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**Katarzyna HEBEL<sup>1</sup>, Marcin WOŁEK<sup>2</sup>**

## **CHANGE TRENDS IN THE USE OF PASSENGER CARS ON URBAN TRIPS: CAR-POOLING IN GDYNIA**

**Summary.** The wide accessibility of European citizens to cars results in problems caused by their excessive use as a means of urban transport. Given this situation, it is necessary to find new solutions for the more efficient use of passenger cars in cities. This problem affects almost all European cities, including those in Poland. The paper analyses the level of motorization and modal split in Polish cities with county status, while selected European cities serve as a background to determine the scale of the problem. In the search of solutions in relation to Poland, an analysis of different documents outlining the directions of urban mobility was conducted. One of these documents concerned the promotion of car-pooling, the history of which dates back to the Second World War and the 1950s. Initially introduced in the USA, its increasing development in European cities has been witnessed in recent years. Research on the evaluation of real car-pooling in Polish cities was conducted in Gdynia by the authors of this study. The results of marketing research presented in the article have determined the degree to which participants in urban mobility are inclined to take part in car-pooling schemes in Polish cities.

**Keywords:** car-pooling; motorization; marketing research

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<sup>1</sup> Faculty of Economics, University of Gdansk, Armii Krajowej 119/121 Street, 81-824 Sopot, Poland. E-mail: khzh@wp.pl

<sup>2</sup> Faculty of Economics, University of Gdansk, Armii Krajowej 119/121 Street, 81-824 Sopot, Poland. E-mail: mwol@wp.pl

## 1. INTRODUCTION

Cars occupy a special position in the transport market of urban areas. The need to own a vehicle is common and any restriction on the extent of car ownership seems very difficult to achieve. Reducing the degree to which cars are used is essential as currently most vehicles carry only one passenger, namely, the driver. The problem of limited space in urban areas forces city authorities to put in place initiatives aimed at improving the quality of life in the city, including those that look to optimize road usage and parking spaces. Various solutions of either a restrictive (forbidding) or inclining (persuasive) character are intended to achieve this effect. The best results are obtained by the simultaneous implementation of a number of solutions that are convincing to a wide group of inhabitants, especially car owners. It is, therefore, important to establish a widely acceptable role for cars within cities, which is convincing for their inhabitants.

## 2. MOTORIZATION IN SELECTED EUROPEAN CITIES

Accessibility to cars is currently unlimited for all European citizens. Fig. 1 presents the individual motorization rate for European countries in 2015, compared to 1999. The data confirm that, at present, practically every second European citizen (regardless of age) owns a car, which they are able to use for urban trips, meaning they are independent of public transportation. The most spectacular growth in the motorization index between 1999 and 2015 was noted in Poland (125%), followed by Romania (95%), Bulgaria (79%) and Greece (74%). It should be noted that those countries had a very low level of motorization in 1999, compared to Germany, Italy, Luxembourg or Austria (at that time, the index value exceeded 500 cars per 1,000 inhabitants).

## 3. TRENDS IN PRIVATE MOTORIZATION DEVELOPMENT IN POLISH CITIES

An assumption was made that the majority of urban traffic is found in cities with county status, which usually have more than 50,000 citizens. There are 65 such cities in Poland. As of 2015, the total number of citizens living in these cities was 12.42 million or 32% of the country's population. In the same year, the number of cars registered in these cities was 6.63 million (32%) out of 20.72 million cars registered in the whole of Poland. Fig. 2 presents the process of individual motorization growth between 2009 and 2015 among Polish cities, as well as the individual motorization index, which ranges from 394 (Białystok) to 723 (Sopot) cars per 1,000 inhabitants. The city of Gdynia was characterized by moderately dynamic growth (23%) but a higher motorization index than average for all cities (542). The average values for the described cities were 534 cars/1,000 citizens and 23% of the growth in the number of cars.

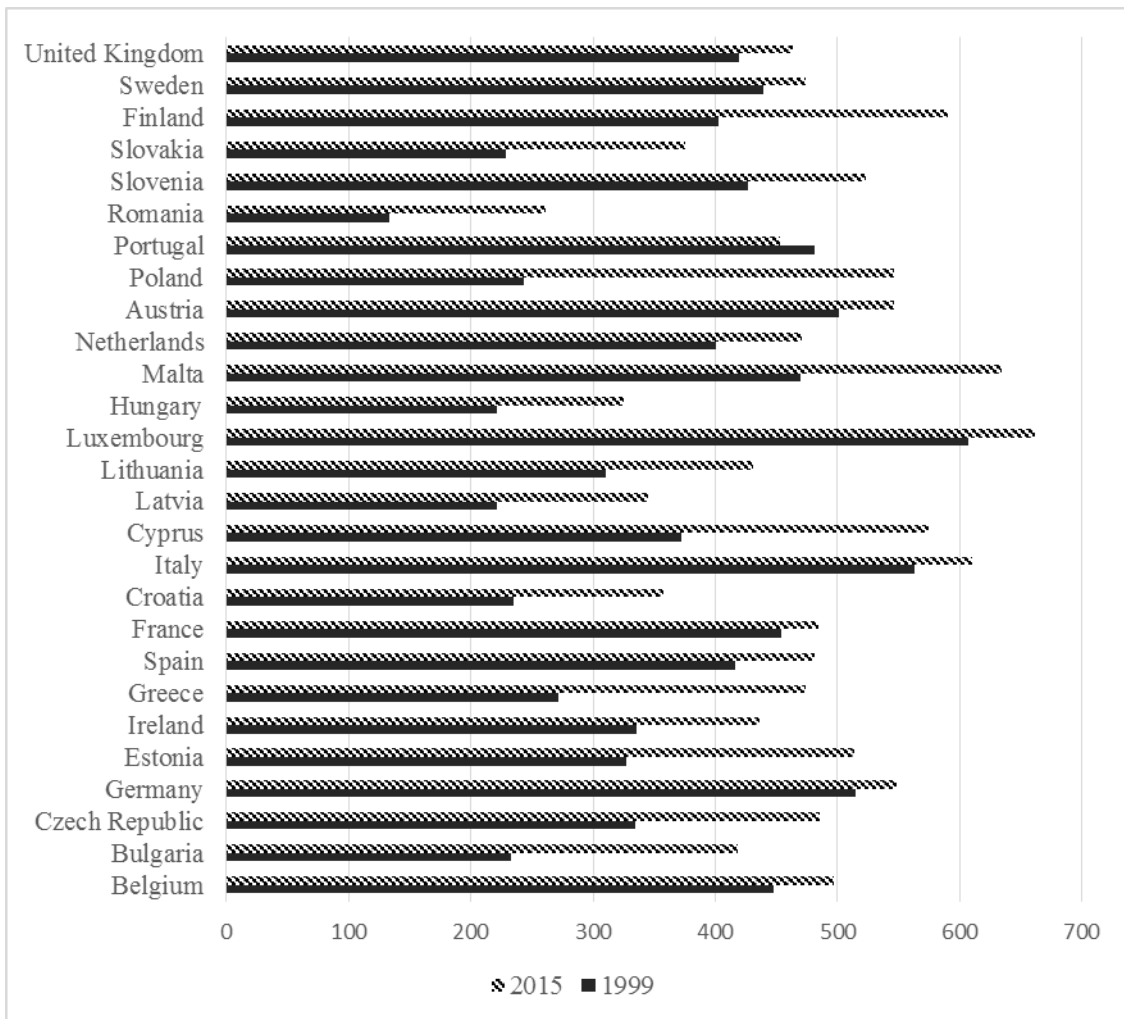


Fig. 1. Motorization index of selected EU countries in 1999 and 2015 [6]

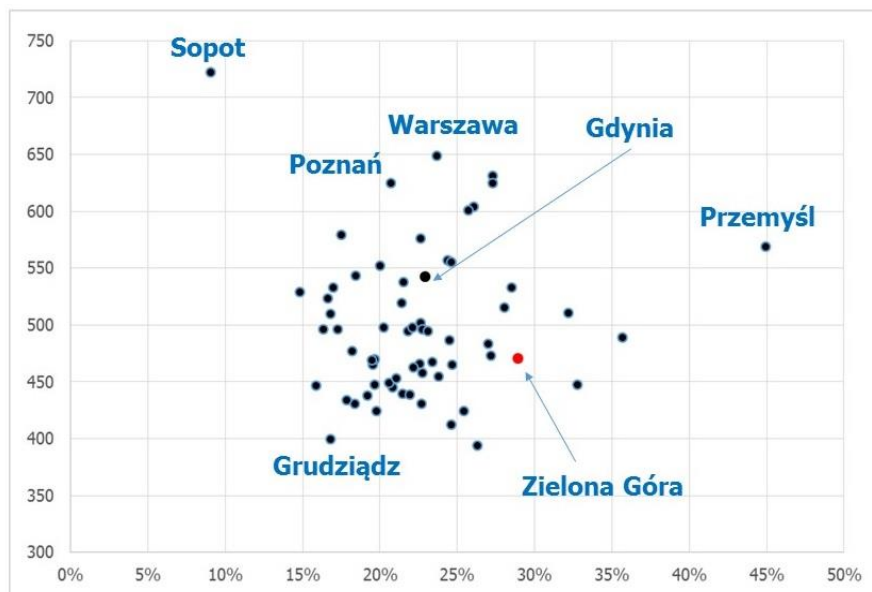


Fig. 2. Individual motorization index (Y axis) and dynamics of growth in 2009-2015 (axis X) of Polish cities with county status [12]

#### 4. MODAL SPLIT IN SELECTED EUROPEAN CITIES

At this moment in time, a car is the main mode of transport in European cities. This fact finds its confirmation in modal split research, which has been conducted in some of those cities. The nature of research is both nationwide (uniform methodology for studies conducted across all cities) and individual for each city. The results of those various studies have been collected on the European Platform on Mobility Management. Fig. 3 presents the modal split for cities with more than 200,000 inhabitants where such research was conducted in the years 2014-2016.

In Palermo, 78% of urban trips are completed by car. The fact that a car permits its passengers to travel door-to-door means that it provides freedom of travel within cities, although this is contingent on infrastructural factors, such as the quality and parameters of the road and parking spaces. This freedom, in turn, has caused greater congestion, resulting in a decrease in the attractiveness of cars as a mode of transportation.

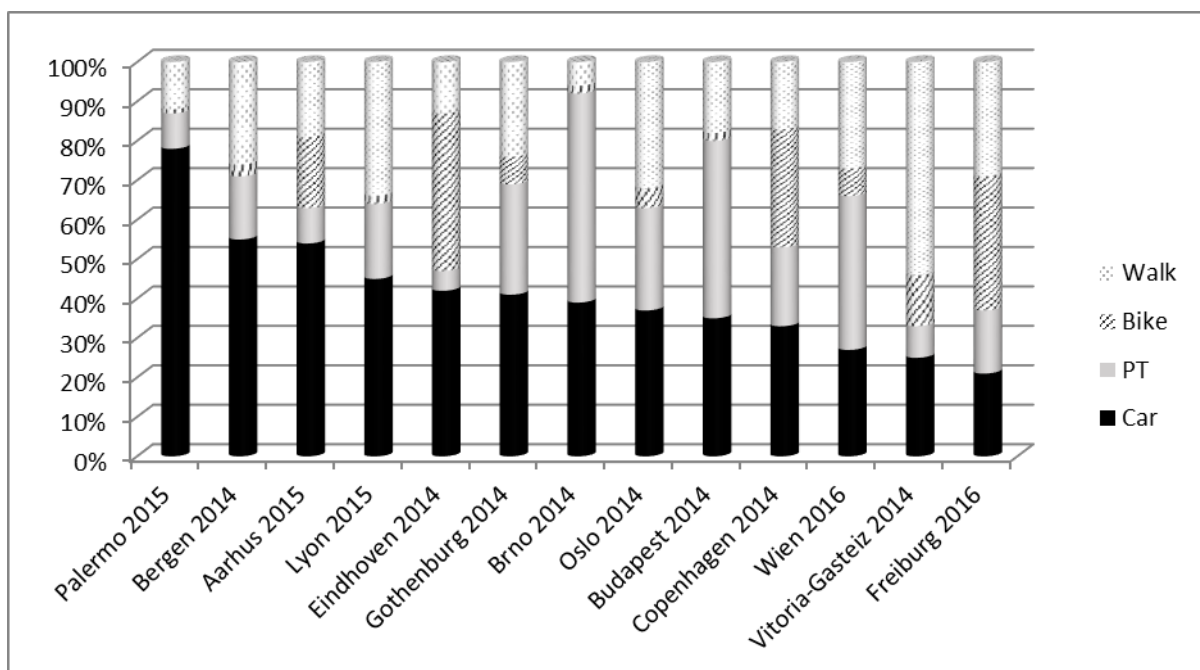


Fig. 3. Modal split of selected European cities [5]

Moreover, there are many other serious negative impacts of mass motorization, including pollution, traffic accidents, upstream and downstream effects (covering all effects before and after the utilization phase), climate change, land use patterns and noise. The last category is difficult to measure as it includes many sub-impacts, such as the disturbance of social communication, concentrated working, recovery and sleep phases, a reduction of activities leading to annoyance, loss of efficiency, and the permanent modification of behaviour. Another category of traffic noise impact is that it disturbs autonomic functions causing multifactorial conditioned chronic (cardiovascular) diseases [1].

Modal splits in cities are different, although the car maintains a stable market position. The difference in modal split morphology lies in the share of other forms of travelling, such as public transport, cycling and walking. The least accurate form of urban travel to measure is walking, as there are many definitions of pedestrian travel (focused on time or distance),

while the precise measurement is always a challenge because of the strong influence of spatial, economic and sociocultural factors. The situation in Freiburg (230,000 inhabitants) and Vienna (1.8 million inhabitants) allows for an optimistic forecast: they provide confirmation that a 25% share of car travel is possible for a modal split in large and medium cities, although both cities are regarded as very advanced in terms of cycling (Freiburg) and public transport (Vienna) development.

## 5. DIRECTIONS FOR SHAPING URBAN MOBILITY IN THE LIGHT OF POLISH STRATEGIC DOCUMENTS

The level of motorization development in Polish cities confirms that this issue is a permanent element in the landscape of mobility. While the complete elimination of passenger cars is impossible, there are many initiatives to increase the efficiency of their use in urban areas. Multiple solutions aimed at limiting urban car travel are being implemented alongside such systems as Park&Ride [13], Park&Rail, Kiss&Ride, car-pooling and car-sharing.

The review of strategic documents clearly highlights the car as a negative factor in the development of cities in Poland. Without arguing for a highly optimistic vision of the development of Polish spaces by 2030, modern forms of car use (based on sharing schemes) should be taken into consideration. Documents approved since 2013 point to selected shared mobility schemes (mainly car-sharing and bike-sharing) as ways to ensure cars are used in a more efficient way (Table 1).

Tab. 1

Review of strategic documents at the national level in Poland related to transport and mobility between 2010 and 2017

Document	Year	Description
National Strategy for Regional Development	2010	Public transport is not seen as an attractive alternative to the car, which results in increased pollution, noise and congestion
Concept for Spatial Organization of the Country up to 2030	2011	The urban sprawl is seen as a main reason behind the ineffective allocation of public resources, which is the opposite to sustainable development and social justice. Promoting cheap housing on “cheap land” costs twice as much as it does in the zone of intense development. Such a model fosters further growth in individual motorization (p. 161)
Long-term Strategy for the Country’s Development: Poland 2030	2011	“Sustainable mobility solutions include the reconstruction of the road system in the city, the use of innovative methods of traffic management, improved alternatives to car-based forms of mobility and increasing the quality of public transport”
Strategy for the Country’s Development	2012	“One of the most important improvements is the organization of efficient and consistent transport in the metropolitan area” (p. 108)

Strategy for Transport Development up to 2020 (with a Perspective to 2030)	2013	“The biggest disadvantage of this rapidly developing motorization was the low average number of passengers in the car during the journey, ranging from 1-2 people moving within agglomerations to 2-5 people on international journeys. This is one of the main reasons for the increase in congestion, which can be eliminated by promoting systems of so-called car-sharing and car-pooling” (pp. 12-13)
Partnership Agreement	2014	Transport in Polish cities is a major source of emissions. In 2003-2011, the length of roads increased by 27.3% and the number of vehicles increased by 127%, which was the main reason for bottlenecks
National Urban Policy	2015	<p>The growth in motorization is one of the most important challenges for Polish cities. In addition, unfriendly urban spaces often do not encourage pedestrians and cyclists. What is needed is the rationale use of existing transport subsystems.</p> <p>Public cycle systems should be developed and integrated with other forms of transport. Car-sharing is also seen as a real mechanism to limit the use of cars by residents, but only to the situation where it is actually necessary. Local governments should be responsible for the implementation of such solutions; where direct public action is not justified, the should be at least widely promoted and supported [p. 47].</p> <p>Cities could become involved in organizing a system to charge batteries for electric vehicles. These activities may be combined with the creation of an electric car-sharing system for short city journeys (similar to a public bicycle system), although they should not be restricted. Electric cars should start to be seen as an alternative to diesel cars [p. 62].</p>
Responsible Development Plan	2017	<p>The number of cars in Poland has doubled since 2000. In 2015, it exceeded 20 million cars, while the individual motorization index was 550 cars per 1,000 inhabitants. The average age of the car is higher than the EU average, which creates an additional negative impact on the natural environment.</p> <p>Among the set of complex and diversified actions focused on diminishing the role of the car, the support for vehicle-sharing systems, especially in rural areas, is proposed in order to reduce the cost of commuting, as well as the pressure on the environment.</p>

Own study, based on [4, 10, 11, 15, 17, 19, 20, 21]

## **6. BASIC CHARACTERISTIC OF CAR-POOLING**

Car-pooling and car-sharing are based on the concept of people travelling to work together in one (shared) vehicle. Car-pooling involves passengers riding in each other's cars interchangeably, whilst car-sharing only involves one car in constant use, with passengers splitting the cost of travel between them. It is characterized by the fact that even those who do not own a car may use this method of travel, although there are alternative ways to organize their trips at their disposal, namely, via public transport or on a bike. Vehicle ownership plays a crucial role in the distinction between car-pooling and car-sharing. In car-sharing, the car is owned by the company, while the vehicle is privately owned in the case of car-pooling [3]. Car-pooling has been known since the 1950s, although the first trials were conducted during the Second World War to save fuel and tyres, which were regarded as strategic resources. Such a solution was then implemented in the USA.

The issues related to car-pooling are connected with the anxiety that results from sharing a vehicle with strangers. Safety may be increased by the verification of personal data prior to registration on the system. The development of the system is also inhibited by different agendas among potential car sharers, as well as many additional errands that may require the attention of the passengers of one vehicle. Work commutes provide fertile ground for these solutions as trips to work are, by definition, regular and repetitive.

The scale of car-pooling is difficult to assess as many trips are informally made. Some researchers position car-pooling as the second most popular way of commuting [9], although there are many differences between countries and continents.

There are different car-pooling models, ranging from organized, professional platforms, company-driven or office building schemes, and family- and friends-oriented networks to accidental, random activity that is almost impossible to track and evaluate [2]. Currently, this form of travel is popular in many US cities (10.4% in modal share including both inter- and intra-household car-pools in 2007) [23, 25], as well as German, UK, Canadian, Australian and Italian cities. In Poland, car-pooling was introduced as a pilot solution in Cracow among the employees of the Technical University of Cracow [8]. In a recent study, when driving short to medium distances, car-pooling was found to reduce 20-40% of CO<sub>2</sub> emissions [14].

Its further development is strongly affected by the technological development and growing popularity of smartphones, which could serve as gateways to modern just-in-time systems. In 2014, there were 189.5 million such devices in Europe and it is estimated that their number will grow. More than 80% of European households owned a smartphone in 2015 (the highest rate was in the UK – 88%, followed by Spain – 87% and Germany – 85%), while monthly mobile data transfer is expected to reach 13 GB per active smartphone by 2021 [7, 16].

## **7. CAR-POOLING IN GDYNIA**

The results of primary research conducted by the Chair of the Transportation Market and Board of Urban Transport in Gdynia in 2013 and 2015 play a significant part in the verification of the research thesis. The aforementioned research was conducted on a research sample of 1% of the inhabitants of Gdynia between 16 and 75 years of age (2,000 people). The research was conducted using the individual survey method among households, each time on a stratified random sample. The city district, as well as the gender and age of the respondents, was taken into account when identifying and constructing each stratum.

The questionnaire included more than 40 questions and was divided into three categories: respectively, transport behaviour, transport preferences and characteristics of the respondent. Recent research has shown that the share of households having at least one car increased from 56% in 2004 to 75% in 2015.

Car-pooling questions were answered by persons who were the main user of a passenger car, carrying out their urban journeys always or mainly by car. Shared use of the car in urban journeys (commuting) was declared by a third of the respondents. The difference between family members and other persons was very low, but passengers belonging to the same family were taken more often (Table 2).

Tab. 2

Shared use of the car in urban journeys (commuting) [18]

Option	Passenger [%]	
	Family member	Outside the family
Every day (seven days a week)	0.62	0.41
A few times a week (four to six days a week)	13.96	8.01
A few times a month	11.91	13.14
Once a month	2.87	5.34
Less than once a month	8.01	8.01
I do not take any passengers	62.63	65.09

Another picture of car-pooling emerges from the study on travel for another reason (Table 3). In that case, car-pooling is quite common, although it does not happen with any regularity and frequency as in the case of commuting. More than 75% of drivers take family members as passengers, with one third doing so a few times a week. The intensity of car-pooling outside of the same household (family) is much lower: 20% of such drivers only take passengers a few times a month, but half of them take no passengers.

Tab. 3

Shared use of the car in urban journeys: other reasons [18]

Option	Passenger [%]	
	Family member	Outside the family
Every day (seven days a week)	2.04	0.29
A few times a week (four to six days a week)	34.84	5.54
A few times a month	32.94	19.39
Once a month	3.06	6.56
Less than once a month	4.66	17.78
I do not take any passengers	22.45	50.44

Being inclined to regularly take a co-worker on the whole or part of a commute was declared by almost two thirds of the respondents who were the main user of a passenger car (Fig. 4), including 40% who declared that they would take passengers free of charge. More than one third (38%) was negative about such an option.



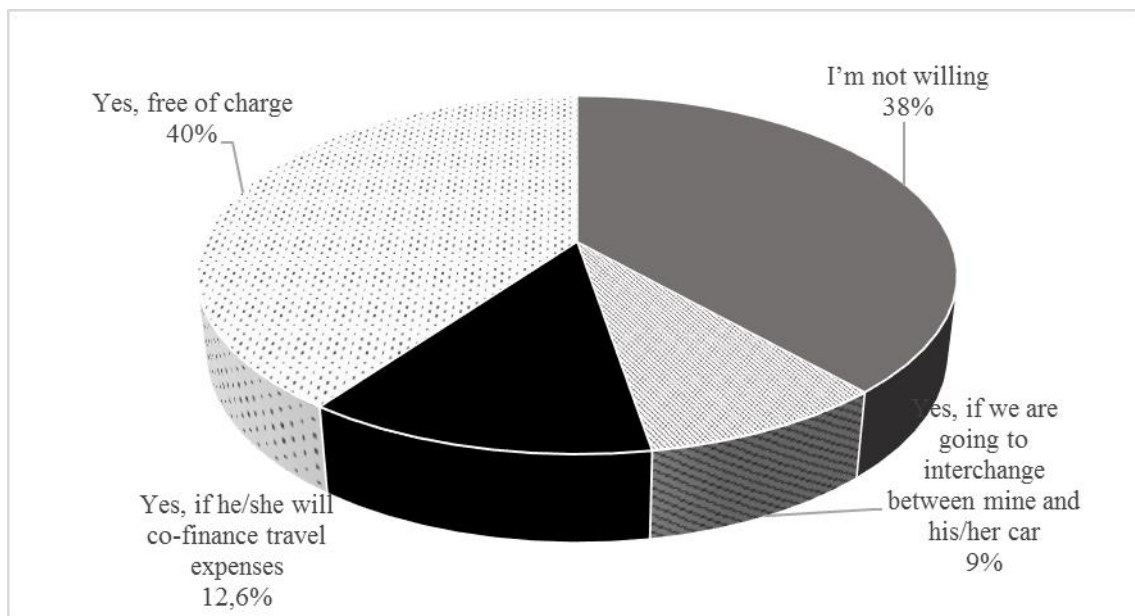


Fig. 4. Inclination to regularly take a co-worker on the whole or part of a commuting travel [18]

## 8. SUMMARY

The fast pace of technological development and the associated increase in the number of smartphones can provide car-pooling participants with one of the most effective methods to decrease the dependence on privately owned vehicles in European cities. Although the real scale of car-pooling is still unknown (due to informal forms of car-pooling based on networks of family or friends, often defined as “informal forms of ride-sharing”), it could play an important role in commuting, especially from rural and less dense urban areas. The development of car-pooling forms in areas that are characterized by a high level of public transport supply could be counterproductive from the perspective of public finances and the environment [22, 84].

Nevertheless, car-pooling may be regarded as one of the tools within complex solutions focused on solving the commuter demands during peak hours.

In Polish cities, based on the example of Gdynia, the rapid growth in motorization was observed, mainly at the expense of public transport. The scale and structure of car-pooling is unknown, such that the data presented should be treated as an introduction to further research on the motivations and inclination to use a private car in a car-pooling scheme. One of the most promising results of the research is the strong inclination to give a lift to a co-worker for either the whole or part of a commute (almost two thirds of respondents who were the main user of a passenger car). Taking into account that the motorization index for many Polish cities is approaching the level of saturation, further activities aimed at the more efficient use of cars should become an important part of any sustainable urban mobility strategy. The recent documents on transport policy and economic development, which has been approved at a national level in Poland since 2013, highlight shared mobility schemes that would make use of cars in a more efficient way.

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