

## THE EFFECT OF THE ROAD TRANSPORT IMPACT ON THE NATURAL ENVIRONMENT IN POLAND AND ON THE COSTS OF ROAD TRANSPORT

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### **Abstract**

*The structure of the article will include the characteristics, particularly, of the Polish fleet of trucks involved in the transport of cargo. The volume of transport and haulage work of the goods carrying road transport in 2011, dominant in the branch structure of transport, was presented. The number of trucks and semi-trailer tractors registered in Poland, including the estimated number of vehicles with a maximum weight exceeding 3.5 Mg, was quoted. The numbers of commercial goods carrying companies (international and domestic) in Poland have been presented. The consumption of gasoline, diesel and liquid petroleum gas by the Polish fleet of trucks, special cars and buses in 2010 and the projected consumption of these energy sources and natural gas as well as electricity by the vehicles fleet by the 2030 has been estimated. The estimates of greenhouse gases emission and selected other pollutants from the engine exhaust systems of the said fleet, in the years 2010, 2015, 2020, 2025, 2030 have been presented. Characterized were, currently in force in Poland, environmental fees and their impact on the costs of road transport companies in Poland. The conclusions should be of particular interest to both TFL sector entities as well as those who are involved in creating transport and environmental policy in Poland.*

**Keywords:** *transport heavy goods vehicles, fuels, pollutants emission, costs*

### **Introduction**

The issue of the protection of the environment, including reducing greenhouse gases emission has become one of the priorities of the European Union, including Poland. It concerns also the transport, especially road transport. The share of road transport in total emissions of the main greenhouse gases (carbon dioxide, methane and nitrous oxide) from the entire economy in Poland in 2010 amounted to approximately 16% [5]. Passenger cars, trucks and buses in Poland represent roughly (95-97%) share in the emissions of such air pollutants like carbon dioxide, carbon monoxide, sulphur dioxide, nitrogen oxides and particulate matter from the entire road transport means [5].

Taking up, by the individual member states, a variety of activities to reduce emissions of air pollutants does not always produce the intended effects. For example, the fees in force in Poland, resulting from the emission into the atmosphere of greenhouse gases from motor vehicles fleet have minimal impact on the transport costs and do not contribute to reducing the competitiveness of this mode of transport against such one as the rail transport. For example, the costs associated with the charges for the use of toll roads have a greater impact on the costs of the transport companies than the costs arising from environmental charges because, among the others, they are strongly dependent on the emission standards met by the different categories of vehicles.

#### *Fleet and trucking companies in Poland*

Dynamic development of the road transport, due to the number of companies, vehicles and transport operations, particularly evident since Polish accession to the EU, is still continuing. That is the case due to the specific characteristics of this sector, which enabled its smooth transition to the active functioning in the free market structures.

Road transport, especially of cargo, has strengthened its position in the total transport of Poland, becoming its leading sector, as evidenced by shares in 2011 in the number of tons transported in total – 83.5% and haulage work performed – 69.0%. In absolute numbers, cargo road transport in 2011 amounted to 1,596 million tons, and the haulage work amounted to 218.9 billion ton-km (in 2012 – 1548 million tons and 233.3 billion ton-km respectively).

The total number of trucks and semi-trailer tractors, registered in Poland, by the end of 2011 amounted to 3131 thousand units, including the number of 239 thousand of semi-trailer tractors (in 2012, 3178 thousand and 257 thousand units respectively) [6]. It is estimated that the number of trucks and semi-trailer tractors of over 3.5 Mg, registered in our country at the end of 2011, amounted to about 841 thousand.

If one assumes that about one third of trucks over 3.5 Mg registered in Poland (and the oldest vehicles) is technically incapable of operation or even physically no longer exists (while are still listed in the records), the average age of the said type of vehicle is estimated to be about 14 years old.

An advantageous situation, due to the age structure of vehicles, occurred with semi-trailer tractors. The renewal of the trucks fleet, including semi-trailer tractors in Poland, happens as a result of the purchase of both new vehicles and used, mostly imported from other EU countries. In 2011, more than half of semi-trailer tractors registered for the first time in Poland were new vehicles.

Assuming that the oldest, more than a quarter-century old, semi-trailer tractors appearing in the records, may be unsuitable for the operation, the average age of such vehicles in the country would be around 10 years.

Since the Polish accession to the EU, the share of haulage conducted by the commercial road transport has been increasing in the structure of cargo transport. In 2004, it accounted for 75% and in 2012 – 83 percentage.

The number of commercial road transport enterprises dynamically increases. At the end of 2011, there were a total of 136 089 companies operating in Poland, out of which:

- 25 868 international transport companies,
- 64 400 domestic transport companies,
- 45 821 commercial transport companies with the vehicles up to 3.5 Mg maximum weight (not requiring a license) [2].

Based on the discernment of the changes, occurring in recent years, in the renewal of the trucks fleet it is possible to ascertain that in terms of its pollutants emission characteristics, from internal combustion engines of the fleet, there has been a significant change in quality. A modern rolling stock undoubtedly, in the case of many companies ensuring its proper use, can reduce operating costs in part dependent on the mileage (e.g. fuel consumption), including technical costs in the case of favourable conditions for companies offering new vehicles.

The membership of the EU has made to the Polish carriers easier access to new technologies, while forcing their application, especially in companies that perform international transport. On the domestic transport market, the situation is less favourable, as a result of the smaller financial capabilities and therefore the process of renewal of the rolling stock is slower. Widely available and easy method of acquiring newer fleet has been created by a form of leasing.

Generally, companies invest primarily in successive replacement of the rolling stock into the more modern one, and to a lesser extent, an increase of the already owned.

#### *Demand for the energy sources by the 2030*

Consumption of diesel oil by the trucks fleet and the fleet of special cars and buses was in 2010 about 6107 Gg [12]. Gasoline consumption by the said group of vehicles categories was about 406 Gg, and the consumption of liquid petroleum gas amounted to 237 Gg.

Forecasts indicate a high growth of road haulage in Poland. The haulage work to be carried out, by the Polish road carriers in 203, will amount to 352-381.1 billion ton-km (an increase from

164% to 178% in the years 2010 to 2030) [3]. The consequence of the development of the road haulage will be an increased demand for fuel.

The prognostic assumptions and calculations made based on them, indicate that the consumption of diesel by Polish fleet of trucks and special cars and buses will increase to about 8389 Gg in the 2030 [12]. Consumption of petrol by the said group of vehicles categories will decrease, reaching about 183 Gg in 2030. Consumption of propane – butane will decrease, and 2030 will be about 191 Gg. It is expected that the consumption of natural gas in the form of CNG or LNG will reach in 2030 about 87 Gg, and the consumption of electricity by the said group of vehicles categories will be 6.5 MWh.

*Tab. 1. Consumption of energy sources by vehicles other than passenger cars*

Itemisation	Measurement unit	Years				
		2010	2015	2020	2025	2030
Petrol	Mg	406	325	260	216	183
Diesel oil	Mg	6107	6820	7606	8041	8389
Liquid Petroleum Gas (LPG)	Mg	237	239	229	201	191
Natural Gas (NG)	Mg	0	0	3	58	87
Electric energy	MWh	0.0	0.0	0.0	3.8	6.5

Source: [12]

#### *Emissions of greenhouse gases and other pollutants from the exhaust systems of vehicles*

One of the main factors determining the external costs of road transport is the emission of air pollutants from car engines.

The weight of air pollutants emissions from the car fleet is dependent on:

- the amount of fuels consumed by the vehicles' fleet arranged by type and category of vehicles,
- the pollutants emission indicator, applicable to different types of fuels, vehicle categories associated with the level of technical development of the combustion engines design of the rolling stock, road traffic conditions and other operating conditions, in which vehicles are used [4].

The energy indicators, adopted in the presented results of the calculations, of the greenhouse gases emissions from the vehicles' fleet in Poland are published by the National Centre for Emission Balancing and Management (KOBiZE) [7]. The methodology for estimating greenhouse gases emissions used, by KOBiZE, for the pollutants emissions inventory, for all mobile sources is an indicator method. The pollutants emission is calculated as the product of individual fuels consumption by vehicles of each category specified, and the appropriate energy indicators of the pollutants emission. The domestic carbon dioxide emission energy indicators from motor vehicles fleet are adopted by KOBiZE based on the documents of the Motor Transport Institute.

The source of data about the average pollutants emission indicators from the car fleet of the remaining substances (carbon monoxide, non-methane volatile organic compounds, nitrogen oxides, particulate matter, as well as sulphur dioxide) are KOBiZE's reports [8].

The estimated carbon dioxide emission from the motor vehicles fleet other than passenger cars in 2010 amounted to 21 346 Gg, 1.692 Gg of methane and 0.842 Gg of nitrous oxide (Tab. 2.). Carbon dioxide emission from the engines of the said fleet accounted for approximately 47% of this gas emission of from the engines of Polish motor vehicle fleet in total. The methane emission accounted for 36%, and nitrous oxide emission – about 48%, accordingly.

Among the remaining major air pollutants from the engines of the Polish cars fleet, the emission of carbon monoxide dominates in the weight context – (140.6 Gg) and the emission of nitrogen oxides (150.5 Gg). The emission of non-methane volatile organic compounds amounted to 40.5 Gg, and particulate matter (TSP) was 12.8 Gg [1].

Tab. 2. Emissions of greenhouse gases and other major air pollutants by vehicles other than passenger cars in Poland in 2010

Carbon dioxide emission	Methane emission	Nitrous oxide emission	Carbon oxide emission	Nitric oxide emission	Emission NMLZO	Sulphuric dioxide	Ammonia emission	Emission TSP
CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	CO	NO <sub>x</sub>		SO <sub>2</sub>	NH <sub>3</sub>	
Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg
21346	1.692	0.842	140.6	150.5	40.5	0.651	0.147	12.8

Source: [1]

### *The effect of environmental charge on the costs of road transport companies*

Environmental charge is one of the instruments for environmental protection policy in the European Union. It is an economic tool designed to make the economic environment to introduce such transport technologies, which will significantly affect the reduction of greenhouse gases emission.

In Poland, the amount of the pollutants emission costs depends on the amount of gases emission in the given period and on the rates of the applicable fees for polluting the environment. Rates of the charges for the commercial use of the environment are published in the form of announcements of the Minister of the Environment [9] based on the Environmental Protection Act [10]. The valid table includes rates of the charges, making the rates dependent on the motor vehicle types, fuel types and the characteristics of the vehicles, whose determinant is the EURO pollutants emission standard of the vehicle (Tab. 3).

In Poland, each company operating cars is required to account for the use of the environment. Entrepreneur, regardless of whether he has or uses passenger cars, trucks or buses is required to make a report and incur the costs associated with the emission of pollutants from motor vehicles engines. The fees are paid to the marshal's office appropriate to the place of the registration of company. The business entity calculates itself the height of the environmental fee based on the knowledge of the fuel consumed by cars used in the enterprise using the applicable fees for use of the environment [9]. The company does not make a charge for the introduction of gases or dusts into the air when the annual fee payable to the account of the marshal's office does not exceed 800 PLN [10].

In the case of estimating the costs associated with the emission of pollutants from internal combustion engines of the Polish cars fleet, these calculations assumed average weighted rates for the emission of gases calculated based on the cited Decree of the Minister of Environment and the weights, representing shares of the annual rolling stocks mileages, arranged according to the periods of production in the total amount of the annual mileage of each specified group of vehicles. However, due to the lack of availability of the relevant data for Poland, the calculations used the available data on the structure of the annual vehicles' fleets mileages acc. to the Euro standards existed in Germany in 2007. This data, naturally simplified, takes into account the fact of certain delays in the development of motorism in Poland in comparison with economically developed EU countries.

The costs of pollutants emission resulting from combustion of fuels in the engines of vehicles, other than passenger cars, accounted for, in 2010, around 106 million PLN (Tab. 4).

The total mileage of the Polish fleet of heavy-duty trucks is estimated at about 19.2 billion vehicle-km in 2010. AT the average cost of 3.05 PLN/ kilometre of mileage [11], the costs of cargo haulage can be estimated at about 58.5 billion PLN. The estimated costs associated with the emission of air pollutants from the combustion engines of the trucks fleet (according to the fees rates for the emission of air pollutants from the combustion of fuels in internal combustion engines of vehicles) amounted to 66.4 million PLN. Hence, under the existing rates of fees the share of external costs arising from pollutants emissions from the engines of the Polish trucks fleet, represents about 0.11% of the total costs of the said fleet, thus it constitutes a small percentage of



the operating unit costs structure [12]. Moreover, given the fragmentation of Polish truck transport, (about 70% of the commercial transport companies have up to 4 trucks) and the fact that, by law, not all companies are required to bear the costs of air pollutants emissions, a large part of them does not include these costs in their calculations.

Tab. 3. Charges rates for the air pollutants emissions from the combustion of fuels in internal combustion engines of vehicles other than passenger cars in PLN/ Mg of the fuel burnt [9]

Type of vehicles	First registration pollutants emission standard	Rate acc. to the announcement of the Minister of the Environment		
		BS	LPG	ON
		PLN/Mg	PLN/Mg	PLN/Mg
Trucks, special vehicles of the max. weight < 3.5 Mg and buses of the max. weight < 5 Mg	to 1993.30.09.	68,05	45,14	23,69
	EURO 1	35,95	39,96	14,53
	EURO 2	21,48	23,58	14,53
	EURO 3	13,89	15,29	10,97
	EURO 4	7,29	7,85	6,28
	EURO 5	6,77	7,12	4,29
<b>Calculating average rate for the trucks, special vehicles ≤ 3.5 Mg and buses ≤ 5.0 Mg average</b>		<b>17.72</b>	<b>18.39</b>	<b>11.91</b>
Trucks, special vehicles of the max. weight > 3.5 Mg	to 1993.30.09.	91,97	—	47,78
	EURO I	—	—	20,03
	EURO II	—	—	15,65
	EURO III	—	—	11,46
	EURO IV	—	—	8,31
	EURO V	—	—	5,78
<b>Calculating average rate for the trucks, special vehicles &gt; 3.5 Mg</b>		<b>—</b>	<b>—</b>	<b>16.71</b>
Buses of the max. weight > 5 Mg	to 1993.30.09.	—	—	55,45
	EURO I	—	—	20,03
	EURO II	—	—	15,65
	EURO III	—	—	11,46
	EURO IV	—	—	8,31
	EURO V	—	—	5,78
<b>Calculating average rate for the buses &gt; 5 Mg</b>		<b>—</b>	<b>—</b>	<b>16.84</b>

Tab. 4. Calculating external costs based on the amount of fuels consumed and charges for gases or dusts introduced into the air from the combustion of fuels in combustion engines of the car fleet in Poland in 2010 [1]

Type of vehicles	Category	Fuels consumption Mg	Rate acc. to the Notice of Min. of Envir.			Pollutants emission costs			Pollutants emission costs in total mIn PLN
			BS	ON	LPG	BS	ON	LPG	
			PLN/Mg	PLN/Mg	PLN/Mg	mIn PLN	mIn PLN	mIn PLN	
Trucks and special ≤ 3.5 Mg and buses ≤ 5,0 Mg	2.ii.BS	406000	17.72	—	—	7.19	—	—	7.19
	2.ii.ON	1578100	—	11.91	—	—	18.79	—	18.79
	2.ii.LG	237300	—	—	18.39	—	—	4.36	4.36
<b>Trucks and special ≤ 3.5 Mg and buses ≤ 5.0 Mg in total</b>									<b>30.35</b>
Trucks and special with a maximum weight > 3.5 Mg	2.iii.ON	3975900	—	16.71	—	—	66.43	—	66.43
Buses with a maximum weight > 5.0 Mg	2.iv.ON	552600	—	16.84	—	—	9.30	—	9.30
<b>Specified cars fleet in total</b>									<b>106.08</b>

BS – motor gasoline, ON – diesel oil, LG – petroleum gas

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