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European Union's Goals Towards Electromobility: An Assessment of Plans' Implementation in Polish Cities

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Abstract:

Purpose: *The majority of world's population live in cities, this trend is also visible in the European Union (EU). This creates both opportunities and threats including social and environmental tensions. One of the solutions to eliminate traffic pollution is electromobility. Therefore, the aim of this article is to examine the implementation of EU's electromobility goals based on the example of Polish cities.*
Methodology: *Following the documentary research, the main tool used in this research is an omnibus study. Nearly 10% of all Polish cities took part in this study, including 74% of cities a status of a county.*
Findings: *The results show that there are many barriers and challenges to the development of electromobility in Polish cities. This includes a slow phase of growth in the number of electric vehicles and charging stations, and insufficient funds in municipal budgets for investment in infrastructure and electric fleets.*
Practical Implications: *Public transport based on electromobility currently does not play a significant role in improving the quality of life in Polish cities. Also, even when considering funding opportunities from the EU and ambitious national plans to introduce 1 million electric cars in Poland by 2025, one cannot expect changes in cities in the relatively fast pace.*
Originality/Value: *The presented results of studies show both research and practical value regarding the current state of art regarding the electromobility in cities while comparing strategic documents and policies with practical actions taken in cities so far and discussion regarding the next steps towards the year 2025 and further.*

Keywords: *Electromobility, electric vehicles, sustainability, quality of life, cities.*

JEL: *O18, P18, Q4, R41.*

Paper Type: *Research Paper*

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1. Introduction

The recent decades can be characterised by dynamic changes and rapid economic development, which, in addition to theirs' positive effects, also have an adverse impact on societies and natural environment (Friedman, 2009; Ratcliffe *et al.*, 2010; Beatley, 2010; Moraci *et al.*, 2020). Therefore, for many years the issue of sustainable development has appeared in scientific literature, as well as being raised by organizations and governments around the globe (Baker *et al.*, 1997; Jansen, 2003; Blewitt, 2018; Bexell and Jonsson, 2016). Because an increasing number of the world's population live in cities, sustainable development is of particular importance to urban areas (Chakrabarti, 2013; Cleland, 2013; United Nations, 2018) and mobility plays a crucial role in it. People travel across cities every day for numerous reasons, including work and school. Many of these journeys are made in private cars. One of the key areas to achieve sustainability is reduction of pollution generated by urban transport through, inter alia, the development of electromobility (Kowalski and Depta, 2019; Patola and Szpytko, 2021; Wörner, *et al.*, 2021).

Before fully walkable communities or local centres become standard in cities – if ever – trends including electromobility could prove important in enabling the creation of a sustainable and higher quality of life, achieved by improved air quality or the reduction of noise levels (European Commission, 2016a; Pisoni *et al.*, 2019; Pietrzak and Pietrzak, 2020). As Sendek-Matysiak and Grysa (2021) stated "currently, the aspect of eco-friendliness, i.e., the necessity to reduce the negative impact on the environment, is the main factor leading to the development of techniques and technologies and organizations in all fields of economy, including especially transport" (2021: 1). Many solutions already exist – including electric vehicles – both in terms of technology and charging infrastructure. However, they are not commonly implemented for several reasons including their cost and the efficiency of batteries used in electric vehicles (Chruzik and Graboń-Chałupczak, 2021; Jeon *et al.*, 2021; Porzio and Scown, 2021; Huang *et al.*, 2021).

In the light of the above, this article will focus on electromobility and its current and possible future role in increasing the quality of life and sustainability of Polish cities. Discussion will centre on the meaning of electromobility for cities and the policies and action taken to support development of such subsystems and other plans in the past decade. This study aims to verify the following hypotheses:

1. Effective and efficient public and private transport based on electric mobility plays an important role in improving the quality of life in Polish cities.
2. Polish cities actively support the development of electromobility solutions.
3. Electromobility in Poland is a highly developed subsystem owing to the implementation of numerous projects and solutions in cities for public and private use.

The study is based on primary and secondary research and applies methods such as omnibus study, literature review, critical analysis of source texts and comparative studies.

2. Theoretical Framework

2.1 Electromobility in the EU

To discuss the meaning of electromobility for contemporary cities and quality of living (QoL) for citizens one must first consider sustainable development. It is certainly not a new concept and has been already widely discussed on various levels including local, national, and international. For instance, United Nations (UN) conferences and reports (United Nations 2012; 2015), European Union (European Commission, 2010; 2011). In addition, there are numerous definitions of the concept, many of which point to the same thing, balancing what goes in with what comes out, so that the entire process of development is regenerative in nature. A frequently quoted definition of sustainable development was coined by the World Commission on Environment and Development in the Brundtland Report of 1987, describing it as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987: 41). However, a significant shortcoming of this definition is that it does not clearly state the importance of ensuring that economic activities do not exceed the regenerative capacity of the global ecosystem. This includes the use of energy and mobility in cities, the focal point of this article.

At an EU level, numerous important documents referring to sustainable development already exist, including directives, strategies and roadmaps concerning energy and mobility. For example:

- Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 (European Parliament and the Council, 2009) on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directive 2003/30/EC (European Parliament and the Council, 2003), which obliges states to achieve a share of energy from renewable sources in all modes of transport in 2020 of at least 10% of final energy consumption in transport.
- Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 (European Parliament and the Council, 2014) on the deployment of alternative fuels infrastructure, which obliges Member States to develop a national policy framework for market development regarding alternative fuels in the transport sector and the development of appropriate infrastructure and defines their scope along with deadlines for implementation.
- The European Low-Emission Mobility Strategy, which sets out a roadmap to 2050 with the headline target of achieving greenhouse gas emissions from the transport sector at least 60% below the gaseous emissions achieved in 1990 and then further truncated to zero.

On a strategic level, the Europe 2020 document played an important role in helping chart a path towards sustainable, smart, and inclusive growth. It was created while Europe was emerging from an economic and financial crisis of 2008 (Klikocka,

2019). One of the headline targets of this strategy was the "20/20/20" climate/energy targets to be met (including a 30% reduction in emissions if the conditions were right). To achieve these ambitious goals the Commission also indicated priority themes, in-cluding 'Resource efficient Europe', which will decouple economic growth from the use of resources, as well as increasing the use of renewable energy sources and modernising the transport sector to support energy efficiency.

Unfortunately, Europe 2020 goals regarding infrastructure and development around energy and mobility have not yet been achieved in numerous European Union countries, including Poland. To counteract this, the European Commission in 2010 called for the development of country-specific recommendations. This resulted in a revision of goals for all member states leading up to 2030. The new goals for the power sector were defined as follows (European Commission, 2021a):

- renewable sources should constitute at least a 32% share in gross final energy consumption,
- an increase in energy efficiency of 32.5%,
- the completion of the internal EU energy market.

It is important to mention that Europe 2020 was developed as a response to the 2008 economic crisis and, separately, to stimulate the markets in member countries (European Commission, 2009). More recently, similar plans for EU members have been created to counteract the negative consequence of the COVID-19 pandemic. Therefore, it seems that the next important step for EU countries will be the implementation of projects within the framework of the European Green Deal. Among the many important goals of the Green Deal is the plan to achieve zero net emissions of greenhouse gasses by 2050, and transportation will play an important part in it (European Commission, 2020). It is expected that the Green Deal will boost the progress of carbon-neutral mobility, an objective welcomed by the public and bene-ficial to the environment.

However, there are concerns about the automotive industry's failure to set its own ambitious targets and provide corresponding solutions to achieve them. The European Commission has stated that "the European Green Deal sets out how to make Europe the first climate-neutral continent by 2050, boosting the economy, improving people's health and quality of life, caring for nature, and leaving no one behind" (European Commission, 2019). Since already over 70% of the EU population lives in cities, these changes will have an impact on quality of life and well-being (European Commission, UN-Habitat, 2016). It is important to emphasize that, according to the European Commission, budget expenditure from the multiannual financial framework for 2021-2027 will be consistent with principles of the European Green Deal (European Commission, 2021a).

Going further, the European Commission published in mid 2021'Fit for 55' legislative package (EASA, 2021). It includes proposals for changes to 10

regulations in energy and climate policy, to support EU to reduce emissions by 55% compared to 1990 (European Commission, 2021b). Transport plays a key role to achieve this goal, because it is one of the main sources of greenhouse gas emissions in the EU. European Commission proposed acceleration of the process of electrification of passenger cars and vans in the member states by 2030. Also, average emissions from new vehicles are set to be cut by 55% and 50% respectively, and to zero by 2035 (Bajczuk, 2021). These ambitious plans require not only resources, but also increase of research and development (R&D) projects and change of user's habits to switch to electric cars. This change is supposed to increase the quality of life by improving the air quality, noise reduction, as well as energy savings.

Quality of life can be measured in many ways. Discrepancies in the selection and assessment of indicators are visible both in research conducted at a national level (social diagnosis, quality of life capital) and at a city level (Czapiński, 2013; Jeran, 2015; Peach and Petach, 2016; Gądecki, 2018). Due to the growing complexity of the quality of life category, it is more and more often replaced by terms such as: happi-ness, life satisfaction, general life satisfaction, well-being (mental or psychological) (Słaby, 2011). This approach is consistent with the World Health Organization's (WHO) definition of quality of life as an individual's perception of life position in the cultural context and the value system in which he or she lives, and in relation to the expectations and standards set out in environmental conditions (WHOQOL Group, 1995). It is important that quality of life in cities is influenced by both material con-ditions and non-material aspects. This includes income, unemployment level and housing conditions, as well as health, education, environmental quality, and even the balance between professional and private life of residents (Stanca, 2015).

A similar approach is used in many other studies and city rankings, including, for example, the Monocle and Arcadis rankings, which focus on quality of urban living. The EU itself also conducts studies and introduces metrics to describe the quality of life in European cities. The latest document, 'Report on the quality of life in European cities (European Commission, 2020a) includes data gathered from 83 cities in the EU, European Free Trade Association (EFTA), the United Kingdom, the Western Balkans and Turkey. Among numerous features concerning public services and satisfaction of living, mobility in cities was also investigated. Transport itself should be less polluting and achieving its sustainability means putting users first by providing them with more affordable, accessible, and cleaner alternatives to their current mobility habits (Eu-ropean Commission, 2021c). In the meantime, the results presented in the report on the quality of life show that on a typical day up to 46% of city residents in the EU use their cars (European Commission, 2020b).

Looking at specific cities, the share of residents who use a car varies from around 30% (for instance, in Groningen and Copenhagen) to over 60% (including Braga and Reykjavik). This clearly shows the need for a change in the habits of car users,

orientating them towards other trans-portation modes. Yet, taking into consideration the significant percentage of car journeys every day in many European cities, accessibility of public transportation and the current COVID-19 pandemic during which many city dwellers started using private cars on daily basis instead of public transportation, it is also important to make cars more efficient and environmentally friendly (Szczech-Pietkiewicz *et al.*, 2020). Although it is not the only solution, electromobility has the potential to improve city dwellers' quality of life. This includes improving air quality by reducing carbon dioxide (CO2), carbon monoxide (CO) and nitrogen oxides (NOx) emissions (Tucki *et al.*, 2020). Another important issue is the reduction of noise pollution. Recent studies have shown that noise negatively impacts human mental health and causes insomnia. Near-silence EVs can lower the noise level in already noisy inner-city environments. This applies not only to private vehicles, but trucks and delivery vans, and public transport (European Commission, 2021d).

Electromobility, or e-mobility, refers not only to private cars, but also to public transport like buses and trolleybuses, as well as infrastructure, including charging points and equipment infrastructure (Bolesta *et al.*, 2018). In other words, the term describes the use of vehicles such as cars, buses, trucks, as well as bikes or scooters, which are fully or partly driven electrically, obtain energy from the power grid and can store energy (Bebat, 2021). More common use of electrical technology in vehicles and broader in public transportation could be an important part of the transformation of the energy industry, transport sectors and cities into sustainable entities – particularly if it is based fully or mainly on energy produced from renewable sources to stop reliance on fossil fuels and to decrease environmental pollution (Pisoni *et al.*, 2019; Szczech-Pietkiewicz *et al.*, 2020;). Already numerous "European countries have made considerable efforts to increase the share of electrification in the transport sector in recent years" (Morrissey, 2015). Yet, the road towards e-mobility is still long and will take time counted in decades.

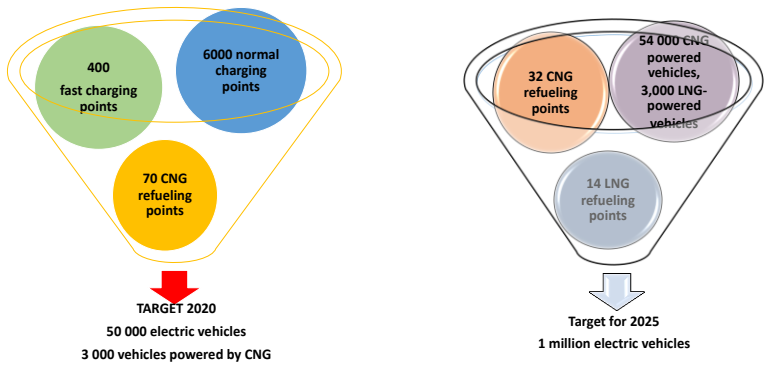
2.2 Electromobility in Poland

Regarding Poland, the importance of sustainable development has previously been emphasized by the Polish authorities, reflected in Article 5 of the Constitution from 1997, which states: "The Republic of Poland guards the independence and inviolability of its territory, ensures freedom and human and civil rights as well as the security of citizens, protects national heritage and protects the environment, guided by the principle of sustainable development" (1997). Additionally, the Constitution obliges public authorities to adopt policies ensuring ecological safety and environmental protection. The Constitution therefore also covers sustainable development in the context of meeting ecological goals. The issue of sustainable development, together with mobility and energy, had already been addressed in the strategic documents Poland 2030 (Department of Strategy, Ministry of Development Funds and Regional Policy, 2020) and Medium-term National Development Strategy 2020 (Ministerstwo Rozwoju Regionalnego, 2012).

However, both documents were formulated the former government and have been abandoned by the current governing coalition. Documents touching on the issue of electromobility in Poland are:

- "The Electromobility Development Plan" from 2017 by the Polish Ministry of Energy, which includes areas and phases of electromobility development up to 2025, along with the requisite action and supporting instruments. The plan assumes that by Poland will have 1 million electric cars by 2025 (see Figure 1) (Polish Ministry of Energy, 2017).
- The national policy framework for the development of alternative fuels in the transport sector and deployment of the relevant infrastructure, a document also adopted in 2017, which assesses alternative fuel infrastructure in Poland (including electric vehicle charging infrastructure) and sets out goals and tools for further development. It also includes a list of agglomerations and conurbations where publicly available charging points for electric vehicles and CNG refuelling points are to be built (European Commission, 2017; Ministerstwo Energii, 2017).
- The 2018 "Act on Electromobility and Alternative Fuels" (IEA, 2020), which provides for numerous benefits to companies, the abolition of excise tax on private electric cars and plug-in hybrids (PHEV), exemption from parking fees in cities and the development of infrastructure network for alternative fuels in densely populated areas.

Figure 1. *Framework of the Electromobility Development Plan in Poland*



Source: *Own elaboration.*

Unfortunately, despite strategies and policies being introduced only recently, problems with the implementation of the goals set have already emerged. One major obstacle is the financial means required to fulfil such ambitious plans and the need to build the infrastructure. This resulted in two amendments to Poland's Energy Policy. Firstly, setting a new deadline of 2030 (Ministerstwo Gospodarki, 2009), and then moving this again to 2040 (Ministerstwo Klimatu i Środowiska, 2021). The three

pillars of the strategy towards 2040 – transformation, zero-emission energy system, good air quality – clearly show references to sustainable development and the improvement of quality of living. In line with aims of the strategy towards 2040, also specific objectives concerning the development of energy markets were formulated. Point C of the objective refers to the development of electromobility. Part of it includes reducing emissions from fossil fuels and a shift towards the use of alternative energy sources in transport. In general, in Poland main goals of the energy policy are "to secure energy, to improve the economy's competitiveness and energy efficiency, and to limit the energy sector's impact on the environment. The energy policy is drafted by the minister responsible for energy and adopted by the Council of Ministers (government)" (Aruba *et al.*, 2021: 2).

Providing power to many charging points, especially in the case of fast chargers consuming a lot of power, is associated with the need to expand or reconstruct existing medium and low voltage power networks. According to the research conducted by the authors, this may constitute a significant technical barrier for the development of electromobility in Poland due to several factors (Stankowska, 2020):

- long waiting time for obtaining the conditions for connection to the power grid, long duration of the connection agreement on the part of the system operator
- transmission due to formal and legal procedures as well as internal DSOs,
- the need to obtain all legal approvals and permits.

The existing network is considered sufficient to power the charging stations infrastructure. Unfortunately, along with the planned addition of charging stations, it will be necessary to rebuild the existing ones, in particular replacing low voltage/medium voltage (LV/MV) transformers with units of greater power or constructing new MV/LV stations. Additionally, the construction of charging stations for the city bus fleets will requires the construction of a completely new electricity infrastructure. Moreover, with the increase in the number and power of charging stations, problems may later arise in relation to the impact of the charging infrastructure on compliance qualitative parameters of electricity in the network, due to their use in stations' power electronic converters. As a result of the initial research conducted by the authors, the following problems in the field of electromobility development can be identified:

- the suburbanization of cities, resulting from the settlement of residents in suburban areas,
- a lack of passenger information systems on the means of transport available,
- the low availability of infrastructure, e.g., cycle paths, pedestrian routes,
- a large share of individual road transport,
- no alternatives to individual transport,
- air pollution,
- a lack of comprehensive traffic management solutions.

Until these plans are acted upon numerous issues and obstacles will remain, especially at a city and municipality level in Poland. Real change will only take place at a local level. This will require investment in infrastructure as well as changes in users' habits to switch e-mobility. In this context, the research team undertook a study focussing on electromobility in Polish cities.

3. Methodology

The two main methods used in this research were an omnibus study and documentary research focussing on electromobility and quality of life in Polish cities. This research was a part of a wider enquiry undertaken by academics from the Innovative City Department of Warsaw School of Economics, and it was therefore decided that the omnibus study would be the most suitable method to reach the target audience i.e., Polish cities. The research was undertaken between September 2018 and December 2020. The omnibus study prepared by the researchers was used as a tool for data gathering in early 2020. The questions used in the survey were multiple-choice with an option to add information. Then between June and December 2020 the obtained information was verified with city representatives or based on public data published by cities in form of on-line communications or reports.

A significant number of cities took part in the survey. Out of a representative sample of 117 cities invited to take part in the study 83 cities responded to questions regarding quality of life and electromobility (see Figure 2 for their locations). Among them were 49 cities with county rights (counties, in Polish powiat, are self-government units and they are ruled by the county council elected in universal and direct elections for the term of 4 years). There are 66 cities in Poland with county rights (KSNG, 2020). In needs to be emphasized that the study covered nearly 10% of all Polish cities, and among them 74% of cities with a status of a county. Regarding city size there were:

- 12 cities with a population of over 200 000 inhabitants.
- 29 cities with a population of 50 000 or more.
- 4 cities with a population of 20 000 to 50 000.
- 38 cities with a population below 20 000.

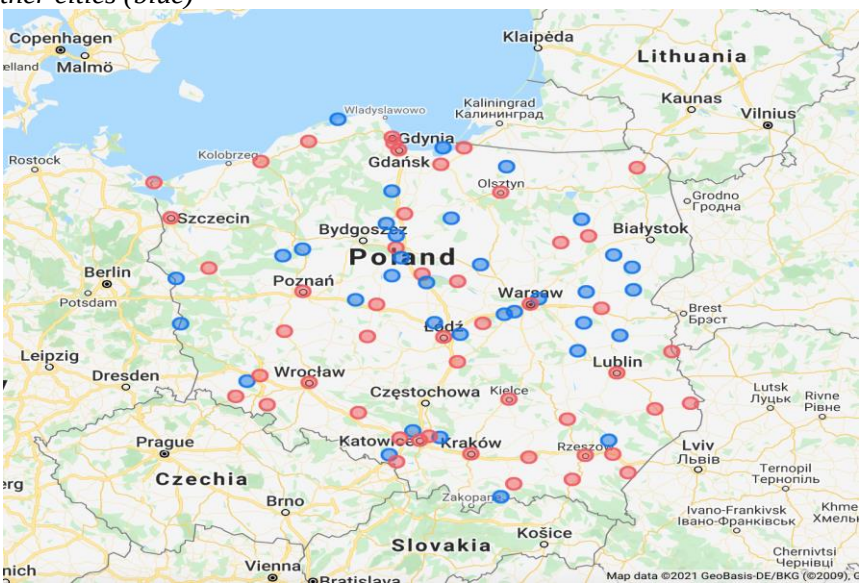
In terms of income per capita 7 cities taking part in the survey did not gave the answer regarding the income. Therefore N=76, out of which:

- there was only one city with income per capita under 1 000 PLN (approx. 220 Euro).
- 20 cities with income ranging from 1 000 to 2 000 PLN (approx. 220- 440 Euro).
- 15 cities with income ranging from 2 000 to 3 000 PLN (approx. 440-665 Euro).
- 6 cities with income ranging from 3 000 to 4 000 PLN (approx. 665-885 Euro).

- 19 cities with income ranging from 4 000 PLN to 5 000 PLN (885-1110 Euro).
- 15 cities with income above 5 000 PLN (1110 and more Euro).

Due to the large geographical range, it was decided to collect data using a survey based on the computer-assisted web interview (CAWI). The selection of methods was determined by the entities researched – cities. This method allowed quick access to respondents and made it possible to automate the processing and presentation of the results obtained (Stanisławski, 2017). The results of the omnibus study were also compared with the available national and municipal documents, domestic municipal and national level websites, and information from magazines and industry portals. All gathered information was used to verify the hypotheses and to form conclusions, including main barriers and necessary changes in the electromobility plans at a national and local level.

Figure 2. *Cities participating in the study. own elaboration. Cities with county right (red), other cities (blue)*



Source: *Own elaboration.*

4. Results and Discussion

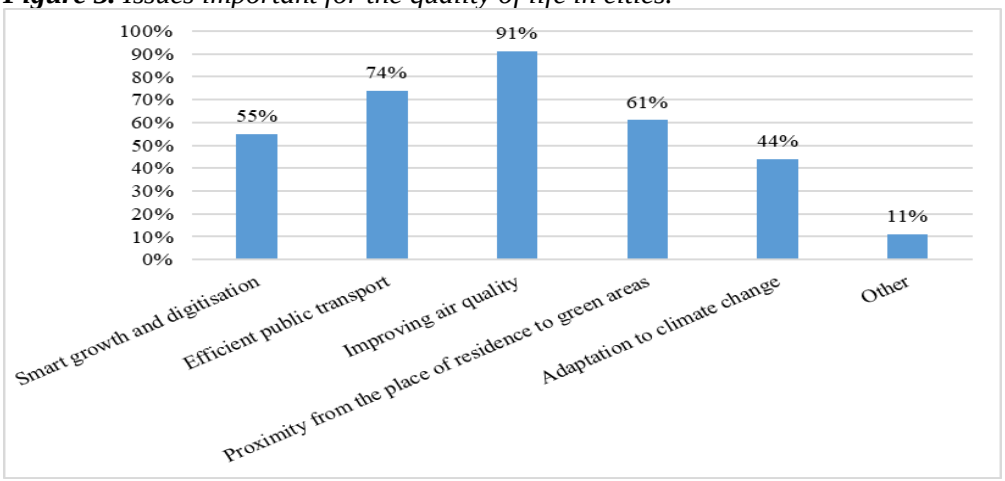
The omnibus questions regarding electromobility included aspects of quality of life, city strategies and plans to develop infrastructure and fleets. Each city filled in one survey. To contact them the research team used a Warsaw city data base, which also gave them access to a specialist responsible for strategy and mobility policy in the majority of Polish cities.

At the beginning, respondents were asked to indicate which matters were taken into consideration when assessing improvements to the quality of life in their cities (see

Figure 3). They could choose from, smart growth and digitalisation, efficient transport and public transport, improvement of air quality, action supporting adaptation to climate change, accessibility and proximity to green areas, including parks and squares, other (respondents were asked to explain which ones). Most respondents (91%) answered that improving air quality was by far the most important aspect. Effective and efficient public transport was also important for 74% of survey participants. Both issues are directly connected with e-mobility. Other areas seen as important were access to urban green areas within a walkable distance, smart growth, and digitalisation, as well as adaptation to climate change – all of which have direct links to mobility in cities.

It is also worth mentioning that 11% of respondents chose to answer 'other'. Among them was Wroclaw, citing the development of an environmental protection programme against noise. Other cities included Poznan, citing plans to support entrepreneurship leading to social and business innovations (also concerning mobility), and Kielce, with ideas to implement smart city solutions, which also refer to mobility. These specifically include electromobility, which according to Kielce, is an integral part of the smart city concept and is connected to sustainable development through energy management, mobility, and environmental protection.

Figure 3. *Issues important for the quality of life in cities.*

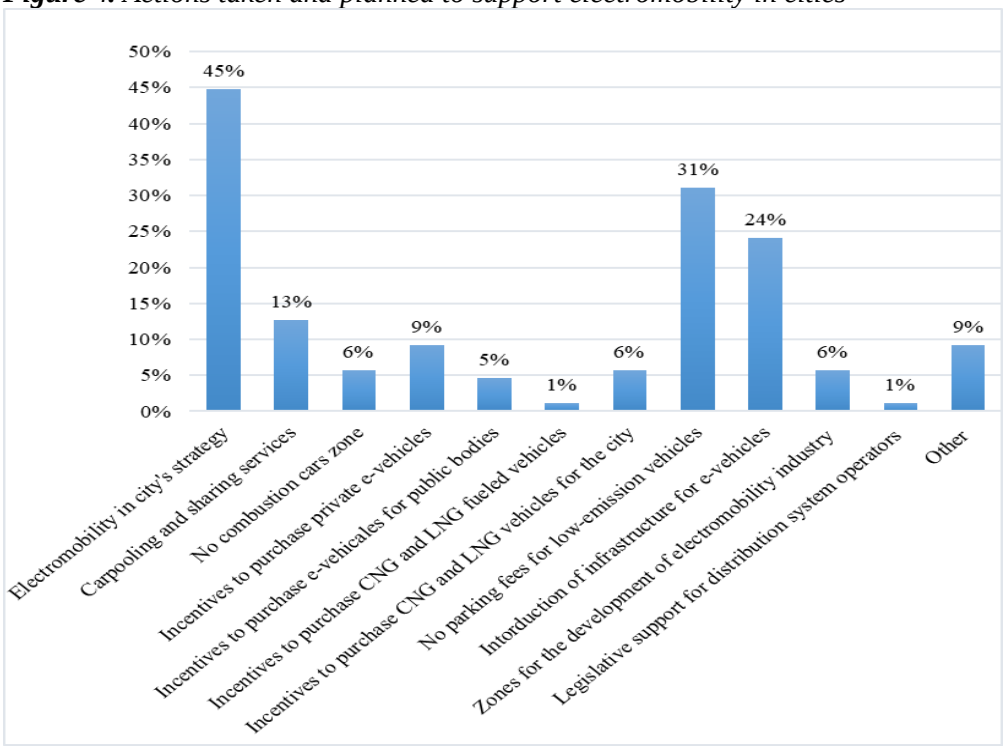


Source: *Own elaboration.*

Focusing solely on electromobility, the next questions concerned action taken by cities to date and plans to support electromobility development in the future. In response to the second question (refer to Figure 4) about action cities take to support the development of electromobility, only 45% stated that they had introduced the concept of electromobility into the city strategy. Among other action cited by respondents was abolition of parking fees for low-carbon emission vehicles (31% of cities) and support for the development of infrastructure for electric cars (24% of survey participants). A possible systemic challenge and administrative oversight is

the fact that only 1% of respondents legally supported an operator's distribution system (DSOs) around adapting the power grid.

Figure 4. *Actions taken and planned to support electromobility in cities*

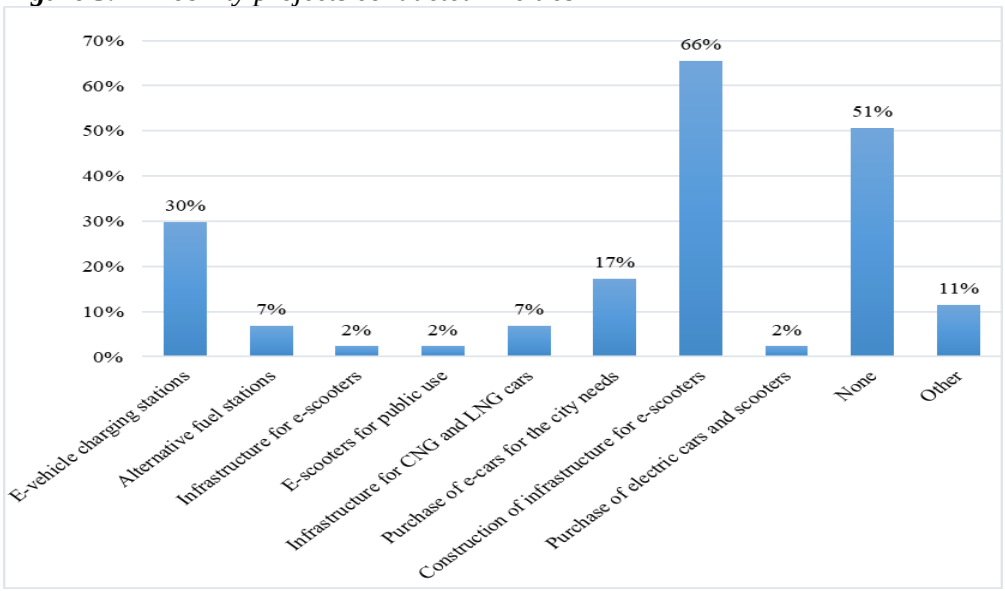


Source: *Own elaboration.*

The third question focused on e-mobility projects, which cities had already conducted between 2009 and 2019 (see Figure 5). Unfortunately, in the studied group 51 % of respondents indicated that that no projects were implemented in the research period. In the remaining group 49 % of cities, the results were different. Out of the cities which already took or plan actions to support electromobility 66% pointed that they had managed to build infrastructure for electric scooters only and 30% had invested in the construction of vehicle charging stations. Another 17% answered that they had purchased electric vehicles for the city.

This clearly shows that despite the introduction of mobility strategies and policies aimed at making transport more efficient and environmentally friendly, no significant solutions were brought in at a city level and that to fulfil ambitious aims outlined in the national level documents and plans and meet regulations most action will need to be taken in a relatively short time span. Other indicatives include, for example, the development of the Electromobility Strategy for the city of Skierniewice, and the construction of cycle paths and Clean Transport Zone (meaning: zone where combustion vehicles are not allowed to enter).

Figure 5. *E-mobility projects conducted in cities*



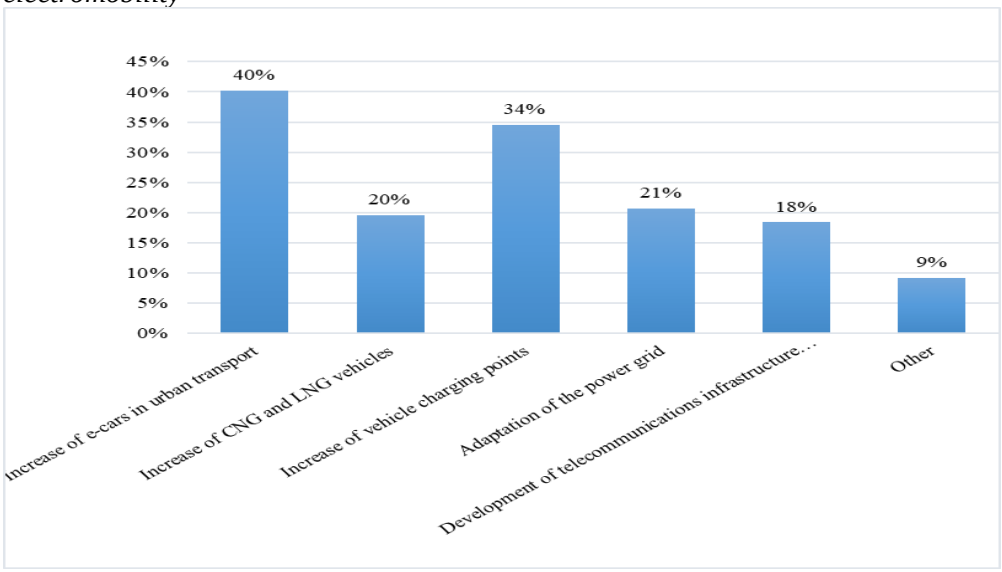
Source: *Own elaboration.*

In response to the fourth question, which was focused on how the implementation of action outlined in the city strategy would contribute to the development of electromobility and to what extent, 40% of respondents stated that it would lead to increase in the share of electric cars in urban transport. Unfortunately, no one was able to determine by how many percent per year. Similarly, regarding vehicle charging points. 34% of respondents declared that implementation of strategy will contribute to an increase in such points. Yet again, no one was able to specify by how many. Around one fifth of respondents said also that strategies to support e-mobility would be adaptation of the power grid (21%), an increase in the share of compressed CNG and LNG vehicles (20%) and the development of telecommunications infrastructure ensuring connectivity (18%) (refer to Figure 6). Other initiatives included, for example, city car rental, purchase of electric buses, ESPRIT2GO, Clean Transport Zone and the development of trolleybus infrastructure.

The penultimate question focussed on the main barriers to the development of electromobility in cities. In this case an overwhelming 82% of respondents said that there were insufficient funds for the implementation of electromobility projects in cities. Another issue seen as a significant obstacle was the relatively high price of electric cars in Poland and their relatively small ranges (61% of survey participants). This, combined with insufficient funds to adapt existing infrastructure for electric vehicles (as stated by 51% of city representatives) indicated how difficult the situation is and the significant challenges that lie ahead. Worth stressing here is the fact that only 3% of respondents claimed a lack of consent from the local community could halt e-mobility (see Figure 7). This is a positive sign, showing that potential

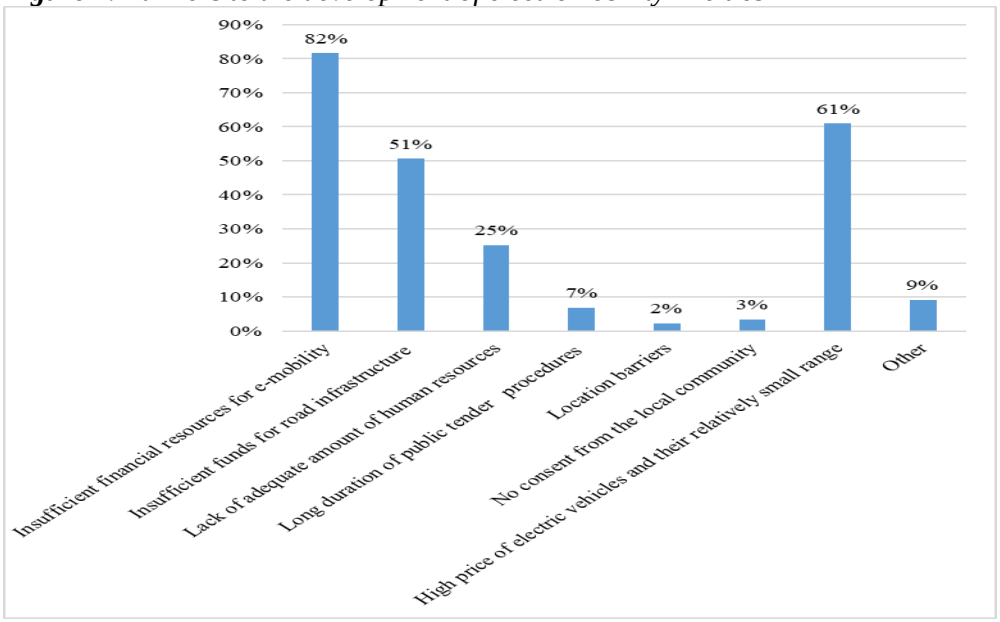
users of private and preferably public e-vehicles support such measures. Other activities included, for example, the purchase of hydrogen buses and zero-emission buses.

Figure 6. *Actions outlined in the city strategy contributing to the development of electromobility*



Source: *Own elaboration.*

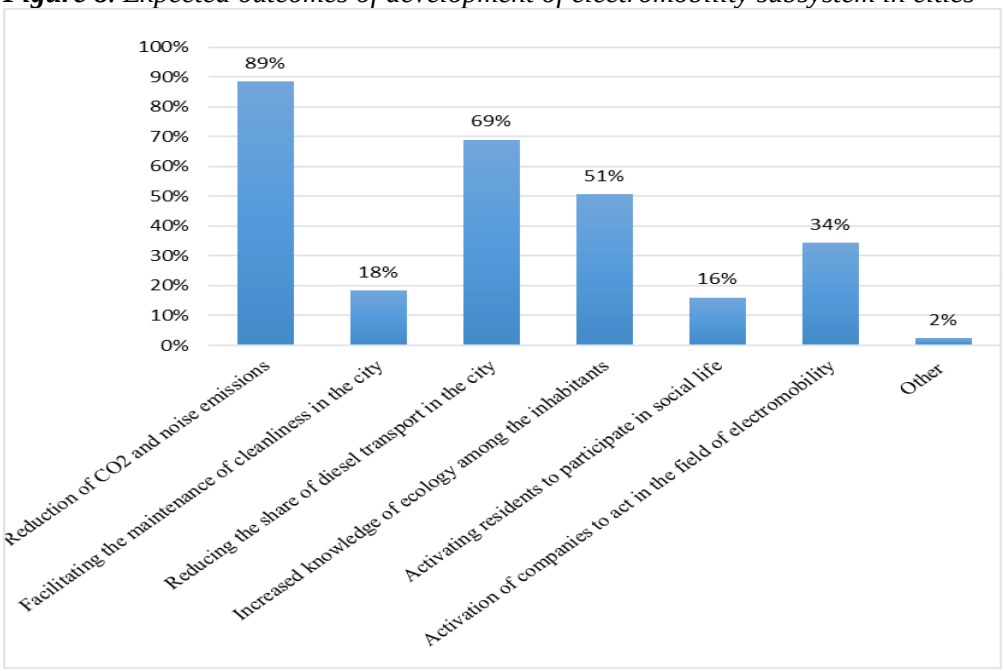
Figure 7. *Barriers to the development of electromobility in cities*



Source: *Own elaboration.*

Finally, the respondents were asked to specify what they expected from the development of an electromobility subsystem in their city (refer to Figure 8). Most respondents (89%) chose environmental improvement throughout the city due to reductions of CO2, dust, and noise emissions. A reduction in the share of diesel transport in the city was important for 69% of survey participants. Increased awareness of ecology issues among inhabitants was important to just over half the cities (51%). Accepting that electromobility could trigger innovation, over one third (34%) of respondents said that they expected it to activate and encourage the private sector to create and provide new products and services around e-mobility. Less important for respondents were the possibility to make the city cleaner (18%) and to encourage residents to participate in social life (16%). A small minority (2%) of respondents stated that residents would expect the city to be promoted as a seaside health resort.

Figure 8*. Expected outcomes of development of electromobility subsystem in cities*



Source: *Own elaboration.*

5. Conclusion

The results of the study prove that there is great potential for the development of electromobility in Polish cities and an understanding of its ability to increase the quality of citizens' lives and sustainability in general. Corresponding strategies have already been introduced at both a national as well as local level. Many of the cities researched have included electromobility in their strategic documents. However, there is a discrepancy between aspiration and practice. Data regarding completed

municipal projects in the past decade or so proves this. The introduction of a million electric cars in Poland will be a real challenge for the foreseeable future. Without action at a municipal level, the national government's ambitions will not be fulfilled.

This research shows that there are numerous barriers and challenges to developing electromobility in Polish cities. These includes only a slow increase in the number of electric vehicles and charging stations and a lack of sufficient funds in municipal budgets to invest in infrastructure and electric fleets. It is also important to point out that electric vehicles are more expensive than traditional ones and have a relatively short range, which forces driver to charge them more often than to refuel. There are also numerous systemic and planning challenges to be overcome, including a significant percentage of private cars per inhabitant used during weekdays in Polish cities.

A study based on an analysis of literature and a questionnaire addressed to Polish cities, showed that as part of improving the quality of life of residents, issues relating to the social and environmental dimension of sustainable development, including improvement of air quality, was important to almost all respondents, followed by efficient transport (both public and private), smart growth and adaptation to climate change. Electromobility could be used by cities as an effective tool to increase the quality of air, support the development of effective transportation and smart growth, as well as adaptation to climate change. This was also emphasized in responses regarding expected outcomes of e-mobility.

It is therefore important to note that, despite high hopes and a relatively positive attitude towards this concept among cities taking part in the omnibus study, less than half of them have yet to introduce the concept of electromobility into their growth strategies. The cities researched represent almost 10% of all cities in Poland, thus proving that there is still a room for improvement. The situation looks even more challenging when taking into consideration projects and solutions introduced to cities in the past decade. The most frequently mentioned solution was the development of an infrastructure for e-scooters and e-cars. At the same time, as many as half the cities had not implemented even a single project or solution. Moreover, majority of them did not introduce any measures to monitor the effects of e-mobility. In addition, conducted study proves that the main obstacle on the path towards e-mobility in Polish cities is simply a lack of funding sources. This includes, for instance, public investment in fleets of vehicles like buses, and the charging infrastructure to support them.

Regarding the research hypotheses, the results of the study proved that they are false. Firstly, effective and efficient public transport based on electromobility currently does not play an important role in improving the quality of life in Polish cities. This is mainly due to the lack of such schemes and initiatives, though it needs to be stressed that cities do recognise its potential. Secondly, cities in Poland do not actively support the development of electromobility solutions. This is evidenced by

the dearth of projects and services introduced at a municipal level in the past decade. This leads to the third conclusion, that electromobility in Poland in general is not a highly developed subsystem to date. Considering recent developments at an EU level regarding strategies and policy packages such as the European Green Deal and Fit for 55, as well as national level the New Polish Order, it seems likely that the next decade will bring easier access to funds for municipalities to implement electromobility solutions at a local level. Yet, one cannot expect changes taking places in cities in the relatively fast pace. On this basis recommendations for further research include investigation and evaluation of electromobility solutions which will be implemented in Polish cities within the frames of New Polish Order and from a broader perspective by comparing initiatives based on the Europe Green Deal and Fit for 55 in the cities across the EU with a perspective towards 2030 or further and not till 2025.

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