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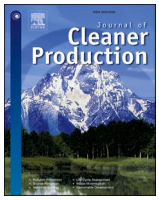

A systematic analysis of different forms of procedural injustice associated with reindustrialization in Hungary: A case study on the lithium-ion battery industry

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ABSTRACT

Following the global financial crisis in 2008–2009 and the subsequent COVID-19 pandemic, many developed economies pursued reindustrialization. Although governments in Western countries are striving to boost industrial production by promoting innovative industries, the location of manufacturing plants poses a challenge in post-industrial societies. For example, recognizing the opportunities in the global electric vehicle revolution, the Hungarian government has sought to attract lithium-ion battery manufacturing companies and establish a national battery industry with a globally significant production capacity. Consequently, Hungary is experiencing a rapid expansion of large-scale battery factories and related industrial facilities. However, concerns regarding the environmental, health, and social impacts of battery production—including the potential release of toxic chemicals and excessive use of natural resources—have incited public opposition. In the communities accommodating or assigned to accommodate battery factories, residents have increasingly expressed dissatisfaction, and civil society organizations (CSOs) have protested against the government's strategy. This has generated significant conflict between local communities and CSOs on one side, and authorities and local governments on the other. This study explores the forms of conflict between these actors and the procedural injustices that communities and CSOs perceive on the part of those in positions of power. The analysis includes a review of major online news outlets and interviews with representatives of CSOs and non-governmental organizations (NGOs). The results show that procedural injustice is an issue in reindustrialization, especially in the development of the battery industry; however, there are also indications of changes.

1. Introduction

Since the 1970s, advanced economies, including those of Western European Union (EU) member states, have experienced significant deindustrialization marked by declining manufacturing output and employment (Capello and Cerisola, 2023; Rodrik, 2016; Rowthorn and Ramaswamy, 1999). Concurrently, global manufacturing has shifted to East Asia—particularly China—increasing Western dependence on Asian industrial output. In response, major economies implemented reindustrialization strategies following the 2008–2009 global financial crisis. The urgency of this reindustrialization intensified during the COVID-19 pandemic when national shutdowns caused supply chain disruptions, highlighting the vulnerabilities of globalized production systems (Harapko, 2023).

Contemporary reindustrialization does not mean reviving traditional industries but promoting sectors aligned with sustainability and technological innovation. A key sector is the electric vehicle (EV) industry, which includes electric cars and lithium-ion battery production. As governments promote decarbonization and sustainable mobility, the EV industry has become central to new industrial policy. According to S&P Global (2023), by 2030, the major battery producers are projected to be China (3675 GWh), the United States (990 GWh), Germany (414 GWh), Hungary (170 GWh), and India (145 GWh).

Hungary has a pivotal role in this transformation. The Hungarian government has prioritized attracting manufacturing investment, particularly in the automotive and battery sectors (Gerőcs, 2022). In 2022, over 700 automotive companies, including five manufacturers, were active in Hungary. The Hungarian Investment Promotion Agency

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(HIPA) reported that the automotive sector contributed approximately 4 % to the country's gross domestic product (GDP) and is expected to reach 10 % by 2026. The government supports reindustrialization through subsidies and incentives. While car manufacturers dominated previously, in recent years, lithium-ion battery companies have become the main beneficiaries of state support. In 2024, the estimated subsidies for battery companies totaled approximately 1500 billion forints, representing approximately 1.9 % of national GDP. The National Battery Industry Strategy 2030, launched in 2022 by the Ministry of Innovation and Technology, identifies the battery industry as a strategic priority, aiming to create an "internationally competitive national industry." By 2024, approximately 40 companies in the battery sector had a presence in Hungary, with further investments planned. The strategy aims to integrate Hungary as a key actor in the European EV supply chain.

For developed countries, reindustrialization seeks to reduce reliance on foreign production and address supply chain risks. However, in postindustrial societies, this process can be contentious. Communities often resist large-scale industrial developments due to concerns about pollution, health risks, and the intensive use of land and water resources. Local opposition to the battery industry has emerged in cities including Montreal (Canada), Shanghai (China), Marshall (Michigan, USA), Grünheide (Germany), Brest (Belarus), and throughout Hungary. Critics cite concerns about environmental degradation from emissions and resource overuse. Despite this resistance, governments can override local opposition to secure projects considered economically vital. When industrial investments proceed without adequate public involvement or consideration of local concerns, people perceive procedural injustices, which are a form of environmental injustice.

This study examines the procedural injustices associated with reindustrialization. The battery industry was chosen for analysis because it has become one of the fastest growing industries in the world and is often feared to pose environmental risks. Hungary is a pertinent case, illustrating how rapid industrial expansion can conflict with public interest. Thus, the central research question in this study is: What procedural injustices characterize the development of the battery industry in Hungary?

2. Literature review

The concept of environmental justice originated in the United States during the 1970s, primarily to address the disproportionate siting of hazardous waste facilities and polluting industries in communities predominantly inhabited by racial and ethnic minorities and low-income populations (Bullard and Johnson, 2000; Taylor, 2014). The initial focus was on distributive justice, examining the inequitable allocation of environmental burdens, including exposure to toxic emissions, and associated contrasting health outcomes (Kurtz, 2003).

Environmental justice scholarship rapidly expanded beyond this initial focus. Young (1990) highlighted the underlying social structures and processes that generate injustice, while Schlosberg (2004, 2013) advocated for a multifaceted framework incorporating distribution, recognition, and participation. This participatory dimension, termed "procedural justice," emphasizes the fundamental right of people to meaningful involvement in environmental decision-making processes that shape their lives (Schlosberg, 2004). Inclusive participation is essential for social justice; therefore, excluding affected parties from such decisions is inherently unjust (Young, 1990).

Procedural environmental injustice manifests in diverse forms. Key issues include exclusion from decision-making (Schlosberg, 2013), information asymmetry limiting informed participation (Kulkarni, 2000), tokenistic engagement lacking influence (Gillard et al., 2017; Santos et al., 2021), biased regulatory processes, and unequal access to legal or technical resources. Achieving procedural fairness is crucial as processes perceived as just significantly enhance local acceptance of potentially contentious outcomes (Syme et al., 1999). Leventhal (1980) identified six criteria that must be met to ensure procedural justice: (1) the equal treatment of people and situations (consistency), (2) the absence of self-interest (bias-suppression), (3) full and correct information (accuracy), (4) the potential to retract decisions (correctability), (5) the involvement of all parties in the decision-making process (representativeness), and (6) adherence to elementary moral and ethical values (ethicality) (Zoellner et al., 2008). Importantly, contemporary scholarship emphasizes that effective procedural justice requires more than formal consultation; impacted communities must be able to substantively engage as empowered partners throughout environmental decision-making (Skinner-Thompson, 2022).

Environmental justice concerns frequently intersect with industrialization processes and decisions on facility locations (Laurian, 2008). Selecting communities to accommodate installations with perceived environmental risks often triggers perceptions of distributive injustice (Hall et al., 2013; Vilhunen et al., 2022), and communities expect governing bodies to rigorously protect public health and environmental quality during industrialization (Kulin and Johansson Sevä, 2019). Conflict occurs when economic priorities appear to supersede local environmental and health concerns, particularly following inadequate or unfair participation. Therefore, addressing procedural deficits through fair, transparent engagement is essential to achieving socially acceptable and sustainable industrial development. This aligns with cleaner production principles that emphasize proactive environmental management and stakeholder collaboration to build trust and realize long-term social license for projects, moving beyond adversarial approaches (Harvey and Bice, 2014).

Research on environmental and procedural justice within the lithium-ion battery lifecycle has mainly focused on the upstream stages—specifically, the extraction of raw materials (Amnesty International, 2019; Canelas and Carvalho, 2023; Escosteguy et al., 2024; Sovacool, 2019). These studies have frequently addressed the environmental burdens and social impacts of mining key components, including lithium and cobalt. A significant portion of the existing literature has focused on case studies from the Global South, with Africa (Congo, Zimbabwe) and South America (Argentina, Bolivia, Chile) prominent regions (Liu and Agusdinata, 2020; Sovacool et al., 2021). These investigations have often highlighted issues of distributive injustice in which local and indigenous communities disproportionately bear the environmental costs of mining for battery production (Wörmann, 2022). Furthermore, procedural justice limitations, including inadequate community engagement and transparency in decision-making processes for mining projects, are frequently examined (Akrofi et al., 2024; Escosteguy et al., 2023). While the focus has been on resource extraction, the implications of battery manufacturing and end-of-life management, including recycling, have gained increasing scholarly attention (Domingues et al., 2024; Tejeda, 2022).

In Hungary's current (re)industrialization phase, including the battery sector's expansion, environmental justice concerns have become prominent in public discourse. Recent controversies indicate that potential negative impacts may affect a wider socioeconomic spectrum than historically marginalized groups. This evolving situation highlights the critical need to investigate the procedural dimensions that govern development approval and oversight. Thus, this study examines the emergence of procedural injustices associated with battery manufacturing, with a focus on the value chain's midstream phase (e.g., materials processing and cell/module production).

The study addresses three main research gaps. First, while the environmental and procedural impacts of the upstream phase (e.g., mining) have been widely studied, the midstream phase remains underresearched despite increased attention in news media. Second, there is limited empirical knowledge on how these injustices materialize regarding battery manufacturing. Third, this study contributes to a growing but relatively limited body of research on environmental and procedural injustice in Central and Eastern Europe (CEE), a region undergoing rapid industrial transformation.

3. Materials and methods

The research was conducted in Hungary, which has implemented a large-scale reindustrialization strategy focused on developing its automotive and lithium-ion battery industries. By 2024, approximately 40 companies in the EV sector and associated battery industry had established or announced manufacturing facilities in Hungary (Fig. 1), including Contemporary Amperex Technology (CATL), EVE Energy, Samsung SDI, BYD, and BMW Group.

This research uses a mixed-methods approach to investigate the complex phenomenon of procedural environmental injustice. Both media analysis (Deacon et al., 2015) and interviews (Schuster et al., 2023) have been widely used in environmental justice research, providing distinct but complementary perspectives on the relationships between power, communication, and community experiences in development decision-making processes. Media analysis was used to examine how environmental injustices are framed in public discourse and how different actors, including policymakers, corporations, activist groups, and local communities, construct narratives that may reveal procedural inequalities (Lester, 2010). In parallel, interviews provided deeper insights into expert views and local experiences, enriching and contextualizing the broader patterns identified through the media analysis.

3.1. Media analysis

The selection of online news outlets was based on the results of online media analysis conducted by the National Media and Infocommunications Authority (Nemzeti Média- és Hírközlési Hatóság – NMHH) in September and October 2024 (NMHH, 2024a; NMHH, 2024b). The following three criteria were considered when selecting the news outlets for analysis.

(1) Whether the news outlet was among the 10 websites with the highest number of users.
(2) The traffic visiting the front pages of online portals identified as news outlets by the NMHH.
(3) The presence of full paywalls.

An initial list of news outlets was identified based on these criteria. In addition, lower traffic outlets producing investigative and watchdog journalism and in-depth analyses were also included. These outlets (e.g., atlatszo.hu and valaszonline.hu) often identified deeper connections, and their articles were sometimes partially or fully cited by the most visited news outlets. The final list of news outlets included in the analysis is presented in Table 1.

On these selected news outlets, the search term *akkumulátorgyár* (battery factory) was used. In several instances (such as with index.hu and telex.hu), articles were already tagged with this keyword. This pre-tagging assisted the search process. Where possible, the results were filtered to only include articles published in domestic news sections (e.g., index.hu and origo.hu). In addition, the search timeline was restricted to publications appearing after 2010.

A total of 2423 search results were collected from these news outlets. This was undertaken using the free Google Chrome extension web-scraper.io, which enabled the compilation of a combined Excel database. The database included the article title, uniform resource locator (URL),

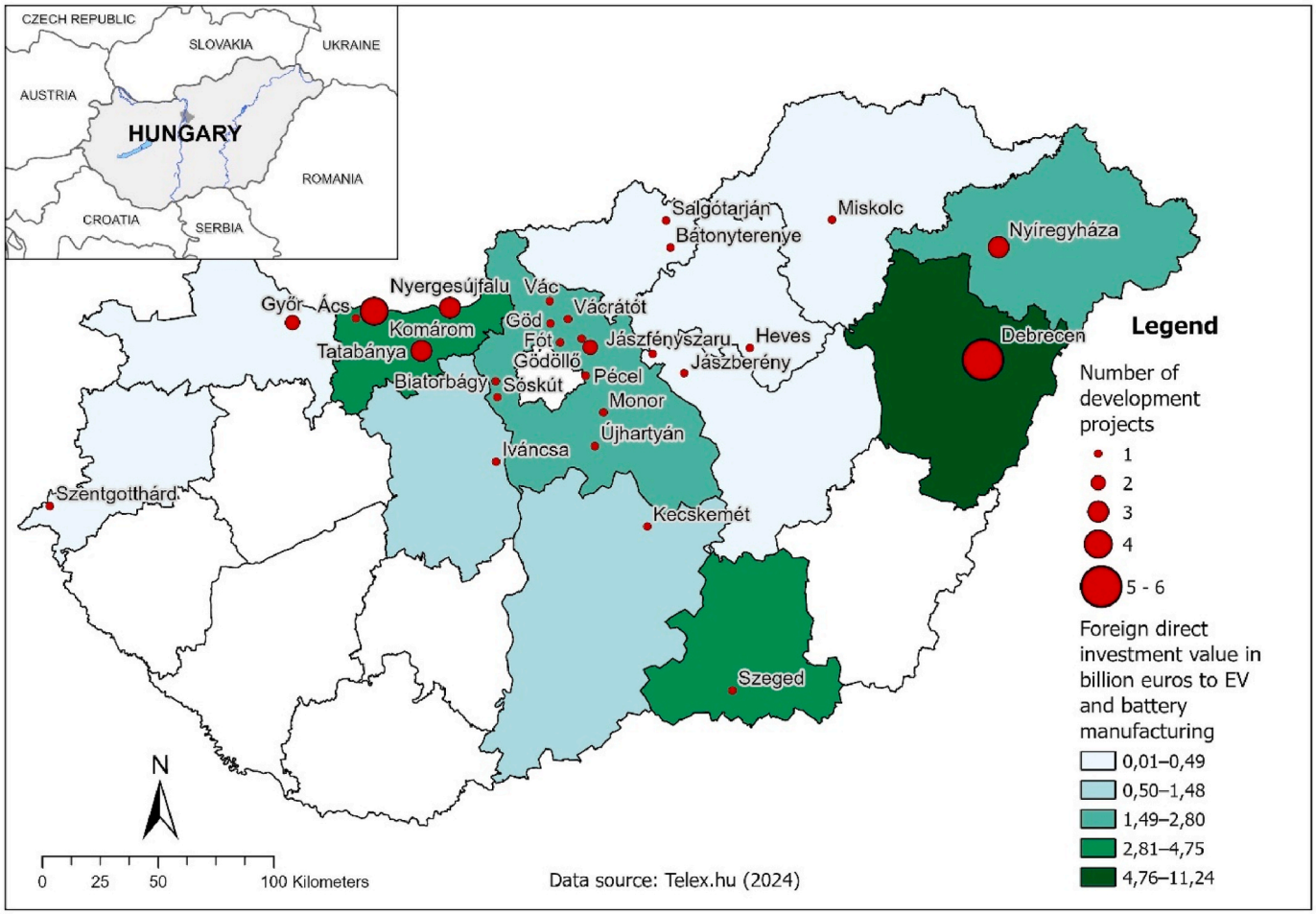

Fig. 1. Geographical distribution of electric vehicle and battery industry investments in Hungary in 2024.

Table 1
News outlets and the number of articles included in the media analysis.

News outlet	Paywall	Total number of articles related to battery industry developments	Of these, the number of articles included in the analysis	Percent of articles analyzed, %
Magyar Hang	partly	591	179	30,3
24.hu	partly	702	170	24,2
telex.hu	no	334	132	39,5
atlatszo.hu	no	249	127	51,0
index.hu	no	186	73	39,2
HVG360	partly	198	23	11,6
origo.hu	no	130	6	4,6
valaszonline.hu	no	33	5	15,2
Total		2423	715	29,5

Source: own compilation

publication date, and, where available, tags and introductory texts. Following the research objectives, 715 articles were selected from the total results. This selection was based on the article titles and any associated information. Each selected article was assigned to between one and three of the following predefined thematic categories.

(1) Authorities
(2) Local governments
(3) Participation
(4) Environmental aspects
(5) Social aspects
(6) Protests and demonstrations, or public opinion

The distribution of the analyzed articles across these thematic categories is presented in Table 2.

The selected articles were bulk downloaded by thematic category using WinHTTrack Website Copier software. A thorough review of these articles was then conducted. The presence of procedural injustices related to each theme was analyzed. Consequently, a detailed note was prepared that highlighted specific examples of procedural injustices by theme. This was then verified by another researcher for accurate identification and interpretation. Finally, a general summary was produced that provided the basis for the media analysis results presented in Section 4.1. During this process, two themes—"Participation" and "Protests and demonstrations, or public opinion"—were merged (as "Public participation") owing to their close relationship.

While the study included both pro-government and independent online news portals, the analysis is limited by the general tendency of digital news media to highlight negative content—a bias often reinforced by audience-driven selective exposure and structural incentives within the media to emphasize negativity (van der Meer et al., 2018, 2020; Watson et al., 2024).

Table 2
Number of analyzed articles by the thematic category related to procedural injustice.

News outlet	Theme 1	Theme 2	Theme 3	Theme 4	Theme 5	Theme 6
Magyar Hang	66	44	38	33	19	57
24.hu	62	31	27	37	21	47
telex.hu	59	38	29	28	9	34
atlatszo.hu	65	8	7	46	3	29
index.hu	23	17	11	20	2	31
HVG360	6	3	2	11	2	8
origo.hu	4	1	0	3	0	1
valaszonline.hu	1	2	0	3	0	1
Total:	286	144	114	181	56	208

Source: own compilation

3.2. Interview method

The individuals interviewed included representatives from the Hungarian Battery Association, the Environmental Management and Law Association, Greenpeace, the World Wide Fund for Nature (WWF), CSOs, and independent experts with comprehensive knowledge of battery industry investments. The selection of these organizations was based on the results of the media analysis, with their opinions and actions regarding battery factories appearing frequently and prominently in the online outlets. Insights were sought from these specialists and stakeholders with extensive knowledge of the development of the battery industry and associated aspects related to environmental justice. During the primary data collection in autumn 2024, detailed interviews with 10 individuals were conducted. The interviewees were deeply familiar with reindustrialization and its social effects, with some participants knowledgeable about the complex environmental and social problems since the 2000s. All interviews were conducted in person, and each lasted at least 1 h. Perspectives were obtained on the national and local impacts of the battery industry and the positive and negative aspects of these investments. Eight of the participants were aged over 40 and two under 40, with an equal gender distribution.

The interviewees were politically neutral, highly credible experts and civil society professionals with higher education degrees, many of whom voiced criticism of reindustrialization and battery production. This is understandable, as their perspectives reflect concerns related to environmental injustice. Consequently, the sample included fewer respondents supportive of the battery industry, which introduces a certain asymmetry and constitutes a limitation of the analysis.

The fundamental principles of qualitative interviewing were adhered to throughout the process, with an Interview Protocol Refinement (IPR) (Castillo-Montoya, 2016) utilized. The participants' rights and anonymity were ensured. While a set of predetermined interview questions was used, participants were also allowed to talk about topics they considered essential. The semi-structured interview questions are presented in Appendix 1.

4. Results

4.1. Media analysis

The media analysis identified procedural injustices associated with battery manufacturing investments and production. The findings are summarized under the following five thematic areas.

4.1.1. Authorities

Environmental use permits for battery factories and other industrial facilities are issued by county government offices, while disaster management permits are the jurisdiction of county disaster management directorates. Permits have always been granted, even to companies with a record of regulatory violations. In several cases, investments were not classified as environmentally impactful despite the likelihood of significant environmental consequences, exempting these investments from environmental impact assessments (EIAs).

Authorities are responsible for monitoring regulatory compliance and emissions thresholds; however, many battery-related facilities have not been subject to such oversight due to their classification. In addition, authorities have frequently withheld information on factory inspections and their outcomes. The fines imposed for violations have been minimal and have failed to incentivize compliance with environmental or occupational safety standards. Factory shutdowns have been non-existent. Authorities have also demonstrated a reluctance to share information with CSOs or local mayors. As a result, CSOs have sometimes pursued legal action to access data on factory operations. While county courts generally appeared impartial, authorities have often appealed unfavorable decisions to the Supreme Court, which has frequently altered the initial rulings.

4.1.2. Local governments

Industrialization and the development of a national battery industry are high government priorities. Some local governments have supported industrial investments, including battery factories, due to anticipated increases in business tax revenue. In these cases, local decision-makers have avoided public consultation and refrained from organizing hearings owing to awareness of widespread public opposition. Withholding information on industrial projects and their impacts has been common.

In other instances, local authorities have lacked sufficient information on proposed investments, hindering the provision of information to communities on their potential environmental consequences. Opposition to central government-backed investments has previously resulted in land designated for such projects being reclassified as a special economic zone, transferring control from municipal to county-level governance (this practice has since changed).

The government has introduced several legislative measures to facilitate industrial development, potentially undermining local autonomy. One such example is Act LIII of 2006 on the acceleration and simplification of the implementation of investments of special importance to the national economy, which has streamlined investments considered of national economic significance. When such a designation is made, special regulatory frameworks can be applied to the area concerned.

4.1.3. Public participation

Communities have often felt excluded from decisions related to industrial developments, believing that local authorities have prioritized economic interests and state-level objectives over environmental protection and public health. Local opinions have seldom been sought in advance. The first formal opportunity for public input has typically occurred during the environmental permitting procedure, when the competent government office has organized a public hearing; however, developments are already under construction by this point.

These hearings have frequently been contentious. In response, the government has permitted online hearings, limiting public engagement to emailed questions and enabling authorities to decide which queries to address. In another case, residents were only able to submit a 3-min voicemail summarizing their concerns.

Attempts by individuals, CSOs, and opposition parties to initiate national or local referendums on battery industry development have failed. The Supreme Court rejected a proposal for a national referendum on banning battery factories, reasoning that such factories already exist and are under construction, making a retroactive law infeasible.

4.1.4. Social aspects

To support its economic strategy, the government plans to relocate approximately 500,000 guest workers to Hungary. According to the Ministry for National Economy, 120,000 guest workers were employed in 2024. Cities with significant industrial activity, including Debrecen, Miskolc, Győr, Göd, and Iváncsa, have hosted most of these workers.

Accommodation for guest workers has often been poorly managed, creating social tensions. In larger cities, worker dormitories have been built within or near industrial zones with approval from local authorities. Residents have sometimes observed large construction projects near their homes without being informed of their purpose, causing speculation and concern, which has often focused on whether the buildings would provide dormitories.

In suburban areas, private investors have often converted single-family homes into unofficial worker dormitories. As only tourist accommodation and official dormitories require operating permits, these informal arrangements are legal, even if used to house numerous tenants. Local governments and authorities have often lacked the capacity or inclination to intervene in such cases.

4.1.5. Environmental aspects

Environmental concerns related to battery factories have been commonly reported in online media. These concerns comprised two main categories: (1) overexploitation of environmental resources and (2) local pollution risks. First, large-scale industrial and infrastructural developments have often encroached on protected natural areas and consumed significant land and water resources. Second, potential pollution—including electrolyte spills; elevated nickel levels during production; and air, water, and noise pollution—has caused public health concerns.

To secure land for industrial projects, municipalities have purchased or expropriated private property from residents, sometimes without fully informing the owners of their legal rights or providing consultation opportunities. Some property owners have reported feeling pressured by local authorities. Older landowners, recalling earlier socialist state expropriations, have expressed concerns about legal repercussions if they refused to sell, even when offered below-market prices.

Both residents and city officials have often been unaware of potential pollution risks. Before 2023, companies were not legally required to install emissions monitoring systems on-site. Therefore, authorities have relied on factory management to self-report accidents, many of which have been unreported. Consequently, mayors and emergency services have lacked the information needed to effectively respond to environmental incidents, placing residents at risk.

4.2. Interviews

4.2.1. General concerns: risks and deficiencies

Following the media analysis, interviews with 10 experts from different CSOs and other organizations were conducted. All of the participants agreed that electromobility and its related sectors, particularly the battery industry, are critical to advancing climate neutrality. Some of the interviewees suggested that battery production capacity expansion in Hungary is aligned with EU and national climate protection goals, effectively embodying the green transition. Other participants expressed only partial agreement and noted that while industrial growth related to EV production is essential, this growth has become excessive and may be disproportionate to Hungary's available resources.

Several concerns were raised regarding the rapid development of battery production. According to most of the interviewees, this sector does not effectively promote environmental protection, with current battery technologies (including production, disposal, and recycling) generating considerable ecological risks. Nine of the participants highlighted that the water and land requirements of the planned production volume surpass existing carrying capacities and threaten local energy resources. Only one participant suggested that renewable energy (primarily solar energy) may meet the additional electricity demand from battery factories. These experts considered it a significant flaw that strategic environmental assessments have not been mandated for large factories. Several interviewees noted that environmental licensing procedures for facilities have been classified as notable "priority investments." From a national economic perspective, such investments have been specifically expedited owing to this classification, thereby precluding appropriate impact assessments: "No impact studies were prepared, neither for individual plants nor for the sector as a whole."

Most of the interviewees expressed concerns that the National Battery Industry Strategy 2030 lacks sufficient detail and does not fully align with other national strategies. As one expert in environmental protection and economic policy expressed, "The environmental and social impacts of the sector remain largely unclear and unknown. We do not know the benefits the battery sector might bring to Hungary, nor if it justifies the current level of support." For most of the participants, the broader economic value of battery factories to the national economy remained uncertain, and the rapid establishment of these facilities has led to conditions indicative of procedural injustices. An optimistic view was also shared: "There is a learning process happening across Europe. In Hungary, all stakeholders are gradually becoming more informed. This industry requires a cautious approach, transparency, and

continuous professional dialogue among the government, local authorities, institutions, foreign companies, and the public. Regulation is getting stricter, and discourse is improving."

However, most of the participants were critical, citing a lack of social partnership and a sense that public information should be more precise, accurate, and balanced. They noted that local communities received inadequate information regarding factories, essential documents were missing, and opportunities for constructive discourse were lacking: "Communities were presented with a fait accompli, while the industry's local impacts remain unpredictable. This approach is neither fair nor democratic. Furthermore, some settlements with new factories do not benefit from business taxes, and only a few residents are employed at these facilities. The influx of guest workers, which is expected to increase, will pose additional challenges." The participant continued, stating, "In addition, the accelerated investment process has made upholding environmental interests and rights impossible. This has led to local conflicts, and the issue even impacts the entire country and reflects current power dynamics and the vulnerability of local governments."

4.2.2. *Democratic deficits and forward-looking proposals*

Several interviewees emphasized that investments have infringed on environmental rights, creating a "democratic deficit." While these issues may directly affect communities living near factories, the unresolved concerns accompanying this industrial expansion raise broader societal questions. As one environmental law expert remarked, "The absence of environmental impact assessments, the threat to natural resources, and the excessive use of energy resources (without the knowledge or involvement of affected communities) are issues beyond the outrage and complaints of concerned local activist groups."

Some of the participants argued that Hungary has neglected its commitments under the Aarhus Convention. Large-scale investments in the battery industry have overlooked essential principles, including access to information, transparency, public participation in decision-making, and environmental justice. Both professionals and the public have only learned about these investments after governmental decisions had been made: "There are situations when the legality and rule of law are questionable; such as when authorities fail to respond to reports of problematic cases or outright deny them." One interviewee noted, "The Greens are automatically categorized as anti-government, which is inaccurate. Concerns about the battery industry are not tied to political affiliations; experts seek a meaningful professional dialogue and the promotion of long-term sustainability interests." They then added, "The government's communication about this sector is unclear, and, in some cases, even misleading, while local civil society and larger organizations are labeled as 'scaremongers.' We face a systemic problem where inhumane situations arise. The legal pathway often fails in contentious cases, forcing associations to turn to the press and media as their last resort. While debatable, it's the only avenue to voice our concerns."

While acknowledging certain negative aspects, some of the interviewees were less pessimistic. They felt that the government had attempted to balance environmental and social considerations alongside economic goals in recent years, which had led to a gradual increase in public acceptance of battery factories and a clearer understanding of their environmental impacts: "As of 2022, there has been a stronger enforcement of expectations toward investors, and responsible agencies have taken steps to systematically and proactively disseminate information."

Some of the participants viewed the debate on battery factories as an opportunity to activate smaller communities; nevertheless, establishing meaningful success had proven challenging: "It's unclear whether the numerous lawsuits will advance environmental democracy or whether those attempting to assert their rights will eventually give up." This was a view expressed by representatives from various organizations. In addition, "The efforts of citizens, associations, and organizations working for environmental justice face significant obstacles, with limited cooperation inside and outside their networks." The interviewee continued, stating, "We approach authorities, engage legal representatives, and strive to inform the public on these issues, yet community interest remains low. Some prefer to leave their living place or avoid any civil movements altogether. Local governments and mayors are also not always reliable partners, while authorities and courts often delay responses, provide inadequate answers, or even obstruct the resolution and legal settlement of emerging concerns."

All of the participants agreed that the domestic presence of the battery industry warranted greater public attention, as the factories' long-term viability depends on sustained public support. As such, the interviewees felt that far wider professional and social consultations should have preceded the establishment of battery production on such a scale: "With clear communication and comprehensive information, the outrage and fears among more sensitive parts of the population could have been mitigated. Although there are environmental risks associated with these factories, an open dialogue could reduce the sense of vulnerability. Negotiations between the state and investors must be made public." Several participants noted that institutional improvements are needed: "Establishing an independent environmental protection ministry, effective authority activities, and transparent environmental monitoring of companies would all significantly enhance environmental safety, democracy, and justice." "The only way to ensure a harmonious coexistence between the battery industry and domestic society is through transparency and minimizing environmental harm," a senior expert confidently stated.

5. Discussion

It has been firmly established in the relevant literature that (re) industrialization often occurs alongside perceived environmental injustices by local communities (Boone et al., 2014; Elliott et al., 2004; Liu et al., 2021; Viel et al., 2011). Furthermore, distributive injustice and procedural injustice are cited as the most common forms of environmental injustice regarding industrial developments (see, for example, Barragan-Contreras, 2022; Huang and Chen, 2021; Laurian, 2008; Malin and Ryder, 2023). This study investigated whether the establishment of battery factories in Hungary is associated with perceived procedural injustices by local communities. Moreover, as the EV transition expands and countries worldwide—including advanced, post-industrial economies—intensify efforts to expand their battery industries, cases are likely to become increasingly common.

Based on the media analysis and interviews, the exclusion of people from decision-making on battery industry investments is the most important form of procedural injustice. There are two main reasons why people and CSOs are excluded from this decision-making. First, Hungary's reindustrialization is a highly centralized process—which the government promotes—that aims to position Hungary among the most industrialized countries in Europe. For example, the government recently announced its "150 Factories Program," which aims to establish numerous factories throughout the country (https://kormany.hu/hirek/a-150-uj-gyar-program-segiti-az-ipari-termeles-helyreallasat). Expanding the EV and lithium-ion battery industries is central to reindustrialization in Hungary, but it is also a priority for many other countries. Clearly, the government does not want Hungary to fall behind in this global competition. As time is a critical factor in the battery industry's development, the government wants to remove obstacles that may prevent battery companies from establishing factories in Hungary or impede ongoing construction. Second, reindustrialization is characterized by a democratic deficit. As Warren (2009) argued, "governments are in democratic deficit when their citizens come to believe that they cannot use their participatory opportunities and resources to achieve responsiveness." Reducing opportunities for public participation in decision-making on industrial investments is a routine phenomenon around the world (Cerchione et al., 2025), even in Western democracies such as the EU and the United States (Eriksson et al., 2024; Jerez et al., 2021; Slattery et al., 2023). In the Hungarian context, the demand for a

local referendum on the establishment of battery factories was rejected on the grounds that citizens had already expressed their opinions on the development of their settlements when they elected their leaders; therefore, there was no need for them to further express their opinions. Overall, the above findings suggest that the democratic deficit associated with both the operation and development of contemporary capitalist economies is partly systemic in nature and reflects broader tensions within Western democracies (Wagner, 2011).

In addition, many other forms of procedural injustice also occur regarding industrialization, particularly the development of the battery industry. A notable phenomenon is withholding information, which often arises during industrialization. In some cases, the central government has not informed local governments about which investors plan to establish manufacturing facilities in their towns, rendering the local governments unable to alleviate community frustrations. In other cases, authorities have been reluctant to share information with CSOs and communities on factory operations or faults that may have caused environmental pollution. The erosion of transparency fosters distrust as people do not believe that authorities will protect them from potential environmental harm (see, for example, Éltető, 2024). Another phenomenon relating to procedural injustice is when the central government uses legal means to enforce its will on municipalities that are reluctant to accommodate industrial facilities owing to concerns about their harmful environmental and social impacts. To further its economic interests, the government is willing to use its power against entities that also form part of the public administration system (see a similar example from the United Kingdom by Cotton, 2017). In Hungary, a new phenomenon of procedural injustice is limiting local governments' rights over their land (Csomós et al., 2024).

The dismantling of environmental institutions and the inconsistent or selective enforcement of environmental regulations constitute another form of procedural injustice. For example, there was an independent Ministry of Environmental Protection in Hungary until 2010; it was then abolished, and its tasks were first transferred to different ministries and then to the Ministry of Energy in 2022. The lack of preparedness of the institutions responsible for environmental protection was demonstrated by the fact that battery factories began operating in Hungary before these competent authorities had introduced emissions limits for chemicals specifically used in battery production (e.g., N-Methyl-2-pyrrolidone). Other countries have also shown signs of easing strict environmental regulations to enable the development of industries that present potential environmental risks. For example, to support the government's reindustrialization efforts, including promoting oil and gas production, the Environmental Protection Agency in the United States launched a major deregulation initiative, seeking to reverse 31 climate, air, and water pollution and emissions-related regulations (EPA, 2025). The evidence indicates that industrialization is often associated with a reconsideration of environmental regulations that impede the establishment or development of certain industries.

While the media analysis and expert interviews show that procedural injustices are part of the battery industry's evolution, there are also signs of change. As one expert argued, the European battery industry is developing rapidly, and neither the relevant authorities nor the people have experience in battery production and its impacts. All of the actors involved in or affected by the battery industry are in a learning phase. For example, the competent authorities have required CATL to install 10 monitoring wells at its Debrecen battery factory and conduct regular water testing for the materials it uses or produces during battery production. In addition, the municipality has established an air quality monitoring system, with multiple stations across the city, enabling real-time daily emissions data collection. Moreover, following repeated calls from CSOs and Greenpeace to tighten the emissions thresholds for N-Methyl-2-pyrrolidone, the government lowered the threshold from 150 to 1 mg/m^3.

6. Policy implications

The study findings have identified critical policy areas where adjustments may promote more sustainable and equitable environmental governance and industrial development, both in Hungary and internationally. These modifications are particularly relevant to large-scale industrial investments, such as giga-factories (e.g., lithium-ion battery factories), which present substantial environmental, governance, and procedural justice challenges. Key elements should include.

(1) Early and substantive stakeholder engagement: Developers and authorities should engage with local communities and stakeholders from the initial stages of project conception—well before major decisions are made—enabling meaningful input into project design and mitigation strategies.
(2) Transparent and accessible information: Comprehensive and independently verified EIAs, including risk analyses and proposed mitigation measures, should be made publicly available promptly and in a comprehensible format.
(3) Independent and impartial review processes: Environmental assessments and permitting decisions should be based on clear, objective criteria and be free of political or economic influence. The independence of the EIA process is essential.
(4) Open and accountable redress systems: Accessible channels should be established to enable citizens to raise concerns, submit complaints, and seek remedies when procedural rules or environmental standards are breached.
(5) Adaptive regulatory framework: Continuous scientific assessments and periodic reviews, and the rigorous tightening of environmental standards, are needed for battery manufacturing facilities. Therefore, establishing a dynamic mechanism to enable stringent regulatory updates is imperative to ensure long-term environmental sustainability and the safety of local communities.
(6) Government institution responsible for environmental protection: A government body should be established and endowed with sufficient resources, expertise and political authority to strengthen environmental governance. Such an institution could effectively enforce regulations, coordinate long-term sustainability strategies, and ensure that ecological aspects are appropriately integrated alongside economic and social objectives.

As one interviewee noted, truly zero-impact battery production is currently not feasible, and the application of the best available techniques can only mitigate rather than eliminate environmental burdens. Consequently, the extent of environmental impacts largely depends on the regulatory framework, specific investment decisions, and operating practices.

7. Conclusions

This study shows that the lithium-ion battery industry, which only recently emerged in Hungary, has expanded rapidly and without sufficient institutional safeguards, causing significant procedural injustices at multiple governance levels. The unprecedented speed and scale of this industrialization have meant that society has had little time to meaningfully respond. Public awareness has only emerged in recent years, after key decisions had already been made. The lack of adequate institutional oversight, combined with insufficient opportunity for civil monitoring and discourse, reflects a broader governmental hegemony undermining both environmental governance and justice. Consequently, the burdens of industrial development have disproportionately affected local communities, who have had limited influence on decisions impacting their environment and health. The lack of transparency, restricted public participation, and prioritization of economic objectives over environmental and social considerations present significant challenges. A just and sustainable future for the battery industry and its host

communities requires greater transparency, stronger local democratic engagement, greater regulatory system independence, and a genuine commitment to environmental and social responsibility. These findings highlight the urgent need for inclusive professional and societal dialogue before large-scale industrial projects.

CRediT authorship contribution statement

György Csomós: Writing – review & editing, Writing – original draft, Supervision, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization. **András Donát Kovács:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation. **Jenő Zsolt Farkas:** Writing – review & editing, Writing – original draft, Software, Methodology, Formal analysis, Data curation, Conceptualization.

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Declaration of competing interest

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jclepro.2025.146298.

Data availability

No data was used for the research described in the article.

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