

## THE USE OF THE TAX ON MEANS OF TRANSPORT AS AN INSTRUMENT AFFECTING THE NUMBER OF ELECTRIC AND HYBRID VEHICLES – A CASE STUDY

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**Purpose:** The aim of the work is to determine whether and how the local government authorities of the largest cities in Poland apply reliefs and exemptions in the tax on means of transport to support owners of hybrid and electric trucks. In addition, an answer was sought to the question whether the amount of the aforementioned preferences was correlated with the dynamics of the number of vehicles powered in whole or in part by electricity in the analyzed period.

**Methodology:** The study covered all 63 cities in Poland with poviats rights. The resolutions adopted by the local government authorities of these centers in 2018-2020 regarding the rates of tax on means of transport were reviewed. Based on the texts of legal acts, the criteria used for granting tax preferences were defined, the amount of reliefs was calculated, and the statistical tool in the form of the Pearson correlation coefficient was used to check whether there is a relationship between the scale of tax benefits and the growth rate of the number of hybrid and electric vehicles.

**Findings:** It was found that only half of the municipalities used reduced tax rates in the analyzed period, while different requirements regarding the level of exhaust gas emissions were adopted in different local government units, so that owners of hybrid and electric trucks in individual cities could usually benefit from the reduction on an equal footing with owners of similar vehicles with lower but also different emission standards from Euro 1 to Euro 6.

**Practical implications:** The results of the research can be used by local governments. They show, among other things, that the mere reduction of tax rates is insufficient for the promotion of environmentally friendly means of transport and that these activities should also be supported by other solutions.

**Originality/value:** In the literature, the subject of differentiation of tax rates on means of transport to stimulate the increase in the number of rolling stock powered by electricity has not been generally taken up so far or has been the subject of research very rarely.

**Keywords:** local government, tax, means of transport, hybrid and electric drive.

**Category of the paper:** Research paper.

## 1. Introduction

The need to protect the natural environment is a challenge for many entities managing the economy and operating at various levels, including local government units. They are equipped with a whole range of competences, the use of which should have a positive impact on the condition of natural resources and the possibility of exploring them in a manner consistent with the principles of sustainable development. It is worth noting that conservation activity is an important component of this concept, and local authorities have an important role to play here, which has been emphasized in many works dedicated to sustainable development for many years (Harris, 2000; OECD, 2002; Kates et al., 2005). Although the legal systems in force in individual countries differ from each other in terms of the scope of powers of local officials in the field of environmental protection (Mazur, 2011, p. 12), there are objectively observed possibilities for local governments to influence pro-ecological behavior, inter alia, by using economic instruments, including tax (European Commission, 2012, p. 23). Tools of this type include the tax on means of transport. For example, as stated in one of the OECD reports published in December 2020, in every third out of 37 member countries of this organization it is local authorities that tax the possession or use of motor vehicles. The same study points out that in most of these countries, when determining tax rates, the level of carbon dioxide emissions is taken into account (OECD, 2020).

Poland is one of the countries where local authorities are empowered to apply different rates of tax on means of transport. In the Polish legal system, the tax on means of transport is regulated by the Act of 12 January 1991 on Local Taxes and Fees (Act, 1991). Pursuant to Article 8 of this legal act, this tax is subject to taxation:

- Trucks with a maximum permissible weight of more than 3.5 tonnes and less than 12 tonnes and equal to or greater than 12 tonnes.
- Tractors and ballast tractors adapted for use together with a semi-trailer or a trailer with a permissible total weight of a combination of vehicles from 3.5 tonnes and less than 12 tonnes and equal to or greater than 12 tonnes.
- Trailers and semi-trailers which, together with the motor vehicle, have a permissible total weight of 7 tonnes and less than 12 tonnes and equal to or greater than 12 tonnes, except for those related solely to agricultural activity conducted by an agricultural tax payer.
- Buses.

The amount of tax rates on means of transport is determined by the commune council by way of a resolution, with the legislator adopting upper quota limits (Art. 10). The tax obligation rests with natural persons and legal persons who own vehicles (Art. 9). Article 12 gives municipal councils the right to introduce additional objective exemptions other than those provided for in the Act, excluding exemptions for trucks, tractors, trailers and semi-trailers with a weight equal to or greater than 12 tons.

It is reasonable to ask whether and to what extent local government authorities want to use these powers to improve air quality by giving tax advantages to owners of vehicles using those types of propulsion that can be considered relatively the most environmentally friendly. Another important issue seems to be the effectiveness of such an impact. These problems will be discussed in this paper on the example of a group of the largest cities that, in the Polish local government conditions, operate with *poviat* rights. The subject of interest is the tax levied on owners of trucks with hybrid or electric drive in 2018-2020. The aim of the work is, in particular, to find answers to the following questions:

- Do local government entities managing cities introduce lower tax rates on means of transport or tax exemptions for owners of trucks with hybrid and electric drive and what is the scale of preferences?
- What are the benchmark criteria for benefiting from the preferential tax rate?
- Does the application of higher discounts lead to a faster increase in the number of hybrid and electric vehicles?

## 2. Literature review

Taxes are more and more often perceived in the literature as tools the use of which can positively affect the state of the environment and its protection. Some works emphasize, among other things, that a properly constructed tax system can stimulate the desired attitudes, both rewarding for commitment and discouraging certain behaviors (Bouwma et al., 2015; Postula, Radecka-Moroz, 2020). As it is noted in one of the reports, they can be used as an impact instrument in the exploitation of various environmental resources, but also in the situation of using preparations harmful to the environment (artificial fertilizers, pesticides), the amount of which must be appropriate to provide an appropriate signal for potential taxpayers (Bräuer et al., 2006). As Binning and Young (1999, p. 17) write, the benefits of such protection are greater than what is directly obtained from the exploration of natural ecosystems, provided that the protection itself is treated as a profitable form of activity. Considering taxes as tools for environmental protection, Wasiuta (2015) points to their greater flexibility and easier modification and adaptation to changing conditions.

A certain part of the publication is devoted to the issue of using taxes imposed by local governments to achieve environmental goals. The real estate tax is considered the most promising in this respect (Podstawka, Rudowicz, 2010; Kettunen et al., 2017). However, the potential of this tax is not properly used to promote pro-ecological behavior, as evidenced, *inter alia*, by the results of research presented in works on the tax policy of selected cities in Poland (Śmiechowicz, 2013; Adamczyk, Dawidowicz, 2017; Dziuba, 2015). Some authors seem to see the possibilities of environmentally friendly use of forest tax. As concluded by

Dziuba and Życzkowska (2021), the policy of communes in Poland in the field of this tax is characterized by low activity of local governments. On the other hand, another recently published study points out that the protection of forest areas through an appropriate tax policy can be seen as an investment for the future, contributing to the potential increase in budgetary revenues of municipalities with a high level of afforestation (Kołoszko-Chomentowska, 2022).

As mentioned above, not in all countries, taxation of the possession of means of transport is the responsibility of local governments. For this reason, the issue of the possibility of influencing the decarbonisation of means of transport through appropriate tax solutions is often discussed without the role of local officials in this process. Mostly the emphasis is on taxes levied on car manufacturers, road taxes or taxes contained in fuels. This group of works includes both those discussing the effects of using single instruments in selected countries (Mabit, 2014; Giblin, McNabola, 2009; Ciccone, 2018; Sánchez-Braza et al., 2014; Yan, Eskeland, 2018) and those proposing a more comprehensive approach to decarbonisation (Lam, Mercure, 2021; Jenn et al., 2018). In a report prepared for the needs of the European group for clean transport Transport & Environment, the main topic of which is the transition to the new European standard for measuring CO<sub>2</sub> emissions in vehicles, the author not only refers to the impact of this process on the increase in the amount of taxation of car manufacturers, but also criticizes the fact of taxing the vehicles themselves, not their use, stating that it leads to buying excessively large and too broadcasting cars (Poliscanova, 2019). Delucchi and Murphy (2008), based on data from the US economy, argue that the owners of petroleum-powered vehicles enjoy many tax preferences in the form of subsidies, although they do not dare to state unequivocally that the liquidation of these facilities it could reduce the use of vehicles with traditional propulsion in favor of alternative means of transport. In publications relating to the tax on means of transport levied on vehicle owners in Poland, the topic of their importance as a source of income for municipalities seems to be dominant (Felis, Rosłaniec, 2017; Dziuba, 2014; Giżyński, Burchat, 2017). Sometimes attention is also paid to the impact of this tax on the activity and competitiveness of business entities (Suproń, 2018; Skica et al., 2011).

Based on the above literature review, it should be stated that in previous studies, the issue of the impact of local governments on the development of environmentally friendly means of communication through tax instruments, including preferences in the tax on means of transport, was not properly addressed. According to the author, this gap should be eliminated, especially since, as it was said earlier, the use of such tools is possible in many countries, and it would be useful to decide whether they are potentially promising solutions and how they could be used to reducing exhaust gas emissions.

### 3. Research materials and methodology

The study covered 63 largest cities in Poland, which, being local government units, operate in the Polish legal system as communes with poviatic rights. According to the data of the Central Statistical Office (GUS), an institution collecting and publishing statistical data in Poland, the total number of people in these centers at the beginning of 2017 was 12,6 mln people, which constituted approx. 33% of the total population of the country (Statistics Poland, 2017). The analysis covered the years 2018-2020.

In order to examine to what extent the local government authorities of these urban centers use their right to grant reliefs in tax on means of transport for owners of trucks with hybrid and electric drives, the method of analyzing resolutions adopted by these units was used. Based on these documents, it was determined what solutions were adopted in individual cities in the field of taxation of trucks with hybrid and electric drive, and the amount of relief (if introduced) was calculated in subsequent years according to the following formula (1):

$$U = \left(1 - \frac{x_N}{x_P}\right) \times 100\% \quad (1)$$

where:

U – relief (w %),

$x_N$  – the amount of the lower tax rate in a given year,

$x_P$  – the amount of the basic tax rate in a given year.

Due to the fact that local government authorities sometimes adopted different solutions in their resolutions regarding the methods of determining tax rates, the following principles were applied for calculation purposes:

- When the city council differentiated the rates according to the year of production, the basic rate was the rate for the oldest vehicles.
- When the city council introduced two separate rates for hybrid and electric vehicles, the average of these rates was used in the calculations.
- When separate rates were not adopted for electric and hybrid vehicles, the calculations took into account the rates assigned to vehicles with the highest exhaust emission standard included in the resolution.

The data on the number of vehicles was obtained from the database of the Central Statistical Office under the name Local Data Bank (Statistics Poland, 2022). The index formula was used to illustrate the dynamics of changes in the analyzed period (2):

$$i = \frac{x_d}{x_p} \times 100\% \quad (2)$$

where:

$i$  – index of change,

$x_d$  – value of the variable in a given period (number of vehicles at the end of a given year),

$x_p$  – value of the variable in the base period (number of vehicles at the end of the preceding year).

In order to check whether there is a relationship between the amount of the tax relief and the dynamics of the increase in the number of electric and hybrid vehicles, a statistical tool was used in the form of the Pearson linear correlation coefficient calculated by the formula (3):

$$r = \frac{\sum(x - \bar{x})(y - \bar{y})}{\sqrt{\sum(x - \bar{x})^2 \sum(y - \bar{y})^2}} \quad (3)$$

where:

$r$  – Pearson's linear correlation coefficient,

$x$  – relief in the tax on means of transport for electric and hybrid trucks applicable in a given year in a given local government unit,

$\bar{x}$  – average relief in tax on means of transport for electric and hybrid trucks in a given year in the group of local government units applying the tax preference,

$y$  – index of change in the number of electric and hybrid trucks in a given year in a given local government unit applying a tax preference,

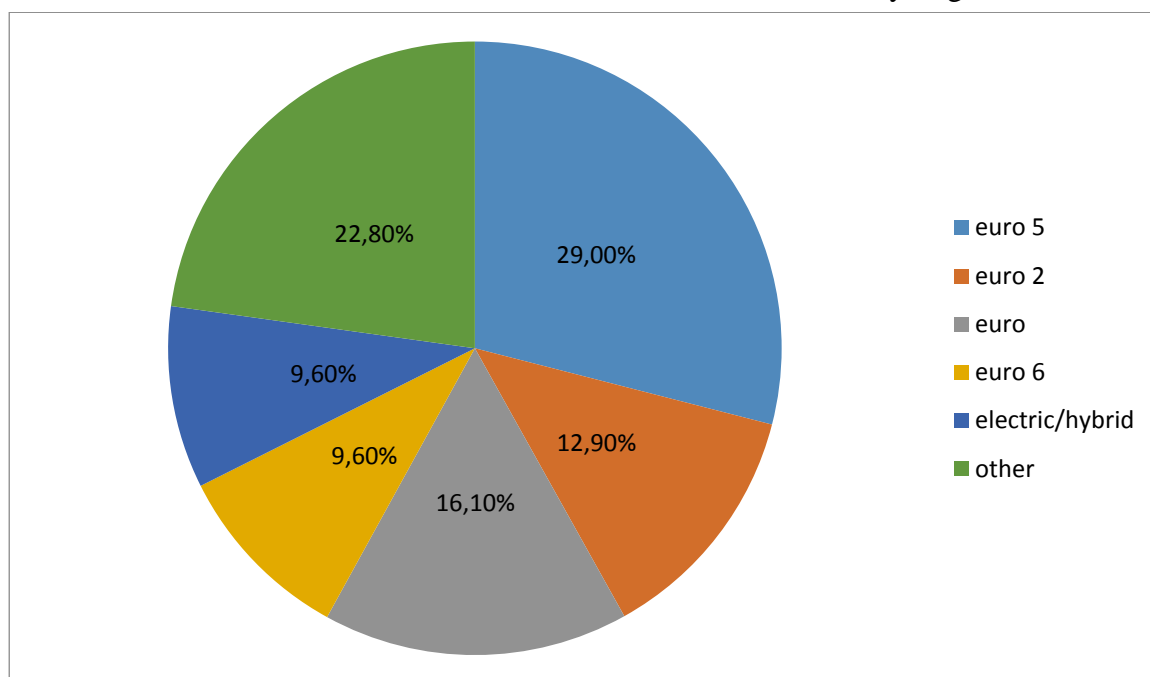
$\bar{y}$  – average index of change in the number of trucks with electric and hybrid drive in a given year in a group of local government units applying a tax preference.

In addition, to determine whether the number of hybrid and electric trucks increased faster in the cities introducing the discounts than in the cities not applying the preferences, the average annual indexes of change in this number in both groups were calculated and compared.

#### 4. Research results

Based on the texts of the resolutions of the city councils of the 63 largest Polish cities from 2018-2020 regarding the rates of the tax on means of transport, it can be concluded that the application of preferences in this tax for owners of trucks with hybrid and electric drive was decided in 31 urban centers, which accounted for 49,2% of the total number of entities covered by the analysis. The scale of benefits was varied, as was the criterion regarding the type of drive used. While in some cities (e.g. Warszawa, Poznań) a separate, lower tax rate was adopted for

vehicles with hybrid or electric drive, in others (e.g. Łódź, Kraków, Wrocław) owners of relevant trucks paid lower rates on an equal footing with owners of vehicles that meet selected EURO emission standards. The most frequently used criterion for the application of the reduced tax rate was the vehicle's propulsion with the exhaust emission standard of at least EURO 5, less often local municipalities adopted a lower limit for exhaust emissions at the level of any EURO standard and EURO 2 standard (Figure 1). It should be noted that the local authorities of some towns have introduced quite non-standard solutions in this respect. For example, the local government of the city of Ostrołęka, located in the north-eastern part of the country, introduced the same lower tax rate on means of transport, among others, for owners of hybrid or electric vehicles, but also those equipped with an exhaust gas catalyst, engine sound reducer and gas drive. The city hall of Konin in the western part of Poland went even further, enacting the same reduction in the tax rate for 2020 for owners of electric and hydrogen vehicles.



**Figure 1.** Exhaust emission criterion used by owners of trucks with hybrid or electric drive, paying a lower tax rate on means of transport, according to the percentage of local governments using a given solution.

Source: Own study.

Table 1 shows the amount of relief in the tax on means of transport resulting from the reduced rates of this tax applicable in the years 2018-2020 for owners of trucks with hybrid and electric drive in cities where local government authorities have adopted such a solution. As the data shows, most local governments applied tax preferences throughout the analyzed period, maintaining their mostly stable level. In isolated cases, the local authority introduced new, more favorable rates with some delay, and the most striking example in this respect is the city of Konin, where after two years of not applying any tax relief, it was decided to introduce a complete exemption for electric vehicles in the third year. This solution has also been adopted in several other local government units, while in one of the cities (Jaworzno) the abandonment of tax collection was extended in 2020 also to vehicles with hybrid drive.

**Table 1.**

*The amount of tax relief on means of transport for owners of trucks with hybrid or electric drive*

Town	Relief (%)			Town	Relief (%)		
	2018	2019	2020		2018	2019	2020
Warszawa	40	40	40	Skierniewice	6,1	6,1	6,1
Kraków	62,5	62,5	65,5	Ostrołęka	4,1	4,1	4,1
Łódź	9,6	9,6	9,6	Siedlce	22,3	15,6	3,8
Wrocław	50	50	50	Krosno	21,5	21,5	21,4
Poznań	62,8	86	86	Tarnobrzeg	6,2	6,2	6,2
Gdańsk	29,7	29,7	29,7	Słupsk	5,7	5,2	14,2
Szczecin	55,1	55,1	55,1	Sopot	22,1	21,9	21,5
Lublin	10,6	10,6	10,6	Chorzów	44,7	44,7	44,7
Katowice	49,7	51,1	51,3	Jastrzębie-Zdrój	50	50	50
Częstochowa	49,7	49,7	49,8	Jaworzno	0	0	100
Radom	16,6	16,6	16,6	Tychy	33,8	33,8	33,8
Toruń	48,7	48,5	48,4	Kielce	9,9	9,9	9,9
Olsztyn	58,9	58,9	58,9	Konin	0	0	50
Zabrze	0	39,9	39,9	Leszno	6,4	6,4	6,4
Ruda Śląska	18,2	18,2	18,2	Koszalin	8,8	8,8	8,8
Legnica	7,9	50	50				

Source: Own study.

Data from the Central Statistical Office clearly show that in the years 2018-2020 the number of hybrid and electric trucks in cities applying the discounts was increasing every year. The only exceptions to the rule are Warsaw, Ruda Śląska, Skierniewice and Chorzów, where a minimal decrease in the number of such vehicles was observed in 2020 (Table 2). It should be noted that in the surveyed group of urban centers the growth rate of the number of the discussed means of transport was similar and only in individual cases exceeded 10%.

**Table 2.**

*The amount of tax relief on means of transport for owners of trucks with hybrid or electric drive*

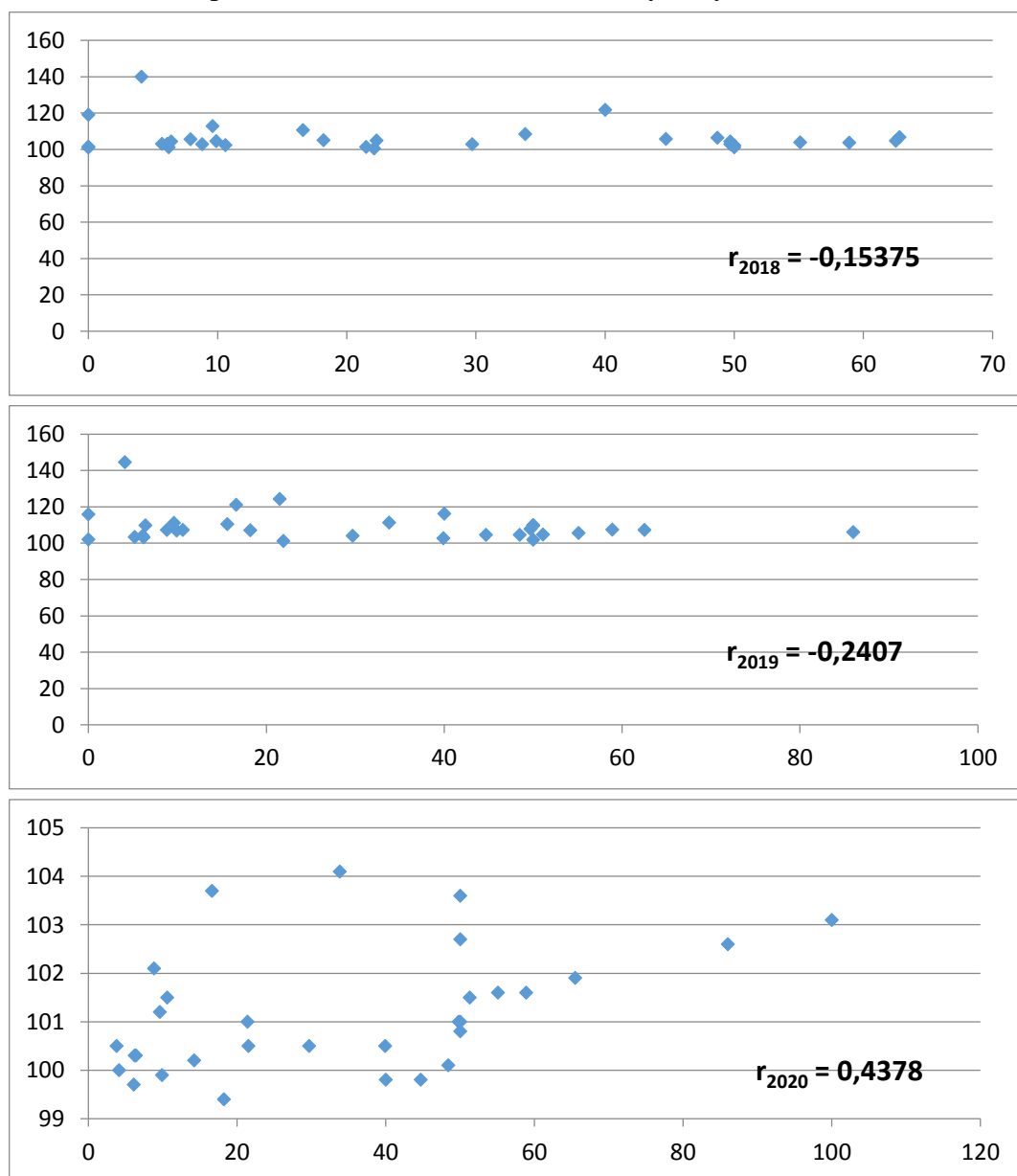
Town	Previous year = 100			Town	Previous year = 100		
	2018	2019	2020		2018	2019	2020
Warszawa	121,8	116,2	99,8	Skierniewice	103	104,2	99,7
Kraków	104,7	107,4	101,9	Ostrołęka	140	144,6	100
Łódź	112,8	111,2	101,2	Siedlce	104,9	110,6	100,5
Wrocław	102,2	101,9	100,8	Krosno	101,3	124,3	101
Poznań	106,7	106,2	102,6	Tarnobrzeg	101,1	103,3	100,3
Gdańsk	102,8	104,1	100,5	Słupsk	103,1	103,4	100,2
Szczecin	103,8	105,7	101,6	Sopot	100,5	101,3	100,5
Lublin	102,4	107,3	101,5	Chorzów	105,8	104,6	99,8
Katowice	104,3	104,8	101,5	Jastrzębie-Zdrój	101,2	110	101
Częstochowa	102,9	107,9	101	Jaworzno	101,6	102,1	103,1
Radom	110,7	121,2	103,7	Tychy	108,4	111,4	104,1
Toruń	106,4	104,7	100,1	Kielce	104,5	107	99,9
Olsztyn	103,7	107,5	101,6	Konin	119	116	103,6
Zabrze	101	102,7	100,5	Leszno	104,3	109,9	100,3
Ruda Śląska	105,1	107,2	99,4	Koszalin	102,8	107,3	102,1
Legnica	105,6	109,7	102,7				

Source: Own study based on Local Data Bank (Statistics Poland, 2022).

The relationship between the amount of the relief in the tax on means of transport and the dynamics of the increase in the number of trucks with electric and hybrid drive was examined on the basis of the Pearson linear correlation coefficient. The calculated ratios for 2018, 2019

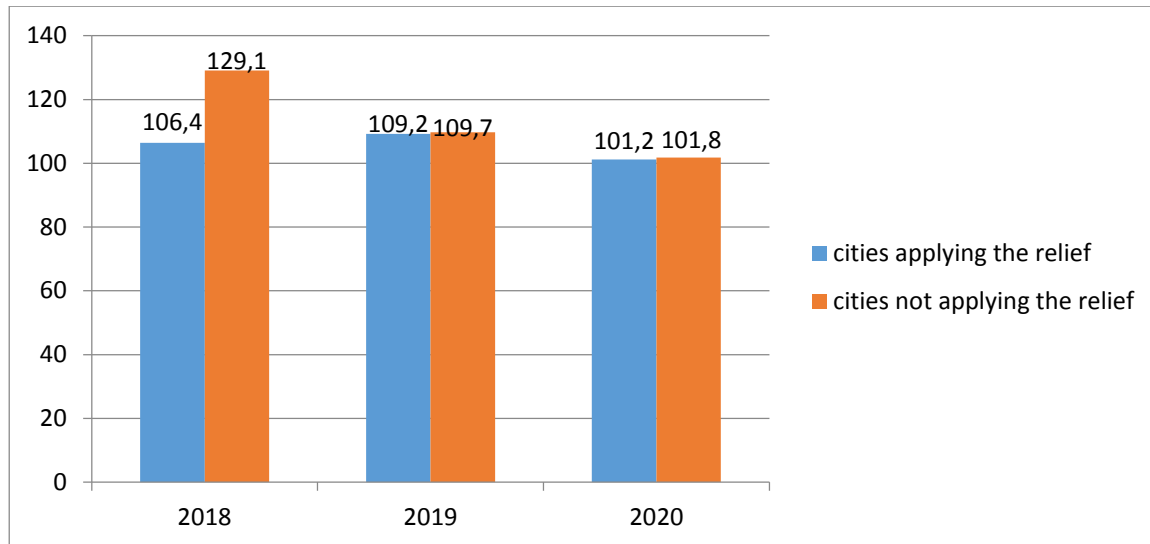


and 2020 indicate a generally very poor correlation of the above-mentioned data (Figure 2). According to J. Guilford's classification used by many authors to assess the strength of correlation (e.g. Van Aswegen, Engelbrecht, 2009; Putri et al., 2020), only in the last of the analyzed years it can be described as average. The obtained statistical result seems to correspond with the data presented in Figure 3, which compares the average indexes of changes in the number of electric and hybrid trucks in local government units applying reduced tax rates with analogous indicators for cities where tax preferences were not proposed at all. In the group of urban poviats in which it was decided to introduce tax support, the average dynamics indicator was lower each year than in the group of other local government units, with the largest difference in this respect recorded in the first of the analyzed years, i.e. 2018.



**Figure 2.** Pearson's linear correlation coefficient for 2018-2020 complex systems of polygamous holes made from one cluster to several coal deposits.

Source: Own study.



**Figure 3.** Average annual index of change in the number of electric and hybrid trucks in the surveyed urban centers in 2018-2020 Pearson's linear correlation coefficient for 2018-2020.

Source: Own study.

## 5. Conclusions

The results of the research discussed above entitle the formulation of the following conclusions corresponding to the research questions posed in the introductory part of the work:

- Local government authorities managing communes in Poland may apply discounts to owners of electric and hybrid vehicles in the form of lower tax rates on means of transport. Based on the review of resolutions adopted in 2018-2020 by city councils of the largest cities in Poland operating with poviats rights, it was found that at that time only half of local governments used this competence by reducing tax rates for owners of trucks powered entirely or partially by electricity.
- In the vast majority of centers it was not decided to introduce a separate lower tax rate for the discussed group of means of transport, thus their owners benefited from the relief on an equal footing with those who owned vehicles with a lower standard of exhaust emissions, such as EURO 5 or even EURO 1.
- In all analyzed centers, there was an increase in the number of trucks partially or entirely powered by electricity.
- There is no statistical evidence that the dynamics of the number of trucks with hybrid and electric drive in individual local government units is correlated with the amount of reliefs in the tax on means of transport applied by local governments. This is indicated not only by the values of the correlation coefficient, but also by comparing the average dynamics in cities applying preferences with centers that have not introduced appropriate reliefs.

There are some limitations in the study, the results of which are presented in this paper. Other factors that may potentially affect the number of electric vehicles in a given area have not been taken into account. The reduced rate of tax on means of transport is not the only tool that can be used by local governments to stimulate an increase in the number of hybrid and electric vehicles in a given area. For this reason, the results of the study should be treated as an introduction to a broader analysis. This is in line with the postulates of some authors writing about stimulating the development of means of communication driven by electric and hybrid motors (Lam, Mercure, 2021; Jenn et al., 2018). According to one study, potential users of hybrid and electric vehicles expect greater support from the city authorities in terms of subsidized parking spaces and the expansion of the charging station network (Inci et al., 2022, p. 14). An appropriate information campaign aimed at disseminating among vehicle users the knowledge about the amenities that they can count on in the event of changing the means of transport to "cleaner" is also important. Lack of promotion can also be considered as a factor that could reduce the effectiveness of all pro-environmental solutions, including tax ones (Jenn et al., 2018, p. 352). Of course, the aforementioned activities require increased financial involvement of municipalities. In Polish conditions, this topic was raised a few years ago in the work, where the authors showed that the level of financial participation of municipal authorities in the development of low-emission transport only through tax solutions has been rather low so far (Felis, Rosłaniec, 2017).

In the context of what was said earlier, the most important practical implication of the conducted study is the need to combine appropriate tax tools with other solutions stimulating the increase in the number of low-emission cars as part of the local government policy of supporting environmentally friendly transport. Continuing research in this area, in the era of increasing pressure to implement pro-ecological projects, and at the same time new challenges in the field of financing that local governments have recently faced, seems to be justified.

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