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Aspects of electric vehicle battery production in Hungary

Andrea Éltető[1]

Abstract

The significant expansion of Hungarian domestic electric vehicle battery manufacturing capacity by early 2023 has become a major topic of public debate in the country. South Korean battery factories have been operating in Hungary since 2019 with Asian-owned suppliers and further Asian plants have been established since then. This paper presents the various aspects of scaling up battery production, drawing on official documents, press information, studies, statistics, and video and audio material. It shows how the functioning plants operate in Hungary, how industrial safety and environmental regulations are breached, and what the attitude of local authorities and civil groups is. The study evaluates the location factors like availability of workforce, energy and water, pointing out their scarcity. There is also a painful lack of responsible cost-benefit analysis, a credible and flexible government strategy and fact-based information.

JEL: L62, L98, F23, O14,
Keywords: EV batteries, industrial policy, FDI, Hungary

1. Introduction

In Hungary, the strong increase of electric vehicle (EV) battery production capacities has become a debated topic from the autumn of 2022. The mass production of batteries is necessary for the green transition of the automotive industry. Hungary's reliance on the foreign-owned automotive industry has not decreased over the past decade and foreign car manufacturers welcome the extension of the domestic battery industry in the country. South Korean battery factories have been operating in Hungary since 2019, their Far-Eastern suppliers are also present and further Asian plants have been set up or announced in the country.

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In this paper, I examine several aspects of the expansion of domestic battery production, like the economic and environmental factors, official communication, civil opposition and social effects. I analysed official documents, articles, studies, regulations, statistics, video and audio material published in the Hungarian and international press and prepared four interviews[2]. I believe it is important to document the issue as clearly and accurately as possible, and to present many sides of the issue, as this can provide the basis for a meaningful debate.

The largest investment in Hungary so far, but also the second largest capacity battery plant in Europe, would be the Chinese CATL (Contemporary Amperex Technology Co. Limited) factory. It was announced in August 2022 and is going to be built in Debrecen[3]. The size, location and impact of the factory have led to public protests, which have attracted the attention of the national and foreign press. Chapter 10 of the study presents the factory and the plans for the Debrecen plant.

The battery production process requires the mining of the necessary raw materials (cobalt, lithium, graphite, nickel, copper, etc.), which is carried out on a large scale in African, Latin American, Asian countries or in Australia, although there are also small deposits in Europe (González-de Haan, 2020). Further stages of EV battery production can already be found in plants in Hungary too. The components of the battery cells are the anode (graphite) and the cathode (usually lithium metal oxide), the separator foil and the electrolyte that conducts the ions. The anode and cathode suspensions are mixed separately with solvents, binders and additives. The solvent of the anode suspension may be butanediol, and that of the cathode suspension is usually NMP (N-methyl-2-pyrrolidone[4]). This is followed by coating, drying, pressing, pre-cutting, slitting. The bundles are folded, pressed and then subjected to X-ray quality control. Then come the following processes: welding, packaging, drying, electrolyte injection, ageing, self-discharge. Depending on the manufacturers and their technologies,

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[2] The articles of Átlátszó helped to find several official documents. Interviews were made with civil activists in Göd and one at CATL The study is laregly based on Éltető (2023) and was closed on 15 June 2023.

[3] https://www.portfolio.hu/uzlet/20220812/itt-a-bejelentes-gigantikus-autoipari-beruhazas-indul-magyarorszagon-560967

[4] Material causing serious eye, skin and irritation, fetal harm, the Europan Commission suggested to restrict the usage of NMP in 2018.
https://echa.europa.eu/documents/10162/17233/entry_71_how_to_comply_hu.pdf

battery cells can be in the form of a pouch (SK), a slit (Samsung) or a cylinder (Tesla). The cells are assembled into modules, where bonding, welding, heating, cooling, insulation testing, casing is performed. More information on the manufacturing process is provided by Dühnen et al (2020), Duffner, et al (2021). The end of the process is recycling, which is particularly important when raw materials become scarce in the longer term (see chapter 5 for more information on recycling methods).

This study describes the EV battery capacities and plans in Hungary in the beginning of 2023 and evaluates the issues of job creation, energy and water needs, environmental and social impacts, safety at work, communication with the public and the longer-term development of the Hungarian economy.

2. The electric transition in the automotive industry

The number of electric cars will increase significantly in the future. It is predicted that by 2030, 60% of all cars sold and 14% of the car fleet will be electric. According to a McKinsey report, by 2030, 120-150 new EV battery factories will be built around the world[5].

With 6.7 million electric cars expected to be produced in Europe by 2030, battery production is a key EU target (Transport & Environment, 2023). In 2019 and 2021, the European Commission decided to support the R&D of the pan-European battery value chain (Important Projects of Common European Interest). From Central Europe, Poland and Slovakia received funding at that time.

The EU aims that by 2035, the new cars sold should be powered by electric battery or e-fuel internal combustion engines. If all planned projects are completed, European companies would account for more than half of European battery production by 2030. In the wake of the US $150 billion battery subsidy package, the EU is also taking administrative steps to speed up and facilitate the licensing of battery factories. Due to the US "deviating effect", a Transport&Environment study estimates that one fifth of planned battery capacity in Europe is at serious risk and half at medium risk, mostly in Germany, Italy, Spain and Hungary (Transport&Environment, 2023).

[5] ttps://www.mckinsey.com/capabilities/operations/our-insights/batteries-included-building-and-operating-sustainable-gigafactories

One of the most famous battery factories in Western Europe is Northvolt in Sweden. Győrffy (2023) describes the conditions there, which are quite different from those in Hungary (close cooperation with local authorities, establishment of a Nordic value chain, availability of raw materials and renewable energy). The cold climate means that cooling processes there require much less energy and water, and there is a strong R&D base, skilled labour and infrastructure. The 60 GWh plant received little state aid and was built largely with private capital.

EV battery factories have been built also in Central Europe[6]. *In Poland,* LG Chem in Wroclaw, has 15 GWh capacity since 2018, but is expanding to 65 GWh, and there are several supplier and recycling plants[7]. (In Godzikowice in Lower Silesia, the local municipality forced by lawsuit the Chinese Guotai-Huarong electrolyte plant to redesign the plant. The municipality in Srem refused a first version of the environmental impact assessment of the Chinese Capchem plant due to public concerns.[8]) *In the Czech Republic,* the joint venture Magna Energy Storage started a plant in Horní Suchá in 2020 with 1.5 GWh of its own Czech-developed HE3DE battery capacity[9]. In Moravia there are plans for a LG plant[10] and in Líny (near Plzen) a Volkswagen gigafactory with a capacity of 40 GWh and 4,000 employees on the site of an old military airfield. Volkswagen has not yet decided, and local residents, drivers and the mayor of Plzen are protesting, saying that the traffic and environmental impact of the factory is high, and that the Czech government wants to push through the construction without proper preparation. In Plzen, a civil association has been formed to participate in the construction process[11]. *In Slovakia,* the Slovak-owned InoBat operates an R&D centre and has set up a 3 GWh plant for self-developed batteries in Voderady[12] and plans to build a production plant in Bratislava for consumer batteries (45 GWh), an electric car battery plant in Serbia (by 2025, with a final capacity of 32 GWh) and further investments in Europe[13]. *In* Subotica,

[6] https://www.dekra-solutions.com/2022/04/battery-cells-made-in-europe/?lang=en
[7] https://insideevs.com/news/576028/lges-ev-battery-gigafactory-poland/
[8] https://visegradinfo.eu/index.php/national-policy-reports/609-will-europe-run-on-polish-lithium-ion-batteries
[9] https://www.magnastorage.cz/kopie-o-nas
[10] https://thenationupdate.com/recent-news/332496.html
[11] https://czechia.postsen.com/local/99381/Gigafactory-near-Pilsen-near-the-ice-Volkswagen-postpones-plans-writes-the-Financial-Times.html
[12] https://www.inobat.eu/our-batteries/
[13] https://www.reuters.com/business/autos-transportation/slovakias-inobat-eyes-electric-vehicle-battery-plant-serbia-2022-11-14/

Serbia, the local company ElevenEs currently operates a proprietary LFP (cobalt and nickel free) battery plant for storage, consumer, and industrial applications[14]. The company has its own R&D laboratory and plans to set up an electric car battery factory (8-16 GWh)[15].

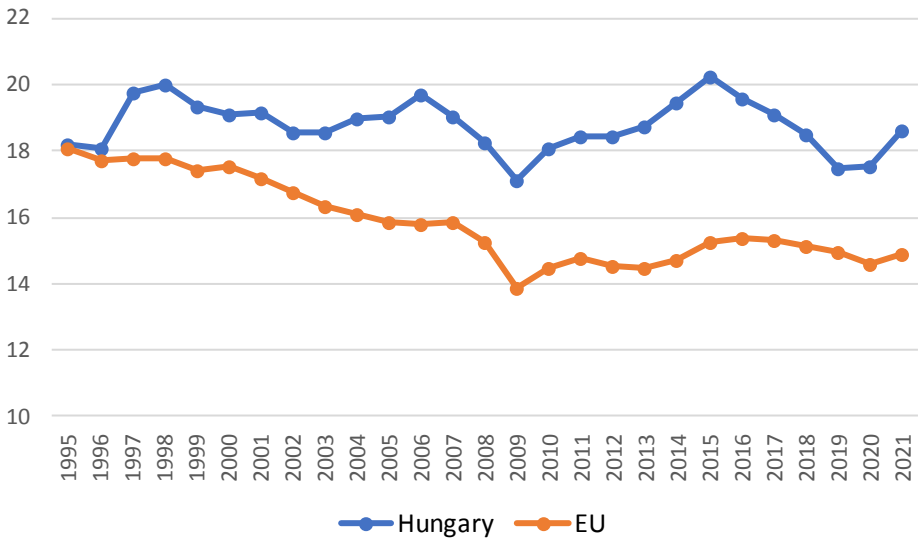
The European Commission presented a 137-page draft regulation on batteries, and their environmental impact in December 2020. It sets out, for example, a minimum percentage of recycled materials per type by 2030, detailed technical documentation, labelling, detailed rules on the materials to be used, the life cycle and safety of batteries and end-of-life management[16]. Electric battery technology is evolving rapidly, but lithium-ion batteries remain with us for a while.

3. EV battery plants in Hungary

In Hungary (and in the neighbouring Visegrad countries), the role of industry, especially manufacturing, in GDP and employment has always been higher than the EU average. As Figure 1 shows, this gap really peaked around 2015, with the automotive sector certainly contributing to this. Around 16% of the Hungarian manufacturing workforce is directly employed in the automotive sector and it is well known that the sector is also a key export contributor (Szigetvári-Túry, 2022).

[14] https://elevenes.com/#solutions
[15] https://seenews.com/news/serbias-elevenes-to-build-1-bln-euro-ev-battery-factory-trade-chamber-759094
[16] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020PC0798

Figure 1: Value added of manufacturing as a percentage of GDP



Source: World Bank, World Development Indicators

The government argued that the dependence on the automotive industry and its electrification would make mass EV battery production necessary. In 2020, the EIT InnoEnergy Scandinavia was commissioned by the then Ministry of Innovation and Technology to prepare a strategic background paper for Hungary in English, with the involvement of Hungarian experts[17]. The Hungarian version of the strategy was published on the Ministry's website in September 2022. The document lists six main objectives: 1. decarbonisation, 2. competitive value chain, 3. strong Hungarian R&D&I, 4. ensuring a skilled workforce, 5. sustainable circular raw materials, 6. strengthening international cooperation. The objectives are accompanied by thematic action plans and a SWOT analysis. There is no mention of occupational safety, and the environment. Circular production is mainly addressed in the context of waste management, collection and recycling (p. 45) and environment is mentioned with a general normative statement: '*Battery production should be subject to strict environmental standards and its environmental impact should be minimised.*' (p.4). The Strategy is short on concrete steps, but the objectives outlined are quite fair and might work in a Western European democratic state.

[17] https://hungarianbatteryday.hu/wp-content/uploads/2021/09/InnoEnergy_Reference_Strategy_Final.pdf

In any case, the Hungarian government has been attracting more plants and suppliers to the existing battery factories in the country, and the official rhetoric is proud that Hungarians have been the first to gain advantage in a big competition. *"We started negotiations with CATL two and a half years ago, when the company was still thinking about another location, so you could say that we managed a sliding tackle and make the Chinese side understand the advantages offered by our country and the city of Debrecen[18]."* (Péter Szijjártó, minister of foreign affairs 07.09.2022) *"In Romania, the automotive industry accounts for fifty percent of exports, and they have no investment in the battery industry. That is why they are looking with open mouths at what is happening in our country, and they are also a bit envious of the fact that we are not just talking about it: we are actually attracting investors[19]"* (Péter Kaderják, head of Hungarian Battery Association 24.02.2023)

The arguments include that Hungarian exports and GDP will grow significantly and even 35% of European demand will be served from Hungary. According to Eurostat's Comext data, the HS8506 and HS8507 product groups (battery cells and batteries) already accounted for 4.6% of Hungarian exports in 2022. In any case, with the capacities already built and soon to be operational, this export share will grow dynamically, even without CATL and additional factories. The Hungarian government intends to increase the EV battery production capacity to 250 GWh and become 4th "battery power" in the world.[20]

The Hungarian Battery Association, with more than seventy members brings together the players in the Hungarian battery industry chain[21]. Table 1 summarises the plants operating or being produced in Hungary, covering the whole value chain except mining. The table already includes CATL, with a reported 9,000 jobs planned. The basis for Table 1 is Table A1 in the Annex, where each factory is listed by name and city.

[18] https://www.haon.hu/helyi-gazdasag/2022/09/szijjarto-a-catl-beruhazas-csak-akkor-johet-letre-ha-mindvegig-megfelel-a-leheto-legszigorubb-kornyezetvedelmi-felteteleknek
[19] https://www.haon.hu/helyi-gazdasag/2023/02/az-ipari-forradalomhoz-hasonlithato-az-akkumulatoripar-fejlodese-debrecen-catl-haon
[20] https://www.budapesttimes.hu/corporate/economic-development-minister-meets-south-korean-executives/
[21] https://www.hu-ba.hu/

Table 1: Battery-related plants in operation or announced in Hungary

Battery manufacturing related function	**Number of plants (2 German, others Asian)**	**Direct State aid HUN bn ***	**Existing and prospective workplace**
Raw material suppliers	10	33,3	3,035
Spare parts manufacturers	10	15,9	1,963
Cells, module manufacturers	7	482.9	15,761
Battery assembly, kieg.	3	19.1	1,000
Recyclers	3	4.5	296
Hazardous materials warehouse	1	-	
Total	34	555.7	22,055

*Excluding infrastructure and tax benefits.

Source: Éltető, 2023, and press releases

The table summarises the total direct government subsidies that can be calculated from the available data (including CATL's EUR 800 million subsidy estimates[22]). However, tax breaks and significant infrastructure investments for the factories financed by public money are not included.

Regarding suppliers, the National Battery Strategy admits that there are no domestic suppliers yet, but it would be desirable. *"Most of the members of the Hungarian Battery Association are SMEs that see potential in this industry. We also have larger companies, such* ***as Videoton****, which already have orders based on lithium-ion technology[23]."* At the same time, companies in the domestic industry still see no chance of getting involved: *'We are probably the second largest consumer battery installer in Eastern Europe ... we use 150 million cells a year. But when we approached these 4-5 big Asian companies, they said, well, they don't even have the drawings translated into English, what do we want, they have their suppliers available from the Far East for the next 17 years[24]."* (Péter Lakatos, Director, **Videoton,** interview, 08.02.2023, 44.29). Language skills are also a limiting factor and will remain so, as the level of foreign language skills of Hungarian youth and adults is also very low by international standards, with one third of the population not speaking a foreign language (Lennert-Holb, 2021). While in the German car industry,

[22] https://hvg.hu/gazdasag/20230208_Nem_kinai_informacio_hogy_a_kormany_320_milliard_forinttal_csalta_Debrecenbe_a_CATLt

[23] https://alfahir.hu/hirek/akkumulator_kaderjak_peter_magyar_akkumulator_szovetseg_energetika_kornyezetszennyezes

[24] https://www.youtube.com/watch?v=SX7onZ_5ZWo

domestic suppliers have been able to enter the value chain after a while, some at a higher level (Szalavetz, 2022), this is not really expected from Asian battery firms with different cultures and strictly Asian suppliers. Of course, cleaning, catering, security, temporary employment, construction, logistics, law firms will find jobs and assignments in Asian factories.

Location of the battery plants is debated by locals. In several places, good quality farmland was destroyed in the industrial area. Residents questioned why these factories are located on good arable soil and why these are greenfield investments, rather than brownfield sites such as CATL's German factory in Arnstadt (built on the site of a former solar cell factory). Another objection from residents is the proximity of residential areas, with houses 50-900 metres to the factories. Municipalities, however, are motivated by business tax hopes and factories use the infrastructure facitities.

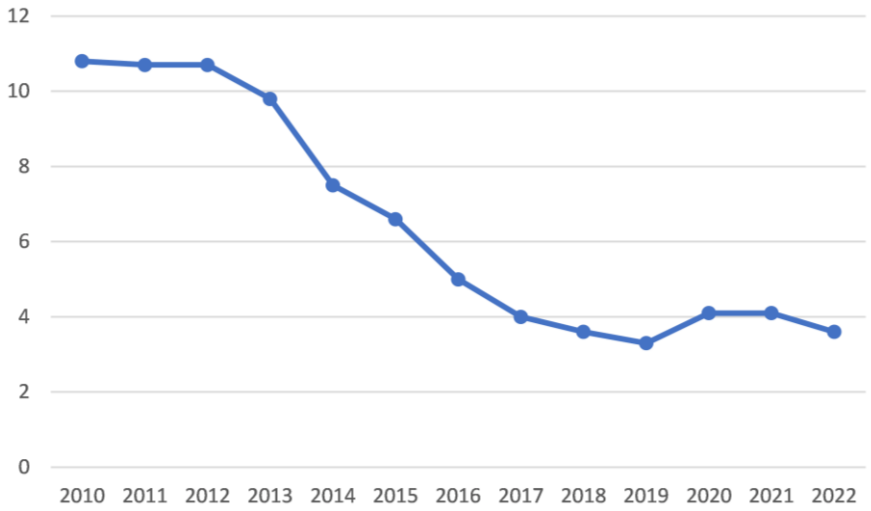
The National Battery Strategy sets out the principles of location (17.*"In the future*, *gigafactories* ***should be located*** *where (a) the* ***cost of expanding the utility networks*** *needed for manufacturing capacity* ***can be minimised****: the additional capacity needed to accommodate gigafactories is almost non-existent in the utility (water, sewage, gas and electricity) networks, (b) easy access to* ***international logistics routes is ensured****; and (c) an adequate and skilled* ***workforce*** *is available. In addition, the investor has, of course, his own specific requirements, but these should not override the 3 principles mentioned above."*

The environmental impact assessment document for the CATL 1 plant in Debrecen (p.9) states similarly: *"A company producing electric cars is expected to be established in Debrecen, so it is advisable to locate the planned battery factory near this plant. The proximity of the M35 motorway and the 47 motorways to the site provides a good logistical link. Another advantage is that the city of Debrecen is easily accessible by air. Another reason for choosing this site was that the utility connections needed for the operation could be established within a short time*".

4. Job creation

One of the biggest arguments for battery factories is that they create jobs. Given that unemployment in Hungary has fallen dramatically over the past decade (see Figure 2) and that company surveys have shown that the shortage of skilled labour has been the biggest problem for years, this argument may seem strange at first sight.

Figure 2: Unemployment rate in Hungary



Source: Hungarian Central Statistical Office

However, in the automotive industry, the electric transition will free up some labour. Electric cars do not require as many workers as conventional cars with internal combustion engines (Szabó et al, 2022). In Hungary, the automotive industry directly employs around 175,000 people, some of whom may become redundant. In the short to medium term, however, investment in the automotive sector will have a draining effect in the labour market due to labour shortages. BMW's plant in Debrecen and Volvo's plant in Kassa are channelling the region's spare labour. According to Czirfusz (2022), the biggest shortage is of skilled workers with a secondary education who understand battery production processes, and the chemical vocational schools are located far from the battery factories. According to the commercial director of the recruitment agency Trenkwalder, it will be difficult to find domestic labour for battery factories: *'There are not enough people in other areas of the industry either, so there is no reserve for new factories, nor is there enough supply to solve this problem in the foreseeable future.*

Operators also need to have at least a secondary education. All this poses a serious challenge for HR in a labour-scarce market. The battery sector will show an explosive growth, but the market is not ready to serve it[25]." (József Nógrádi, 18.01.2023)

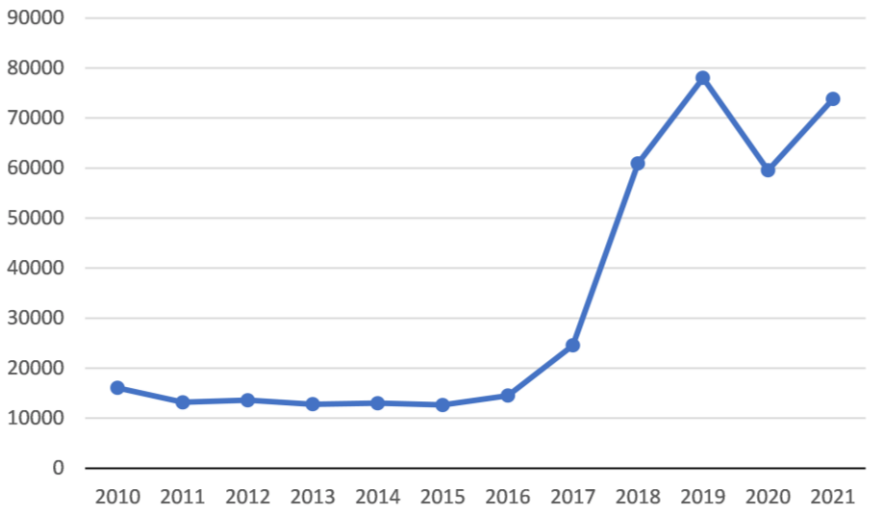
Downward employment is also a problem in the battery sector. Graduate engineers are required to work below their university qualifications, just to check that machines programmed in Asia are doing their job properly: "*most of the engineers are needed to supervise production: to make sure there are no short circuits in the batteries being made, that electrodes are cut in the right places, or that the conveyor belt is carrying the batteries at the right rate*"[26] .

Battery companies will need to import labour from abroad. The Hungarian authorities have eased the licensing procedure for foreign workers in 2017 and 2022, resulting in an increase in the number of foreign (mainly Asian) guest workers working in Hungary[27] (Figure 2). According to the vice-president of the National Association of Hungarian Industrialists, "*Some of the domestic job seekers are difficult to employ, or if yes, not in companies that require high-tech, efficient work. If we want to bring in foreign workers, we need to look further than Europe, to countries where labour is plentiful and wages are significantly lower, such as the Philippines, Vietnam, India, or even South America.[28]"* Samsung SDI employs around 6,000 people in Göd, half of the workers are foreigners, according to a statement at the public hearing on 31 January 2023[29].

The recruitment of medium-skilled workers for large battery factories is therefore very difficult due to three main factors: 1. about one third of the current unemployed are unskilled because they can barely read and calculate (Csillag et al, 2021); 2. engineers with university degrees have higher skills and are not attractive for these jobs in the long run; 3. the existing pool of skilled workers is small and is absorbed by other companies.

[25] https://autopro.hu/hr/ki-fog-dolgozni-az-akkugyarakban/835048
[26] https://telex.hu/komplex/2023/02/06/akkumulatorgyarak-orban-god-debrecen-catl-beruhazas
[27] https://www.portfolio.hu/gazdasag/20230217/ozonlenek-magyarorszagra-a-kulfoldiek-semmi-sem-allithatja-meg-oket-596270
[28] https://24.hu/fn/gazdasag/2023/02/23/kormanytamogatas-kulfoldi-beruhazasok-filippino-mongol-kazah-munkasok/
[29] https://24.hu/fn/gazdasag/2023/01/31/akkumulatorgyar-nem-kell-samsung-godi-kozmeghallgatas/

Figure 4: Number of foreigners applying for a work residence permit



Source: the National Directorate General for Immigration

Not only is it difficult to attract workers, but also to retain them, fluctuation is high. SK Battery's HR manager, who had to recruit 1,400 employees, said that they were able to hire 100-150 people per month from 2019 on. 20% of the workforce is coming over from Slovakia. They offered an attractive basic salary and cafeteria benefits. "An *adequate benefit package is the minimum expectation. To have them stay you need to offer more than that, in terms of company culture, career paths, development opportunities*.[30]"

A study by Czirfusz (2022) shows that wages are higher than the sectoral average in the battery basic material and recycling branch, at around the average in the parts sector, while lower in the metalworking sector. Among battery cell manufacturers, Samsung SDI has higher personnel costs per employee than SK On and GS Yuasa's Miskolc plant. The wage differential between the two large cell manufacturers that dominate the sector is also affected by temporary agency work, because personnel costs include only wages paid directly to employees, while temporary agency costs are included in material costs (for Samsung, this was HUF 19 billion in 2021). According to Czirfusz (2022), the Hungarian battery industry is characterised by the fact that the wages needed for a decent living can only be achieved by extraordinary working hours and bonuses for production line workers.

[30] https://www.youtube.com/watch?v=kTIUMjeRLcI

5. Energy demand

The battery production processes (heating, drying, dehumidification) and the equipment (boilers, extractors, machines) use significant amounts of energy. Analysts estimate that on average 41.5 kilowatt-hours of energy are needed to produce 1 kilowatt-hour of battery capacity (Degen-Schütte, 2022), about half of which is natural gas (for drying) and half electricity. According to a study by Emilsson-Dahllöf (2019), 70% of the energy demand is used for cell production. 80% of this energy is used for the evaporation of the NMP solvent and for the drying rooms (dehumidification). For example, the environmental study for CATL Plant 1 states: *'The site is supplied by 4 gas boilers (heat transfer medium: thermal oil) with a rated thermal input of 17.5 MW each and 6 natural gas-fired steam boilers with a rated thermal input of 17.5 MW each. The boilers are fired by natural gas. The site is served by a steam network for dehumidification units, air handling units and NMP recovery systems. The steam network also supplies the heating needs of the production areas and all buildings* "[31] (p.18) CATL states that the average consumption is forecast to be 80 MW in the first phase and 300 MW after the completion of the three phases.

Cathode production is also energy-intensive, especially for NMC (nickel-manganese-cobalt oxide) or NCA (nickel-cobalt-aluminium oxide), due to the so-called precipitation (12 kWh of heat are needed to produce 1 kg) and the calcination (fusion with lithium compound), where 400-500 °C is needed for 4-5 hours, followed by 700-900 °C for 8-10 hours (Porzio-Scown 2021). The EcoPro Global plant in Debrecen, South Korea, will produce NCA cathode, and according to the environmental permit, "*the daily electricity demand is 161 000 kWh, of which 1 000 kWh is for the electricity demand of the buildings and the rest for the heat demand of the technology (mainly calcining equipment*).[32]"

The battery recycling is also energy-intensive, it is done in three main ways. The most energy-intensive is pyrometallurgy (the batteries are ground and then incinerated, and due to impurities additional sub-processes are needed to recover the necessary

[31] https://www.kormanyhivatal.hu/hu/hajdu-bihar/kornyezetvedelmi-es-termeszetvedelmi-hirdetmenyek/kornyezetvedelmi-termeszetvedelmi-es-hulladekgazdalkodasi-foosztaly-hirdetmenye-191
[32] https://www.kormanyhivatal.hu/download/3/a6/28000/JHNY_00748_47_k%C3%B6zh%C3%ADrr%C3%A9%20t%C3%A9tel_alairt.pdf

metals). The second method is hydrometallurgy (batteries are dissolved in acidic pools and the necessary materials are extracted as salts) and the third is direct recycling, which has been used to a lesser extent (this is time-consuming, requires precise knowledge of the cell properties and, due to the rapidly developing technology, there may not be enough demand for older types of cathodes). There is also a new fourth type of ultrasonic method, but this is not yet widespread.

The aim would be for these factories to use the greenest energy possible. As long as the energy is largely derived from fossil fuel power plants instead of renewable energy, battery production will have a negative impact on the environmental balance of electric cars (Anisits-Tóth, 2017). The current infrastructure capacity and imported volumes of energy are insufficient to meet the needs of the planned battery factories in Hungary. The Prime Minister announced the construction of three domestic gas-fired power plants (CCGT), which is a good idea in the event of a capacity shortfall for renewable but have huge costs (it would require importing about the same amount of gas as the entire population uses today) and perpetuates Russian dependence. In addition, the water consumption of gas power plants is also high[33].

CATL plans to build its own solar farm, but it would only have around 18 MW capacity[34]. The government is also looking to boost renewable energy production to some extent, along with wind power, which has been sidelined for so long. Hungary has applied for money from the EU's Recovery Fund to modernise the energy grid, on condition that the ban on solar PV systems being connected to the grid is lifted.

6. Water demand

The cell production plants in Göd, Komárom and Iváncsa are located on the Danube. However, SK ON in Komárom is so demanding on the city's water network that the karst aquifer of the Tata basin has to be used to supplement the water. Construction of the water pipeline from Tatabánya started in February 2023 and continues with destruction

[33] https://24.hu/belfold/2023/03/28/energiaigeny-akkumulatorgyartas-debrecen-catl-gazeromu-napenergia-holoda-attila/

[34] https://telex.hu/gazdasag/2023/03/27/a-debreceni-catl-ismertette-a-terveit-jovore-probauzemet-ket-ev-mulva-mar-eles-gyartast-szeretne

of environmental protection areas.[35] When the pipeline was planned, it was still classified as an industrial project, but was later approved as a drinking water pipeline. The karst water system is complex, depending on rainfall and temperature, it is not known how much the water level will sink if tens of thousands of cubic metres are removed from the system. Contrary to the high costs of wastewater purification, clean karst water can be used and extracted cheaply (95% of Hungary's drinking water supply comes from groundwater, which is the basis of the water network[36]).

In the case of Debrecen, there is no large river nearby, groundwater must be used by CATL, but also by other factories. The EcoPro Global cathode plant has a 364-page Impact Assessment and Environmental Permit Application Document and on page 88 it says: The *operation of the plant will result in the withdrawal, use, purification and discharge of significant quantities of groundwater to the atmosphere as evaporative losses and to surface water as treated wastewater... The operation of the plant may cause a long-term and significant depletion of groundwater resources, leading to a quantitative and therefore qualitative deterioration of groundwater resources... The impact on groundwater is* ***damaging."*** (In the case of battery manufacturing plants, the impact is almost always classified as "tolerable" everywhere else). The word "damaging" is no longer used in the 31-page environmental permit given for the cathode plant[37].

The daily water demand of the EcoPro cathode plant is documented as 3306m^3 and CATL has given a daily demand of 3378-6232 m^3 in its revised safety report of January 2023. Other battery, automotive and other factories in the Debrecen industrial parks will also have water needs, these altogether with the water necessity of the city can reach the capacity limits of the Debrecen Waterworks (105 000 m^3 per day)[38].

The fact is that Debrecen is underlain by a so-called depression funnel, with the city sinking by 6.6mm per year (Nagy-Verdó, 2012). This "*means that when large amounts of water are abstracted from drinking water wells, the groundwater level sinks like a funnel. The huge depression beneath Debrecen alters groundwater flow conditions*

[35] https://24.hu/fn/gazdasag/2023/05/26/akkumulatorgyar-akkugyar-komarom-viz-vizugy-karsztviz-tata-tatabanya-sk-innovation-beruhazas-civil-meszaros-lorinc-vizvezetek-fakivagas-kornyezetpusztitas-termeszet/

[36] http://www.nyuduvizig.hu/index.php/vizkeszlet-gazdalkodas/felszin-alatti-vizek

[37] https://www.kormanyhivatal.hu/download/3/a6/28000/JHNY_00748_47_k%C3%B6zh%C3%ADrr%C3%A9%20t%C3%A9tel_alairt.pdf

[38] https://www.debreceninap.hu/helyi/2023/01/13/a-debreceni-vizmu-teljes-mellszelesseggel-a-kinai-akkumulatorgyar-mellett-all/

and sucks contaminants from the periphery into drinking water wells. The Debrecen area is the most subsided in Hungary, the impact of increasing water abstraction on subsidence should be investigated.[39]" The conclusion of Nagy-Verdó's (2012 p.92) study is that it is essential to reduce groundwater use in order to protect drinking water. "*Reducing industrial and other private water use is essential, and the efficiency of wastewater treatment should also be improved."*

According to the CATL Environmental Impact Assessment, "*nearly 85% of the water used will evaporate.*" According to information from the company, 80% of the water demand is for cooling towers, about 10% is for workers, and another 10% is for washing and solvent dilution during production. The use of "grey water" (treated wastewater) is emphasised by factory representatives and the media. The environmental permit states that *"it will be assessed how the industrial water demand can be met from treated wastewater or non-potable water."* (p. 94) Grey water "*specifically means that the treated effluent from the Debrecen treatment plant, which is mechanically filtered and biologically well cleaned, would be discharged to the plants in the required quantities, after the necessary facilities have been implemented."* (page 154). There are therefore three types of water: drinking water, grey water and wastewater, with a separate pipeline planned for grey water.

Cooling towers in battery factories generate significant amounts of water vapour. The average specific volume of water discharged to the air is 1.2 litres of water/minute/m^2 of installation area (this is 1728 l/m^2 per day) according to the CATL 1 Unified Environmental Permit. The aim is to minimise the impact of water vapour from the cooling towers on the site environment. The impact on the traffic of the nearby airport is not clear from the permit: "*answering safety questions related to the airport* is *outside the scope of this document.*" (p 111)

Because of the Samsung factory in Göd by the Danube, the southern groundwater basin in Vác is being reopened. This was closed 43 years ago (for 50 years) due to severe pollution then from the Chinoin pharmaceutical and Taurus rubber factory[40]. The water

[39] https://24.hu/tudomany/2023/03/06/debreceni-akkumulatorgyar-strategia-kornyezeti-hatastanulmany-vizigeny-hatasok/

[40] https://qubit.hu/2020/06/02/40-eve-tortent-az-egyik-legszornyubb-kornyezetpusztitas-magyarorszagon

extracted from here is purified in a new surface water extraction plant and then piped separately as industrial water to the Samsung factory. The drinking water capacity of the Göd industrial park will increase threefold and the industrial water demand will increase 12-fold. Wastewater from the Göd factories will be discharged to 13 km to Vác, where a brand-new wastewater treatment plant will have to be built next to the existing one[41]. The water pipeline construction has begun, and trees were cut in March 2023 along the bicycle line around Sződliget.

In the winter of 2022, rainfall was low in Europe, and reservoirs (lakes and rivers) were not filled for the summer months. The drought will cause permanent damage and water supply problems on the continent in the years to come. In view of this, we do not know any medium- and long-term hydrogeological calculations for the Tata basin and for the CATL factory[42]. The Debrecen Waterworks' position on this can be found in the CATL's environmental permit: '*Debrecen Waterworks Ltd. and all other water utility operators in the country are not competent and do not have the responsibility to calculate the recharge of water resources. This, as well as the registration and calculation of water resources, the measurement of water-holding elements (infiltration, evaporation, run-off, precipitation), the decision on the quantities of water that can be released to different water users (residential, agricultural, recreational, etc.) are the responsibility of the Water Management Directorates, with whom the Authority, in cooperation, decides on the* quantity *of water that can be extracted when issuing the water operating licence.*" (p.154) The Tiszántúli Water Management Directorate's expert opinion was that CATL's water management should be redesigned, as it would impose a serious burden on the city's water management in a few years' time. The director who signed the document was relieved from his position by the Minister of the Interior[43].

The condition of domestic water pipes is very poor. Due to the populist economic measure of cutting utility bills, the losses of utility companies have prevented the renovation of the outdated pipe infrastructure. According to a study by the Water Coalition (2022), the average renovation cycle for water pipes is 271 years, and the average loss of drinking water supply networks was 23% in 2020, but there were areas

[41] https://godihirnok.hu/jo-es-rossz-hireket-is-kapott-god-vizugyekben-a-vaci-forumon/
[42] https://www.vg.hu/nemzetkozi-gazdasag/2023/03/2023-is-az-extrem-idojaras-eve-lesz
[43] https://24.hu/belfold/2023/03/23/catl-akkumulatrgyar-debrecen-tiszantuli-vizugyi-igazgatosag-szakvelemeny-pinter-sandor-kirugas/

where 60% were leaking due to bad pipes[44]. The critical condition of water utilities was already highlighted in official documents in 2017, yet no improvement has been made[45]. Around the battery factories, it will be necessary to upgrade the water pipes – diverting huge financial and human resources from other areas of the country.

7. Environmental impacts

Hungary's Fundamental Law (Constitution) states (page 5, Article P/1) that "*natural resources, in particular arable land, forests and water resources, biodiversity, in particular native plant and animal species, and cultural values are the common heritage of the nation, the protection, maintenance and preservation of which for future generations is the duty of the state and of all.*"

If the rules are not respected, battery factories could become polluting plants, the costs of which they would have to bear. *"The price of climate protection should be paid by the climate destroyers, so let the big companies bear the burden*[46]*"* (Viktor Orbán's speech, 2021).

According to the Minister of Economic Development, "*the government expects and even demands that all investments, including battery investments, in Hungary should be carried out in compliance with the strictest possible environmental standards. The authorities must act accordingly, it is in the interest of all of us. And in many cases, Hungarian environmental standards are stricter than EU standards, for example on water use, water quality, soil quality and soil protection, emissions of pollutants, air quality*[47]".

This picture is somewhat nuanced by the practice that has (also) developed so far in relation to existing battery factories in Hungary:

1. The plants are classified as "priority investments of national economic importance" (often "requested" by the municipalities themselves). In addition, two special economic zones have already been created around battery factories (Samsung-Göd, SK-Iváncsa and its surroundings). These priority investments and zones are subject to fast-track,

[44] https://www.facebook.com/watch/live/?ref=watch_permalink&v=515470223510845
[45] https://hirlevel.egov.hu/2017/07/16/kritikus-allapotban-a-vizkozmuvek-egyszeruen-elfolyik-a-viz/
[46] https://2015-2022.miniszterelnok.hu/a-magyar-csaladok-helyett-a-klimaromboloknak-kell-megfizetniuk-a-klimavedelem-arat/
[47] https://www.vg.hu/vilaggazdasag-magyar-gazdasag/2023/03/nagy-marton-ne-terjunk-le-az-utrol

simplified procedures, lighter regulations (e.g. no environmental impact assessment was required for the Samsung expansion[48], the first phase of the SK in Komárom, the electrolyte plant in Soskút and the start of the SK investment in Iváncsa.) and municipalities have no say in the decisions. The possibility of such priority investments was created by the 2006/LIII law, with the aim of speeding up procedures, shortening deadlines.

2. There is no prior public consultation and information, decisions are not transparent. Investment permits are granted very quickly, despite civil protests, and construction starts quickly. The authorities, which are increasingly understaffed, are pressed by deadlines and the information available to them is incomplete, but permits must be granted within the given time limits. *"The Safety Report has been prepared with "reduced content" in accordance with the possibility offered by the regulation. The reason is that the technological and architectural design process has been - and is still being - carried out in parallel with the analysis of the Safety Report. For this reason, not all data were available in a final and accessible form for use in the Safety Report. As a result, complete design data on the buildings (dimensions, fire compartments, openings/passages, fire extinguishing system, ventilation, etc.) were not available"* (CATL Phase 1, Safety Report).

As the legislation allows for this, the authorisation process is carried out in sections, with the whole project being sliced up into phases. This "salami-slicing" has been strongly criticised by WWF[49]. The Samsung, SK, CATL were also licensed by expansion phases, the whole picture, the impact of the whole investment is never known, never estimated.

3. In case of problems, factories and authorities sometimes classify or delay information, and investigations are not always thorough enough. In the case of accidents at work, information is withheld. Factories are fined with small amounts for non-compliance because the legal background makes it possible. For example, the Government Decree 259/2011 (7.12.2011) on fire safety fines and on the compulsory safety of workers contains an annex with the maximum fines of only HUF 1-3 million for each case[50].

4. The construction of certain industrial parks and the construction of utilities are

[48] https://www.kormanyhivatal.hu/download/4/e0/f5000/04968-22_2020.pdf
[49] https://greenfo.hu/hir/a-fenntarthato-akkumulatorgyartas-felteteleinek-10-pontja/
[50] https://net.jogtar.hu/jogszabaly?docid=a1100259.kor

usually carried out by the same crony companies. The land and logistics are usually provided by the National Industrial Park Management and Development Ltd. owned by people close to the government.

The trends summarised in these four points are not the fault of the investing companies, they simply take advantage of the opportunities and small penalties.

7.1. Göd and Samsung

In the context of the EV battery factories operating in Hungary, the most public protests reported in the press have been about Samsung SDI in Göd.

Preparations at government level for the Samsung's investment started early. In 2016, Hungary applied to the EU to amend the regional aid map (Göd and Sződliget were included, other two cities were excluded), and Samsung's application for state aid was notified to the European Commission on 3 July 2017[51]. The battery factory was declared a national priority investment by a government decree in 2016. The application for building the plant was submitted at the end of June 2016. The local Government Office granted the permit for seven buildings, with various mechanical, environmental and safety conditions, less than a month later. Samsung was granted the landscaping permit in January 2018, which required the planting of 806 trees (which was not subsequently implemented anyway). In May 2018, a further "Zone C" and in June 2018, a "Zone B" building permit was granted, with conditions for the use and storage of hazardous materials. No environmental impact assessment procedures were required for the successive expansions of the factory[52]. The expansion of the factory was promoted by the Fidesz-led municipality in July this year, asking for the creation of a new industrial area: *'We need to draft a letter asking the foreign minister: Göd has plans to create an industrial area. We do not mention Samsung in the letter. We only say that we would like the land here to be taken out of agriculture. Then we will turn it into an industrial economic area and then Samsung will win the tender." (*05.07.2018 Extraordinary

[51] https://ec.europa.eu/competition/elojade/isef/case_details.cfm?proc_code=3_SA_48556
[52] https://www.kormanyhivatal.hu/download/4/e0/f5000/04968-22_2020.pdf és https://drive.google.com/file/d/1DqQsNo7k0_xvXQ-9xEta1kK_Hh3aMcT7/view, 14. old.

meeting[53], Mayor József Markó).

The state has a loan for the purchase of the properties, and in addition, Göd received a development aid also for the replacement of the 25 hectares of forest[54]. Samsung was keen to build as soon as possible*. They are fighting for the forest to be planted somewhere else, because so the process would happen faster, then they could start the work and they wouldn't have to wait until we make an agreement with the private owners here in Göd.*"(ibid.)

The construction of the factory was not fully carried out according to the specifications, and the buildings had started operation without the required permits, for which Samsung were later fined HUF 1 million in May 2021[55]. "An *on-site inspection established that the extension of the main building of the battery manufacturing plant marked with zones B and C on the property in question was in use despite the fact that it did not have a permit for use, and therefore I prohibited the use of the building part with immediate effect by a decision dated 10 February 2021. On 13 May 2021, I carried out a further on-site inspection of the part of the building concerned by the prohibition of use and found that the part of the building was in use and the production lines were in operation."* (Extract from the punitive resolution).

As the unauthorised operation continued, another fine was imposed. The various, serial fines imposed on the Samsung factory have been documented by the NGO GÖD-ÉRT. In February 2023, a parliamentary reply from the Secretary of State revealed that between 2019 and 26 January 2023, the factory had been fined 39 times for industrial safety reasons, totalling HUF 101 million[56]. Despite these a further extension permit was granted for the factory in early 2023[57]. Compared to Samsung SDI's turnover and profits (see Table 3), the serial fines are hardly "visible". Consideration should be given to overhauling the old laws governing fines (e.g. Government Decree 259/2011 (7.12.2011)) and to imposing fines on a percentage basis of turnover instead of an absolute amount.

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[53] "Gödi sírások" https://www.youtube.com/watch?v=KIgkYZNaJO4
[54] http://www.kozlonyok.hu/nkonline/MKPDF/hiteles/MK18126.pdf, 68.old.
[55] https://kimittud.hu/request/16712/response/26056/attach/7/SKM%20C224e21061612000.pdf
[56] https://drive.google.com/file/d/1JAhTC7GzvU2t_qK_yaNMUGrpHSAvwFLf/view
[57]https://telex.hu/komplex/2023/02/20/akkumulatorgyartas-az-iparag-amelynek-az-utjabol-eltakaritjak-a-torvenyeket

Table 3: Samsung SDI and SK ON, financial data

	Samsung SDI			SK ON usd		
million EUR	**2020**	**2021**	**2022**	**2020**	**2021**	**2022**
Net turnover	1,363	2,058	4,075	265	488	914
Profit before tax	17	46	84	-1.4	-5. 4	18.8
Corporation tax	2	4	7	-0.1	-0.4	1.6
Wages	46	62	77	29	29	40
Social security contribution on wages	8	9.7	9.7	-	-	-
Employees	1,980	2,452	2,667	1,132	1,276	1,278
Temporary work		54	72	-	-	-

Source: https://e-beszamolo.im.gov.hu/, USD data of SK converted into EUR at the average exchange rate for the year

The residents of Göd submitted a series of complaints to the authority about the noise from Samsung. The municipality was rendered powerless, because in early 2020 the government classified the industrial area of Göd as a special economic zone, thus removing the authority of the opposition-led municipality over the Samsung factory. (The city lost the factory's business tax, which was one third of its total yearly revenue.) The environmental authority ordered the battery company to prepare a noise reduction plan in September 2020[58]. However, the plan did not address the real location of the noise and committed to reducing it in three phases with a deadline of one and a half years[59]. Samsung failed to meet even the long deadline, the noise reduction plan was not completed, and Samsung was fined to HUF 200,000 (but the decision was not published)[60]. In the meantime, in early August 2021, on a quiet night, the KG Filter Laboratory (commissioned by Samsung) made measurements and did not find any

[58] https://merce.hu/2021/02/03/nem-szamithatnak-gyors-es-hatekony-zajcsokkentesre-a-samsung-gyarat-ejjel-nappal-hallgato-godiek/
[59] https://drive.google.com/file/d/13XoyUbW-o_qPtUXI7d-osGDY7g7DUy72/view
[60] https://drive.google.com/file/d/15pEuYv-5Vli6gFuH6Rb3D6qn_7PZYSPL/view és https://kimittud.hu/request/20155/response/28574/attach/4/PE%2006%20KTF%2000684%203%202022.pdf?cookie_passthrough=1

exceedance of the noise limit values in two areas of Göd[61].

The GÖD-ÉRT civil association had tried to request Samsung's groundwater monitoring protocols from the Budapest Disaster Management Directorate through a public interest data request from 1 January 2018 on. The authority refused to provide data, so the NGO filed a lawsuit. The authority responded with a counterclaim, referring to lack of data, as no monitoring tests were carried out at the factory in 2019 and 2020 (although these annual tests had been required by the same authority). On the other hand, according to their position, the samples and official documents of wells and desiccating reservoirs on Samsung's industrial site are "not public for ten years from their creation[62]".

Meanwhile, in spring 2022, an independent engineering firm was commissioned by the GÖD-ÉRT association to sample groundwater wells in three locations in the city. Laboratory analysis of the water samples found low levels of lithium and 12-17 µg/l NMP. "The *presence of this compound cannot be explained by natural causes. Its human health effects range from skin and eye irritation to reproductive toxicity. The compound is known to be used as a solvent in lithium battery manufacture*." - says the laboratory result[63]. Since the case has been highly publicised, the Danube Regional Waterworks Ltd. has tested the drinking water of Göd and the wastewater of Samsung, and no NMP was found in either sample[64]. As to how NMP could have entered the groundwater wells, no investigation was launched.

The Court of First and Second Instance ruled in favour of the civilians and ordered the Metropolitan Disaster Management Directorate to release the water monitoring data. These showed that the monitoring well at the factory had not been sampled since 2016 and had been buried during construction. However, a new monitoring well was not required, the water authority only required testing for the stormwater ponds at a depth of 0.5 - 1 metre[65].

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[61] https://drive.google.com/file/d/1-VmYZsdCh6f0NFnAb1osdxdk-9LNlwar/view
[62] https://drive.google.com/file/d/1Vs6ME7uYFFx2Js8HnHExDFCw2gYcNR__/view
[63] https://drive.google.com/file/d/1VAUdfzPi1pY8tkREvr-K6tKbFmWDuyQF/view
[64] https://www.dmrvzrt.hu/static/internet/download/22_589_1_6.pdf
[65] https://atlatszo.hu/kornyezet/2023/01/12/pert-nyertunk-es-kiderult-betemettek-a-kutat-ami-megmutatna-mergezi-e-a-talajvizet-a-godi-akkumulatorgyar/

7.2. Komárom - SK ON

In 2017, the Fidesz-led Komárom municipality decided to sell 43 hectares of industrial park land to the South Korean battery manufacturer SK Battery Hungary, and the expansion of the industrial park was classified as a priority investment in the national economy by the government in November. The Korean company submitted its application for the operation of the facility in June 2019, and the investigation procedure was closed on 6 August by the County Government Office, which concluded that "*I accept the preliminary documentation, since the environmental impacts are not significant, subject to the conditions set out in Chapters IV-V of this decision, and there are no grounds for exclusion of the planned activity, and therefore no environmental impact assessment is required.*[66]" These chapters provide, on the one hand, that the company must apply to the environmental authority for a noise emission limit value and measure the noise level after the plant has been put into operation and, on the other hand, that the company must obtain permissive opinions from the disaster control, public health, soil protection, mining, heritage protection and architectural authorities. The plant started operations at the end of 2019 and produced 10 million battery cells by 2020.

In 2019, a decision was also taken to build a new, larger factory employing thousands of people[67]. The investment was supported by the Hungarian government with HUF 32 billion (14% of the total investment value), which was approved by the EU in July 2021[68]. SK Battery was renamed SK ON in November 2021.

The battery factory in Komárom has also been a source of noise problems for residents. Following petitions, the construction of a noise barrier was finally planned for 2023[69].

[66] https://www.kormanyhivatal.hu/download/9/f8/75000/4362%2023.pdf
[67] https://hipa.hu/hir/masodik-europai-uzemet-is-magyarorszagon-letesiti-az-sk-innovation/
[68] https://ec.europa.eu/competition/elojade/isef/case_details.cfm?proc_code=3_SA_58633
[69] https://skonhungary.com/hu/2021/12/21/zajcsokkentesi-intezkedesi-tervenek-kivitelezesere-adott-megbizast-az-sk-komaromban-2/

Table 4: Carbon dioxide and NMP from industrial activity in the air of Komárom and Göd

	CO_2 city industry, kg	CO_2 Battery, dry cell production	NMP, kg
Göd			
2018	1,766,374	n.a	-
2019	3,017,155	n.a	349
2020	12,690,745	n.a	354
Komárom			
2018	30,085,978	n.a	-
2019	1,744,188,658	n.a	0
2020	2,042,486,792	1,999,163,830	403

Source: OKIR database

Data from the National Environmental Information System (OKIR) is available only until 2020. Table 4 shows the soaring carbon dioxide emissions of Göd and Komárom. Filtered by activity, only Komárom has data for 2020, which shows that battery production accounted for 98% of industrial CO_2 emissions. The data also show negligible NMP content in the air for two years.

7.3. Sóskút, Iváncsa

In relation to the Dongwha electrolyte and NMP processing plant, the municipality of Sóskút commissioned a law firm in January 2020 to prepare a "national priority investment" in the industrial park, which was known to be a Korean plant and a supplier to Samsung. On 18 June 2020, an environmental permit application was submitted for the electrolyte plant, which the Pest County Government Office rejected six days later, saying it was not necessary because it was not a chemical plant, there were no chemical processes, only physical ones[70]. A public hearing on the electrolyte plant's safety report of just 18 pages was held in September, where residents objected to the confidentiality of detailed information[71]. The electrolyte plant received a building permit on 24 September 2020. Dongwha NMP has also set up a recycling plant, for which an environmental permit was required, which was dated on 21 October. The documentation was prepared by the company ENVIPROG (the same as for Samsung and

[70] https://kimittud.hu/request/15636/response/22360/attach/7/17932%203%202020.pdf
[71] https://www.soskut.hu/?module=news&action=show&nid=132861#MIDDLE

CATL), and a public hearing was scheduled for 30 November. This was changed by the relevant Government Office to a public hearing by telephone in view of the pandemic situation, but the telephone number was constantly busy. However, some residents were able to ask questions, which were later answered in writing by the company[72]. The plant was granted an environmental permit on 15 December. In May 2022, IMSYS Ltd. issued an amended safety report for the two Dongwha plants, now 140 pages long, which is "*an extended version of the safety report, which was prepared with the plant design plans already available*" (p.12) [73].

In February 2021, it was revealed that SK ON will build a new factory in the Iváncsa industrial park. In April 2021, the ENVIPROG company submitted the documents for Phase 1 of the battery factory. It is a Li-ion battery cell plant with a capacity of 30 GWh, 2500 employees, 25 air pollution point sources, 125 delivery trucks per day, 1435 parking spaces, 17 000 tons of NMP consumption per year[74]. On 11 May 2021, the Fejér County Government Office, as the environmental authority, issued a decision closing the preliminary investigation on the factory under the registration number FE/KTF/4423-30/2021, stating that the implementation of the activity *will not have significant environmental impacts and that the activity is not subject to an environmental use permit*[75]. Government Decree 362/2021 (28.VI.) of 1 July 2021 designated a special economic zone in the administrative area of Iváncsa municipality.

The investor later decided to develop the plant with a larger production capacity, which will involve an increase in the number of combustion installations (9 hot oil gas boilers and 4 steam generators). An environmental permit for the boilers was issued in July 2022[76]. Subsequently, due to the expansion of the factory, SK applied for an environmental impact procedure, for which the impact assessment (except for the boilers) was completed on 23 January 2023. Production at the factory is scheduled to start in 2023. On 6 June 2023 dozens of workers fell ill at the factory construction site

[72] https://www.soskut.hu/?module=news&action=show&nid=134988#MIDDLE
[73] https://www.soskut.hu/?module=news&action=show&nid=143952
[74] http://kornyezetvedelem.fmkh.hu/hird2009/2021/FE-KTF-4423-30-2021_1620727520.pdf
[75] http://kornyezetvedelem.fmkh.hu/hird2009/2021/FE-KTF-4423-30-2021_1620727520.pdf
[76] https://filr.kh.gov.hu/filr/public-link/file-download/8a4880ee814901f9018267cd33062791/128099/296931361630865888/8597.zip

inhaling toxic materials.[77]

Usually, the environmental impact is not limited to a factory and its immediate surroundings, but covers a much larger area, due to the commuting workers by buses, the construction of infrastructure (pipelines), and the transport of supplies and waste of production. The transport of materials, products and workers will generate extra road traffic. The increased traffic will create more noise, dust, air pollution and the road and water pipe construction threaten ecological corridors. (In 2021, the Fejér County Directorate of Disaster Management fined Samsung for HUF 75,000 for violating the regulations on the transport of dangerous goods by road. An inspection at the M7 motorway revealed that the truck carrying 21 tonnes of lithium-ion batteries did not have the correct UN 3480 hazardous material markings on its load[78]).

8. Workplace safety

Almost all activities in the battery industry involve increased occupational health and safety risks due to increased exposure to chemicals (Czirfusz, 2022). The proportion of temporary and foreign workers is high, and communication problems arise due to the different languages spoken. (Foreign workers were among the victims of fatal accidents during the construction of battery factories. [79]) Below are some of the workplace safety problems that have been publicised.

Among the aforementioned series of fire and disaster control fines for Samsung in Göd, a 5 million HUF fine was the most notable, when 36 battery modules caught fire and Samsung failed to produce the fire extinguishing equipment permit, the fire protection regulations, the education and lightning protection protocol. The main fire switch was not installed, so power could not be immediately cut off during the fire

[77] https://hungary.postsen.com/news/195105/Index-%E2%80%93-Domestic-%E2%80%93-Several-hundred-people-went-on-strike-in-the-Hungarian-factory-where-several-people-fell-ill.html
[78]https://kimittud.hu/request/21221/response/30069/attach/4/Hat%20rozat%20anonim.pdf?cookie_passthrough=1
[79] https://www.duol.hu/helyi-kek-hirek/2023/01/ujabb-halaleset-az-ivancsai-gyarban

suppression[80]. A number of irregularities were also found in the storage of hazardous materials[81].

According to the air monitoring report of June 2020, in one of the sections "*the levels of respirable dust and N-Methyl-2-pyrrolidone exceeded the measured* limit"[82]. In autumn 2021, toxic sludge was found on the floor of a wastewater treatment plant[83]. In November 2021, there was a fatal accident at work, partly due to employee error, but due to employer negligence, the Pest County Government Office imposed a HUF 3 million fine[84].

In battery cell production, the bundles are subjected to X-ray quality control. SK Battery, for example, was granted a licence by the National Atomic Energy Office to operate thickness measuring equipment containing built-in radioactive sources in November 2019, for industrial X-ray equipment for coarse structure testing in 2020 but also Toray Industries Hungary Kft (separator foil factory) and obviously other similar plants. At the public hearing in Göd on 31 January 2023, a resident mentioned that the Samsung factory has a glass plate in front of the X-ray machines to protect workers, but that this is not a closed system, and that the combined radiation from the many X-ray machines can put workers at risk. According to a Samsung representative, the occupational safety and health authority found everything in order at the plant[85].

The accident at the SK battery factory in Komárom occurred in early 2022, with 12 people hospitalised, according to the factory and 14 according to the emergency services. Workers were not allowed to comment, and the company withheld any news. Several sources said there had been a leak of hazardous substances, but the test results did not confirm this[86].

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[80] https://kimittud.hu/request/19436/response/30078/attach/5/36300%201887%206%202021%20lt.pdf?cookie_passthrough=1

[81] https://drive.google.com/file/d/1xkqZP15RmegXxVarC3xW3CQR0v1We_OY/view

[82] https://kimittud.hu/request/19795/response/28358/attach/5/1902%203%202021.hat%20rozat.pdf?cookie_passthrough=1

[83] https://kimittud.hu/request/19436/response/27779/attach/6/4412%202%20Samsung%20hat%20rozat%20zemzavar%20esem%20nnyel%20kapcsolatban%20V%20signed%20sign....pdf?cookie_passthrough=1

[84] https://kimittud.hu/request/19795/response/28358/attach/6/231%206%202022.hat%20rozat.pdf?cookie_passthrough=1

[85] https://www.youtube.com/watch?v=cgNnznIyQxI **4:56:01**

[86] https://24.hu/fn/gazdasag/2022/01/20/komarom-akkumulatorgyar-baleset-uzemzavar-veszelyes-anyag-szivargas-tuz-robbanas/

The South Korean-owned SungEel Hitech plant in Szigetszentmiklós has been in operation since 2019. In 2021, SungEel's turnover was HUF 5.4 billion[87]. In July 2021, the company's plant in Bátonyterénye was also inaugurated, which processes 28,000 tonnes of scrap batteries from Göd and Komárom and also carries out NMP recycling. It started its operations without a safety permit and was fined HUF 3 million[88]. In July 2022, an unlicensed cell-grinder machine exploded at the company and four people were injured. As documents obtained by a public request show, SungEel has been fined several times for industrial safety problems.[89] In March 2023 the County Government Office controlled the plant and found repeatedly irregularities, storage of hazardous material without permission, strong chemical smell, and the controllers themselves got skin and throat irritation. The fine was HUF 31 million this time.[90]

Serious health and safety problems were found at SungEel's Szigetszentmiklós site in August and October 2022 (for example, 18 workers were found to have toxic exposure according to their laboratory results), and the Pest County Government Office imposed a fine of HUF 8.4 million[91]. The decision mentions serious risks of several workers and lists the shortcomings in 24 points. These include the fact that the authority's measurements showed that the concentration of several hazardous substances in the air at the production lines significantly exceeded the limit values, the exhaust fan was not maintained, its tube was missing, workers did not have prior medical permission to work with carcinogens, they were not wearing protective gloves, some control panels were marked only in Hungarian, but the worker was foreign, carcinogenic dust was stored in an accident-prone manner, contaminated water dispensers, drinking cups were found by the inspectors, etc.

In October 2022, SungEel submitted an application for expansion of its site in Bátonyterénye, because the expansion of the Samsung and SK ON factories will require a

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[87] https://e-beszamolo.im.gov.hu

[88] https://kimittud.hu/request/20750/response/29254/attach/5/SungEel%20birsag%20es%20koteleges.pdf?cookie_passthrough=1

[89] https://atlatszo.hu/orszagszerte/2023/03/07/rakkelto-anyagokkal-veszelyeztette-dolgozoit-a-godi-samsung-gyar-selejtes-akkumulatorait-feldolgozo-ceg/

[90] SungEel Hitech Hungary Kft., 3078 Bátonyterenye, Hatvani út 2. szám alatti telephelyen jogellenes hulladékgazdálkodási tevékenység folytatása ügyében – hulladékgazdálkodási bírság kiszabása. NO/HGO/1297-1/2023.

[91] https://kimittud.hu/request/21818/response/30745/attach/5/5528%2025%202022%20SungEel%20hm.s%20b%20rs%20ghat%20rozat%20anonimiz%20lt.pdf?cookie_passthrough=1

much larger (52 thousand tonnes per year) capacity for scrap and waste battery processing. "*The Nógrád County Emergency Management Directorate has reviewed the documentation and concluded that it does not consider the expansion of the capacity of the subject activity to be justified.*[92]" An environmental impact assessment procedure has been imposed by the Government Office. This impact assessment was also carried out by IMSYS Ltd. in Budapest (the same company as for example at Dongwha). The assessment recommends monitoring, otherwise the environmental impact is not considered harmful. The company received the permission on 31 March 2023.[93]

The above cases all concern Korean plants. Other Asian plants (Japanese, Chinese) built and operating in Hungary are not known to have such documentation of problems (Korean Japanese LG Toray Hungary received a HUF 350 000 fine in 2021 for failure to report GHG emissions[94]), but they have not yet started production, or are component manufacturers that do not require large quantities of hazardous substances. It does not follow, of course, from the discovered infringements that new investors will do the same. In any case, industrial safety legislation and penalties could be tightened up and worker safety and worker representation is still a little discussed issue.

9. Some social aspects

Increased numbers of foreign workers arriving to build and later operate battery factories could cause ethnic tensions. There is no apparent government strategy for dealing with these, and the mentality of many people has been influenced in this direction by the anti-immigrant and anti-refugee state campaigns of recent years. According to surveys, Hungarians are by far the most anti-immigrant in Europe (Messing and Ságvári, 2018).

Public sentiment against foreign workers is usually channelled mainly by the right-wing Our Homeland party[95]. At the public hearing on the CATL factory in Debrecen on 20 January 2023, it was also said that the Chinese could spread tropical diseases and

[92] https://nmkh.hu/images/KVO/SungEel_Hat%C3%A1rozat.pdf 20.old
[93] https://nmkh.hu/images/KVO/SungEel_Hat%C3%A1rozat.pdf
[94] OKIR adatbázis
[95] https://magyarjelen.hu/a-mi-hazank-tobb-10-ezer-fulop-szigeteki-vendegmunkas-erkezese-ellen-tiltakozik/

that Hungarian land is not for sale to the Chinese[96]. In addition to the xenophobia of Hungarians, the mixing of guest workers of different nationalities can also cause tensions between themselves.

In addition to the direct effects (e.g. noise, dust, haze), the lives of people living near the factory are also affected by the depreciation of their property, making it difficult for them to move away. One interviewee from Komárom said that they could only sell their detached house for 60 percent of the price offered by the estate agent. The first buyer to come forward was a South Korean catering contractor who was a subcontractor to the company running one of the factory's units[97]. At the public hearing in Göd, a woman said that she could only sell her 210 m2, six-room, double-comfort house with a basement for up to only HUF 30 million[98]. At the same time, as in Komárom, rents are soaring because of the influx of migrant workers. This is also expected in Debrecen, and this will negatively affect people looking for renting, even university students. The presence of dangerous factories and the fear of pollution may increase the eco-anxiety of nearby residents. There may be increased out-migration, population turnover. Many residents in Iváncsa are considering moving and advertising their homes.

One of the unintended social effects of battery factories is the strengthening and unification of civil movements. Links are being forged, civil groups from other cities participate in public hearings and demonstrations, and joint events are being held. The safety and environmental impact assessments of factories are read by civil society and comments are submitted to the authorities. Hundreds of comments have been received on the environmental permit for the CATL 1 plant. Civilians are sharing information with each other, thus increasing public awareness to some extent.

Further investments (e.g. power plant construction) due to battery factories may also affect more remote settlements. In addition to the direct impacts, there may be no money left to develop other areas of the country and other sectors. The indirect and

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[96] https://www.facebook.com/Debreciner2.0/videos/k%C3%B6zmeghallgat%C3%A1s-debrecenben-a-k%C3%ADnai-akkumul%C3%A1torgy%C3%A1rr%C3%B3l/874618703652803/

[97] https://index.hu/gazdasag/2023/03/07/akkumulatorgyar-komarom-helyszini-riport/

[98] https://www.youtube.com/watch?v=cgNnznIyQxI&t=3h30m55s (3:30:55-tól)

social impacts of the development of the industry's power plants should be analysed in more depth.

10. Debrecen and the CATL

CATL is the world leader in battery manufacturing, with a market share of 37%[99]. The company is one of China's leading companies and a leader in research and development. Its founding chairman is Zeng Yuqun (Robin Zeng), who is also on the advisory board to the Chinese Communist Party (Tyler-Dudley et al., 2021). This suggests that although the Party does not have much influence on the company's activities, Zeng may have some influence on economic policy as long as he is allowed to. Zeng was an early collaborator with German car companies, strongly supporting the internationalisation of CATL, which led to the company investing in Germany and planning a factory in the US with Ford. The Chinese investment is not being welcomed by conservative, Republican politicians in the US[100]. CATL is working with TESLA, Zeng and Elon Musk are on good terms. However, CATL's international expansion has recently raised concerns from the Chinese president about security concerns and the backlash from other Chinese companies[101].

In summer 2018, it was announced in Germany that the Chinese company CATL would invest in Arnstadt, Thuringia. (A good location factor that 40% of young people in Thuringia study science, technology, engineering and mathematics, and there are four universities, Fraunhofer Institutes and an electromobility research centre nearby). Construction of the CATL factory started in October 2019, with the agreement of the Arnstadt municipality and residents. In the spring of 2022, the public was faced with 130 lorries per day and support for CATL declined slightly[102]. Due to increased truck traffic and transport safety, negotiations between DB Cargo and CATL on the renovation of the freight yard and tracks at Arnstadt have intensified. However, on 17 January 2023, it was announced that DB Cargo had calculated that the increased construction and

[99] https://cnevpost.com/2023/02/08/global-ev-battery-market-share-2022-catl-37-byd-13-6/
[100] https://insideevs.com/news/652686/ford-battery-deal-with-catl-draws-backlash-from-us-senators-reps/
[101] https://www.reuters.com/world/china/chinas-xi-tells-catl-he-has-mixed-feelings-about-its-battery-dominance-2023-03-07/
[102] https://www.zeit.de/2023/04/catl-batteriefabrik-thueringen-arnstadt-china

environmental costs would not be worth it and would abandon the project for the time being[103].

The investment in Debrecen is announced to be a 100 GWh capacity factory complex covering 220 hectares, but only the first plant is currently being built and licensed. The legal background ensures that the impact assessments do not cover the whole project. "*If an investment is planned to be built in several phases, there is no legal obligation to carry out an environmental impact assessment of the final phase or to obtain an environmental permit for it*." - says CATL 1 in its environmental permit. The first CATL plant would employ 2668 people. According to the company, 10 to 15 percent of these will be Chinese. This is also indicated in the environmental permit: "*In order to make the factory a success from an early stage, senior staff from the technology and management department will be sent to work in Hungary from the headquarters"* (p.146). (A similar situation is seen at CATL's Arnstadt factory, where part of the workers are Chinese, working 12 hours a day, 3 shifts, 6 days a week.)

The information provided by the investor is available from the CATL Phase 1 Environmental Use Permit. The plant would produce 40 GWh of battery capacity on 67 hectares. It will handle 350 trucks per day with an expected loading noise of 89 dB. The plant will have 49 air pollution point sources, 10 of which will be chimneys, the rest will be other vents. The plant would also have 10 boilers, emitting 288 000 tonnes of carbon dioxide per year. 50 000 tonnes of carbon dioxide emissions from associated traffic and a further 169 000 tonnes of carbon dioxide emissions from electricity consumption could be accounted for, but not on-site (in total, 507 000 tonnes of CO_2 emissions could be associated with the first plant).

The CATL site is classified as an upper-tier establishment of dangerous substances. The hazardous substances used are: 2,000t solvent (NMP)+ 115t butane diol per year, Li-ion battery electrolyte (700t), lithium nickel cobalt manganese oxide (1,695t), cathodic dispersant (21t), ethanol (1.3t), natural gas (0.08t), diethyl carbonate (DEC, 1.6t), hydraulic oil (0.3t), anti-rust oil (WD-40, 2.3t), ISOGUARD fluid (0.04t), diesel (0.8t), biocil-B (0.3t), + polyvinyl fluoride (168t), adhesives (613t).

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[103] https://wirtschaft.thueringen.de/ministerium/presseservice/detailseite-1/umbau-des-gueterbahnhofs-arnstadt-wird-nicht-wie-geplant-umgesetzt

The 18,300 tonnes of dangerous waste and scrap batteries generated annually will be treated on site, with the on-site NMP regeneration system expected to be operational by the end of 2025, until then the recycling will be outsourced to a Korean company based in Hungary. The total amount of waste generated by the planned activities of Plant 1 is about 1/8 of the amount of waste generated by the production activities in Debrecen on an annual basis.

12 monitoring wells were planned for the factory site, which is an improvement compared to Samsung in Göd, where none were planned for five years (and none were used ever). The impact assessment on wildlife took place on 14-15 March 2022. As one NGO noted, many of the breeding birds, butterflies and insects are not yet present at this time, so it would have been better to carry out observations throughout several months.

Table 5: Battery plants in the Southern industrial park of Debrecen

	Semcorp (separator film)	**EcoPro cathode plant**	**CATL 1**	**Total**
Hazardous material stored at one time, tonnes	8,175 Year: 42,769	18,438 Year: 227,000	4,535	31,148
Hazardous waste/year, tonnes	37.5	7,601	18,300	25,938.5
Water demand/day, m^3 (peak water demand)	1,662	3,306	3,378-(6,232)	8,346 (11,200)
CO_2 , tonnes, equivalent/year*	n.a.	484,599	507,000	991,599
Number of air pollutant point sources	45	86	49	180

Source: environmental and safety documentation of the plants. * Most of the CO_2 emissions do not take place in Debrecen.

So far, the data only refer to the first phase of CATL, but the southern industrial park in Debrecen also has a separator film plant (Semcorp) and a cathode plant (EcoPro Global). Both work with hazardous materials and have water and energy requirements. However, it is difficult to calculate aggregate impacts from the factories' documentation

because the data are not consistent or the information is incomplete. Table 5 attempts to provide some kind of summary for the battery manufacturing plants in the Southern Industrial Park. If the plans are implemented, two more CATL plants could be added to the table. It should also be mentioned that BMW will also establish a battery assembly plant and Eve Power a cell producing factory in the northern industrial park.

11. Communication with authorities and government

In today's autocratic Hungary, environmental and other NGOs generally find it difficult to access information. They can mostly resort to public interest requests for information, or to obtain official documents. The strength and activity of an NGO in a given municipality varies greatly. Among the towns near the battery factories, the most active was Göd (GÖD-ÉRT association). In the case of the planned battery factories, the associations Szívügyünk Szentiván (Our Heart in Szentiván) in Győrszentiván and Mothers for the Environment (Miakö) near Debrecen are active in protesting against the planned battery factories. Local governments usually do not cooperate with NGOs, with the exception of the oppositional mayor of Göd, elected in 2019 who had also problems obtaining information. "*When I ask for information officially on behalf of the municipality, I ask for data in our status as a client, and one time they refuse, saying that we are not clients, another time they give me a evasive answer, a third time they transfer me to another department and stall me, and in the end they give me an extract from the documents that would tell me what water capacity they are working with, what materials they are working with. They give you a synopsis of the substantive information that just makes you suspect what it is they're trying to hide.*" (Csaba Balogh, oppositional mayor of Göd, resigned on 10 February 2023).[104]

In the case of the Dongwha plant in Sóskút, the local mayor explained why the public was not informed in time[105]: *"Of course, I could have made these negotiations public as mayor, but anyone who knows anything about economic and political management knows that there is a protocol. As the negotiations continued until the last days, the final announcement was made by the CEO of the investing company and our*

[104] https://hvg.hu/gazdasag/20230130_Fulke_akkugyar_kisokos_Debrecen_God_Catl
[105] https://www.facebook.com/permalink.php?story_fbid=169484991376329&id=105354747789354

Foreign Minister. Can you imagine that I could have informed the international press days or weeks in advance? "

In the context of the public hearings in Debrecen, the media picked up the battery industry. Instead of a meaningful reaction, government communication tried to portray the public protesters as some kind of foreign agents[106]. For a long time only the leader of the Hungarian Battery Association, Péter Kaderják, tried to make any kind of professional argument. The government was unable to refute the above-described cases in Göd, and trivialised or silenced the NMP found in the groundwater there.

The Parliament's Sustainable Development Committee held a meeting on 14 February 2023 on the state of battery factories and water utilities. Representatives from a number of large and small NGOs attended it, but no one from the government. The director of the Hungarian Battery Association said they have no role in solving sustainability and environmental problems, nor they have any responsibility for ensuring that companies and authorities comply with legislation and environmental regulations, but that if "NGOs work well" there will be no problem.

In the current situation, government cannot communicate easily, because so far it has been possible to propagate simple messages of a few words ("stop Soros," "protect our children," "let there be peace"). Industrial policy is more complicated, and it is difficult to understand why factories have been allowed to break rules with small fines or why another huge factory has to be built on the best land. Residents fear for their water, their air, their environment, protect their children and this time they communicate with simple messages. "No to battery firms!," "No to sell Hungarian land!," "Our health is not for sale!" etc. The public no longer believes the authorities, mainly because of the experience in Göd and other cases. At the public hearing in Debrecen a resident pointed out:" *We do not want to argue about what will happen if they measure high levels of pollution and close the factory. If the factory has to close, then the problem has already happened. We want to avoid that risk.* [107]" Because market competition and

[106] https://telex.hu/belfold/2023/02/08/akkumulatorgyar-debrecen-tiltakozas-propaganda-kormanykommunikacio-reakcio-szijjarto-peter

[107] https://www.portfolio.hu/krtk/20230202/miert-all-a-bal-most-debrecenben-a-kinai-catl-akkumulatorgyarak-europai-tanulsagai-594024

the rule of law mechanisms are distorted in the country, the citizen is left defenceless. Therefore, he does not want a dangerous plant in the first place.

The Fidesz government claims that the protests against the battery factories are politically motivated. No doubt, seeing the public concern and resistance, opposition parties are also trying to capitalise on this: LMP, Momentum, Mi Hazánk have all moved. LMP has called for a national referendum on the issue, which was rejected, like all other referendum, requests from locals.[108].

11.1. Public hearings

The authorisation procedures for factories under construction require mandatory public hearings. Here, safety and environmental plans (where available) are presented by the experts preparing the documentation, and questions are answered by representatives of the factory and the authorities. At the public hearings on battery factories, the public usually asks many questions which are rarely answered by the authorities due to lack of competence or information. After the public forums, the factories quickly obtain the necessary permits. In the case of priority, specific investments, local authorities are often faced with a ready-made situation.

According to the representatives of the Iváncsa municipality, they only found out about the gigantic project after the contract had been signed. The industrial land is owned by the National Industrial Park Operating and Development Company, which is owned by the state. According to the mayor's report of 1 February 2021, "On *Thursday afternoon, I was informed by telephone that the SK Innovation group had chosen Hungary, including Iváncsa, from a number of possible countries. This was the basis for Friday's announcement that the largest greenfield investment in Hungary's history will take place in the Iváncsa Industrial Park*[109]. " SK has purchased eighty hectares of land for the production of Li-ion battery cells and module assembly using pouch technology. "*During Covid, while everyone was worried about staying alive, the factory was already structurally ready. By the time the first public hearing was held, the concrete was poured and the*

[108] https://www.portfolio.hu/gazdasag/20230321/nem-lehet-nepszavazas-magyarorszagon-az-akkumulatorgyarakrol-604284
[109] https://www.facebook.com/permalink.php?story_fbid=2892036067730015&id=1956638591269772

supporting columns of the factory were in place[110]." In September 2021, a four-hour public hearing on the battery factory was held in Iváncsa. Here, the county representative pointed out that there is a serious labour shortage in the county, the company's task is to find workers, and the authority cannot interfere in this. The managing director of SK Korea said that in Komárom more than 90% of the workers in their factories live within a 50 km radius and that they are also trying to do the same in Iváncsa. Questions were raised about the environmental impact of the only 2 m high, non-forested protective filling and also about noise. "*I don't want tolerable noise, I want silence*", said one man.

On 8 January 2020, the Managing Director of Generisk Ltd., the company preparing the Safety Report, gave a projected presentation on the requirements that the Samsung factory will have to meet in order to meet the upper threshold. The questions asked at the public hearings in Göd received few substantive answers from residents. This was the case, for example, at the last five-hour forum on 31 January 2023[111]:

- At what price and under what contract does the factory receive the electricity? Answer: *contracts cannot be published.*
- How many cubic metres of water does the factory use per day and what hazardous substances does the industrial wastewater come into contact with? Answer from a Samsung representative: "*We do not have specific figures for production."*
- The licence for the 5 new monitoring wells promised by Samsung will only allow for testing of substances in the soil to a depth of half a metre, but this depth is not suitable for measuring groundwater, which is much deeper. Samsung replied: *'I don't have it in front of me now, but clearly we will dig down to where the groundwater is.'*
- The water officer of the disaster management department *could not say* what the NMP limit was, but said that *this could be checked in individual permits.*

[110] https://telex.hu/belfold/2023/03/01/ivancsa-akkumulatorgyar-epitkezes-akkumulator-munkas-halalozas

[111] https://merce.hu/2023/02/03/kedves-godiek-jatsszanak-tovabb-a-samsung-gyar-kepviseloi-az-eletunkkel/

- Asked where the noise map can be viewed, the factory representative said that Samsung is making it for itself, and that *they do not think it is necessary to publish it at the moment*.

Despite public opposition at a public hearing in Göd, the disaster management authority has granted permission for the use of the new Samsung factory buildings[112].

At the public hearing in Komárom in January 2023, "*no substantive answer was given to any question that really addressed important issues, i.e.: that the city administration found uncomfortable. As time went on, it became clear that the central issue here was going to be the industrial park, even from the mouths of many of the questioners. Is there a battery factory coming or not, is it dangerous or not, who measures emissions or not, why are we wasting arable land and crystal-clear karst water, where to run to in case of trouble*?[113]"

In Győrszentiván, on the outskirts of Győr, in a suburban area, the Municipality wishes to reclassify 350 hectares of excellent agricultural land. The partnership consultation forum was scheduled for Friday 5 August 2022 at 10am, but despite the early start, 200 people turned up at the Town Hall. Here, the residents were able to find out exactly where the industrial park is being built and that it was already classified in January as an investment of national economic importance, in which the city of Győr has little say. However, the city has received 10 billion forints in subsidies, so it has to buy out or expropriate the land and reclassify the area as a major industrial area of significant disturbance (GIPZ). This means an area with a risk of fire, infection and explosion. In September 2022, a residents' forum was held, where the mayor did not appear and residents did not get answers to their questions. Officials have repeatedly said that they do not know what kind of plants will be located in the industrial park, but earlier the President of the Chamber of Commerce and Industry of Győr-Moson-Sopron County referred to the Volkswagen battery factory[114]. A significant coalition led by the NGO group Szívügyünk Szentiván, with environmentalists, bioengineers, lawyers and

[112] https://merce.hu/2023/02/12/a-lakossag-tiltakozasa-ellenere-kiadta-a-godi-samsung-ujabb-engedelyet-a-katasztrofavedelem/

[113] https://www.facebook.com/people/%C3%89lhet%C5%91bb-Monostor%C3%A9rt/100063808794621/ 2023.01.27 bejegyzés

[114] https://www.vg.hu/megyefokusz/2022/06/elkeserito-a-munkaerohiany-az-osztrak-szlovak-magyar-harmas-hatarnal

members, has gathered 5585 signatures against the project[115]. The data requests of the NGOs were completely rejected by the mayor's office and the government office, and partially by the disaster management department, which replied that they had no such case[116]. In the meantime, the landowners have received a rather low purchase offer from the municipality through a law firm, which has not yet been accepted. The NGOs submitted 900 comments, but they were not read by the Urban Strategy Committee during the partnership consultation, and the NGOs have therefore initiated a legal supervision procedure against the municipality at the government office[117]. They also raised 16 million forints for soil and air pollution measuring equipment.

The largest publicity was given to the public hearings in Debrecen, especially the second one. One was already held on 9 January 2023 as part of the CATL plant's emergency licensing procedure, which lasted for six hours, the mayor of Debrecen told the audience that they did not consider the project to be damaging to the environment. The next day he said he would support the project even if the people of Debrecen did not[118]. At the event, the authorities tried to reassure the public about their concerns, but this was not very successful due to a lack of definite answers.

The second public hearing, held in Debrecen on 20 January 2023, attracted a lot of media attention and the outraged atmosphere was broadcasted across the country. This public hearing was part of the environmental licensing of the CATL factory and lasted 10 hours. The county governor and Hungarian and Chinese representatives of the factory were present, but not the mayor of Debrecen. "*A typical feature of the public hearing was that the representatives of the environmental, water and disaster control authorities, as well as the expert of the company preparing the environmental documentation, tried to convince the audience that the battery factory is not dangerous for the environment or human health, but the residents who spoke one after another said that they do not trust the*

[115] https://www.youtube.com/watch?v=E4FGkeqTugw
[116] https://magyarnarancs.hu/kismagyarorszag/gyorszentivan-akkugyar-egyetlen-adatigenylesukre-sem-kaptak-erdemi-valaszt-tiltakozo-civilek-256977
[117] https://telex.hu/belfold/2023/03/20/cim-1
[118] https://www.klubradio.hu/adasok/debrecen-fideszes-vezetese-akkor-is-tamogatja-az-akkumulatorgyar-megepiteset-ha-a-lakossag-nem-132019

authorities, based on the official malpractices and their own negative experiences with the Samsung factory in Göd.[119]"

Public hearings are therefore usually a meeting between the public, who have questions and doubts and who are opposed to the project, and the local or county authorities. However, these authorities are not competent decision-makers on the main issues: *'The question of why this investment is being carried out there, and what it is, is not a matter for the government office to decide*'[120] (Director of the Sopron County Government Office, Győr-Moson). Local authorities can only apply sanctions laid down in the legislation, for example in the case of certain irregularities. As it was said at the Göd forum in response to the question why there is no more severe punishment: 'the *Civil Protection is a law enforcement body, not a legislative body*' (Göd public hearing, 31 January 2023). The members of the Hungarian government who make decisions and legislate never meet the population in these matters. Local authorities are sometimes feared by the residents who are at their mercy. "*The fear is palpable. At the second hearing in Debrecen, there were so many mothers with small children and then they disappeared overnight. As it turned out, whispers started to spread that anyone who was there with their child would be targeted by the family protection authority*.[121]"

In April 2023 the Hungarian government issued a decree stating that in the future public hearings can be held without the participation of the public. [122]

Excessive centralisation has drastically reduced the powers and financial resources of local authorities. On the one hand, they no longer have any influence on industrial investments (due to the designation of priority government investments), and in most cases they do not manage industrial parks (the National Industrial Park Management and Development Company does). On the other hand, they are forced to rely on the revenues from the industrial tax on large investments (which they can take away at any time, see Göd). By often not involving the managers of the area in the investments in the area concerned, central interests prevail instead of local interests. This is illustrated by

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[119] https://www.szabadeuropa.hu/a/a-polgarmester-lemondasat-koveteltek-a-debreceni-akkumulatorgyarrol-szolo-kozmeghallgatason-catl/32233454.html

[120] https://youtu.be/cn5RyddTyXg 10.17

[121] https://www.youtube.com/watch?v=OAllK1rzUow 34:05 debreciner podcast

[122] https://telex.hu/english/2023/04/28/new-decree-makes-public-hearing-without-the-public-present-possible-in-hungary

the example of Tatabánya (where a Korean electrolyte plant supplying Komárom SK is located), Antalóczy el al. (2022). In some regions this can lead to over-specialisation and vulnerability, which in the long run can lead to the decline of the region (Boschma-Lambooy, 1999). This can be avoided by developing human capital, which allows for flexible adaptation and innovation, but as the next section describes, this is hardly possible in the Hungarian case.

12. The middle-income trap

Hungary has been classified by the World Bank as a high-income country, along with all other EU Member States. Hungary's economic development model is dependent on foreign capital (this dependence is asymmetrically reciprocal, see Farkas, 2018), and capital investment is declining globally. The productivity of the Hungarian economy has been relatively low for many years[123], as well as the domestic value added in exports[124], thus the question of the "middle income trap" arises. This means that in the longer term, “assembly economies” face limits to growth and competitiveness (Győrffy, 2021). Since the 1990s Hungary is one of the most integrated countries in the world into the global value chains due to the subsidiaries of multinational companies (Stehrer-Stöllinger, 2015, Vakhal, 2020). The President of the Hungarian National Bank pointed out that "*it is good to import advanced technology, it is good to import new modern technology, but if you don't and you have low added value, for example 18% in the battery sector, then it is a trap*." The literature also points to the detrimental effects of top-down industrial policy, "picking winners": short-term gains can turn into long-term disadvantages (Dirkmaat, 2019).

Foreign capital inflows have also been a useful engine for economic development in the countries of our region. In the countries of the region, the economy shows a more balanced sectoral distribution, while in the Slovak and Hungarian cases, the specialisation in the automotive sector is very strong. In Hungary, several large German investors are embedded in the economy by building networks, clusters and university links, given the time, financial investment and commitment (Józsa, 2019). It is well

[123] https://privatbankar.hu/cikkek/makro/munkatermelekenyseg-magyarorszagon-326527.html
[124] https://g7.hu/vilag/20211207/zakatol-de-nem-jut-elore-a-magyarorszag-nevu-osszeszerelo-uzem/

known that large German car manufacturers have direct governmental connections (Panyi, 2020) and their needs have been maximally served by economic policy through legislation and regulations. In 2010, for example, a Natura 2000 site was reclassified as an investment area by fast-track decree in order to expand Audi[125]. For battery factories, too, the picture is that what they ask for, they get. The mayor of Göd also made this clear at Samsung: "*These Koreans are just thinking of something then if you don't do it, they won't stay here."*[126] *(*05/07/2018 Extraordinary meeting of the board, Mayor József Markó).

Serving foreign factories has not only created jobs, it has also brought some Hungarian companies certain upgraiding in the production chain. This complex process is illuminated from several angles in Szalavetz's (2019) book. After a while, a few leading Hungarian companies were able to link up with German vehicle manufacturers and their first-tier suppliers, and dual training and R&D cooperation was also initiated. However, these examples cannot be generalised, and the shortage of skilled workers limits the process. Cooperation with foreign multinationals requires building trust and professional compliance. Also, potential innovative start-ups need a long validation period before a large manufacturer is willing to deal with them (Szalavetz, 2022). Looking at the Central European automotive industry, Pavlínek (2012) found that Western European parent companies are only willing to outsource non-strategic R&D tasks to subsidiaries. This is even more the case in Asian battery factories, where the production process is an absolute secret. In the case of the CATL factory, the uneasy relationship between the EU and China means that a Chinese company will not outsource its strategic research to an EU member state, possibly only for minor testing and development tasks if there is local expertise.

The success of Asian countries based on industrialisation is often cited as an example by Hungarian decision makers. Analysing the economic policies of East Asian developing countries, Benczes-Ricz (2021) summarise the crucial conditions for success in several points, such as: balanced development of the agricultural sector and industry (not excessive industrialisation), emphasis on human capital development, substantial

[125] http://reflexegyesulet.hu/index.php/termeszetvedelem/344-a-termeszet-legazolva-megint-egy-beruhazas-gyori-modra-2

[126] "Gödi sírások" https://www.youtube.com/watch?v=KIgkYZNaJO4

financing of education and health, a balanced relationship between the dream and the business sector and between the state and society, curbing corruption, fomenting competition and meritocracy. These conditions are not really present in Hungary, and a major damage has been done to the human capital, which (naturally for a small country with few resources) had long been Hungary's most important locational/competitive advantage. Hungary can turn to a Latin American or Tunisian pattern: a powerful state setting industrial policy, favourizing friendly corporations, pro-government actors, some corporate lobbyists turning it to their own advantage through a reshaped institutional system (Dirkmaat, 2019, Rijkers et al 2013, Haber, 2002). Szanyi (2022) describes the mechanism of rent-seeking in Hungary.

Unfortunately, the deliberate dismantling of education over the last decade has become a barrier not only to the development of quality industry, but also to the development of digitalisation and Industry 4.0. The development of the modern economy requires skills that today's Hungarian primary education can barely provide, and there are serious gaps in secondary and tertiary education. Functional illiteracy is growing at an astonishing rate in our country, while the number of teachers is rapidly declining[127]. In addition to the hundreds of billions of euros spent on power politics, there are no resources for valuing Hungarian human resources. The catastrophic state of the Hungarian health care system and disease prevention is well known, such as is the miserable situation of teachers.

The quality of human resources also becomes a barrier to dual training, at least for Hungarian students. It is in vain that Óbuda University launches an English-language course called "Production of automotive Li-ion batteries" in cooperation with Samsung, if fewer and fewer Hungarian students can speak English (since the language exam is no longer compulsory for university admission and foreign language teaching is not effective in Hungary) and fewer and fewer students can read or are interested in physics. As a chemistry teacher remarked: *"In May last year, fifteen chemistry teachers and eighteen physics teachers applied nationally, of whom about four will graduate and*

[127] https://www.portfolio.hu/gazdasag/20220719/rado-peter-folytatodik-az-onsorsronto-oktataspolitika-556649

two will possibly start working. There is a staggering shortage of staff, there are no teachers and no children who are attracted to these subjects.[128]"

Besides the dependence on the German automotive industry, the more the domestic production of the big Asian battery factories expands, the more vulnerable the Hungarian economy will become to the global corporations (including Korean and Chinese companies in addition to the Germans). The current situation raises the question whether Hungary is capable of anything other than being trapped in the middle-income trap. As Szalavetz (2019) points out, human capital development requires decades of economic policy efforts and consistent programmes, and its impact is only felt in the long term. Economic policy makers tend to prefer short term plans. In addition, although the 13 years of the Orbán government could have provided an opportunity to develop knowledge capital, the Hungarian illiberal leadership has had no interest in doing so.

The strategy to increase battery production is not coordinated with the climate objectives of Hungary or of the municipalities concerned. The increase in energy use and emissions of carbon dioxide and other harmful substances, and the reduction in water resources, are contrary to these objectives. Analysts point out that encouraging car-sharing and developing public transport should be an important direction to take in order to mitigate the negative environmental and social impacts of the battery chain (González- de Haan, 2020).

13 Summary

The significant expansion of domestic battery production capacity by early 2023 has become a major topic of public debate. Those who oppose the factories sometimes just call them giant polluting plants, while those who support them speak about the importance of battery production as if there were no five large Korean cell companies and their suppliers already in the country (operating or started). The interests of the different players are different, sometimes conflicting. The main objective of the government is to maintain power, and to attract and keep foreign investment. The

[128] https://www.valaszonline.hu/2023/03/21/szakmany-csaba-oktatas-termeszettudomyany-kemia-fizika-interju/?

foreign investor's interest is profit, with favourable production conditions. The Hungarian Battery Association averts responsibility for damages and does not seek to encourage companies to keep the rules. The companies that carry out impact studies, documentation and licensing, are also interested to make profit. Local authorities, poorly staffed with professionals, sometimes face conflicts of interest because, on the one hand, they have an executive role (in the case of priority government investments, only the regulations need to be implemented quickly) and, on the other hand, local government bodies are supposed to represent the interests of the population who vote for them, which are in conflict with the investment. They try to manage this conflict either by withholding information or by shaking off responsibility (the Waterworks is not responsible for groundwater assessment, the disaster management is not a legislative body, it is not the responsibility of the government agency to decide where and what the investment will be, etc.). The public's interest is to live and work in an acceptable environment.

The government narrative is reassuring: environmental rules are strict. However, as experience shows, it is just the legislation passed by the government that exempts investments from environmental impact assessment procedures and minimises fines. The county and local authorities have to adapt to this legislation, and anyone who calls for caution is sacked (see TIVIZIG Director-General).

The study reveals that there is no adequate Hungarian workforce available for the planned further increase in domestic battery production, more than doubling existing capacity. The cost of generating the necessary energy is huge and the domestic water base will be depleted. Because of cost reasons even factories near the Danube (Göd, Komárom) prefer to use groundwater, where reserves are dwindling due to climate change.

As we have seen, most European countries have battery factories. Typically not too many per country and not only from Asia. European governments are trying to support domestic or European production and innovation. The communication of the Hungarian government to increase battery mass production is not convincing, because there are no serious economic and environmental impact assessments. The huge additional investments from taxpayers' money (power plants, infrastructure) will draw

resources from elsewhere – and at the same time public constructions have been stopped, education and healthcare are strongly underfinanced.

The pros and cons are not of equal weight. It is important for the government to increase GDP and exports, for the municipality to have a business tax, but it may be more important for the locals to still have water in five- or ten-years' time, to avoid hazardous substances leaking into the environment or an unexpected fire in a nearby factory. Those who have had their farmland taken away from them are not comforted by the fact that the government's interests coincide with those of German car manufacturers in the mass attraction of Asian firms. Nor are the workers at risk in Korean factories compensated by the central ideology of how good it is that East meets West in Hungary.

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Annex

Table A1: Factories connected to EV battery production in Hungary (functioning and started or announced)

Company	Product	Country of ownership	Plant location	State aid (HUF bn)	Jobs
Base material producers (10)					
Soulbrain HU Kft.	Electrolit	South Korea	Tatabánya	0.4	45
Dongwha Electrolyte Hungary Kft.	Electrolit, NMP recycling	South Korea	Sóskút	n.a	90
ECOPRO GLOBAL HUNGARY Zrt.	Cathode	South Korea	Debrecen	n.a	631
TOYO INK Hungary Kft.	CNT dispersion (cathode)	Japán	Újhartyán	0.7	45
Volta Energy Solutions Hungary Kft. (Doosan)	Copper foil	South Korea	Környe	13.2	281
LOTTE ALUMINIUM Hungary Kft.	Aluminium foil	South Korea	Tatabánya	1,1	107
LG Toray Hungary Kft.	Separator foil	South Korea-Japan	Nyergesújfalu	4.5	188
W-Scope Hungary Plant Kft.	Separator foil	Japan	Nyíregyháza	n.a	1,200
SEMCORP Hungary Kft.	Separator foil	China	Debrecen	13	440
CK EM Solution HUN Kft.	Glue material	South Korea	Heves	0.38	8

Table A1 Continued

Parts, components (10)					
Sangsin Magyarország Kft.	Aluminium-battery house	South Korea	Jászberény	3.1	150
NICE LMS Hungary Kft.	Aluminium-battery house	South Korea	Vác	0.5	60
Kedali Hungary Kft.	Battery part	China	Gödöllő	1.2	330
Bumchun Precision Hungary Kft.	Battery part	South Korea	Salgótarján	2.7	200
SHINHEUNG SEC EU Kft.	Battery part	South Korea	Monor	0.8	435
Mektec Manufacturing Corporation Europe HU Kft.	Battery part	Japan	Pécel	0.6	251
INZI Controls Hungary Kft.	Battery part (module)	South Korea	Komárom	1.6	122
Halms Hungary Kft.	Battery part	China	Debrecen	1.7	300
Nippon Paper Industry	Battery part (CMC)	Japán	Vácrátót	2.3	60
Sanga Frontec	Műanyag akk. alkatrész	South Korea	Szada	1,4	55
Cell producerts (7)					
GS Yuasa Magyarország Kft.	Battery cell	Japan	Miskolc	0.8	51
SAMSUNG SDI Magyarország Zrt.	Battery cell	South Korea	Göd	35.5	1,800
SK Battery Manufacturing Kft.	Battery cell	South Korea	Komárom	8.1	410
SK On Hungary Kft.	Battery cell	South Korea	Komárom	28.5	1,000
SK On Hungary Kft	Battery cell	South Korea	Iváncsa	76	1,900
CATL	Battery cell	China	Debrecen	320	9,000
EVE Power	Battery cell	China	Debrecen	14	1,000

Table A1 Continued

Module assembly, cover plate (3)					
BYD	Battery assembly	China	Fót		100
BMW	Battery assembly	Germany	Debrecen	13.5	500
Boysen Battery C.Hungary Kft	Battery cover plate	Germany	Nyíregyháza	5.6	400
Recycling (3)					
JWH Kft.	Substances	South Korea	Komárom		41
SungEel Hitech Hungary Kft.	Batteries	South Korea	Szigetszentmiklós, Bátonyterenye	2.8	100
NIO Power	Battery exchange stations	China	Biatorbágy	1.7	155
Hazardous material store (1)					
HTNS Hungary Kft	Samsung store	South Korea	Fót	n.a	

Source: Éltető (2023), EKD list, press info. As of June 2023.