Policy Paper

THE FUTURE IS ELECTRIC: ROLE OF VISEGRAD COUNTRIES IN THE EV BATTERY SUPPLY CHAIN

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March 2023

EUROPEUM

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Co-funded by the Citizens, Equality, Rights and Values Programme (CERV)

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Executive summary

Despite the adoption of electric vehicles (EVs) growing and the sale of new cars with internal combustion engine (ICE) declining across the EU, the domestic production of EVs is still lagging behind the US and China. At the same time, the car manufacturing industry is critical for EU's GDP, tax revenues and employment, accounting for over 11% of manufacturing jobs.[1]

The Visegrad Group (V4) countries – Czechia, Hungary, Poland, and Slovakia – are known for their high concentration of automotive industry. The V4 has been turning its attention to electromobility, particularly the production of EV batteries to support their and pan-European car industry. The energy crisis and the Russian invasion of Ukraine have speeded up those efforts.

To ensure a reliable supply of EVs, a reliable and sustainable supply chain for EV batteries is critical and spans from mining and refining of critical raw materials (CRM), to the manufacturing of EV battery components, to their end-of-life management (reuse and recycling). The V4 countries have started positioning themselves along the whole EV battery supply chain. While there is currently limited mining and refining in the Visegrad Group, the countries are exploring previously known deposits of CRM.[2]

Critical raw materials necessary for the EV battery production currently used are lithium, cobalt, nickel, manganese, graphite, and copper. These materials are sourced from a few countries, mostly outside of Europe. Therefore, reliable and sustainable sourcing of CRM is a primary concern for the EU. The EU is aiming to diversify its CRM sourcing and battery production in order to decrease its dependency on third countries. The V4 countries are well positioned to become

[1] https://www.acea.auto/press-release/new-vision-and-look-for-auto-industry-association-acea/
[2] https://www.irena.org/-/media/Files/IRENA/Agency/Technical-Papers/IRENA_Critical_Materials_2021.pdf

EU's green manufacturing hub. However, with the increasing competition from both China and the USA, it becomes a matter of urgency.

Since 2018, several gigafactories have started being built across V4 countries, particularly in Hungary and Poland. Research and development in recycling and in new battery cell chemistries are important for a more sustainable supply of materials for battery production. V4 countries have also built facilities to contribute to that.

Recommendations

- **Developing national strategies:** In order to secure presence along the EV batteries supply chain, the V4 countries should develop ambitious and actionable national strategies for new mining, processing and recycling projects, including an analysis of the current state of play and the potential opportunities for development. In addition to joint European efforts, national commitments are necessary to boost the national green transitions and ensure a stable investment environment. Political support for clean technologies, including the electrification of transport, should be reflected in long-term plans and strategies.
- **Dedicating more to R&D:** Investing in research and development is important in order to strengthen the position on the market. Investments in EV, battery and raw materials R&D should be the priority to improve the efficiency and sustainability of the products. Material innovation to replace critical materials with more available and affordable materials is crucial. Circular economy, including reuse and recycle methods, should be the aim of this process.
- **Engagement and strategic communication among the V4 countries:** Strategic communication and collaboration within the Visegrad Group can boost the region's position as the next clean tech hub of Europe. The war in

Ukraine has questioned the future of the Visegrad formation, however, in order to stay competitive with global stakeholders, regional collaboration and exchange of best practices can be beneficial.

- **Strengthening the skill-oriented education and training:** The V4 countries have a long tradition of automotive sector education and employment. In order to adapt to the changes on the global markets and remain competitive in the years to come, strong focus should be placed at providing the necessary education and skills for the future workforce. Dedicating appropriate investment, developing new national curricula and implementing re-skilling and up-skilling programs is crucial to ensure the countries benefit from the green transition.
- **Ensuring environmental and social safeguards:** Before launching potential battery factories, the states should consider the potential environmental and safety concerns in order to mitigate the ecological or human rights risks during production. Countries should avoid repeating the experience of Hungary, where the gigafactories operated by Chinese and South Korean companies were poorly regulated and caused backlash by local communities.

Decarbonisation of road transport

The car industry is at the centre of global decarbonization efforts. Countries and regions all over the world are banning the sale of new internal combustion engine (ICE) vehicles with the EU joining them and banning ICEs since 2035[3] and slowly introducing measures to scale-up production of electric vehicles (EVs).

[3] https://www.europarl.europa.eu/news/en/headlines/economy/20221019STO44572/eu-ban-on-sale-of-new-petrol-and-diesel-cars-from-2035-explained

After China, Europe (including Norway) is the second largest market for EVs representing over 35% of new EV sales. In 2022, that amounted to approximately 3.8 million EVs, a 65% increase from 2.3 million in 2021.[4]

While the sale of EVs is growing in the EU, the domestic production of EVs is lagging behind the US and China. The car industry is crucial for Europe, as it represents 8% of the EU GDP, contributes with over EUR 374.6 billion in tax revenues to EU governments in major markets and employs over 11% in manufacturing jobs.[5] While the EU car industry has a long experience in research and innovation contributing with over 32% of total EU spending[6], it entered the global EV race late and now faces fierce global competition particularly from China and the US.

The Visegrad Group – Czechia, Hungary, Poland and Slovakia – has been known as a hub for their previous automotive investments and are now catching up and turning their attention to electromobility, particularly the production of EV batteries to support their and pan-European car industry.

EV batteries and critical raw materials

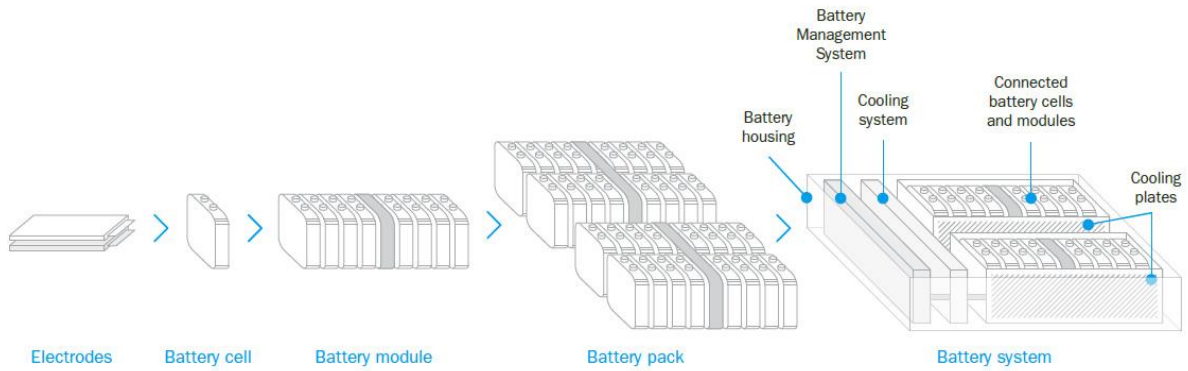
Currently used EV batteries are lithium-ion batteries and include lithium nickel-manganese-cobalt (NMC), lithium nickel-cobalt-aluminium (NCA) and lithium-iron-phosphate (LFP) cathode chemistries. NMC batteries are currently the most preferred chemistry used by the European car manufactures. On the contrary, LFP chemistry is a preferred option in China. But several other battery cathode chemistries such as sodium-ion or solid-state are emerging. On the anode side, the currently dominating chemistry is graphite, but other chemistries such as adding silicon to graphite or purely silicon chemistries are emerging. These

[4] https://assets.bbhub.io/professional/sites/24/2022-COP27-ZEV-Transition_Factbook.pdf
[5] https://www.acea.auto/press-release/new-vision-and-look-for-auto-industry-association-acea/
[6] https://clepa.eu/mediaroom/energy-crisis-impact-on-competitiveness-of-eu-auto-sector/

developments are important to watch as they will inform the future requirements for critical raw materials and investment opportunities.

The production of a typical lithium-ion battery consists of several steps: the production of electrodes, cells, modules, and packs (Figure 1). While the production of battery electrodes and cells is a chemical process, the production of battery module and pack is a mechanical assembly process.[7]

Figure 1: Battery components



Source: Outokumpu, 2023[8]

Battery cells have 4 components: anode, cathode, separator, and electrolyte (Figure 2).

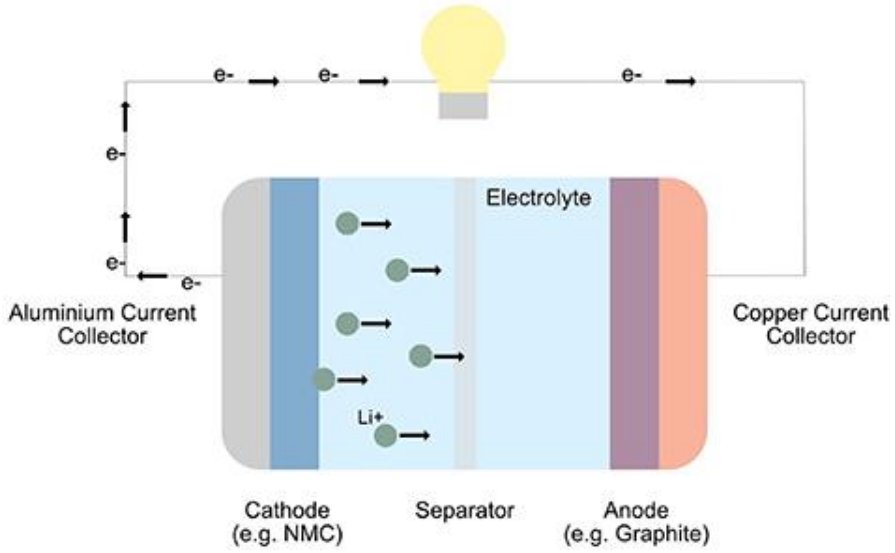
- An **anode** is a negatively charged electrode in a battery cell and has impact on battery charging time. The most used material is graphite. Anodes are held by a copper foil.
- A **cathode** is a positively charged electrode in a battery cell and has impact on battery performance, such as range. Cathodes are held by an aluminium foil. The type of the battery normally refers to the materials used in cathodes (lithium, nickel, cobalt, manganese, and aluminium) with the most

[7] https://www.acc-emotion.com/stories/battery-cell-module-or-pack-whats-difference-infographics
[8] https://www.outokumpu.com/de-de/expertise/2022/stainless-steel-makes-a-powerful-case-for-ev-battery-modules

used ones being lithium nickel-manganese-cobalt (NMC), lithium nickel-cobalt-aluminium (NCA) and lithium-iron-phosphate (LFP) chemistries.

- A **separato**r separates anodes and cathodes, while an **electrolyte** acts as a medium to transport negative and positive ions between cathodes and anodes.

Figure 2: Components of a lithium-ion battery cell



Source: IOP Science[9]

The production of current lithium-ion batteries and their anodes and cathodes rely on various critical raw materials (CRM) including lithium, cobalt, nickel, manganese, graphite, and copper.

[9] https://iopscience.iop.org/article/10.1088/2515-7655/ac0c04

Box 1: What are critical raw materials

Critical raw materials (CRM) refer to minerals and metals that are expensive and difficult to extract, their production is geographically concentrated in a few countries, which ores quality is declining, and their prices are volatile.[10]

Particularly due to the supply risks associated with their geographically concentrated production and refining and the importance to the EU economy, the EU has been developing lists of CRMs since 2011 and regularly reviewing and updating it.[11] To date, 4 lists have been developed: the 2011 list with 14 CRM, the 2014 list that grew to 20 CRM, the 2017 list with 27 CRM and the current 2020 list which contains 30 CRM. For comparison, the latest 2022 list from the US contains 50 CRM.[12]

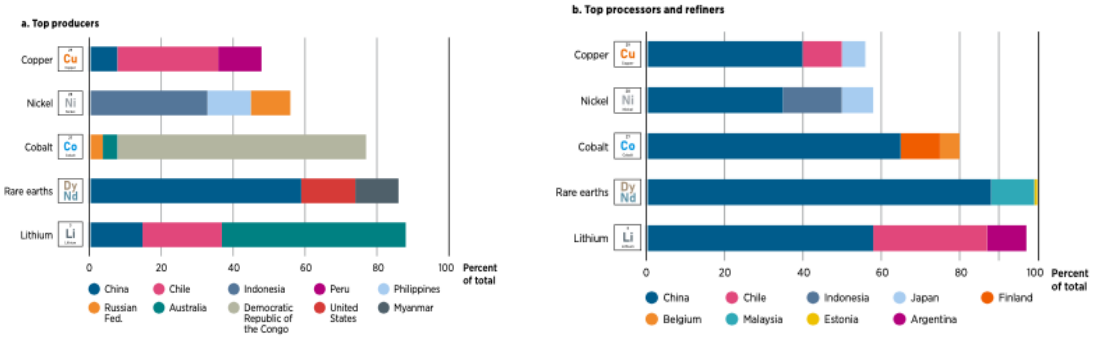
The reliable and sustainable supply of these materials in terms of mining and refining is the primary concern to the EU as they are concentrated in a few countries mostly outside of Europe (Figure 3). While mining of battery materials is more geographically distributed among various countries, refining is in the hand of a few with China dominating most of the processes. China refines over 60% of world cobalt, almost 60% of world lithium, 40% of world copper and over 30% of world nickel.

[10] https://www.irena.org/-/media/Files/IRENA/Agency/Technical-Papers/IRENA_Critical_Materials_2021.pdf

[11] https://single-market-economy.ec.europa.eu/sectors/raw-materials/areas-specific-interest/critical-raw-materials_en

[12] https://www.usgs.gov/news/national-news-release/us-geological-survey-releases-2022-list-critical-minerals

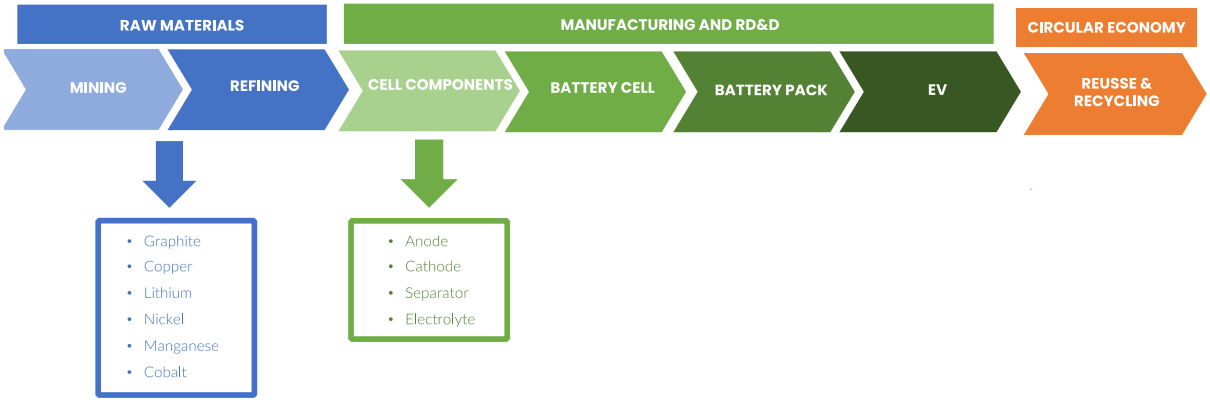
Figure 3: Top three countries mining and processing key raw materials such as copper, nickel, cobalt, lithium



Source: IRENA[13]

Battery value chain (Figure 4) goes beyond mining and refining and includes the manufacturing of batteries and the EVs, as well as their reuse and recycling.

Figure 4: Battery value chain



Source: EUROPEUM

China is by far the largest lithium-ion battery manufacturer holding 77% of current manufacturing capacity, but is projected to lose a portion of that capacity by 2027 (Figure 5). The EU, on the other hand, is expected to significantly expand its manufacturing capacity. According to the projects in the pipeline, both Poland and Hungary (projected capacity of over 300 GWh) are set to lose to Germany

[13] https://www.irena.org/Digital-Report/World-Energy-Transitions-Outlook-2022#page-7

(projected capacity of over 500 GWh) by 2027.[14] Most of the European gigafactories, however, will produce Chinese and Korean batteries.

Figure 5: Top 10 countries by current and projected manufacturing capacity of lithium-ion batteries

Country	2022 GWh	2022 %	2027 GWh	2027 %
China	893	77%	6,197	69%
US	70	6%	908	10%
Poland	73	6%	112	1%
Germany	31	3%	503	6%
Hungary	38	3%	194	2%
Rest of the world	58	5%	1031	12%
Total	**1 163**		**8 945**	

Source: Visual Capitalist, 2023[15]

Visegrad Group battery supply chain: status quo and opportunities

The automotive industry has been a major economy driver in the Visegrad countries for a few decades. Recent legislative developments at the EU level to ban the sale of new ICE cars as of 2035[16] and decarbonise the road transport have created both challenges and opportunities for these countries. While the sale of EVs in V4 countries lags their western neighbours, countries started seeking opportunities to play an active role in the road transport decarbonisation and started developing their own battery production capacities along the supply chain from mining, manufacturing to recycling. The energy crisis and the Russian invasion of Ukraine have only speeded up those efforts.

[14] https://www.visualcapitalist.com/chinas-dominance-in-battery-manufacturing/
[15] https://www.visualcapitalist.com/chinas-dominance-in-battery-manufacturing/
[16] https://insideevs.com/news/652486/eu-parliament-votes-ban-sales-ice-powered-cars-from-2035/

Thanks to its geographical location and high manufacturing capacity, the V4 is well positioned to function as the green technology hub for lithium-ion batteries in the years ahead and play an essential role in the European green transition. Developing the region's battery-producing capacity (in the automotive industry especially) could fulfil the increasing market demand for clean technologies in Europe. This momentum presents new opportunities for the Visegrad countries, which the governments should utilise.

"While the Visegrad countries have started positioning themselves along the EV battery supply chain, the enabling environment at the national and EU levels would need to be strengthened significantly to have them succeed."

While the Visegrad countries have started positioning themselves along the EV battery supply chain, the enabling environment at the national and EU levels would need to be strengthened significantly to have them succeed. This is particularly relevant in response to the US Inflation Reduction Act (IRA), which poses a major threat to EU clean energy investments. It is already happening with the case of Volkswagen which may lose its gigafactory in Czechia to the US.[17] This is particularly worrying to secure economic resilience for the Visegrad countries, their supply chains and the growing battery industry. To protect Visegrad countries as a green hub and a vital part of the European lithium-ion production, the EU and national policies and regulations must attract investment and make building facilities along the supply chain faster and easier.

[17] https://www.reuters.com/business/autos-transportation/volkswagen-postpones-decision-gigafactory-eastern-europe-by-several-months-ctk-2022-12-08/

Mining and refining

The green energy transition and electrification of transport needs to be planned with the necessary critical materials in mind. Currently, over 80% of lithium-ion battery manufacturing in centred in Asia, while the majority of lithium and other vital raw materials are sourced outside of Europe.[18]

An underinvestment into mining and refining of critical raw materials due to unpredictable and risky outlook and volatile prices happened all over the world, except China. But since governments have committed to decarbonising road transport, the demand for EVs has risen exponentially. Thus, mining and refining of critical raw materials has become an opportunity, and more countries and companies are exploring possible deposits.

While there is currently limited mining and refining in the Visegrad Group, countries are exploring previously known deposits. To advance on that, the public perception of mining and refining will be key to avoid hindering or halting mining or refining projects. Proper regulatory aspects of Environmental, Social and Governance (ESG) requirements will be needed to ensure limited carbon and environmental footprints of the projects. The key aspects that need to be monitored and regulated are: energy and water conservation, avoiding water, soil and air pollution, avoiding biodiversity loss, respecting human and labour rights, and creating benefits to local communities. Companies will need to focus on increased transparency and reduced corruption as well.[19]

[18] https://www.statista.com/statistics/235323/lithium-batteries-top-manufacturers/
[19] https://www.c-resource.com/2023/01/23/what-lies-ahead-in-2023-critical-resources-picks-for-the-top-3-e-s-and-g-trends-following-a-tumultuous-2022/

Figure 6: Existing and potential mining and refining projects in Visegrad Group

Location	Material	Amount	Development stage
Czechia - Cínovec	Lithium	1.3 Mt 29 kt/pa[20]	Declared strategic[21]
Czechia - Tisová	Cobalt	NA	Exploration
Czechia - Chvaletice	Manganese	960 kt	Feasibility completed
Czechia - Český Krumlov and other locations	Graphite	NA	Discovery
Slovakia - Kolba	Cobalt-nickel-copper	NA	Exploration
Slovakia - Dobšiná	Cobalt-nickel-copper	NA	Exploration
Slovakia - Kovohuty	Copper recycling-refining	50 kt/pa	In operation
Poland	Copper mining production	390 kt/pa[22]	In operation
Poland	Copper refinery production	590 kt/pa[23]	In operation
Hungary - Úrkút	Manganese	NA	NA

[20] https://www.europeanmet.com/wp-content/uploads/EH_19Oct22-Initiation.pdf
[21] https://www.miningweekly.com/article/cinovec-lithium-project-declared-strategic-2023-01-30
[22] https://pubs.usgs.gov/periodicals/mcs2022/mcs2022-copper.pdf
[23] https://pubs.usgs.gov/periodicals/mcs2022/mcs2022-copper.pdf

Lithium: The supply of lithium is a top priority for securing the EV battery production. The Cínovec lithium mining project owned by the Czech ČEZ and Australian EMH in Czechia offers tremendous opportunity to become the fifth-largest deposit globally with 1.3 megatons of lithium resources.[24] The feasibility study puts the current annual mining and refining rate at 29 kt of lithium hydroxide over a mine life of 25 years.[25]

Cobalt-nickel-copper: Cobalt is usually a co-product or by-product[26] of the nickel and copper mining. Two projects – Kolba and Dobšiná[27] – are currently in an exploration phase in Slovakia with reported cobalt grades up to 1.92%. Tisová in Czechia is also being explored with cobalt grades being around 0.9%.[28]

The Sudety mountains at the Czech-German borders were past producers of cobalt as a co-product of nickel and silver mining and have been again studied recently.[29] No information on annual potential production is currently known.

Manganese: The increasingly short supply of manganese used in cathode is worrisome, as demand is projected to grow exponentially. Czech's Chvaletice manganese project is not a mining project but rather an innovative waste / tailings recycling initiative with a plan to provide up to 20% of projected 2030 European demand for high-purity manganese over the 25-year life span under Czechia's stringent environmental regulations and standards. The project amounts to 960 kt reserves in total.[30]

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[24] https://pubs.usgs.gov/periodicals/mcs2022/mcs2022-lithium.pdf
[25] https://www.europeanmet.com/cinovec-project-overview/
[26] Co-product refers to a product that is produced along with the main product and carries equal importance as the main product, while by-product refers to an unplanned product.
[27] https://www.europeancobalt.com/copy-of-investors
[28] https://www.sciencedirect.com/science/article/pii/S0169136820311008
[29] https://www.sciencedirect.com/science/article/pii/S0169136820311008
[30] https://www.mn25.ca/chvaletice-project

The Úrkút manganese ore deposit located in Hungary has estimated 31 Mt of manganese carbonate ore and 600 to 700 kt manganese oxide ore.[31] It, however, seems to have closed its operation in 2017, with very little follow up information available.[32]

Copper: Poland has the 7th largest copper reserves globally of 31 Mt.[33] In 2020, Poland mined 393 kt of copper, which decreased to 390 kt in 2021.[34] It has 6 mines in operation – Lubin, Polkowice, Rudna (largest copper/silver ore in Europe), Sieroszowice, Malomice and Głogów Głęboki Przemysłowy.[35]

Copper and nickel are often mined together. There is in theory a potential for nickel mining also in Poland in the future.

Poland is a global leader for copper refining. Its copper refining production grew from 560 kt in 2020 and to 590 kt in 2021[36] in its 2 operating plants.

Kovohuty in Slovakia produces refined copper from the scrap of planned 50 kt per year.[37]

Graphite: There is no mining production of graphite in Czechia, but there are some discovered deposits of flake graphite in 4 different areas in Southern Bohemia.[38]

Manufacturing

Meeting the Paris climate targets includes switching to electro-mobility on a global scale. The Russian war in Ukraine also laid bare the need for the V4 countries to

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[31] https://thediggings.com/mines/usgs10207231

[32] https://akjournals.com/view/journals/24/62/1/article-p100.xml

[33] https://pubs.usgs.gov/periodicals/mcs2022/mcs2022-copper.pdf

[34] https://pubs.usgs.gov/periodicals/mcs2022/mcs2022-copper.pdf

[35] https://storymaps.arcgis.com/stories/e7b67d22566c4cc699c6544e7f27979e

[36] https://pubs.usgs.gov/periodicals/mcs2022/mcs2022-copper.pdf

[37] http://ild-ua.com/en/kovohuty-company/

[38] http://www.geology.cz/extranet-eng/publications/online/mineral-commodity-summaries/mineral%20-commodity-summaries-2018.pdf

decarbonise and decrease their dependence on fossil fuel imports from third countries. Due to their manufacturing capacity, the Visegrad countries could serve as the next green technology hub for lithium-ion batteries in the years ahead. V4 countries have been attracting investments into battery manufacturing due to their affordable labour and land costs, particularly in Poland and Hungary.

Hungary and Poland belong to top 5 manufacturing countries globally, representing 9% of EV battery manufacturing capacity amounting to over 110 GWh in 2022. Hungary is projected to grow its capacity 5-fold in the next 5 years and become the number 2 producer in Europe and number 1 among V4 countries. Poland is currently number 1 European manufacturer by capacity and will grow 2-fold in the next 5 years.[39] Poland has good conditions for importing CRM, with access to ports and copper refining and mining expertise that could give it a competitive advantage.

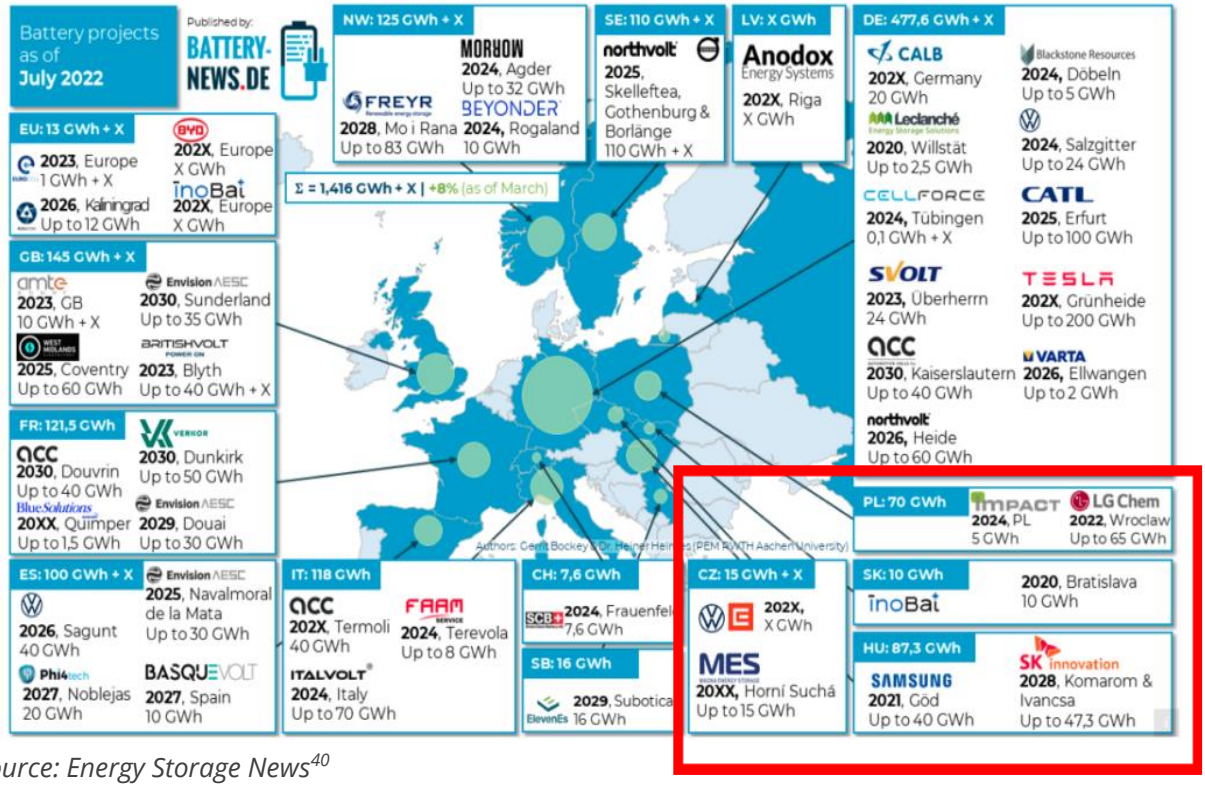
"Gigafactories are producers of EV batteries at the larger scale. It is also an area where the Visegrad countries saw an opportunity and put a lot of efforts."

Building on its strong car industry, Slovakia with the IPCEI grant has fostered a growing gigafactory with important R&D aspects into different chemistries and into recycling. Compared to its neighbours, Czechia struggles to attract investment for gigafactories and currently operates only a small-scale battery manufacturer.

Gigafactories are producers of EV batteries at the larger scale. It is also an area where the Visegrad countries saw an opportunity and put a lot of efforts. Since 2018, several gigafactories have started being explored across all four countries (Figure 6 and Figure 7).

[39] https://www.visualcapitalist.com/chinas-dominance-in-battery-manufacturing/

Figure 7: Gigafactories announced as of July 2022



Source: Energy Storage News[40]

Country overviews

Hungary is projected to be the 2nd largest lithium-ion battery producer in Europe by 2027 behind Germany[41] due to its geographical position, cheap labour and cheap land.[42] It has attracted several investors and companies building gigafactories, some in operation and some planned:

- GS Yuasa Hungary produces 500 000 lithium-ion batteries annually using renewable energy for the plant's heating operations.[43]

[40] https://www.energy-storage.news/nearly-all-lithium-battery-gigafactory-projects-in-europe-face-delays-while-catl-announces-second-facility/
[41] https://www.visualcapitalist.com/chinas-dominance-in-battery-manufacturing/
[42] https://source.benchmarkminerals.com/article/hungary-set-to-be-europes-leading-tier-1-battery-producer-this-decade
[43] https://www.yuasa.co.uk/2023/

- Samsung SDI operates a 30 GWh battery plant in Göd, with two additions in pipeline. The third plant is expected to produce battery cells solely for BMW.[44]
- Two SK Innovations' Hungarian plants in Komárom are operating with capacity of 7.5 GWh and 9.8 GWh. SK Innovations is currently constructing its third plant in Iváncsa, with a projected capacity of 30 GWh.[45]
- A new plan for BMW is under construction in Debrecen and expected to open in 2025. BMW aims to produce cells using renewable energy and secondary raw materials (SRM) to decrease dependency on supply.[46]
- China's Contemporary Amperex Technology Limited (CATL) plans to build a major 100 GWh plant in Debrecen and create 9,000 new jobs.[47]

Poland has over 60 plants manufacturing battery components including cathodes, electrolytes, separators and 2 gigafactories, one in operation and one planned. Poland's geographical location provides access to European transportation hubs and Baltic Sea ports. Poland has also skilled engineers and cheap workforce. This combination of factors has enabled Poland to attract investors for battery manufacturing. This in addition to its mining and refining capacities can help it become European and global leader in battery manufacturing.[48]

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[44] https://batteriesnews.com/samsung-sdi-considering-building-joint-battery-plant-hungary-with-bmw/
[45] https://www.electrive.com/2021/06/10/sk-innovation-receives-loan-for-2nd-hungarian-battery-plant/
[46] https://www.press.bmwgroup.com/deutschland/article/detail/T0405972DE/bmw-group-investiert-bis-2025-mehr-als-2-milliarden-euro-in-ungarisches-werk-debrecen?utm_source=article-extern&utm_campaign=BMW%20Group%20PressClub%20Deutschland&utm_medium=Email
[47] http://english.scio.gov.cn/internationalexchanges/2022-09/06/content_78406716.htm
[48] https://www.pmgroup-global.com/news/poland-europes-li-ion-bat/PM-Group-Poland-EV-Battery-market-report-.pdf

Figure 8: Poland's EV/li-ion battery investment overview

Source: PM Group Poland[49]

LG Energy Solution Gigafactory in Wroclaw (previously known as LG Chem) has a capacity of up to 65 GWh[50] and makes Poland the number one exporter of automotive batteries in the EU.[51] Clean Power Technology (Impact) started the construction of its GigafactoryX with planned capacity of 4-5 GWh.[52]

Slovakia has one gigafactory operated by InoBat Auto with a current capacity of 2 GWh but is aiming to scale up to 10 GWh by 2030.[53] The company has been building an R&D facility that focuses on the whole supply chain solutions towards a circular economy. InoBat Energy also received a grant from the Slovak government and has been approved for a grant under the Important Projects for Common European Interest (IPCEI).[54] InoBat is exploring opportunities abroad in

[49] https://www.pmgroup-global.com/news/poland-europes-li-ion-bat/PM-Group-Poland-EV-Battery-market-report-.pdf
[50] https://www.energy-storage.news/nearly-all-lithium-battery-gigafactory-projects-in-europe-face-delays-while-catl-announces-second-facility/
[51] https://www.sustainable-bus.com/components/teamtechnik-impact-gigafactory-battery-poland/
[52] https://invest-in-wroclaw.pl/volkswagens-gigafactory-for-car-batteries-to-be-built-in-lower-silesia-we-are-on-vws-list
[53] https://smartmobility.gov.sk/en/slovakia-is-working-its-way-into-battery-industry/
[54] https://inobatenergy.eu

efforts to expand its operations. It signed a declaration of intent in Serbia and Spain to construct recycling plants and gigafactories. The gigafactory in Serbia aims to start operation in 2025 with initial capacity of 4 GWh and up to 34 GWh.[55]

Back in 2021, the Czech Ministry of Industry and Trade and ČEZ signed a memorandum to set up a gigafactory with an annual production capacity of 40 GWh and are in discussion with the German Volkswagen concern.[56] Magna Energy Storage (MES) announced their intention to build a gigafactory with a production capacity up to 15 GWh, but its date is not set.[57] In addition, a small-scale battery manufacturing has been in operation in Brno since 2011 and currently aims to increase their annual capacity to 25 MWh and potentially to 1 GWh.[58]

"Recycling can become an additional and more sustainable supply of materials for the battery production, but not before 2030 due to not yet accumulated stock."

Recycling

Recycling can become an additional and more sustainable supply of materials for the battery production, but not before 2030 due to not yet accumulated stock. However, there is a lack of economic incentives to recycle without governments mandating it. At the same time, current recycling technologies (pyrometallurgy, hydrometallurgy and direct recycling) require improvements to increase recovery rates, lower their costs and particularly decrease their emissions as current technologies are very polluting.

[55] https://www.electrive.com/2022/11/15/inobat-to-build-battery-factory-in-serbia/
[56] https://www.cez.cz/en/media/press-releases/the-first-step-to-towards-the-construction-of-the-gigafactory.-the-mit-and-cez-sign-a-memorandum-147566
[57] https://www.energy-storage.news/nearly-all-lithium-battery-gigafactory-projects-in-europe-face-delays-while-catl-announces-second-facility/
[58] https://www.businessinfo.cz/clanky/prostejovska-ev-battery-skokove-navysi-vyrobu/

Slovak InoBat set up a recycling centre using hydrometallurgy with 95% metal recovery rate that will result in CO2 emissions reduction of 20%.[59]

Another type of recycling is using mine tailings that consists of a large level of manganese carbonate that can be used in lithium-ion batteries, such as the Chvaletice Manganese Project (CMP) in Czechia.[60]

R&D into emerging chemistries

Slovak InoBat established the National Battery Centre (NBC) to develop and produce new and improve existing EV batteries through public and private partnerships. The programme has led to new materials for electrodes of lithium-ion batteries, increasing performance and prolonging EV battery life. The NBC is currently developing sodium-ion and sodium metal batteries through Horizon 2020[61] particularly for energy storage applications. If European EV producers start to rely on sodium-ion batteries, the supply chain of the cathode (lithium, manganese, cobalt, and nickel) will decline. Investors who are looking to open mines such as Cínovec may realize that less lithium than initially projected is needed. If investors are not aware of other battery chemistries, risks of stranded assets can have environmental and social consequences.

European supporting frameworks

The European Commission has proposed a number of supporting regulations and funding schemes in order to boost the resilience of European battery industry and supply chains. As the global competition increases, most recently with the US adoption of the Inflation Reduction Act, the underlying policy framework will become ever more important to provide a stable and predictable environment for investments and reshoring of clean tech production back to Europe.

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[59] https://www.warehouserentinfo.sk/article/warehousemarket-news/inobat-recycling-establishes-a-recycling-center-in-slovakia
[60] https://www.mn25.ca/chvaletice-project
[61] https://smartmobility.gov.sk/en/slovakia-is-working-its-way-into-battery-industry/

European Battery Alliance (EBA)

In 2017, the European Commission established the European Battery Alliance (EBA) to promote a cross-border integrated European approach for sustainable battery production and usage and competitive battery manufacturing. It has currently over 800 members from member states, the European Investment Bank, the industry, and the scientific community aiming to create a domestic battery supply chain.[62]

The European Strategic Action Plan on Batteries

In 2018, the European Commission published the Strategic Action Plan on Batteries to promote cross-border and integrated European approach along the whole battery supply chain with a particular focus on sustainability and circular economy.[63]

In 2022, the Strategic Action Plan was updated by EBA to enable 90% of the EU demand for batteries to be met domestically by 2030.[64]

EU Battery Regulation

In December 2022, the European Parliament and the Council provisionally agreed on new rules on batteries throughout their entire life cycle, making them more sustainable and durable. The Regulation will have requirements regarding the capacity, performance, durability, or chemistry of the batteries. EV batteries will also require a 'digital battery passport' that would include information on the battery model and its use. In addition, operators placing batteries on the EU market will develop and implement a due diligence policy to address ESG risks linked to mining, processing, and trading raw materials. The Regulation also sets

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[62] https://www.eba250.com
[63] https://eur-lex.europa.eu/resource.html?uri=cellar:0e8b694e-59b5-11e8-ab41-01aa75ed71a1.0003.02/DOC_3&format=PDF
[64] https://www.energy-storage.news/european-action-plan-to-accelerate-growth-of-battery-value-chain/

up requirements for collection and recycling targets.[65] The Regulation is yet to be formally approved by the European Parliament and the Council.

Important Projects of Common European Interest (IPCEI) on Batteries

IPCEI are transnational projects with a highly important contribution to the economic growth, jobs and competitiveness of the EU industry and economy. They are funded by state aid with the aim of attracting further private investments. Battery production under IPCEI is broken down into two parts: (1) IPCEI on Batteries and (2) IPCEI European Battery Innovation (EuBatIn) including participation from the complete battery supply chain and fostering a network of companies sharing common interest. Projects aim to develop an innovative and sustainable battery supply chain from mining, refining, repurposing, and recycling. The objective is in line with advanced material and manufacturing of cells (cathode, anode), development and innovation (RDI), first industrial deployment (FID) and software systems committed to testing and solutions.[66]

EU Critical Raw Materials Act

The EU is trying to decrease its dependence on China's dominant position in the fields of extraction, processing, and recycling of critical raw materials, which are the core of the green and digital transition.[67] In March 2023, the European Commission introduced targets for raw materials self-sufficiency in the Critical Raw Materials Act. By 2030, the EU aims to be able to cover at least 10% of its raw material annual consumption from own extraction, as well as at least 40% of processing and 15% of recycling. Overall, no more than 65% of EU's consumption of each strategic raw material should come from a single third country.[68] The targeted raw materials projects in the EU would be achieved within the framework

[65] https://www.europarl.europa.eu/news/en/press-room/20221205IPR60614/batteries-deal-on-new-eu-rules-for-design-production-and-waste-treatment
[66] https://www.ipcei-batteries.eu/about-ipcei
[67] https://ec.europa.eu/commission/presscorner/detail/en/STATEMENT_22_5523
[68] https://ec.europa.eu/commission/presscorner/detail/en/ip_23_1661

of the European Raw Materials Alliance, a network of raw material agencies involving the private sector.[69]

Conclusion

The car industry is a crucial player for the economies of each V4 country, but to remain competitive it needs to be adapted. This is particularly critical in views of the EU ban on new combustion engine vehicles as of 2035. The V4 countries have positioned themselves along the different parts of the EV battery supply chain from mining, refining to manufacturing, reuse and recycling as well as R&D into new battery chemistries. To benefit from the current momentum and to strengthen the European and V4 security of critical raw materials, create jobs and economic value, V4 countries need to address the related challenges and opportunities urgently. This also includes proper regulatory aspects of ESG as well as national and EU level policy and regulation to ensure energy conservation and environmental protection, reduce corruption, ensure benefits for local communities and attract investment. The EU supporting frameworks should be utilised by V4 countries to maximise their chances at successfully becoming the EU's next clean tech hub.

[69] https://single-market-economy.ec.europa.eu/sectors/raw-materials/areas-specific-interest/critical-raw-materials_en