EU'S ROAD TRANSPORT SECTOR IN THE CONTEXT OF GREEN ECONOMY

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Abstract
The decision makers and the specialists draw attention to the energy consumption and the pollution generated by the road transport sector as the number of vehicles and the circulation of people and goods are constantly increasing. Although, the motor vehicles are performing better in terms of cleaner fuel use than in the past, the road transport sector is still energy intensive and high pollutant. This paper discusses the EU's road transport sector from green economy's points of view which, among others, promotes the sustainable transportation. The research focuses on exploring the pathway of road transport sector in the European Union by analyzing a series of indicators in accordance with the EU's binding targets. The results indicate the reductions of the carbon dioxide emissions per kilometer from new passenger cars, as well as, slight decrease of the overall energy used by the EU road transport mode. Yet, some member states might not reach the limitation of the new cars' emissions as one of the EU's binding targets requires: to achieve less than 95g CO_2/km by 2020. Further studies could be conducted in forecasting the future emission targets for testing the achievement of EU's binding limits.

Keywords
emissions, energy consumption, green economy, road transport sector

Introduction

Since the negative effects of climate change have been worldwide acknowledged, the policy makers and the specialists formulate guidelines for improving energy efficiency of economy and for diminishing GHG emissions. As well as other fields, the transport sector contribute to fulfilling green economy's objectives: reaching energy efficiency, using renewable energy, making the transport sustainable, reducing emissions and other types of pollutants. However, this paper focuses only on road transport sector, because of its high complexity and impacts on environment and society. In view to avoid the high risk of rapid growth of passenger transport emissions due to income increases as previously estimated, these could be reduced by avoiding traveling as much as possible, by using public transportation, by purchasing, if needed, an energy performing vehicle, such as electric cars. (Sims et al., 2014, pp. 603) European Union has established the following targets for the relation between the road transport sector, the energy and the emissions for greening the economy: to increase the biofuel use by 2015, to limit the average emissions to 95g CO_2/km for passenger cars by 2020, to limit the average emissions from new cars to 130g CO_2/km by 2015 and to 95g CO_2/km by 2020, to reduce by half the conventionally fuelled cars in cities by 2030, to completely eliminate conventionally fuelled cars in cities by 2050, to shift the majority of long- and medium‑distance passenger road transport to rail by 2050 (European Environment Agency, 2013; Eurostat, 2015). Withal, the member states must "increase the use of renewable energy to more than 10% of the final consumption of energy in transport by 2020 and renewable energy should be used to at least 10% of the overall EU transport energy consumption by 2020". (European Environment Agency, 2013; Eurostat, 2015) Given the climate and energy policies and their related targets,

researchers, also, analyze the current status of EU's member states and propose solutions on improving the activities in the road transport sector. There is a large and growing body of literature that investigates energy efficiency and environmental impacts in subfields of road transport sector at country or at country area level (Fameli and Assimakopoulos, 2015; Mundaca et al., 2015) or in overall transport sector (Zachariadis and Kouvaritakis, 2003; Klessmann et al., 2011; Yeh, and Sperling, 2010). Yet, few studies focus on discussing the road transport sector at EU level, namely the studies made by the EU organizations (European Commission, 2012).

In this context, this study aims to explore the European Union's road transport sector in terms of energy consumption and emissions by analyzing these indicators in relation with the mode of transport, the motorization rate, new registration of motor vehicles, the number of vehicles by motor energy, as well as considering the green economy targets. This study uses an empirical analysis based on the European Commission's database (Eurostat) and it shows member states comparison since 2003. The main questions of this research are: is EU road transport heading towards sustainability and where are the critical points? Hence, the purpose of this analysis is to present an overview of the EU's road transport sector in the light of green economy and to suggest where should be made the necessary improvements. Further studies could be conducted in forecasting the future emission targets for testing the achievement of EU's binding limits.

1. Literature review

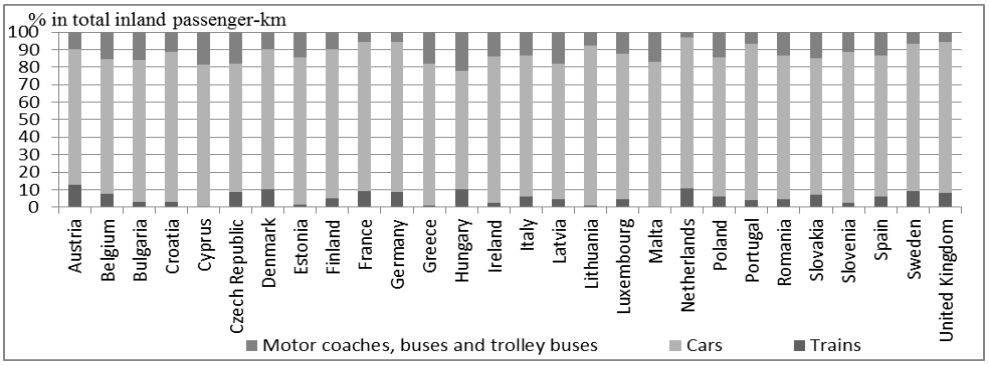
Green economy promotes the sustainable tourism. European Union's policies on road transport points out the high dynamics of this sector and its importance in EU's sustainable development. A careful attention should be paid to efficiency, safety and environmental impacts, as well as to oil dependency and renewable consumption (European Commission, 2012). In 2010, around 18% of all EU emissions were generated by road transport, so it is imperative to make the transport cleaner by improving the energy performance of engines and by using cleaner fuels (European Commission, 2012). Projections were calculated by European Union and other researchers (Kousoulidou et al., 2008) and EU targets were imposed to be applied in road transport sector for improving the energy efficiency and for reducing the negative environmental impacts. A forecasting study by Kousoulidou et al. (2008) reported that the reductions of exhaust emissions from passenger cars could emerge at the level of 18 EU member states by 2020 and that, since 2005, transport by passenger car, respectively freight, could grow by 40%, respectively 67% by 2030. These findings have determined the interested researchers to shift towards a sustainable, low-carbon road transport system in order to mitigate dangerous climate change by making changes in land-use policies, road transport demand management, alternative fuel technologies, and infrastructure investments (Creutzig, 2011). Thiel et al. (2014) consider that the EU emissions reduction is related to vehicle technological improvements, the diminution of oil fuels consumption, and other driving forces. Also, policy analysts in this field (Creutzig, 2011) claims that regulators should focus on emissions' decomposed factors -carbon intensity, energy intensity and travel demand- when trying to reduce market failures. Thus, this study concludes that the use of some incentives could increase the transport fuel consumption due to partially counteract carbon intensity and that the fuel standards from renewable sources are less comprehensive in regulating the transport emissions as compared to low-carbon standards (Creutzig, 2011). Another study (Klessmann et al., 2011) indicates that the development of EU energy transport is mostly based on biofuels increases which raise concerns "about the sustainability of energy crops and the efficient use of biomass". In addition, studies indicate "the increase of electricity use in the road transport sector as the

solution for diminishing the consumption of oil based fuels that represent an important cause of GHG emissions in road transport" (Bleijenberg et al., 2013). Indeed, the electric vehicles are a viable solution for eliminating oil fuel use by passenger cars and, not only, as well as public incentives should be used in order to promote their acquisition (Thiel et al., 2014). Furthermore, the EU projected scenarios of emissions evolution from electric vehicles provide a positive situation for the future as these could be reduced by 24–42% in 2010 - 2020 and by 36–48% in 2010-2030. Policy assessment in road transport field is made by Litman (2013) which considers in its analysis the diminution of the energy demand and pollution emissions from motor vehicles. Studies (Fameli and Assimakopoulos, 2015) suggest that the highest level of carbon dioxide emissions is in and near urban areas where their limits are generally exceeded and that emissions inventory should be carried out at national level in order to find and implement the best energy and climate policies in the EU road transport.

2. Results and discussion

As worldwide concerns regarding the evolution of the energy use and the emissions of the road transport activities are gaining more and more attention, this analysis wishes to determine the changes appeared in the road transport sector in the European Union since 2003. The analysed indicators are analysed in the context of green economy objectives established by the European Union.

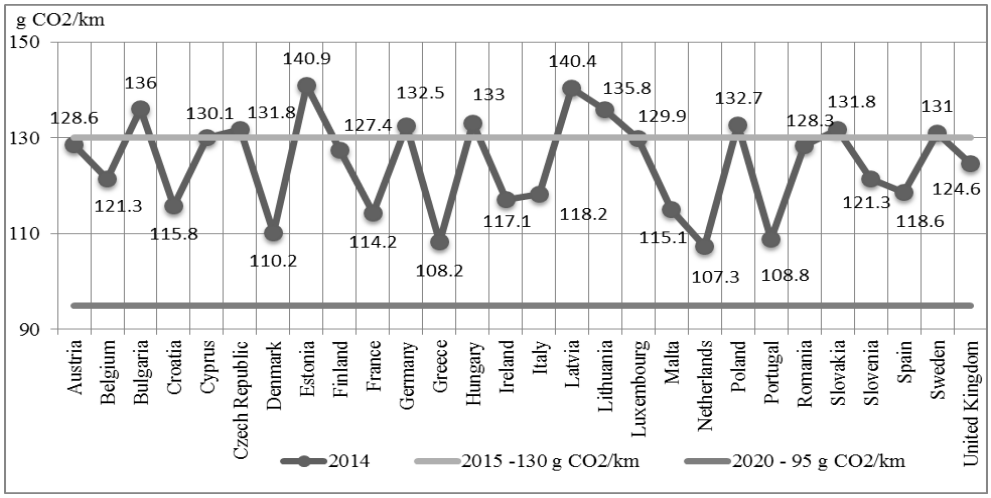
The type of the passenger transport used influences the energy use and, respectively, the emissions in a positive way – that of reduction – if the transport tendency is to use public transportation and more energy efficient passenger cars. The analysis of passenger cars (PC) and motor coaches, buses and trolley buses (CBT) suggests that, in overall European Union, there were insignificantly small changes (of 1%) in choosing the mode of passenger transport between 2003 and 2013. Also, the PC and CBT share in total inland passenger-km was 92.4% in 2013, increasing by 0.1% since 2012. The evolution of this indicator should reach towards reducing the passenger cars use while increasing the public transportation (CBT). Yet, both PC and CBT are diminishing their share during 2003-2013, but more in the case of CBT. The highest ranking four EU countries (Bulgaria, Estonia, Poland, and Slovakia) that reduced their share of CBT use in total inland passenger-km have instead increased their share of PC use in total inland passenger-km. This situation shows that some member states still experience significant shifts in the modal split of passenger transport that it will affect the overall EU targets accomplishments regarding energy efficiency and emissions. Figure 1 illustrates the EU's modal split of passenger transport in 2013.



Source: EUROSTAT. 2011a. Eurostat—Transport Data Navigation Tree.

Fig. 1 EU's modal split of passenger transport in 2013

The modal split of passenger transport in 2013 differs from member state to member state due to several possible drivers: population's income, road transport infrastructure, country's culture. According to Baptista et al. (2012), the growing incomes of EU's population generate, as well, continuously increases in the number of cars per 1000 inhabitants (motorisation rate) until a stabilization level is reached. The EU available data suggest that the motorisation rate is constantly increasing overtime in almost all member states while the highest concentration in the number of cars per 1000 inhabitants appears in the more developed EU countries (Luxemburg, Italy, Lithuania, Finland, Cyprus, Germany) while the lowest concentration is in Romania, Hungary, Latvia, Slovakia, Croatia, Bulgaria. This indicator is important to be analysed because it presents the increasing demand of cars in EU since 2003. Moreover, the new registrations of PC and CBT could explain the technological improvements in the stock of vehicles, because, lately, EU has imposed a series of standards that contribute to increasing energy efficiency of a vehicle and, so, the reduction of GHG emissions. The available data of this latter indicator show that the more developed EU countries have made much more changes in the PC and CBT stocks compared to the less developed ones. These changes could be due to population purchasing power and changes in human behaviour and culture. As previously mentioned, European Union tries to limit the average CO_2 emissions from new cars to 130g/km by 2015 and to 95g/km by 2020 (European Environment Agency, 2013; Eurostat, 2015). The findings regarding this matter suggest that all member states register continuously decreases of the new cars' emissions. The figure 2 illustrates the 2014 status of these emissions by relating them with the EU targets.



Source: EUROSTAT. 2011b. Eurostat-Environment and Energy, Environment, Data Navigation Tree.

Fig. 2 Average carbon dioxide emissions per km from new passenger cars in 2014 and EU's limits

Although, the sales of new vehicles are focusing on diesel based ones because of their lower impact on environment and energy use compared to the oil based ones, the shifts towards greener vehicle stock in EU is being delayed (Baptista et al., 2012) due to various barriers of the market (for example, low infrastructure in some member states for electric cars). The EU's carbon dioxide emissions from new passenger cars has significantly decreased by approximately 20% in 2014 compared to 2007, reaching to a level of 124.7 g /km in 2014.

This means that the 2015 EU overall target has been achieved from at least two years ago. 17 of 28 EU member states have reached the 2015 level target of 130 g CO_2 per km from new passenger cars. Still, by analysing the past 3 years (from 2014) reductions of its values, not all member state might fulfill the binding target. Moreover, based on the past evolution, EU might not achieve the 2020 target of reducing the average carbon dioxide emissions per km from new passenger cars to a maximum of 95g /km. By taking into consideration these findings, the poor performed member states should focus more in finding supplementary measures for diminishing the emissions from the new passenger cars.

Furthermore, when analysing the number of PC and CBT by motor energy, it could be noticed that their evolution is partially in accordance with greening the economy. While the number of oil based PC and CBT is generally decreasing and the number of greener vehicles is increasing instead, yet, the stock of passenger cars and motor coaches, buses and trolley buses (regardless the energy used) is growing in the majority of member states. This means that traffic is increasing in the road transport sector. As a result, the overall pollution could increase. Still, when analysing the EU's volume of passenger transport (PC, CBT, trains) relative to GDP, it could be noticed that there is starting the decoupling between the passenger kilometres growth and GDP growth. Moreover, the volume of passenger transport went down in relation with GDP, contributing to environmental benefits. Yet, the analysis of this indicator is not enough to determining the impact on environment because more important could be the energy consumption.

In this context, another important indicator is the energy use of road transport. Its indicators and shares are presented below (table 1).

Table 1 Indicators of road transport's energy consumption in European Union

Member State / EU	$(I_{2013}-I_{2003})/I_{2003}*100$ (%)	$(I_{2013}-I_{2007})/I_{2007}*100$ (%)	2013 country share (%)	2007 country share (%)	2003 country share (%)
Malta	29.69	40.54	0.06	0.04	0.04
Cyprus	-0.89	-13.61	0.22	0.23	0.21
Estonia	13.43	-8.02	0.25	0.24	0.21
Latvia	2.37	-26.95	0.30	0.37	0.28
Lithuania	28.49	-15.17	0.49	0.53	0.37
Slovenia	39.61	7.33	0.64	0.54	0.44
Croatia	11.85	-7.64	0.64	0.63	0.55
Slovakia	33.41	5.24	0.71	0.61	0.51
Luxembourg	12.96	-1.91	0.75	0.70	0.65
Bulgaria	16.39	-0.18	0.84	0.77	0.70
Hungary	-2.08	-21.39	1.17	1.36	1.16
Ireland	-4.68	-25.85	1.23	1.51	1.25
Denmark	-7.06	-16.99	1.27	1.40	1.32
Finland	2.39	-3.04	1.37	1.29	1.29
Romania	22.33	16.24	1.67	1.31	1.32
Greece	-17.68	-26.12	1.76	2.17	2.07
Portugal	-18.17	-15.85	1.81	1.97	2.14
Czech Republic	12.24	-8.65	1.91	1.91	1.65

Member State / EU	$(I_{2013}-I_{2003})/I_{2003}*100$ (%)	$(I_{2013}-I_{2007})/I_{2007}*100$ (%)	2013 country share (%)	2007 country share (%)	2003 country share (%)
Sweden	1.48	-5.29	2.51	2.42	2.39
Austria	1.45	-2.13	2.68	2.50	2.55
Belgium	-2.53	-0.65	2.84	2.61	2.82
Netherlands	-3.61	-8.68	3.71	3.71	3.72
Poland	58.67	6.47	5.26	4.51	3.21
Spain	-15.02	-25.35	8.90	10.89	10.13
Italy	-14.29	-16.06	11.54	12.55	13.03
United Kingdom	-6.59	-9.36	12.99	13.09	13.46
France	-4.25	-4.52	14.40	13.78	14.55
Germany	-2.45	1.21	18.11	16.34	17.97
EU 28	-3.22	-8.66	100.00	100.00	100.00

Source: own calculations based on EUROSTAT. 2011c. Eurostat—Sustainable Development Indicators, Sustainable transport, Transport and mobility, Data Navigation Tree.

Table 1 illustrates the results of the increase or decrease rate for the energy used by the road transport since 2003 and 2007, as well as, the share of each member state in the total energy consumption of the EU28 road transport. I, also, calculated this rate considering the fix base year of 2007 because at that time EU28 has reached the peak in road transport energy consumption. Despite the increase of this indicator between 2003 and 2007, that it indicated a negative situation, since 2007 the values have started to register a decreasing trend, meaning that there is a positive situation and, so, the road transport is leaning towards greening the economy. The table 1 shows that energy consumption of the road transport has decreased by 3.22% since 2003 and by 8.66% since 2007. The highest values of this indicator with a small decrease could be observed in Germany (-2.45%) and France (-4.25%) between 2013 and 2003. If those two countries would register a highest reduction the EU overall road transport energy consumption could considerably decline in the future. In addition, from the seven member states (Germany, France, UK, Italy, Spain, Netherlands, Poland) with a share of more than 5% of total road transport energy consumption Poland has increased its energy consumption by 58.67%. This means that Poland represents a negative example because it has both the share and the increase significant at EU level. Poland should take action for implementing promotion instruments in order to reduce this indicator level. At EU level, 15 member states have increased their energy consumption of road transport while only 13 have reduced it. Although EU has overall diminished its energy consumption in this sector, still it may not be representative enough. The 15 member states should focus more on diminishing both their shares in total EU energy consumption and their consumption in order to greening the road transport sector and, so, the economy.

Conclusions

The recent green approach to the road transport sector promotes the energy efficiency of vehicles and the reduction of environmental negative impacts. The road transport policies of the European Union focus on turning to a sustainable transport, which could be achieved by complying with the binding targets - reducing the EU's average CO_2 emissions from new cars to less than 130g/km by 2015 and to less than 95g/km by 2020 – while reducing as much as possible the road transport sector by using other modes of transport by 2050 (Eorustat, 2015). Likewise, another desideratum is to enhance the public transport. These EU objectives were established in a context of continuous increase of the road transport emissions which are generated by increased traffic, by fuel cars, by increased number of passenger cars and so on. This paper focused on analysing the energy consumption and the average emissions from new passenger cars in order to make an opinion about EU's road transport sustainability. In addition, the author tried to find out where could emerge the critical points which could represent a limit for greening the road energy transport. The main indicators analysed for this small piece of research were gathered from the European Commission database, and these are: the modal split of passenger transport, the motorisation rate, the new registrations of PC and CBT, the average emissions from new cars, the number of PC and CBT by motor energy, and the energy consumption of road transport.

The findings regarding the share of PC and CBT in total inland passenger-km indicate an increase of 0.1% since 2012, with a share of 92.4% of total inland passenger-km in 2013. Even though, the trend for greening the road transport sector should head towards reducing the use of passenger cars while increasing the public transportation (CBT), the share of the latter has decreased more than the share of PC of total inland passenger-km in European Union during 2003-2013. Some member states still experience significant shifts in the modal split of passenger transport that it will affect the overall EU targets accomplishments in terms of energy efficiency and emissions. Moreover, the motorisation rate indicates a constant increasing demand of cars in EU since 2003, with highest values of this indicator in the more developed member states. In addition, while European Union is improving their energy efficiency and environmental standards for transport sector, it could be observed a trend of improvements of vehicles regarding this matter. Some driving forces of these changes could be the increase of population's purchasing power and the changes in human behaviour as well as the culture.

So far, the results of the analysed indicators create the starting point for the analysis of the average CO_2 emissions per kilometer from new passenger cars and the energy consumption of the road transport. These two indicators could show key EU developments of the road transport sector. Overall, the European Union registered significant decreases of the average emissions from new cars (by approximately 20% in 2014 compared to 2007) until the 2015 limit target of 130g CO_2/km have been surpassed, reaching a level of 124.7g CO_2/km in 2014. These findings conclude that the road transport sector is becoming greener. Still, by analysing the yearly decreasing trend of each member state, the future forecasts of the average emissions from new cars might suggest that not all EU's member state would fulfill the binding target in 2015 even though, at EU level, this target has already been achieved. Likewise, the 2020 target of 95g carbon dioxide emissions per kilometer from new passenger cars might not be achieved. Therefore, the member states' focus should be on promoting more the need of achieving this target and on implementing viable and easily accessible instruments.

The quantity of emissions depends on the type of used fuel and energy efficiency. Thus, improvements in energy efficiency of vehicles were made at EU level, but the stock of passenger cars and motor coaches, buses and trolley buses is growing in the majority of

member states. This situation could generate increases of the overall pollution. Next, the analysis of the energy consumption of road transport indicates a consumption peak in 2007. Yet, the evolution of this indicator at European Union's level suggests a decreasing trend during 2003-2013 (by 3.22% since 2003 and by 8.66% since 2007). In addition, 15 member states have increased their energy consumption of road transport while only 13 have reduced it. Although, EU has overall diminished its energy consumption in this sector, still it may not be representative enough. The 15 member states should focus more on diminishing both their shares in total EU energy consumption and their consumption in order to greening the road transport sector and, so, the economy.

Finally, it could be concluded that the road transport sector is heading slowly towards green economy in terms of improving energy efficiency as well as reducing energy consumption and emissions.

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