
Polish Electric Vehicle Market Development Prospects

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Abstract:

Purpose: The purpose of the paper is to present the legal and financial solutions implemented by the Polish government with the goal of promoting electromobility and counteracting environmental pollution. It demonstrates possible applications of electrical energy-powered vehicles as electricity banks in the prosumption model, provides an overview of the development of electromobility in Poland and present the sales figures of electric vehicles in comparison with other European countries.

Design/methodology/approach: Analysed are legal acts related to the development of electromobility and the use of renewable energy sources, the strategy adopted by the government and data acquired from organisations analysing electromobility development. The paper uses the descriptive and analytic-synthetic method. Data from the Polish market were compared with data from EU countries.

Findings: The article has been hypothesized that the Polish government's legislation will help to develop the electromobility market. The negative impact of the traditional automotive industry on the environment in Poland is noticed. In addition, emphasis is put on the fact that technological progress paved the way for electrical energy-powered vehicles, and that solutions referred to as energy prosumption render which possible reduce the operating costs of vehicles, positively impacting the environment. Poland is presented in this context as a country which attempts to adapt the environmental protection priorities set by the EU.

Practical implications: This paper helps to understand trends in the Polish automotive market in terms of the electromobility and prosumptions compared to other European countries. The practical recommendation from the analysis is the continuation of the adopted strategy by the Polish Government. Proceeding this strategy will cause an increase in the share of electric cars. This will have a positive impact on the environment, energy stability and the development of the prosumption.

Originality/value: The current study is the first analysis of the emerging electromobility market in Poland. It is a basis for further electromobility market research.

Keywords: Electromobility, electric vehicle market, environmental protection, ecology, prosumption, legislature.

JEL Codes: K32, A14.

Paper type: Research Paper/Case Study.

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1. Introduction

The Polish energy industry is in need of innovative solutions which would render it possible for to function as part of the European regulatory environment, which exerts increasing influence over Poland. Adapting to the stringent environmental and climate requirements forces Poland is ready to open its doors to electromobility – however, current prices of electric vehicles constitute a significant obstacle in this respect. The environmental protection aspect thus encourages the government to subsidise automotive solutions based on such alternative energy sources as electric power, hydrogen and gas. In the case of electric vehicles, the operating costs can be greatly reduced by implementing solutions developed by the prosumer energy industry, which is also supported by the state. In Poland, however, switching to ecological electric vehicles is problematic due to the fact that the majority of electrical energy is generated with the use of fossil fuels, including black and brown coal.² Nevertheless, electric vehicles currently offer an opportunity to greatly reduce the negative impact of the automotive industry on the natural environment. In addition, vehicles charged using prosumer energy sources do not contribute to the consumption of energy generated from conventional sources.

Lowering the operating costs of vehicles for owners and the prospect of "being ecological" constitute a growth opportunity for electromobility in Poland, as well as being a sufficient reason for the government to introduce financial incentives for consumers who opt for an electric vehicle, and develop pro-consumer renewable energy sources.

2. Market Analysis

An electrical energy-powered car is a complex technical device comprising mechanical, electrical, electronic and electromechanical systems (Karwowski, 2018). The history of electric cars dates back to late 19th century. The first company which operated a fleet of electric taxis was founded in New York in 1897. Modern electric cars have a range between 100 and 200 km, which is sufficient for everyday use in urban and suburban areas. Automotive companies continue to introduce new models of electric vehicles – the US company Tesla has been successfully implementing new solutions and is the leading electric car manufacturer in the United States. Electric vehicles are also manufactured by all leading automotive companies around the world.

In Poland, however, the electric vehicle market is still in its infancy – the demand is low, and electric cars are very expensive. Poland also lacks the necessary charging infrastructure as a result of the low demand for such services. Therefore, an increase in the interest in electromobility is required, which necessitates raising the ecological awareness of the local population. Ecological transportation should thus

²The Belchatów Power Station is considered one of the least ecological in Europe.

become a subject discussed in early childhood and primary education. An important priority for the development of electric vehicle market is to integrate electric cars with the electrical grid.

2.1 The Polish Electric Vehicle Market

The Polish regulatory environment for the development of electromobility, which consists of the National Framework Policy for Alternative Fuel Infrastructure Development enacted by the Polish government in 2017, offers instruments which facilitate integrating electric cars with the grid, as well as instruments for developing the charging infrastructure, the purpose being to accelerate its construction. The development of the electric car market must also go hand-in-hand with the construction of smart networks which can effectively connect the actions and behaviours of all users. In addition, it requires developing a standardised offering for electric vehicle owners. Lower prices and special offers should constitute an incentive to charge cars at home at night, when power consumption is at its lowest.

The prospect of Polish electric vehicle market development will translate into more electric car manufacturers becoming interested in it. This, in turn, may promote pro-ecological attitudes in society and encourage buyers to opt for an electric vehicle. Public interest in purchasing a new electric car has been on the rise in recent years. In 2017, 12% of respondents considered purchasing such a vehicle, in 2018 – 17%, and in 2019 – as many as 28% (Raport Barometr Nowej Mobilnosci, 2019/20). In 2019, 30% of all interested consumers reported that they would be willing to purchase a car costing PLN 50-100,000, and 31% would be willing to purchase a vehicle costing PLN 100-150,000. Unfortunately, the prices of new electric vehicles in Poland exceed these amounts by up to 40%. In this context, subsidies would incentivise 76% of the respondents or VAT exemptions 72% of the respondents.

Apart from the financial aspect, free parking was considered an important incentive by 75% of the respondents, and the ability to use bus lanes – by 67%. The majority of the participants (92%) reported that they would like to charge their vehicle where they live. According to 71% of the respondents, the greatest advantage of electric vehicles is their ecological nature, and for 29% – lower operating costs. Price was the most significant obstacle to 59% of the participants, while technological barriers (such as range and lacking infrastructure) were chosen by 41% of all respondents. 28% said that they would purchase an electric vehicle within the following 3 years (Raport Barometr Nowej Mobilnosci, 2019/20). The majority of the participants (84%) also said that price would be the deciding factor when purchasing an electric car. Other factors included classification, size and body style (65%), battery capacity (57%) and brand (45%). 92% of all respondents would like to be able to charge their vehicle at home, which is currently possible for those living in detached homes and for garage owners. These data paint a positive picture of the development prospects of the electric vehicle market. Unfortunately, the sales of electric vehicles compared to the total sales of new vehicles in Poland in 2019 were very low.

The most popular vehicles on the electric car market, and those with the highest sales in Poland, were the BMW i3, Nissan Leaf and the Renault Zoe. Table 1 presents the 10 most frequently registered electric vehicle makes.

Table 1. 10 most frequently registered electric vehicles in Poland in 2019.

Model	Number of registered vehicles*	Lowest new vehicle price**	
	Number of cars	Price in PLN	Price in EUR ³
BMW i3	603	158 000	34503.84
Nissan Leaf	106	118 000	25768.69
Renault Zoe	50	87 000	18998.95
Jaguar I-Pace	43	336 000	73375.26
Audi e-tron	42	262 000	57215.23
Volkswagen e-Golf	27	153 000	33411.95
Hyundai Kona	23	166 000	36250.87
Tesla Model 3	16	295 000	64421.73
Tesla Model S	10	399 000	87133.12
Tesla Model X	8	420 000	91719.08
Total:	928		

Source: Author's own work based on data from:

*<https://e.autokult.pl/34301,prawdziwy-obraz-rynku-samochodow-elektrycznych-niemal-wszystkie-kupuja-firmy>

** <https://otomoto.pl> lowest prices of new vehicles as of 20.02.2020.

An attractive SUV available on the Polish market – the Hyundai Kona Premium, costs PLN 165 900 (36229 EUR) and features a 39,2 kWh battery and offers a range of 289 km, or PLN 189 000 (41274 EUR) for a version with a 64 kWh battery and a range of 449 km. In comparison, the price of the Premium version of the car with the most powerful (177 hp) internal combustion engine and a four-wheel drive is PLN 110 000 (24022 EUR) (Price Hyundai, 2020). The least expensive combustion variant is PLN 62 000 (13539 EUR). Considering the high price of this electric model, its low sales come as no surprise, with only 23 cars sold in 2019. Economically-motivated buyers of new cars frequently opt for cheaper petrol cars instead. In 2019, a total of 928 electric vehicles were registered in Poland. However, governmental electromobility development policies may help change the situation with the help of financial incentives and new charging infrastructure.

2.2 Poland and other EU Countries

In order to accelerate the adoption of electric cars, European governments provide tax breaks and subsidies for consumers opting for new electric vehicles. The amounts offered vary – from 6500 euros in Spain to even 20000 euros in Denmark. However, it should be noted that subsidies can be obtained for a limited number of vehicles. Nevertheless, despite government attempts, electric vehicle sales in Europe remain low at below 1% (Fic, 2019). In practice, this means that only very wealthy and pro-ecological consumers opt for electrical energy-powered cars. However, it should be noted that the operating costs of an electric vehicle can be several times

³1EUR = 4,5792 PLN <https://www.nbp.pl/home.aspx?f=/kursy/kursya.html> (03.04.2020).

lower compared to a regular car. In the case of a household equipped with solar panels, possessing several such vehicles can prove highly cost-efficient. As has already been proven, the same is true in Poland – the most popular prospect is combining an electric vehicle with electrical energy prosumption.

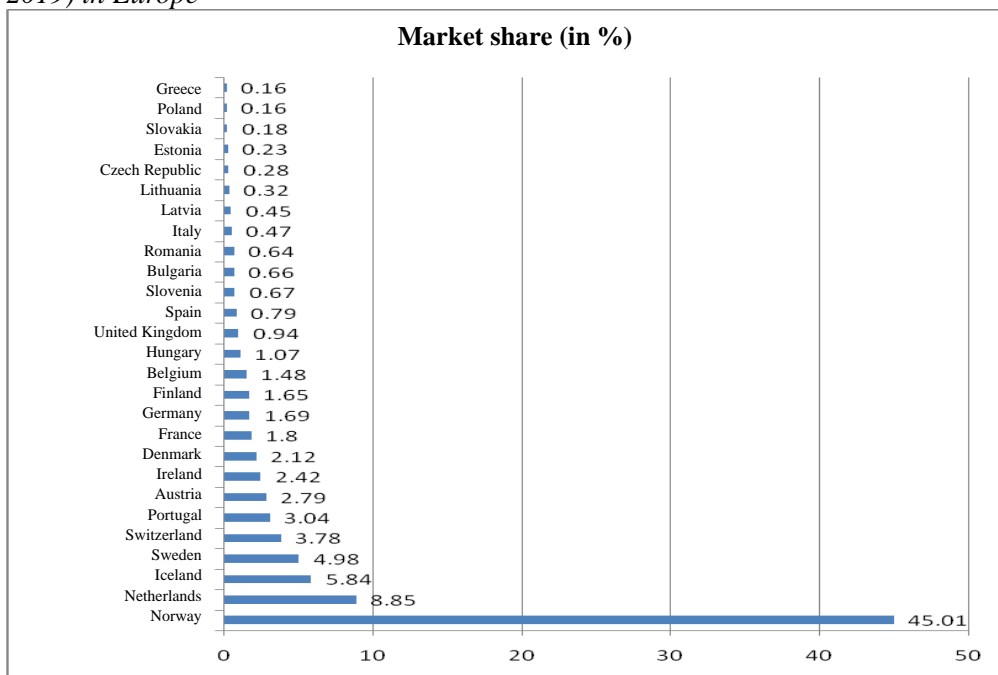
A review of various studies conducted in other EU countries⁴ demonstrates that the popularity of electric vehicles is slightly higher than in Poland, with 40% of the respondents considering purchasing an electric car as their new vehicle. The rest, similar to Polish respondents, cited reasons such as the excessive cost of acquiring an electric vehicle and insufficient charging infrastructure. Some also reported possessing inadequate knowledge of the subject, while others claimed the range of available vehicles to be too limited. The highest percentage of respondents interested in purchasing an electric car was found in Spain (59%), followed by Italy (58%), Sweden (46%), Hungary (45%), Belgium (44%), United Kingdom (40%), France and Germany (39%). The most cited obstacles, apart for financial ones, included the range and functionality of electric vehicles, battery charging time, having to find a place to charge and safety of use. The factors encouraging potential buyers included the positive environmental impact and savings resulting from using an electric car. Figure 1 presents the number of new electric cars in comparison to total new car sales in various EU member states. It illustrates that Poland and Greece are countries with the lowest percentage of electric vehicle sales. This is a result of the low wealth of these populations and high prices of electric cars. The above data also demonstrates that Poland differs from the "strong economies". For example, the percentage in Germany is 1.69%, in the United Kingdom 0.94%, in Austria 2.79% and in Switzerland 3.78%. As can be seen above, the sales of electric vehicles in Europe differ between countries. The common factor for all European markets is the high price of such vehicles, which are dedicated for wealthy, highly ecologically-conscious customers.

An exception on the European electric car market is Norway, whose percentage share exceeds 45% and can serve as an example for Poland to follow. Norwegians purchased a total of 147,929 cars in 2018, 46,143 of which were electric vehicles, and 42,869 hybrids. In comparison, in the first three quarters of 2018, a little more than 400,000 cars were sold in Poland, but only 958 were electric, and 16,205 were hybrids (Report Norway, 2018). The reason for the success of electric cars in Norway is their price. In Norway, electric cars are less expensive than comparable petrol cars as a result of tax breaks – electric vehicles are exempt from VAT, which is 25%. Another incentive for Norwegians is that electric vehicles do not incur a carbon tax, which is calculated based on the total amount of carbon dioxide emitted by a petrol vehicle and its mass. Implementing such a solution raises the price of petrol vehicles, reducing their competitiveness on the market. Other incentives to

⁴*Study conducted by Ipsos Mori for Transport & Environment (T&E) in September 2018 in nine EU member states – Belgium, France, Spain, Germany, Poland, Sweden Hungary, United Kingdom and Italy (Raport Barometr Nowej Mobilnosci 2019/20).*

purchase an electric car include the lack of road tax, discounts on toll roads and ferries, less expensive parking in cities and being allowed to use bus lanes.

Figure 1. Electric vehicles compared to the rest of the new car market (first half of 2019) in Europe



Source: Author's own work based on data from: <https://elektrowoz.pl/auta/wyniki-sprzedazy-samochodow-elektrycznych-w-polsce-12-nowych-aut-na-1-milion-obywateli-i-polrocze-2019/> (20.02.2020).

3. The Development of the Electric Car Market in Poland

The first energy-related crisis emerged as early as in the 20th century, and was a result of depleting fossil fuel sources and the necessity to protect the natural environment. Current ecological threats are directly or indirectly related to environmental pollution (Nowak, 2010). The direct effects include deteriorating air quality, qualitative and quantitative changes in water resources, decreasing availability of agricultural land and changes in its quality. The indirect effects include losses incurred by the agricultural, forestry and fishing sector, worsening work and recreation conditions, as well as deteriorating human health. Humans have therefore attempted to reduce their negative impact on the environment, which has given rise to an interest in electrical energy-powered vehicles.

In general, the early 20th century, with its low prices of liquid fuels, their abundance and the low awareness of their negative impact on the environment among users, was a period when electric vehicles could not compete with internal combustion

engines. The situation has now changed, however. Fuel prices are rising, and the prices of electrical energy are lower compared to liquid fuels. Also on the rise is the ecological awareness of consumers, as it is beyond all doubt that humanity is responsible for climate change, primarily due to greenhouse gas emissions, including carbon dioxide. The greenhouse effect is a natural process caused by the presence of greenhouse gases in the atmosphere. These gases absorb some of the long-wavelength thermal radiation reflected off our planet's surface. Apart from carbon dioxide, natural greenhouse gases include water vapour, methane and nitrous oxide (Liszka, 2008). However, human activity leads to an increase in the amount of what is referred to as synthetic greenhouse gases, which include freons and halons. Both synthetic and natural greenhouse gases form a "screen" which renders it more difficult for the solar radiation absorbed by the planet to be emitted back into space. The resulting accumulation of energy causes atmospheric temperature to rise, an effect which is referred to as global warming. The energy sector is the largest contributor to greenhouse gas emissions. Cognisant of this issue, the European Union implemented the 3x20 programme in 2007 to protect the environment. The goal is to limit greenhouse gas emissions by 20%, increase energy efficiency by 20% and increase the contribution of renewable energy sources to 20% by 2020.

Reports compiled by the Polish Supreme Audit Office indicate that the air in Poland is highly polluted. This is caused by the use of fossil fuels, frequently of low quality, by the Polish industry, households and power stations. In an attempt to minimise its negative impact on the environment, Poland signed and ratified the Convention on Climate Change in Rio de Janeiro in 1992 and in 1994, the Kyoto Protocol in 2002, as well as adopting the Polish Climate Policy in 2003, which involves reducing greenhouse gas emissions by 40% by 2020 (Miklaszewski, 2015).

As an EU member state since 2004, Poland has been adapting its developmental priorities to the requirements of the European Union. Using renewable energy sources, including the prosumer energy model, is currently a good solution to the air pollution issue. The prosumer energy model comprises (Bajor, 2016) small-scale renewable energy generators for households which sell surplus energy, e.g. solar modules, smart devices which adapt to changing energy prices, e.g. washing machines and dishwashers, central temperature control systems which automatically adjust the temperature based on information received from the energy provider regarding dynamic energy price changes depending on network load and the needs of building inhabitants, and electric cars which render it possible to reduce the consumption of energy in the transport sector (and which can simultaneously act as energy banks). The fundamental determinants of the development of the Polish electric vehicle market are as follows:

- legal, part of the development strategy of a country,
- financial – for buyers of electric vehicles,
- ecological.

3.1 Legal Determinants of the Polish Electric Vehicle Market

In the summer of 2015, the 20th level of electrical power supply limitations was introduced in Poland. This was a result of several factors:

1. a mismanaged maintenance policy (a large number of generators were shut down for maintenance or reported as malfunctioning at the same time),
2. a long-lasting drought resulting in the inaccessibility of cooling water for power stations, as well as moving water for hydroelectric power plants,
3. a lack of wind rendering wind turbines incapable of providing enough power,
4. a lack of energy storage facilities.

The event was considered a warning regarding possible serious consequences for the energy market resulting from energy deficits. An effective solution in this context were actions aimed at managing the demand for electricity. Electromobility was identified as a potential tool in this context, and, on 16 March 2017, the Polish government adopted the Electromobility Development Plan in Poland devised by the Ministry of Energy, and the Act on electromobility and alternative fuels, published in the Journal of Laws of 2018 (item 317), was enacted on 11 January 2018.

3.1.1 *Electromobility Development Plan in Poland*

Technological progress renders it possible to store energy in car batteries and electricity banks. Electric vehicles can be treated as power banks which serve as a source of energy when necessary, and be charged at night, when power consumption is at its lowest. According to the Plan, there should be approximately one million electric cars in Poland by 2025, which should generate an additional 4.3 TWh of annual demand for electricity (Electromobility Development Plan in Poland, 2020). This is good news from the point of view of the predicted increase in income from energy sales, which is estimated at PLN 20 billion. It should be noted that Poland possesses sufficient fossil fuel reserves to satisfy its energy-related needs, but the same is not true for oil. Therefore, focusing on electromobility could increase the energy security of the country. The Electromobility Development Plan in Poland sets three fundamental goals to be achieved by 2025:

1. creating conditions conducive to the development of Polish electromobility,
2. growing the electromobility industry,
3. stabilising the power grid (Electromobility Development Plan in Poland, 2020).

In order to create conditions for the convenient use of electric vehicles, one of the goals involves constructing EV charging infrastructure and developing a system of financial and operating cost incentives (subsidies, free parking in paid parking areas

in city centres, being allowed to use bus lanes). One of the factors listed as influencing the development of the electromobility industry was creating incentives for businesses to bear the costs of electromobility-related innovations and development. Power grid stabilisation is understood as the necessity to adapt the existing network infrastructure to the increasing demand for electricity, which requires substantial investments.

Such a large project had to be divided into stages, and several cities were selected for pilot implementation. The years 2017-2018 were spent on developing procedures, creating a test environment and increasing public interest in the matter. A research and implementation agenda, based on the results of the pilot programme and a catalogue of best electromobility development practices, will be developed between 2019 and 2020. Tested best practices are scheduled for implementation in the rest of the country between 2021 and 2025, in addition to pilot commercial solutions. The Plan also involves the replacement of all car fleets owned by the administration with electric vehicles, scheduled to begin in 2019 and 2020. The goal of 50% of all cars in all fleets being electric should be achieved by 2025. Another point of the plan is the creation of an alternative fuel infrastructure development policy. The necessary infrastructure should be ready by 2020, assuming that one million electric vehicles will indeed be registered in Poland by the end of 2025.

The Electromobility Development Plan also identifies the need to implement changes in the taxation system which would benefit electric car owners (changes to the excise tax, VAT, electric vehicle depreciation rate). Also included is the implementation of a fee based on the price and emissions generated by a vehicle, which will directly increase the prices of emission-generating cars.

In order to support the electromobility industry, the Plan lists mechanisms ensuring the continued financing of innovations. The priority is to introduce preferential electrical energy prices for users of electric vehicles and charging stations. In addition, the government plan adopts an alternative fuel infrastructure development policy which also involves achieving the stated goals by 2020. Moreover, it is correctly assumed that building charging infrastructure is necessary to commence with the process of developing the electric car market in Poland, as without it, the Electromobility Development Plan will surely fail to achieve its goals. The development goals were formulated and incorporated into the country's strategy in the Act on electromobility, which constitutes an executive act for the Electromobility Development Plan in Poland.

3.1.2 The Act on Electromobility and Alternative Fuels

In Article 2 points 11 and 12 of the Act on electromobility and alternative fuels enacted in 2018, vehicles which are subject to the Act are defined as follows:

1. electric vehicle – a vehicle which uses solely electrical energy accumulated by being connected to an external power source; BEV⁵,
2. hybrid vehicle – a vehicle combining an internal combustion engine and an electric generator, which generates electricity when connected to an external power source; PHEV⁶.

This provision eliminates traditional hybrid vehicles which use HEV generation to accumulate electrical energy⁷, Article 2 points 18 and 19 define charging stations as charging stations with normal power, i.e., between 3.7kW and 22kW, as well as high-power charging stations (exceeding 22kW). Point 7 defines open-access charging station owners as subjects responsible for the construction, management, safety of operation, use, maintenance and repairs of stations. The Act also defines the obligations of open-access charging station operators, in addition to introducing the concept of charging service provider. It also lists the obligations of public entities regarding the development of alternative fuel infrastructure. Article 34 imposes an obligation on the primary administrative organs to ensure that at least 50% vehicles in fleets belonging to territorial authorities are electric vehicles, with the exception of gminas, where at least 30% of cars should be electric. Gminas can also establish clean transport zones and charge owners of emissions-generating vehicles for entry. Article 42 imposes an obligation to maintain a registry of alternative fuel infrastructure on the President of the Technical Supervision Office (UDT), who is also responsible for keeping the registry publicly available. The Act also specifies the minimal number of charging stations to be installed by 31.12.2020 as:

1. 1000 charging stations – in gminas numbering more than 1,000,000 inhabitants, with more than 600,000 registered vehicles, with at least 700 vehicles per 1000 inhabitants.
2. 210 charging stations – in gminas numbering more than 300,000 inhabitants, with more than 200,000 registered vehicles, with at least 500 vehicles per 1000 inhabitants.
3. 100 charging stations – in gminas numbering more than 150,000 inhabitants, with more than 95,000 registered vehicles, with at least 400 vehicles per 1000 inhabitants.
4. 60 charging stations – in gminas numbering more than 100,000 inhabitants, with more than 60,000 registered vehicles, with at least 400 vehicles per 1000 inhabitants (The Act on electromobility and alternative fuels, 2020).

In addition, by 15 January 2020, mayors of villages, towns and cities were obliged to create reports on the number of charging stations installed in their gminas. Should a report indicate that the minimum requirements were not met, the mayor was obliged

⁵Battery Electric Vehicle.

⁶Plug-in Hybrid Electric Vehicle.

⁷Hybrid Electric Vehicle.

to create a plan of constructing more open-access charging stations. The plan should be relayed to Distribution Network Operators (DNO), who must agree upon a draft plan which takes into account the connection power specified in the development plan, and to develop a programme of integrating stations with the distribution system. Article 64 imposes on DNOs an obligation to build stations and bear the costs of their construction as reasonable costs within the meaning of the Energy Law.

3.2 Financial Determinants for Buyers of Electric Vehicles

The 2018 act regulates the development of electric vehicle charging infrastructure, but does not introduce any regulations which would incentivise buyers to opt for electric cars. This issue was only tackled in a regulation of the Minister of Energy of 5 November 2019 on the specific conditions for providing support from the Low Emission Transport Fund for natural persons not engaged in economic activity purchasing new vehicles, and the financial aspects of this support. The regulation was published in the Journal of Laws on 13 November 2019 (item 2189), (Regulation of the Minister of Energy, 2019), and regulates the preferential terms of purchasing new (not previously registered) vehicles. The maximum subsidy amount which can be obtained by a natural person purchasing a vehicle powered purely by electricity is 30% of the value of the vehicle, up to PLN 37,500. The support for purchasers of hydrogen vehicles was also set at 30% and up to PLN 90,000. At the same time, the maximum value of vehicles which could be purchased was limited to PLN 125,000 for electric vehicles and PLN 300,000 for hydrogen cars.

The regulation also details the data which must be provided by a purchaser to receive the support, which is granted based on an agreement concluded between the manager of the support fund and the natural person making the purchase. The requirement for receiving the support is submitting a declaration that the vehicle will not be sold within 2 years, that it will be registered on the territory of the Republic of Poland, and that the buyer agrees to insure the vehicle against damage or loss resulting from collisions, fortuitous events and theft. Should the above conditions be violated, the amount received has to be returned with interest. The support is given after the following documents are submitted: a copy of the invoice, a copy of the registration book and a copy of the insurance policy. Support is only provided as part of a call for applications and only vehicles purchased after the previous call has ended are eligible to participate. It is provided by the Low Emission Transport Fund until the funds dedicated for the project are exhausted.

The conditions specified in the regulation demonstrate that this solution is temporary and its impact will unfortunately be limited due to the fact that it excludes businesses, which possess much more purchasing power compared to natural persons. This greatly limits the range of the electromobility development programme and restricts the options of businesses as regards building fleets of vehicles which can serve as energy banks. No subsidies for businesses are likely a result of the

small-scale budget for the electric vehicle subsidy project. It would therefore be beneficial if businesses were encouraged to build fleets of electric vehicles via a system of affordable energy prices and prosumption development incentives for companies. Such a system currently does not exist in Poland, even though many businesses decide to build their own micro-power stations due to the increasing energy prices caused by emission taxes. A surplus of energy can currently be sold to the power grid, or used to charge electric vehicles. Unfortunately, for economic reasons, companies do not build fleets consisting solely of electric vehicles as such purchases are considered economically unreasonable.

3.3 Ecological Determinants

It should be noted that, despite the rising environmental awareness of our society, the main factors influencing decision-making when purchasing a new car in Poland is the price, the availability of charging infrastructure, especially in the case of long travels, as well as the increasing prices of charging resulting from rising prices of electrical energy. The latter is a result of the use of fossil fuels, which are subject to high emission taxes imposed by the EU.

Countries with the highest number of electric cars have well-developed renewable energy infrastructure. Poland is dominated by high-emissions, conventional means of generating power, which means that an increase in the demand for electrical power will be tantamount to an increase in the demand for power derived from conventional energy sources. Of course, from the point of view of urban residents, it is beneficial for the smoke and CO₂ generated by cars to instead be generated by conventional power stations located outside cities, but in order to effect real ecological change in Poland, it is necessary to develop renewable energy solutions.

Thus, on 7 June 2018, the uniform text of the Act on renewable energy sources, which puts emphasis on developing renewable energy sources, including energy prosumption, was published in the Journal of Laws of 2018 (item 1269) (Renewable Energy Act, 2018). The document is based on the Act of 20 February 2015 on renewable energy sources (Journal of Laws of 2017 item 1148), and includes amendments introduced in other acts. On 19 July 2019, in the Journal of Laws 2019 (item 1524), an amendment to the Act on renewable energy sources was published, which remains in effect to this day. The amendment specifies the rules governing the generation of energy using renewable sources and the instruments for supporting such energy generation, the principles of the national action plan related to renewable energy sources and more. In line with Article 3 of the Act, businesses generating energy using renewable sources must first obtain a permit specified in the Energy Law. However, this requirement does not apply to micro-generators and small-scale agricultural biogas and bioliquid generators. The act defines the terms:

1. small-scale generator – a renewable energy generator with a total power greater than 40 kW but not exceeding 200 kW, connected to a power grid

- with a rated voltage lower than 110 kV or a heat cogeneration capacity larger than 120 kW and not exceeding 600 kW.
2. micro-generator – a renewable energy generator with a total power not exceeding 40 kW, connected to a power grid with a rated voltage lower than 110 kV or a heat cogeneration capacity not exceeding 120 kW (Renewable Energy Act, 2018).

A subject generating energy using the above-mentioned generators is referred to as a prosumer. In addition, according to Article 40.1, the President of the Energy Regulatory Office appoints what are referred to as "obliged sellers", who must purchase such energy and settle its purchases. Formal settlements between them and prosumers are cashless. Obligated sellers track the amount of energy fed into the grid by a prosumer and the energy consumed by them at a 1/07 ratio for small-scale generators and 1/08 for micro-generators. In practice, this means that a prosumer generating electricity at a time when their consumption is low can feed it into the power grid and only consume it when necessary, but at a loss of 30% for small-scale generators or 20% for micro-generators. Any surplus energy fed into the grid by the prosumer exceeding what they have consumed belongs to the seller and the prosumer receives no remuneration for it. Settlements between prosumers and sellers occur on a biannual basis. Taking the above into account, building small-scale and micro-generators should always be weighted against the needs of the prosumer.

Building a prosumer generator, in addition to greatly reducing the costs of electrical energy required to operate a business or for heating, for example, can be a reason to oversize a generator and consider purchasing an electric vehicle or a fleet of electric vehicles, which can then be charged from one's "own" energy source free of charge, in addition to serving as a power bank. No pricing solutions currently exist which would enable the selling of energy from such storage facilities, but it would be possible to develop a system of financial incentives for selling energy from banks when faced with a national deficit. Subsidies are another incentive to build micro-generators. The majority of gminas in Poland currently subsidise photovoltaic micro-generators for owners of detached homes, and the subsidies amount to up to 50% of the cost of constructing such a generator. Prosumer generator construction subsidies, combined with financial support for electric vehicle buyers, could thus be an effective stimulus for the development of electromobility in Poland. Of course, the issue of charging a vehicle outside of work or home is a significant obstacle, but this problem has been solved by the above-mentioned statutory obligation to build rapid charging stations.

Financial incentives for prosumption and electromobility thus constitute a real opportunity for renewable energy source development, leading to an increase in the amounts of energy generated from ecological sources, resulting in a decrease of CO₂ emissions generated by conventional power stations and internal combustion engines, which is a natural consequence of an increase in the number of electric vehicles sold on the new car market.

4. Conclusions

As a community, the European Union requires its members to reduce carbon dioxide emissions generated by the energy sector, including the carbon dioxide generated by cars. The purpose of the wide range of environmental protection measures implemented is to combat global warming and the deteriorating quality of air. Technological progress offers help in the fight for a better environment – however, currently available automotive solutions are still very expensive. The fact that various governments are quick to implement legal solutions promoting electromobility to limit the negative impact of the automotive industry on the environment is a good sign.

In Poland, this process began relatively late, with an electromobility development plan being created in 2017, followed by the Act on electromobility and alternative fuels from 2018, and a regulation introducing subsidies being enacted in 2019. However, the financial solutions facilitating electric car purchases are only now being implemented. As of writing this paper, none of the electric cars sold in Poland has been subsidised – they have all been purchased by wealthy, highly ecologically-conscious Poles.

However, it should be noted that the comprehensive nature of the legal regulations on electromobility development, combined with promoting renewable energy sources and the increasing availability of such solutions in Poland suggest that the sales figures of electric vehicles will increase rapidly. The purpose of the government's solutions is to ensure that the necessary charging infrastructure is available and to shift the balance towards ecological, renewable and emission-free energy sources. The system of financial incentives and privileges for owners of electric vehicles are certain to constitute an important factor in the purchasing process.

The stated goal of 1 million electric vehicles by 2025 is very ambitious and seemingly impossible to achieve. A total of 278,000 cars were purchased in Poland in 2019. If the sales figures remain relatively constant, approximately 1,400,000 new cars will be purchased in the following 5-year period. In order to achieve the above goal, 71% of all cars purchased would have to be electric, which does not appear possible considering today's level of 0.16%. However, Norway demonstrates that consistent application of a wide range of incentives can result in achieving a 50% market share in 6 years.⁸ Poland has just embarked on this journey, and it is the resolve of the Polish authorities that will determine the end result in 2025. A quick implementation of an incentive system targeting businesses would greatly contribute to achieving the goal. If replacing an entire fleet were greatly profitable, entrepreneurs would certainly support the government in its attempts. Of course, ascertaining whether Poles will be able to purchase one million electric vehicles is

⁸ *The relevant legal solutions were implemented in Norway in 2013.*

not a goal in itself. What is more important is to promote a pro-ecological attitude in society and the Polish government, which could help improve the air quality in Poland and reduce the country's CO₂ emissions. Poland is only now setting out on this path, and it is important that it is consistent in its efforts.

The legislative solutions presented in the article constitute a great opportunity for electromobility development in Poland, whose pace will of course greatly depend on the implementation of the incentive system, as well as on the electric car manufacturers themselves. It is highly likely that, as a result of rapid development of battery manufacturing technologies, their prices will begin to decrease, and that, with time, the prices of electric vehicles will become closer to those of petrol cars.

Subsidies and tax breaks should thus only constitute a stimulus accelerating the electrification of the automotive sector. Another opportunity presents itself in the form of the development of electrical energy prosumption. However, this solution is currently only available to detached home owners and businesses. This is why it is important to ensure access to neighbourhood charging stations for owners living in blocks of flats and adjusting energy prices to the wealth of customers, as electrical energy is currently rapidly becoming expensive in Poland. One of the possible obstacles to the development of electromobility is thus a situation where the cost of driving 1 km with an electric vehicle exceeds the cost of doing so with a petrol or diesel car. It is in the best interest of the environment for ecology to win this struggle and for charging rates to be set at affordable levels.

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