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# Electromobility in Poland, Availability, Trends and Challenges

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***Abstract:***

***Purpose:*** *The article deals with the issue of changes that take place in the habits of car users and in the automotive market in terms of introducing electromobility solutions. Basic documents show the necessity and possibility of developing electromobility in Europe and Poland. It indicates the harmfulness of the current transport model. The author paid special attention to the study of automotive preferences among the inhabitants of Polish cities*
***Design/Methodology/Approach:*** *The survey was carried out using the CAWI and direct survey method on a sample of over 200 residents from the ten most populated Polish cities.*
***Conclusionss:*** *The study shows that choosing an electric car in the near future will become as common as petrol one. At the same time, the lack of sufficient infrastructure, especially public availability is clearly indicated.*
***Practical Implications:*** *The availability of charging points and the level of household income should be indicated as key for the development of electromobility. Consumers' attitudes related to experiences and concerns about new products are also not without significance.*
***Originality/value:*** *An attempt to identify the current mood towards electromobility, as well as practical obstacles in the purchase and operation of this type of vehicle.*

***Keywords:*** *Electromobility, sustainable development, consumer moods.*

***JEL classification:*** *L62, N74, O33, R40.*

***Paper Type:*** *Research article.*

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## 1. Introduction

Almost all over the world, the last decades have brought significant economic growth, improved living conditions and thanks to trade, the availability of goods has also increased. Contemporary societies, especially those living in developed countries are characterized by high transport needs related to consumption, tourism and professional activity, however transport generates numerous problems, especially related to the emission of harmful substances, land consumption, noise and congestion.

Societies of EU countries are more and more aware of these threats, hence their attitude, as well as legal guidelines or support programs for solutions, that may reduce these negative effects. Although individual transport is definitely not environmentally friendly one. Electromobility is a chance to significantly reduce its negative effects in terms of emissions and especially the concentration of these harmful substances in urban areas.

## 2. Problems Related to Road Transport

When addressing the issue of emissivity, a collective approach to Greenhouse Gases (GHG) emissions is often used. It includes Water vapor (H2O), Carbon dioxide (CO2), Methane (CH4), Nitrous oxide (N2O), Ozone (O3), Chlorofluorocarbons (CFCs) and Hydrofluorocarbons (includes HCFCs and HFCs). In transport, attention is most often focused on CO2 and methane emissions due to their significant share in both exhaust gases and the atmosphere.

According to the data provided by the European Environment Agency (EEA) in the countries it studied, transport and separate road transport accounted for the following percentage of harmful substances emissions in 2017, as presented in Table 1.

***Table 1.*** *Emissions of the main air pollutants by non-road and road transport in the EEA-33*

| Air pollutants | Road transport | Non-road transport |
|---|---|---|
| NH3 (ammonia) | 1,16 % | 0,01 % |
| NMVOC | 7,77 % | 0,97 % |
| NOx | 36,48 % | 8,73 % |
| PM 2,5 | 10,67 % | 2,69 % |
| Sox | 0,13 % | 1,57 % |

***Note:*** *Other sectors in research, energy production and distribution, energy use in industry, commercial institutional and households, industrial processes and product use, agriculture, waste and other.*

***Source:*** *Emissions of the main air pollutants by sector group in the EEA-33 in 2017, https://www.eea.europa.eu/data-and-maps/daviz/share-of-eea-33-emissions-5.*

According to available studies, transport activity is responsible for almost a quarter of Europe's GHG emissions and is the main cause of air pollution in cities. Within this sector, road transport is by far the biggest emitter accounting for more than 70% of all GHG emissions from transport in 2014 (Strategy for Low-Emission…, 2016).

Apart from the influence of greenhouse gases on the temperature increase and the related consequences, the mentioned pollutants also influence many processes directly affecting the life and health of humans and other living organisms, for example non-methane volatile organic compounds - NMVOCs (such as benzene or ethanol) are thought to be responsible for cancer and genetic diseases. The enormous social, environmental and economic costs make actions to reduce the harmful impact of transport one of the most important challenges and necessary actions for the next decades.

The United Europe and its predecessors, realizing the importance of transport for an efficient economy and trade, acted to create a legal and strategic framework to improve the economy and reduce the external costs of transport. It can be assumed that these policies approach the issue in a holistic way. The general goal of these politics and strategies is to improve the efficiency of transport processes, transport corridors including the so-called green transport corridors, promotion and support of intermodal transport.

There are proposed actions to promote the use of industries with the lowest environmental impact in relation to the transport work i.e. inland water transport, short sea shipping or the use of rail.

The key documents of the last decades are the White Paper on the future development of the common transport policy from 1992 (European Commision, 1992). It advocated the opening up of transport markets, extending the Trans-European Transport Network, improving safety and harmonizing social provisions. It shows the imprtance of integrated, intermodal approach based on the model of sustainable mobility. Almost ten years later, in 2001 the EU Commision published the next „White paper European Transport Policy for 2010: Time to Decide" (European Commision, 2001). The main goal was to underline the need to manage the development of transport by achieving a more sustainable use of all means of transport. The main goal was to underline the need to manage the development of transport by achieving a more sustainable use of all means of transport. Then in 2011 White Paper - Roadmap to a Single European Transport Area - Towards a competitive and resource efficient transport system was published. This strategy, approved by European Commission called „Transport 2050".

It predicts an increase in mobility and reducing Europe's dependence on oil imports, as well as cuttin carbon dioxide emissions in transport by 60% (European Commission, 2011). What are the most recent publications should be also considered, especially the so called „European Green Deal". This is a package of

legislative proposals to adapt the EU's climate, energy, transport and tax policies to meet the goal of reducing net greenhouse gas emissions by 2030 by at least 55% compared to 1990 levels. Meeting this target within the next ten years is crucial for United Europe to become the world's first climate neutral area by 2050 (Eurpean Green Deal, 2019).

The European Union does not limit itself to setting orientations but also devotes significant resources to helping meet the goals of reducing emissions from transport. The transport-related envelope under the European Structural and Investment Funds totals EUR 70 billion, which includes EUR 39 billion for supporting the move towards low-emission mobility. This in turn includes EUR 12 billion for developing low-carbon, multi-modal sustainable urban mobility. The Connecting Europe Facility offers EUR 24 billion. A significant portion of Horizon 2020's transport research and innovation program amounting to EUR 6.4 billion is focused on low-carbon mobility. It should also be emphasized, that the need to conduct research and find the best path to move away from the consumption of fossil fuels. (Strategy for Low-Emission…, 2016)

Goverments have to act as quickly as possible because the vehicles that will appear on the roads today, will be on them for many years. When implementing solutions for low-emission transport, they should be approached in a similar way as for infrastructure investments because vehicles are most often used for at least a dozen years.

The policy of Poland is obviously related to the policies and strategies of the EU in this area. In Poland, national policy framework is developed and adopted under the Act on Electromobility and Alternative Fuels of 11 January 2018. (Act, 2018) Another important document in this area is the Transport Sustainable Development Strategy until 2030 (Strategy, 2019). It indicates the main goal of "Increasing transport accessibility and improving the safety of road users and the efficiency of the transport sector by creating a coherent, sustainable, innovative and user-friendly transport system in the national, European and global dimension" and to enable its achievement within the following directions of intervention:

- building an integrated, interconnected transport network for a competitive economy;
- improving the way the transport system is organized and managed;
- changes in individual and collective mobility;
- improving the safety of road users and transported goods;
- limiting the negative impact of transport on the environment;
- improving the efficiency of using public funds for transport projects.

Programs facilitating the purchase of electric vehicles by individual consumers or entrepreneurs, including the requirements for the use of low-emission

technologies in public transport or in the transport of cargo will be of great importance. It is important to consolidate the awareness of climate threats but equally important to properly identify barriers to the development of low and zero-emission solutions in transport because this is only way to reduce this risk.

## 3. Barriers to the Development of Electromobility in Poland

In Poland, as in other EU countries, there is a need to abandon transport based on fossil fuels. The drive towards low-emission transport today means in practice a transition to hybrid, electric or hydrogen vehicles, however the process is extremely slow. The barriers can be divided into economic, legal and infrastructural.

The automotive market cannot be considered in isolation from economic realities. Taking into account the net earnings, a single person in Poland without children earns an annual average of about EUR 10.000, while a married couple with two children on average less than EUR 25.000. For comparison, countries where sales of electric cars are the highest, such as the Netherlands, have these indicators at the level of less than EUR 40.000 for a single person and EUR 80.000 for a married couple with two children. In turn, in countries with the largest automotive market in Europe, i.e., Germany, these values are at the level of over EUR 30.000 for a single, up to less than EUR 70.000 for a married couple with two children (Eurostat, 2019).

Of course, higher earnings often mean higher costs for living, renting or buying real estate, food and services in a given State. Despite these circumstances, funds available for purchase or rent vehicle remain correspondingly higher. Considering that apart from a few exceptions, such as Denmark, the prices of new cars in most European countries are at a similar level, it is not difficult to find out why there is relatively little interest and as a result the low share of PHEV, BEV and Hydrogen vehicles in Poland.

Analyzing the price list of a popular car in Europe, such as the Skoda Octavia, the differences in prices with comparable equipment amount to approx. EUR 8.000-9.000 to the disadvantage of the PHEV model. It should be noted that the PHEV version has more power and based on the manufacturer's data, has better performance and several times lower fuel consumption (especially when we take into account the distance that can be covered mostly using EV mode). This makes it difficult to directly compare these vehicles.

There is no doubt, that regardless of the brand, the threshold for acquiring a PHEV version is from about EUR 2.500 to almost 14.000 higher than with only combustion engine, comparing the almost the same equipment versions (Price lists and specifications, 2021)

The same tendency can be observed in the case of purely electric cars (BEV). Many manufacturers create electric cars from scratch and in this case the comparisons become extremely complicated but there are also those who do the same models with different types of drive. In addition, there are manufacturers like Tesla who have a different business model (operation, contact with the customer and service than other brands), hence it is difficult to compare them.

It is commonly believed that the electric drive at the current stage of development is particularly suitable for use in city cars (short distances). The reason is the battery capacity, that limits the range and an energy consumption and recovery structure that looks relatively good in city traffic. This is also favored by the city's policy related to the preferential treatment of BEV and PHEV cars (the possibility of using bus lanes, cheaper or free parking).

Another difficulty is the ability to charge vehicles. Charging the batteries of popular electric vehicles from the network with the use of specially prepared ones for this purpose chargers last from several dozen minutes in public chargers, up to even several hours with the use of electricity from a household socket. As a result, people who do not have their own garage or driveway would be doomed to use generally available chargers. Currently, it is difficult to assess their availability in Poland as satisfactory and it cannot be stated that the electromobility infrastructure exceeded the needs and constituted an incentive to change the vehicle to the BEV or PHEV type.

There is no official data on the number of chargers in each city. You can rely on internet portals dealing with this subject and associating the community that uses electromobility. The source of information can also be applications downloaded on smartphones, most often used by electric vehicle users. The number and location of charging stations in selected cities in Poland are presented in Table 2. It presents data from the most frequently downloaded application, assuming its position and number of users as significant social evidence, however this does not change the fact that no official map of this type of service is available.

***Table 2.*** *Number of vehicle charging stations in Poland*

| City | The number of charging stations based on the data of the most popular applications | Population in thousands |
|---|---|---|
| Białystok | 19 | 297 |
| Bydgoszcz | 15 | 350 |
| Gdańsk | 90 | 467 |
| Kraków | 63 | 771 |
| Lublin | 18 | 340 |
| Łódź | 27 | 685 |
| Poznań | 58 | 536 |
| Szczecin | 25 | 407 |

| | | |
|---|---|---|
| Warszawa | 130 | 1778 |
| Wrocław | 44 | 641 |

***Source:*** *The authors' own study based on data form PlugShare app Recargo inc. (access 27.09.2021) and Population of cities which in 2018 exceeded 100 thou. people, as of 31 December 2018, Demographic Yearbook, Central Statistical Office, Warsaw, 2019 p. 100.*

The data shows that in the most populous Polish cities, there is one charging station for over 12.800 inhabitants, it is important to emphasize that at the beginning of 2021 it amounted to about 17.000 inhabitants, therefore the dynamics of the increase in the number of charging stations is very significant but it seems to be a far unsatisfactory number considering the average number of vehicles in Poland in 2019, which according to the data of the Central Statistical Office amounts to over 634 cars per 1.000 inhabitants. In the largest Polish cities there is currently 1 charging station for over 8.000 cars. It should be considered that most stations offer more than one charging station, usually two and sometimes even eight although such a situation is rare and usually takes place at shops with their own parking lots and complements their environmental policy and image.

Data analysis from the application as well as empirical data verification indicate a certain regularity that in the outskirts of cities, often outside the formal boundaries of a given commune, there are many large-format stores or car services and showrooms where such devices are also available. On the other hand, it should be noted that some of the indicated devices are in closed paid or reserved parking lots only for hotel guests or clients of the office building, which again limits their real availability.

Comparing it with a network of petrol stations is unjustified as they usually have 4 to 10 refueling stations in Poland and the process itself takes a few minutes. In the case of charging electric cars, especially with alternating current, we are talking about hours to fully charge a discharged battery. What is more, there is lack of unification of charging systems. In the presented list there was no distinction between AC or DC chargers and plugs to different charging sockets for electric cars available at individual stations. These differenecs makes explotation of BEV or PHEV more complicated.

Another barrier is psychological related to the "unknown", a novelty that is commonly available electric cars. Few drivers have had the opportunity to drive or even be a passenger in an electric vehicle. The maintenance costs of such a vehicle, durability, and the price on the secondary market remain unknown. There are doubts about safety, both related to accidents and the operation of this type of drives, especially when they have become worn out. Of course, with the popularization this phenomenon will fade away. Solutions related to car rental or leasing will probably help, where operational issues are clearly defined in the contract and the user will not face unexpected expenses.

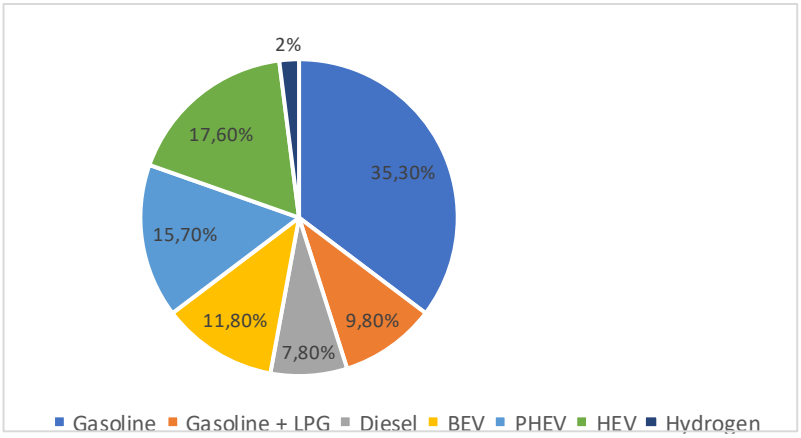
## 4. Research Results

In order to better understand the situation related to changes in the development of electromobility, a survey was carried out among 204 respondents from the 10 most populated Polish cities. Firstly, it was checked what type of propulsion the surveyed overs of vehicles are currently using. Almost 67% use cars with gasoline engines, nearly 20% use diesel and 4% gasoline + LPG. The other so-called modern drives, i.e., HEV and PHEV, accounted for almost 6% and almost 4%, respectively.

None of the respondents stated that they were using a BEV or hydrogen. Importantly, as many as 71% of respondents intend to and another almost 18% consider changing the vehicle in use in the next 5 years. Figure 1 shows the assumptions of the respondents as to the propulsion of their next car.

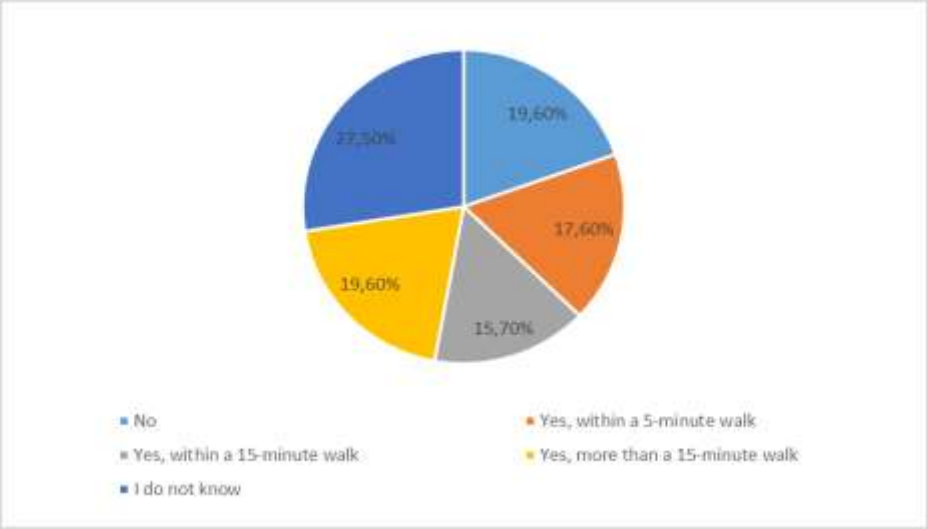
As many as 47% plan to choose one of the modern types of drive such as HEV, PHEV, BEV or Hydrogen, nearly 12% plan to buy a BEV car. Considering that in the last 5 years, the number of newly registered cars ranged from nearly 500.000 to over 600.000 annually, in 5 years' time, almost 300.000 BEVs and respectively 400.000 PHEVs can be expected on the streets. At the same time as many as 67% of respondents do not have the option for charging the vehicle at their place of residence. The availability of vehicle charging points is as shown in Figure 2.

***Figure 1.*** *What kind of drive is the most likely to be in the car that you will be using in 5 years?*




***Source:*** *Own study based on research.*

***Figure 2.*** *Do you have a public electric car charger near where you live?*




***Source:*** *Own study based on research.*

Research results shows that almost 67% of responers have no real possibility to use the publicly available charging infrastructure near their place of residence or are unaware of its existence. With the current development of technology, access to charging points at home or possibly at work seems to determine the possibility of using electric vehicles. The respondents indicate a clear willingness to use electromobility with simultaneous shortages of access to charging infrastructure.

In this case, as in the case of transport needs, the infrastructure should also precede needs. Otherwise ultimately few will decide to change their habits when they would not have easy possibility to load batteries of their vehicles. In the debate on the development of infrastructure for electromobility, there is often an argument that the creation of EV infrastructure in public places deprives i.e. parking places users of traditionally powered vehicles. It should be noted that these traditional cars cause greater external costs which affect everyone and not only their users (Drożdż and Pomianowski, 2020). Thus it has the hallmarks of social justice and draws on the idea of internalising costs.

## 5. Conclusions

The lack of official charging point maps is another obstacle forcing users to either use paid applications or trust content from free ones. The main question seems to be in countries where the market of energy operators is not too dispersed, whether their role should be to aggregate data on new connections of this type and publish them in the network and for the convenience of users to establish an appropriate alliance and jointly conduct it at one address including the whole country is within

its reach. The role of DSO must of course be limited in accordance with Article 33 (2) of Directive 2019/944 introduces the principle that DSOs may not own, develop, manage or operate electric vehicle recharging points, however the EU legislator has adopted two exceptions to this principle:

(1) the exception stipulated in Article 33(2), according to which DSOs may own private recharging points solely for their own use;
(2) the exception stipulated in Article 33(3), i.e., allowing DSOs to own, develop, manage or operate recharging points under several conditions, (Drożdż, Mathews, and Radziński, 2020) although their involvement together with city governments could very effectively increase access to the charging infrastructure.

Secondly, it should be considered whether, following the standards of carsharing services, it should not be possible to book a charging point using the application, e.g., 10 minutes before arrival, even with the use of a deposit. Considering the waste of time and energy it is to move to a busy station, where another customer (vehicle) can occupy a position for up to several hours. Even though the electric motorization has over 100 years, we still call it a novelty and its contemporary dimension and challenges still require social acceptance.

The technology and scale of production must reach a high level in order to achieve greater price competitiveness in order to eliminate the existing barrier of high threshold for acquiring PHEV or BEV. Navadays there is a situation where governments pay the richest to buy relatively expensive cars and consequently the development of infrastructure for using them may be negatively perceived by the wider masses of society.

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