Chapter 7
The Hungarian automobile industry: towards an understanding of the transition to electromobility

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1. Introduction

The automotive industry has been a key driver of Hungary's economic growth and has led its integration into global value chains. Through this, the country has become a prominent element of the European industry by providing the manufacturing know-how and the low wages which have been key to ensuring the competitiveness of particularly German original equipment manufacturers (OEMs) such as Audi and Mercedes-Benz (Pavlínek 2017; Gerőcs and Pinkasz 2019). The industry'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 and Krzywdzinski 2009; Pavlínek 2020). Over the years, manufacturers have streamlined their production of internal combustion engines (ICE) but the industry may be confronted with its biggest challenge yet: the shift to electric vehicles (EV). The Hungarian automotive industry 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 an exploration of how actors within the industry are assuming that these dynamics will unfold.

The jobs ensured by Hungarian OEMs and their suppliers are vulnerable to global competition. An immense portion of the industry's revenue hinges on the success of German firms (Braun et al. 2020) and their ability to compete in international EV markets. Chinese manufacturers have emerged as strong competitors in this space, which can have an adverse impact on the prospects of the Hungarian firms embedded in German value chains. To adapt, Hungary's automotive industry has to reposition itself from a focus on ICE vehicles (ICEVs) and component manufacturing to EVs. This transition may be slow, leaving actors with the 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 required by EVs.

This study seeks to answer several questions related to the transition of the automotive industry, including what role Hungary will play in the changing European industry production chain. Will the transition from ICEV to EV production involve closing existing capacities and actors exiting the market? How great a threat is a downgrading of the industry 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 digitalisation? While we address all these questions to some extent, it is their employment-related dimension that we tackle head-on in this study.

To answer these questions, we conducted a literature review, carried out desktop research and held interviews with experts, in addition to participating in three workshops focused on the matter. We convey our findings in this chapter, which continues with the research design in Section 2 and a broad introduction to the Hungarian automotive industry in Section 3. It then discusses the employment-related trends surfacing with the transition to EVs, before Section 5 looks at the impact of decarbonisation and automation. Section 6 explores the risks and opportunities embedded in the transition, while Section 7 provides an overview of the role that Asian battery manufacturers are playing in the country. Section 8 draws conclusions, based on which Section 9 offers policy recommendations.

2. Research design

Our research was driven by a curiosity about the emergent discourses pertaining to the automotive industry's transition and its impact on employment. This transition is still in its nascency, which limits our inquiry to what stakeholders think about the transition and how they are discussing it. We set out to sample the positions of key actors in the Hungarian industry who constitute six groups: (1) companies specialised in ICE-associated manufacturing (both OEMs and suppliers); (2) Hungary-based firms which are adapting to e-mobility; (3) new sectoral actors (e.g. battery manufacturers); (4) industry associations; (5) trade unions; and (6) the government. We were curious which narratives each 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 early nature of the transition to EVs means that there is only a small amount of scholarly literature available on the matter. We complemented this with industry reports, policy papers and newspaper articles.

As a second step, we conducted our interviews. Our choice of stakeholders was based on the six groups listed above and which we identified from the literature review. We also sought input from researchers and consultants focused on the industry. 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.[2] For the interviews we did not develop a research instrument or a list of specific questions but relied rather on our overarching themes to provide a basis for the questions we tailored to respondents. We inquired about three topics: (1) the expected impact of

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-Stiftung in November 2020 on the transformation of the automotive industry, with participants representing Hungarian trade unions.
2. Each interviewee was classified with a code, with specific contributions appearing in our text with that code in square brackets.

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 the issues that interviewees themselves deemed to be the most prominent.

We then 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 the emerging themes (Neuendorf 2019). To capture the similarities and differences in individual narratives, we revisited our data multiple times, comparing and contrasting the perspectives of the individual experts we interviewed. Furthermore, we triangulated our interview input with other primary sources (e.g. policy papers) and secondary sources (Stake 1995).

3. The history and role of the automotive industry in Hungary

3.1 A brief history

The Hungarian automotive industry'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 and Africa. After 1990, sales to eastern bloc markets fell sharply as the lack of development during the preceding decades had rendered many firms uncompetitive vis-à-vis western companies. Ikarus, for instance, quickly became indebted and, despite multiple changes in ownership, has still not been able to recover and launch the mass production of vehicles (Bódy 2015). Regime change also adversely affected Rába (Germuska and Honvári 2014), partly due to the loss of market share and outstanding debt. However, Rába managed to overcome the hardships and, following a successful reorganisation, became a leading axle manufacturer and a major automotive supplier. Rába's story underlines the general trend in which the Hungarian industry became predominantly limited to the production of components after the transition (Havas 2000; Stefanovics and Nagy 2021). This was partially a result of Hungarian OEMs' low competitiveness and the large investments made in component manufacturing during the 1990s.

The transition saw numerous suppliers go bust, but a handful were able to adapt and become pillars of Hungary's automotive industry. Rába Mór Kft., Videoton Holding, Kaloplastics, Ajkai Elektronikai Kft., Kunplaszt-Karsai Rt. and Pannonplast Group are amongst the core domestic suppliers that underpin the industry. 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 industry has seen rapid growth since then, with large OEMs including Opel, Suzuki, Audi and Mercedes-Benz all launching operations. Production value more than doubled between 2005 and 2015 (see Table 1), driven by companies reinvesting earnings and shareholder loans (Báger 2015). Growth has slowed since 2015, primarily due to stagnant EU sales, but the industry's overall output remains substantial in a national, regional and European context.

The automotive industry accounts for 5 per cent of Hungarian GDP, 25 per cent of value added and 21 per cent of exports (ITM 2021). A total of 740 companies are involved in the manufacture of 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 vehicles and undertake assembly-oriented activities (Lung 2007; Barta 2012; Gerőcs and Pinkasz 2019) – lower value added manufacturing is dominant (Pavlínek 2017). It is mostly the tier one suppliers that 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 industry accounted for 10.22 per cent and 11.15 per cent of total R&D expenditures, respectively (Kuthi 2020).

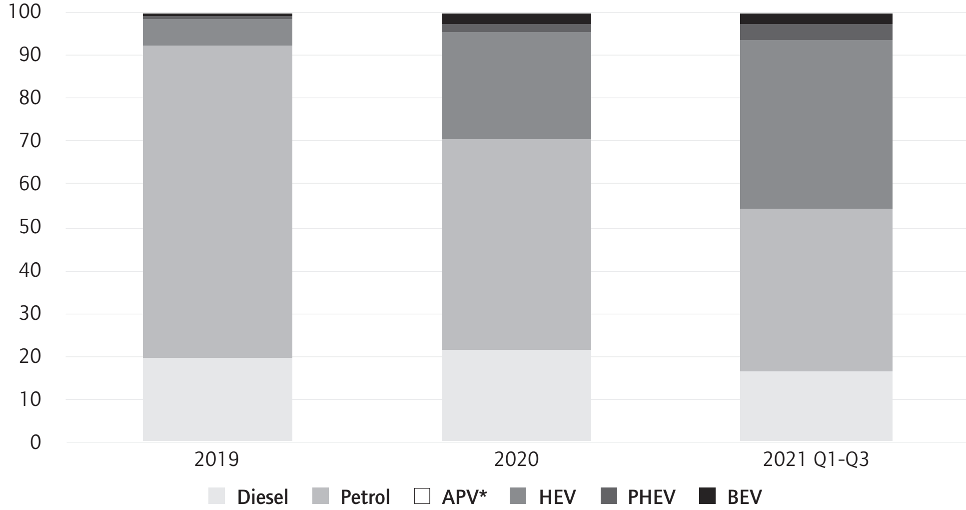
Table 1 **Main indicators of the Hungarian automotive industry**

Year	2005	2010	2015	2016	2017	2018
Enterprises (number)	507	485	494	487	491	497
Production value (million euros)	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 independently of 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 buying environmentally friendly cars (Csernátony 2021). The number of alternative propulsion vehicles as a percentage of all new vehicles sold showed a significant increase, from 8 per cent to 47 per cent, between 2019-21 (see Figure 1), led by a boom in the purchase of hybrid vehicles (from 6 per cent to 39 per cent of total sales). However, this remains a fraction of both the number of registered vehicles and the entire vehicle fleet. For example, relatively costly EVs essential for the decarbonisation of transportation are still beyond the reach of most people. This is reflected in EV penetration rates, which are 2.5 per cent in Hungary – despite doubling between 2019-20 – and which pale in contrast to Sweden (16.1 per cent), the Netherlands (12.7 per cent), Austria (12.7 per cent) and Germany (11.7 per cent).

Figure 1 **New car sales by powertrain in Hungary**



Source: ACEA (2021).

3.2 Production by location

There are four OEMs present in Hungary – Opel, Suzuki, Audi and Daimler (i.e. Mercedes-Benz) – and these are 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, 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 (PSA) in 2017, the company further narrowed its focus to concentrate on internal combustion engines. The merger of Fiat Chrysler Automobiles and PSA 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 invest in upgrading production lines and expanding output by 2023 (Szandányi 2021). Production has declined significantly in recent years and the plant is currently a long way from its maximum capacity of 350 000 engines per year; indeed, only 156 500 engines were produced in 2019 (see Table 2). The future of production in Hungary in the long term has been determined by PSA's announcement at the end of 2020 that it will no longer be investing in the development of internal combustion engines (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 medium term (five to ten years), but it is unclear when and how it may begin to undertake EV production (Autósajtó 2021) [IND2]. The plant's significance stems from its long-standing reliance on domestic companies which, in the early days, comprised 36 per cent 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 one suppliers in 2019 (Gáspár et al. 2020).

Audi launched the production of internal combustion engines in Győr during 1993. The plant gradually became the wider Group's central powertrain supplier and the world's largest engine manufacturer, with a capacity of two million units per year. This scale underpinned its role as a key player within 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 vehicles until 2014 after which it increased to 165 000. In addition to engine production and vehicle assembly, the Győr facility also participates in developing engines and vehicles, as well as the tools used by other Audi plants. Audi Hungaria launched a shift to EV production in late 2018, reaching 5 per cent of total output in 2020 due to the slump induced by Covid-19 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, in which it increased its number of compact car models from two to five. The factory produces around 190 000 vehicles a year and 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. Construction eventually began, however, 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 production in Hungary**

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 motors	0	0	0	9453	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 investment in the automobile industry

Hungary has attracted significant investment supporting the expansion of its automotive industry since the 1990s. Alongside the four operating OEMs and the pending fifth, nearly 150 foreign suppliers have 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 stock of foreign capital investment in transport equipment was 9.2 billion euros (see Table 3). This is roughly a quarter of the total stock of foreign capital investment in Hungary's manufacturing sector, making the industry by far the largest recipient of investment. These levels have, however, declined in recent years. There have been no prominent plant closures, but output has declined recently, partly due to stagnant European demand and export opportunities outside Europe. The transition to electromobility is also a significant financial expense for companies (both OEMs and suppliers) [IND4]. Experts suggest that owners have gradually reduced their capital stock and that this may well have continued during the suspension of activities during the Covid-19 pandemic.

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 inward stock of FDI	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
	Manufacturing 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 inward stock of FDI	Transport equipment (NACE C29)	…	…	…	…	…	…	9.7	8.7	8.3	7.7	9.9	10.0	n.a.
Slovakia inward stock of FDI	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); and NBS (2022).

According to calculations by Pavlínek (2020), the index of foreign control in the Hungarian automotive industry was 94.9 in 2015. Antalóczy and Sass (2012) suggest that FDI data derived from current account statistics does not adequately reflect capital investment, meaning that we 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 2021a).

It was greenfield investments that accounted for the growth in the 1990s, but the industry has generally made significant investments over the course of the past two decades as companies operating in the country have reinvested their profits (Ministry of National Economy 2013; Vápár 2013; Pavlínek 2020). For example, Audi invested more than 11.7 billion euros in Hungary up to 2020, expanding its scope of activities and developing the technologies it uses in its facilities (Audi Hungaria 2021). More recently, electromobility and investments in battery production have played a significant role in this investment boom. Suppliers have also undertaken significant greenfield and additional investments. Robert Bosch (2021), for instance, has invested a total of 200 million euros in its four production sites over the years. However, the overall picture shows significant capital withdrawal due to the consolidation of the industry. For instance, Audi Hungaria has reduced its share capital several times in recent years, transferring dividends to its parent company (mfor.hu 2021).

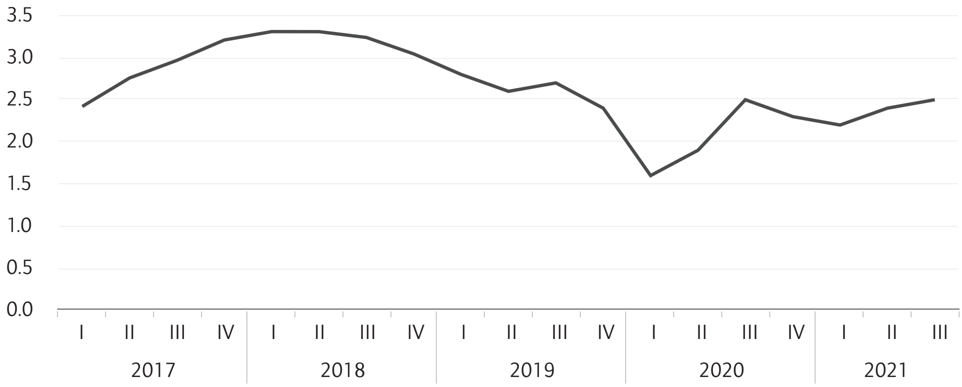
4. Developments in employment

As Section 3 (Table 1) discussed, employment in the Hungarian automotive industry has generally been on the rise in recent years: direct employment climbed from nearly 76 000 in 2010 to slightly below 161 000 by 2019; while indirect employment also increased, from 27 000 to 58 000, during the same period. Achieving such increases has been a strategic ambition of the governments that were in power during this period, all of them underscoring that their push to develop the industry was driven by its ability to provide good jobs [GOV2]. Government officials have repeatedly asserted that national economic development, quantified as GDP growth, rising amounts of local value added and a strengthened role for domestic suppliers, industrial and regional policy advances and even R&D development, is closely related to the jobs provided within the automotive industry. They have used this argument to justify the exorbitant subsidies provided to firms within the industry (Bucsky 2020). According to Vasvári et al. (2019: 1043), state subsidies amounted to 55 000 euros per job created by foreign-owned OEMs and suppliers in the period between 2004 and 2018, more than 70 per cent of all the subsidies allocated to foreign investors. In exchange for state support, companies used employment numbers as their ‘bargaining chip’ [GOV2]. Simply put, they claimed that more subsidies would lead to higher employment.

Historically, the common narrative and concern promulgated by experts is that the Hungarian automotive industry is only an assembly hall for OEMs (Gerőcs and Pinkasz 2019). In the 1990s and early 2000s, Hungary’s competitive advantage hinged on a number of factors, the most prominent of which was a large, relatively skilled and cheap labour force, sustained as 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 proximity to their main European markets (e.g. Germany) where they would also receive generous government support for their activities. The country welcomed these companies with open arms as it urgently needed an inflow of capital, while successive governments saw this as an opportunity to increase employment and boost the economy, ultimately underpinning their success in elections. The presence of jobs does offer a tangible outcome of governments' successful negotiations with corporations [GOV2] but this may be mostly rhetorical; jobs are a key testament to success but, in a context of the tightness in the labour market, noted by all interviewees, the need for them in the first place may have been something of a fiction.

Indeed, several indicators suggest that there are lingering labour shortage problems in Hungary. One is the decline in unemployment rates, which reached 3.7 per cent at the beginning of 2022. The figures are, however, disputed, since some calculations suggest that there are 180 000 active job seekers, although survey results indicate that this may be as high as 300 000 (Hornyák 2022). Meanwhile, the share of unfilled vacancies fluctuates around a relatively low level of 2.5 per cent (Figure 2). Employers are managing this situation mainly through overtime agreements, but a rising number are reporting labour shortages as an effective constraint on production – Astrov et al. (2021) suggest that, in 2019, this was close to 60 per cent 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 per cent 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 [IND1; IND3; EXP1]. In 2019, the manufacturing sector employed 108 680 agency workers, 20 100 of whom were in the automotive industry (ITM 2020). This, in part, reflects the tightness of the market since workers have the ability to change jobs quickly and seek positions that offer the highest wages [IND3; UNI1]. High labour turnover also stems from the decline of regular employment providing job security and benefits. This became evident during the Covid-19 crisis when supply chain issues led OEMs and suppliers to lay workers off [UNI1], with those on temporary contracts the first to lose their jobs. While they were re-hired following the relaunch of production, it demonstrates the precarious position that many are in within the industry.

Thus, the quality of jobs is mixed at best: many relatively well-paying jobs are available but these are not necessarily accompanied by long-term job security and the benefits that were once available to employees. That being said, the tightness in the Hungarian labour market is shown in that OEMs establishing their operations were anticipating attracting labour from within their proximity (10-25 km), but this has now expanded substantially to multiple hundred kilometres, with workers frequently crossing borders [GOV5]. Thus, industrial areas are now seeking to compete to attract labour. In theory, this provides workers with leverage but there is a lack of organisation and mobilisation to expand the reach of unions beyond the few that are active.

The automotive industry has nonetheless been of appeal to workers since it offers relatively high wages both nationally and, especially, in the Hungarian regions where they operate [GOV5; UNI1]. Higher pay is still a key lure but Hungary's weaker labour laws undermine job quality. Most recently, Parliament's ratification of the so-called 'Slave Law' increased the amount of 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 broader 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 industry is relatively high in a national context, but their historical role does not reflect deep roots comparable to the German system, for instance [UNI1]. Unions were set up afresh after the communist era and sought 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 on a handful of occasions [EXP1].

The trajectory of employment has not yet led stakeholders to sound alarm bells. However, the tightness of labour supply may worsen in the short term, not least as BMW moves towards launching operations at its Debrecen factory. The manufacture of electric vehicles may generally be less labour intensive than their ICE counterparts (FTI 2018), but the wider dimensions and full implications of this transition have yet to be explored in Hungary. Most interviewees were not particularly worried about job losses in the short to medium term, although their reasons varied [IND8; GOV1]. One key factor underlined by most interviewees is their expectation that the transition will be gradual, providing all actors with ample time to respond, although some strongly dispute this [EXP2]. While the European Commission's 'Fit for 55' targets will hasten the transition to EVs, it still leaves five to ten years for actors to adjust. Corporate stakeholders did not expect further large-scale lay-offs related to ICE technologies since large portions of manufacturing processes have already been automated [IND2]. Most OEMs have concluded their automation programmes and do not anticipate further lay-offs [IND3].

A number of factories are undertaking activities such as the assembly of vehicles that would not require a smaller labour force as the EV transition escalates. Vehicle assembly does play a prominent role in Suzuki and Mercedes-Benz and, to some extent, Audi.

While the latter assembled a record 171 015 vehicles in 2021 (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 that same year, but the number of electric powertrains was a mere 96 976 – just 6 per cent of the total. The firm anticipates gradually increasing the role of EV production in line with its headquarters' strategy, the most recent of which was '*Vorsprung 2030*'. Based on this and the additional guidelines provided by Audi, the Hungarian subsidiary is developing five-year product, financial and manufacturing plans [IND3]. Interviewees suggest that the competitiveness, geographical location and capacities of the plant position it well in adapting to the transition, which it has signalled through further investments in its tooling plant and other technical developments (Audi Hungaria 2022).

Regarding suppliers, our interviewees contend that their firms are specialised in producing components that can be integrated into both ICEVs and EVs [IND6; EXP2]. Consequently, they suggest that the transition will not jeopardise their employees. In 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 labour market will be restructured during the transition. There are two important dynamics here. The first is that German automotive manufacturers are committed to state mandates to maintain their employment numbers [IND3]. They can do this either by 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 relationship to vehicle ownership, car sharing becoming increasingly popular amongst younger generations [GOV5], and this may impede higher sales. Both limit the growth of German manufacturers. Thus, alternatively, to maintain their labour force, these companies must seek to deepen production which entails them expanding in-house activities. This can lead OEMs to acquire suppliers and integrate their activities which, through streamlining, could lead to lay-offs. In this way, OEMs would be able to maintain employment figures but this is bound to have an adverse effect on SMEs and employment throughout the value chain.

Secondly, interviewees noted that the labour force is migrating from one part of the value chain to another. The skilled workforce currently focused on R&D may be forced to take jobs in manufacturing and in 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 projects could be reskilled to take relatively good jobs (e.g. in manufacturing, automation or as project engineers) in the manufacture of EVs. The shift will be a step down for many, but it would still provide relatively high living standards for skilled professionals. Instead of mechanical engineering-type tasks, they may be assigned the design of automation or of assembly lines, the ramping up of production or 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.

A further factor in employment hinges on the activity of trade unions. These are currently mostly occupied with managing day-to-day activities and have little surplus capacity to tackle the long term issues presented by the transition [UNI1; UNI2]. As the labour market is restructured by the prevailing dynamics, workers are set to be further atomised and 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-training programmes) [UNI2], but their role is limited and this is poised to weaken further 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 the initiative to organise [GOV5]. This can be a crucial point of departure that reverses the negative implications of structural changes in automotive industry employment.

These will, however, face an uphill battle as Asian firms (e.g. Suzuki) and newly established battery manufacturers have been especially attentive to, and dismissive of, unionisation (Papp 2019).

5. Possible effects of decarbonisation and digitalisation

5.1 Technology

Decarbonisation and the adoption of new technologies will considerably change the automotive industry, but how this will materialise is still the object of speculation. Some of our interviewees are questioning which technology will emerge as the leader out of the technological alternatives available [IND1; IND8; UNI1]. Nonetheless, there is broader consensus that EVs will become dominant [NGO1; NGO2; IND1; IND3], even if they may be complemented with other technologies. This contingency causes concerns for stakeholders since they do not know where to invest. Irrespective of the outcome, multiple interviewees noted that the wider industry is aware that current investment patterns will not be sufficient to maintain the competitiveness of the value chains already in place [GOV2; IND11; UNI1]. However, 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, to what extent the government should be involved in choosing favourites or allowing the market ultimately to decide remains unclear [GOV2]. The government of Hungary has continued to provide some support for ICEVs, but it has begun to place greater emphasis on 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 for decarbonisation is its involvement with improving R&D capabilities within the country [GOV5]. It approaches R&D as a cost-efficient point at which to intervene in the automotive value chain, allowing local actors to develop technologies, increase value added and develop facilities that support output in Hungary. This was also confirmed by one interviewee [IND4], who commented that increasing value added was also key for the competitiveness and survival of suppliers. This would also enhance the resilience of the domestic sector regarding future changes [GOV6].

A flagship project of the government in this area 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 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 is fostering the development of domestic manufacturing and encouraging improvements in the education system. The latter is urgently needed, with government expectations suggesting that the 3000 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 its curricula frequently lags behind the rapid technological progress made by the industry. There is already a strong concerted effort between government and industry to establish education programmes that cater to rising needs, which – combined with the still relatively inexpensive workforce – would offer a key competitive advantage for Hungary in the maintenance or even advancement of its position in European value chains [GOV6; UNI1]. The issue is that it takes two to three years to develop engineering education programmes while large parts have already 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 clear that new competencies needed to be added to the skillsets of employees, considering the skill requirements posed by automation, digitalisation and the transition to e-mobility. Digitalisation and the increasing automation of 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 issue raised by interviewees was the need for a new set of safety measures to be learned and included in a variety of tasks [UNI2; GOV6)]. In contrast, interviewees claimed strongly 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 correctly to interpret feedback from the machines (when controlling automated systems) is paramount. A knowledge of how to keep operations running requires a more advanced skill set from the labour force.

The changes in employment are, however, unfolding slowly. New products – be that a vehicle or a part or component – introduced by manufacturers requires employees to be trained since these all involve incremental adjustments in tools and ways of working or, on occasion, they 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 the accumulation of new digital skills and the upgrading of the content and quality of work, one interviewee [UNI2] described an adverse scenario involving an automation-induced process of deskilling. In this scenario, the core processes are robotised and, in consequence, fewer skilled operators are needed. For instance, in the case of welding operations, workers would not be engaged in operational interventions using special purpose equipment to carry out given processes. Instead of welding, workers would perform simple auxiliary tasks alongside welding robots, including monitoring them. This grim picture was, however, not supported by other interviewees [IND2; IND3]; what is more, interviewees suggested that automation may have to be accelerated to overcome labour shortages: a contrasting view to automation leading to unemployment or the materialisation of 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 – and primarily the 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, the transition may have outcomes that are worse than expected and this may lead to a substantial decline in the labour force employed within the industry. 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 transportation segments [GOV5]. Difficulties among OEMs would send shockwaves through the value chain and endanger lower tier suppliers, especially locally 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 industry 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 training programmes without which the transition may wreak havoc. Skilled labour in 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 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 be a sustained one.

A recurring pattern in our interviews is employers highlighting 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 changes from time to time); and problem-solving skills [IND8; GOV1]. This will be even more important if automation-heavy production expands. One interviewee noted that:

> Employers are looking for different competences than before. Previously, when we asked what kind of new employees they were looking for, companies pointed to specific occupations, informing us that they needed 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 of the labour force to adapt is certainly one of the largest risks that Hungary's automotive industry faces.

7. Foreign investments by Asian manufacturers in Europe with a focus on new technologies

Historically, investors channelled funds into the development of ICEV but this has shifted to electromobility since the mid-2010s. As discussed above, traditional manufacturing plants and component manufacturers geared towards ICEVs have begun to expand their portfolio to EVs as well. Investments that are solely targeted at EV output have accompanied this. One of the world's leading electric vehicle manufacturers, the Chinese firm BYD, has set up a plant in Komárom to produce electric buses. Its operations launched in 2017 and output was envisaged as growing 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's 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 industry. 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 plans suggest that further expansion will continue (Schade et al. 2022). This was a common theme of our interviews in which all interviewees addressed the recent emergence and rapid expansion of Asian battery production capacities in Hungary. A total of 5.29 billion euros has been directed into battery production since 2016, creating 14 000 jobs (ITM 2021), while production capacity has risen to 20 GWh per year – compared with the EU's 35 GWh (Major 2021). Battery production has also become a leading point on the government's industrial policy agenda through which it has lent support predominantly to Asian firms. Hungary has attracted substantial investment from Chinese, Japanese and South Korean companies, with others also considering investing 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 et al. 2022).

Table 4 **EV battery manufacturers in Hungary**

Company	Country	Activity	Location	Investment (bn forint)*	Year of establishment
Tier one / 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 two and three 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	Aluminium anode foils	Tatabánya	44	2019

* Average forint:euro exchange rate for 2021 was 358.5:1.
Source: Authors' compilation based on ITM (2021).

The rapidly expanding battery production facilities cater to the rising demand of automotive OEMs and others. So far, these activities have been led by east Asian companies that have established labour intensive, but low value added, production sites. For example, SK Innovation's gigafactory in Iváncsa, the largest greenfield project in Hungary to date, enables the production of batteries for approximately half a million EVs a year (HIPA 2021). Hungary ranks 16th on the global lithium-ion battery supply chain ranking by BloombergNEF (2021), behind 14th placed Poland and 15th Czechia, but ahead of Slovakia, which highlights its prominent role in the sector. This is further underscored when considering its expected growth.

These production capacities are, however, targeted at foreign markets, indicating that domestic value chains have not yet shifted their operations to absorb battery output, unlike in Czechia, for instance.

Battery factories have created a significant number of new jobs. During one 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 operating production line machines. 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 can be learned 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.

However, concerns over working conditions have been raised. While the level of pay is acceptable, they have been referred to as bad jobs [UNI1]. There are also concerns about working with hazardous or toxic materials, suggested by interviewees [NGO1; NGO2; UNI1; EXP1] but also publicly reported (Partizán 2020), even if those working within the sector question or refute such claims [IND5; IND11]. Such factories have also had a negative impact on the environment, as well as on those who live near the 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 rather helpless (Partizán 2020).

8. Conclusion

Drawing on the experiences of Hungarian automotive stakeholders, this chapter investigated whether the disruptive forces transforming the industry are producing 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 the transition of production to electromobility and digital. Our point of departure was that the structural transformation of the Hungarian automotive industry 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. As the EU-driven response to the climate crisis unfolds and global demand for internal combustion engines withers away, the Hungarian industry has also begun to adjust and shift operations to produce electric vehicles.

For now, there is a tightness in the labour market and demand for labour is robust, but the Covid-19 shock and the disruption in the supply of chips have highlighted the precarious position that many workers are in. Those on short-term contracts or employed by companies lower in the value chain are susceptible to disruptions as they are the most vulnerable. The government has supported job creation related to EVs to preserve the industry and adapt it to a decarbonised world, so it has been able to create jobs although these have not always been good jobs. 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 the actors.

Our results do not confirm that the country's industry faces a structural lock-in; at least, not in the short or medium run. They do show a case that we refer to as a lock-in *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, while engendering industry concentration at 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 chain. Specifically, this regards the decision of whether the existing investors remain committed to locating capital and knowledge intensive activities in 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 momentum may be lost. Moreover, policymakers needs to consider carefully the quality of the jobs that it maintains since this will be crucial in sustaining the wellbeing of citizens and their support for the transition.

9. Policy recommendations

Our findings suggest that the imperative of aligning policy instruments in a synergistic way should be a focal consideration pursued by policymakers when developing their agenda. The importance of consistency and coherence cannot be overstated as haphazard interventions without long term, aligned goals will inhibit the Hungarian automotive industry'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 are fostering the industry's adaptation to high value added activities within EV supply chains. Programmes that support firms' digitalisation and the implementation of advanced manufacturing solutions will increase investors' commitment to developing the EV-specific production activities of their Hungarian subsidiaries. This is something which is also deeply reliant on supportive education policies being developed in cooperation between the state and the industry.

In contrast, there has been an overwhelming government push to introduce labour market policy instruments which attract FDI, but are characterised by 'race-to-the-bottom' behaviour, suppressing wages while reducing the stability of jobs, offering subsidies from public purses and curtailing environmental standards. Examples include the so-called 'Slave Law' deregulating 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 behaviour is that it hinders the creation of quality jobs. In the quest for low labour costs, the upgrading of vocational and higher education is being neglected, exacerbating the shortage of skilled labour. Consequently, investors are not motivated to locate high value added activities to local production sites – including EV-specific production that requires a skilled 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 intermediate technical competencies).

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All links were checked on 19.01.2023.

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 one supplier
9	IND5	Anonymous	HR officer	Battery manufacturer
10	IND6	Anonymous	Deputy managing director and marketing manager	Tier two supplier
11	IND7	Levente Reizer	E-mobility project manager	Nissan
12	IND8	Szabolcs Karaszek	Director of human resources	BorgWarner Oroszlány (Tier one supplier)
13	IND9	Anonymous	Project manager	Test track operator
14	IND10	Anonymous	Executive director	Tier two supplier
15	IND11	Anonymous	President	Electromobility association
16	UNI1	Anonymous	Executive	Trade union
17	UNI2	Zoltán László	Vice-president of union federation	Vasas trade 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