

Hungarian Battery Production – Public Opinion on Sustainability, Labor Market and the Environmental Protection

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Transportation in the 20th century was linked to hydrocarbons. The first steps of the transition to electric propulsion are currently underway. Technical experts are still debating whether this is the ideal solution while producing the batteries required for the method has begun. One of the main areas of high-speed industrialization is Hungary. The government's intention is clear, primarily to increase GDP and create jobs. The population knows that jobs can only be filled by foreign, immigrant workers and is extremely worried about possible accidents during production and destruction. The research aims to explore the opinions in detail and examine the possibilities of approximating different positions. This quantitative study found that the respondents would like to live at an unrealistically large distance from such facilities. Many people want the battery factories to be banned or the investments to be stopped, and the fact that very few people are informed from the literature plays a significant role. The greatest fear is experienced among the middle-aged, and we justify our findings with social facts and negative events. In order to resolve the tensions, it is recommended to educate the masses on the one hand, and on the other hand, stricter control, and more significant sanctions. These methods ensure that negotiations between the population, civil organizations, and companies end with a compromise created by a debate supported by arguments in civilized conditions.

1. Introduction

Economic Geography is a subject taught in higher education. The study aims to determine whether future students will learn about Hungary and the fact that our country is one of the leading producers of batteries for electric cars. The research examined its effects on the country's GDP and the environment if all this happens. The compelling reason for the transition to electric cars and vehicles is the depletion of fuels. The switch would really make sense if the emission of harmful substances decreased. Currently, the battery assembly process is the reason why we cannot reach the set goal. In the case of electric vehicles, technological developments are necessary. However, all technical and economic experts see that once these are implemented, they will be more environmentally friendly than internal combustion engines (Vitta, 2021). Based on current research, it can be stated that the emission of greenhouse gases can be reduced by 59 – 70 % due to the use of electric vehicles. The more favorable value occurs if the charging of the special batteries does not occur during the electrical network's peak load (Fan et al., 2022). Such an advantage accumulated during the battery's useful life cannot be nullified by the higher water and energy consumption necessary during production, reuse, or destruction. The legitimate requirement for battery production is to protect employees' health and prevent contamination from entering residential areas. If they meet these requirements, definite advantages can be demonstrated. Internal combustion engines release nitrogen, carbon, and sulfur dioxide compounds into the air. These endanger human health and even life and lead to the formation of acid rain (Palkowski, 2016). The location of battery manufacturing is of great importance. It is necessary to have domestic or settled labor available and to be located in an area that is not environmentally sensitive. In the case of already built polluting factories, there is also the possibility of relocation. In such cases, the direct benefit remains below the costs; however, the indirect effects tip the balance (Lavee, 2012).

In 2016, 44 % of the employees in Hungary worked in a position threatened by the development of digital technologies. Likely, battery production will soon follow the robotization goals in order to protect human health, and then humans no longer have to worry so much about the health of the workers (Illéssy et al., 2021). If foreign workers from developing countries are employed in the investigated factories, it represents a backup option for times of crisis from the point of view of the domestic workforce. Currently, the majority of employees have a choice, but during a crisis, all opportunities must be seized in the hope of income. Typically, unemployment and a labor shortage are both features of our region simultaneously. The latest trends predict an increase in the number of foreign workers. In addition to the general examination, differences within the country must also be paid attention. It can be compared to the plans for the installation of battery factories.

The environmental protection goals of the European Union are to reduce harmful emissions by 62 % and to comply with the "polluter pays" principle. This is an emission trading system in which the pollutant units have both bid and auction prices. All proceeds from auction sales are to be used for activities related to environmental protection (Pölös, 2022).

Many foreign researchers have dealt with the problem under investigation. According to Polish research, an essential question regarding batteries is examining the entire life cycle. The population will only accept the rise of lithium batteries if a comprehensive management system for various wastes and batteries is developed (Dobrowolski et al., 2021). Suppose the goal is to promote the adoption of electric vehicles. In that case, battery production should be addressed, and battery cost, life, safety, reliability, sustainability, and usability should be considered to increase the popularity of electric vehicles in society. Mexican researchers have presented a safety mechanism that can be used to avoid accidents and environmental damage during the life cycle of batteries (Pérez, et al., 2021). There would be a need for life-cycle-based comparative studies, such as the study by Stoppato et al. (2021), followed by public disclosure of comparative data for electric transport and hydrocarbon-based propulsion. It is not easy to create harmony between extreme environmentalists and job-creating politicians. It would help if correct comparisons were made about the ecological footprint covering the entire life cycle of gasoline, diesel, and electric cars.

At the moment, the technology related to lithium batteries is not fully mature. The production, destruction, possible recycling (Latini, et al., 2022), and even the operation in different temperature conditions (Menale and Bubbico, 2023) also contain risks. With technological development comes the creation of dangerous plants, which must be acknowledged, but the hazards need to be minimized by regulation and control. In the case of high-tech plants, it can be stated that accidents can only be caused by human error as a result of costly procedures. In the field of transport, it has already been shown that the vast majority (98 %) of accidents can be traced back to human error (Herke, 2021).

The research aims to explore the opinions in detail and examine the possibilities of approximating different positions. Furthermore, the study seeks to understand the underlying factors contributing to the public's apprehension toward battery factories and their associated risks.

2. Methodology

The basic idea of the research is that following the principles of sustainability cannot cause the consequences below:

- The rejection of new technologies, the economic backwardness of the country and the minimal participation in the supply chain of car production, the rejection of FDI,
- Operation of under-regulated production plants, serious accidents, and minimization of sanctions.

Figure 1 shows the logical model of the research, in which information collection and the synthesis of learned opinions and facts play a significant role. The discovery of the presumably negative public opinion was an important goal. In addition, efforts had to be made to develop proposals that would bring the extreme positions closer to each other.

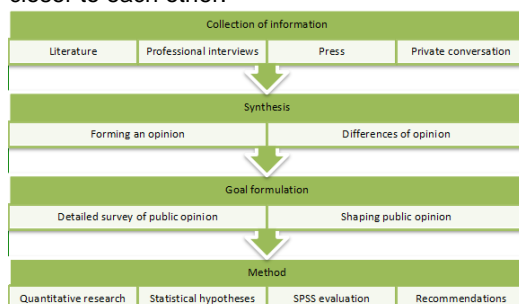


Figure 1: Research model

A quantitative method was chosen to evaluate public opinion. The compilation of the questionnaire was preceded by 20 professional interviews with transport experts, leaders of civil organizations, and macroeconomic specialists. The data was collected in Western Hungary from the beginning of April to the end of July 2023. The 305 respondents form a non-representative sample that represents all aspects. The research presents how the survey respondents think about the labor market effects. Professional interviews helped to learn about the situation and set up the following hypotheses.

H1: The examined respondents from Western Hungary do not want to live in the immediate vicinity of a battery factory.

H2: Not even 25 % of the examined respondents in Western Hungary are willing to obtain information from the literature about the environmental hazards arising from the use or destruction of battery production and the prevention of environmental damage.

H3: At least 10 % of the investigated respondents in Western Hungary do not consider the realities. They agree with the statement that all battery factories in Hungary should be closed and that new factories should not be granted permission.

H4: Among the investigated respondents in Western Hungary, the middle-aged group is the most opposed to installing battery factories.

3. Analysis

3.1 Demography

The sample distribution in terms of educational level roughly reflects the composition of the population. The largest number of high school graduates are included in the sample. The sample was collected in Western Transdanubia, with Győr as the center, so this city dominates the distribution by place of residence. Some of the respondents from Budapest have temporary residences in Western Transdanubia. Since transport and car parts are mainly among the topics of interest to men, the number of female respondents is slightly lower. When answering the question about income, more than half of the respondents considered their financial situation average. 3-3 % belong to the extreme category (Table 1).

Table 1: Demographic distribution of respondents

Demographics, n=305, percentage distribution (%)			
Education		Age	
Elementary school	18.7	18-29 years	12.5
Vocational education	13.1	30-39 years	23.9
School-leaving exam	23.6	40-49 years	35.1
Higher vocational education	12.8	50-59 years	15.7
Bachelor's degree	10.2	60 years and above	12.8
Master's degree	21.6		
Place of residence		Income	
Village	21.97	Well below average	3.0
Small town	10.16	Below average	19.3
Big city	65.25	Average	54.4
Capital city	2.62	Above average	20.3
		Well above average	3.0

Table 2: Perceived labor market impact of battery factories

Perceived truthfulness of labor market statements, n=305, distribution in %	Yes	No	No expression of opinion
Battery factories reduce unemployment	62.3	20.0	17.7
It is not possible to recruit enough domestic workers	49.2	47.2	3.6
Battery factories operating only with foreign labor are also conceivable	57.7	30.5	11.8
In times of crisis, foreign workers can be replaced by domestic workers	41.0	39.3	19.7

3.2 Labor market

62.3 % of the respondents believe that unemployment will decrease as a result of battery production. Unfortunately, this is not necessarily true, as only a small percentage of the unemployed have a technical orientation or education. Approximately half of the respondents state they cannot recruit enough domestic

workers for the mentioned plants. 57.7 % of respondents believe that plants operating exclusively with foreign workers are conceivable. Roughly 40 % of the respondents believe, and the same proportion do not believe, that in the event of another crisis, the place of workers in battery factories can be taken over by domestic workers. 20 % are uncertain about the answer (Table 2).

3.3 Verifying hypotheses

Even after removing the outlier values, interesting results were obtained. On average, battery factories are considered safe at a distance of 140 km. The minimum expected distance is 5 km, and the median value is 50 (Table 3). The Hungarian population takes the accidents of the past decades as a basis. On April 26, 1986, an explosion occurred at the Chernobyl nuclear power plant. Thanks to the whimsical play of the winds, it was possible to measure the radiation at a distance of thousands of kilometers within a short period (Kékesdi-Boldog, 2020). In Szombathely, it was so strong that it exceeded the measurement limit of the instrument. The distance between Chernobyl and Szombathely, as the crow flies, is more than 1,000 km (Pais-Horváth, 2016).

On January 30, 2000, a facility in Nagybánya released 100,000 m³ of wastewater containing cyanide and heavy metals into the Lápos River. The toxic substance reached the Tisza through the Szamos, destroying its wildlife. In the Hungarian section of the river, cyanide concentrations dangerous to the human body were measured (Lakatos, et al., 2003).

On October 4, 2010, a red mud storage dam burst. The more than one million m³ of waste spread over 40 km² claimed ten lives and caused enormous natural damage. The minimum distance of 5 km required by the respondents would have also been insufficient in this case (Sarlos and Szondi, 2015). The first hypothesis, according to which the respondents do not want to live in the immediate vicinity of a battery factory, was fulfilled.

Table 3: Expected distance of battery factories from residences

N Valid	Missing	Mean	Median	Variance	Minimum	Maximum
286	20	140.34	50	20613.14307	5	600

However, the expected long distances do not only stem from the memory of the disasters but also from the fact that a small proportion of the Hungarian population is informed by literary sources. According to Table 4, the respondents get their information from various sources, but the literature occupies the last place among them. According to our second hypothesis, the amount of information obtained from the literature is less than 25 %. According to the hypothesis test result regarding the ratio ($p=0.001$; $n=294$), the proportion of those who obtain information from relevant sources is significantly low, so the second hypothesis was verified.

Table 4: Respondents' sources of information

Sources of information regarding battery factories, n=305, distribution in %	Yes	No	No expression of opinion
Literature	17.4	79.0	3.6
Press	97.0	3.0	0.0
Television	70.2	29.8	0.0
Internet	97.0	3.0	0.0
Social networking sites	72.1	25.9	2.0
Friends, family	48.2	42.6	9.2

The inaccuracy of knowledge also contributes to the fact that residents expect unrealistic economic measures from the government. It would be a completely natural wish if, in accordance with the experts, they wanted to slow industrialization, increase controls, and increase penalties. However, a significant number of protesting residents demand the closing of all battery factories and the halting of further investments.

Table 5: Comprehensive opinion of respondents

Respondents' overall opinion about battery factories, n=305, distribution in %	Yes	No	No expression of opinion
All of them must be stopped	32.1	42.3	25.6
Permits must not be granted for new factories	66.9	30.2	3.0
The installation of factories must be slowed down	75.1	21.3	3.6
Stricter controls are required	89.5	7.5	3.0
Fines need to be increased	63.9	33.1	3.0

According to the third hypothesis, the proportion of those with unrealistic demands exceeds 25 %. There was a significant difference comparing 32.1 and 68.9 % with the standard 25 % ($p=0.007$, $n=227$; $p=0.000$, $n=296$). Based on the results the hypothesis about unrealistic wishes has been fulfilled.

It is considered essential to examine which age group has the greatest resistance to the new type of industrialization activity. It is supposed that young people are less concerned with battery factories and avoidable environmental damage due to recent educational policy problems. The older age group do not question any of the achievements of technical progress, acknowledge that the world is changing, but do not express an opinion in the form of public involvement in the framework of civil organizations or at demonstrations. During the analysis an average was created for each age group since the Likert scale can be understood as an interval scale. For the examined question, a low value means that the respondent has less faith in the success of protection against environmental damage, while based on a high value, the person filling out the questionnaire trusts that employee illness, soil, and air pollution, and the destruction of groundwater resources can be avoided with appropriate technical solutions. According to the fourth hypothesis, the least trust can be experienced in the case of the middle-aged, and this is indeed what the data in Table 6 shows. Thus, this hypothesis has been fulfilled. In this part, the following question was asked from the respondents: "To what extent do you believe that battery production and disposal can be carried out without harming the environment?". The age group usually raises small children, and there is great concern about the successor's health. In addition, they are also afraid of the devaluation of real estate, in which case no one will compensate those who have worked for many years for their home.

Table 6: Age group trust in avoiding environmental damage

Respondent evaluation	18-29 years	30-39 years	40-49 years	50-59 years	60 years and above	Total
1	0.0 %	30.1 %	27.1 %	18.8 %	7.7 %	20.7 %
2	5.3 %	43.8 %	32.7 %	8.3 %	10.3 %	25.2 %
3	55.3 %	9.6 %	19.6 %	18.8 %	25.6 %	22.3 %
4	28.9 %	9.6 %	18.7 %	4.2 %	25.6 %	16.4 %
5	10.5 %	6.8 %	1.9 %	22.9 %	30.8 %	11.1 %
6	0.0 %	0.0 %	0.0 %	27.1 %	0.0 %	4.3 %
Total	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
Average	3.45	1.89	2.08	3.67	3.54	2.64

5. Conclusion

One of the most important findings of our study is that the respondents want to live at an unrealistically long distance (150 kilometers) from the battery factories. This is justified by the tragedies of the past decades. Those filling out the questionnaire believe that the consequence of industrialization will be a decrease in unemployment. Only 17.4 % of respondents obtained information from specialist literature. 32.1 % support the complete shutdown of battery factories, and 66.9 % think permission should not be granted to establish new factories. The middle-aged group is the least likely to agree that the examined facilities can be operated safely if the rules are followed. A significant discrepancy between public opinion and facts can be seen as a result of the research.

The aversion of Hungarian residents largely stems from a lack of knowledge, but this can be helped with education free from partiality. On the other hand, the rejection of battery production can be derived from the fact that establishing an employment relationship is essential for the country's residents. However, only very few imagine their life as an operator or assistant worker. The short-term tasks of the professionals responsible for innovative industrial installation could be clarifying the labor market goals, thoroughly pre-screening investors and guest workers from the appropriate cultural circle, geographically limited fulfillment of distance requirements, and strict installation control. Not only should the sanction of high fines be applied to companies that violate sustainability rules, but termination of the contract is also conceivable.

Public fears regarding the production of batteries used for electric cars can be experienced, but do the protesters now know that the risk is also high in the case of traditional lead and acid components? Increased levels of lead have been found in the blood of factory workers and nearby residents (Chen et al., 2012). The correct response to public protests could be if investors guarantee the development of the Smart Factory. In this case, the health of the employees and the release of harmful substances into the environment are not left to human factors. The Smart Factory belongs to the Industry 4.0 tool system, and information adapted to the age group expressing the most opposing opinions would reduce resistance (Park and Lee, 2017).

Foreign labor reduces problems in case of labor shortages and supports the citizens of poorer countries. Market economies can use guest workers as a security buffer in times of crisis, and both the sending country and the

guest workers are aware of this (Abadan-Unat, 2011). In the case of guest workers, it is possible to select those who comply with European standards of behavior. Environmental pollution and accidents caused by irregularities are behind the protests of Hungarian civil associations. Their publicity leads to the fact that the majority of residents completely reject the establishment of new factories. The Hungarian study on the subject shows that the current regulation, the accelerated licensing procedures, and the low fines by no means guarantee that the drinking water supply will remain sufficient, harmful substances will not leak, and the affected properties will not lose value (Éltető, 2023).

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