


Adapting the infrastructure of the Bieszczady region to electromobility

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Abstract

The main purpose of this article is to prepare an appropriate plan for the development of the infrastructure of the Bieszczady region for the use of electric cars as the primary means of mass and private transport for residents and tourists in the Bieszczady region. Over the next few years, electric cars will be available to an increasing number of people, thanks to more affordable purchase costs. This is made possible due to the dissemination of technology on the market and the emergence of increasing competition in individual segments of the automotive industry. The decisive condition will be the appropriate infrastructural facilities – i.e., chargers for electric cars, both those “fast” for direct current (DC) and “slow” for alternating current (AC). The development of infrastructure directly contributes to the purchasing decisions of electric cars made by residents of a given territory or people traveling through a given country with their own cars in the context of potential supplementation of electricity. In the first part, a review of the literature on the topic of electric cars is introduced. The second part presents the Bieszczady region in the context of electromobility implementation. In the last part, a detailed analysis of the region’s infrastructure (roads and car parks) is prepared, and, as a consequence, places are selected where the construction of a charging station would be justified. During point selection, the key parameters are the current condition of the road and parking infrastructure, the number of residents and tourists in a given zone of the region, and the strategic importance of the region. This article presents a detailed infrastructure analysis of locations where charging stations could be installed, including their amounts and power, in the Bieszczady region. The latter is divided into communes (i.e., Ustrzyki Dolne, Czarna, and Lutowiska), which provide a total of 14 locations, 55 stations, and 113 charging points.

Introduction

In the face of the challenge of the current climate crisis, it is necessary to accelerate the so-called energy transition to mitigate the harmful effects on the planet caused by the increase in greenhouse gas emissions into its atmosphere over the last few decades (Cook et al., 2013). One of the main pillars of this transition is the decarbonization of the

economy, which includes the electrification of the transport sector, accompanied by a commitment to the generation of energy from 100% renewable sources (Rojano-Padrón et al., 2023). Electromobility is a concept that assumes the use of emission-free electric vehicles instead of vehicles powered by fossil fuels (Janczewski, 2018). The implementation of electric mobility is primarily related to the implementation of energy and ecological goals set

by the European Union and other state authorities (Klimach & Figurska, 2022). Energy goals are the pursuit of independence from fossil fuels, the availability of which continues to lower due to the finite Earth's resources and the impossibility of their secondary use (Gołabeska & Harasimowicz, 2023). Ecological goals include reducing emissions of CO₂ and other pollutants, e.g., PM10 and PM2.5 dust, into the atmosphere and soil (Kamiński et al., 2019). As part of the strategy to combat climate change and the use of conventional energy sources, vehicle manufacturers are implementing alternative technologies (Osieczko et al., 2021). Electric vehicles have many advantages: they are characterized by high efficiency, their engines operate quietly and smoothly, and they can recuperate energy during braking without emitting harmful substances while driving (Kopta, 2019). Following the Ministry of Climate and Environment, for which electromobility is one of the key areas of activities performed by the Ministry, the development of this sector results not only from environmental and climatic conditions, but also from innovative solutions that change the competitiveness of industries and modify the world map of dependence on raw materials. Further work in this area will have a positive impact not only on the automotive industry but also on the entire economy. On February 2, 2021, the Council of Ministers approved the "Energy Policy of Poland until 2040". This is a new important date for the Polish fuel and energy sector. Twelve years after the establishment of the previous policy, a new strategic document was adopted, setting the direction for the development of this sector. PEP2040 is a compass for entrepreneurs, local governments, and citizens in the field of transformation of the Polish economy towards low emissions (MKiŚ, 2019).

Literature review

Over the years of the presence of electric cars on the market, we can observe their gradual development (Paoli & Gü, 2022). Research has shown that the development of electromobility is consistent with a vision of the EU's modern, competitive, and climate-neutral economy to be achieved by 2050 (European Council, 2018). The successful implementation of the electromobility development plan is conditioned by overall activities aimed to transform the energy system by developing a dispersed network of renewable energy sources, creating the charging infrastructure, and initiating an effective system of incentives for the buyers of electric cars

(Remeikienė et al., 2021). According to Łuszczuk et al., in Poland, attention should be paid primarily to the development of the charging infrastructure and increasing the share of renewable sources in the energy balance (Łuszczuk et al., 2021).

Thanks to the constantly developing technology, current electric cars receive increasingly more innovative solutions that expand their efficiency through, for example, increasing range, which is the result of the development of electric cells. Due to the systematic development of electric cars in Poland and worldwide, their escalating use on the roads has occurred. The direct translation of this phenomenon is the total decrease in the amount of harmful substances emitted into the environment. Electric vehicles (EVs) are gaining momentum due to several factors, including price reduction as well as climate and environmental awareness (Sanguesa et al., 2021). The operating characteristics of this type of vehicle are similar to those of cars powered by conventional energy sources. However, they are distinguished by a basic factor – combustion cars emit harmful substances into the atmosphere during their operation (driving), such as carbon dioxide, and generate noise relating to engine operation. The flagship feature of an electric car is the emission-free and noiseless operating system (when driving an electric car, only the rolling resistance of the wheels relating to the friction on the road and the air streams circulating the vehicle cabin are audible).

Sustainable transport is necessary for the development of every urban space and is the basis for the mobility of its dwellers (Wiktorowska-Jasik, 2020). The development of a fleet of modern sustainable vehicles, powered in an environmentally friendly way, is currently one of the main pillars of the activities of developed countries (Tomaszewski, 2019). The results of the forecasts clearly indicate that, in 15 years, as many as 40–50% of electric cars (including vans) will be driven in the European Union (McKerracher & Wagner, 2021). Notably, the European Parliament plans to ban the sale of internal combustion vehicles from 2035. Given the planned activities and the development of the electric car market, a country that does not have an adequate supply of chargers will become an unattractive trading, tourist, and service partner, which will have a significant impact on its economy. In the case of Poland, a country where road transport plays a key role in the economy, the decrease in turnover in this field caused by infrastructure deficiencies will prove unfavorable for the entire economy and weakens its position on the global market. Therefore, in the

coming years, to improve the situation of the “electric charger network”, the legislator should implement pilot programs for the construction of such places by state-owned companies, such as Orlen or PGE, and support private investors as part of the development of an infrastructure network adapted to the functioning of electromobility. Charging infrastructure is a major issue – investment is high – but there is significant uncertainty regarding effective demand (Machado et al., 2020).

Figure 1 presents the predicted global sales of internal combustion (ICE), electric (BEV), and hybrid (PHEV) vehicles and the percentage of market sales of electric and hybrid vehicles. The purpose of the figure is to show the impact of vehicles powered by unconventional energy sources on the market of all vehicles in particular years.

The data presented in Figure 1 shows that the share of sales of electric cars is growing and continues to ascend year-by-year, which directly relates to

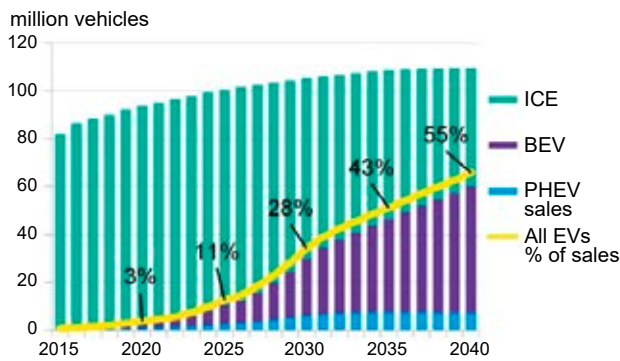


Figure 1. Annual global light-duty vehicle sales (Bloomberg New Energy Finance, 2018)

the legal provisions presented above. Figure 2 displays sales of all-electric cars (excluding hybrids) in the EU in 2019.

One of the basic reasons that determines the “weak” growth in the number of electric vehicles in Poland is the road infrastructure, the development of which is not a priority for the legislator. Accounting for the rate of growth in the number of charging stations in the leading European Union countries in this aspect, a massive investment in this type of activity should be started, beginning with the structures of local government (municipality, district, and province) as is the case, for example, in the Netherlands.

The infrastructure necessary for the operation of electric vehicles is intended to ensure their mass use. The infrastructure includes charging stations, signage, parking spaces, emission-free movement zones (mainly in large cities), and technical facilities for servicing electric vehicles. Appropriate facilities for electric car chargers, both those “fast” for direct current (DC) and “slow” for alternating current (AC), contribute directly to the purchasing decisions of electric cars made by residents of a given territory or people traveling through a given country in their own cars in the context of a potential electricity supplement (Mastoi et al., 2022). The development of the infrastructure necessary for electromobility for a country whose national and international economy is largely based on transport is necessary for economic reasons. The functioning of electromobility in proper harmony with the environment requires obtaining energy in a way that minimizes environmental degradation.

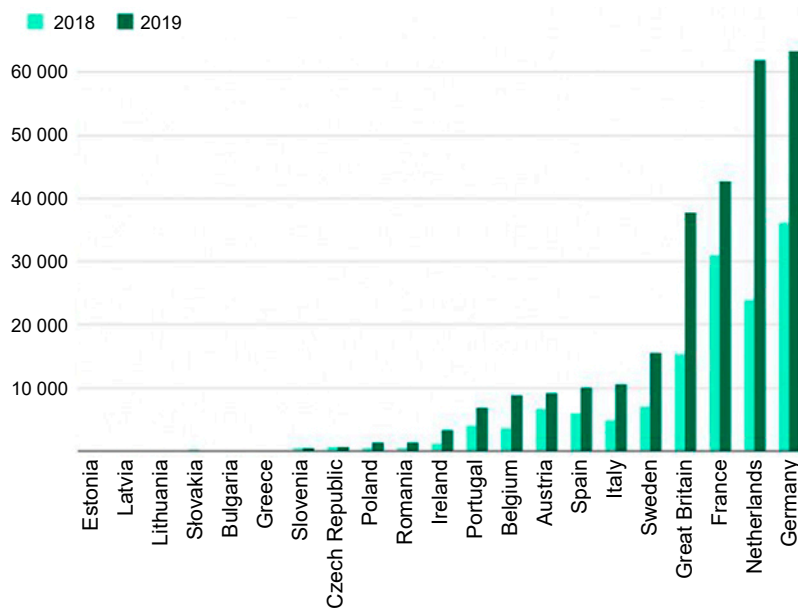


Figure 2. Sales of electric cars in 2019 (Napradzie.pl, 2020)

Today's ways of obtaining energy, mainly focusing on conventional raw materials, distort the basic assumption of zero emission of the entire ecosystem. An additional problem resulting from obtaining electricity from finite sources is the efficiency of coal-fired power plants, which oscillates between 33–34% (Kasztelewicz & Patyk, 2015). The low efficiency of the power plant generates huge losses of conventional raw material, which results in a rapidly depleting resource on the planet. Therefore, within the next few years, the production of electricity from renewable energy sources (RES) should be implemented on a massive scale (Wang et al., 2021). The methods of obtaining energy from renewable sources are based on resources or phenomena occurring on the planet, as a result of which they are not degraded. An example of converting this type of energy into electricity is photovoltaic installations, the use of which can be individual (installations supplying a specific household) or mass (a form of photovoltaic farm supplying energy to a given region). The advantage of obtaining electricity through photovoltaic installations is their emission-free operation and the systematically increasing efficiency of photovoltaic cells (the ability of the installation to convert sunlight into electricity), which in 2020 was on average 20% (Sailor, Anand & King, 2021).

Indeed, coal-fired power plants are now more efficient in generating electricity (Spath, Mann & Kerr, 1999). However, when considering their degrading impact on the environment through greenhouse gas emissions and the finite resources on Earth, their operation should be stopped within the next few years. According to the data provided by the Polish Alternative Fuels Association, at the end of 2021, there were a total of 1932 charging stations, out of which 587 offered fast (DC) and 1345 slow (AC) charging. POPIHN established that out of this number, 159 fast and 75 slow chargers were installed at filling stations that also sold motor fuels. This represents 27% of fast chargers and 6% of slow chargers nationwide (POPIHN, 2021). The development of the charging network for electric vehicles does not go hand-in-hand with the increase in the number of e-vehicles. The number of electric passenger cars per public charging point in Poland is 8.8. The number of passenger electric cars in Poland exceeded 64,705 pieces. In Poland, there are currently (as of January 2023) almost 2565 public charging stations for electric vehicles (PSPA, 2023). This number is still insufficient in relation to the expected results of the development of electromobility in Poland (Brdulak & Pawlak, 2021).

Summing up the trends determining the development of electromobility in individual countries, we can see that the number of charging stations for electric vehicles directly proportionally affects the increase in the number of electric vehicles on the roads. Certain facilitations concerning the spread of electric cars may apply not only to the owners of such vehicles but also to entities interested in building charging stations (Klimach & Figurska, 2022).

Research method

The research method involves a literature review on the topic of electromobility. The logistic potential of Bieszczady was analyzed to identify those infrastructure elements that can be used to implement electric vehicles, i.e., roads and parking lots. The development of the infrastructure development plan for the charging station network in the Bieszczady region was preceded by an analysis of the needs of residents and tourists visiting this region of Poland. When choosing the positions where the charging stations should be located, the key parameter was the current condition of the road and parking infrastructure. The installation of the charging station requires a hardened surface, access to the power grid, and appropriate markings. The location of electric car charging stations in the presented plan was mainly determined by two factors: the number of residents and tourists in a given zone of the region and the strategic importance for the region. Ustrzyki Dolne is characterized by the largest number of inhabitants among all the towns of the Bieszczady region and is the point where the inhabitants most often and most meet their life needs, which conditioned their saturation with the largest number of charging stations. The latter should be installed in easily accessible places, which explains why some of them have been placed in car parks along provincial road 896, the main road leading to the High Bieszczady Mountains. The decision to choose these car parks was dictated by the needs of tourists who start visiting the Bieszczady Mountains from exactly these places. The research plan consists of the following steps:

1. Identification of point infrastructure of the Bieszczady region with a division into communes.
2. Checking the financial capabilities of individual communes. The budgets of individual communes, their potential for obtaining external funds, and the enterprises located in their area, which in public-private partnership can help in the implementation of investments, were analyzed.

3. Checking the already existing charging infrastructure for electric cars.
4. Selection of the most touristic places in the region.
5. Checking the size of the car parks.
6. Checking the number of tourists in a particular place.
7. Adapting the number of chargers to the size of the parking lot and the number of visitors.
8. Suggesting a location for the installation of new electric chargers, specifying the number, power, and number of charging places.

Analyzing the current situation of the road and parking infrastructure of the Bieszczady region and accounting for the theoretical gaps in the literature on the subject, this article explores and analyzes possible adaptation of this region to electromobility and highlights the needs of residents and tourists. To realize this goal, it is necessary to answer some research questions:

RQ1: What is the current situation of the Bieszczady region in the context of adapting infrastructure to electromobility?

RQ2: Where exactly, in what quantity, and what power of electric chargers should be installed to make the region more attractive?

Considering the trend of the popularity of electric vehicles and the need to limit exhaust fume emissions, the answer to these questions seems to be crucial in the context of the development of the tourist region of the Bieszczady Mountains.

The Bieszczady region in the light of electromobility

The road infrastructure of the Bieszczady region consists of municipal, regional, provincial, and national roads. In terms of area, the Bieszczady region covers an area of 1139 km² and is inhabited by 21,664 people (Statistical Office in Rzeszów, 2019). The Bieszczady region includes the urban-rural commune Ustrzyki Dolne together with the city of Ustrzyki Dolne and the rural communes Czarna and Lutowska. The photograph of Figure 3 shows the area of the Bieszczady region and its border location (the Bieszczady region borders both Ukraine and Slovakia).

The national road (DK84) runs through the territory of the Bieszczady region, the only road of this class with a length of 19.2 km. However, its course is strategic since it leads through the only city in the Bieszczady Mountains and is currently the capital of the county – Ustrzyki Dolne. In addition, it connects

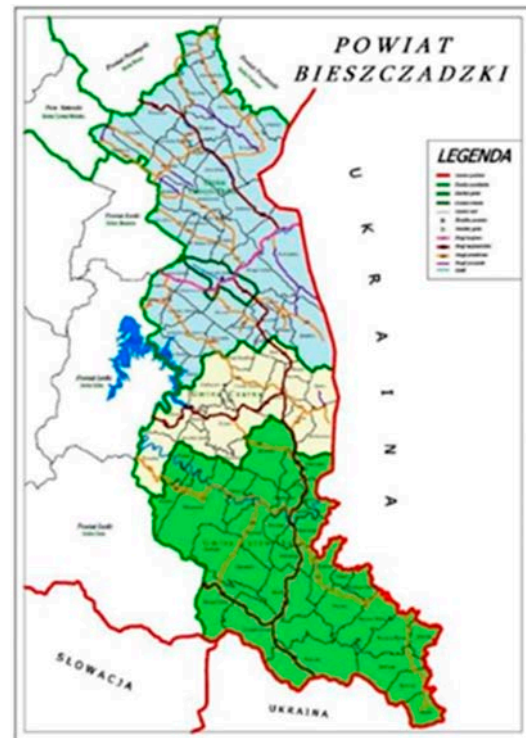


Figure 3. Map of the Bieszczady region (District Office in Ustrzyki Dolne – Department of Communications and Roads)

Poland and Ukraine since it leads to the border crossing in Krościenko.

The implementation of the electromobility development plan requires the identification of road infrastructure, which is currently located in the Bieszczady region. The process of recognizing the possibilities of parking lots and other public utility facilities is used to define possible locations for the installation of electric car charging stations. The installation of an electric car charging station requires earthworks relating to hardening the area, markings, and separating parking spaces (including for people with disabilities), providing an electricity connection with the power required by the charging station and a permanent connection to the Internet. The condition of the road infrastructure that could be adapted to the implementation of electromobility in the Bieszczady region varies in each commune. Based on this relationship, the financial and resource capabilities of each commune should be adjusted in such a way as to achieve maximum efficiency in individual local government units, which will contribute to a developed infrastructural network in the entire Bieszczady region. The Ustrzyki Dolne commune has the largest financial and resource base in the Bieszczady region; therefore, the list of public car parks where public charging stations for electric

cars could be built is the longest. Passenger cars are the basic means of communication in the Bieszczady region. This is due to poorly developed public transport and the shape of the Bieszczady region. There are places in the region of the district where access by a public transport vehicle, especially in winter, is limited or impossible to implement. Individual transport using passenger cars is responsible for the main source of transport-related CO₂ emissions in this region. Table 1 shows passenger cars registered in the Bieszczady region in 2019, which accounts for the division into power (fuel) sources.

Table 1. Passenger cars registered in the Bieszczady region in 2019 (Central Statistical Office)

Passenger cars registered in the Bieszczady region, as of 2019				
Power source	Gasoline	Diesel	LPG	Other
Quantity (pcs.)	5296	6240	1723	4356
Sum	17,615			

However, there is currently no precise data on the actual number of passenger cars driving on the Bieszczady roads. It is estimated, however, that in the summer season, i.e., May–August, 200% of passenger cars registered in the Bieszczady region travel each day in the Bieszczady Mountains. Such numerous passenger cars generate the need for continuous modernization of road infrastructure, which is mentioned by local government units managing the road network in the district. The process of installing an electric car charging station is complex and needs to be planned accordingly. The road infrastructure of the Bieszczady region has wide development opportunities to become a friendly place for electric cars. It is noteworthy, however, that the cooperation of three local government units and private investors is required for its balanced development. Developing a network of charging stations for electric cars will be the basis for reducing CO₂ emissions into the atmosphere, resulting mainly from private transport through the use of passenger cars powered by conventional power sources. As part of the pilot program promoting the development of electromobility in the region, local government units, to minimize the cost of investing public funds, may use public car parks under their jurisdiction to install public charging stations for electric cars. The legitimacy of installing electric car charging stations in places popular for tourists and, at the same time, located on the main road leading to “Bieszczady Wysokie” is justified by the potentially high profitability. The revenue from electric car charging stations is higher and, what is more, the number of recipients of a given station is

also higher. Due to the number of cars annually traveling on provincial road 896, this type of operation becomes justified not only by its positive impact on the environment but also by the financial benefits for the potential investor.

A plan of adapting the infrastructure of the Bieszczady region to electromobility

The procedure for building an electric car charging station involves the implementation of several steps (Figure 4).

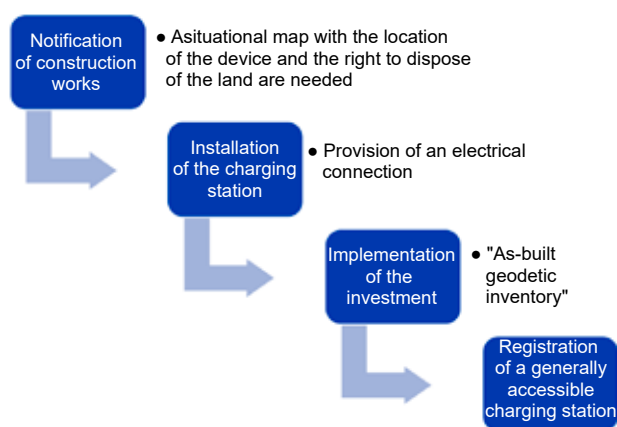


Figure 4. Procedure for building an electric car charging station

The first is the notification of construction works pursuant to Art. 29 in sec. 1, point 8a of the Construction Law Act. This type of notification is made at the eldership or city office. Its attachment should be a situational map with the location of the device, as well as information on the right to dispose of the land (Smolny, 2022). The second step is the installation of the charging station in the planned place and the provision of an electrical connection, the power of which depends on the power of the device. The next step relating to the implementation of the investment is the “As-built geodetic inventory”. As part of this activity, the station should be marked on the numerical map. This task is carried out by the surveyor. An electric car charging station intended for public use requires a technical inspection by the Office of Technical Inspection. After a positive inspection and commissioning of the station, it is necessary to register a generally accessible charging station with the Register of Alternative Fuels Infrastructure. To provide continuous information to EIPA, the charging station must be equipped with software and permanent access to the communication network. The above activities are conditions for

the correct and lawful implementation of electric car charging stations for public use.

When choosing a specific device, it is worth paying attention to the simplicity of its use (so that the customer does not have to think about its operation), the possibility of financial settlements for the charging service (e.g., by registering on the portal and assigning a bank card or directly through an integrated payment terminal) and power (the charging time of an electric car depends, among others, on the power of the charging station). The infrastructure accompanying the charging station itself includes designated parking spaces, parking bumpers (they prevent damage to the charging station via impact with a car), and road markings (signs indicating a charging station in a given place). The above-mentioned elements should be considered in the process of designing the space around the device (Dz.U. poz. 317, 2018). The average price of 1 kWh, at the operators of the 22 kW charging station network in 2021, was PLN 1.20 gross. This means that the return on investment for the purchase of one charging station occurs after a total charge of 16,667 kWh, i.e., after about 758 hours of continuous operation (the cost of purchasing 1 kWh at the level of PLN 0.66 was assumed for the calculations).

Figure 5 shows a map with a list of locations in the Bieszczady region where an electric car charging station can be installed.

Table 2 presents a detailed plan on the locations in which charging stations could be installed, including their amounts and power settings in the Bieszczady region, divided into communes (i.e., Ustrzyki Dolne, Czarna, and Lutowiska), which provides a total of 14 locations, 55 stations, and 113 charging points.

The above plan (Figure 5 and Table 2) offers the author's strategy for the development of electromobility in the Bieszczady powiat. The presented plan has been divided into individual local government units to enable its decentralization. Within each commune, there is space to provide public charging stations for electric cars. Activities relating to the implementation of the charging stations, which in combination will form the entire network, have been divided into local government and private investments. The cooperation of these two sectors, and preventing the mutual cannibalization of charging stations, will lead to a sustainable development of electromobility throughout the county.

To summarize, the selection of the number of charging stations installed in individual zones in the Bieszczady region was determined on the basis of the frequency of visits to individual places by potential customers (both residents and/or tourists). The car parks where it was decided to install charging points are of strategic importance for tourism, service, and commercial industries.

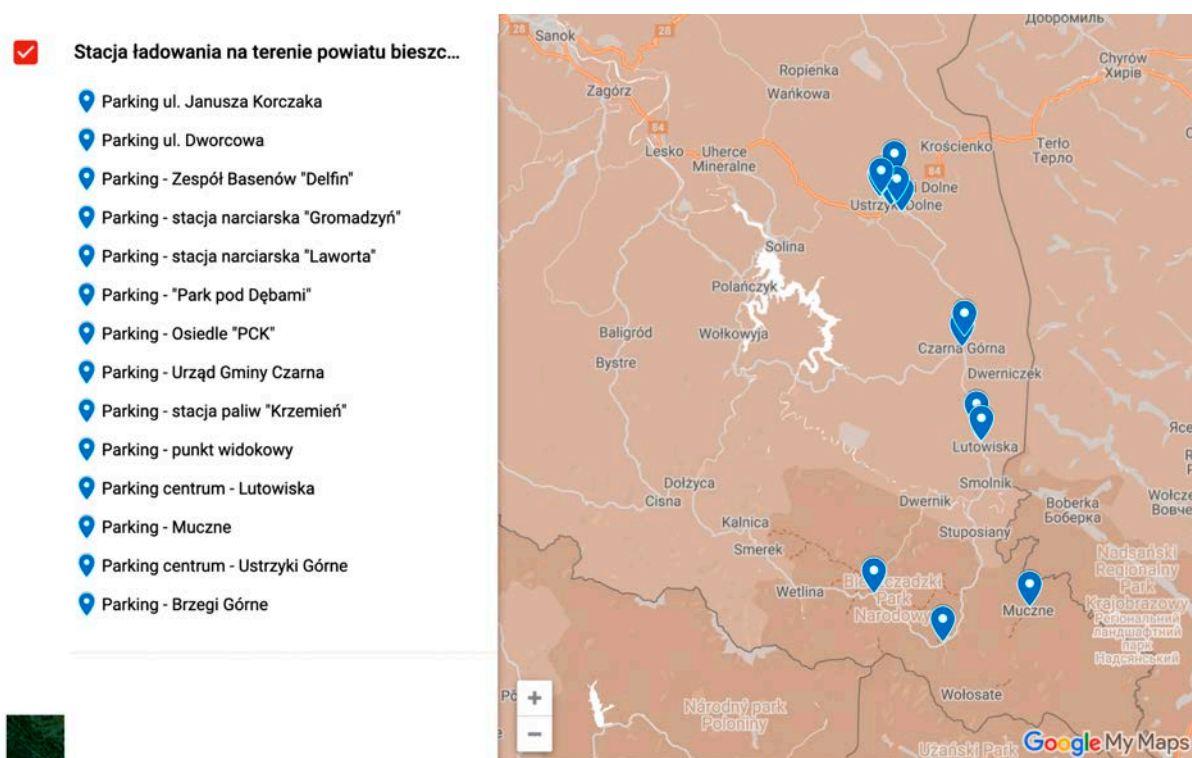


Figure 5. Map of points – proposed stations in car parks

Table 2. Possible places to install charging stations in the Bieszczady region

Location	Number of charging stations and power	Number of charging points
Ustrzyki Dolne Commune		
1. Parking lot at Janusza Korczaka Street in Ustrzyki Dolne	3 charging stations with a power of 22 kW	6 charging points
2. Parking lot at Dworcowa Street in Ustrzyki Dolne	3 charging stations with a power of 22 kW	6 charging points
3. The car park is located near the “Delfin” Swimming Pool Complex in Ustrzyki Dolne	1 fast charging station with a power of 100 kW	Sufficiently long cables (7 meters) will ensure the possibility of charging for 3 cars simultaneously
4. Parking at the “Gromadzyń” ski station	5 charging stations with a power of 22 kW	10 charging points
5. Parking at the ski station “Laworta”	5 charging stations with a power of 22 kW	10 charging points
6. Parking at the “Park pod Dębami” in Ustrzyki Dolne	5 charging stations with a power of 22 kW	10 charging points
7. Ustrzyki Dolne housing estate (PCK)	7 charging stations with a power of 22 kW	14 charging points
Total in Ustrzyki Dolne: 29 charging stations		56 points equipped with a power of 22 kW and 3 fast charging points up to 100 kW
Czarna Commune		
8. The car park is located at the Commune Office, Health Center, and near the Border Guard facility	3 charging stations with a power of 22 kW	6 charging points
9. Petrol station “Krzemień” in the village of Czarna Górna	1 fast charging station with a power of 100 kW	3 charging points
Total in Czarna Commune: 4 charging stations		9 charging points
Lutowiska Commune		
11. Parking at the viewpoint	1 fast charging station with a power of 100 kW and 3 charging stations with a power of 22 kW	9 charging points
12. Parking in the center of the village	5 charging stations with a power of 22 kW	10 charging points
13. Parking in the town of Muczne	3 charging stations with a power of 22 kW	6 charging points
14. Parking in the center of Ustrzyki Górne	5 charging stations with a power of 22 kW	10 charging points
15. Parking w Brzegach Górnych	5 charging stations with a power of 22 kW	10 charging points
Total in gminie Lutowiska Commune: 22 charging stations		45 charging points
Total in Bieszczady region: 55 charging stations		113 charging points

Conclusions

In its assumptions, the infrastructure development plan presented here was not intended to specify a specific “time frame” for its implementation. As part of the recommendation, information was presented on the need for cooperation between local government units, entrepreneurs, and other formal and legal organizations to implement it as quickly as possible. Due to the complexity of issues relating to electromobility, decentralization of activities is required, which simultaneously should include the rational arrangement of charging points for electric cars to avoid their mutual cannibalization. An opportunity for the development of electromobility may be via EU funds under which programs have been

created to subsidize the construction of electric car charging stations, which will be addressed (from January 2022) to local governments, formal and legal organizations, and entrepreneurs. Universal access to infrastructure enabling charging electric cars will allow an extensive number of journeys by electric car. An important factor in the context of launching a charging station is to match its power to the local energy capabilities, the environment in which it is to be located, and the number of potential users. The legitimacy of the investment for environmental reasons is clear, but it should be remembered that electromobility is a growing market, which is significant in the financial context. The gradual development of electric cars, and their increasing numbers over the next few years, will result in a systematic increase

in revenues for the investor who has an electric car charging station. The rate of return for a charging station depends on the frequency of its use. The presented plan was created with the prospect of several years of implementation, which has not been precisely defined, because the whole depends on the global financial situation and the behavior of the supply chain. The trend relating to the widespread use of electric cars will continue in the coming years, and its scale will systematically increase. In connection with the above, activities relating to the development of electromobility infrastructure should not be significantly delayed. This is because, over time, a region without it will become unattractive in terms of business and tourism, which will result in a local financial crisis.

The greatest limitation of the research was the geographical specificity of the Bieszczady region, which strongly limited the space that could be developed for the purpose of installing the charging station. There are numerous nature reserves and parks in the Bieszczady region, which serve as places of protection for plants and animals. Investments in such positions are expensive and difficult to perform due to formal and legal restrictions. In response to the restriction, it was decided to develop the existing car parks, which are the most popular among tourists and residents, and their location is strategic in the context of tourism and the organization of everyday life. Capital expenditures relating to the installation and commissioning of charging stations are subject to high volatility. Financial and spatial factors are the two largest challenges in adapting the Bieszczady region to electromobility. Considering these dependencies, a plan was created, the implementation of which will interfere with the environment to a minimum extent while maintaining the maximum usability resulting from the use of AC and DC charging stations. It is also noteworthy that it is impossible today to indicate the actual needs of the region for charging stations in a given time unit. This is due to the small share of electric cars in the total number of vehicles on the Bieszczady roads. Promoting the Bieszczady region as electromobility-friendly will result in an influx of electric car users who will charge their vehicles while carrying out professional or personal matters. During this period, a practical verification of the implemented plan will occur, which will be additionally burdened by the electric cars of residents.

The development of electromobility is a continuous process; therefore, attention should be paid to the need to expand the infrastructure for charging

electric cars. The electromobility development plan aims to initiate the process of creating the Bieszczady Mountains as an electromobility-friendly region. However, over time, it will be necessary to further develop the plan, which will enable the technological progress already visible today.

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