SHIFTING TO E-MOBILITY: CHALLENGES AND ACCOMPLISHMENTS IN CEE AUTOMOTIVE INDUSTRY

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Abstract: The European Union (EU) is currently undergoing considerable simultaneous challenges pertaining to climate change, in the context of its commitment to achieving climate neutrality by 2050. In pursuing the decarbonisation goal that underlies the assumed energy transition, a shift from fossil-fuelled to electric vehicles (EVs) represents a crucial step. In this context, the objective of our article is to conduct a comprehensive analysis of three key areas: (a) the potential impact of road transport electrification on the automotive industry in Central and Eastern European (CEE) countries and Romania; (b) the current state of development of battery cell production for EVs in each of these states; and (c) the prospects for implementing the transition to e-mobility in the region.

Keywords: Central and Eastern European countries, CEE, Romania, transport electrification, automotive industry transition, electric vehicles (EVs), Li-ion battery.
JEL Classification: L62, L98, O13, O25

1. Introduction

Western Europe invented the car approximately two hundred years ago and has practically always been a force in the manufacturing of conventional cars equipped with internal combustion engines. Even nowadays, the large German, French, Italian, Spanish or Northern European manufacturers, along with their plethora of sub-suppliers are generating the second largest sectoral contribution to the EU trade surplus: +EUR 96 billion in 2022 (+EUR 112.2 billion, in 2021), with only the chemical industry (+EUR 198 billion, in 2022) surpassing the automotive industry in this respect.

Central and Eastern Europe has become a strong hub of the European automotive industry, particularly in the recent decades. After 1989, the year that marked the fall of Communism, the comparative advantages of these countries – the highly skilled, professional, and cheap workforce, the proximity to and, later on, membership of the EU, with all the advantages of the single market – as well as the national programmes that these countries implemented to encourage foreign investment, allowed CEE countries to attract an increasing number of large automotive manufacturers. The majority of these were Western European companies (Renault and PSA in Romania, Volkswagen in the Czech Republic, Fiat in Poland and Serbia, and, a little later on, many others from the luxury segment, particularly in Slovakia and Hungary – BMW, Mercedes-Benz Group, Audi, Volvo Cars, Jaguar, Porsche), but there were also companies from Asia (Daewoo in Romania, Suzuki in Hungary, Toyota in Poland, Kia in Slovakia, Hyundai in the Czech Republic and, more recently, even Chinese companies: Great Wall in Bulgaria – unsuccessfully, BYD in Hungary), as well as U.S. companies (Opel and Ford in Romania).
These companies either took over locally well-known manufacturers (such as Dacia or Skoda, for example) in the context of the local privatisation programmes that these countries had underway, built new facilities at grassroots level (for example, those in Hungary, where there was no automotive industry prior to 1989), or relocated to the CEE a part of their business already operating in other areas, triggering similar moves from their sub-suppliers. As a result, the CEE area came to be included in the European and global automotive and component manufacturing networks and in the regional and global supply chains, they received inflows of capital, technological and organisational know-how and good practices, while the local industries were able to modernise and to significantly improve their productivity and competitiveness, created jobs and became the source of decent salaries for their employees, of an improved standard of living in the CEE and of economic growth in these countries.

2. Brief literature review

Given the unprecedented transformations currently underway in the European and global automotive industry aimed at achieving climate neutrality by 2050, the issues related to the challenges of electrifying transport have been extensively analysed and well documented in the international economic literature of recent years. A review of the specific literature reveals a multitude of scientific papers that examine the implications of transitioning to electric vehicles, several of them focussing on Central and Eastern Europe and Romania, an approach particularly relevant considering that a significant proportion of the cars produced in Europe are manufactured in this region (e.g. Kozinski, 2023; Hilllebrand, 2023). Consequently, a number of studies have explored the challenges of this transition for the CEE automotive industry, in the light of their position as an "assembly hub" for Western car companies. From this perspective, the potential impact on regional employment – which is double than the European average – has been considered, especially in the context of less labour-intensive EV production. (e.g. Szabó, 2023; Hruby, 2024). Furthermore, a substantial volume of scholarly research has assessed the capacity of CEE to meet the evolving demands of the automotive industry, in which the production of batteries represents a pivotal sector. Among these studies, Szilagy (2022) and Ioniță (2023) examined the role and position of CEE countries in the manufacture of cells for electric batteries, a crucial driver of the transition to e-mobility. They also emphasised the significance of attracting foreign investment to this end.

3. A concise description of the methodology employed

In order to provide the most accurate representation possible of the impact that the electrification of transport will have on the automotive industry in Central and Eastern Europe, and in this respect, in each of the countries that comprise the region, a set of research tools was employed throughout the research.
A quantitative analysis was thus conducted with the objective of synthesising the conclusions of the most relevant regional studies. The objective of this analysis was to identify the challenges that the manufacturing of electric vehicles poses for automotive industries in the countries under examination, for the value chains involved in EV manufacturing, and for employment. Subsequently, a quantitative analysis was employed to assess the current status of Li-ion battery production in each of the CEE countries and in Romania, given the pivotal role this factor plays in the transition to e-mobility. Additionally, a series of relevant case studies were presented, which enabled an accurate assessment of the current electric battery production capacity in each of the CEE countries. This assessment allowed for the establishment of their position in the regional and global hierarchy, as well as the identification of their capacity to attract foreign investment and of the main investing companies.

4. In a nutshell: CEE automotive industry in European and global context

Today, the automotive industry in the CEE countries accounts for 25% of the 194 automotive plants in Europe, while four of the most important countries in automotive manufacturing in the Central and Eastern Europe – the Czech Republic, Slovakia, Romania and Hungary – together account for one third of the car manufacturing output in Europe as a whole (Kozinski, 2023; Hilllebrand, 2023). Of particular note is the fact that no other country in the world manufactures more cars per thousand inhabitants as Slovakia (raking 1st worldwide with 180 units/1,000 inhabitants/year), followed by the Czech Republic (ranking 2nd) and Slovakia (3rd) [Table 1].

Table 1: Total car manufacturing output of CEE countries in 2022* (thousands of units)

	Czech Republic	Slovakia	Romania	Hungary	Poland	Slovenia
Number of cars	1221.3	970.3	509.5	453.4	451.1	67.9

Note: * Total conventional and electric cars.
Source: Authors' compilations based on data published by Statista (2024).

The only one of these countries that did not experience a decline in production in 2021 under the impact of the COVID-19 pandemic was Slovakia, and the only CEE country that did not exceed in 2022 the production level of 2020 was Slovenia. Car manufacturing continued to decline in Slovenia, reaching half its 2020 level in 2022. Romania on the other hand had a record output in 2022, with over half a million cars, for the first time in history.

During the last few decades, in many of the CEE countries the automotive industry became an essential pillar of the economy, a sector that ensures jobs for hundreds of thousands of citizens (around 800 thousand direct employees in the automotive industry in the Visegrad countries plus Romania), a business area that has become the driving force behind numerous other industries at horizontal level, contributing with considerable amounts to national exports (10%-15%) and holding a significant share of the gross domestic product (GDP), such as, for example: 13% of the GDP in Romania (2023); 13% in Slovakia (2022); 9% in Poland and the Czech Republic; 5% in Hungary, etc. (Hillebrand, 2023; Dumitrescu, 2023; Prandin et al., 2023; Poland Alternative Fuels Association [PSPA] 2022; Liss, 2023).

While, on average, people working directly in the automotive industry only represent 8.5% of the total number of employees in the European industry as a whole, in the CEE countries the situation is very much different, with the percentage of those directly involved in automotive manufacturing of the total industry workers being as much as twice higher than the European average, in some countries: in Slovakia, for example, it stands at 16%, in Romania at 15%, in the Czech Republic at 13.8%, and in Hungary at 13.1%. This indicator is below the European average only in Poland, at 7.7% (Hillebrand, 2023).

This indicates a high degree of dependency on the wellbeing of this industry and of the related international market which, in a certain context, could become a significant vulnerability for the countries concerned, in particular if we take into account the fact the most of the automotive companies are foreign companies which, at turning points, decide the fate of their production facilities and, implicitly, of their employees in various countries. According to Hillebrand (2023), over 90% of the automotive manufacturing output in CEE countries (EU Member States) is controlled by foreign companies, therefore the decisions regarding the automotive industries of CEE countries are made outside this region. This reality is all the more important to consider as the automotive industry has entered the amplest and most profound stage of its transformation, the development of electromobility[1] by transitioning from the internal combustion engine using fossil fuels, to electric engine propulsion.

The Romanian automotive industry had a total turnover of EUR 3 billion in 2022, accounting for 12% of the GDP. This includes the achievements of the over 230,000 employees working in two large automotive companies, Dacia Renault (5% of the GDP) in Mioveni and Ford-Otosan in Craiova, but also of the employees of the over 500 companies that supply components, parts and technologies, which are covering around 60% of the local automotive industry and are also major exporters (Cornea, 2022; Alecu et al., 2023).

The automotive industry is Romania's main exporter, accounting for approximately 14.2% of the country's total exports (EUR 92 billion[2] in 2022) (Alecu et al., 2023; Romanian National Institute of Statistics [INS], 2024). It is worth noting that Romania's car manufacturing output grew practically around 100 times since 2000, after the existing facilities – *Dacia* and *Automobile Craiova* – were taken over by the large automotive manufacturers *Renault* and *Ford*, respectively. Romania's automotive production is overwhelmingly exported to other European countries, with the three largest exporters from Romania in 2022 being, in descending order: (1) *Dacia*, (2) *Ford*, and (3) *Star Assembly*, part of the *Mercedes-Benz* giant, which manufactures gearboxes, drive lines and components in Alba County (Cornea, 2022).

It is worth highlighting that in the entire Central and Eastern European area, *Daci*a and *Skoda* are the only two companies that preserved their original local brand names, surviving the difficult market economy transition faced by the countries of the former Communist Bloc with the contribution of the two large Western companies that took them over, developed and promoted them, Renault and Ford.

5. Road transport electrification's impact on CEE automotive industry

The transition towards fully electric transport entails a fundamental technological change, reflected in a completely different logic of car manufacturing. While many of the components of the conventional car are kept, the main conceptual change consists of the EV powertrain, in terms not only of the energy used, but also in terms of how this energy is stored and distributed: EV construction no longer includes an internal combustion engine and, as such, entire conventional automotive manufacturing systems are eliminated – the fuel tank with its entire fuelling system (fuel pump, pipes, filters, etc.), the internal combustion system (piston, spark plugs, etc.), alternator, the complex multiple-gear transmission system, the exhaust gas evacuation system. All these are replaced by an electric engine, a rechargeable battery, cables for electricity transmission and a simple gearbox.

[1] Electromobility/e-mobility is the mobility provided by electrically powered vehicles.

[2] According to the National Institute for Statistics (INS), the total value of Romania's exports in 1991 equalled the equivalent of EUR 3.5 billion. Over the course of 30 years, it grew 26 times (Romanian National Institute of Statistics [INS], 2024).

A BEV[3] car is at the same time simpler, easier to assembly and significantly more expensive than a conventional one. Its powertrain comprises only a few hundred components, around 400, compared to the at least 1,000 components of the conventional vehicle, but it is a lot costlier due to the high price, diversity and much higher quantity of minerals used in the construction of the battery and of the engine, most of these being critical mineral resources. According to calculations made by the Price Waterhouse Cooper consultant (PWC, 2020), the cost of manufacturing one electric powertrain stood at around EUR 9,500, while the cost for the manufacture of a conventional powertrain amounted to only EUR 5,000.

Another important change brought about by the radical shift in technology, from conventional vehicles to EVs, consists of the fact that electronics and software became a lot more important in the functioning of the EV, and their share in the total manufacturing cost of a car tends to increase substantially, accounting for as much as up to 10% din of the total manufacturing costs. According to Hillebrand (2023), these cost structure changes determine the transfer of the main link where the most added value is created in the case of the electric vehicle manufacturing chain, from the companies that manufacture/assemble the final product, as it was the case for conventional automotive manufacturing, to the companies that manufacture the main component, the battery, plus those that produce the electronics and software which equip the electric vehicle and which its proper functioning depends on.

As far as the automotive manufacturer is concerned, the shift towards BEVs does change the type of activities, but, according to more recent research, it will not have as great an impact on the required workload as had previously been thought. The German Fraunhofen Instutute calculated for Volkswagen that the workload required to manufacture an electric powertrain, including the battery, is 41% lower than that required to manufacture a conventional powertrain but, nevertheless, this decrease in necessary labour is compensated by increases at other stages of the assembly process (such as, for example, the installation of the wiring or the recharging of batteries). Overall, the required workforce is not significantly lower in BEV manufacturing, but only 3-4% lower following the transition to e-mobility, only that the workforce input is of a different type and necessary at other manufacturing stages. In other words, a company shifting towards BEV assembly does not require staff cuts, but rather employee reskilling.

As such, the EV manufacturing value chain is no less workforce-intensive than that of conventional manufacturing and, as a result, the effects in terms of the workforce engaged in the European automotive sector will not be as dramatic as initially thought. The change will be in terms of the type of activities necessary and of the qualifications and skills required to perform them.

The constructive novelties of the electric car and its manufacturing technology entail the radical transformation of the entire manufacturing process, the provision of new workforce qualifications and skills, the provision of with new equipment and, in particular, the changing of a significant part of the supplier chains. Practically, component suppliers that ensured the supply of parts and systems that are eliminated from the construction of the new type of car, briefly listed above, become useless and are bound to go bankrupt unless they promptly shift towards different activities that are needed on a fully changed automotive market or on other markets.

This is the major risk faced by entire clusters of CEE component manufactures that supply not only the national conventional car industries, but that are also important exporters to other countries with strong automotive industries. Poland, for example, is among the top ten countries globally in this respect, with annual exports of automotive components amounting to more than USD 12.3 billion. In Romania as well, the manufacturing and export of components are very important: 7 of the country's 10 most exported products are related to the automotive industry. In 2021, around EUR 6 billion worth of automotive components, EUR 3.5 million worth of wiring, plus dashboards, consoles and tires were exported from Romania.

CEE-wide, 80% of the jobs in the automotive industry are in facilities that manufacture components and parts, a large number of the employees working in those very facilities that will be most affected by the EV transition: the manufacturing of internal combustion engines and transmission systems. According to calculations made by PWC for the European Association of Automotive Suppliers (CLEPA), it is expected that by 2040, 43% of the jobs estimated to be lost in the manufacturing of conventional powertrains, including internal combustion engines, will not be compensated by the new jobs created in the manufacturing of electric powertrains. Several studies suggest however that the transition towards electromobility will be considerably slower in the CEE area than in Western Europe and, as a result, for an additional considerable length of time, the European ICE industry will remain concentrated and active in the CEE countries (Hillebrand, 2023), especially since the electromobility

[3] Battery Electric Vehicle [A/N];

issue seems to have been resolved only as far as passenger cars and urban public transportation are concerned, but viable solutions are yet to be provided for long-haul freight trucking. At the same time, in many developing countries the transition towards e-mobility will very likely be even slower than in the CEE, and therefore they will remain viable markets for European ICE manufacturers. As a result, these manufacturers will no longer face an immediate shock, but instead will have the necessary respite to adapt and reorient themselves according to the circumstances.

According to PWC, the number of employees involved in the European manufacturing of components for conventional powertrains will reach its peak in 2030, after which it will decline, and this will also happen in the CEE countries. According to this forecast, the strongest impact on the employed staff will be felt in Romania, where 48% of the jobs in the field may (gradually) disappear if no new jobs are created as soon as possible in the manufacturing of EV components, to absorb the staff laid off from the conventional manufacturing area. In Poland, the estimated impact is substantially lower, at 20%, and for the Czech Republic PWC expects the conventional powertrain system manufacturing sector to remain stable.

6. Li-ion battery manufacturing in the CEE

The impact of the transition to e-mobility, the extent and ways in which this process will affect the automotive industry in the CEE countries and their economy largely depend on how well these countries will manage to attract strong investors to develop their manufacturing of rechargeable EV batteries. For countries that have already had notable successes in this area, as is the case of Hungary or Poland, the impact will depend on the extent to which they will be capable of maintaining the very good positions they hold at present.

The global demand for EV Li-ion batteries increases rapidly and will reach 9,300 GWh in 2030, an increase of 1,600% compared to its level in 2020 (Buthada, 2022). With this dynamic, demand constitutes one of the major factors driving the accelerated increase in EV battery manufacturing capacities, along with the effort to decarbonise economies and stop global warming, and the strategic objective of the EU and other developed economies to reduce dependency on China and Asia. Against this background, the development of ever more comprehensive regional (and even internal, in large economies) supply chains becomes increasingly important for countries with a significant automotive industry, in the effort to ensure the transition from conventional technologies developed around the internal combustion engine to the fully electric drive.

The production of electric battery cells is very capital-and energy-intensive, but not workforce-intensive, because manufacturing is largely automated. Therefore, such an investment has a very limited positive effect on the volume of hires, but it is essential for the transition of the local automotive industry towards electromobility and, in the end, not only for the survival of an industry that is extremely important for the economies in question, but also for a very promising future of this industry in the long run, with an increased positive impact on national economies.

The criteria investors look for when choosing the overseas location for a new EV battery manufacturing facility are related to the proximity of the downhill user industry facilities, the availability of high-skilled labour and of sufficient energy resources and, of course, the cost of these inputs. These are objective economic criteria, which are well met by the CEE countries. At the same time, an important factor in the decision to invest in CEE countries is the intention of foreign companies – such as those in Asia, in particular China, the world leader in the production of batteries for electric vehicles – to enter the European single market not only as exporters (which could be or become problematic), but also as local manufacturers.

As far as China is concerned, a very important factor when choosing the location of any external investment, and even more so in the case of an investment of very high value such as the construction of Li-ion battery factories is, the intensity of China's political relation with the beneficiary country, the level of their mutual support and trust, as well as the level of influence obtained by China in that country are more important than the economic and commercial criteria. Because it must be remembered that Chinese companies, though they may be private ones, always follow the foreign policy of the Chinese state and only make decisions that are approved or even indicated by the Communist Party, through its leaders who hold the highest positions in the state's administration. It is not rarely that a decision of this kind made by China also seeks to have a demonstrative effect for other potential partners and takes the appearance of a reward for the country that responded to its political expectations, as part of a "carrots and sticks" external strategy, such as the one China employs towards CEE countries, in the 16+1 format.

Regarding the evaluation of CEE countries in terms of their attractiveness for investments in EV battery manufacturing, a European Trade Union Institute (ETUI) report considers the local labour and energy costs as

essential for the decision of foreign companies to invest, these alone accounting for 50% of the score required for a positive assessment. Based on a localisation matrix designed by the authors, the report concludes that while Hungary and the Czech Republic have very good scores, already confirmed by the number and volume of related investments attracted (which is correct in the case of Hungary, but not in the case of the Czech Republic), other CEE countries such as Poland and Slovakia would receive a sensibly inferior score (Schade, Haug, & Berthold, 2022). Hillebrand (2023) cites the ETUI Report in its own analyses, including Romania along with Poland and Slovakia in the category of countries with lower scores, which would not be attractive for investments in the production of Li-ion electric batteries, while Romania was completely absent from the original ETUI Report analysis. However, the inconsistencies between the theoretical model based on the localisation matrix and reality raise serious doubts as to the thoroughness of the assessments that use this system (for example, Italy has a very weak score and Poland a weak score, but both have investments in the battery industry, while Norway has the best score but has not attracted any investment in this industry).

In 2022, according to the same report, there were 25 electric battery cell factories in Europe, plus another 6 about to be announced. In 2023, the production capacity announced should have reached a total of 157 GWh and then reach 900 GWh in 2030 (in almost all cases the production started with smaller outputs and grew gradually, as the market evolved, until reaching maximum production capacity). According to the calculations in this report, around 50% of the production capacity in 2030 would be held cumulatively by European investing companies, while the remaining foreign companies, both Asian, and American would strive to adjudicate more consistent and firmer positions on the European market which promises to become an extremely competitive one as a result. Europe's problem at this moment is related to the fact that while foreign Asian companies, in particular CATL (China) and American ones represented by Tesla are one step ahead, being already established on the market and operational, while European companies are barely now entering the Li-ion battery market and starting to operate, with significantly less experience than, for example, their Chinese competitors.

6.1. Central and Eastern Europe

CEE is well positioned to meet the increased demand for EV batteries, increasingly outlining its future as a centre for the manufacture of batteries and other EV components, as well as for the assembly of electric vehicles. In the recent years, many European investors and from outside Europe implemented and/or announced new investments in the manufacture of Li-ion batteries in the CEE area.

In an industry such as that of EV batteries, characterized by an entirely different dynamic in the last decade that is forecasted to remain the same in the future, statistical data regarding cumulated production capacities located in different countries may vary a lot, depending on the source of the data, the time when they were collected and the stages those investments are at, and can also present a certain volatility because there is a considerable possibility that potential investments may not always turn into real investments. As a consequence, these data are often ephemeral and can easily become contradictory when statistics from different sources are compared. Keeping these observations in mind, these were the statistical data in February 2021 regarding battery production capacities (Table 2) cumulated by countries based on the announcements made by companies and provided by S&P Global Marketing Intelligence, for the period 2018-2025 (Yu & Sumangil, 2021). Although at present the figures in Table 2 are very likely obsolete, given the extraordinary dynamics of the sector, they still reveal some important aspects, including with regard to the situation of the CEE countries, which we are looking at in this section in particular:

i. in 2018, China (ranking 1st worldwide at present) already had a significant advance compared to all the other countries, which it permanently increased over the years, while much more developed economies in Asia barely made timid steps in this industry, and while others from Europe were either at the beginning (UK) or did not have such initiatives before 2021 (Germany);

ii. in the CEE countries of the Visegrad group (V4), foreign investments in EV battery factories had a more rapid start, ahead of both other CEE countries and even of large automotive manufacturing countries in Western Europe;

iii. Hungary and Poland gained early recognition as locations of choice for investors in the battery industry and the countries' continued efforts to attract such investors bore fruit, as they took and kept top positions both in the CEE and the EU rankings, and in the global hierarchy (Table 3).

Table 2: EV Li-ion battery production capacities 2018-2025, by countries and large regions (GWh)

	Country	2018	2019	2020	2021	2022	2023	2024	2025
	Australia	0	0	0	1	1	1	4	7
Asia	China	260	268	350	558	718	884	944	944

	Country	2018	2019	2020	2021	2022	2023	2024	2025
	Japan	17	17	17	17	17	17	17	17
	South Korea	11	18	18	18	18	18	18	18
	Thailand	0	0	0	1	1	1	2	2
Europe	**Czech Republic**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**1**
	France	0	0	0	0	0	20	32	32
	Germany	0	0	0	11	52	93	128	164
	Hungary	**3**	**14**	**20**	**28**	**37**	**47**	**47**	**47**
	Poland	**6**	**6**	**6**	**22**	**54**	**70**	**70**	**70**
	Slovakia	**0**	**0**	**0**	**0**	**0**	**0**	**5**	**10**
	Sweden	0	0	0	4	14	23	32	32
	UK	2	2	2	2	2	5	12	12
North America	US	27	37	42	44	51	76	91	91
TOTAL		325	362	455	706	966	1,246	1,403	1,447

Source: Authors' compilations based on data published by S&P Global Marketing Intelligence (company disclosures; data as at 1 February 2021).

Table 3: Hierarchy of EV Li-ion battery manufacturing countries in 2021 and 2025 (GWh)

	2021				2025 P		
1.	China	558	79,0%	1.	China	944	65,2%
2.	USA	44	6,2%	2.	Germany	164	11,3%
3.	**Hungary**	**28**	**4,0%**	3.	USA	91	6,3
4.	**Poland**	**22**	**3,1%**	**4.**	**Poland**	**70**	**4,8%**
5.	South Korea	18	2,5%	**5.**	**Hungary**	**47**	**3,2%**
6.	Japan	17	2,4%	6.	Sweden	32	2,2%
7.	Germany	11	1,6%	7.	France	32	2,2%
8.	Sweden	4	0,6%	8.	South Korea	18	1,2%
9.	UK	2	0,3%	9.	Japan	17	1,2%
10.	Australia	1	0,1%	10.	UK	12	0,8%
	Other	1	0,1%		Other	20	1,4%
TOTAL WORLDWIDE		706	100.0%	TOTAL WORLDWIDE		1,447	100.0%

Source: Authors' compilations based on data published by S&P Global Marketing Intelligence (company disclosures; data as at 1 February 2021).

Hungary and Poland are among the top five countries worldwide in the production of EV batteries, ranking the 3rd and 4th, respectively, in 2021. According to S&P forecasts, Poland was expected to preserve its 4th position in 2025, while Hungary was going to fall to 5th place. However, regardless of the positions they will hold in the hierarchy, what is remarkable is that the two CEE countries are in the foreground of the automotive industry electrification trend, on top positions, and cumulatively hold significant shares of the global production of EV batteries – 7.1% in 2021 and, potentially 8.0% in 2025. Beyond their competitive advantages, which other countries in the region also have (lower production costs, qualified staff, high-performing technological universities, proximity of the downstream industries, access to the single market, to financing, etc.), these two states used more coherent and more active policies to encourage investors and concerned themselves earlier and more insistently with the creation of a friendly business environment, with the development of the necessary transport infrastructures, with granting state aids and other incentives for investors.

6.2. Poland

Today, Poland is not only one of the large producers of Li-ion electric batteries, with a production capacity of 72 GWh in 2022, but also the largest exporter of these batteries in Europe and the 5th exporter worldwide. 90% of its export of batteries is represented by the Li-ion batteries, which are already accounting for 2% of the Polish annual export revenues (Kozinski, 2023). This country also supplies batteries internally, for the factories held on its territory by the companies Volkswagen, Fiat, Toyota, Opel and soon Mercedes-Benz, which currently runs an investment of EUR 1.3 billion in a facility that will produce minibuses. The electric battery industry also supplies

various local manufacturers, such as, for example, producers of electric buses, a field in which this country performs very well, Poland currently being the largest exporter of electric buses in Europe (Kosc, 2021).
Poland's foreign investors in the production of Li-ion batteries are numerous and important. Thus:

⇒ Kobyerzice is the location of an investment of the company *LG Chem* (South Korea) which, with an annual output capacity of 20 GWh, is currently the largest Li-ion battery production facility in Europe. It has 50 manufacturing lines for both battery cells, and complete cell packs. It is designed to be able to reach an annual capacity of 65 GWh, but the Polish government announced in 2021 that it will grant the company an aid of EUR 300 million to be able to extend the output capacity of this facility to 100 GWh annually, the equivalent of 60% of the European needs per year.

⇒ The companies *Umicore, Foosung and Enchem* from Belgium have four factories in Poland manufacturing components for Li-ion batteries: *Umicore* has 2 factories, and the other companies have one each;

⇒ *SK Nexis*, from South Korea, is building a battery copper foil factory in Stalowa Wola due to start operating mid-2024.

⇒ The company *Northvolt* from Sweden has already built a very large factory in Gdansk for stationary energy storage equipment (Kosc, 2021; Kozinski, 2023; Ioniță, 2023).

6.3. Hungary

Hungary attracted important car manufacturers – *BMW, Audi, Daimler-Benz, Suzuki, Stellantis* – who are or will soon be producing in their Hungarian facilities the hybrid or BEV versions of the vehicles in their ranges. The same goes for *Suzuki* (Japan), the first automotive company that arrived in Hungary, currently manufacturing hybrid models for the Hungarian market and for the EU. In a somewhat visionary take, the Hungarian government supports the development of autonomous cars and, to this end, it financed the construction of a special track to test them, as well as the construction of a company dealing exclusively with the development of artificial intelligence technologies and of the film cameras required for this new type of transport.
To further develop the Li-ion electric battery industry, Hungary attracted many investors in the field, in particular from Asia. As such (Szilagy, 2022; Ioniță, 2023):

⇒ The Japanese company *GS Yuasa*, the second largest in the world, built a battery factory in Miskolc in 2019, which is operational at present;

⇒ The South Korean company *SK* already has two factories - one operational, of 7.5 GWh in Komarom, and a second one, of 30 GWh, currently being constructed in Ivancsa -, and is planning to build a third facility at a site adequate to service Daimler and Audi plants in Hungary;

⇒ The South Korean company *Samsung* transformed a TV factory it had in Gor into a battery factory with a capacity of 3GWh, and is envisaging extending it to 15 GWh; and

⇒ Most recently, the Chinese company *CATL*[4], the largest in the world in the manufacturing of Li-ion batteries, has commissioned the building of a USD 7.5 billion and 100 GWh factory in Debrecen, which will increase the total Hungarian output capacity to 152 GWh annually, that will bring the country to the second place in Europe, after Germany. It was reported that the plant will hire 9,000 workers and will drive the continued development of electric and hybrid vehicle in Hungary. Economist Tamas Matura warned however of the obstacles that this grandiose project, which would double or even triple the volume of Chinese investments in Hungary will have to overcome: (i) the huge consumption of energy required for the operation of such a factory: "*We will need a new 1 GW nuclear plant! So where is the electricity going to come from?"* – he wondered; (ii) the absence of workforce, both in numbers, and in terms of skills and specific qualifications; (iii) the impact on the environment. At the same time, Matura pointed out the creation of an excessive dependence on the automotive industry, in particular when its future "*...is increasingly about electronics and software, not about hardware"* (Hompot apud Matura, 2023; Szilagyi, 2022).

6.4. Slovakia

Slovakia is attempting to develop the EV and the EV battery industries in parallel. Already the Swedish company *Volvo* is making a large investment in a facility that will manufacture 250,000 EVs annually and has started talks regarding a parcel of land in the vicinity, to be able to build a Li-ion battery factory in the future. The Bratislava government encouraged this investor by covering a fifth of the investment. Slovakia is a European leader in terms of the number of EV models it currently assembles (9), which is likely to also attract investors in the EV battery industry:

[4] CATL = Contemporary Amperex Technology Co. Ltd [A/N].

⇒ The Slovakian start-up *Inobat Auto* is building a Li-ion battery factory in Bratislava with a capacity of 10 GWh annually, which will be able to ensure the provision of batteries for 240,000 EVs annually for the local facilities of *Volkswagen, PSA and Kia*, from the beginning of 2024 (Ioniță, 2023; Szilagy, 2022). In September 2023, the Chinese company *Gotion High Technology* bought a 25% stake in the Slovakian company and, two weeks later, the two announced that, beginning in 2024, they will build together a Li-ion battery factory in Europe with a capacity of 20 GWh. The location is yet to be decided, and several European countries are considered for this purpose. The factory is set to start operating in 2026. It is worth noting that the majority shareholder of the Chinese company is Volkswagen, which signed an exclusive agreement with it to enable it to provide batteries outside China. On the other hand, we note that *Inobat Auto* had already signed memoranda (MOUs[5]) with Spain and Serbia, regarding the construction of factories for EV batteries in these countries (Carey, 2023).

6.5. The Czech Republic

To the dissatisfaction of automotive manufacturers, the Czech Republic was late in adopting policies to incentivise the EV and EV battery industries, because of the government officials' reluctance with regard to this true breakthrough in the field. *Volkswagen*, which years ago took over the local company Skoda, has however a mega-project involving the construction of a battery factory near Pilsen which would create 4,000 jobs, but for a long time was unable to decide on the country where to locate it, while waiting for a government decision on state aid. Once the government agreed to provide a consistent subsidy for this investment, *Volkswagen* began its project to make *Skoda* one of the largest EV manufacturers in Europe, with the first major step being a EUR 4.4 billion investment in the Li-ion battery plant.

In the meantime, the *Skoda* plants began producing their own EV battery systems in the Northern region of the country, in Mlada Boleslaw. *Skoda* is already producing hybrid models but has much higher ambitions.

An important comparative advantage for the Czech Republic is represented by its resources of lithium, a mineral that is not very present in Europe, but which is vital for the EV electric battery industry, which has become its main consumer industry. The government has yet to decide whether to approve the mining of lithium, which is extremely pollutant and could be rejected by the population[6]. Other arguments in favour of the production of Li-ion batteries are the fact that the Czech Republic hosts investments from important EV and EV component manufacturers, as well as 49 local start-ups active in the field of electric car manufacturing (Kozinski, 2023; Szilagy, 2022).

6.6. Bulgaria

Bulgaria has also been approaching, more recently, the development of a new local electric EV batteries industry, although it is not an automotive manufacturer. There are organisations such as *Automotive Cluster Bulgaria* which are willing to support investors wishing to establish themselves in this country with services such as finding the right plot of land, the local partners or the staff to hire. Following these endeavours, a battery manufacturing company in South Africa, Solar MD, has recently opened in Ruse a manufacturing facility for $LiFePO_4$ batteries, initially aiming for an annual output of 60MWh for clients in Bulgaria, Romania, Turkey and the Middle East. The most important components will be produced in China, while the rest will engage local producers, with the Ruse factory to only deal with the assembly. The electric battery cells will be produced by CATL (Ioniță, 2023; Todorović, 2023a)

On the other hand, the Bulgarian Ministry of Energy and the EBRD have signed two agreements based on which the EBRD will analyse the existing energy storage technology and recommend those most adequate for Bulgaria, and then deal with the organisation of calls for tenders for the turn-key delivery of two such systems to this country (Ioniță, 2023).

A daring endeavour started in 2017 by the Bulgarian group *Monbat,* a manufacturer of conventional (acid) batteries, to expand towards the production of Li-ion batteries by taking over two German companies (*GAIA Akkumulatorenwerke GmbH* and *EAS Germany GmbH*[7]) failed in 2022, when the two companies,

[5] MOU = Memorandum of Understanding [A/N].

[6] At present, Europe has only one active lithium mine, in Portugal, but the EV industry needs more such exploitations on our continent, in the countries that have such reserves: Portugal, Spain, Germany, the Czech Republic, Finland, and Austria. The governments concerned have the same problem: the pollution entailed by lithium extraction and the risk of encountering a firm resistance from the communities in the areas in question.

[7] *GAIA Akkumulatorenwerke GmbH,* now at the forefront of the field in Germany, is a high-tech company specialising the production of large-format cells and Li-ion batteries, for trucks, buses and maritime activities, and *EAS Germany GmbH* manufactures Li-ion batteries for hybrid heavy transports and military use.

consolidated into one (*Monbat Holding GmbH*), were taken over by *Britishvolt* for EUR 36 million and a number of shares, with the Bulgarian company becoming a minority partner in the British company (Kokalova-Gray, 2022).

6.7. Romania

Romania is in its turn concerned with becoming part of in the production networks and supply chains in the EV battery industry, a field which is now growing at an extremely rapid pace in the EU area, in the effort to implement the EU strategies for stopping global warming, developing the green economy and reducing trade dependency on China. The EU incentive and financing programmes that come to support the business environments and the stakeholders of road transportation electrification, as well as the development of production activities surrounding this process have obviously provided a significant momentum for investments in the constructions of Li-ion battery factories in Europe, including in the CEE countries.

Romania – which is also an important car manufacturer – must align with this trend. Although later than other companies on the continent, from the CEE and from around the world, the two large manufacturers in our country, Dacia-Renault and Ford-Otosan, will also manufacture their own light hybrid and BEV models in Romania.

Dacia manufactured its first electric car, the *Spring* model, in China, at the Renault-Donfeng plant in Shiyan, Hubei Province. It was imported and sold successfully in Romania and in the rest of Europe and at present it accounts for 12% of total sales. However, in 2023, Dacia began in Mioveni the production of its first hybrid model, *Jogger Hybrid 140*, with an autonomy of over 900 km. The first step towards Dacia BEV variants produced in Europe will be made with the *Sandero* model, but in Morocco, beginning in 2028, and then there will be a fourth generation of the *Duster* model, full electric, the first BEV manufactured in Mioveni starting only in 2033. Starting 2035, according to Denis Le Vot (CEO of the Dacia brand within the Renault Group), all Dacia models will be electric: "*We are now producing lower cars in Morocco and higher ones such as SUVs and crossovers – Duster, Jogger and Sandero Stepway in Mioveni. The next Duster will be an internal combustion engine one* (in 2025, author's note) *and the generation to follow, most probably in 2033, will be electric,"* Le Vot explained (Meșter, 2020; Alecu, 2022).

*Ford-Otosan***,** a joint venture of the U.S. company Ford with a Turkish partner[8], took over the Craiova plants in 2022 (motor vehicles and engines) from Ford, which had bought them in 2007 from the Romanian state. Ford-Otosan announced it was going to invest EUR 490 million in Craiova during the first three years, to launch a new generation of the Courier model in 2023, both in its *Transit* variant (for freight transportation), and in the *Tourneo* variant (for passenger transport), followed by their full-electric versions (BEV) beginning in 2024. At the same time, *Ford Puma,* the best sold Ford model in Europe, will also be manufactured in a BEV version, also in Craiova and also starting in 2024 (Chirileasa, 2022). In May 2023, Ford-Otosan announced a hiring campaign for 1,300 new jobs required to support an increase in annual production from 250,000 to 272,000 *Transit Courier* and *Tourneo Courier* units*,* each in both drive variants, ICE and electric. As such, the entire staff in Craiova will reach 6500 employees working three shifts.

In this effervescent national and European context, the need to build more plants manufacturing Li-ion batteries is understood by everyone and the and new projects emerge almost daily throughout Europe. Without having been at the forefront of the phenomenon, Romania is working towards building such production facilities for itself. As such:

⇒ Although it is not a large-scale project yet, it is absolutely remarkable the initiative of two Romanian entrepreneurs to establish, in 2016, a Romanian start-up called *Prime Batteries Technology* (PBT) which produces Li-ion batteries in Cernica, near Bucharest. PBT is a high-tech company focusing on Li-ion battery packs and electric powertrain systems for EVs, individualised according to customer requests.

⇒ In 2017, the South-African company *Metair* purchased a 35% stake in the PBT capital through its fully-owned subsidiary called *Rombat* (a Romanian manufacturer of conventional acid batteries), with the two companies aiming to develop Li-ion electric batteries together, and in December 2019 *Metair* announced that *PBT* and *Rombat* completed the installation of a Li-ion battery production capacity of 600 thousand to 1 million cells per year, following a greenfield investment of EUR 13.6 million by *Metair.* The production was due to start mid-2020 (Venter, 2018). Since 2022, the *Metair* shareholders decided to withdraw from the manufacturing of

[8] Ford Otosan is a joint venture created with the participation of Ford (41% of the capital) and of the Turkish holding company Koc Holding (41%), the difference of 18% of the share capital being listed at the Istanbul Stock Exchange (Chirileasa, 2022).

both electric and lead-based batteries, and to sell the facilities in Romania, Turkey and South Africa, with the company announcing its departure from Romania in 2023.

In November 2022, *PBT* signed an investment agreement with *EIT InnoEnergy*[9] aiming to increase its production capacity up to 8 GWh. By this agreement, *EIT InnoEnergy* became a shareholder of PBT, and was due to invest EUR 1.0 billion in the extension of its production capacity to 8 GWh annually (Ernst, 2022). This small factory is the first in Romania and in the entire Southern and Eastern Europe that manufactures Li-ion batteries targeting both the automotive industry, and other industrial users, solar parks, wind farms, the national energy system, but also users who are electricity producers, by also offering stationary energy storage equipment.

⇒ However, the largest Greenfield investment in Romania in the field of Li-ion batteries is that of EUR 1.4 billion by the Belgian group *Avesta Battery & Energy Engineering (ABEE),* announced in the summer of 2023. The new plant with a capacity of 22 GWh annually will be built in Galați, in the free port, on an area of 60 hectares, already taken under a lease by ABEE, and will produce batteries solely for the automotive industry. According to the project, a battery recycling factory will also be built there, with a capacity of 50,000 tons/year, following an additional investment of EUR 200 million. ABEE investments will eventually generate 8,000 new jobs. The project is currently in the process of obtaining all the permits, which should be completed by mid-2024, followed by the construction of the building and the purchase and installation of the production lines between 2024 and 2025, followed by the start-up of the new producer, called Romvolt, in 2026 (Energy Industry Review, 2023; Roberts, 2023).

⇒ There is also an announcement by the German company *Draxlmaier,* which operates in the automotive component industry regarding its intention to invest in an electric battery factory in Timișoara, and information from the Ministry of European Funds in relation to the discussion held with the German company *Varta* which is considering Romania as well in its decision regarding the location of a battery factory worth EUR 1 billion, partly financed from European funds (Neagu, 2022).

⇒ As far as the sub-suppliers of the Li-ion battery industry are concerned, we can also point out to a memorandum signed by the Canadian company *RockTech Lithium* with the Romanian officials (Prime Minister Nicolae Ciucă), regarding an investment of EUR 400 million in Romania, in a factory producing materials for Li-ion battery materials. This company currently produces lithium hydroxide, and will have two facilities in Europe, in Germany and in Romania, which will produce Lithium powder. The Romanian factory will create 700 jobs and will meet the demand for 500,000 EVs/year (Neagu, 2022).

⇒ In the same context, it is worth reminding that the Romanian company *Salrom* will produce (in addition to salt) *graphite,* one of the critical minerals that are essential for the EV electric battery industry, representing the anode in the Li-ion electric battery cells. *Salrom* and, possibly other companies that may engage in the extraction of natural graphite must be supported in getting involved in this activity and make it part of the European graphite and even cathode supply chains.

⇒ Also of great importance is the decision of the German company *Mercedes-Benz A.G*., to manufacture in its local divisions, *Star Assembly* and *Star Transmissions,* electric engines for its EV lines equipped with EV batteries. Production will start in 2024, in the facilities in Sebeș and Cugir. Of the total EUR 40 billion allocated by *Mercedes-Benz* to the transition to electric drive, part will go to these two factories in Romania which are currently manufacturing gearboxes and other components for petrol and diesel oil engines (Dumitrescu, 2022).

⇒ Finally, although not strictly related to the automotive sector, we have to point out here an Austrian investment into a stationary electricity storage facility: *Megalodon Storage* – a Romanian company controlled by Austrian investors[10]. The facility has a maximum capacity of 7 MW and is located near Bucharest, in Căciulești Village, Moara Vlăsiei Commune, having the purpose of balancing the energy system. It has already been commissioned in June 2023, with an increase of its storage capacity to 14 MW to follow in a second stage of the project.

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[9] *EIT InnoEnergy* is considered the most active local investor in sustainable energy, it is the driving force behind the *European Battery Alliance* (EBA), and receives technological innovation support from the *European Institute of Innovation and Technology* (EIT). *EIT InnoEnergy* is recognised as a major investor in budding initiatives, with notable successes in the development of operations of giga-factories that are now famous, from *Northvolt* (Sweden), to *Verkor* (France) (Ernst, 2022).

[10] The shareholders of *Megalodon Storage* are: Austrian investment fund *Core Value Capital* (33,33), *Gerdan Real Estate*, controlled by the executive management of *LSG Group* (33.34%) and an Austrian manufacturer and operator of solar parks, *Green Source* (Todorovic, 2022).

The system has a NMC Li-ion battery produced in Romania by *Prime Batteries Technologies*. So far, this is the first largest such equipment in Romania, with only another one, EDPR's 2 MW facility, being operational in Dobrogea, in the proximity of the wind farms (Todorovic, 2022).
Stationary energy storage systems will develop at an accelerated pace in the coming years, driven by the increasingly large-scale use of renewable solar and wind energy which, due to their fluctuating nature, require interventions to balance the national energy system, which would be impossible in the absence of electricity storage capacities.

⇒ Other investments similar to the Austrian one are going to follow in Romania. The Romanian company *Electricom,* an electricity producer and provider, is already considering a 10 MW project to be installed in the proximity of the Tulcea wind farms, through an EUR 5 million investment for the financing of which the company intends to rely on EU funds (Todorovic, 2022).
The Romanian government will authorise the Ministry of the Economy, which has responsibilities in the field of industrial policies, to identify financing opportunities through a state aid scheme for the manufacturing of EV batteries.

7. Looking into the future

Focussing on the European automotive industry, an analysis of the consulting company Buck Consultants International (BCI, 2023) estimates that in the next 10 years, another 250 electric battery factories will be built on our continent. Of this entire fulminant, 800% increase of the global EV electric battery market during the next 5 years, the largest part will be in Europe. Most of the new facilities opened here will produce Li-ion batteries for the European electric vehicle manufacturers, with the EU strategy stimulating the development of local battery supply chains fit to satisfy the rapidly increasing demand of the European EV industry internally, in order to thus reduce Europe's excessive dependency on China and Asia in this respect.

Another forecast, presented by *Benchmark Mineral Intelligence*, is more toned down. It claims that 200 new mega-factories for EV batteries will be built around the world by 2030, most of them in China (148 plants, around 80% of the total), followed by Europe with only 21 plants, then by the US (11 plants) and other economies (20 plants) (Buthada, 2022).

Not only well-established manufacturers in the field, mainly from Asia – CATL, BYD, LG, Panasonic – will be investing in the European Li-ion battery market, but also the sub-suppliers of their components (anodes, cathodes, separators, electrolytes, battery management systems), as well as the automotive manufacturers themselves. As such, for example, *Tesla* is considering a second European mega-factory in the field, and *Volkswagen* intends to build 9 electric battery factories in Europe by 2030, with a cumulated capacity of 240 GWh. Some of the investments of the German company will probably target CEE countries as well, more likely the Czech Republic and/or Slovakia, but Romania is not excluded either, as we have seen.

In the CEE countries, a recent forecast by *Erste Group* considers that the more important annual outputs in 2023 will be in: 1. Hungary – with electric batteries totalling 250 GWh; 2. Poland – 150 GWh; 3. The Czech Republic – 25 GWh; 4. Romania – 22 GWh and 4. Slovakia – 10 GWh (Erste Group, 2023).

On the other hand, according to a forecast of the U.S. consulting company *McKinsey & Company,* in 2040 the increase of European electric vehicle manufacture will have triggered a substantial increase in the manufacturing of electric batteries in Europe, already bringing an additional annual capacity between 0.7-1.5 TWh, the equivalent of another 45-95 new very large plants. At an annual demand of 1200 GWh in 2040, only the value of the battery cell market would amount in Europe to around EUR 90 billion[11] per year, with the potential to generate approximately one quarter million new jobs in the manufacturing of battery cells and in the related R&D&I field[12].

Battery manufacturers will have a large spectrum of possibilities to choose from for the location of their investments in Europe, therefore it is important for the countries that could be the potential beneficiaries of these investments to understand that meeting the needs of investors is an attitude that is beneficial for the country itself, if attracting this industry to the national economy becomes a priority. Battery manufacturers will typically look for locations that provide them with the best business outlook at the lowest level of risk, in a political environment that supports investors, enables the provision of financial incentives to companies and provides them with a supple approval granting system (Eddy, Pfeiffer & Van der Staaij, 2019).

[11] Taking into account an average price of USD 76/battery in 2040.
[12] Taking into account the same requirement in terms of jobs for an annual GWh capacity applied by the giant factory owned by Tesla in Europe to a capacity of around 1200 GWH/year in 2040.

According to the McKinsey study, large plants, of over 8 GWh annually, proved to be twice more productive per invested euro than battery factories with lower capacities. Recent projects above 8 GWh/year have engaged investments of around USD 120 million/1 GWh on average, which, extrapolating, could lead to a total investment volume of approximately USD 150 billion in Europe, to cover an additional capacity requirement of 1200 GWh/year by 2040.

Such projects support the development of local upstream industries, but also FDI in upstream and downstream activities, generating more jobs, cost efficiencies along the supply and production chains and additional merchandise availability for export, creating a beneficial internal competition but also opportunities for cooperation between manufacturers, and between them and the academia or various local service providers. For countries that have their own automotive industry, investments in the electric battery industry help stabilize it, preventing a possible relocation of manufacturers to countries with more favourable business environments and costs, or may even protect them from bankruptcy through the support provided for a smoother transition towards EV manufacturing. For the automotive industry in the beneficiary country these investments open the road towards a successful future, all the more so when market opportunities witnessing an exponential growth are tapped into earlier. At the same time, countries with natural resources useful for these industries, which are also willing to develop the processing thereof for the battery and EV industry have, on the on the one hand, an additional advantages in the competition to attract foreign investors and, on the other hand, additional chances of becoming part of the European supply chains and production networks in the field of electric vehicle manufacturing.

References:

[1] Alecu, B. (2022, October 10). *Este oficial: Dacia va produce maşini electrice în România.* Retrieved from Ziarul Financiar: https://www.zf.ro/auto/este-oficial-dacia-va-produce-masini-electrice-in-romania-la-mioveni-21242171.

[2] Alecu, B., Tiron, M., Ciutacu, A., & Rosu, R. (2023, April 11). Cifra de afaceri a industriei auto româneşti a revenit la peste 30 mld. euro în 2022. *Ziarul Financiar*, pp. https://www.zf.ro/companii/industria-auto-romaneasca-revenit-peste-30-mld-euro-business-2022-21784724.

[3] Buthada, G. (2022, February 28). *Mapped: EV Battery Manufacturing Capacity, by Region.* Retrieved from Visual Capitalist: https://www.visualcapitalist.com/sp/mapped-ev-battery-manufacturing-capacity-by-region/.

[4] Carey, N. (2023, September 18). *Gotion, Inobat to build 20 GWh battery plant in Europe by 2026.* Retrieved from Reuters: https://www.reuters.com/business/autos-transportation/gotion-inobat-build-20-gwh-battery-plant-europe-by-2026-2023-09-18/.

[5] Chirileasa, A. (2022, March 16). *Ford transfers Romanian factory to Turkish partner Ford Otosan, announces electric models to be built in Craiova.* Retrieved from Riomania-Insider: https://www.romania-insider.com/ford-otosan-craiova-electric-models-romania.

[6] Cornea, O. (2022, December 02). Mașina românească prinde viteză în Europa. Drumul din comunism în capitalism a industriei de care depinde PIB-ul țării. *Europa Liberă*, pp. https://romania.europalibera.org/a/industria-auto-dacia-ford-industrii-romania-1-decembrie/32151988.html.

[7] Dumitrescu, C. (2023, November 11). Industria auto contribuie cu 13% la PIB-ul României, . *Infofinanciar*, pp. https://www.infofinanciar.ro/industria-auto-contribuie-cu-13-la-pib-ul-romaniei.html.

[8] Eddy, J., Pfeiffer, A., & van de Staaij, J. (2019, June 03). *Recharging economies: The EV-battery manufacturing outlook for Europe.* Retrieved from McKinsey&Company: https://www.mckinsey.com/~/media/McKinsey/Industries/Oil%20and%20Gas/Our%20Insights/Recharging%20economies%20The%20EV%20battery%20manufacturing%20outlook%20for%20Europe/Recharging-economies-The-EV-battery-manufacturing-outlook-for-Europe-vF.pdf.

[9] Energy Industry Review. (2023, June 30). *ABEE to Build EUR 1.4 Bln. Battery Plant in Romania.* Retrieved from Energy Industry Review: https://energyindustryreview.com/construction/abee-to-build-eur-1-4-bln-battery-plant-in-romania/.

[10] Energy Transitions Commission (ETC). (2023, July). *Material and Resource Requirements for the Energy Transition.* Retrieved from ETC: https://www.energy-transitions.org/publications/material-and-resource-energy-transition/.

[11] Ernst, I. (2022, November 11). *Romanian Li-ion battery maker teams up with EIT InnoEnergy to scale up production with EUR 1 bln investment.* Retrieved from Romania-Insider: https://www.romania-insider.com/prime-batteries-eit-innoenergy-join-investments-2022.

[12] Hillebrand, E. (2023). *The transition to electric vehicles in CEE. What does it mean for thye automotive sector in Central and Eastern Europe?* Budapest: Friedrich-Ebert-Stiftung (FES). Retrieved from https://library.fes.de/pdf-files/bueros/budapest/19975.pdf.

[13] Hompot, S. (2023, November 20). *China's Controversial €7.3 Billion EV Battery Investment: A Game Changer in China-Hungary Relations.* Retrieved from Central European Institute of Asian Studies (CEIEAS): https://ceias.eu/chinas-controversial-e7-3-billion-ev-battery-investment-a-game-changer-in-china-hungary-relations/.
[14] Hruby, M. (2024, January 2024). *Shift happens: Will the EU-CEE automotive industry benefit or suffer from the industrial reshuffling?* Retrieved from IDDRI Instute of policy research: https://www.iddri.org/en/publications-and-events/blog-post/shift-happens-will-eu-cee-automotive-industry-benefit-or-suffer.
[15] Ioniță, A. (2023, May 30). *Why CEE countries are in top 5 battery manufacturers worlwide.* Retrieved from The Recursive: https://therecursive.com/why-cee-countries-are-in-top-5-lithium-ion-battery-manufacturers-worldwide/.
[16] Kokalova-Gray, A. (2022, May 25). *Bulgaria's Monbat to sell German battery cell unit to UK Britishvolt.* Retrieved from Renewable Now: https://renewablesnow.com/news/bulgarias-monbat-to-sell-german-battery-cell-unit-to-uk-britishvolt-785828/.
[17] Kosc, W. (2021, February 10). *Central Europe becomes the EU's e-car battery supplier.* Retrieved from Politico: https://www.politico.eu/article/central-europe-eu-e-car-battery-supplier/.
[18] Kozinski, A. (2023, July 04). *Central Europe Goes Electric.* Retrieved from 3 Seas Europe: Highlights from Central Europe and the 3 Seas Initiative: https://3seaseurope.com/central-europe-goes-electric/.
[19] Liss, P. (2023). *Automotive industry in Central and Eastern Europe.* Retrieved from RSM Insights: https://www.rsm.global/poland/en/insights/doing-business-poland/automotive-industry-central-and-eastern-europe.
[20] Meșter, M. (2020, October 16). *Dacia made in China: Dacia Spring primul model electric al mărcii va fi produs la uzina Renault-Dongfeng din Hubei, China.* Retrieved from Auromarket: https://www.automarket.ro/stiri/dacia-made-in-china-dacia-spring-primul-model-electric-al-marcii-va-fi-100763.html.
[21] Neagu, B. (2022, March 13). *Canadian company to invest EUR 400 million in a lithium factory in Romania, .* Retrieved from Euractiv: https://www.euractiv.com/section/politics/short_news/canadian-company-to-invest-e400-million-in-a-lithium-factory-in-romania/.
[22] Poland Alternative Fuels Association (PSPA). (2022). *Poland drives e-mobility.* Warsaw: Poland Alternative Fuels Association. Retrieved from https://pspa.com.pl/wp-content/uploads/2022/09/PSPA_Poland_Drives_e-Mobility_Report_2022_EN-1.pdf.
[23] Prandin, F., Theisen, N., Hidi, J., Pridi, J., Suta, C.-M., Barbieri, L., . . . Križanský, P. (2023). *Slovakia Automotive Industry 2.0: The time is now to retool for the e-mobility era.* https://www.seva.sk/wp-content/uploads/2022/04/AutoFocus-Report-FINAL-29_2_22.pdf.: GLOBSEC, Slovak Electric Vehicle Association (SEVA), Automotive Industry Association of the Slovak Republic (ZAP).
[24] Price Waterhouse Cooper (PWC). (2020). *Staying profitable in the newera of electrification: Powertrain study 2020.* https://www.strategyand.pwc.com/cn/en/reports/2020/powertrain-study-2020.pdf: Price Waterhouse Cooper: London.
[25] Roberts, G. (2023, June 28). *EV battery plant planned for Romania – report production would be aimed at the car sector.* Retrieved from Just Auto: https://www.just-auto.com/news/ev-battery-plant-planned-for-romania-report/.
[26] Romanian National Institite of Statistics [INS]. (2024). *EXP101F - Export value (FOB) by Combined Nomenclature (CN) group of products*. Retrieved from Institutul National de Statistică/INS: TEMPO online database: http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table.
[27] Schade, W., Haug, I., & Berthold, D. (2022, March 25). *The future of the automotive sector: Emerging battery value chains in Europe.* Retrieved from European Trade Union Institute (ETUI): https://www.etui.org/sites/default/files/2022-08/Emerging%20battery%20value%20chains%20-%20Schade%20et%20al..pdf.
[28] Statista. (2024, October 07). *Number of cars produced in Central and Eastern Europe from 2021 to 2022*. Retrieved from Statista: Transportation & Logistics›: https://www.statista.com/statistics/1099393/cee-car-production-2018/.
[29] Szabó, J. S. (2023, January 03). *Central and Eastern Europe's Automotive Sector May Be on a Path to Nowhere*. Retrieved from LeftEst: https://lefteast.org/cee-automotive-sector-on-path-to-nowhere/.
[30] Szilagyi, B. (2022, September 12). *Batteries are powering CEE's e-mobility transition - CET analysis.* Retrieved from Central European Times (CET): https://centraleuropeantimes.com/2022/09/batteries-power-cee-e-mobility-transition/.
[31] Todorović, I. (2022, August 2022). *Austrian investors building largest battery unit in Romania.* Retrieved from Balkan Green Energy News: https://balkangreenenergynews.com/austrian-investors-building-largest-battery-unit-in-romania/.
[32] Todorović, I. (2023, May 03). *Battery factory launches operations in Rousse in Bulgaria.* Retrieved from Balkan Green Energy News: https://balkangreenenergynews.com/battery-factory-launches-operations-in-rousse-in-bulgaria/.

[33] Venter, I. (2018, February 19). *Metair expands lithium-ion capabilities in Romania.* Retrieved from Engeneering News: https://www.engineeringnews.co.za/article/metair-expands-lithium-ion-capabilities-in-romania-2018-02-19.

[34] Yu, A., & Sumangil, M. (2021, February 16). *Top electric vehicle markets dominate lithium-ion battery capacity growth.* Retrieved from S&P Global Market Intelligence: https://www.spglobal.com/market-intelligence/en/news-insights/research/top-electric-vehicle-markets-dominate-lithium-ion-battery-capacity-growth.