with respect to 2005 the shares of CH₄ and N₂O emissions in GHG emissions are envisaged to decrease in all scenarios. It should be mentioned that the vehicles consuming gasoline emit ~ 17% of the total N₂O emissions, while the diesel – almost 80%. In all the three scenarios, by 2020 the share of CO₂ emissions increases.

Comparing the results of the modelled scenarios and the data on the greenhouse gas emissions of 2005 shown in Fig. 4 it could be seen that the most unfavourable as to the control over such emissions from the road transport is the basic scenario. Indeed, in this scenario the amount of GHG emissions increases by 17.5% in 2015 and by 26.3% in 2020.

Slowing down the rise in GHG emissions is possible in the scenario with updated technologies (Scenario 2), which for 2015 envisages an 11.5% increase and for 2020 – a 12.3% increase, as well as the scenario with updated technologies plus biofuel E10 and B7 (Scenario 3), with the mentioned indices 9% and 9.8% for 2015 and 2020, respectively. It should be noted that cutting the CO₂ emissions via the use of biofuels is calculated taking into account the criteria of biofuel sustainability.

Fig. 4. Comparative results on the greenhouse gas emissions according to three scenarios.

Analysis of the results obtained for the third scenario (the total annual mileage, total fuel consumption, and total amount GHG emissions see in Fig. 5) shows that in the time span under consideration (2005–2020) at 37% increase in the total annual mileage the fuel consumption rises by 14%, while GHG – only by 10%.

Fig. 5. Dynamics of characteristic parameters of road transport (total annual mileage, total fuel consumption, total greenhouse gas emissions, 2005 = 1) in the third scenario.

One of the most important indices that characterise the tendency of road transport development is the level of CO₂ emissions per km (g/km). On the

average, this index as considered for the total road transport fleet is decreasing (Fig. 6). This is especially noticeable in the second and third scenarios, where in 2020 almost 19% decrease in the CO₂ emissions is envisaged as compared with the first scenario. Significant factor in this tendency giving a 24% decrease is the use of passenger cars with updated technologies.

Fig. 6. Average CO₂ emissions per km for the total road transport (left) and passenger cars (right).

5. CONCLUSIONS

The results of our research show that in 2020 – similar to the present time – the road transport sector will consume a substantial proportion of fossil fuel (oil products) in the total primary energy consumption, thus playing a significant role in the achievement of greenhouse gas emissions reduction in compliance with the national limits set for the non-ETS branches.

Analysis of the potential scenarios allows for the conclusion that – despite the expected rise in the number of transport vehicles – by 2020 it is possible to cut the fuel consumption and the relevant emissions owing to the use of efficient cars with updated technologies, which would be running on biofuel.

ACKNOWLEDGEMENT

This work has been supported by the National Research Programme 2010-2013 “Technologies for Innovative Production and Use of Energy Resources and Provision of Low Carbon Emissions by Means of Renewable Energy Sources, Support Measure for the Mitigation of Environment and Climate Degradation – LATENERGI”

REFERENCES

1. European Union climate and energy package.
http://ec.europa.eu/environment/climat/climate_action.htm
2. Ceļu satiksmes drošības direkcija. www.csdd.lv
3. COPERT. www.emisia.com/copert/
4. Noteikumi par benzīna un dīzeļdegvielas atbilstības novērtēšanu. Ministru kabineta noteikumi Nr.332, Rīgā 2000.gada 26.septembrī.
<http://www.likumi.lv/doc.php?id=11217>
5. EMEP/EEA air pollutant emission inventory guidebook 2009, Jun 19, 2009
<http://www.eea.europa.eu/themes/air/emep-eea-air-pollutant-emission-inventory-guidebook/emep>.

6. Latvijas statistika. Statistikas datubāzes. <http://www.csb.gov.lv/>
7. Latvia's Informative Inventory Report 1990-2009. Submitted under the Convention on Long-Range Transboundary Air Pollution. 2011, <http://eur-lex.europa.eu/lv/index.htm>

SILTUMNĪCEFĒKTA GĀZU EMISIJU SAMAZINĀŠANAS FAKTORI AUTOTRANSPORTĀ LATVIJĀ

L. Gračkova, G. Klāvs

K o p s a v i l k u m s

Izmantojot scenāriju modelēšanas pieeju un COPERT IV modeli, novērtēts siltumnīcefekta gāzu emisiju samazināšanas potenciāls autotransportā Latvijā līdz 2020. gadam. Modelēšanas rezultāti un analīze ļauj secināt, ka neskatoties uz sagaidāmo automašīnu skaita palielināšanos, jaunu energoefektīvu automašīnu ar augstākiem izmešu standartiem izmantošana un biodegvielas piemaisījuma palielināšana autotransportā izmantojamā degvielā ļauj ierobežot siltumnīcefekta gāzu emisiju pieaugumu.

08.01.2013.