



Slovakia Automotive Industry 2.0:

The time is now
to retool for the
e-mobility era

AutoFocus Slovakia is a GLOBSEC initiative funded by the European Climate Foundation. The aim is to support a long-term national strategy for Slovakia's automotive transformation from ICE to EV production that is commensurate and competitive with the Visegrad 4. The findings and messaging for Slovakia are relevant for the wider Central and Eastern Europe (CEE) region forming Europe's automotive manufacturing 'backbone' that face similar challenges. The aim is to encourage a 'race to the top' to provide the conditions for attracting EV and battery investment, which includes improved domestic e-mobility perceptions and capabilities. The study could also serve as a model for the green industrial transformation in other sectors which should benefit from policy spillover and best practices.

GLOBSEC has hosted several stakeholder meetings since the initiative was launched in the fall of 2020, with leading voices from Slovak academia, industry, and government, both on and off the record. This was made possible with support from ZAP (Automotive Industry Association of the Slovak Republic) Slovak Battery Alliance (SBaA), Slovak Electric Vehicle Association (SEVA), the German-Slovak Chamber of Commerce, and the French-Slovak Chamber of Commerce.

Cambridge Econometrics performed the macro-economic modelling underpinning the report using the E3ME model. Scenarios, assumptions, and preliminary outcomes were further developed and refined over a three-month stakeholder consultation process with industry representatives in the fall of 2021.

It is worth specifying that the modelling analysis and outcomes only factor in the potential for EV and battery production relative to the manufacturing of combustion powertrain vehicles - which itself requires multiple layers of data and assumptions. There are several additional e-mobility sub-sectors with growth potential that can have a positive employment substitution effect, from the construction of physical charging infrastructure to the development of digital software and AI.

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Preface

The Slovak industrialization success story can be largely attributed to the growth in the automotive manufacturing sector over the past thirty years, beginning with Volkswagen's (VW) Bratislava plant in the early 90s, followed by Peugeot Citroën (PSA), Kia, and Jaguar Land Rover (JLR) in the decades that followed. We are now approaching the middle of another decade unlike any other for the industry, when seeds of EV and battery production are being sown, and the window is closing fast. For a substantial EV uptake by 2030, investment decisions need to be made by 2023 and are expected even this year.

In addition to that, the current decade is shaking and shaping the automotive sector, and the international community more broadly, with two unprecedented shocks: the Covid-19 pandemic (2020-2022) and the more recent Russian aggression in Ukraine. The former has presented the industry with adaptation challenges linked to fostered digital and green transitions while upending international supply chains, with consequent trade and production pressures. The war in Ukraine further exacerbated this situation, adding to the huge shortage of semiconductor chips, which already in 2021 cut the automotive industry's output by 8 million vehicles globally.¹ According to preliminary estimates, the conflict is expected to cause global vehicle production to drop by 1.5 million this year, that is 2% less than the 84 million vehicles planned.²

Further disruptions are expected in both global EV battery cell and combustion engine vehicle manufacturing due to the shortage of crucial raw materials mined in Russia and Ukraine. Notably, Russia extracts 40% of the world's palladium, used in catalytic converters in gasoline-powered vehicles.³ Additionally, concerns over European energy security have intensified due to its structural dependence on Russia's fossil fuels, with energy prices reaching record highs and fear of disruptions in gas, oil, and coal supplies.⁴ Against this background, the development of domestic battery ecosystems would benefit Slovakia in three key ways, by: 1) reducing asymmetrical trade dependencies 2) transforming the country into an innovation hub within the EU, and 3) offsetting the losses from the ICE vehicle supply chain dismissal.

“Slovak economy is heavily dependent on car manufacturing. With the fast transition from internal combustion engine to electric vehicles, Slovakia has to transform and adjust to the new situation. The study presents a clear and thoughtful roadmap for such challenging transformation.”

Vazil Hudák
Vice-Chairman. GLOBSEC

- 1 Hyunjoo J., “Automakers, chip firms differ on when semiconductor shortage will abate”, Reuters, February 4, 2022, <https://www.reuters.com/business/autos-transportation/automakers-chip-firms-differ-when-semiconductor-shortage-will-abate-2022-02-04/>
- 2 Rhodes, B., et al., “Major revision for global light vehicle production forecast – what it means for OEMs’ technology deployment” 07 October 2021, <https://ihsmarkit.com/research-analysis/major-revision-for-global-light-vehicle-production-forecast--w.htm?ite=1001653&ito=1276&itq=fc9ec941-075f-4aa9-a106-eaedc2ae6e2f&itx%5Bidio%5D=775416589>
- 3 Pakiam, R. “Markets Wild Palladium Rally at Risk From Recession Later This Year”, Bloomberg, <https://www.bloomberg.com/news/articles/2022-03-14/palladium-s-russian-rally-at-risk-from-recession-later-this-year>
- 4 Al-Jazeera, “Europe’s energy security worries NATO amid standoff with Russia”, January 30, 2022, <https://www.aljazeera.com/news/2022/1/30/nato-europe-energy-security-ukraine-russia>

The transition towards zero emission vehicles, and especially to battery electric cars (BEV) has been accelerating during 2020-2021. Regulators around the globe have been introducing strategies to switch from internal combustion engine (ICE) to electric vehicles (EVs) as part of the overall efforts towards a more sustainable world. 74% of Slovakia's key export markets have already announced bans on ICE vehicles sales by 2035.⁵ The country's strong reliance on car manufacturing makes it particularly vulnerable to EV adoption trends. Domestic producers will have to adapt to the changing market situation, regardless of the local rate of the EV take-up, if they are to remain competitive.

This is a wake-up call for Slovakia to get behind e-mobility with implementable plans and concrete actions. A coherent strategy requires leadership and must be driven by inter-ministerial coordination, based on a common framework of understanding and acceptance that EVs uptake is inevitable, and those who do not adapt will be left behind. If the government does not demonstrate to OEMs and other prospective investors that they mean business for e-mobility, not only as the future of the industry but as part of Slovakia's smart and sustainable transport, JLR could be the last such greenfield investment in the sector. Everyone expects real steps in the use of BEVs and the development of an appropriate charging infrastructure, which must follow the principles of Alternative Fuels Infrastructure Regulation (AFIR).

This report presents the results of a research on the impacts of the transition from ICE to EVs on Slovakia's GDP and employment outlook. The study foresight scenarios that highlight the potential benefits and risks associated with this process, providing policymakers with recommendations on how to cope with the transformative wave in the automotive sector. Against this background, this research aims to support Slovakia in facing the greatest challenge to transform its economic anchor and national identity – the passenger vehicle – to meet the global mobility demands of the future. The study also seeks to become a case study for green industrial transitions across the EU.

The green transition offers Slovakia the opportunity to become a leader in EVs production. Building on this opportunity, Slovakia's automotive industry would modernize with positive effects on GDP and employment. For this to happen, the labour market needs to be prepared to meet the demands of e-mobility specializations, which is already at a deficit. Beyond electric, the future of mobility is smart, which will demand significant new and upgraded infrastructure underpinned by IT company services. All of this requires proper training and education,

which should go hand in hand with R&D prioritization and funding.

Slovakia is competing, especially with its neighbors, to grab a share of the 500 GW EU battery pie expected to be worth EUR 50 billion later this decade. Losses in the internal combustion powertrain supply chains could only be compensated for by developing a battery industry.

This report is divided into four interrelated sections:

1. Context and indicators providing an industry overview and V4 trends;
2. Economic impact highlighting 2035 employment and GDP modelled outcomes;
3. Policy recommendations to overcome persistent challenges slowing investment and innovation;
4. Methodology for the modelling.

Making the leap to e-mobility requires government commitment and collective public buy-in which we hope to further justify and build upon with the launch of this report and subsequent engagements.

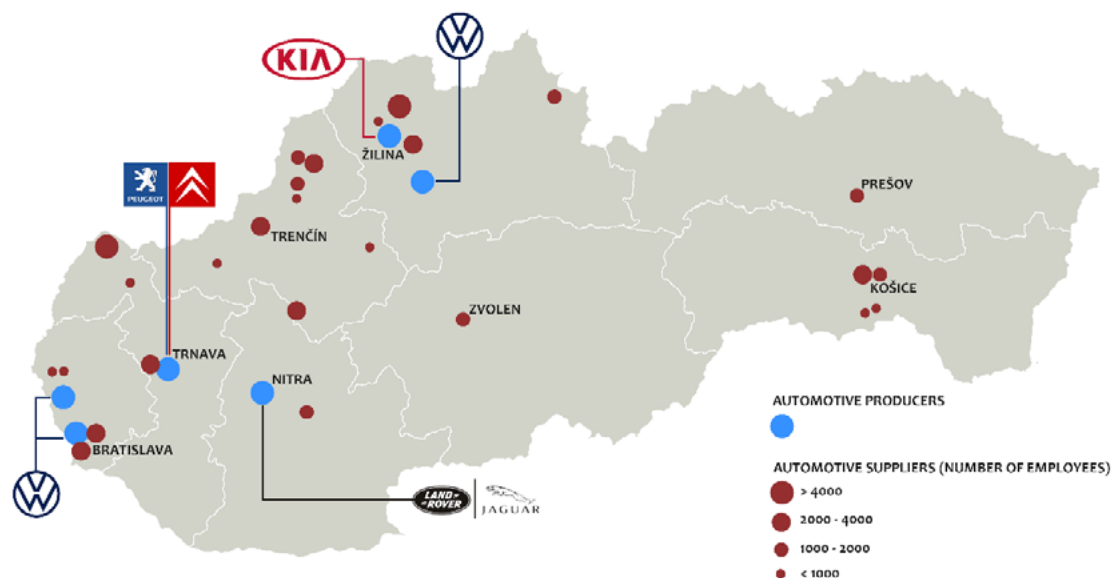
Signed,



Vazil Hudák, Alexander Matušek and Patrik Križanský

Context and Indicators

Slovakia's automotive landscape



Source: SARIO (internal documentation)

Today Slovakia is the leading car producer per capita in the world, owing to four world-class automotive companies (Big 4) opening their factories: Volkswagen Slovakia in Bratislava (since 1991), PSA Peugeot Citroën Slovakia in Trnava (since 2003), Kia Motors Slovakia in Žilina (since 2004) and Jaguar Land Rover in Nitra (since 2015).

Slovakia deeply identifies with its automotive tradition as the sector has grown to become the driving force of the economy. Car manufacturing is the largest industry in the country, constituting 13% of GDP, 54% of industrial production (compared to 33% in Hungary 31% in Czechia), 33% of industrial exports and 10% of the employed population (approximately 275,000 jobs between Tier 1 (177,000) and Tier 2 and services 98,000).⁶

There are more than 350 automotive suppliers in Slovakia accounting for the vast majority (89%) of direct jobs across the industry. The large Tier 1 foreign affiliates account for most of the value added in the sector compared to Tier 2 suppliers, which are typically Slovak small and medium-sized enterprises (SMEs).

Among the Visegrad 4, Slovakia is the least diversified in terms of its production portfolio with only one plant producing engines and all four factories dedicated to passenger vehicles. Comparatively, Polish manufacturing focuses on buses and engines with two of its 16 plants producing passenger vehicles. Czechia mainly produces passenger cars and engines, although some companies focus on buses and heavy duty vehicles manufacturing. Hungary produces passenger cars, engines and buses.¹ Nonetheless, Slovakia is currently among the top European producers of electric cars (75,575) behind only Germany and France.

With EVs constituting 70% less parts than ICE vehicles, robotization and Industry 4.0, the transformation of the automotive industry will significantly impact the current workforce, creating distributional employment effects throughout regions and communities depending on the car component and the company's willingness and ability to adapt.

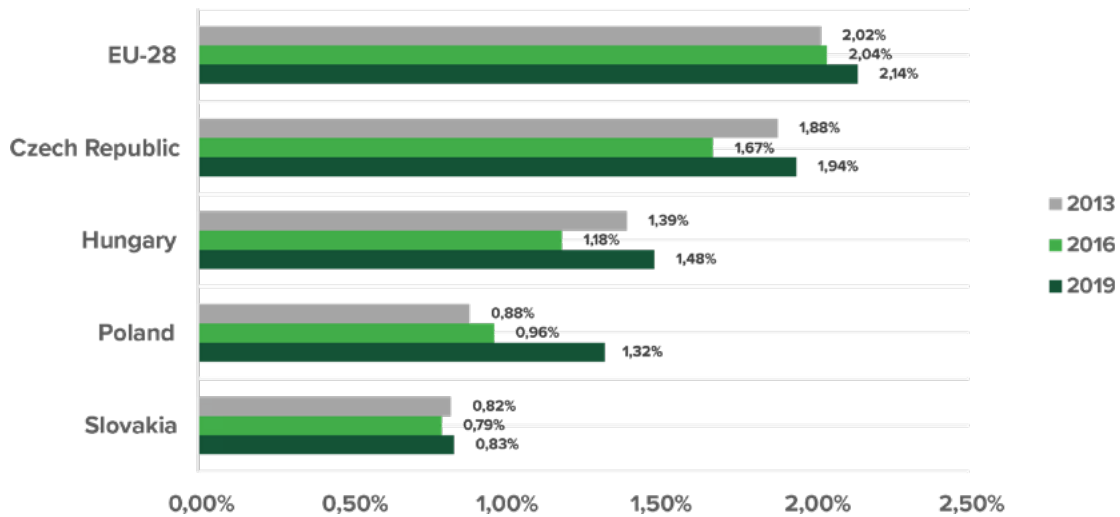
This study shows how urgent it is for Slovakia to invest in innovative projects that would foster battery and EV production. Historical data further support this conclusion. As the graph below illustrates, in 2019, public and private R&D investment in Slova-

6 Hubatka S., "Slovakia: An Automotive Industry Perspective", GLOBSEC, July 2021, <https://www.globsec.org/wp-content/uploads/2021/08/AutoFocus-Slovakia-An-Automotive-Industry-Perspective.pdf>

kia amounted to 0.83% of GDP, of which only 0.01% went to energy and environmental R&D. These figures are well below the EU average and the lowest among the V4, as shown in the chart below:

The lack of resources for innovation is also reflected in the low number of patents per million inhabitants in Slovakia, which scores last among the Visegrad4, all far below the EU average:

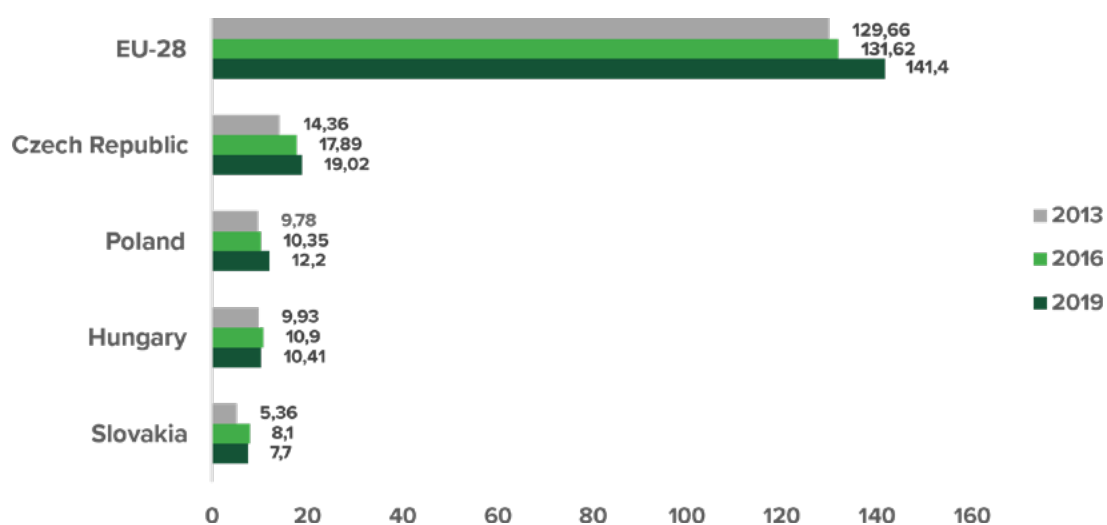
Gross Domestic Expenditure on R&D as percentage of GDP, V4 and EU-28



Source: Eurostat ([eurostat/data](https://eurostat.data))

The chart below shows that the Visegrad 4 labour productivity in the automotive manufacturing sector is about half the EU average. Among V4, Hungary and Czechia are the most productive, Poland the lowest, and Slovakia ranks average. While cars are traditionally manufactured in Slovakia, the development of new concepts and innovative products mostly happens in the parent company headquarters.⁷ Investments need to no longer target the assembly line only, but upskilling, reskilling, and R&D, in the country.⁸

Patent applications to the European Patent Office, per million inhabitants, V4 and EU-28

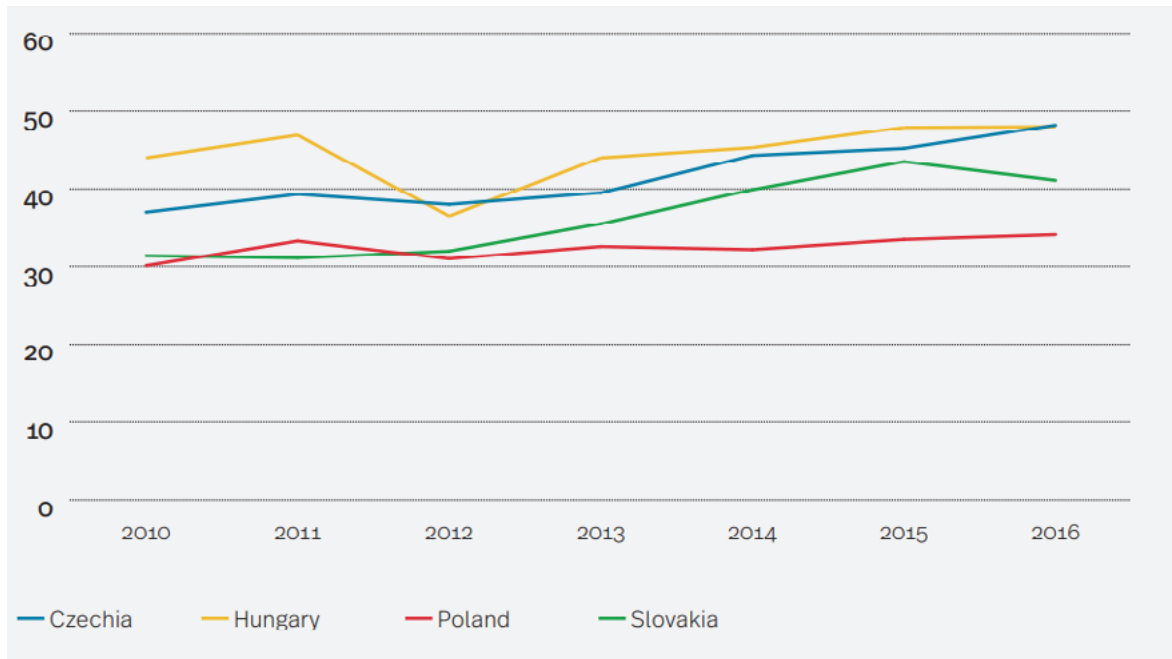


Source: Eurostat ([eurostat/data](https://eurostat.data))

7 <https://www.globsec.org/publications/slovakia-an-automotive-industry-perspective/>

8 Insights collected during stakeholders consultations.

V4 Labour Productivity in the Manufacturing of Motor, Vehicles, Trailers and Semi-trailers, gross value added per employee (thousands of Euro) 2010-2017



Source: Polish Economic Institute (https://pie.net.pl/wp-content/uploads/2019/08/PIE-Raport_Automotive.pdf)



Economic Impact

The global transition from the internal combustion engine (ICE) to electric vehicles (EVs) will inevitably affect Slovakia's key export markets, 74% of which have announced bans on ICE vehicles sales by 2035.

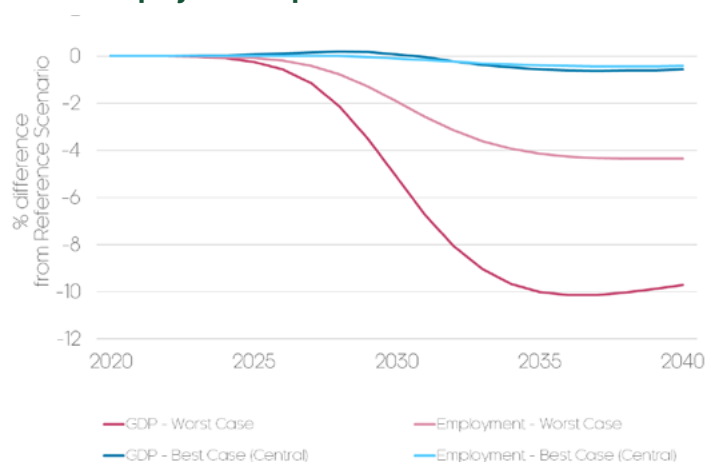
This study evaluates the economic impacts of increasing EV demand from such export markets. The assessment builds upon two scenarios: a worst-case or business-as-usual scenario in which the switch to EV production does not take place, losing the majority of its ICE market share, and a best-case scenario under which Slovakia adapts its vehicle manufacturing sector to external trends in EVs uptake.

Results show that the stakes are high for Slovakia. In the worst-case/business-as-usual scenario, national GDP will be 10% lower than in the best-case scenario.

The overall net employment effect is also significant, with a 4% difference between the two scenarios. While the worst-case is expected to bring a 4.5% job loss, in the best-case total employment will drop by 0.3%. At the same time, the best-case scenario will see a net increase of 18%, or 8,000, jobs in the electrical equipment sector. Slovakia will still need to develop its own domestic battery production capacity, rather than relying on import, to capture value added.

The graph below visualizes the above-mentioned data:

GDP and Employment Impact in central scenarios



Source: Cambridge Econometrics⁹

9 For more information about this model and the related assumptions, consult section (VI) on methodology.

10 UNHR, Operational Data Portal, <https://data2.unhcr.org/en/situations/ukraine>

11 Novotný, L., et al., "International migration to an economically lagging EU region: case study of Ukraine and Eastern Slovakia", *Geographia Cassoviensis*, January 2020, https://www.researchgate.net/publication/348195496_International_migration_to_an_economically_lagging_EU_region_case_study_of_Ukraine_and_Eastern_Slovakia

12 Ibid.

The net impact of the transition to EV production is sensitive to whether Slovakia will secure enough domestic battery production capacity to meet EVs demand from its export markets. The COVID-19 crisis before and the Russian war in Ukraine now remind us about the risks of supply chain disruptions and the need to pursue a dual-strategy of supply diversification and domestic production. Should Slovakia be able to secure such production, employment and economic losses from the ICE vehicle supply chain would be offset. However, this would require Slovakia ensuring substantially more battery production than the one currently planned.

If Slovakia was to follow the best-case scenario and transition from ICE to EV vehicle production, substantial investments would be needed to 1) build new EVs or retrofit existing ICE production facilities and 2) produce batteries to meet EV production requirements. Results show that:

1) The required total investment in EV production facilities should be €3.4bn by 2040. The estimation is broken down for select year in Table 32.

Table 32: Calculation of investment in EV production facilities

	2025	2030	2035	2040
EV Share of exports	10%	60%	95%	100%
Additional EV share of exports (compared to 2020)	4%	54%	89%	93%
Vehicle production	1,000,000	1,000,000	1,000,000	1,000,000
EVs produced	43,287	536,740	889,079	932,121
EV production investment per annual vehicle production capacity (€m/vehicle)	0.0036	0.0036	0.0036	0.0036
EV Production Cumulative investments (€m)	157	1952	3233	3390

Source: Cambridge Econometrics

2) Slovakia would need 65 GWh of batteries annually to be able produce all the EVs in the best-case scenario, which means €5.6bn of investment, as detailed in the table below:

Table 33: Calculation of investment in EV battery production capacity

	2025	2030	2035	2040
Additional EV share of exports	4%	54%	89%	93%
Vehicle production	1,000,000	1,000,000	1,000,000	1,000,000
EVs produced	43,287	536,740	889,079	932,121
Battery size (kWh)	70	70	70	70
Total battery requirements (GWH)	3	38	62	65
Cost of investment per GWH capacity (€m per GWH)	85	85	85	86
Cumulative investments (€m)	258	3,194	5,290	5,611

Source: Cambridge Econometrics

Policy Recommendations

Key tasks for the government

Lack of innovations in Slovakia is largely connected to failure at attracting enough investment. Despite this has been acknowledged by both the private and public sectors, substantial changes have not been implemented yet. In addition, Slovakia was one of the poorest performers in EU fund absorption in the 2014-2020 period (38%).

In the upcoming 2021-2027 period, Slovakia will have EUR 12.8 billion in grants at its disposal, supporting three priority areas – Innovative Slovakia, Ecological Slovakia for Future generations, and Mobility, transport, and connectivity (see detailed chart in Annex 1). All of these are connected to the automotive transformation and should overlap and reinforce the twin green and digital agendas of the Recovery and Resiliency Facility (RRF), from which more than EUR 600 million will go towards innovations.

New and specific skills are needed across the e-mobility value chain, specializing in areas such as high voltage operating systems, data network risk management, and AI, among others. This requires not only reskilling and upskilling where applicable, but a wholesale reform of the university education system.

The following policy recommendations are meant to support the government effort to forge a path for Slovakia's automotive transformation. Their uptake would improve the business environment, facilitate talent and innovations development, with positive spillover effects for unlocking the green and digital transformations across economic sectors and industries:

- ▶ **Improve general business conditions especially for green projects by speeding up the administrative process and cutting red tape**

- ▶ **Clarify and support eligibility of green projects for EU financing to leverage risk capital**

- ▶ **Integrate EU funds with European Investment Bank (EIB), Slovak Investment Holding (SIH) and commercial loans in consultation with businesses that will use them**

- ▶ **Accelerate implementation of the EU green public procurement (GPP) scheme supporting green innovations, science, and research**

- ▶ **Prepare potential greenfield sites (in terms of ownership, change of use etc.)**

- ▶ **Follow through with ambitious tax reform including '1 in 2 out' principle that was delayed by COVID-19**

- ▶ **Foster collaboration between tech universities and industry and within the wider RDI ecosystem in the region**

- ▶ **Strengthen international university exchanges and collaboration between regional research institutes**

- ▶ **Using dual education and creating new in demand majors at universities**

- ▶ **Develop a strategy for 'brain drain to brain gain' in cooperation with universities that removes structural barriers to the Just Transition Fund (JTF)**

Furthermore, given its unique experience and current position at the heart of the global automotive supply chain, Slovakia should also:

- ▶ **Appeal to VW and other car manufacturers to cooperate in R&D, focusing on subcontractor autonomy, decision-making powers and a singular grant agency (following the Czechia model) through which companies can support science, research and development through grants, i.e. Center for Research and Development of New Batteries in cooperation with InoBat and ZAP**

- ▶ **Set similarly high standards for battery production as automotive manufacturing, developing high-quality products that bypass Chinese manufacturers lacking such regulations**

- ▶ **Connect IT development to the automotive industry, rolling out relevant pilot projects in Slovakia.**

“It is critical to equip Slovakia’s R&I ecosystem with new tools to boost the capacity of the industry and public R&D sector. This should encourage stakeholders to develop technologies or help universities and startups transfer innovations to the market.”

Patrik Križanský
Director, Slovak Electric Vehicle Association

Key measures to ensure EV production shift

Short-run strategies include direct government subsidies or loans to support investment into retooling existing production facilities for EVs and battery factories into the country. The following key considerations need to be considered:

- ▶ These government actions are crucial to bring quick and large success in creating workplaces and securing EU battery supply chains. However, they are often contested by EU competition authorities and governments need to prove that the aid is necessary to attract the given investment to the region. Additionally, it must be ensured that the subsidy does not distort competition at the expense of taxpayers and other regions (European Commission (2021)¹³). Thus, it is argued that most private investments and expansions would occur without state support.
- ▶ These government actions are considered as short-run strategies based on the workplaces and value added they create. The new factories are often assembly plants of large producers for low- and mid-skilled workers creating little value added. Although, both factors are important for domestic product in the short-run this strategy may lock regions in their assembly status without the ability to capture high value-added elements of the value chain in the long-term (Grieveson et al. (2021)¹⁴).

Long-term strategies include investments in infrastructure and human capital, research, and the labour markets.

- ▶ These types of strategies may have a longer maturity but ensure sustained and long-term competitiveness without unnecessary subsidies which crowd out private investments. Providing the underlying infrastructure that supports competitive companies and training a skilled workforce that is adaptive to digital and green transition are the keys to attracting and keeping production for each country. By investing in training and R&D, countries are able to attract the high-profit components of the supply-chain including headquarter services (Grieveson et al. (2021)). Human capital and infrastructure investments foster general growth and have strong positive spillover effects on the productivity of other sectors. This reduces exposure to structural breaks and changing trends in a single sector.

Slovakia has to balance the short and long-term policies to preserve its central role in the automotive industry; to create favourable conditions for battery factories but also to invest in its skilled workforce to maintain its place in the global value chains in the wake of the green transition.

This makes it all the more critical for the Slovak government to implement a series of policies that will attract investment and ensure future growth in e-mobility, especially to show these global companies that the state will support the industrial transformation and domestic e-mobility.

13 European Commission (2021). State aid: Commission approves €2.9 billion public support by twelve Member States for a second pan-European research and innovation project along the entire battery value chain, Press release on 26 January 2021. https://ec.europa.eu/commission/presscorner/detail/en/IP_21_226

14 Grieveson, R. et al. (2021). Avoiding a Trap and Embracing the Megatrends: Proposals for a New Growth Model in EU-CEE. wiiw Research Report 458. <https://wiiw.ac.at/avoiding-a-trap-and-embracing-the-megatrends-proposals-for-a-new-growth-model-in-eu-cee-dlp-5987.pdf>



“Europe had decided to make a fundamental change of powertrain in cars. The car manufacturers are transforming production and switching from internal combustion engines to electric cars. Does Slovakia really capture this trend, and does it understand how fundamentally car industry will change in less than eight years, in 2030?”

Alexander Matušek
President, Automotive Industry Association of the Slovak Republic

Methodology

For this study we designed a set of scenarios covering a wide range of possible outcomes, from the worst-case scenario where Slovakia's car manufacturing sector fails to adjust to EV adoption trends in their main export markets, to the best-case scenario where the switch to EV production is successful and Slovakia maintains market share in its destination markets.

The role of battery cell manufacturing is especially important for EV production. In Slovakia, it is highly uncertain whether battery cells supplying the EV manufacturing will be produced locally or imported. To cover this uncertainty, the research includes a sensitivity analysis that explores the implications of imported or locally produced battery cells on the value chains and employment.

The research process consisted of three phases:

1. **Stakeholder consultations**, aimed at identifying the variables and modelling assumptions to be included in the analysed scenarios.
2. **E3ME macroeconomic modelling**, aimed at applying the modelling assumptions to the E3ME macroeconomic model and assess the wider socio-economic implications of the switch to EV production.
3. **Net employment impact**, derived from the E3ME model, aimed at estimating jobs gains and losses by economic sector and occupational category.

Core scenarios

The central scenarios assume a high level of EV uptake in Slovakia's export markets, in line with the latest European Commission policy commitments (all new vehicles are to be emission-free by 2035) and UK, US, and China targets (all new vehicles to be emission-free by 2040, 2035, and 2035 respectively).

Worst-case scenario / Business-as-usual

The worst case-scenario scenario assumes that as EV demand rises, Slovakia is unable to adapt to demands of their export markets and loses market share in proportion to the EV share in that market.

Best-case scenario

This scenario assumes that Slovakia shifts its vehicle production from ICE to EV to match export demands and is successful in securing battery manufacturing. As such, Slovakia maintains its market share for exporting vehicles while securing further domestic battery production.

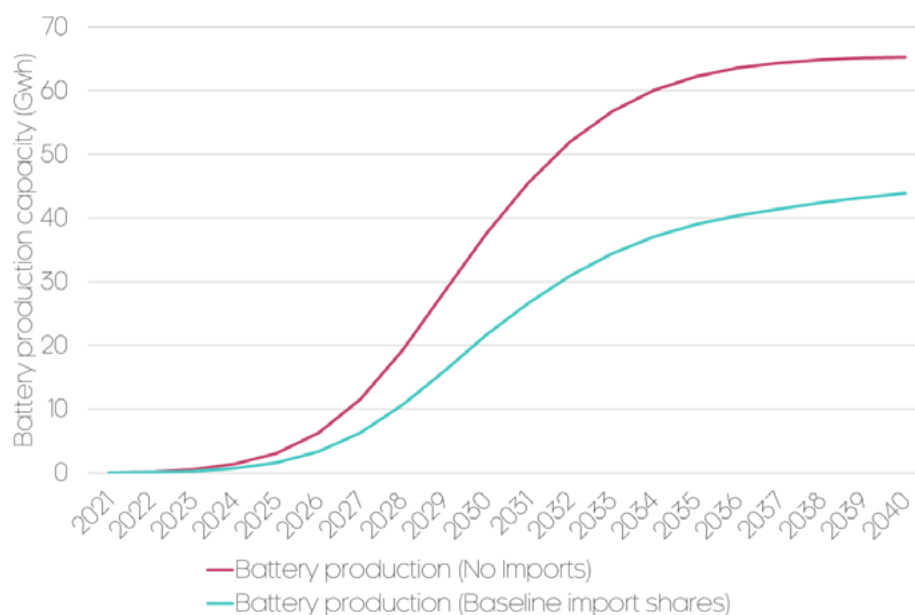
Battery cells as crucial variable

Battery cell manufacturing makes up a large proportion of the production value of an EV. Consequently, where the battery cells are produced, whether in Slovakia or abroad, is crucial since it has considerable impact on the economic outcomes of the transition to EVs.

Slovakia does not currently have any substantial battery production though home grown Inobat is moving forward with a 1 GW production facility which it wants to grow to 10GW. While there is some indication that this will happen in the coming years, it is still uncertain. Even if Slovakia can secure EV manufacturing, there is no guarantee that this will bring about battery production from foreign OEMs or battery producers, which countries in the CEE region are all competing for. Three sensitivities will be tested within the best-case scenario to account for this uncertainty:

1. Slovakia is unable to secure battery production locally and reliant on imported batteries for 100% of its battery demand for EV production.
2. Slovakia can secure battery production locally to meet 100% of its battery demand from EV production.
3. Slovakia can secure battery production for 50% of its battery demand from EV production.

Domestic battery capacity requirements for best case scenario under different import assumptions



Source: Cambridge Econometrics

The above figure shows that under the best-case scenario, the proposed 10GWh capacity may be sufficient in the short term, but it is going to be insufficient to meet demand in the long term as battery demand to meet all additional EV production would reach 65 GWh by 2040. As such Slovakia would need to secure additional battery production in the longer term. Given the continuing demand for battery production across Europe it is certainly possible for Slovakia to secure additional domestic production, but it is far from certain.

Under the best-case scenario, the economic impacts are more limited as Slovakia shifts production from traditional motor vehicle production to EVs. Overall production of vehicles is maintained, but under the central case Slovakia is reliant on imports for 50% of battery cells and other equipment for the electrical powertrain. The import intensity of the electrical equipment is higher than for the traditional motor vehicle sector, hence less value is captured within Slovakia. This results in a small GDP reduction relative to the reference case.

The net impact from the central best-case scenario shows that the economic benefits of EV production to the electrical equipment sector do not outweigh the losses to the motor vehicle sector in response to the loss of ICE powertrain production. The main driver of this relative impact is the import intensity of supply for the motor vehicle relative to electrical equipment. In the motor vehicle sector, today Slovakia's import share of total supply is about 25%. In the electrical equipment sector, it is around 50%. This means that even if the final production value is similar in the long term, less of EV powertrain value is retained in Slovakia's domestic supply chain.

Impacts of transition on the motor vehicle supply chain

Modelling element	Modelling assumptions
Shift in production value from traditional motor vehicle manufacturing to EV/electrical equipment	<p>The main shift in production value from ICE to EV is mostly from the substitution of the internal combustion engine with electric motor and battery.</p> <p>Currently the battery accounts for about 35% of the vehicle cost¹⁵. Based on expected battery cost reduction from \$137/kWh in 2020 to \$58/kWh in 2030¹⁶ the value of the battery could fall to ~15% of the vehicle cost.</p> <p>Data from the ICCT shows that a conventional powertrain makes up about 29% of the vehicle¹⁷ while an EV powertrain cost around 63% of the value of a conventional ICE vehicle today. Overall cost of ICE powertrain is currently much lower than an EV (\$15,000 for electric powertrain vs \$6,800 (2017 prices).</p> <p>Import requirements for batteries come in the form of battery cells which are then assembled as part of EV production. Battery cells make up 70% of the overall battery cost¹⁸.</p>
Labour productivity of electric powertrain versus electrical equipment sector	<p>Labour productivity of electric powertrain is estimated based on the relative productivity between electrical equipment as a whole and the manufacture of batteries from EU data from Eurostat SBS¹⁹. This data suggest battery production is 46% more productive per worker than the wider electrical equipment sector.</p>
Labour productivity growth assumption	<p>Real labour productivity (output per worker employed) for motor vehicles and electrical equipment is assumed to continue to grow based of recent historical productivity growth between 2015 and 2018. Motor vehicle labour productivity grows by 1.8% per annum and electrical equipment grows by 0.3% per annum.</p>
Labour market impacts	<p>E3ME sectoral detail allows us to look at impacts to the direct jobs in the motor vehicle sectors in which are around 80,000 people employed (Eurostat SBS). However, the data from a Globsec report²⁰ shows that the wider vehicle manufacturing supply chain supports 177,000 jobs (Big 4 and Tier 1) and a further 98,000 tier 2 suppliers.</p> <p>These are captured in other economic sectors within E3ME, and they will be accounted for in the wider supply chain impacts.</p>
Investment in battery production facilities	<p>Analysis by Schroders showed that investment of around €85million per GWh of annual production.²¹</p> <p>Total investments required calculated based on Slovakia vehicle exports and the share of batteries that are domestically produced.</p> <p>We assume a 70kWh battery for each vehicle produced²².</p>
Investment in EV production	<p>We assume transition to EVs is achieved from investment in existing plants to transition from ICE to EV manufacturing plants.</p> <p>Initial estimates based on Volkswagen's conversion of the Zwickau plant investment of €1.2 billion to convert existing ICE vehicle plant producing 330,000 vehicles to full EV production.</p> <p>The investment ratio is then applied to total EV production based of the EV export market share.</p>

15 <https://www.globsec.org/publications/slovakia-an-automotive-industry-perspective/>

16 <https://about.newenergyfinance.com/electric-vehicle-outlook/>

17 https://theicct.org/sites/default/files/publications/EV_cost_2020_2030_20190401.pdf

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Annex 1
Slovakia's 2021-2027 MFF Investment Plan

INVESTMENT PRIORITIES	COMPONENT	PLANNED ALLOCATION
Innovative Slovakia:	Research and innovation <ul style="list-style-type: none"> • cooperation of research institutions and universities with companies • support for research capacities • building infrastructure 	1.97 billion €
	Digitization <ul style="list-style-type: none"> • digital and data economy • smart cities and regions • Ultra-fast internet for all households 	
	Competitiveness of small and medium - sized enterprises	
	Development of digital skills	
Ecological Slovakia for future generations:	Energy efficiency and emission reduction <ul style="list-style-type: none"> • solutions for companies, renovation of buildings 	3.99 billion €
	Promotion of energy from renewable sources <ul style="list-style-type: none"> • in businesses and households 	
	Development of smart energy networks	
	Adapting to climate change	
	Sustainable water management	
	Circulating economy <ul style="list-style-type: none"> • waste prevention, recycling 	
	Nature and biodiversity protection	
	Rehabilitation of environmental burdens	
	Promoting urban mobility, including bicycle transport	
Mobility, transport, and connectivity:	European corridors <ul style="list-style-type: none"> • completion of motorway connections D1 and D3 • construction of expressways (especially R2, R3, R4) • railway infrastructure and junctions • water transport 	2.22 billion €
	National and regional infrastructure <ul style="list-style-type: none"> • 1st class roads, intersections, bridges • routes II. and III. classes • local roads • bicycle transport as an associated investment in road projects • regional rail transport 	
Social, just and educated Slovakia:		2.93 billion €
Quality of life in the regions:		603 mil. €
Total		12,8 billion €

Source: Ministry of Investments, Regional development and Informatization

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