Article

Key Factors of Development of Electromobility AMONG Microentrepreneurs: A Case Study from Poland

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Abstract: Microentrepreneurs contribute to the growth of electromobility, and hence to sustainable transport, by the purchase of alternative fuel vehicles (AFV). This article attempts to identify key factors that may affect the growth of interest in AFV among microentrepreneurs. To find the key factors, data from 181 Polish microenterprises was collected and analyzed by means of the factor analysis. The results showed that in contrary to the popular opinion, it is not the price of the car that is crucial for its purchase, but the information that leads to knowledge about technical and utility values, and to legal and economic predictability.

Keywords: electromobility; sustainable development; micro-, small and medium enterprises (SMEs); entrepreneurship; principle component analysis; key factors; information; COVID-19

1. Introduction

Currently, there are almost 1.3 billion passenger and commercial vehicles on the world's roads. More than 80% of these cars are classified as light passenger vehicles. The vast majority of them (almost 95%) use a conventional petrol or diesel fueled combustion engine. However, there are also other drive systems, so-called non-conventional or alternative (AFV) ones. Among them we can distinguish:

- battery electric vehicles (BEVs), powered exclusively by an electric battery
- plug-in hybrid electric vehicles (PHEVs) that can be charged from the power grid but also have a combustion engine
- hybrid electric vehicles (HEVs) that combine an internal combustion engine with an electric drive to increase efficiency and performance.

According to the data of the Polish Alternative Fuels Association (PSPA), at the end of July 2020, 13,057 electric passenger cars were registered in Poland. 55% of them (7231 cars) were fully electric vehicles (BEV) and the rest (5826 cars) belonged to plug-in hybrids (PHEV). There has been some progress in increasing the share of electric cars in the total number of cars. In the first seven months of 2020, 4061 cars were added, which is 78% more than in the corresponding period of 2019. Despite this noticeable growth, electromobility in Poland is still in the initial stage of development mainly due to high price of BEVs, limited number of charging stations and very unstable and unclear legal regulations [1].

Polish economy, similarly to other economies of the European Union (EU), is dominated by microenterprises. According to the Entrepreneurs' Law [2] microentrepreneur is an entrepreneur *"who, in at least one year of the last two financial years, met the following conditions jointly: employed an average of less than 10 employees and achieved an annual net turnover from the sale of goods, products and services and financial operations not exceeding the PLN equivalent of 2 million EUR, or the total assets of its balance sheet prepared at the end of one of these years, did not exceed the PLN equivalent of EUR 2 million"*.

In Poland, microentrepreneurs constitute as much as 96.7% of all enterprises active on the market, and their number is systematically growing from year to year. It is necessary to

emphasize the role of micro, small and medium enterprises (SMEs) in the labor markets and their importance in the development of entrepreneurship and innovation in the EU, which translates into an increase in the competitiveness of the economy [3]. In the EU, microenterprises constitute as much as 93.0% of all enterprises, creating jobs for 29.7% of employees [4]. In Poland they have the largest share in the creation of GDP—even 30.3% in 2017 among all enterprise groups, and generate 40.8% of jobs in the entire sector [3].

It is emphasized that entrepreneurial individuals can discover, create and use opportunities for sustainable development thanks to social and technological innovations leading to institutional and market transformations [5]. It is also argued that, for example, in family businesses, the non-financial aspects that meet the emotional needs of the family play a key role in making decisions about strategic choices for these businesses. They are aimed at achieving often uneconomical goals and are oriented towards accepting the choice made by the family. There is often no economic justification for making such decisions [6]. In a similar way, social entrepreneurship is created, which can be defined as "seeking opportunities to create social value and catalyse social change", which also often runs beyond the economic utility of business, rather focusing on the willingness to support the local community [7]. Finally, we can also talk about environmental entrepreneurship, which consists in solving problems related to the excessive exploitation of natural resources and in effective functioning in accordance with environmental resources. In particular, it refers to activities aimed at achieving sustainable development by limiting the consumption of natural resources or introducing the principles of environmental protection [8]. Any microenterprise can implement such measures. Each, even the smallest pro-ecological change in the global effect will bring invaluable positive effects.

Simultaneously, an analysis of the AFV literature and the automotive market shows that entrepreneurs can play a significant role in the development of the transportation sector. That is why in this paper the authors have focused on the issue of responsibility for environmental protection by declaring a willingness to purchase a company car with an alternative drive. Therefore, the main research question refers to the analysis of factors that may affect the development of electromobility in microenterprises and the identification of the key factors in this issue. In particular, the research identifies the key factors that are responsible for the passive attitude of microentrepreneurs in the field of purchasing a car with an alternative drive (electric, hybrid or plug-in hybrid) for the needs of their company.

The analysis of the key factors was based on microentrepreneurs' attitudes to many functional, technical and economic features related to the possible purchase of an AFV. The data was collected through a telephone interview (CATI) in January 2020 on a population of 181 Polish microentrepreneurs. The second part of the survey was conducted on-line (CAWI) in March and April 2020. In this part of the survey among others the impact of COVID-19 pandemic on purchase of a car was checked.

The issue raised in the article is important and fundamental for several reasons. Firstly, it concerns two aspects that are important today: The development of electromobility in Poland and the involvement of a significant economic and social force in this process, such as microenterprises. Secondly, the importance of the issue is confirmed by the data on the rising use of AFV in passenger transport, in the numerous studies and reports [1,9–11]. Thirdly, it touches the right idea of the functioning of the world on the basis of sustainable development, which postulates stricter standards for air pollution caused by cars in the field of environmental protection. Fourthly, the conducted research indicates important and key factors that may affect the decision to purchase a car with an alternative drive, other than an internal combustion engine. This can make a difference and can be used by governments and policymakers when designing campaigns to encourage consumers to buy environmentally friendly cars.

The remainder of the paper is as follows: Section 2 contains an overview of the most important literature on both electromobility and the application of the principle of sustainable development in microenterprises. It is also a review of significant research on the identification of factors that may influence the decision-making by consumers to

buy a AFV. Section 3 describes the research data and justifies the selection of the statistical method. Section 4 presents the results. Finally, Section 5 is devoted to discussion of the results and conclusions obtained. It provides also an incentive for further research and discussion of the key factors that may affect decisions about purchasing an electric, hybrid or plug-in hybrid car for the company's needs.

2. Literature Review

2.1. Environment and Sustainable Transportation

Poland is one of the countries where, despite legislative changes and infrastructure development the AFV sector is one of the smallest in Europe [1]. In Poland there are only 0.2% of all charging points in Europe [12]. The average growth rate of the charging point network in 2020 was 2% on a month-to-month basis. At the end of the first half of 2020, 1194 (2258 points) public electric vehicle charging stations existed in Poland [12,13]. At the same time the legislation framework has changed several times leading to confusion and lack of trust among potential buyers [3].

Figure 1 indicates that in many countries there is a much higher percentage of electric cars in the total number of vehicles than in Poland. However, further development of electromobility in Poland is necessary for many reasons. Firstly, the most important one includes a chance to reduce the impact of fluctuations on the crude oil market by decreasing consumption of crude oil for transport purposes, which has positive consequences for people and the environment. Secondly the reduction of air pollution mainly in urban areas due to zero direct emission of electric cars can be very beneficial for the health and quality of life [9].
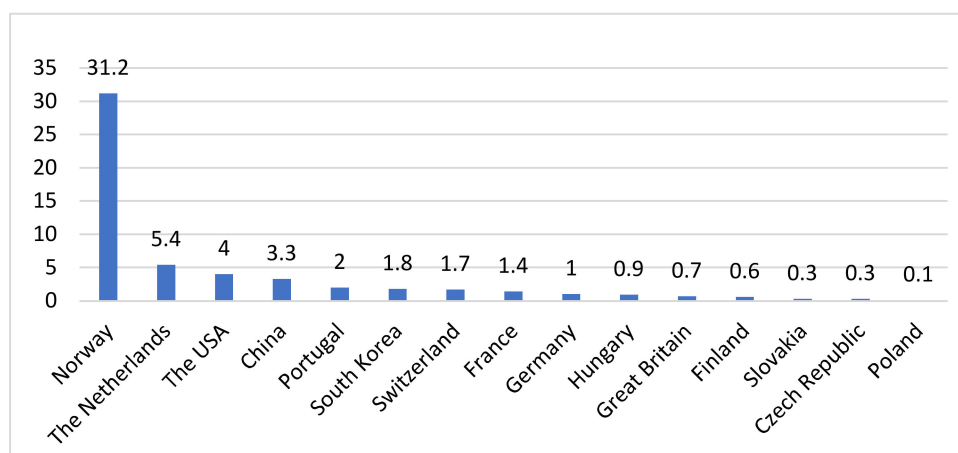

Figure 1. Percentage of registered electric cars among passenger cars in Poland and selected countries (2018, %) (reproduced from [9], p. 24, Polski Instytut Ekonomiczny).

One of the recent reports of the Supreme Audit Office (NIK) shows that Poland so far cannot cope with reducing pollution generated by transport [14]. Eurostat data reveal that although the emissions of carbon dioxide (CO_2) to the atmosphere, generated by passenger transport, are systematically decreasing, this change is slow and does not meet expectations [15]. In countries like the UK and the US, the transport sector is now responsible for emitting more greenhouse gases than any other, including electricity production and agriculture. Globally, transport accounts for around a quarter of CO_2 emissions.

Meanwhile, according to the World Health Organization air pollution from transport is harmful to human health [16]. Road traffic is considered to be the most important source of some pollutants (for example nitrogen oxides, benzene and carbon monoxide), which are of great concern with regard to the impact on human health and life. In the last decades emissions caused by the ever-increasing number of cars have been reduced thanks the improvement of the engines, usage of new materials that can also be used in catalysts and are capable of absorbing and products polluting photodegradation [17], but the problem

still exists. Hence protecting the air from pollution is an important element of European environmental policy.

The discussed issue is a part of the real problem of the development of the world economy in accordance with the general principles of sustainable development. These principles were adopted by the UN General Assembly in 2015. They established a new global policy framework that sets itself three main tasks to be carried out: (1) eradiating all forms of poverty, (2) fighting inequalities in every aspect of life, (3) combating climate change (UN, 2017). These aims have been divided into 17 intermediate sustainable development goals, including among others point 13. Climate Action, which talks about climate change caused by human activity, in particular greenhouse gas emissions to the atmosphere caused by broadly understood transport. The strategic long-term vision of the Commission—Clean Planet for All [18], as well as The European Green Deal [19] where the importance of sustainable mobility is particularly emphasized, create a roadmap for the further sustainable development. As of today, the EU plans to reduce greenhouse gases in transport by 30% by 2030 compared to 2005. The Commission also reaffirms the key role transport plays in reaching a climate neutral Europe by 2050.

Due to the already mentioned role of micro and medium-sized enterprises in the development of the European economy, it should be assumed that without their involvement and interest in AFV, the wide development of this sector will not be possible. The decisions of microenterprises made by small business owners regarding the purchase of a conventional car or AFV are in line with the broadly understood theory of sustainable development, in particular climate action. Often, the owners of microenterprises in their business activities comply with the principles of sustainable development without knowing it and without defining such a behavior [20].

2.2. Factors in Making Decisions by Consumers on the AFV Market

The broadly understood market of products and services related to electromobility is a very rapidly growing segment of the economy on a local and global scale. The potential of this market is noticeable and verifiable by the publication of numerous forecasts concerning its development both in Poland [3,21–25] and in the other countries [26–31]. It is estimated that around 500 million BEVs will be driving on the roads of the world in 2040. Forecasts therefore indicate that every fourth car will be powered by this technology, and the expected sales of such cars are in the order of 40 million in 2040 [26].

Although there are studies examining the attitudes and preferences towards AFV among fleet managers in big enterprises [32–37], no similar research among microenterprises has been found. As microenterprises are usually family businesses, the decision-making process is closer to the one faced by the households rather than large companies. A number of studies have been proposed in the literature on the factors that may affect the purchasing decisions of consumers regarding cars with an alternative drive [10,38–40]. For instance, studies regarding Spanish consumers indicate that emotional issues, product price, vehicle acceleration and low engine noise have a significant impact on consumer attitudes, which in turn has a positive effect on EV purchasing intentions [41]. The same study found that quality and social value did not have a positive effect on consumer attitudes. The Polish Economic Institute in its report indicates several aspects that may be important when deciding to purchase an alternative fuel vehicle [9]. These are both financial, technical and structural factors. These include, among others, government funding for the purchase of an alternative drive car, infrastructure for charging cars while traveling, and operating costs. Importantly, this report also shows a high level of fear of new technology, which is caused by ignorance, lack of information and uncertainty about the economic future.

It seems that despite the existence of incentives to support electromobility, and governments working on such solutions in many others, competition with conventionally powered vehicles is difficult. Consequently, it is expected that the diffusion of cars with an alternative drive other than internal combustion engine will largely depend on subsidies for their purchase or other forms of financial gratification, such as tax reduction [42] or

exemption from parking fees in zero-emissivity zones [43]. Adler et al. [44] examined the purchasing preferences for natural gas and hybrid vehicles (NEVs) in California, CA, USA. It was found that the factors that may have an impact on the purchase of such a car are, among others, tax cuts when purchasing vehicles and non-financial benefits facilitating, for example, driving around urban zones.

Although there are studies which indicate that government subsidies may to some extent stimulate the willingness of consumers to buy electric vehicles, the effect is relatively weak [45]. It also entails the need to introduce stricter CO_2 regulations, which entails costs for the consumer [46] and technical improvements and public investments in infrastructure [47–49]. Ito et al. [50] in their research even states that in the Japanese market consumers are very eager to pay for infrastructure that allows them to freely charge an electric car anywhere. Vehicle charging is an important problem for many consumers, as revealed for example by some studies conducted in China [51].

The energy saving and environmental protection belong to the consumers' motivations to purchase electric vehicles, but at the same time their exact impact on the willingness to pay is ambiguous [52]. Some authors claim that environmental protection and energy savings belong to the main motivation for purchasing electric vehicles [51]. Others indicate that environmental awareness is an important aspect in the decision-making process of purchasing a car by consumers, as much as for example the proposed technological solutions for an electric vehicle or access to the charging stations [13,53,54]. On the other hand, however, there are studies that say that environmental protection matters less to consumers than price and performance [55].

Taking into account the factors influencing the choice of a conventional car [56,57], one could risk a statement that the technical aspects of the car [58,59], and above all its price, will be of key importance for a microentrepreneur wishing to purchase a car with a drive other than an internal combustion engine. Of course, that would be a big simplification. It turns out that the electric car buyer today is a different consumer than the conventional car buyer. The decision of the private consumer is influenced, among others, by such aspects as monthly income, the number of cars already owned by the family, the comfort of the vehicle, but also care for the natural environment. Information and knowledge about electric vehicles also have a significant impact on the purchasing behavior of consumers [60,61]. Consumers seem to prefer to be convinced by objective information, expert opinions, and government policy support, rather than by the feelings of friends and acquaintances—"consumers believe in objective information" [53,62]. Although some experts are convinced that the operation of an electric vehicle can be completely emission-free and climate-neutral [43], close attention should be paid to studies that question whether these green technologies proposed in the automotive industry can actually bring about significant reductions in CO_2 emissions to effectively combat climate change [63,64]. On the other hand, Ajanovic and Haas [11,65], conducting research in nine cities in different countries on the factors influencing greater public interest in electromobility, proves that all benefits, both financial and prestigious, should depend on the form of electricity production that is beneficial for the environment.

To sum up, there are many factors indicated by scientists and researchers from all over the world and in numerous reports that may have an impact on the increased interest in AFV also in Poland. The most frequently mentioned can be combined into three main issues:

- financial incentives—such as, for example, tax advantages, subsidies to buy a car, free parking in urban areas, free charging of the car on the road;
- infrastructure improvement—first of all, investments in the expansion of the network of free car charging places;
- access to information—in particular, attention should be paid to providing the consumer with expert knowledge on alternative drive cars, as well as information providing legal, price and economic predictability to entrepreneurs.

The current literature findings formed the basis for the development of the questionnaire for this study. It contained a number of questions regarding both the technical and functional characteristics of the car, the method of financing, the amount allocated to the purchase of the car or the way of life related to the broadly understood environmental protection.

3. Materials and Methods

The main goal of this article was an attempt to identify factors that may affect the purchase by a microenterprise of a car with a drive other than an internal combustion engine and to isolate the key factor. The main question referred to the hypothetical purchase of a car, where the entrepreneur could choose between a car with an electric, hybrid or plug-in hybrid engine. It should be emphasized that only people interested in buying a car (conventional or AFV) in the next 12 months or those who bought a car in the last six months participated in the study. The questions asked in the telephone interview concerned, among other things, the advantages, benefits and importance of the features that an AFV should stand out. On the basis of the obtained answers, an attempt was made to identify the key factor that may affect the growth of interest in non-diesel cars among micro-entrepreneurs.

The survey questions were developed based on the analysis of previously published research on factors that could affect purchasing decisions regarding cars. They concerned both the preferences of the respondents as to the technical and utility values of the car and personal attitudes towards the broadly understood environmental protection. The studied phenomenon is obviously multidimensional, therefore the statistical research method used for the analysis of data collected was chosen from the methods of statistical multivariate analysis.

For the purposes of this study, exploratory factor analysis with the principal components method was used. The main purpose of using this method was to isolate the most important factors from the set of primary variables. It allowed to reduce a large number of variables (37 elements) to a smaller set (6 factors) that represent the variability of the same factors, i.e., that the random variables in a given group are to some extent dependent on each other.

As a result of its operation, factor analysis determines the matrix of factor loadings a_{ij} for $i \in \{1, \ldots, p\}, j \in \{1, \ldots, m\}$. We interpret these charges in such a way that the weight of the factor is the correlation coefficient between the variable and the factor (1), that is:

$$r_{X_i} = a_{ij} \; for \; i \in \{1, \ldots, p\}, \; j \in \{1, \ldots, m\} \tag{1}$$

where:

- $m < p$,
- a_{ij} for $i \in \{1, \ldots, p\}$—factor loadings describe the contribution of a given variable to individual factors.

The variables with the highest (in absolute values) value of factor loadings for given factors are selected for interpretation. These loads describe the contribution of a given variable to individual factors. Each factor explains some percentage of the variance. The part of the total variance explained by the *j*-th factor is calculated from Equation (2):

$$h_j = \frac{\lambda_j}{\lambda_1 + \ldots + \lambda_m} \times 100\% \tag{2}$$

where:

$$\lambda_j - j - \text{this eigenvalue of the correlation matrix for } j \in \{1, \ldots, m\}$$

The percentage of total variation explained by the first k factors is calculated as follows:

$$H_k = \sum_{j=1}^{m} h_j \qquad (3)$$

4. Results

4.1. Definition and Analysis of Variables

Exactly 181 microentrepreneurs took part in the telephone survey (CATI) conducted in January 2020, of which 164 were qualified for further research using factor analysis. These were the respondents who declared the choice of the type of engine for the hypothetical car from the AFV group that they would like to buy if they had such an opportunity. Figure 2 shows the division of the respondents according to the type of engine of the future car they want to buy (left panel) and the hypothetical purchase of the car with AFV type of engine (right panel).
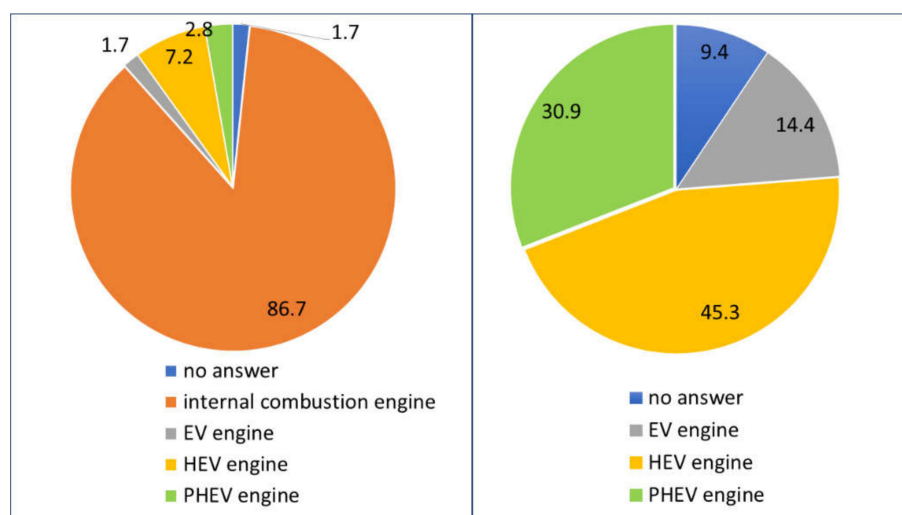

Figure 2. Engine type of the future car (**left** panel); Engine type of the hypothetical purchase of AFV (**right** panel), N = 181.

The questionnaire adopted a 5-point Likert scale, with a choice of answers from 1 (strongly disagree) to 5 (strongly agree). The surveyed microenterprises represent a wide variety of industries and all Polish voivodeships. The exact demographic data of the companies participating in the survey is presented in Table 1.

The vast majority of the owner of the examined microenterprise is a man (72.9%) aged 30 to 50 (61.8%), definitely with higher education (39.8%) or secondary technical education (20.4%). The company's seat is registered throughout Poland, most often in the Lower Silesia (14.9%), Masovian (14.4%) and Greater Poland (11.6%) provinces. Most of them are companies from the S sector of the economy that declare that they conduct other service activities (29.3%) and other service sectors, such as the K sector—financial and insurance activities (8.8%), health care and social assistance (Sector Q—6.6%), but also there is a group of entrepreneurs from sector G—wholesale and retail trade (11.6%). A detailed breakdown of the surveyed micro-enterprises by type of business activity is presented Figure 3.

A large part of micro-entrepreneurs intend to buy a car in the form of leasing (46.4%), only 7.7% declared long-term rental, and almost 44.2% intend to buy a car in cash or with a loan (Figure 4).

Table 1. Demographic and economic variables microenterprises that took part in the study (N = 181).

| Variable		Frequency (%)	
Gender	Male:	132 (72.9%)	
	Female:	49 (27.1%)	
		Female	Male
	20–30 years old:	7 (14.9%)	31 (23.7%)
	31–40 years old:	24 (51.1%)	48 (36.6%)
Age	41–50 years old:	14 (29.8%)	33 (25.2%)
	51–65 years old:	2 (4.3%)	19 (14.5%)
	No answer:	3 (1.7%)	
		Female:	Male:
	Primary School:	0 (0.0%)	1 (0.6%)
	Basic Vocational School:	0 (0.0%)	7 (3.9%)
	Technical College:	2 (1.1%)	37 (20.4%)
Education	Secondary School:	2 (1.1%)	13 (7.2%)
	Post-secondary school:	0 (0.0%)	2 (1.1%)
	Masters Completed:	44 (24.3%)	71 (39.2%)
	PhD Completed:	1 (0.6%)	1 (0.6%)
Technical education	Technical education:	9 (5.5%)	83 (50.3%)
	No answer:	16 (8.8%)	
	Less than 5000 inhabitants:	48 (26.5%)	
	5000–30,000 inh.:	36 (19.9%)	
Place of living	30,000–100,000 inh.:	31 (17.1%)	
	100,000–500,000 inh.:	24 (13.3%)	
	More than 500,000 inh.:	42 (23.2%)	
	0 employees:	65 (35.9%)	
	1 employees:	76 (42.0%)	
	2 employees:	20 (11.0%)	
	3 employees:	5 (2.8%)	
	4 employees:	4 (2.2%)	
Employees number	5 employees:	3 (1.7%)	
	6 employees:	3 (1.7%)	
	7 employees:	2 (1.1%)	
	8 employees:	1 (0.6%)	
	9 employees:	2 (1.1%)	
	1–5 years old:	76 (42.7%)	
	6–10 years old:	51 (28.7%)	
Business years	11–20 years old:	39 (21.9%)	
	21–37 years old:	12 (6.7%)	
	No answer:	3 (1.7%)	
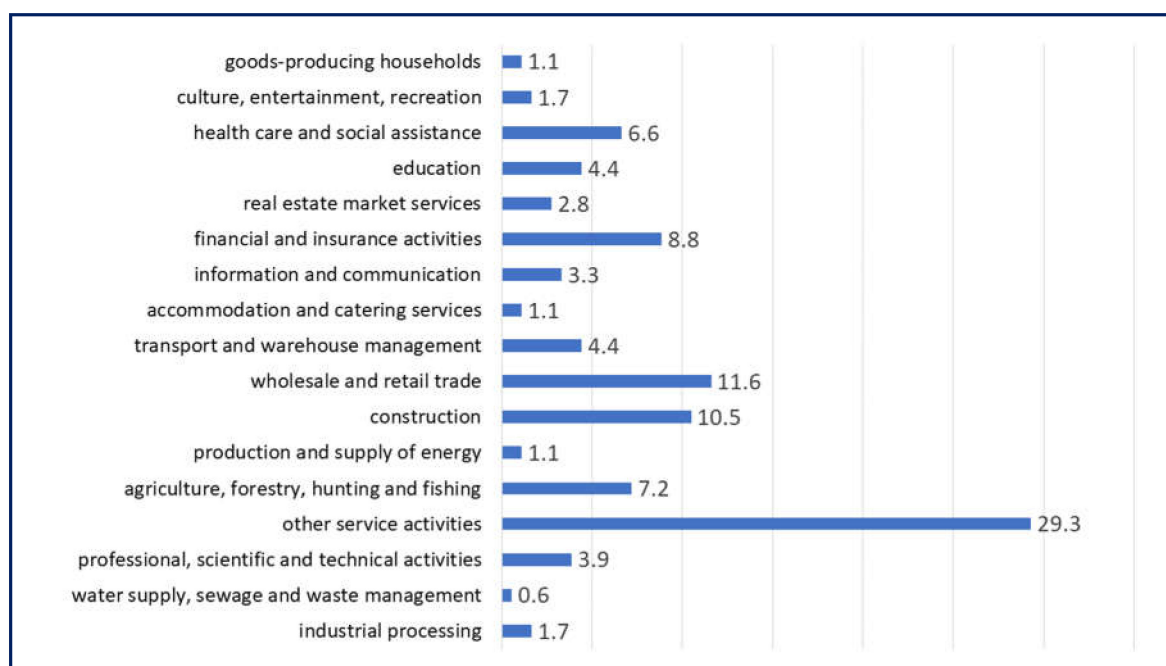
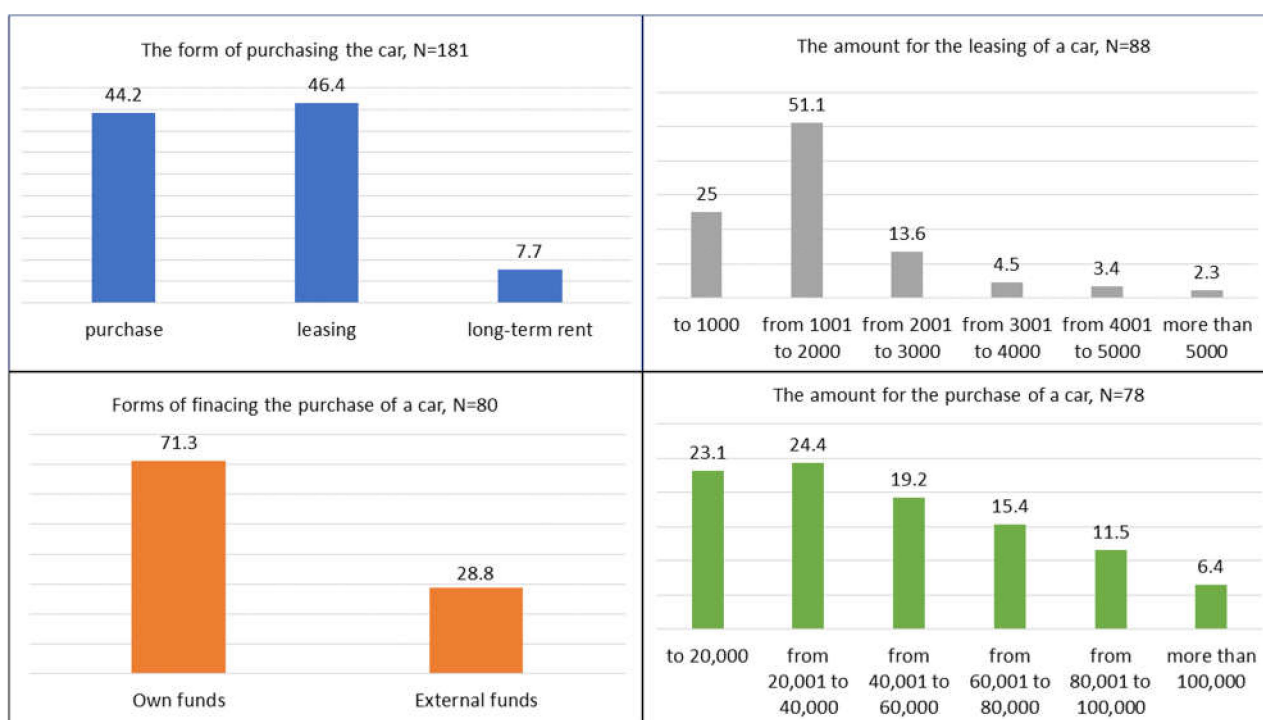**Figure 3.** Enterprises due to the business sector (N = 181, %).

Figure 4. Sources and forms of financing the purchase of a car by microenterprises and the amount for the purchase or leasing of a car (%, PLN).

The lease installment for the purchase of a car ranges from PLN 500 to PLN 6000 (1 PLN = c.a. 0.22 Euro (using the exchange rate on 30 October 2020). Most people want to allocate from 1000 to 2000 for this purpose (51.1%), one fourth of them less than PLN 1000, and only 23.8% more than PLN 2000. The declared amounts that micro-entrepreneurs are willing to spend on the purchase of AFV are very different. Among those who buy for cash, it will cover 71.3% the cost of the car entirely from its own funds, and the rest will support this purchase with a bank loan.

4.2. Initial Selection of Input Variables—Statistical Selection of Variables for Factor Analysis

IBM SPSS Statistics 25 for Windows (PS IMAGAO PRO; Copyright: Predictive Solutions Sp. Z o.o. 2013–2020; IBM Corporation 2000–2019) was used to perform the factor analysis. 37 variables and 164 observations were used in the study. In the first stage, tests were carried out to decide whether the collected data is suitable for the factor analysis. To this end, the following steps were performed: (a) checking the size of the research sample; (b) calculating basic statistics for variables; (c) checking the adequacy of the sample selection; (d) deciding on the number of factors, and (e) substantive and statistical interpretation of the identified factors.

The analyzed variables are of different nature, they are very diverse and constitute a large group consisting of 37 items (Table 2). In order to reject variables with a low differentiating position, the initial procedure of the statistical analysis of variables consisted in calculating basic statistics such as the arithmetic mean and standard deviation and the coefficient of variation for each item of the research tool.

Table 2. Description and basic statistics of variables.

Code	Variable	Mean	Std. Deviation	Coefficient of Variation
X46	The source of information about BEV: Mass media	0.88	0.767	0.872
X47	The source of information about BEV: Observations from the daily life (e.g., in the street)	0.96	0.769	0.801
X48	The source of information about BEV: Conversation with BEV owner	1.40	0.772	0.551
X49	The source of information about BEV: Conversation with BEV dealer	1.50	0.779	0.519
X50	The source of information about BEV: Driving a BEV	1.34	0.763	0.569
X51	The source of information about BEV: Looking for information about BEV	1.52	0.787	0.518
X52	Being a BEV owner	1.62	0.770	0.475
X113	The price of the car	4.22	1.028	0.244
X114	The brand of the car	3.55	1.254	0.353
X115	The range of a car	4.49	0.898	0.200
X116	Access to the service	4.25	1.059	0.249
X117	Access to the charging stations	4.54	0.904	0.199
X118	The car segment	4.08	1.067	0.262
X119	The functional values	4.20	0.951	0.227
X120	The safety	4.52	0.764	0.169
X121	The type of fuel	3.88	1.177	0.303
X122	Reusage of batteries	3.67	1.321	0.360
X123	The impact of weather on batteries	4.06	1.136	0.280
X138	Free parking space	3.96	1.312	0.332
X139	Usage of bus lanes	3.93	1.312	0.334
X140	Usage of zero-emissions lanes	4.01	1.220	0.304
X141	Tax release	4.63	0.817	0.177
X142	The subsidy	4.71	0.778	0.165
X143	Development of charging stations	4.47	0.813	0.182
X144	The longer guarantee	4.48	0.847	0.189

Table 2. *Cont*.

Code	Variable	Mean	Std. Deviation	Coefficient of Variation
X145	Low noise level	3.99	1.234	0.309
X146	Less service needed	4.01	1.115	0.278
X147	Social prestige	2.40	1.237	0.515
X148	Zero-emission of a car	4.15	1.185	0.286
X149	Environmental behavior: Waste segregation	4.64	0.745	0.161
X150	Environmental behavior: Using multiple-usage bags	4.32	1.109	0.257
X151	Environmental behavior: Turning off the light	4.42	0.961	0.217
X152	Environmental behavior: Financial support of environmental protection organizations	1.65	1.210	0.735
X153	Environmental behavior: Lowering usage of water	4.06	1.089	0.269
X154	Environmental attitude: Being glad if climate plays role in politics	3.81	1.370	0.359
X155	Environmental attitude: Being ready to pay higher taxes	2.99	1.432	0.478
X156	Environmental attitude: Believing that everybody has an impact on environment protection	4.69	0.771	0.165

It was assumed that the position elimination threshold will be determined by the standard deviation value lower than 0.7. In most cases, the standard deviation value was greater than or close to 1. The obtained values also showed the fulfillment of the critical value recommended in the statistics for the coefficient of variation (greater than 0.1 or 0.15) for all the studied variables. Before applying the factor analysis procedure, all variables were standardized. In the next step, the Kaiser-Meyer-Olkin test (KMO) was calculated, which expresses the ratio of the correlation of variables to their partial correlations and is an indicator of the adequacy of the sample selection. The value of this statistic is 0.658 and it is satisfactory in the context of further analysis. The last stage was the Bartlett's Test of Sphericity, which also proved to be statistically significant (Table 3).

Table 3. Kaiser-Meyer-Olkin and Bartlett's Test.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.780
Bartlett's Test of Sphericity	Approx. Chi-Square	2746.914
	df	630
	Significance	0.000

The obtained results confirm the belief that the data collected during the study enable factor analysis to be carried out. The strength of the factor loadings for individual tool items was checked, and items with a factor load of less than 0.3 (one item—X113 Price) were removed from further analysis. There are 36 items left in the research tool. Then a decision had to be made on the number of factors that could be distinguished. It should be remembered that the successive factors identified explain less and less variability. In order to determine the factor structure of the studied phenomenon, the Kaiser criterion was used, which determines the number of factors based on eigenvalues exceeding 1. In

the analysis, it turned out that the eigenvalue was greater than one for 11 components, which together accounted for 69.157% of the total variance. As the number of factors distinguished according to the Kaiser criterion was too large in relation to the number of items (11 to 36), the Cattel criterion was used to determine the number of factors. Based on the Scree plot (Figure 5) it was found that six factors should be distinguished. The six-factor solution causes that a total of 52.596% of the total variation is explained and, after analysis, it is characterized by the greatest logical consistency.
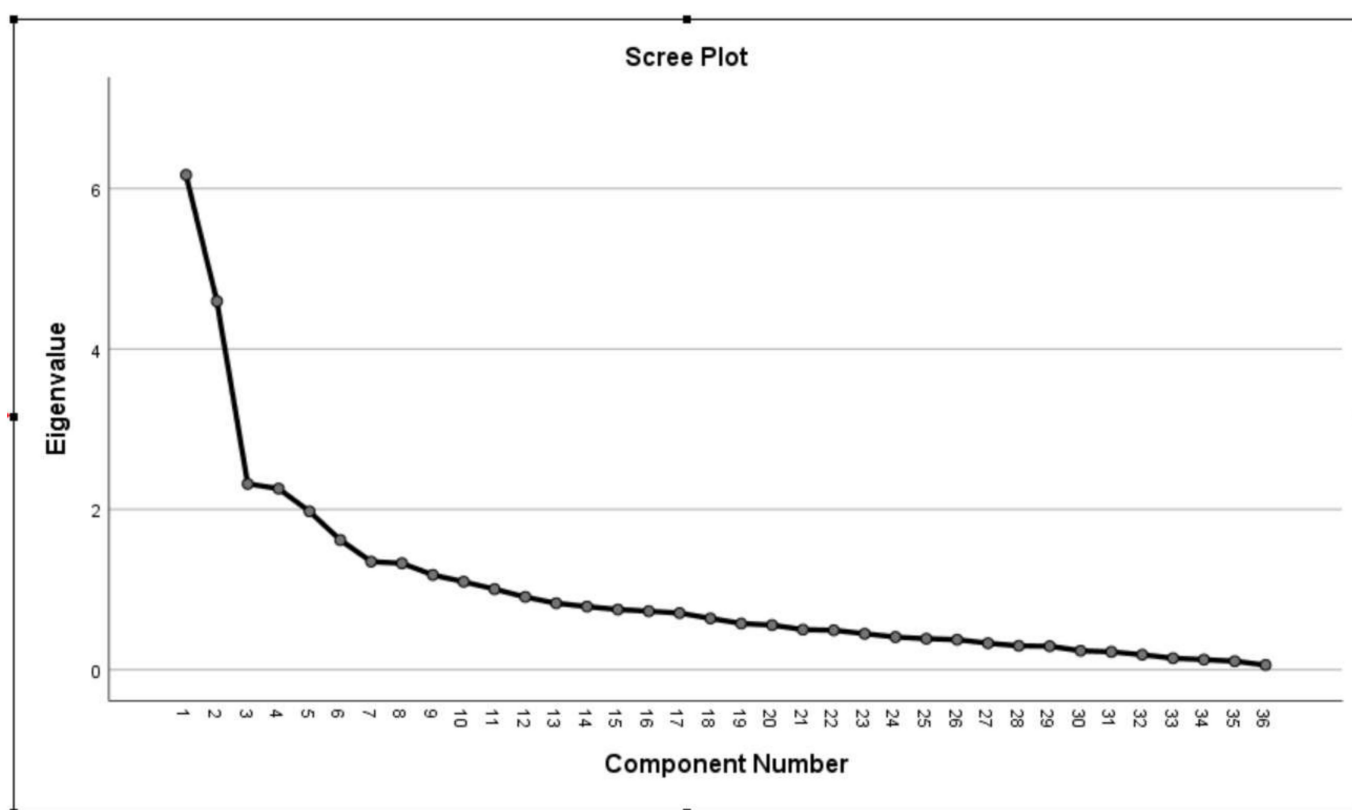

Figure 5. Factors distinguished on the basis of the Scree plot.

4.3. Identification of Factors

In order to identify the variables constituting individual factors, factor rotations were used. It involves rotating the coordinate system containing the data in such a way that the factors are easier to interpret. The factor rotation procedure maximizes the matching of individual questions of the identified factors. The Promax method was used for the rotation of factors, as it is a diagonal rotation and allows the correlation of factors. Table 4 shows the Promax rotation factor loadings for all 36 items. These are the correlation coefficients between a given statement and the factor that is represented by that statement.

As a result of the applied procedures, six empirical factors were distinguished along with the variables that define them (Table 5). In the vast majority of cases, each variable is highly correlated with only one factor. An exception may be the variable X120, which is highly correlated with the third and fifth factors. Its affiliation with the third factor has been established on the basis of substantive premises due to the information it contains.

There are seven items within the first factor. They all constitute a compact logical structure, named **the source of information**. This factor contains a set of sources from which respondents most often obtain information about electric cars. Their factor loadings have very high values (from 0.954 to 0.849), which proves their very good correlation. Therefore, one may be tempted to say that the key factor that may affect the process of purchasing an alternative drive car by a microentrepreneur is the information he has

obtained on this subject and his knowledge in this field. The collected data show that the vast majority of respondents (76.8%) obtain information from social media, from their own observations in the street or from people who own such cars (67.7%), and to a much lesser extent because they have driven such a car and have experience (30.5%). Unfortunately, only 2.4% of them own an electric car and therefore have knowledge and experience in this field (Figure 6).

Table 4. Rotated Structure Matrix after Promax.

Variable	Components					
	1	2	3	4	5	6
X52	**0.954**					
X49	**0.923**					
X51	**0.914**					
X48	**0.908**					
X50	**0.905**					
X46	**0.886**					
X47	**0.849**					
X142		**0.713**	0.389			
X143		**0.696**	0.362		0.386	
X141		**0.692**	0.305			
X140		**0.672**				
X144		**0.668**	0.426			
X139		**0.654**				
X138		**0.636**				
X114		**0.346**				0.329
X153			**0.593**			
X120			**0.591**		0.538	
X151			**0.563**			
X148		0.374	**0.562**	0.423		
X145		0.373	**0.537**			
X147		0.415	**0.518**			
X146		0.368	**0.447**			−0.311
X155				**0.751**		
X154			0.328	**0.649**		
X149				**0.570**		
X152				**0.471**		
X150				**0.378**		
X156				**0.344**		
X123					**0.757**	
X122					**0.709**	
X116			0.375		**0.624**	
X117		0.317			**0.490**	
X119						**0.697**

Table 4. *Cont.*

Variable	Components					
	1	2	3	4	5	6
X115					0.369	**0.548**
X118						**0.519**
X121						**0.491**

6 components extracted. Rotation converged in 11 iterations.

The second factor originally contained 8 variables, finally one variable (X114—The brand) was transferred to the sixth factor because its content more closely corresponded to the substantive content of this factor (the factor load also allowed it, because for the sixth factor for this variable it was 0.329 and for the second factor 0.346, the level of correlation was similar). The second factor was called **the expected benefits** as it entirely includes a set of benefits expected by a potential buyer of an alternative drive car. Financial benefits are of great importance, including subsidies granted by the government for the purchase of an electric car (82.9%), tax reduction (75.6%), free repair of possible damage to the car (longer warranty—64%) or free use of parking spaces—50% (Figure 7).
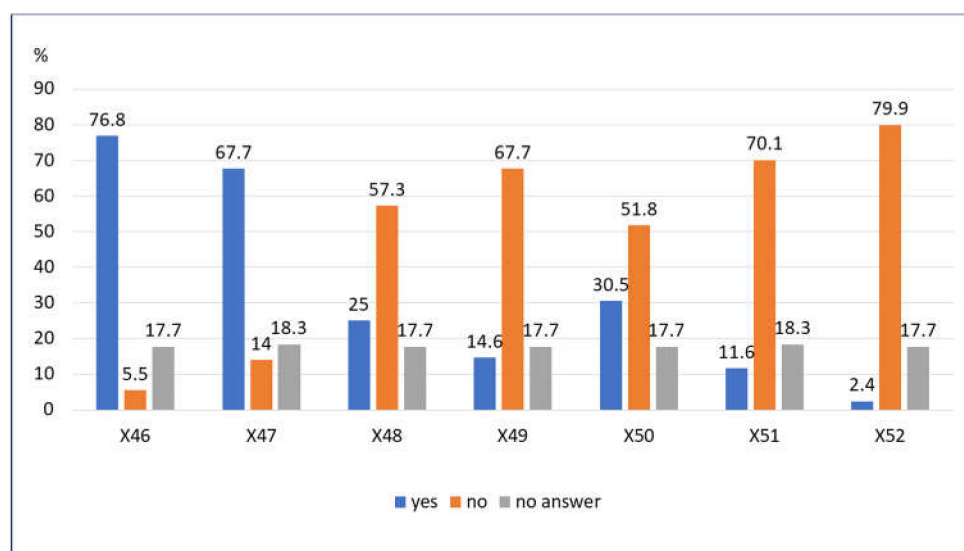

Figure 6. Sources of information about electric cars by the respondents (N = 164).

The third factor reflects well the advantages of having a car with an electric drive (variable: X145—low noise level, X146—less service needed, X147—social prestige and X148—zero-emission). This trend is perfectly matched by the financial benefits of saving water (X151—Do you turn off the light?) and electricity (X153—Do you lower usage of water?) in the daily operation of the company. The relationship between these two variables is presented in the cross table (Table 6). It shows that people who save water also always turn off the light when it is not needed (often—14%, always—39%). The whole thing consists of seven variables that form one substantively coherent factor, which can be called **the advantages**.

Table 5. Factors and variables included in the factors.

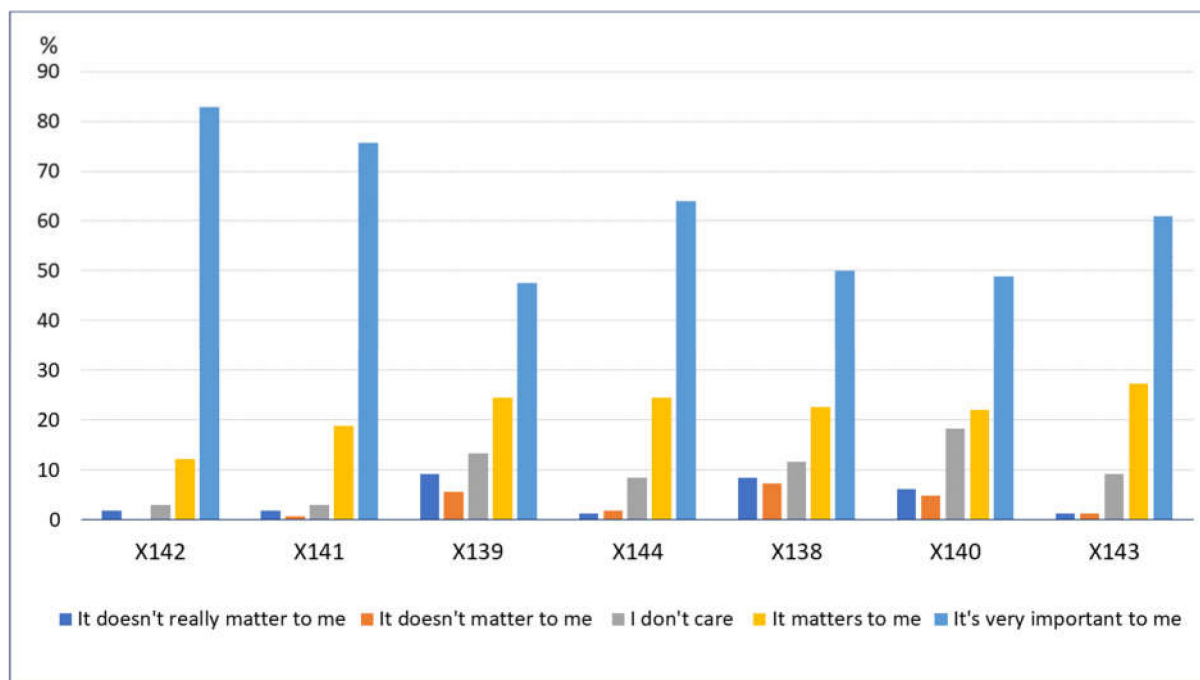| Variable Code	Factors and Variables	Factor Loading
	Factor 1. The source of information	
X52	Being a BEV owner	0.954
X49	The source of information about BEV: Conversation with BEV dealer	0.923
X51	The source of information about BEV: Looking for information about BEV	0.914
X48	The source of information about BEV: Conversation with BEV owner	0.908
X50	The source of information about BEV: Driving a BEV	0.905
X46	The source of information about BEV: Mass media	0.886
X47	The source of information about BEV: Observations from the daily life (e.g., in the street)	0.849
	Factor 2. The expected benefits	
X142	The subsidy	0.713
X143	Development of the charging stations	0.696
X141	Tax release	0.692
X140	Usage of zero-emissions lanes	0.672
X144	The longer guarantee	0.668
X139	Usage of bus lanes	0.654
X138	Free parking space	0.636
	Factor 3. The advantages	
X153	Environmental behavior: Lowering usage of water	0.593
X120	The safety	0.591
X151	Environmental behavior: Turning off the light	0.563
X148	Zero-emission of a car	0.562
X145	Low noise level	0.537
X147	Social prestige	0.518
X146	Less service needed	0.447
	Factor 4. Attitudes towards environmental protection	
X155	Environmental attitude: Being ready to pay higher taxes	0.751
X154	Environmental attitude: Being glad if climate plays role in politics	0.649
X149	Environmental behavior: Waste segregation	0.570
X152	Environmental behavior: Financial support of environmental protection organizations	0.471
X150	Environmental behavior: Using multiple-usage bags	0.378
X156	Environmental attitude: Believing that everybody has an impact on environment protection	0.344
	Factor 5. Weaknesses of BEV	
X123	The impact of weather on batteries	0.757
X122	Reusage of batteries	0.709
X116	Access to the service	0.624
X117	Access to the charging stations	0.490
	Factor 6. The importance of the usage value	
X119	The functional values	0.697
X115	The range	0.548
X118	The car segment	0.519
X121	The type of fuel	0.491
X114	The brand of a car	0.329

Figure 7. Importance of the benefits associated with an electric drive for microentrepreneur (N = 164).

Table 6. Relationship between light off (X151) and turning off water (X153) (N = 164, %).

X151 * X153 Crosstabulation							
		X153—Do You Lower Usage of Water?					Total
		1—Never	**2—Rarely**	**3—Occasionally**	**4—Often**	**5—Always**	
X151—Do you turning off the light?	1—never	0	0.6	1.2	0	0	1.8
	2—rarely	0.6	1.2	0.6	2.4	0	4.9
	3—occasionally	0.6	1.2	3	3.7	1.2	9.8
	4—often	0.6	1.2	6.1	7.9	3	18.9
	5—always	1.2	2.4	7.9	14	39	64.6
Total		3	6.7	18.9	28	43.3	100

The next fourth factor, was defined by six variables. When analyzing the items included in its composition, it can be assumed that the dimension undoubtedly distinguished on the basis of the results of factor analysis determines the broadly understood activities for environmental protection. This factor can undoubtedly be called **the attitudes towards environmental protection**. It should be noted that respondents are willing to pay more taxes in return for caring for the environment (X155 and X154). They also believe that everyone can do something good to protect the environment, such as segregating rubbish or using reusable bags. The fifth factor consists of four items expressing concerns related to possible technical problems that may arise from owning an electric or hybrid car. These are the variables that clearly suggest the respondents' interest in the technical aspect closely related to the use of alternative drive cars, i.e., the use of batteries (X122, X123), the related need for servicing (X116) and access to charging stations (X117). The factor was named **the weaknesses of BEVs**. The last, sixth factor originally consisted of four variables (X115, X118, X119, and X121), but finally the variable X114 was added to it, which corresponds very well with the other variables. The factor indicates the importance for the respondent

of the technical and utility values of the potentially purchased car. These primarily include the entire segment and make of the car (X118 and X114), its functional values (X119) and the range of the vehicle with alternative drive (X115) and of course the associated engine type (X121). The factor was named **the importance of the usage value of the car**.

The study examined the preferences of the respondents as to the brand of an alternative drive car, which they would like to have the most and the least (Figure 8). The most popular brands are Tesla (53.8%—I would love to have, 16.1%—I would like to have), Lexus (47.3% and 28.0%) and Volvo (44.1% and 32.3%). The respondents were least interested in brands such as Renault (2.2%—I would love to have, 8.6%—I would like to have and 36.6%—I would not like at all, 28.0%—I would not like), Peugeot (4.3%, 21.5% and 33.3%, 24.7%) and Kia (2.2%, 18.3% and 30.1%, 21.5%, respectively).
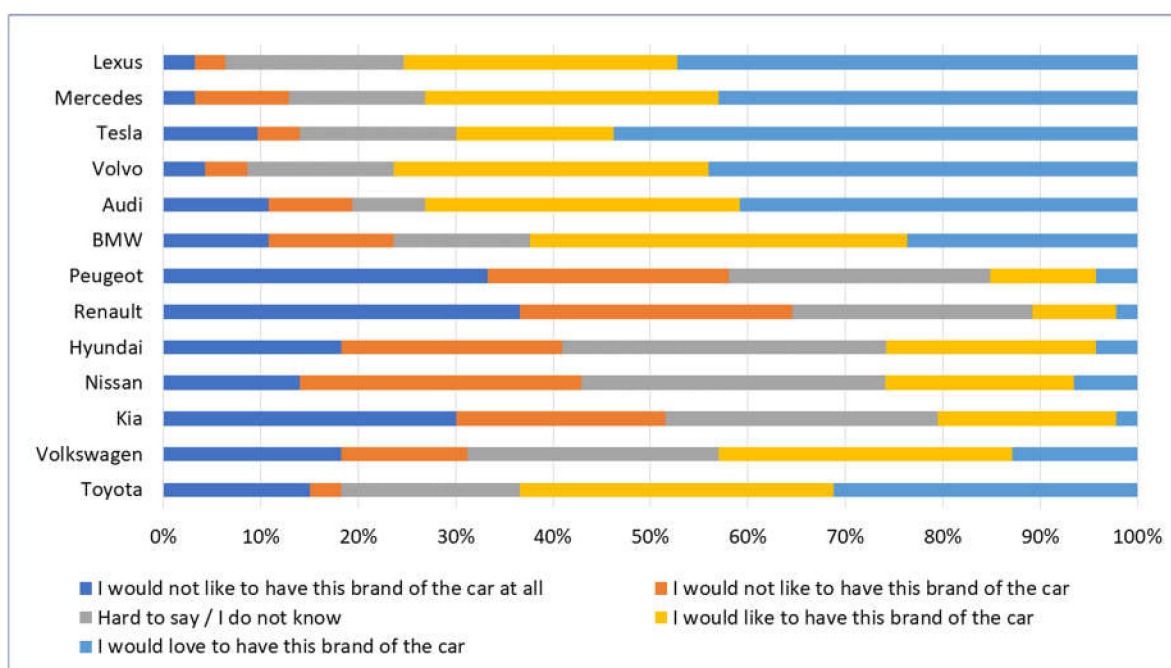

Figure 8. Assessment of the importance of the respondents' preferences as to the brand of potentially purchased AFV (N = 164).

4.4. Statistical Interpretation of the Factors

In order to determine the level of reliability of each distinguished group of variables, which, by definition, were to answer the same issue, the Cronbach's Alpha statistic was calculated. This allowed to find out whether the variables reliably measure what was intended by a given group. A high value of the reliability coefficient (close to 1) means a very high consistency of items included in a given group of questions.

The obtained results (Table 7) clearly indicate a very high reliability for the first factor (α = 0.964) and the second factor (α = 0.823). The high level of internal consistency of the dimension is also indicated by the Alpha value for the third, fifth and fourth factors (α = 0.668, 0.623 and 0.595, respectively). This means that the answers are very similar. The sixth factor (α = 0.570) indicates a good, sufficient level of internal consistency of the dimension. The factor correlation matrix (Table 8) indicates no correlation between the identified factors. Only the relationship between the second and third factors is characterized by a higher correlation coefficient (0.336). However, it is so low that there is no correlation between them. The decision to use Promax rotation was correct. The remaining coefficients are very low, which suggests no correlation between the factors.

Table 7. Cronbach's alpha coefficient for individual factors.

Factor	1	2	3	4	5	6
Cronbach's alpha coefficient	964	823	668	595	623	570

Table 8. Factor correlation matrix.

Component Correlation Matrix						
Component	1	2	3	4	5	6
1	1.000	−0.070	−0.059	−0.050	−0.065	0.011
2	−0.070	1.000	0.336	0.053	0.249	−0.020
3	−0.059	0.336	1.000	0.078	0.279	−0.019
4	−0.050	0.053	0.078	1.000	−0.002	−0.082
5	−0.065	0.249	0.279	−0.002	1.000	0.021
6	0.011	−0.020	−0.019	−0.082	0.021	1.000

Factors are theoretical variables that are represented by a certain number of items in the survey questionnaire. In order to measure them, it is not possible to rely on a single observation, nor can individual test items of the survey be analyzed separately. Indicators averaging the responses of all respondents for items representing a given factor for their normalized values were used (Table 9), which facilitates the interpretation and comparison of factors among themselves.

Table 9. Descriptive statistics for all six factors (standardized variables, N = 164).

Descriptive Statistics	Factors					
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Minimum	−2.17	−5.79	−3.88	−3.56	−3.71	−4.83
Maximum	1.17	1.32	1.85	2.14	1.62	2.68
Range	3.35	7.11	5.73	5.70	5.34	7.51
Mean	0.0	0.0	0.0	0.0	0.0	0.0
Std. Deviation	1.0	1.0	1.0	1.0	1.0	1.0
Variance	1.0	1.0	1.0	1.0	1.0	1.0
Skewness	−1.39	−2.46	−1.04	−0.36	−1.12	−0.96
Kurtosis	0.41	10.25	1.83	0.67	1.48	3.59

The calculated characteristics for the averaged Factor 1: The source of information indicated that its values are in the range from −2.17 to 1.17 (range 3.35), and the value of the skewness coefficient is −1.39, therefore the distribution is left-skewed, which results in a greater concentration of results within high values and their deficiency within low values. A positive, but low value of the kurtosis index indicates a slightly slender distribution in relation to the normal distribution. The Kolmogorov-Smirnov test (K-S, Table 10) used also confirms that there is a statistically significant deviation from normality (statistic K-S = 0.250, $p = 0.000$).

Table 10. Tests of Normality Kolmogorov-Smirnov for all factors.

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Statistic	0.250	0.119	0.068	0.057	0.111	0.094
Significance p	0.000	0.000	0.062	0.200	0.000	0.001

The values for Factor 2: the benefits, behave similarly. The values of the variable range from −5.79 to 1.32, which indicates a large left-skewed, which is confirmed by a large skewness coefficient (−2.46). At the same time, the variable creates a very slender graph (kurtosis = 10.25). The result is a very high concentration of results within the high values and their large dispersion within the low values. The K-S test confirms the lack of a normal distribution for this variable (statistic K-S = 0.119, p = 0.000). The p-factors for the K-S test of the next two factors (Factor 3: the advantages and Factor 4: the attitudes towards environmental protection) do not indicate statistical significance for the deviation from the normal distribution (for Factor 3 = 0.062 and for Factor 4 = 0.2). Both factors are left-skewed with an accumulation of large values and a deficiency of small values. A small, positive factor kurtosis of Factor 4 suggests its slight slimming in relation to the normal distribution. The values of the factor variable Factor 4 are the most symmetrically distributed of all factors. For Factor 6, the range of variability is the highest (range = 7.51), it also has a fairly large kurtosis (3.59), which proves its slimming in relation to the normal distribution and with a skewness of −0.96, the accumulation of higher values (likewise/similarly Factor 5).

4.5. The Impact of the COVID-19 Pandemic on the Purchasing Decisions of the Surveyed Microentrepreneurs

In April 2020, the surveyed entrepreneurs were asked again about the choice of the engine with which they would buy the hypothetical alternatively powered car after the outbreak of the SARS-CoV-2 coronavirus pandemic. At the same time, they were asked if, and if so how, this situation influenced the decision to purchase the car for the company's needs. The answer was received from 92 micro-entrepreneurs who took part in the telephone survey before the pandemic. Before answering the survey questions, the respondents were asked to read the technical information prepared for them about cars with alternative fueling (BEV, HEV, PHEV) engines. This was to broaden their knowledge on the subject.

Figure 9 presents the percentage of people who declared the hypothetical willingness to buy an AFV (BEV, HEV or PHEV) after the pandemic outbreak. In particular, in the case of BEVs the percentage of interested consumers reduced from 14.4% before the pandemic to 13% during a pandemic, and after reading the prepared technical information. In case of HEVs the percentage of people who declared their willingness to buy a hybrid car decreased from 45.3% before the pandemic to 39.1% during the pandemic. In the case of PHEVs the number of people who would be willing to buy increased significantly from 30.9% before the pandemic to 47.8% during the pandemic and after reading the technical information. In this case the impact of information might have led to the increase of respondents' interest.
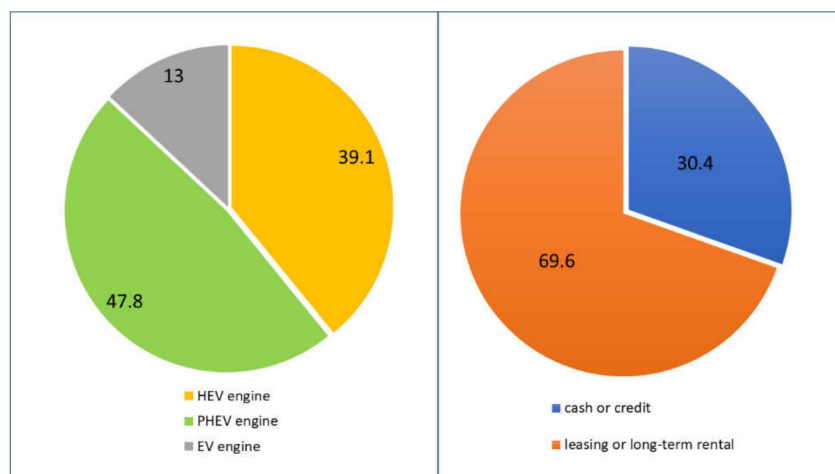

Figure 9. Declaration of individual respondents regarding the purchase of an alternative drive the hypothetical car and its financing during the COVID-19 pandemic (N = 92).

The outbreak of the pandemic influenced the purchasing decisions of microenterprises. Over 50% of them declared that it influenced their decision to purchase the car (27.2%—definitely disagree, 25%—I don't agree). More than 50% of the respondents did not give up the purchase of a new car (26.1%—definitely disagree, 26.1%—don't agree). Interestingly, as many as 27% of them did not have an opinion on this matter, perhaps it was caused by the early stage of the pandemic and little information about its possible course. Almost 55% of the respondents declared that they withhold the purchase of a car for some time (54.4%), but every third of them did not postpone such a decision (32.6%) (Figure 10).
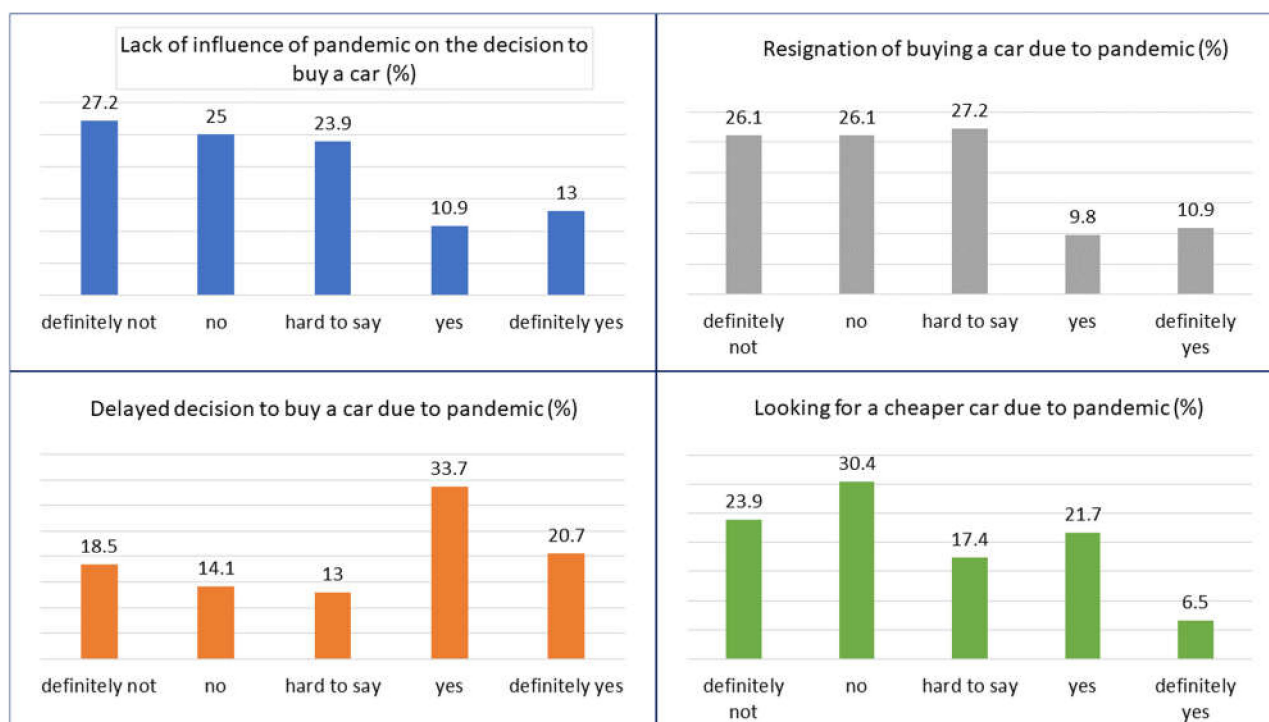

Figure 10. The impact of the COVID-19 pandemic on the decisions of micro-entrepreneurs to buy a car (N = 92).

At the same time, the pandemic did not cause a reduction in the amounts allocated by entrepreneurs for the purchase of this car (54.3%—did not change the allocated amount), only 6.5% of them declared that they would definitely buy a cheaper car (Figure 10). The respondents emphasized the uncertainty related to the lack of knowledge and information about how the pandemic would develop and what would later affect their business.

5. Discussion and Conclusions

The issues of environmental entrepreneurship and sustainable development contribute to the formation of a strengthened pro-ecological attitudes at the level of enterprises. In many companies, sustainable development is seen as a source of new entrepreneurial opportunities to solve social and environmental problems. Entrepreneurs promote changes in the economic and business environment through innovation and thus are ahead of the old ways of operating.

Road transport has a negative impact on the cleanliness of the natural environment, and thus on human health and life. Electromobility is one of the solutions that fit in with the logic of sustainable development. Its purpose is to reduce the nuisance of transport. It assumes the reduction of pollution through the implementation of zero-emission vehicles. Such a solution can improve the quality of life of people, especially in highly urbanized areas, where the demand for services related to the transport of people and goods is particularly large and the related car traffic is increased. However, it should be remembered that environmental pollution caused by the development of the automotive industry is not

only influenced by exhaust emissions. The problem is much more complex, and the entire process of environmental pollution begins with the production of energy in the power plant. Electric vehicles can be environmentally friendly, provided that sustainable and renewable energy sources and ecological methods of producing energy in power plants are used [66]. Then we can assume that the operation of an electric vehicle can be completely emission-free and climate-neutral. However, as long as energy production continues from non-renewable sources, electric cars will not be fully pro-environmental solution.

The disposal of used car batteries is another huge problem. In fact, so far there are no convenient methods to recycle the main component of batteries (lithium), and the recycling cost is higher than the extraction cost. As a result, lithium usually remains in landfills. Secondly, the battery components such as lithium, cobalt, manganese are extracted in developing countries where the conditions of the work do not often meet the ethical and socially acceptable principles.

Identification of the key factors that may affect the consumer's decisions regarding the purchase of an electric vehicle is a necessary link in the electromobility process. It is not only applicable to popularizing electric cars and finding a way to increase their sales. It also serves as the theoretical basis and reference point for the design and development of the vehicles themselves and the space in which we live, so that it better suits our needs. Therefore, both governmental decision makers and relevant manufacturers, in order to develop the economy in accordance with the principles of sustainable development, must consider intensifying information campaigns on alternative fuel vehicles. Achieving the goal of sustainable development regarding climate action must be supported by microenterprises, as they constitute the majority of the economy of both Poland and the European Union.

5.1. Contribution/Main Findings

This paper combines two essential and interrelated aspects: Sustainable development of transportation by the increase of usage of alternative fuel vehicles (AFVs) and the role of microenterprises in the further increase of the AFV market share. Poland is a country where the market share of AFVs is still very small, but keeps increasing. According to the market analysis and reports, the further attempts to raise the AFV presence on the market, needs engagement of the companies, both large, medium and small. In our survey we limit ourselves to the analysis of the points of view of the smallest firms, usually run as family businesses. Their process of decision making is similar to the one done by the households, but still not identical.

Hence, the novelty of the paper refers to analysis of the AFV market from the point of view of microenterprises, which is not common. Most of the studies examine preferences and attitudes towards AFVs of either households or large companies and fleet managers. Moreover the empirical data presented in this paper come from Central European country, representing the market that differs a lot from Western European or American markets which are usually being explored in the empirical analysis. This market differs mainly due to the lower purchasing power of the potential buyers, lower deployment of the system of charging stations and limited experience and exposure to AFVs of the citizenry.

The conducted study was aimed at identifying and analyzing factors that may affect the decision made by a microentrepreneur to purchase an electric or a hybrid car. The study showed that the most important factor is the information itself about the alternatives that the client has and the substantive knowledge about them. The benefits of having such a car and advantages such as safety, quiet driving and fewer service visits are key advantages and are also important factors. The statistical result and the substantive research confirmed that it is acceptable to use the obtained results of the analysis on the key factors of the decision-making process that were identified in this study. The respondents were looking for knowledge and information as they want to know both the strengths and weaknesses of each solution. Most of respondents are aware of the dangers of air pollution. They are quite committed to environmental protection through their everyday behavior (such as waste segregation or the use of reusable bags). They would like to enjoy both the financial

advantages of having an electric car (subsidies, lower taxes) and non-financial advantages (e.g., free parking). At the same time, they are aware of the shortcomings of such a solution in the form of, for example, poor charging infrastructure.

It is a mistake to assume that every consumer is fully aware of the alternatives and can make a rational choice. Even more far-reaching research shows that people should not only be informed about the available alternatives, but should even be guided through the entire decision-making process so that they make the choice that is most appropriate for them. As emphasized by King [56] the information should be passed on to the client, rather than assuming he can find it himself. It seems that access to information and, consequently, an increase in knowledge and awareness of microentrepreneurs about an alternative to an internal combustion engine, will be a key factor in increasing interest in electric or hybrid cars. In a comprehensive review of research on transport and climate change, Schwanen et al. write: *"There is a strong emphasis on mitigation through technology, economic instruments and infrastructure, and less on reconfiguring travellers' psyche through information campaigns and social marketing. It should be considered whether the lack of knowledge and scant information provided to consumers about the effects of the development of electromobility mean that drivers who buy a new car pay limited attention to environmental problems"* [67]. The implementation of ecological technologies only in the very centre of the automotive industry raises reasonable doubts whether the principles of sustainable development will be met in this way. Without dialogue with the consumer, will it be possible to significantly reduce CO_2 emissions, needed to counteract climate change?

5.2. Limitations of the Study

As with all studies, these also have their limitations and imperfections. First, the research could be repeated on a larger sample of microenterprises. Although looking at the demographic cross-section presented by the sample in this study, it reflects well the population on which we draw conclusions, and therefore it can represent it sufficiently. Secondly, the research can of course be extended to appropriate target groups, e.g., due to the industry or the way the car is used dependent on its the function and profession. Theoretically, it can be assumed that the needs and expectations will be different for example for the sales representative, hairdresser or company president.

5.3. Future Research

Research on the same subject, but on the other side of the process, i.e., car manufacturers, may turn out to be a very interesting research topic, which has already been planned for the coming months. Do they also perceive the key factors that could be followed by micro-entrepreneurs when choosing a car with a drive other than internal combustion in the same way? In this context, the opinions of representatives of car manufacturers on the adaptation of their offer of alternative fuel vehicles to micro-entrepreneurs may also be interesting. On the other hand, it is also worth asking microentrepreneurs about the context of environmental protection in accordance with the principles of sustainable development in a broader aspect, not only in the automotive industry, from the point of view of the conducted activity. It would also be worth asking about the advantages and disadvantages of having an AFV to those microentrepreneurs who already use such a car.

Abbreviations

SME	small and medium enterprises
AFV	alternative fuel vehicles
BEV	battery electric vehicles
PHEV	plug-in hybrid vehicles
HEV	hybrid electric vehicles

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