

# The prospects for limiting emissions from road transport: a case study for the Middle Odra and Poland

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**Abstract.** The article presents selected aspects related to emissions that arise during road transport. These impurities are an important component of low emission, which is generated at a height of up to 40 m from the ground level. Low emission in the Middle Odra Region and throughout Poland is a serious problem. Low emission has a significant share in total emissions in Poland, where the air is one of the worst in the EU. The problem of low emission concerns not only highly urbanized areas, but also places where the industry is less developed and the number of inhabitants falling on average per square kilometre is less than in the rest of Poland. An example of such an area is the Middle Odra, which additionally features the highest forest cover in the country (more than 50%). The paper highlights the main causes of road transport emissions and points out the need to take action that can significantly help reduce this phenomenon.

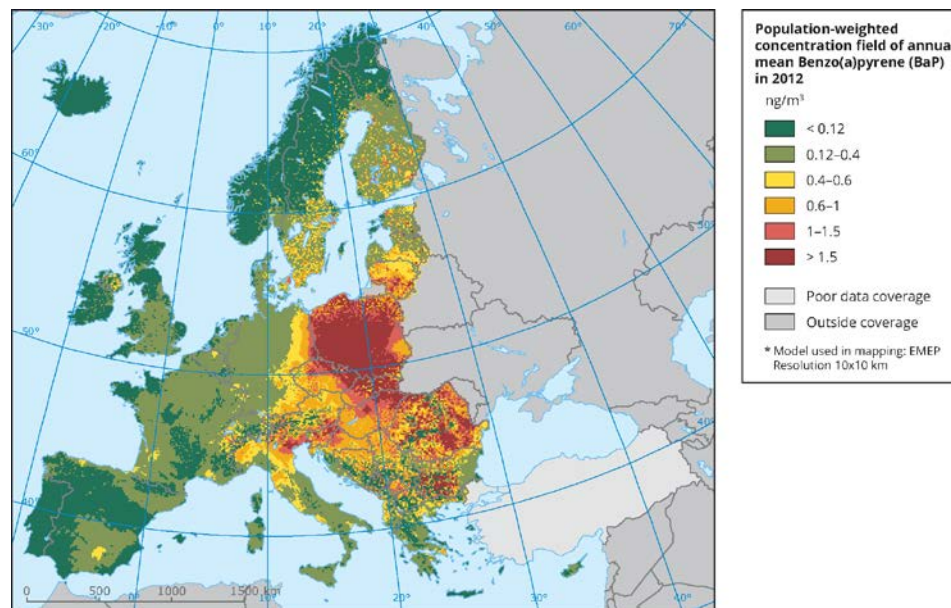
## 1. Introduction

Low emission represents a very serious threat to human health and the environment. It is assumed that low emission is generated at relatively low altitudes from the ground level, which usually do not exceed 40 m. Low emission consists mainly of pollution generated in residential boiler houses during heating, road transport emissions and emissions from small industrial plants. Low emission has a significant share in total emissions in Poland, where the air is one of the worst in the EU [1].

Poor air quality threatens Poland with high levels of EU sanctions, which may amount to around 1 billion EUR. Due to poor air quality in Poland, almost 50 thousand people die annually [2]. The scale of the problem of poor air quality in Poland is reflected in elevated levels of concentrations of many substances. One of them is benzo(a)pyrene (B(a)P), whose elevated air levels are recorded in practically the entire country. Figure 1. presents a map in which Poland as the only EU country is almost entirely covered with red colour, which means that the concentrations of B(a)P are too high [3].

Interestingly, the problem of low emission concerns not only highly urbanized areas, but also places where the industry is less developed and the number of inhabitants falling on average per square kilometre is less than in the rest of Poland. An example of such an area is the Middle Odra River, which additionally features the highest forest cover in the country (more than 50% of the area is forests). In spite of this, the Middle Odra Region is not free of elevated concentrations of harmful substances in the air. Due to the need to refer to statistical data for the purposes of this article, it is assumed that the area of the Middle Odra Region coincides with the area of the Lubuskie Voivodeship (Figure 2).





**Figure 1.** The concentration of carcinogenic B(a)P in Europe in 2012 [3].



**Figure 2.** Location of the Lubuskie Province in Poland.

Source: own elaboration.

## 2. The problem of low emissions from road transport

Road transport contributes significantly to amount of low emissions in Poland. And with the emission from heating buildings it is one of the most serious environmental problems in Poland. However, buildings in Poland are most often heated from October to April, which causes much less emission from this source during the summer. The pollutants, which mostly come from the transport sector are mainly:

- aromatic hydrocarbons,
- carbon monoxide,
- heavy metals,
- nitrogen oxides,

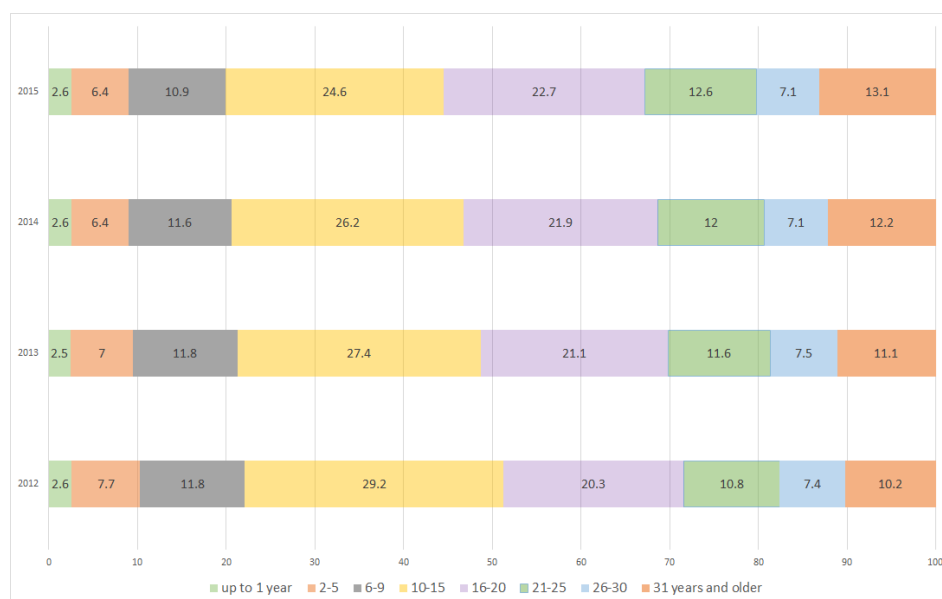
- suspended particulates PM10 and PM2.5 (particulate matter).

Analysing the problem of low emission from road transport, particular attention should be given to nitrogen oxides, which had the largest share in Poland of all other emission sources in 2015. In 2015, nitrogen oxides from road transport accounted for almost 30% of the total emission of this substance into the air (table 1). The amount of NO<sub>x</sub> emission in 2015 increased in relation to 2014 due to higher diesel consumption. It should be noted that despite the production of ever more ecologically-friendly cars that meet current ecological standards, owing to the growing number of vehicles, NO<sub>x</sub> emission from road transport is similar or increases. The other substance that has a high share of total emissions in Poland is carbon monoxide. CO emission is a significant problem not only in the Middle Odra Region but also throughout the country. CO emission in 2015 had an almost 21% share in total emission in Poland. The other harmful substances that came from road transport had less than 20% share in total emission, which does not mean that they can be underestimated [4].

**Table 1.** Emissions of nitrogen oxides in Poland in 2015

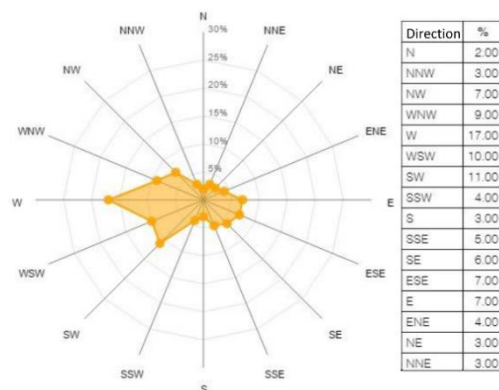
Emission source	Emissions of NO <sub>x</sub>
	2015 Mg
Combustion processes in the industry	67 562.0
Combustion processes in the production and transformation of energy	205 492.4
Combustion processes outside the industry	90 229.3
Production processes	24 481.3
The use of solvents and other products	0.137
Road transport	213 408.2
Other vehicles and equipment	70 952.9
Waste management	1 667.4
Agriculture	40 010.2
<b>Total</b>	<b>713 803.84</b>

Source: [4].



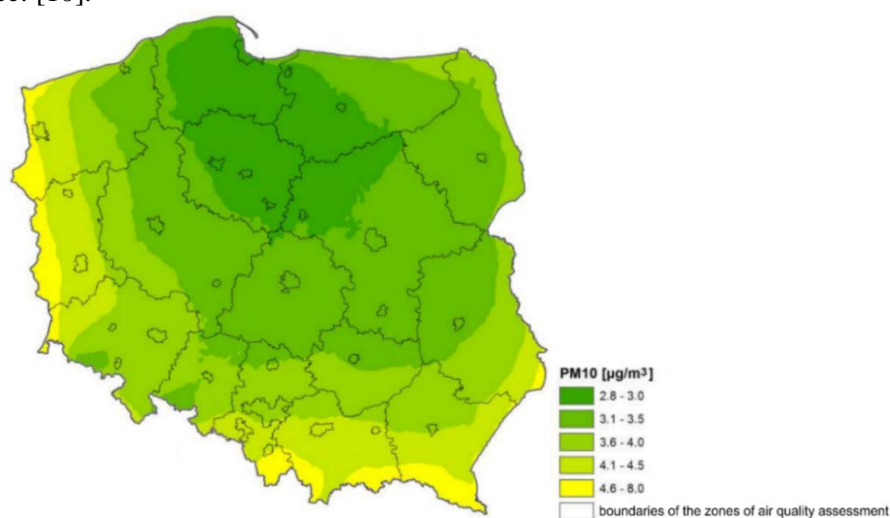
**Figure 3.** The structure of age passenger cars in Poland by age groups in 2012-2015.(Source: [5])

According to SAMAR (The Automotive Market Research Institute) the average age of a passenger car in Poland in 2016 was about 15 years. A relatively high car age in Poland is conditioned by several factors. These include low incomes of a large proportion of households and a large number of old cars imported from abroad. Only in 2016, more than 1 million used cars were brought to Poland, whose average age was 12 years [6]. Figure 3 presents the structure of registered cars by age group in 2012-2015. Old cars do not meet the current standards for the maximum allowable emissions of harmful substances into the air [7]. In Poland there is a *European exhaust emission standard* which applies to new vehicles sold in the European Union [8]. The exhaust emission limit values for new cars are set out in the European Directives. It should be stressed that the impact of air pollution from abroad is also affected by the level of emissions of harmful substances. This particularly applies to PM<sub>10</sub> suspended particulate matter, which is particularly true for the border of the Middle Odra Region. The share of emissions from neighbouring countries in the country is as small as 1-2%. However, in the case of the Middle Odra Region, this indicator is much higher and it is due to the proximity of the Polish-German border and the predominant wind direction in the part of Poland (Figure 4). The level of emissions in the Lubuskie Voivodeship, which originates from the sources located outside Poland, is also influenced by highly developed German industry, which is adjacent to the Middle Odra Region (Figure 4-5)[9].



**Figure 4.** The distribution of wind directions [%] in the Middle Odra (City Żary) in 2016.

Source: [10].



**Figure 5.** The concentrations from neighboring countries (Source: [11].)

### 3. Analysis of measures to limit low emissions coming from road transport in the Middle Odra and Poland

A need for implementation of actions to reduce low emissions from road transport is reflected in the data shown in the table 2. It should be emphasized that the data contained in table 2. present emission figures from one of the smallest regions in Poland (Lubuskie Voivodeship), which is inhabited by a small number of inhabitants. To obtain the volume of emissions of individual substances that would be close to the total emission in the country the values from table 2. should be multiplied by 38, because in the Lubuskie Voivodeship lives about 1 million people and in Poland about 38 million.

**Table 2.** EU Emission Standards for Passenger Cars and emissions in the Lubuskie Province in 2016

Emission Standards for Passenger Cars and Emissions in the European Union								
Stage	CO	HC+NO <sub>x</sub>	PM	km/year	Number of cars	CO	HC+NO <sub>x</sub>	PM
	g/km					Mg		
Compression Ignition (Diesel)								
Euro 1	3.16	1.13	0.14	16000	23670	1197	428	53
Euro 2	1.0	0.7	0.08		31560	505	353	40
Euro 3	0.64	0.56	0.05		31560	323	283	25
Euro 4	0.50	0.30	0.025		23670	189	114	9
Euro 5	0.50	0.23	0.005		31560	252	116	3
Euro 6	0.50	0.17	0.005		15780	126	43	1
Positive Ignition (Gasoline)								
Euro 1	3.16	1.13	-	16000	43395	2194	785	0
Euro 2	2.2	0.5	-		57860	2037	463	0
Euro 3	2.30	0.35	-		57860	2129	324	0
Euro 4	1.0	0.18	-		43395	694	125	0
Euro 5	1.0	0.16	0.005		57860	926	148	5
Euro 6	1.0	0.16	0.005		28930	463	74	2
Total					447100	11036	3256	139

Source: [9, 12].

Although there are many solutions in the world that help to reduce emissions from road transport, Poland has a big problem with implementing good practices. Moreover, there is no strategy now that would significantly reduce emissions from road transport. The actions taken so far have not produced the intended effect. The government of Poland and the local government authorities will have to introduce a number of restrictions that will lead to emission reductions [13]. These actions may involve the ban on entry into urban centres of cars that do not meet current ecological standards [14]. The limitation of passenger traffic in city centres may be implemented in different ways. For example:

- introduction of paid parking zones,
- a ban on entry of vehicles not meeting certain environmental standards,
- excluding parts of roads for car traffic,
- distribution of stations for fast charging electric vehicles,
- construction of lines for urban rail,
- expansion of bicycle paths and pedestrian infrastructure,
- construction of lanes dedicated for buses only,
- designation of free parking zones for electric cars,
- implementation of cheaper or free public transport,

- improvement of road infrastructure, e.g. construction of ring roads,
- ensuring traffic flow of vehicles,
- improving the efficiency of existing infrastructure, e.g. introduction of solutions to improve lighting installation of traffic control,
- reserving part of the parking spaces for hybrid cars[15].

The solutions that the authorities in Poland will have to consider in the long run, are the restrictions that several city authorities around the world decided on by the end of 2016. There will be a ban on driving cars with diesel engines since 2025. In addition to the ban, it was declared to introduce measures to promote the use of more environmentally-friendly vehicles and to introduce well-functioning public transport. It should be noted that the problem of emission from road transport does not concern only large metropolitan areas, even outside large cities these emissions are high. It is especially noticeable on roads that are characterized by heavy car traffic.

#### 4. Conclusions

In the Middle Odra Region and throughout Poland, restrictions should be introduced to reduce the low emission that is caused by road transport. These solutions, although they are effective and used in other countries, in Poland probably would not be acceptable by parts of society today. Therefore, the authorities responsible for the air quality do not take effective action to reduce emissions.

Road transport has a significant negative impact on the environment. Road transport also contributes to economic development and supports the state budget. In Poland there is a growing public awareness of the quality of the environment and its impact on human health. The first symptoms of growing social awareness have been already evident.

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