HRVATSKI GEOGRAFSKI GLASNIK 86/2, 5–17 (2024.)

UDK 621.352(439)
504.5:621](439)
681.11.031.12:504](439)

DOI 10.21861/HGG.2022.86.02.01

Original scientific paper

Received
2024-01-23

Accepted
2024-10-02

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Hungarian Battery Production - Analysis from the Perspective of Environmental Protection and the Labour Market

In the 20th century, transportation heavily relied on hydrocarbons. Currently, the initial transition to electric propulsion is being witnessed. There's an ongoing debate among technical experts regarding its effectiveness alongside the start of battery production. Our research focuses on the labour market impact of companies operating in battery manufacturing, component production, and disposal in Hungary, as well as the opinions of local residents regarding the establishment of these organizations. Our research aims to track the differences and similarities between the governmental standpoint and the population's views. Hungary stands out for its rapid industrialization, focusing on enhancing GDP and job creation. The population is concerned about employing immigrant workers and potential battery production and disposal accidents. Our qualitative study adheres to the European Green Deal principles, including insights on battery manufacturing from transportation experts, manufacturers' associations, and environmentalists. Our quantitative research shows a preference for living at an unrealistic distance from such facilities. Many citizens advocate for the cessation of battery factory operations or investments, a stance mainly due to limited public awareness. Middle-aged individuals exhibit the most fear, and we correlate our findings with societal facts and negative incidents. To mitigate these tensions, mass education, tighter regulation, and increased sanctions are recommended.

Key words: battery production, advantages and obstacles, public opinion, European Green Deal, Hungary

U 20. stoljeću promet se uvelike oslanjao na ugljikovodike, dok se u ovom trenutku bilježi početak prijelaza na vozila na električni pogon. U tijeku je rasprava među tehničkim stručnjacima o njegovoj učinkovitosti uz istovremeni početak proizvodnje baterija. Naša studija istražuje utjecaj tvrtki koje se bave proizvodnjom baterija i njihovih komponenti te njihovim odlaganjem u Mađarskoj na tržište rada, kao i stavove lokalnoga stanovništva o osnivanju takvih tvrtki. Cilj je istraživanja utvrditi razlike i sličnosti između stavova vlasti i stanovništva. Mađarska se ističe brzom industrijalizacijom, usredotočenom na povećanje BDP-a i otvaranje radnih mjesta. Istovremeno je stanovništvo zabrinuto zbog zapošljavanja radnika imigranata i mogućih nesreća u proizvodnji i odlaganju baterija. Kvalitativni dio istraživanja, u skladu s Europskim zelenim planom, nastoji pružiti uvid prometnih stručnjaka, udruženja proizvođača i okolišnih skupina u navedenu proizvodnju. Kvantitativni dio istraživanje otkriva sklonosti stanovništva k stanovanju na nerealnoj udaljenosti od takvih objekata. Mnogi građani zagovaraju prestanak rada ili ulaganja u tvornice baterija, što je povezano s ograničenom javnom svijesti o tom fenomenu. Najveću zabrinutost izražavaju muškarci srednje dobi, pri čemu rezultati istraživanja koreliraju s društvenim činjenicama i negativnim događajima. Da bi se navedeni negativni stavovi ublažili, preporučuje se ulaganje u obrazovanje, strožu regulativa i veće sankcije.

Ključne riječi: proizvodnja baterija, prednosti i prepreke, javno mišljenje, Europski zeleni plan, Mađarska

Introduction

The science of geography is not limited to the analysis of various landscapes and cities with historical pasts, but also extends to the thorough observation of the economic activities in the regions studied. Our research focuses on battery manufacturing in Hungary, its potential international recognition, and the question of whether the successes achieved by our country in this economic segment will be recognised on the global scale. Should Hungary become one of Europe's leading battery manufacturers, this will have a significant impact not only on the national gross domestic product (GDP) but also on environmental conditions. The global shortage of fossil fuels will occur within a few decades, thus the shift to electric vehicles is not only a necessity but also an opportunity for the application of technologies aimed at reducing pollutant emissions. Electric vehicles require special batteries, and although technological developments have not yet concluded, the research results of technical experts make it possible to replace internal combustion engines with a more environmentally conscious technology (Weil et al., 2018; Vitta, 2021; Gao, 2022).

During the operation of internal combustion engines, numerous harmful compounds are released into the atmosphere, which not only significantly degrades air quality but also contributes to the formation of acid rain, thereby endangering human health and life (Palkowski, 2016; Grennfelt et al., 2020; Debnath et al., 2021). One of the most important challenges related to electric vehicles is the manufacturing and environmentally friendly disposal of batteries. It is crucial to prevent the spread of soil contamination to residential areas and protect workers' health. Therefore, the selection of the location for battery factories is of paramount importance. An adequate and properly trained workforce must be available, whether they are domestic workers or foreign workers staying in Hungary for the long term. The chosen site must not be located in an environmentally sensitive area where protected species live or which has outstanding agricultural significance. In the event that a poor site would be chosen, it is possible to relocate; despite the fact that the initial costs may be high, the long-term indirect benefits would justify the decision (Lavee, 2012).

In Hungary, similar to global trends, the spread of digital technologies can lead to job losses. Robotics technology primarily comes to the forefront in work areas where workers' health is at significant risk. An example of such an area is battery manufacturing, where, due to this technological transition, there is no longer a need to worry about the health and safety of employees (Illéssy et al., 2021; Dodoo et al., 2024; Tucker et al., 2024). In Hungary, the phenomena of unemployment and labour shortage can be observed simultaneously. According to the latest trends, workers from developing countries represent a sort of reserve resource during labour market crises, who can be sent back home if necessary, and their places can be filled with domestic labour (Ness, 2007).

The European Union has two defining environmental objectives. One is the reduction of pollutant emissions by 62% while fully enforcing the 'polluter pays' principle. In addition, an emissions trading system is in operation, which includes buying and selling prices (Verde, 2020). The total revenue from the auctions can only be used for environmental protection and sustainability purposes (Pölös, 2022).

Review of previous research

For decades, attempts have been made to solve environmental problems caused by humanity's technical advancements using traditional environmental technologies. Several publications have concluded that these solutions are ineffective under current conditions. Efforts have been made to objectively measure the efficacy of traditional technologies. During these investigations, challenges may arise in toxicity testing and exposure characterization due to the extensive time and resources required. These resources are often limited or unavailable, hindering the accuracy of measurements (Thomas et al., 2019). The increasing use of technology, consuming resources in extreme quantities and causing irreversible environmental pollution, has rendered

traditional environmental methods inadequate. These methods, previously employed for the protection of the biosphere, cannot effectively address global and urgent challenges such as climate change and resource depletion. An integrated problem-solving approach is necessary (Hecht and Fiksel, 2015).

Not only global environmental problems, but specific issues also arise in the use of natural materials. Traditional treatments for wood protection are often inadequate and come with significant negative environmental impacts. Innovations in technology and re-evaluating requirements are necessary to develop sustainable practices (Acker et al., 2023).

The advancement of mobile technologies and internet access has transformed environmental approaches. Citizens have become more informed and are willing to express their opinions on environmental pollution. This transformation requires new institutional approaches, such as scientific initiatives, to keep pace with these changes (Rubio-Iglesias et al., 2020).

Traditional environmental technologies often come with higher costs and do not enable companies to increase productivity and quality, making them less attractive and effective in the current competitive economic environment (Aguilar-Rivera, 2019).

Transitioning to a green economy is a necessary step, but the change requires considerable resources and is challenging. The European Green Deal prescribes solutions and control methods drastically different from previous approaches. It supports a transformation aiming to turn the European Union into a modern, competitive economy and fair society. It addresses climate policy, environmental protection, energy, and the sustainable transformation of transportation, industry, and agriculture (Fetting, 2020). The impact of this document has been analysed in various publications. In their research, Turchyn et al. (2022) analysed the status and motivations of green energy development in the European Union, highlighting the impacts and risks on Ukraine in light of European trends and energy issues. The study examines the opportunities and challenges of green energy development within the EU context, with special attention to the war situation in Ukraine. The publication demonstrates how armed conflict, caused by geopolitical factors, influences a country's geo-economic objectives.

In their study, Tutak et al. (2021) evaluated the current state of sustainable economic development in the energy and climate sectors within EU countries. Using various decision-making methods, they examine the extent to which individual member states progress towards sustainable energy and climate goals. Schunz (2022) worked on analysing the European Green Deal, particularly emphasising how this agreement changes the discourse on environmental sustainability in the European Union. The research investigates how much the agreement represents a shift from previous policies and its potential impact on environmental efforts in the EU and globally. Rządkowska (2022) examined the dynamics between renewable energy sources and fossil fuels within the EU. The research highlights that, due to the policies of the European Green Deal, renewable energy sources represented a larger share in electricity production than fossil fuels for the first time. Cengiz and Kutlu (2021) studied the impact and perception of the EU's green energy strategy on global climate change challenges. The research analysed how the EU's new budget prioritizes climate strategy and the challenges the EU faces due to dynamics among member states and a lack of consensus.

Hafner and Raimondi (2020) discussed the EU's main objectives and challenges, mainly focusing on renewable energy sources, energy efficiency, and reducing greenhouse gases. They emphasize the varying implementation pace among member states and the challenges caused by division among them and popular public resistance. Metaxas (2023) examined the role of natural gas, acknowledging its transitional importance until a complete shift to green energy occurs. The article discusses opportunities such as repurposing pipelines and carbon capture and storage. Asadov and Asadov's (2022) research concludes that the efforts made by the EU in the interest of green energy development are logical and reflect the growing objective needs of the countries in the region, even in the face of existing apparent costs. Among the expected risks, the following can be highlighted:

- The instability of the energy production process and the vulnerability of green energy to natural, political, and other factors.
- The risks associated with renewable energy increase in unfavourable economic environments, potentially triggering social and political crises.
- The high costs and negative consequences of implementing the Green Deal.
- The reluctance of some EU countries to comply with energy conservation regulations under the Green Deal.
- The anticipated impact of alternative energy development on global political processes.

Sztorc (2022) analysed the impact of the COVID-19 pandemic on the energy transformation and the implementation of electrical power consumption in EU countries as part of the Green Deal strategy. Yiasoumas et al. (2023) examined key aspects and challenges of energy communities in the EU, including regulatory frameworks, key technologies, and financing systems. Drăgoi et al. (2023) assessed the impact of the current EU energy crisis on Romania's green energy policies, highlighting the country's further development opportunities in this area.

Projections indicate that Hungary has the potential to emerge as one of Europe's leading battery manufacturers within a decade, a development that could generate a substantial number of jobs, potentially exceeding thirty thousand. However, the industry is grappling with a significant labour shortage, and the current policies in place are merely stopgap measures. It is imperative to ensure employee representation and improve working conditions to harness the full potential of this burgeoning sector. There is a high turnover rate among factory workers, prompting recommendations for increased fines and improved workplace safety. Hungary has become the European hub for Asian manufacturers and the starting point for economic expansion. However, job creation is not the primary goal. The low added value of the Hungarian battery industry does not facilitate economic advancement. Compliance with the EU's social and environmental regulations is necessary (Nagy, 2023). Comparative analysis by Győrffy (2023) reveals that Hungary's battery strategy mirrors the practices of the classic socialist system, while Sweden's approach reflects contemporary 21st century industrial policy ideas. The key takeaway from both cases is that economic development and environmental protection can go hand in hand. In Sweden, these two objectives are mutually reinforcing, whereas in Hungary, battery manufacturing is viewed as a potential threat to both economic convergence and the environment. It is crucial for Hungary to realign its strategy with modern industrial policy ideas to ensure sustainable economic and environmental outcomes. Engelberth et al. (2024) found that although the automotive supply activities partially replaced traditional raw material and energy-intensive sectors, this did not bring significant economic development to Nógrád County, one of Hungary's poorest regions. Battery manufacturing relies on cheap labour, representing low added value, and the labour shortage problem persists in the region, especially for higher-skilled workers. The Hungarian battery manufacturing strategy primarily relies on state interventions. It is less sustainable economically and environmentally than the Swedish model, which is based on research and development and extensive cooperation.

Figure 1 shows the locations of significant companies in the battery industry. The industry's location along the country's largest and highest-water-yield rivers clearly indicates a great need for water, which could raise public concerns due to fears of natural water contamination. The locational arrangement of the economic geography is also influenced by hydrological factors, but it must be considered that large car manufacturers are located in Germany, Slovakia, Poland, and Austria, making it practical to locate lithium battery production and disposal plants close to the consumer market.

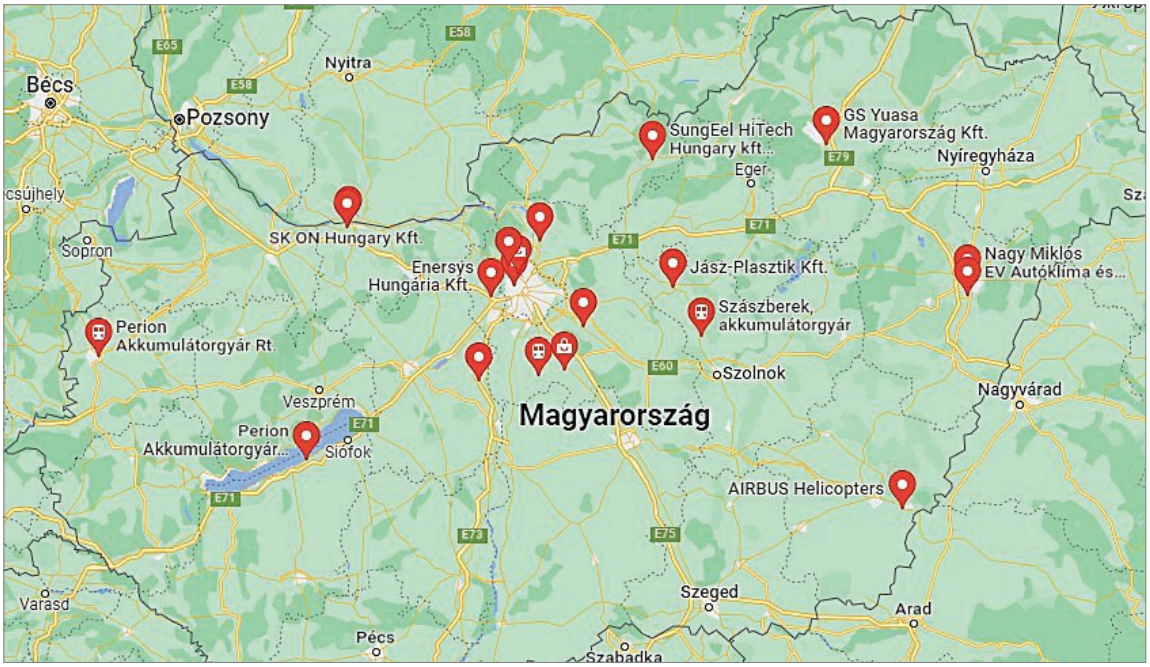

Fig. 1 Major Battery Factories in Hungary
Source: Google Maps (2024)

Methodology

Our research aims to avoid several negative consequences while remaining committed to long-term sustainability goals. These include the categorical rejection of still unrefined technologies, limiting Hungarian participation in the automotive supply chain, and pushing the country's GDP to a lower level due to investments. We also aim to avoid rejecting foreign direct investments (FDI) based on the country of origin, inadequacies in the regulation of manufacturing plants, and serious accidents resulting in loss of life or health impairment. Additionally, we seek to prevent sanctions from being kept at an unjustifiably low level.

Our research's logical model was illustrated in Figure 2, where we focused on collecting information and synthesizing acquired data. During our research, we had substantial reason to assume negative public opinion beforehand, which we cannot ignore. We aim to bring various extreme views—such as the public's hostile stance and state-supported industrial developments—towards a compromise solution. In this study, we focus less on the quantitative evaluation of public opinion; instead, we only present the results and detail the explanations. The questionnaire data collection took place from April 1 to July 31, 2023, in Western Hungary. The non-representative sample of 305 respondents demonstrates how the target audience perceives issues related to battery factories. In our analysis, we emphasize professional interviews and integrate public opinion only as a contrast to the study.

Our respondents primarily live in the Western Transdanubia Region, where the automotive industry and its suppliers have played a dominant role in the economy for decades. However, there have been protests against the planned battery factory.

Based on the literature and the research model, we formulated the following research question: What are the characteristics of the Hungarian public's attitude toward the BEV battery industry?

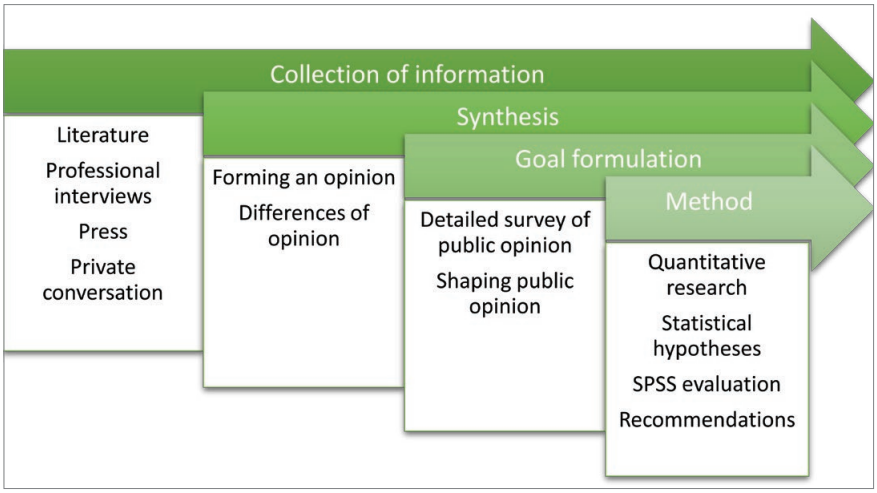

Fig 2 Research model

Qualitative analysis

Opinions on Nature Conservation and the Transition to Electric Vehicle Transportation

The transition to electric vehicle transportation necessitates the production of batteries with appropriate technical specifications. Some environmental organizations strongly oppose the establishment of battery factories in Hungary. However, our interviewee remained grounded in reality. They are aware that European Union regulations demand drastic changes. However, the climate objectives will not be realized immediately. The reasons are as follows.

- The introduction of new technology requires a tremendous number of resources, and the infrastructure to be developed is costly.
- As much as we would like to achieve technological development without human casualties, we must recognize that the processes are still unrefined, and the control methods also need development. Unfortunately, accidents and extraordinary events are inevitable in such phases of technological transition.
- In Hungary, one significant problem is the rapid development of huge manufacturing capacities relative to the country's size. The excessive speed and intensity inevitably lead to errors.
- We are addressing the question of whether electric vehicle transportation or mobility using fossil fuels is more harmful to the environment. It is not clear which method has a greater environmental footprint over the entire life cycle. The method of producing electric energy and the disposal of resulting waste must also be considered.
- Since traditional conservation technologies no longer yield results, novel solutions are needed. Hopefully, a more considered and slower-paced transition to transportation will ultimately have a positive balance.

Producer-Manufacturer Perspectives

In the interviews, the environmental and social impacts of the production and use of lithium batteries were elaborated on in detail by the experts. Below, their opinions are summarized.

The manufacturing process has a significant environmental impact, especially when environmental regula-

tions are inadequate. The production is energy and water-intensive, which poses additional environmental risks. Continuous environmental monitoring is important to check and intervene if necessary to mitigate environmental impacts.

The recycling of worn-out lithium batteries presents technical and public health challenges. The process involves several steps, including storage, testing, disassembly, and separation of components. The organic electrolytes and their degradation products that are found in batteries are harmful to the environment and health, so special attention must be paid to their handling.

The operation of electric vehicles involves minimal pollutant emissions, unlike conventional vehicles. However, the extraction and manufacturing of battery raw materials result in carbon dioxide emissions. Battery factories are striving to switch to carbon dioxide-neutral production.

Considering local geographical and climatic conditions, it is suggested that battery factories be located further away from populated areas. A unified EU regulation could be helpful to in harmonizing protective distances. It is important to provide detailed information to workers regarding the hazards associated with their work, ensure strict adherence to occupational safety regulations, and monitor personal safety regulations continuously. Many other factors influence tourist attraction, so it is difficult to determine the impact of battery factories on this definitively.

Compliance with safety regulations makes the chance of mass disasters caused by industrial accidents minor. Experts generally support the establishment of battery factories, although this can vary for local residents.

Producer-Manufacturer Perspectives on the Environmental and Social Implications of Lithium Battery Production and Usage

The environmental impacts of the production of lithium batteries can be evaluated from several aspects. According to some experts, when carried out in a closed system, adhering to technical and environmental regulations, the manufacturing process does not pose a greater risk. However, others highlight the environmental impacts of lithium extraction and processing, such as air, water, and soil pollution and the depletion of water resources.

Varying views exist regarding the recycling of spent lithium-ion batteries. Some experts believe the batteries can be almost entirely recycled, while others argue that the global recycling rate is only about 10%, which could pose a significant environmental problem. When comparing the environmental impacts of conventional and electrically powered vehicles, experts note that electric vehicles emit minimal pollutants, unlike conventional vehicles. However, the manufacturing process of electric vehicles may result in higher carbon dioxide emissions. From the perspective of soil pollution, the improper disposal or recycling of electric vehicle batteries poses an environmental risk, while in the case of conventional vehicles, the emissions from exhaust gases, tire wear, and brakes can cause environmental stress. According to the responses, battery factories should be located away from populated areas, considering local geographical and climatic conditions. To ensure the health protection of workers in battery factories, the use of protective clothing and equipment, as well as the proper storage and handling of hazardous materials, are of paramount importance.

According to the responses, battery factories are unlikely to have a significant impact on Hungary's tourism attractions. The likelihood of industrial accidents leading to mass catastrophes is low, especially if strict safety regulations are adhered to. Experts believe that establishing battery factories can bring significant national economic benefits and that creating the appropriate social consensus is necessary. There are also varying opinions on environmental impacts, recycling, and the evaluation of manufacturing processes. Experts, however, largely agree that adherence to environmental regulations, worker health protection, and social acceptance are important considerations in establishing and operating battery factories.

Quantitative analysis

Demography

The demographic composition of our sample approximates the structure of the adult population in Hungary (Table 1). According to the analysed data, 21.6% of the respondents hold a master's degree, while the fewest, only 10.2%, hold a bachelor's degree. Additionally, 18.7% completed primary school, 13.1% obtained a vocational qualification, 23.6% finished high school, and 12.8% completed higher vocational education. By age group, those aged 40–49 dominate, making up 35.1% of the sample. The distribution of other age groups is as follows: 12.5% are 18–29 years old, 23.9% are 30–39, 15.7% are 50-59, and 12.8% are over 60 years old. Based on place of residence, the majority of respondents, 65.25%, live in large cities, while only 2.62% live in the capital city. The rural population accounts for 21.97%, while small-town residents comprise 10.16%. In terms of income, more than half of the sample, 54.4%, have an average income. Those with below-average income make up 19.3%, while above-average income is characteristic of 20.3% of the sample. Only 3.0% have significantly below-average or above-average income (Tab. 1).

Tab. 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

Labour Market Perceptions and the Impact of Battery Factories on Employment

In Hungary, economic growth over the past decade has continuously increased the demand for labour, while the tight labour market has made it difficult for many companies to find suitable professionals. This is especially true for skilled workers, whose shortage significantly limits companies' growth potential. The education system and training opportunities do not always keep pace with market demands, further exacerbating the situation. The phenomenon of labour shortages in Hungary can be attributed to several factors, including demographic changes such as an aging population, low birth rates, and the emigration of young, skilled workers abroad. These factors have put pressure on the labour market, particularly in the manufacturing and technology sectors, where the demand for skilled labour is high (Csugány and Kozák, 2018).

Hungary increasingly relies on foreign workers, particularly guest workers from neighbouring countries and Asia, to address the labour shortage. These workers are often employed in industries with the most significant labour shortages, such as construction and manufacturing (Ferenc and Kovály, 2022).

The growth of the electric vehicle market and the development of battery technology have necessitated the establishment of new manufacturing capacities in Hungary. Battery factories, such as Samsung SDI's plant in Göd or SK On Hungary's facility in Komárom, are attracting a significant workforce, including guest workers (Klonka, 2023). This specific example highlights the dynamic nature of the labour market in Hungary and the need for continuous adaptation to meet the changing demands.

Among the respondents, 37.7% believe that the production of batteries will not lead to a decrease in unemployment. This viewpoint is reinforced by the fact that battery factories primarily require skilled workers and professionals trained in technical fields. Participants are divided on the issue of whether it is possible to find a sufficient number of domestic workers for such positions. Concurrently, many respondents are sceptical that filling the new job positions created by battery manufacturing exclusively with domestic labour would be possible.

Findings

We studied the distance the population would consider safe from battery factories. Even after filtering out outlier values, an average distance of 140 kilometres was determined. The population partly bases this opinion on natural and industrial disasters that have occurred in the Carpathian Basin in recent years. An example can be the Chernobyl nuclear power plant accident on April 26, 1986, whose radiation was detected thousands of kilometres away. In the case of Szombathely, the level of radiation exceeded the measuring capacity of the instruments (Pais-Horváth, 2016). At the end of January 2000, a Romanian industrial company discharged water contaminated with heavy metals and cyanide into a nearby river. The toxic substance reached the Tisza through the Szamos River, resulting in the complete destruction of the wildlife in Hungary's second-largest river. The disaster affected not only the fish population but also harmful cyanide concentrations were detected in the Hungarian section of the river (Lakatos et al., 2003).

On October 4, 2010, the dam of the red sludge reservoir in Ajka burst, resulting in the caustic substance spreading across 40 square kilometres, causing irreversible damage to the environment and leading to the death of 10 people. During our investigation, some respondents believed that a distance of 5 kilometres might be sufficient for a safe separation from an industrial facility. However, in the case of the Ajka tragedy, the Chernobyl nuclear accident, and the ecological disaster of the Tisza River, this distance would not have been adequate (Sarlos and Szondi, 2015). Significant environmental damage accidents have occurred even after these events. In Hungary, numerous environmental disasters in recent years have drawn attention to the severe risks of environmental pollution. In 2015, it was revealed that the Budapest Chemical Works' Illatos Road site had improperly stored hazardous chemical waste for a long period, resulting in the detection of additional carcinogenic substance leakages in the area in 2022. In Abasár in 2013, toxic organic solvents were identified in the drinking water, which could be traced back to the activities of a previously operating diode factory. In December 2020, a significant oil pollution event occurred in Szigetszentmiklós, damaging the wildlife of the Ráckevei-Soroksári branch of the Danube. In *Óbuda*, since 2009, it has been known that harmful substances from the former Gas Factory site have been entering the Danube, exceeding the permitted limits several times. On the shores of Lake Fertő, in 2020, significant natural areas were destroyed as part of a large investment project, which was later suspended due to a lack of funds (Czirják, 2022; Juhász 2023).

Tab. 2 Respondents' sources of information

Sources of information regarding battery factories, n=305, distribution in %	Yes	No	No expression of opinion
Scholarly 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

Based on Table 2, the respondents' pronounced resistance to industrial developments primarily stems from the consequences of disasters. Secondly, it indicates that only 17.4% of them seek information from scientific sources. In contrast, the internet, social media, television, and tabloid press dominate the average citizens' information-gathering habits.

The lack of information and concerns related to disasters led to 32.1% of the respondents demanding the immediate closure of battery factories. In comparison, 66.9% advocated for the prohibition of issuing new construction and operating permits. Moreover, it is important to highlight the reasons behind the protests, with particular attention to the active participation of the 30–49 age group. They identified their resistance reasons as follows:

- Concern for the health of their descendants and their children.
- Fear of property devaluation near factories.
- The demand for healthy, safe workplaces for their own age group.

Conclusion

From each of our professional interviews, it can be deduced that there is a need for electric vehicles and batteries. Therefore, society must find a compromise solution between forced industrialization and the resistance of some civil organizations. EU regulations aim to establish a circular economy, which prescribes regulations and rules for every stage of the life cycle of batteries. Adhering to these would mitigate public opposition (European Council, 2019). The resistance of the Hungarian population to battery manufacturing can primarily be traced back to a lack of information, a gap that could be bridged with unbiased education, including various informative articles, public service television announcements, and advertisements. These educational materials could illuminate how sustainable battery manufacturing and disposal are possible with proper attention. Another common reason is that the mentioned factories primarily offer operator and labourer positions, which the Hungarian labour market is only willing to accept to a limited extent. Furthermore, there are also reservations about employing guest workers. Among the tasks facing professionals responsible for innovative industrial installations include precisely defining labour market objectives, thorough preliminary screening of investors and guest workers suitable for Hungary's culture, strict control of the geographical location and distance requirements of sites, as well as rigorous supervision of construction processes. It is not only necessary to increase the amount of fines for companies violating sustainability regulations but also to consider the possibility of contract termination. According to Polish researchers, it is crucial to examine the entire life cycle of batteries; the public will only widely accept the use of lithium batteries if a transparent and comprehensive waste and battery management system is developed (Dobrowolski et al., 2021).

To promote and spread the use of electric vehicles, we must contribute to battery manufacturing development, monitoring their cost, lifespan, safety, reliability, sustainability, and usability. Mexican researchers have developed a safety mechanism to prevent environmental damage and operational accidents throughout the lifecycle (Pérez et al., 2021). Furthermore, life cycle comparative studies, such as those conducted by Stoppato et al. (2021), would be essential, and followed by the publication of comparative data between electric and traditional hydrocarbon-based modes of transportation. Creating a balance between environmental considerations and job creation efforts is not an easy task. A precise and comprehensive comparison of the ecological footprint of cars throughout their entire lifecycle can provide assistance in achieving this balance.

Our research did not address all aspects of the establishment of battery factories. When examining public opinion, it should be noted that the survey reflects initial reactions. The fear for health and property is still extreme, so it is worth repeating the study at a later date. In such a case, there would be an opportunity to significantly expand the questionnaire to examine the differing attitudes of various population segments. Several malfunctions and accidents occurred during 2023 as a consequence of rapid, forced industrial development. It is also worth returning to this topic for further study. We need to examine whether the companies, primarily from the Far East, are willing and able to comply with Hungarian occupational safety regulations and whether the state is capable of enforcing compliance. In the spring of 2024, there was a slight change in the employment of guest workers. Due to a temporary decline in demand, 600 foreign guest workers employed in battery factories were laid off (Kovács, 2024). Since the employment of domestic workers remained unchanged, this fact positively influenced public opinion. Achieving harmony between staunch environmentalists and politicians focused on job creation is challenging. Making accurate comparisons of the ecological footprints over the whole lifecycle of diesel, gasoline and electric cars would be beneficial.

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