The future of the European automobile industry

Is zero-carbon possible with zero job loss?

Country Study: Hungary

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1. Introduction

The automotive industry has been a key driver of Hungary's economic growth and led the country's integration into global value chains. Through this, the country became a prominent element of the European automotive sector by providing the manufacturing know-how and low wages essential to ensure the competitiveness of especially German original equipment manufacturers (OEMs), such as Audi or Mercedes Benz (Pavlínek, 2017; Gerőcs & Pinkasz, 2019). The sector's rise has continued on the back of a favourable business environment and ample foreign direct investment (FDI), contributing to economic growth, exports, and job-creation (Guzik et al., 2020; Jürgens & Krzywdzinski, 2009; Pavlínek, 2020). Over the years, manufacturers streamlined internal combustion engine production, but the sector may be confronted with its largest challenge yet: the shift to electric vehicles (EV). The Hungarian automotive sector and the jobs it provides are vulnerable to the long-term changes unfolding in the transportation sector, the impacts of which remain unclear. This study begins to explore how actors within the sector assume these dynamics to unfold.

The jobs ensured by Hungarian OEMs and their suppliers are vulnerable to global competition. An immense portion of the sector's revenue hinges on the success of German firms (Braun et al., 2019) and their ability to compete for international EV markets. Chinese manufacturers emerged as strong competitors in this space, which can adversely impact the prospects of Hungarian firms embedded in German value chains. To adapt, Hungary's automotive sector has to reposition itself from a focus on ICE vehicle and component manufacturing to EVs. This transition may be slow to unfold, leaving actors time to adapt, but competition between countries and regions to establish themselves as industrial hubs has begun. There is a risk that jobs will be lost due to competition, automation, and the low labour-intensity of EVs.

This study seeks to answer several questions related to the transition of the automotive sector, including what role will Hungary play in the changing European automotive production chain? Will the transition from ICE to EV production involve closing existing capacities, and actors exiting the market? How great a threat is the sector's downgrade due to technological and structural lock-ins? Can local stakeholders count on additional FDI inflows to create EV capacities? How will these developments and local investments be shaped by automation and digitisation? While we address all of these questions to some extent, it is their employment-related dimension that we tackle head-on in this study.

To answer these questions, we, the authors, conducted a literature review, desktop research, interviews with twenty-three experts, in addition to participating in three workshops focused on the matter. We convey our findings in this report, which continues with the research design in section two and a broad introduction of the Hungarian automotive sector in section three. It then discusses employment-related trends surfacing with the transition to EVs, before section five looks at the impact of decarbonisation and automation. Section six explores risks and opportunities embedded in the transition, while section seven provides an overview of the role Asian battery manufacturers play in the country. Section eight draws conclusions, based on which section nine offers policy recommendations.

2. Research design

Our research was driven by a curiosity on emergent discourses that pertain to the automotive sector's transition and its impact on employment. This transition is still in its nascency, which limits our inquiry to how stakeholders think and discuss the transition. We set out to sample the positions of key actors in the Hungarian automotive sector, which constitute six groups: (1) companies specialised in ICE-associated manufacturing (both OEMs and suppliers); (2) Hungary-based firms which adapting to e-mobility; (3) new actors within the sector (e.g., battery manufacturers); (4) industry associations; (5) trade unions; and (6) the government. We were curious which narratives they identified as dominant regarding the transition's path and the issues this raises. To gather data for our discourse analysis (Fairclough, 2013), we combined desktop research and interview-based qualitative data collection (Eisenhardt, 1989). This began with a thorough literature review, but the nascency of the transition to EVs limits the scholarly literature available on the matter. We complemented this with industry reports, policy papers, and newspaper articles.

As a second step, we conducted interviews. Our choice of stakeholders were based on the six groups listed above, which we identified based on the literature review. We also sought input from researchers and consultants focused on the sector. To establish contact with experts affiliated with these stakeholders, we attended several industry workshops[1], drew on our existing networks, identified potential candidates through online searches, and relied on snowballing techniques (Tansey, 2007). We conducted interviews with twenty-three experts, the full list of which is in annex 1. For the interviews we did not develop a protocol or list of specific questions, but rather overarching themes that provided a basis for the questions we tailored to respondents. We inquired about three topics: (1) the expected impact of the transition to e-mobility on vehicle manufacturing in Hungary, with a particular emphasis on employment; (2) the Hungarian state's and companies' preparedness for the transition; and (3) what changes were emerging or anticipated in manufacturing plants. This approach provided us with the flexibility to engage in a discussion focused on issues interviewees deemed to be the most prominent.

We conducted a thematic analysis of the interview data, involving a process of transcribing, reading and re-reading, analysing and interpreting the insights obtained from our interviewees to identify emerging themes (Neuendorf, 2019). To capture similarities and differences in the individual narratives, we revisited our data multiple times, comparing and contrasting the perspectives of the individual experts interviewed. Furthermore, we triangulated interview input with other primary sources (e.g., policy papers) and secondary sources (Stake, 1995).

3. The History and Role of the Automotive Sector in Hungary

3.1. A brief history of the sector

The Hungarian automotive sector's roots date to the Communist era, when output was dominated by bus (e.g. Ikarus) and heavy vehicle (e.g. Csepel and Rába) production. Vehicles were mainly sold in communist countries, but exports reached a number of other countries as well, such as those in the Middle East or Africa. After 1990, sales to Eastern bloc markets fell sharply, as the lack of development during the preceding decades rendered many firms uncompetitive vis-á-vis Western companies. Ikarus, for instance, quickly became indebted and after multiple changes in ownership has still not been able to recover and launch the mass production of vehicles (Bódy, 2015). The regime change also adversely affected Rába (Germuska & Honvári, 2014), partly due to the loss of market share and outstanding debt. However, Rába overcame hardships and following a successful reorganisation it became a prominent axle

[1] These include a Portfolio–MAGE conference dedicated to developments in the automotive industry held in June 2021; a workshop organised by the Jedlik Ányos Hungarian e-mobility Cluster in 2021; and an online conference organised by the Rosa Luxemburg Foundation on the transformation of the automotive industry with participants representing Hungarian trade unions in November 2020.

manufacturer and a major automotive supplier. Rába's story underscores the general trend, whereby the Hungarian automotive industry was predominantly limited to the production of components after the transition (Havas, 1995; Stefanovics & Nagy, 2021). This was partially a result of Hungarian OEMs' low competitiveness and large investments made into component manufacturing in the 1990s.

The regime change led numerous suppliers to go bust, but a handful were able to adapt and become the pillars of Hungary's automotive sector. Rába Mór Kft., Videoton Holding, Kaloplastics, Ajkai Elektronikai Kft., Kunplaszt-Karsai Rt., Pannonplast Group are amongst the core domestic suppliers that underpin the sector. In addition, leading European suppliers (e.g. Autoliv, Bosch, Continental, Schaeffler, Lear, ZF, and Valeo) and overseas suppliers (e.g. Denso, Flex, Hanon, Nemak, Magna International, and Visteon) all established a strong Hungarian presence in the 1990s. The sector has seen rapid growth since then, with large OEMs, including Opel, Suzuki, Audi, and Mercedes Benz launching operations. Production value more than doubled between 2005 and 2015 (see Table 1), which was driven by companies reinvesting earnings and shareholder loans (Báger, 2015). Growth has slowed since 2015, primarily due to stagnant EU sales (ACEA, 2021), but the sector's overall output remains substantial in a national, regional, and European context.

The automotive industry accounts for 5% percent of Hungarian GDP, 25% of value added, and 21% of exports (ITM, 2021). 740 companies are involved with manufacturing vehicles, directly and indirectly employing a total of 175,000 people in 2020 (ITM, 2021). Like most countries in Central and Southern Europe, firms provide components for the vehicles and undertake assembly-oriented activities (Lung, 2007; Barta, 2012; Gerőcs & Pinkasz, 2019) – lower value-added manufacturing is dominant (Pavlínek, 2019). Mostly Tier 1 suppliers have invested in R&D and innovation activities, while this remains marginal in the case of OEMs (Audi is a notable exception). In 2017 and 2018, the Hungarian automotive industry accounted for 10.22 percent and 11.15 percent of total R&D expenditures, respectively (Kuthi, 2020).

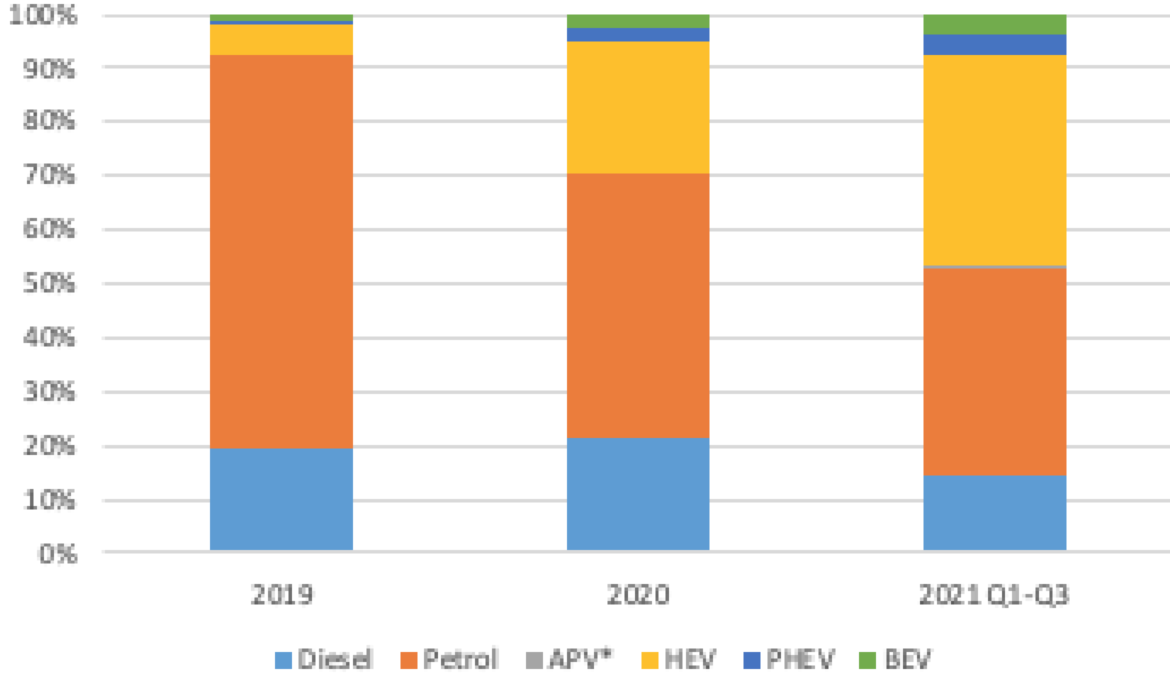
Table 1: Main indicators of the Hungarian automotive industry

	2005	2010	2015	2016	2017	2018
Enterprises (number)	507	485	494	487	491	497
Production value (million euro)	11 040	13 214	25 007	25 086	25 812	26 498
Persons employed (number)	63 236	65 153	88 555	92 958	97 703	101 908
Road vehicle assembly (number)	152 015	211 461	495 370	472 000	505 400	430 988

Source: (Eurostat, 2021)

Hungary's automotive output and its domestic market have generally developed largely independent from one-another. The Hungarian market is small, with a population of under ten million, but also because the relatively low disposable income of households in comparison to their Western European counterparts has historically impeded their ability to buy new vehicles. Instead, Hungarians tend to purchase used vehicles from Western Europe (GOV6) (Szász, 2020). There is nonetheless an openness from consumers to buy environmentally friendly cars (Csernátony, 2021). The number of alternative propulsion vehicles (BEV, PHEV, HEV) as a portion of all new vehicles sold showed a significant increase from 8% to 47% between 2019–2021 (see Figure 1), led by a boom in internal combustion-battery hybrid electric vehicle purchases (6% to 39% of total sales). This nonetheless remains a fraction of both registered vehicles and the entire vehicle park. For example, relatively costly EVs essential for the decarbonisation of transportation are still beyond reach for most. This is reflected in EV penetration rates, which are 2.5% in Hungary – despite doubling between 2019–2020 – paling in contrast to Sweden (16.1%), the Netherlands (12.7%), Austria (12.7%) and Germany (11.7%).

Figure 1: New car sales by powertrain in Hungary



Source: (ACEA, 2021a, 2021b)

3.2. *Production by location*

There are four OEMs present in Hungary: Opel, Suzuki, Audi, and Daimler (i.e. Mercedes-Benz), soon to be joined by a fifth, BMW (see Table 2). Opel was the first to launch operations in Hungary, when in 1992, it began to assemble cars (the Opel Astra) and produce engines in Szentgotthárd. Its plant is in western Hungary near the Hungarian-Austrian border. It ceased vehicle assembly in 1998 and shifted its focus to internal combustion engine and transmission production. After General Motors (GM) sold the plant to Peugeot S.A. (PSA) in 2017, the company further narrowed its focus to producing internal combustion engines. The merger of Fiat Chrysler Automobiles and the French PSA Group led to the establishment of Stellantis, which, as the owner of the Hungarian subsidiary, has announced that it will continue to produce ICE engines at the plant and will invest to upgrade production lines and expand output by 2023(Szandányi, 2021). Production has declined significantly in recent years. The plant is currently far from its maximum capacity of 350,000 per year. In 2019, only 156,500 engines were produced (see Table 2.). The long-term future of production in Hungary is determined by the fact that the direct owner, the French PSA Group, announced the end of the development of internal combustion engines at the end of 2020 (The Detroit News 2020).

Japanese OEM Suzuki launched the assembly of cars in Esztergom (30 km north of Budapest) in 1992. The Hungarian factory is the company's first and only European production facility, where workers currently assemble ICE and mild hybrid models. The company has stated that its facility will continue to churn out hybrids in the mid-term (5–10 years), with it being unclear when and how it may begin to undertake EV production (Autosajtó, 2021; IND2). The plant's significance stems from its long-standing reliance on domestically-owned companies, comprising 36% of its suppliers – higher than in the case of other OEMs (Mészáros, 2009; Urbán 2011). It has maintained this since, with 27 locally owned firms playing the role of Suzuki's Tier-1 suppliers in 2019 (Gáspár et al., 2020).

German Audi launched the production of internal combustion engines in Győr during 1993. It gradually became Audi Group's central powertrain supplier and the world's largest engine manufacturer, with a capacity of 2 million units per year. This scale underpinned its role as a key player within the Volkswagen Group, even though it was initially launched as a pilot project in an empty Rába assembly hall. It began to assemble vehicles in 1998 with small series production, this grew, but total output remained below 60,000 until 2014, after which it increased to 165,000. In addition to engine production and vehicle assembly, the plant also participates in developing engines and vehicles, as well as tools used by other Audi plants. Audi Hungaria launched the shift to EV production in late-2018, reaching 5% of total output in 2020 due to the COVID-19 induced slump in output and the increase in EV sales (Portfolio, 2021).

The latest OEM to launch Hungarian operations is Daimler in Kecskemét (southern Hungary), where the assembly of cars began in 2012. Mercedes-Benz established the facility to support its portfolio expansion, as it increased the number of compact car models from two to five. The factory produces around 190,000 vehicles a year and it began assembling battery electric models in October 2021.

Hungary's fifth car plant will manufacture BMWs in Debrecen (eastern Hungary). It was originally scheduled to start producing in 2022, but COVID-19 delayed the investment decision and the development of the project. The current timeline suggests that construction will begin in 2022 and the plant is poised to start production in 2025, three years later than originally planned (Németh, 2021). The factory will have an output of 150,000 vehicles per year and will only assemble EVs.

Table 2: OEM's production in Hungary (no.)

Number of vehicles/year		**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Audi	Cars	159,842	122,975	105,491	100,000	164,817	155,157
	ICE	2,022,520	1,926,638	1,965,165	1,954,301	1,968,742	1,661,599
	EV motor	0	0	0	9,453	90,367	87,343
Mercedes-Benz	Cars	180,000	190,000	190,000	190,000	190,000	160,000
Opel	ICE	511,000	630,000	486,000	313,000	156,500	n.a.
Suzuki	Cars	185,000	211,266	170,000	175,000	177,718	112,475

Source: Authors' compilation based on companies' financial statements and corporate news

3.3. Foreign direct investments into the automobile sector

Hungary has attracted significant investments that supported the expansion of its automotive industry since the 1990s. Alongside the four operating OEMs and a pending fifth, nearly 150 foreign suppliers established operations in the country (Eurostat, 2021). Their presence reflects the lure of the OEMs and the generally favourable business environment. The Hungarian National Bank's balance of payments statistics suggest that the 2020 foreign capital investment stock was EUR 9.2 billion (see Table 3). This is roughly a quarter of total foreign capital investment stock in Hungary's manufacturing sector, making the automotive sector by far the largest recipient of investment. These levels have, however, declined in recent years. Since there were no closures of prominent plants, output has declined recently, partly due to stagnant European demand and export opportunities outside Europe. The transition to electromobility for companies (OEMs and suppliers as well) is also a significant financial expense (IND14). Experts suggested that owners gradually decreased capital stock which may have continued during the suspension of activities during the COVID-19 pandemic.

According to calculations by Pavlínek (2020), the index of foreign control in the Hungarian automotive industry was 94.9 in 2015. Antalóczy & Sass (2012) suggest that FDI data derived from current account statistics does not adequately reflect capital investment, meaning that one should treat the data made publicly available with caution. Moreover, information published by investors does not necessarily reflect total investment, since it tends to include support received from government or municipal sources without noting their sums (g7.hu, 2019; portfolio.hu, 2021a).

Table 3: Foreign direct investment positions in vehicle production (NACE 29, 30: Vehicle and other transport equipment, billion euros)

		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Hungary FDI flows	**Transport equipment (NACE C29, 30)**	0,2	-0,6	-0,2	-7,8	4,2	1,0	0,4	0,5	0,5	-2,4	0,2	0,6	0,1
Hungary FDI inward stock	**Transport equipment (NACE C29, 30)**	4,6	4,0	3,4	-1,7	2,7	3,5	3,8	4,4	4,8	11,2	9,6	9,9	9,2
	Manufactur-ing sector (NACE C)	17,3	17,2	17,4	10,0	15,8	17,0	20,5	8,5	23,1	32,8	33,1	35,5	37,0
	Direct investment flows in Hungary	0,2	-0,6	-0,2	-7,8	4,2	1,0	0,4	0,5	0,5	-2,4	0,2	0,6	0,1
Czechia FDI inward stock	**Transport equipment (NACE C29)**	…	…	…	…	…	…	9,7	8,7	8,3	7,7	9,9	10,0	n.a.
Slovakia FDI inward stock	**Transport equipment (NACE C29)**	…	…	…	…	…	…	2,9	3,0	3,1	4,5	5,6	5,8	n.a.

Source: Authors' compilation based on (CNB, 2022; MNB, 2021; NBS, 2022)

Greenfield investments accounted for the sector's growth in the 1990s. The automotive sector generally made significant investments over the course of the past two decades, as companies operating in the country reinvest profits (Ministry of National Economy, 2013; Vápár, 2013; Pavlínek, 2020). Audi invested more than EUR 11.7 billion in Hungary through 2020, expanding its scope of activities and developing the technologies it uses in its facilities (Audi Hungaria, 2021). Electromobility and investments in battery production play a significant role in this investment boom. Suppliers also undertook significant greenfield and additional investments. Robert Bosch (2021), for instance, invested a total of EUR 200 million in its four production sites over the years. However, the overall picture shows a significant capital withdrawal due to the consolidation of the industry. For instance, Audi Hungaria reduced its share capital several times in recent years, transferring dividends to its the parent company (mfor.hu, 2021).

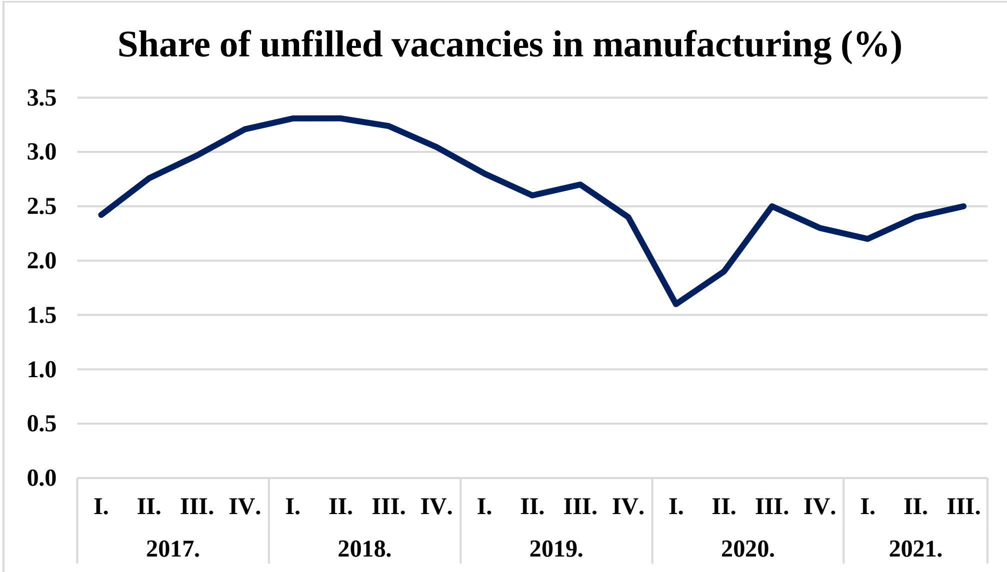
4. Development of employment

As section three (table 1) discussed, employment in the Hungarian automotive sector has generally been on the rise in recent years. Direct employment climbed from nearly 76 thousand in 2010 to slightly below 161 thousand by 2019. Indirect employment also increased from 27 thousand to 58 thousand during the same period. Achieving such increases has been a strategic ambition of ruling governments that were in power during this period, which all underscored that their push to develop the automotive industry was driven by the sector's ability to provide good jobs (GOV2). Government officials repeated that national economic development quantified as GDP growth, rising value-added locally, strengthening the role of domestic suppliers, industrial and regional policy advances, even R&D developments were all closely related to the sector providing jobs. They used this argument to justify the exorbitant subsidies governments provided to automotive firms (Bucsky, 2020). According to Vasvári et al. (2019, p. 1043), state subsidies per job created by foreign-owned OEMs and suppliers amounted to 55,000 EUR, in the period between 2004 and 2018, which is more than 70% of total subsidies allocated to foreign investors. In exchange for the state support, companies used employment numbers as their "bargaining chip" (GOV2). Simplistically put, they claimed that more subsidies would lead to higher employment.

Historically, a common narrative and concern promulgated by experts is that the Hungarian automotive industry is only the assembly hall of the OEMs (Gerőcs & Pinkasz, 2019). In the 1990s and early-2000s, Hungary's competitive advantage hinged on a number of factors, but the most prominent was a large, relatively skilled, and cheap labour force, which was sustained as a part of the Soviet legacy. The value added by Hungarian operations remained low as companies exploited the labour-force, while taking higher value adding processes abroad. OEMs and lower tier manufacturers' sought relatively cheap labour in the proximity of their main European markets (e.g. Germany) where they would also receive generous government support for their activities. The region welcomed these companies with open arms as they urgently needed an inflow of capital and governments saw this as an opportunity to increase employment and boost the economy, ultimately underpinning their success at elections polls. This, however, may be mostly rhetorical, since jobs offer a tangible outcome of governments' successful negotiations with corporations (GOV2). It is a key testament to their success, even though it may respond to a fictitious need, as there is a tightness in the labour market, which was noted by all interviewees.

Several indicators suggest that the labour shortage problems linger in Hungary. One is the decline in unemployment rates, which reached 3.7% at the beginning of 2022. The figures are, however, disputed, since some calculations suggest that there are 180,000 active job seekers, while survey results indicate that this may be as high as 300,000 (Hornyák, 2022). Meanwhile, the share of unfilled vacancies fluctuates around the relatively low level of 2.5% (figure 2). Employers cope with this situation mainly through overtime agreements, while a rising number of employers report labour shortage as an effective constraint on production – Astrov et al. (2021) suggest that in 2019 this was close to 60% in Hungary. To some extent, the increasing inflow of third country nationals has mitigated the problem. According to data published by the National Employment Service, 21,195 foreign citizens were employed in Hungary in 2020, 8.8% of which were employed in manufacturing (NFSZ, 2020). This number has quintupled in the past five years.

Figure 2: Share of unfilled vacancies in manufacturing



Source: (ksh, 2022)

The number of temporary agency workers is increasing in the Hungarian automotive sector (IND1; IND3; EXP1). In 2019, the manufacturing sector employed 108,680 agency workers, 20,100 of which were in the automotive sector (ITM, 2020). This, in-part, reflects the tightness of the market, since workers have the propensity to quickly change jobs and seek positions that offer the highest wages (IND3; UNI1). The high turnover also stems from the decline of regular employment that provide job security and benefits. The matter became evident during the COVID-19 crisis, when supply chain issues led OEMs and suppliers to lay workers off (UNI1). Those on temporary contracts were the first to lose their jobs. While they were re-hired following the relaunch of production, it underscores the precarious position many are in within the sector. Thus, the quality of the jobs is mixed at best: many relatively well-paying jobs are available, but these are not necessarily accompanied with long-term job security and the benefits that were once available to employees. That being said, there is a tightness in the Hungarian labour market, as OEMs established their operation by anticipating to attract labour from within their proximity (10–25 km), but this has now expanded substantially to multiple hundred kilometers, frequently crossing borders (GOV5). Thus, industrial areas seek to compete to attract labour. In theory, this provides workers with leverage, but the lack of organisation and mobilisation to expand the reach of unions beyond the few active ones has been limited.

The automotive sector has nonetheless appealed to workers, since it offers relatively high wages both nationally and, especially, in the Hungarian regions where they operate (GOV5; UNI1). The higher pay is still a key lure of the sector, but the weaker labour laws of Hungary undermine job quality. Most recently, the Parliament's ratification of the so-called "Slave Law" increased the overtime employers can demand from 250 hours to 400, while compensation can be delayed for up to three years (hvg.hu, 2019). This further move in the "race to the bottom" may increase Hungary's competitiveness in the region, but it also curtails the power and well-being of employees (Artner, 2020). Their self-determination is further impeded by the limited influence of workers' unions. Unionisation in the sector is relatively high in a national context, but their historical role does not reflect the deep roots comparable to the German system, for instance (UNI1). Unions were newly set up after the communist era and adopted to mimic the German model, but with little regard to the socio-cultural context. Their influence continues to be quite limited, even though they have been very successful in organising strikes and protests a handful of times (EXP1).

The future trajectory of employment has not led stakeholders to sound alarm bells. Currently, there is a tightness in labour supply. This can worsen in the short-term as BMW moves towards launching operations in its Debrecen factory. Manufacturing electric vehicles may generally be less labour-intensive than producing their ICE counterparts (FTI, 2018), but further dimensions of the transition have to be explored in Hungary to understand its full implications. Most interviewees were not particularly worried about job losses in the short- to mid-term, but their reasons varied (IND8; GOV1). One key factor underscored by most interviewees is their expectation that the transition will be gradual, providing all actors ample time to respond (strongly debated by EXP2). While the European Commission's 'Fit for 55' targets will hasten the transition to EVs, it still leaves 5–10 years for actors to adjust. Corporate stakeholders did not expect further large-scale lay-offs related to ICE technologies, since large portions of the manufacturing processes have already been automated (IND2). Most OEMs concluded automation programmes and do not anticipate further layoffs (IND3).

A number of factories undertake activities, such as the assembly of vehicles, that would not require a smaller labour force as the EV transition scales. The assembly of vehicles plays a prominent role in the Suzuki and Mercedes-Benz, and, to some extent, Audi as well. While the latter assembled 171,015 vehicles (Audi Hungaria, 2022), the relatively large weight of ICE manufacturing in its portfolio makes it susceptible to larger changes that may involve lower labour demand. Its factory in Győr produced 1,620,767 engines in 2021, but the number of electric powertrains was a mere 96,976 – 6% of total. The firm anticipates to gradually increase the role of EV production in-line with its headquarters' strategy, the most recent of which was the '*Vorsprung 2030*'. Based on this and additional guidelines provided by Audi, the Hungarian subsidiary develops five year product, financial, and manufacturing plans (HU_IND3). Interviewees suggested that the competitiveness, geographical location, and capacities of the plant position it well to adapt to the transition, which it has signalled through further investments into its tooling plant and other technical development (Audi Hungaria, 2022). Regarding suppliers, our interviewees contend that their firms are specialised in producing components that can be integrated both into both ICE and EVs (IND6; EXP2). Consequently, they purport that the transition will not jeopardise their employees. By contrast, suppliers specialised in manufacturing parts of ICE drivetrains, such as exhaust systems, will face increased competition and significant reduction in demand (EXP2).

Job losses may not occur *en masse*, but the labor market will be restructured during the transition. We took note of two important dynamics. One of these is that German auto manufacturers have committed to state mandates to maintain their employment numbers (IND3). They can do this by either increasing output or by "deepening production". The feasibility of the former is questionable. Not only is competition intensifying with other OEMs, but there is a generally shifting relation to the ownership of vehicles that may impede higher sales as car-sharing is becoming increasingly popular amongst younger generations (GOV5). Both limit the growth of German manufacturers. Thus, alternatively, to maintain their labour force, these companies may seek to deepen production, which entails that they expand in-house activities. This can lead OEMs to acquire suppliers and integrate their activities, which, through streamlining could lead to lay-offs. With this, OEMs are able to maintain employment figures, but it is bound to have an adverse effect on SMEs and employment throughout the value chain.

Interviewees noted that the labour force is migrating from one part of the value chain to another. The skilled workforce currently focusing on R&D may be forced to take jobs in manufacturing and servicing and maintenance during the next 20–30 years (GOV5; GOV6). Again, the question is what sort of jobs the industry will be able to provide, but interviewees suggested that those engineers working on R&D could be reskilled to take relatively good jobs (e.g. manufacturing, automation, or project engineers) in the manufacturing process of EVs. The shift will be a step down for many, but it still provides relatively high living standards for skilled professionals. Instead of mechanical engineering-type work tasks, they may be assigned the design of automation, design of assembly lines, ramp up production, and the design of testing activities. Demand for some traditional blue-collar activities, such as machining and drilling, is also bound to be reduced. The shift may also force those working lower down the value chain to change their jobs. For instance, those currently employed in manufacturing may be forced to switch to servicing and maintenance.

A further factor in employment hinges on the activity of unions. These are currently mostly occupied with managing day-to-day activities and have little surplus capacity to tackle long-term issues presented by the transition (UNI1; UNI2). As the labour market is restructured by prevailing dynamics, workers are set to be further atomised, as splinters between generations and occupations are already surfacing. This is not to say that unions are not trying to respond (e.g. by launching re-educating programmes) (UNI2), but their role is limited and is poised to further weaken in forthcoming years. However, there is a counterforce: the rising importance and scarcity of electricians and electricity-related skills. While the emergence of these competencies increasingly fragments existing labour relations, these highly skilled workers have the opportunity and have shown initiative to organise (GOV5). This can be a crucial point of departure that reverses the negative implications of structural changes in the automotive sector's employment. These will, however, face an uphill battle as Asian firms (e.g. Suzuki) and newly established battery manufacturers have been especially attentive and dismissive of unionisation (Papp, 2019).

5. Possible effects of decarbonisation and digitalisation

5.1. Technology

Decarbonisation and the adaptation of new technologies will considerably change the automotive sector, but how this will materialise is still the object of speculation according to most interviewees. Some interviewees still question which technology will emerge as the leader from the technological alternatives available (IND1; IND8; UNI1). Nonetheless, there is a broader consensus that EVs will become dominant (NGO1; NGO2; IND1; IND3), even if they may be complemented with other technologies as well. This contingency causes concerns for stakeholders, since they do not know what to invest in. Irrespective of the outcome, multiple interviewees noted that the industry-at-large is aware that current investment patterns will not suffice in maintaining the competitiveness of the value chains in place (GOV2; IND11; UNI1). They did not have answers as to what form government policy should take, since the technological matrix has not been set (GOV5). What is more, it remains unclear, to what extent the government should be involved in choosing favourites or allowing the market to decide ultimately (GOV2). The government of Hungary has continued to provide some support for ICE vehicles, but it has begun to place greater emphasis supporting the move to EV manufacturing (IND10). This has materialised in its support for BMW's EV ambitions and the shift in Audi's plant.

A key pillar of the government's strategy to decarbonisation is its involvement with improving R&D capabilities within the country (GOV5). It approaches R&D as a cost-efficient point to intervene in the automotive value chain, allowing local actors to develop technologies, increase their added value, and develop facilities that support respective output in Hungary. This was also confirmed by an interviewee (IND4), who added that increasing added value was also key for the competitiveness and survival of suppliers. This would enhance the resilience of the domestic sector against future changes (GOV6). A flagship project of the government is the ZalaZONE Test Track and auxiliary facilities, which can offer a platform to develop a host of technologies related to autonomous driving capabilities (IND10). Its appeal lies in the limited availability of such tracks and the low price point at which it can be used, leading it to be fully booked (GOV5; IND9). Simultaneously, it should be noted that the value of the track has been questioned by many, given the high construction costs and concerns over corruption. According to the government's vision, the track and the research facilities in its vicinity will attract further R&D for which the government has provided ample funding (GOV6). It will then become a bridge to European automotive development (EXP3), which would have a spillover effect, boosting manufacturing and other services.

5.2. Skills

By localising R&D capabilities, the government would foster the development of both domestic manufacturing and improve the education system. The latter is urgently needed, as government expectations suggest that the 3,000 engineers currently employed in automotive R&D will double in forthcoming years (GOV5). As it stands, formal education, based on the network of state universities, colleges, and other institutions cannot meet the demand posed by the industry as their curricula frequently lags behind the industry's rapid technological progress. There is already a strong concerted effort between the government and the industry to establish education programmes that cater to newly arising needs, which – combined with the still relatively inexpensive workforce – would offer a key competitive advantage for Hungary to maintain or even improve its position in European value chains (GOV6; UNI1). The issue is that it takes two to three years to develop engineering education programmes, but large parts of this become obsolete in the interim. This has become an especially pervasive problem with regard to newly established and quickly growing sectors, such as battery production, and may pose a general impediment to the domestic sector's ability to adapt to a changing environment (GOV5; IND5).

Interviewees were unanimous that new competencies need to be added to the skillsets of employees, considering the new skill requirements posed by automation, digitalisation, and the transition to e-mobility. Digitalisation and the increasing automation of the main production tasks is considered a more important driver of change in the content of work than e-mobility (IND1). In the case of the latter, the only thing mentioned by interviewees was that a new set of safety measures needs to be learned and included in a variety of tasks (UNI2; GOV6). By contrast, interviewees were unanimous in claiming that workers' ability to perform tasks alongside robots needs to be improved. Given the prohibitively high rate of voluntary departures and labour turnover, even novice employees are found to be familiar with working alongside robots that complete tasks such as line loading, machine tending, and in-plant logistics. However, there is a scarcity of employees with the ability to programme and operate these robots. In a similar vein, the ability to interpret the machines' feedback correctly (when controlling automated systems) is paramount. A knowledge of how to keep operations running requires a more advanced skill set from the labour force, which is generally lacking.

Changes in employment are, however, unfolding slowly. New products, be that a vehicle, a part, or component, introduced by manufacturers requires employees to be trained, since these involve incremental adjustments in the tools, the ways of working, or, on occasion, may lead to even greater changes. Consequently, both operators and employees are accustomed to constant shifts in the way they work, a flexibility which has become a key asset (GOV1). Complementing and adding some nuance to the average rosy picture of accumulating new digital skills and upgrading the content and quality of work, one interviewee (UNI2) described an adverse scenario involving an automation-induced deskilling process. In this scenario, core processes are robotised, consequently fewer skilled operators will be needed. For instance, in the case of welding operations, workers won't be engaged in operational interventions using special purpose equipment to carry out the given processes. Instead of welding, workers will perform simple auxiliary tasks alongside welding robots, including monitoring them. This grim picture was not supported by the industry consensus (IND2; IND3). What is more, interviewees suggested that automation may have to be accelerated to overcome labour shortages, as opposed to leading to unemployment or the materialisation of such dystopian outcomes.

6. Additional risks and opportunities

A key risk is whether foreign OEMs will be able to maintain their market dominance (GOV2; GOV5; IND1). This depends on the European – primarily German – automotive industry's ability to maintain its competitive advantage, as it faces fierce competition with the rise of e-mobility (IND10). Without government intervention and an orchestrated industrial policy, a smooth transition may have worse-than-expected outcomes and lead to a substantial decline in the labour force employed within the sector. This risk is thus mostly linked to broad global trends and the ability of German OEMs to outcompete other companies. It also closely links to manufacturers diversifying between technologies and various branches of transportation (GOV5) . The difficulties of OEMs would send shockwaves through the value chain and endanger lower-tier suppliers, especially domestic-owned, smaller companies that already have difficulties in adapting to a changing context. These provide jobs and growth, but this may decline without sufficient support to adapt to new needs. Successful government policies boosting the competitiveness of small- and medium-sized enterprises will be crucial in forthcoming years to maintain the health of the overall sector and regional economies (GOV3; GOV4).

The transition will also require new skills and competencies in effectively all segments of the supply chain, amplifying the need for innovative, up-to-date education programmes. Without adapting education and equipping the labour force with the necessary skills, the transition may wreak havoc. Skilled labor at existing automotive and new facilities (e.g. battery production) are already in short supply, but there is generally a lack of highly trained electricians and technicians who are competent in processes related to EV development, manufacturing, and maintenance. The government is aware of the matter and has systematically attempted to address the issue by upgrading university research facilities as well as updating education and training programmes (GOV5; GOV6). A recent testament to this is its focus on the ZalaZONE project, but this is only a start and all respondents underlined that the deficit in skilled labour is likely to sustain.

A recurring pattern of our interviews is employers underscoring that the transition will require new skills (EXP2; GOV1). Instead of speaking about specific skills such as arranging wires, mounting bearings, or operating specific shopfloor machinery, employers emphasised that future workers need to possess adaptability skills (e.g., to be able to adapt to new technologies and/or to changing job assignments), collaboration and self-management skills (to be able to work in teams when the composition of teams changes from time to time), and problem-solving skills (IND8; GOV1). This will be even more important, if automation-heavy production expands. An interviewee noted that "[e]mployers are looking for different competences than before. Previously, when we asked what kind of new employees they were looking for, the companies pointed to specific occupations, informing us that they need welders, mechatronics technicians, forging machine operators and so forth. Nowadays, companies rather ask for skills and competences, such as flexibility, openness to learning new skills, basic IT and digital skills, and problem-solving skills. You can imagine how difficult it is, to decide whether a job seeker possesses these competences or not" (GOV1). The ability to adapt the labour force is certainly one of the largest risks Hungary's automotive sector faces.

7. Foreign investments by Asian manufacturers (Japan, China, Korea) in Europe with focus on new technologies (electrical cars, batteries)

Historically, investors channeled funds into the development of ICE vehicles, but this has shifted to electromobility since the mid-2010s. As discussed above, traditionally ICE manufacturing plants and component manufacturers have begun to expand their portfolio to EVs as well. Investments that are solely targeted at EV output have accompanied this. A world's leading electric vehicle manufacturer, Chinese BYD, set up a plant in Komárom to produce electric buses. Its operations launched in 2017 and output will grow to one thousand buses per year by 2022 (Patthy, 2020). Meanwhile, Hungarian-owned Ikarus Járműtechnika and Chinese railway vehicle manufacturer CRRC established a joint venture in 2018 to assemble electric buses. This will take place at Ikarus' Székesfehérvár site, repurposing the assembly hall that once churned out ICE buses, but the timeline for the launch of operations remains unclear. In addition to producing and assembling EVs, Asian investors have also developed production capacities to supply the automotive sector. This entails product development in their existing plants (e.g. TDK Hungary Components, Zoltek) and greenfield investments as well (e.g. Chevron Auto).

Asian investors have already channelled significant amounts into battery production as well (see Table 4), but further plans suggest that expansions will continue (Schade, 2022). This was a common theme of our interviews, with essentially everyone speaking at length about the recent emergence and rapid expansion of Asian battery production capacities in Hungary. A total of EUR 5.29 billion has been directed into battery production since 2016, creating 14,000 jobs (ITM, 2021), while production capacity has risen to 20 GWh per year – compare this with the EU's 35 GWh (Major, 2021). Battery production also became a leading point of the government's industrial policy agenda, through which it has lent support to predominantly Asian firms. Hungary has attracted substantial investment from Chinese, Japanese, and South Korean companies, with further companies considering investments in the country (GOV6). Hungary's popularity is at the intersection of a number of factors, including government policy, the country's pre-existing role in European automotive supply chains, relatively inexpensive labour costs, a favourable corporate tax regime, and low energy prices (Schade, 2022).

Table 4: EV battery manufacturers in Hungary

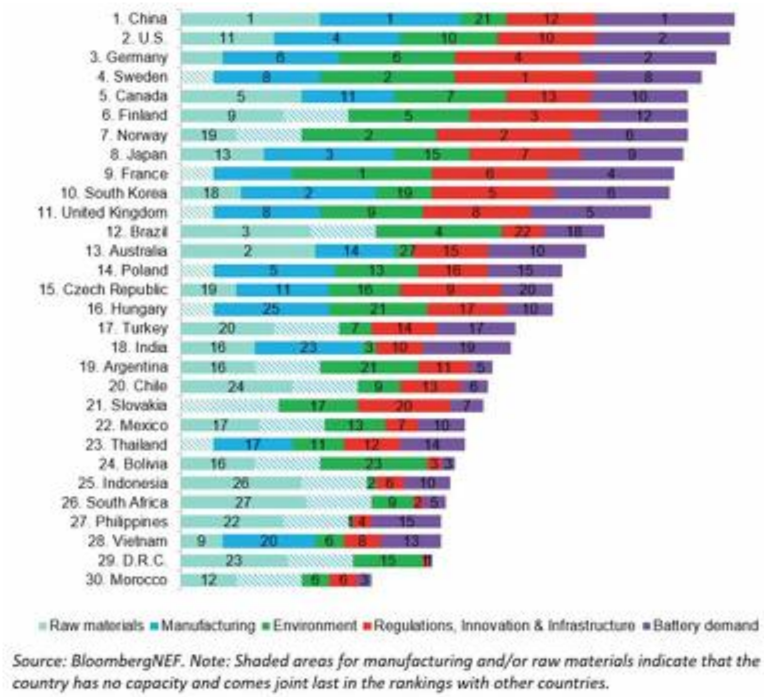
Company	Country	Activity	Location	Investment (bn HUF)	Established
Tier 1 / primary producers					
SK Innovation	South Korea	battery factory	Komárom	689	2018
			Iváncsa	681	2021
Samsung SDI	South Korea	battery factory	Göd	540	2017
GS Yuasa	Japan	battery factory	Miskolc	14.8	2019
Inzi Controls	South Korea	battery parts	Komárom	9	2020
Tier 2–3 suppliers					
Semcorp	China	battery separator foil	Debrecen	66	2021
Solus Advances Materials/Doosan	South Korea	copper foil factory	Tatabánya/Környe	106	2020
Toray/Zoltek	Japan	battery separator foil	Nyergesújfalu	127.5	1995
Soulbrain	South Korea	electrolyte	Tatabánya	n.a.	2021

Mektec/enmech	Japan	battery parts	Pécel	n.a.	2020
Sangsin EDP	South Korea	battery frames	Jászberény	10.5	2018
KDL Shenzhen Kedali Industry	China	battery parts	Gödöllő	14.1	2021
Iljin Materials	South Korea	copper foil factory	Gödöllő	3.8	2021
Dongwha	South Korea	electrolyte and recycling	Sóskút	11	2021
Shinheung Sec	South Korea	battery frames	Monor	8	2019
SungEel Hitech	South Korea	battery recycling	Szigetszentmiklós	1.8	2017
Bumchun Precision	South Korea	aluminium battery terminals for electric vehicles	Salgótarján	13.3	2018
Lotte Aluminium	South Korea	Aluminum anode foils	Tatabánya	44	2019

Source: Authors' compilation based on (ITM, 2021)

The rapidly expanding battery production facilities cater to the rising demand of automotive OEMs and other forms of demand for batteries. Heretofore, these activities have been led by East Asian companies that have established labour-intensive and low value-added production. For example, SK Innovation's Gigafactory in Iváncsa, is the largest greenfield project in Hungary to date, which enables the production of batteries for approximately half a million EVs a year (HIPA, 2021). Other notable Chinese, South Korean, and Japanese battery cell producers include SK Innovation, Samsung SDI, Inzi Controls, and GS Yuasa. In addition, enterprises supplying battery cells have also made considerable investments (e.g., KDL Shenzen Kedali Industry, Toray Group, Iljin Materials, Lotte Aluminium, Sangsin EDP, and Bumchun Precision) (see Table 4). Hungary ranked 16th on BloombergNEF's 'Global lithium-ion battery supply chain ranking', behind 14th Poland, 15th Czechia, and ahead of 21st Slovakia (see figure 3), which underscores its prominent role in the sector. Its prominence is further underscored when considering the expected growth of the sector. These production capacities target foreign markets, indicating that domestic value chains have not yet shifted their operations to absorb battery output, unlike in Czechia, for instance.

Figure 3: 2021 Global lithium-ion battery supply chain ranking



Source: BloombergNEF

Battery factories factories have created a significant number of new jobs. During an interview, a human resources executive revealed that although the battery manufacturing process is highly automated, employment at the local facility is high – more than 1100 employees in 2020 (IND5). Most employees are production operators, who operate machines along the production lines. This requires a certain level of technical knowledge – a basic understanding of the machine as well as expertise in navigating a menu that contains information and instructions – but most of their specific skills that can be learnt on the job. According to the manager interviewed, this expertise is similar to that of mastering the navigation of the menu of a smartphone and typically requires two months of learning by doing. Concerns over these working conditions have been raised. While the pay is acceptable, they have been referred to as bad jobs (UNI1). There are concerns over working with hazardous or toxic materials, which were suggested by interviewees (NGO1; NGO2; UNI1; EXP1), but also reported on (Partizán, 2020), even if those working within the sector questioned or refuted these claims (IND5; IND11). These factories have also had a negative impact on the environment and those living near facilities, exposing them to pollutants and noise pollution, but they have been able to take little action as the government's support and the power of the companies involved has left them quite helpless (Partizán, 2020).

8. Conclusion

Drawing on the experiences of Hungarian automotive stakeholders, this paper investigated whether the disruptive forces transforming the automotive industry produce a structural lock-in in factory economies that are highly specialised in ICE-specific manufacturing activities. More specifically, we explored the first signs of local adaptive transformation, and collected and analysed experts' and stakeholders' views of the medium-term impacts of production transition – to electric and digital. Our point of departure was that the structural transformation of the Hungarian automotive sector is well on its way. The country has a long-standing tradition in manufacturing vehicles, which, until now, have been propelled by internal combustion engines (ICE). As an EU-driven response to the climate crisis unfolds and global demand for internal combustion engines withers away, the Hungarian sector has also begun to adjust and shift operations to produce electric vehicles (EVs).

For now, there is a tightness in the labour market and demand for employees is robust, but the COVID-19 shock and supply disruption of chips have highlighted the precarious position many workers are in. Those on short-term contracts or employed by companies lower in the value chain are susceptible to disruptions. They are the most vulnerable. As the government has supported job creation related to EVs to preserve the sector and adapt it to a decarbonised world, it has been able to create jobs, but not always good ones. Further automation and the expansion of EV production is set to alter the structure of the labour force, shifting many downstream and forcing them to retrain. This is a huge task that needs ample government support and long-term planning, which is mostly absent among actors.

Our results do not confirm that the country's sector faces a structural lock-in at least not in the short or medium run. They show a case that we refer to as a lock *in a dependent model of capitalism* (Farkas, 2011; Myant, 2018; Nölke and Vliegenhart, 2009). Since both the transition to EVs and the implementation of advanced manufacturing technologies elicit significant capital-deepening and engender industry concentration in all stages of the automotive value chain, a dependent factory economy like Hungary will become even more exposed to the strategic decisions of global companies along the automotive value chain, specifically to the decision of whether the existing investors remain committed to locating capital- and knowledge-intensive activities to a host country that has so far been competing on the basis of low labour costs.

Hungary seems to be in a good position, as the output of firms is adapting to changing needs and it has been able to lure both European and Asian companies to establish operations essential to EV production. This may even enhance the tightness in the labour market, but this is unlikely to last long. If government policies are not regularly rethought and adjusted along strategic lines it can lose its momentum. Moreover, policy-makers needs to carefully consider the quality of the jobs that it maintains, since this will be crucial to sustain the well-being of its citizens and their support of a transition going forward.

9. Policy recommendations

Our findings suggest that the imperative of aligning policy instruments in a synergistic way should be a focal consideration pursued by policy-makers when developing their agenda. The importance of consistency and coherence cannot be overstated, as haphazard interventions without long-term, aligned goals inhibited the Hungarian automotive sector's competitiveness and with it the good jobs that it currently sustains. Currently, policies embody conspicuous contradictions. Some support is directed to upgrading the capacities of incumbents and the creation of better jobs. With this, they foster the sector's adaptation to high value added activities within EV supply chains. Programmes that support firms' digitalisation and the implementation of advanced manufacturing solutions increase investors' commitment to develop the EV-specific production activities of their Hungarian subsidiaries. An act, which is also deeply reliant on supportive education policies developed through cooperation between the state and the industry.

By contrast, there has been an overwhelming government push to introduce policy instruments which attract FDI, but are characterised by a race-to-the-bottom behaviour, suppressing wages and reducing the stability of jobs, offering subsidies from public purses, and curtailing environmental standards. Examples include the so-called 'Slave Law', which deregulates overtime work and the lenience of the government towards specific companies, owned by Asian investors who recurrently repress labour unions and ignore employees' rights to decent working conditions (Artner, 2020). The issue with this race-to-the-bottom behaviour is that it hinders the creation of quality jobs. In a quest for low labour costs, the upgrading of vocational and higher education is neglected, exacerbating the shortage of skilled labour. Consequently, investors are not motivated to locate high added value activities to local production sites – including EV-specific production that requires qualified workforce in all business functions (not only IT-specialists and engineers but also technicians with domain-specific and programming skills, and operators with at least medium technical competencies).

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11. Annex 1: Interviewees

No.	Code	Name	Position	Actor type
1	EXP1	Anonymous	Researcher	Research Institute
2	EXP2	Anonymous	Managing Director	Consultancy
3	NGO1	Anonymous	President	NGO
4	NGO2	Anonymous	Expert	NGO
5	IND1	Anonymous	Executive	Industry Association
6	IND2	Anonymous	Executive	OEM
7	IND3	Anonymous	Executive	OEM
8	IND4	Anonymous	Head of Finance and Accounting	Tier 1 Supplier
9	IND5	Anonymous	HR officer	Battery manufacturer
10	IND6	Anonymous	Deputy-managing Director and Marketing Manager	Tier 2 Supplier
11	IND7	Levente Reizer	E-mobility Project Manager	Nissan
12	IND8	Szabolcs Karaszek	Director of Human Resources	BorgWarner Oroszlány (Tier 1 Supplier)
13	IND9	Anonymous	Project manager	Test track operator
14	IND10	Anonymous	Executive Director	Tier 2 Supplier
15	IND11	Anonymous	President	Electromobility Association
16	UNI1	Anonymous	Executive	Labour Union
17	UNI2	Zoltán László	Vice-president of union federation	Vasas Labour Union
18	GOV1	Anonymous	Head of Employment Office	Local government
19	GOV2	Anonymous	Former-Deputy Secretary	Ministry of Innovation and Technology
20	GOV3	Anonymous	Managing Director	Urban Development Organisation
21	GOV4	Anonymous	Project Manager	Urban Development Organisation
22	GOV5	Anonymous	President	Innovation-related Government Organisation

23	GOV6	Anonymous	Senior Advisor	Ministry of Innovation and Technology