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REPORT

Low-emission materials for the Czech automotive industry

FILIP KŘENEK

EUROPEUM
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INSTITUTE FOR EUROPEAN POLICY

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Executive Summary

The Czech automotive industry remains strong despite challenges faced by European carmakers. In 2024, car manufacturers in Czechia produced a record of 1.45 million cars, reaching a 12.7% share of the total EU production. With more than 90% of its car production set for exports, Czechia is the world's 6th largest exporter of passenger cars and 8th largest exporter of battery electric vehicles (BEVs). In 2024, automotive accounted for more than 50 billion € of exports, while imports reached 20 billion €.

Czechia is highly integrated into European automotive supply chains, with Germany as its biggest trading partner, and Poland, Hungary and Slovakia as other major trading partners for the majority of car-related products. Korea is also one of the main suppliers of car parts due to the presence of Hyundai in Czechia, China is the biggest supplier of lithium batteries for electric vehicles (EVs), but increasingly also car parts. This creates a double-sided dependency on German demand and Chinese supply.

According to our estimates, the demand of the Czech automotive sector in 2024 reached around 260kt of aluminium, around 1.4Mt of steel and 20GWh of Li-ion batteries, which translated to around 18.4kt of critical raw materials (Lithium, Nickel, Manganese, and Cobalt). We model a 2030 scenario with a 60% share of EVs, where the demand shifts to 340kt of aluminium, 1.3Mt of steel and 46GWh of batteries (potentially up to twice as much, depending on the assembly of EV battery modules in Czechia).

Czechia is not a primary producer of aluminium, so it has to meet its demand by imports. Domestic steelmaking capacity is 2.4Mt, with around one third of production being used for the automotive. Czechia has two critical raw materials mining projects in the pipeline, but production has not started yet. Secondary production would decrease dependence on imports, but requires a fully functioning market for scrap, where automotive-grade aluminium and steel scrap is retained separately to avoid contamination and degradation of material. Establishing a closed-loop system for recycling material can be done in partnerships between automakers, recyclers and smelters. Battery recycling will also help decrease dependence on primary materials. In all instances, secondary production also decreases emissions.

The upcoming End-of-Life Vehicle Regulation (ELVR) will introduce circular vehicle design and dismantling obligations and set the conditions for secondary material collection and recycling. The Battery Regulation also introduces recycled-content targets for critical raw materials. The Critical Raw Materials Act (CRMA) and Carbon Border Adjustment Mechanism (CBAM) will influence access to strategic inputs and increase the value of low-carbon metals and local processing. The Ecodesign for Sustainable Products Regulation (ESPR) will introduce performance requirements for steel and aluminium, while the Waste Shipment Regulation has already tightened controls on the exports of 'black mass' from shredded batteries.

Czechia is still missing a strategy for securing low-carbon materials for its automotive sector. Strategies such as Circular Czechia 2040 and the Secondary Raw Materials Policy lack concrete measures for steel, aluminium or battery value chains. ELV processing remains below its capacity, even though it might offer a valuable source of material. The absence of large-scale, high-purity sorting and recycling infrastructure risks forcing Czech industry to depend on more carbon-intensive imports.

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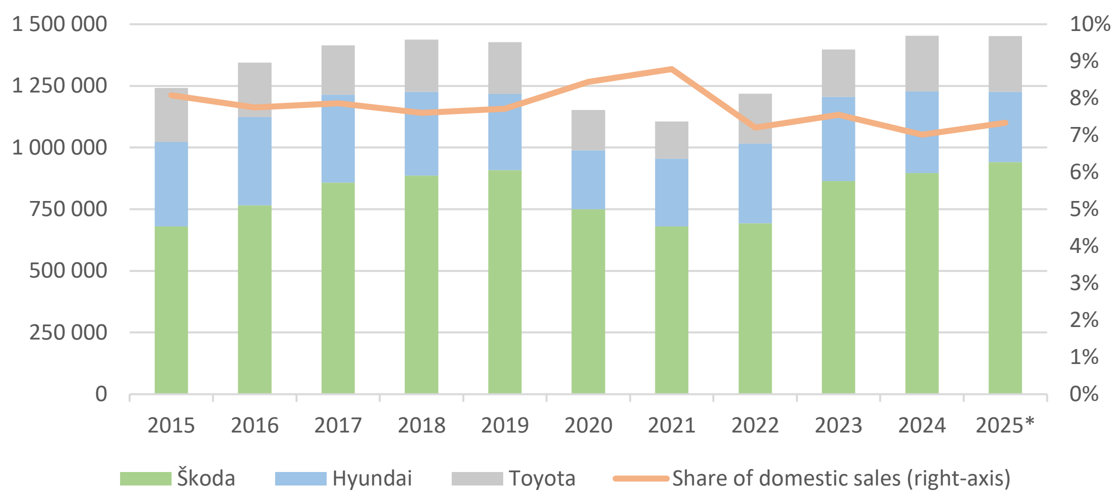
List of abbreviations

BEV	Battery Electric Vehicle
BESS	Battery Energy Storage Systems
BF-BOF	Blast Furnace - Basic Oxygen Furnace
CBAM	Carbon Border Adjustment Mechanism
CRM	Critical Raw Material
CRMA	Critical Raw Materials Act
DRI	Direct Reduced Iron
EAF	Electric Arc Furnace
ELV	End-of-Life Vehicle
ELVR	End-of-Life Vehicle Regulation
EPD	Environmental Product Declaration
ESPR	Ecodesign for Sustainable Products Regulation
ETS / EU ETS	European Union Emission Trading System
EU	European Union
EV	Electric Vehicle
GWh	Gigawatt Hour
ICE	Internal Combustion Engine (vehicle)
IEA	International Energy Agency
kWh	Kilowatt Hour
kt	Kilotonne (thousand tonnes)
Li-ion	Lithium-ion (battery)
LFP	Lithium Iron Phosphate (battery chemistry)
Mt	Million tonnes
NMC	Nickel Manganese Cobalt (battery chemistry)
NZIA	Net-Zero Industry Act
OEM	Original Equipment Manufacturer
PHEV	Plug-in Hybrid Electric Vehicle
t CO_2 / t CO_2e	Tonne of carbon dioxide (equivalent)
TWh	Terawatt Hour

1. Automotive industry in Czechia

Despite many challenges faced by European carmakers, from fierce Chinese competition to US tariffs on EU cars and automotive components, the Czech automotive industry remains strong. In 2024, Czech car manufacturers produced a record of 1,45 million cars (1,48 mil. total road vehicles), a 3,9% increase from 2023, exceeding pre-pandemic levels of production (2018-2019). Czechia also reached a 12.7% share of the total EU production and recorded the highest yearly growth between 2023-2024 while production fell in 8 out of the top 10 other car producing EU countries.[1]

Fig.1 Passenger car manufacturing in Czechia by OEM



Source: Czech Automotive Industry Association, Manufacture and sale of vehicles, *Est. based on Q1-Q3 2025, https://autosap.cz/en/data-and-statistics/manufacture-and-sale-of-vehicles/

The automotive sector is a major contributor to the Czech economy, accounting for 30% of total production and adding 10,4% to the Czech GDP in 2024.[2] It also shows the country's integration into European and global value chains with automotive representing around 10% of total Czech imports and 20% of exports in 2024. The industry employs 180.000 employees directly and up to 500.000 if adjacent sectors are also considered, representing 3.4% and 9.4% of total employment respectively.[3]

There are three large original equipment manufacturers (OEMs) in the country: Škoda Auto (owned by Volkswagen, Germany) operating two production plants in Mladá Boleslav and Kvasiny, Toyota Motor Manufacturing Czech Republic (owned exclusively by Toyota, Japan since 2021) operating one plant in Kolín and Hyundai Motor Manufacturing Czech (Hyundai, South Korea) operating one plant in Nošovice. In addition, the automotive ecosystem consists of over 900 suppliers and indirectly involved businesses which are scattered all over the Czech Republic.[4]

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[1] ACEA. Economic and Market Report Global and EU auto industry: Full year 2024. March 2025. https://www.acea.auto/files/Economic_and_Market_Report-Full_year_2024-rev.pdf

[2] ČSÚ. Cesta od průměru ke špičce. 24 September 2025. https://statistikaamy.csu.gov.cz/cesta-od-prumeru-ke-spicce

[3] AutoSAP, Desk Research – Analysis of the Impact of the Transformation in the Czech Republic, 31 August 2023. https://autosap.cz/wp-content/uploads/2023/11/d2-desk-research-analysis-of-the-impact-of-the-transformation-to-the-stakeholders-operating-in-the-czech-republic.pdf

[4] Hengalová, R. From Stick Shift to Skill Shift, Europeum, March 2024. https://www.europeum.org/wp-content/uploads/from-stick-shift-to-skill-shift.pdf

2. Main trade flows in the automotive sector

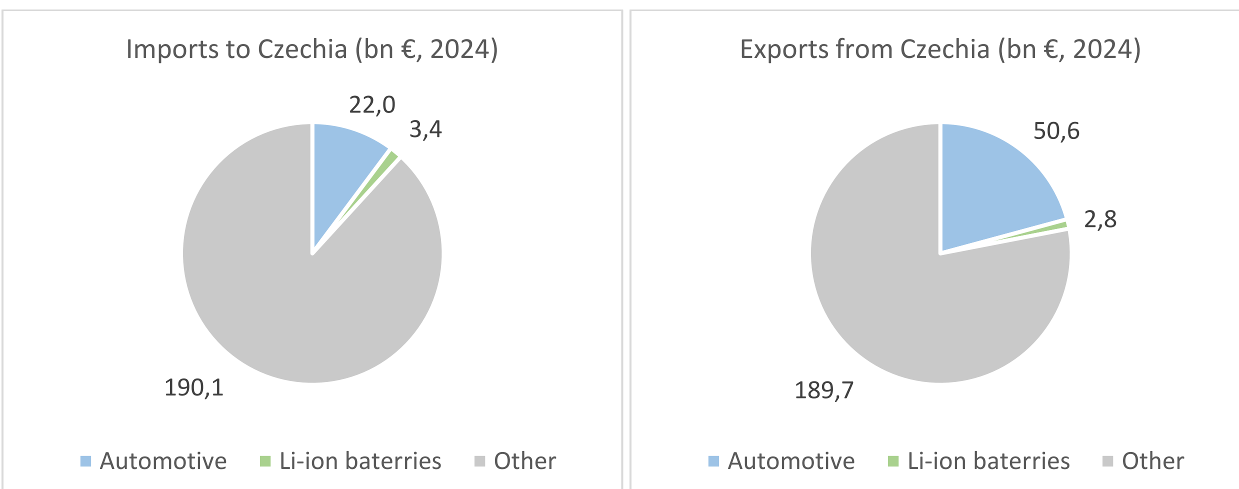
Over 92% of the Czech car production is set for exports, with domestic sales only accounting for 7-8% in 2022-2025. In 2024, Czechia was the world's 6th largest exporter of passenger cars and 8th largest exporter of battery electric vehicles (BEVs) (see Fig.2). In terms of value, automotive accounted for 22 billion € of imports and 50,6 billion € of exports in 2024 (see Fig.3).

Fig.2 World's largest exporters of passenger cars and battery electric vehicles (BEVs)

	Car exports (mil., 2024)	Top 10 ranking	BEV exports (2024)	Top 10 ranking
China	6,63	1.	1 650 917	1.
Japan	5,10	2.	205 892	4.
Germany	4,23	3.	954 293	2.
USA	2,45	4.	107 196	9.
South Korea	2,43	5.	368 492	3.
Czechia	1,45	6.	115 034	8.

Source: United Nations. UN Comtrade. International Trade Statistics, Car exports = HS 8703, BEVs = HS 870380, October 2025, http://comtrade.un.org/.

Fig.3 Czech imports and exports (bn €, 2024)



Source: Eurostat Comext, International trade of EU and non-EU countries since 2002 by HS2-4-6 (DS-059341), Automotive sector = HS 87, Li-ion batteries = HS 850760, October 2025, https://ec.europa.eu/eurostat/comext/.

As an automotive powerhouse, Germany continues to be Czechia's main trading partner for most car-related trade flows, including complete passenger cars (1.8 bn € of imports and 7.3 bn € exports in 2024) as well as for most car parts (4.3bn € IM, 6.8bn € EX). The V4 countries all have a significant presence of some of the biggest European OEMs, including VW, Stellantis, Kia and Jaguar in Slovakia; Audi, Mercedes-Benz, Suzuki, and Stellantis in Hungary; and VW, Stellantis, General Motors, and Mercedes-Benz in Poland. They are also home to a number of Tier 1/2 suppliers. As such, they are all important car part suppliers for the Czech automotive, but also destinations for car parts or semi-assembled products from Czechia, with combined export and import flows of 2.7 bn € (Poland), 2.7 bn € (Slovakia) and 1.4 bn € (Hungary) in 2024. Korea also features high on the list of suppliers, with 0.8 bn € of car parts' imports in 2024 thanks to the Hyundai factory in Nošovice. Finally, Chinese car parts' imports to Czechia have also been growing, reaching 0.5 billion € in 2024. On the demand side, with 0.9 bn € and 0.6 bn € in 2024 respectively, France and Spain are also prime destinations for Czech-made car parts, owing largely to the presence of Stellantis and Renault (France) and Seat (Spain, part of VW group).

The main markets for Czech car exports continue to be Germany, UK, France, Poland, Italy and Spain. On the import side, most cars come from Germany, followed by France, Slovakia, Austria and Japan. Czechia is also heavily reliant on the import of Chinese batteries, which reached a record-high of 2.5 bn € in 2023. Poland and Hungary are also among the top Li-ion suppliers, housing gigafactories of some of the biggest EV battery producers, including Chinese CATL or Korean LG and Samsung. Germany also continues to be an important Li-ion battery supplier for the Czech automotive industry, but also the single biggest destination for battery modules assembled in Czechia (see Fig.4).

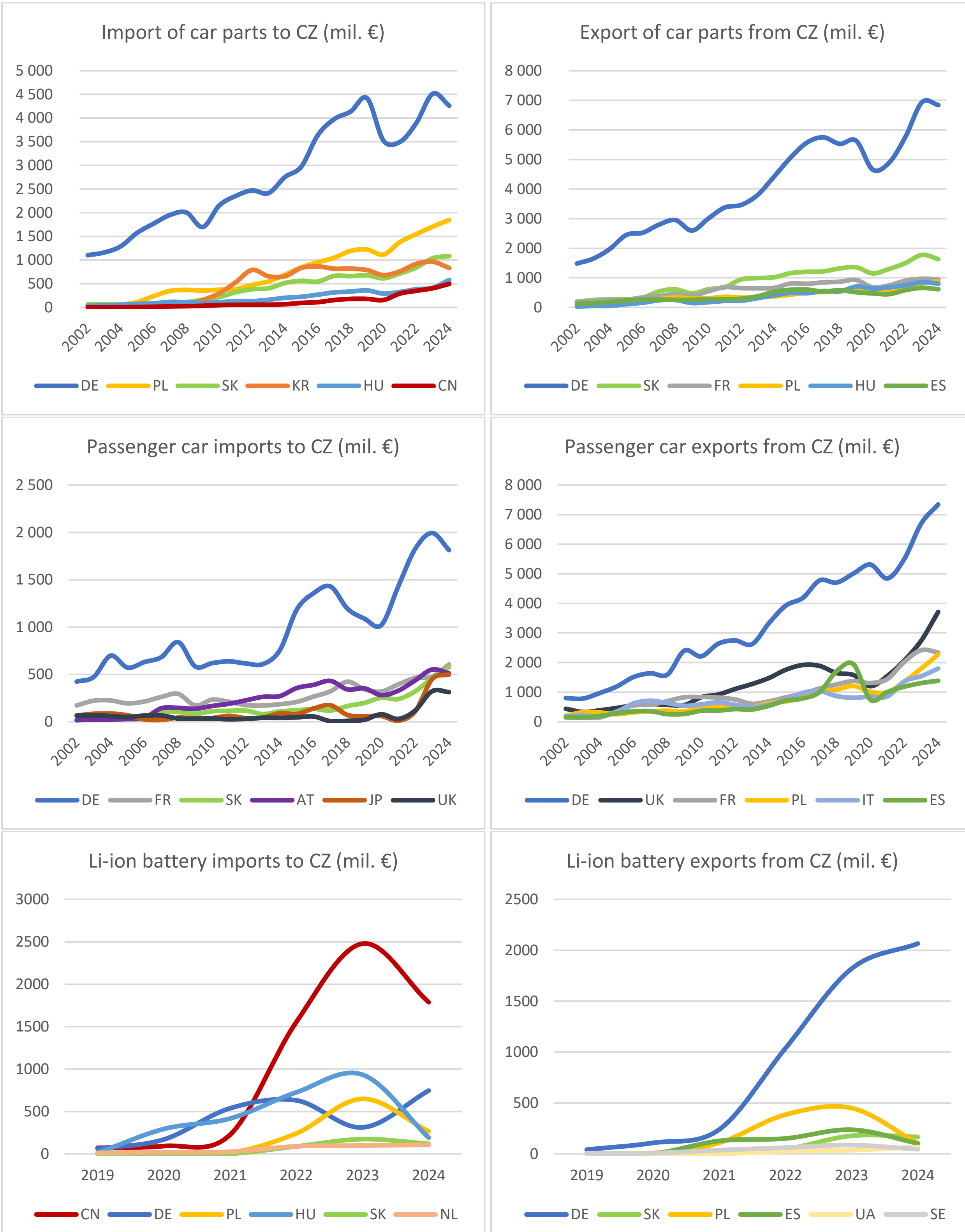
Lithium batteries have also been gaining a share in Czech imports and exports as a crucial component for the production of electric vehicles. In 2024, Li-ion batteries accounted for 3,4 billion €, or about 1,6% of total Czech imports, while generating around 2,8 billion € on exports (1,2% of total exports). Despite increasing use in energy storage systems, electronics and other applications, EVs continue to be the main driver of Li-ion battery growth, accounting for over 90% of global demand.[5] For Czechia, EVs continue to be the main driver of Li-ion demand thanks to the volume of BEV exports as well as battery packs and modules, which are re-exported after assembly (see Chapter 2 on material flows for details).

Despite the diversity of partners, Czech automotive trade remains structurally tied to Germany, which creates advantages in scale and stable demand, but also exposure to potential shocks in the neighbouring economy (both positive and negative). Any slowdown in German automotive output, shifts in platform allocation or supply-chain restructuring would have an outsized effect on Czech production. Upstream, China dominates the supply of batteries and critical raw materials. Chinese cells, modules and precursors form the backbone of battery imports into Czechia, whether directly or via neighbouring EU countries. Foreign ownership of OEMs operating in Czechia reinforces this dependency, since key investment decisions, model allocations and long-term strategies are determined abroad.

Reliance on German demand, Chinese inputs and foreign-controlled OEM strategies limits the room for manoeuvring in times of disruption. However, early signs of diversification are visible (at least on the demand side) with rising EV exports to the UK, France and the Nordics. Given the strong performance of several Czech-made EV models in recent years, expanding exports to these faster-growing electrified markets could reduce reliance on German demand. This shift is closely linked to the timing and success of new model launches and how well Czech-produced EVs compete in key European segments.

[5] IEA, World Energy Outlook Special Report: Batteries and Secure Energy Transitions, April 2024. https://www.iea.org/reports/batteries-and-secure-energy-transitions/status-of-battery-demand-and-supply

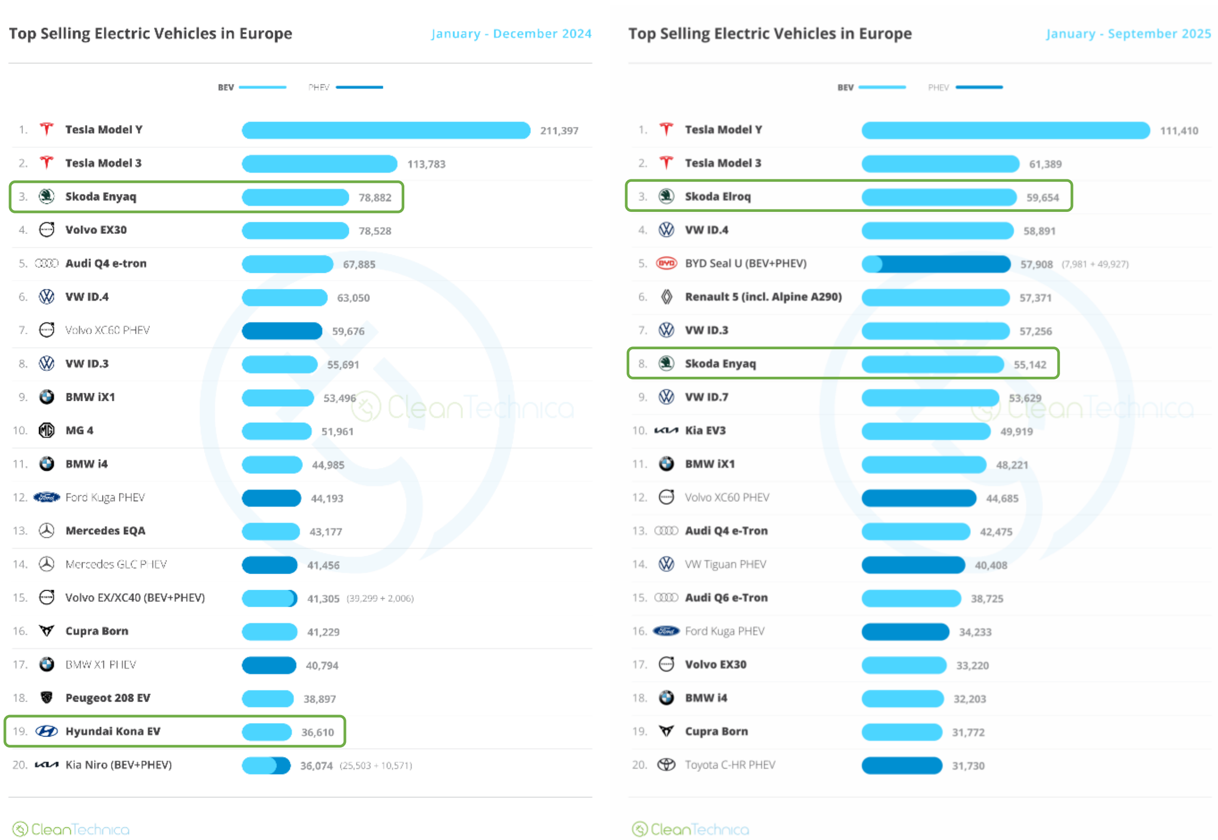
Fig.4 Key automotive trade flows to/from Czechia (mil. €) – top 6 trading partners



Source: Eurostat Comext, International trade of EU and non-EU countries (DS-059341), Passenger cars = HS 8703, Car parts = 8708, Li-ion batteries = HS 850760, October 2025, https://ec.europa.eu/eurostat/comext/.

With OEMs preparing to meet their CO_2 fleet targets, the rollout of several EV models was strategically scheduled for late 2024/early 2025 to boost 2025 EV sales. This contributed to a temporary dip in EV production and sales in 2024, as consumers postponed purchases in anticipation of new models. A clear example of this is the Škoda Elroq. Although mass production only began in January 2025, it quickly became the third best-selling EV model in Europe by September 2025, with close to 60,000 vehicles sold. It replaced the Škoda Enyaq, which held the same position in 2024 with nearly 79,000 units sold. The Enyaq continues to perform well this year. At the same time, the Hyundai Kona EV produced in Nošovice was also among the top twenty best-selling EVs in Europe in 2024. These results show that Czech-based OEMs are not only adapting to the transition, but succeeding in some of Europe's most competitive EV segments (see Fig.5).

Fig.5 Top selling electric vehicles in Europe (2024, Q1-Q3 2025)

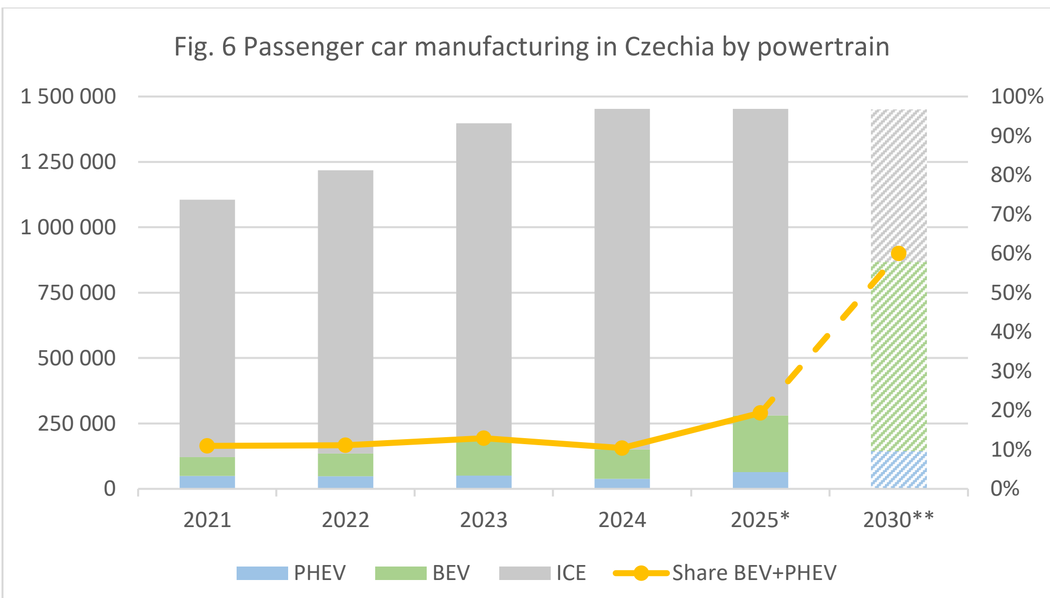


Source: CleanTechnica, https://cleantechnica.com/2025/02/05/23-plugin-vehicle-share-in-europe-ev-sales-report, https://cleantechnica.com/2025/11/04/europe-ev-sales-report-second-best-month-ever

3. Production trends and material needs

Based on the data from the first three quarters of 2025, the EV production in Czechia has nearly doubled while overall car production remains at roughly the same level as 2024. For the purposes of the following sections, we estimate the full production year 2025 based on Q1-Q3 data (*) and we use a model scenario for 2030, with a 50:40:10 ratio of BEV, ICE and PHEV at the same level of production capacity (**), resulting in the annual production of 725.000 BEVs, 580.000 ICEs and 145.000 PHEVs. This model corresponds to an overall electrification of 60%, which is generally consistent with industry estimates and Czech-based OEM announcements. Some analysts project lower electrification rates largely due to uncertainties over the CO2 emission standards for 2030 and 2035 (see Annex 1).

A 55-60% share of EV sales is also consistent with the EU target of reducing fleet-wide CO2 emissions by 55% in 2030.[6] While some reports only expect European BEV sales to overtake ICEs in 2032,[7] our analysis assumes a higher share of EV production in Czechia, which is supported by several contributing factors: the established supply chains and proximity of localized Li-ion battery production (DE, PL, HU, SK), a very high utilization rate of Czech car manufacturing companies[8] and the recent announcement by Toyota to build their very first BEV for the European market in their Czech plant in Kolín.[9] The model scenario is sensitive to policy changes, such as softening the 2030 / 2035 CO2 targets or additional flexibilities for certain powertrains, which would affect not just the speed of electrification, but also the BEV:PHEV ratio.



Source: Own production based on Czech Automotive Industry Association, Manufacture and sale of vehicles, *Based on Q1-Q3, **Model scenario, https://autosap.cz/en/data-and-statistics/manufacture-and-sale-of-vehicles/

[6] Transport & Environment, EV progress report: Which EU carmakers are on track for 2025-27 targets?, 8 September 2025. https://www.transportenvironment.org/articles/ev-progress-report-2025

[7] Reuters, Europe's BEV sales expected to exceed half of new light vehicle sales by 2032 -study. 9 September 2025. https://www.reuters.com/markets/europe/europes-bev-sales-expected-exceed-half-new-light-vehicle-sales-by-2032-study-2025-09-08/

[8] Reuters, Volkswagen's labour clash spotlights Europe's car factory conundrum, 25 September 2024. https://www.reuters.com/business/autos-transportation/vw-labour-clash-spotlights-europes-car-factory-conundrum-2024-09-25/

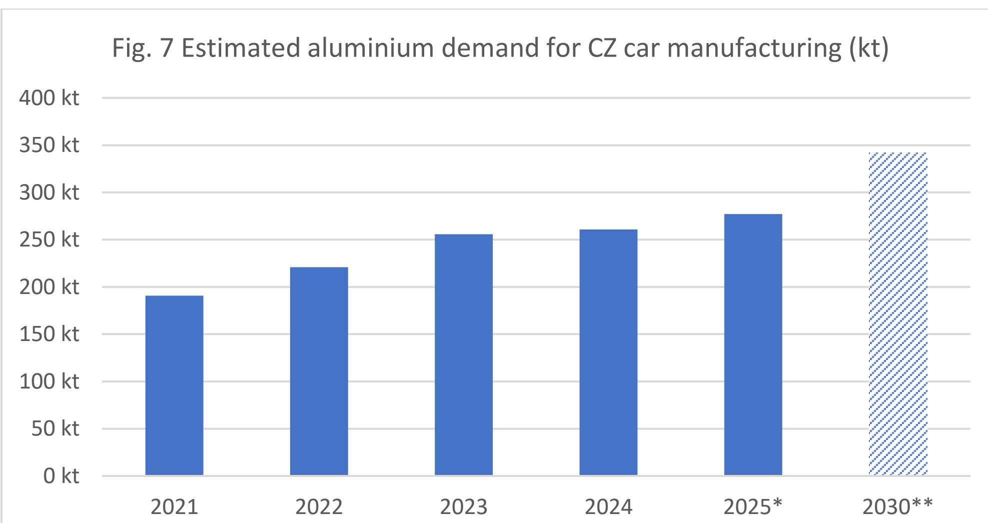
[9] Garáž.cz, Toyota zahájí v roce 2028 výrobu elektromobilů v České republice, 30 July 2025. https://www.garaz.cz/clanek/novinky-toyota-zahaji-v-roce-2028-vyrobu-elektromobilu-v-ceske-republice-21015202

Taking this projection as our baseline, we model the demand for several key materials and components for passenger car manufacturing, which accounts for the vast majority of the Czech automotive sector. We estimate the demand generated by producing final passenger cars, production of car parts for export is disregarded in this type of analysis due to the lack of sufficiently granular data. For reference, the weight of net exports of car parts were between 280-350kt in the period 2021-2024, whereas the weight of net car exports amounted to between 1.35-1.8Mt. Our calculations could therefore underestimate the total construction material demand by about 15-25% if we also take into account the export of car parts.

3.1. Aluminium – demand

First, we estimate the demand for aluminium. An average vehicle today already contains around 230kg of aluminium and this content is projected to reach up to 256kg in 2030 as car manufacturers transition towards heavier BEVs and try to offset some additional mass by substituting high-strength steel with lightweight materials, such as aluminium and synthetic composites. We use industry estimates[10] to model the average aluminium content per powertrain type and production rates to calculate the demand.

According to our estimate, car manufacturing demand for aluminium has grown by 45% between 2021-2025 to almost 280kt, but much of this can be explained by increased car production, which grew by 31% in the same period (see Fig.1 for comparison). However, for 2025-2030, we assume the same level of production, so the main driver for increased aluminium demand remains electrification and lightweighting. Mega-casting may further stimulate aluminium demand, allowing manufacturers to cast a single large format piece instead of hundreds of individual parts and using mostly aluminium alloys.[11] For instance, Toyota plans to replace 177 steel plate parts in EVs by only 3 large aluminium ones.[12]



Source: Own calculation based on production data.

[10] Ducker Research & Consulting, Aluminum Content in Cars: Assessment 2022 and Outlook 2026, 2030 – Public Summary, April 2023. https://european-aluminium.eu/wp-content/uploads/2023/05/2023_04_Aluminum-Content_Ducker-Study_EA-Public-Summary_190423.pdf

[11] S&P Global Mobility, "Gigacasting: The hottest trend in car manufacturing," 1 November 2023. https://www.spglobal.com/automotive-insights/en/blogs/2023/11/gigacasting-the-hottest-trend-in-car-manufacturing

[12] Alcircle, "Japanese firm Ryobi implements gigacasting technology to replace steel with large aluminium auto components," 10 July 2023. https://www.alcircle.com/news/japanese-firm-ryobi-implements-gigacasting-technology-to-replace-steel-with-large-aluminium-auto-components-96512

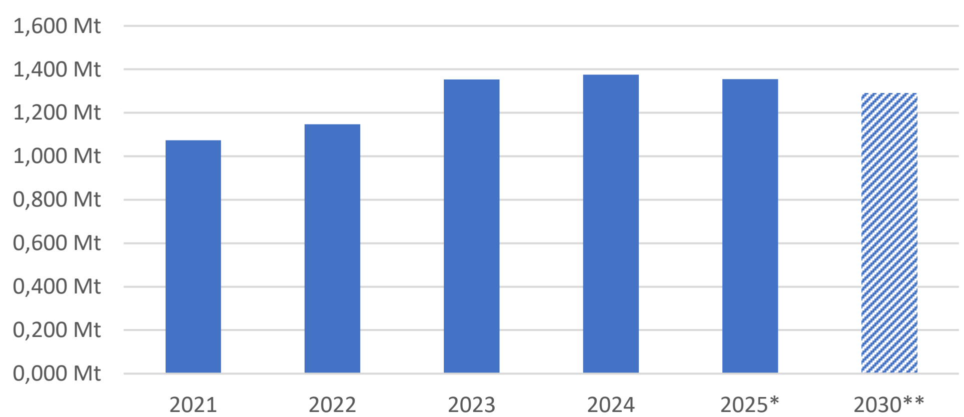
3.2. Steel – demand

Second, we estimate the demand for steel by calculating the average car weight based on export data. We assume substitution of steel for lighter aluminium at a stable volume of construction metals in the vehicle (i.e. 70% aluminium + steel) while observing the overall trend of increasing vehicle weight. The weight of an average Czech-made car grew from 1.45t to 1.63t in 2017-2021 and remained stable afterwards. This is 7% heavier than the EU 1.5t average, but matches the German average of 1.63t.[13] This results in an average steel content of 920kg per Czech-made car in 2024, which can be broken down into 736kg of flat steel (sheets, plates) and 184kg of long steel (bars, rods, etc) assuming an 80:20 ratio.[14] However, material shares vary between car manufacturers depending on the specific vehicle design.

We obtain total demand based on production rates per powertrain. Based on our estimate, steel demand for the manufacturing of cars in Czechia has peaked in 2024 at around 1.4Mt of steel and is expected to gradually decrease towards 1.3Mt. If we include exported car parts, the figure could be around 0.2-0.3Mt higher. But even with the shift to electromobility, total steel demand remains relatively stable.

The projection for 2030 shows only a marginal decline compared with 2023-2025, which indicates that steel remains a core input material even under deep electrification. This stability reflects the fact that BEVs still rely heavily on steel for body structures and safety components. Several factors will drive the demand for steel as the main structural material in the future. Substituting steel for lightweight materials will slightly decrease steel demand, while growing overall car mass (driven by SUVisation)[15] might push demand upwards. At the same time, mega-casting could be a disruptive technology for automotive steel component manufacturing as it not only leads to substitution of materials, but also very high production cost-savings once the relatively high initial investment expenditures are absorbed.[16]

Fig.8 Estimated steel demand for CZ car manufacturing (kt)



Source: Own calculation based on production data.

[13] International Council on Clean Transportation (ICCT), European Vehicle Market Statistics Pocketbook 2023/24, January 2024. https://theicct.org/wp-content/uploads/2024/01/Pocketbook_202324_Web.pdf

[14] Steelonthenet.com, Steel Content in Passenger Vehicles, https://www.steelonthenet.com/files/automotive.html

[15] Gomez Vilchez, J., Pasqualino, R., Hernandez, Y., The new electric SUV market under battery supply constraints: might they increase CO2 emissions?. EC JRC, 2022. 10.2905/7383638C-50CD-4A0E-964B-4B3891C4AC5A

[16] Burggräf, P., Bergweiler G., Kehrer, S., Krawczyk T., Fiedler, F., Mega-casting in the automotive production system: Expert interview-based impact analysis of large-format aluminium high-pressure die-casting (HPDC) on the vehicle production, Journal of Manufacturing Processes, 2024, ISSN 1526-6125, https://doi.org/10.1016/j.jmapro.2024.06.028

3.3. Batteries – demand

Finally, we calculate the demand for Li-ion batteries based on BEV and PHEV models produced by OEMs in Czechia (currently, Škoda and Hyundai). We use a mid-point for the range of battery capacities offered per model and calculate the (direct) demand generated by BEV+PHEV production. Similarly, we estimate (indirect) demand generated by the assembly of Li-ion batteries in Czechia, which are then re-exported, as Škoda also produces battery system (BEV and PHEV) for other VW group vehicles.[17]

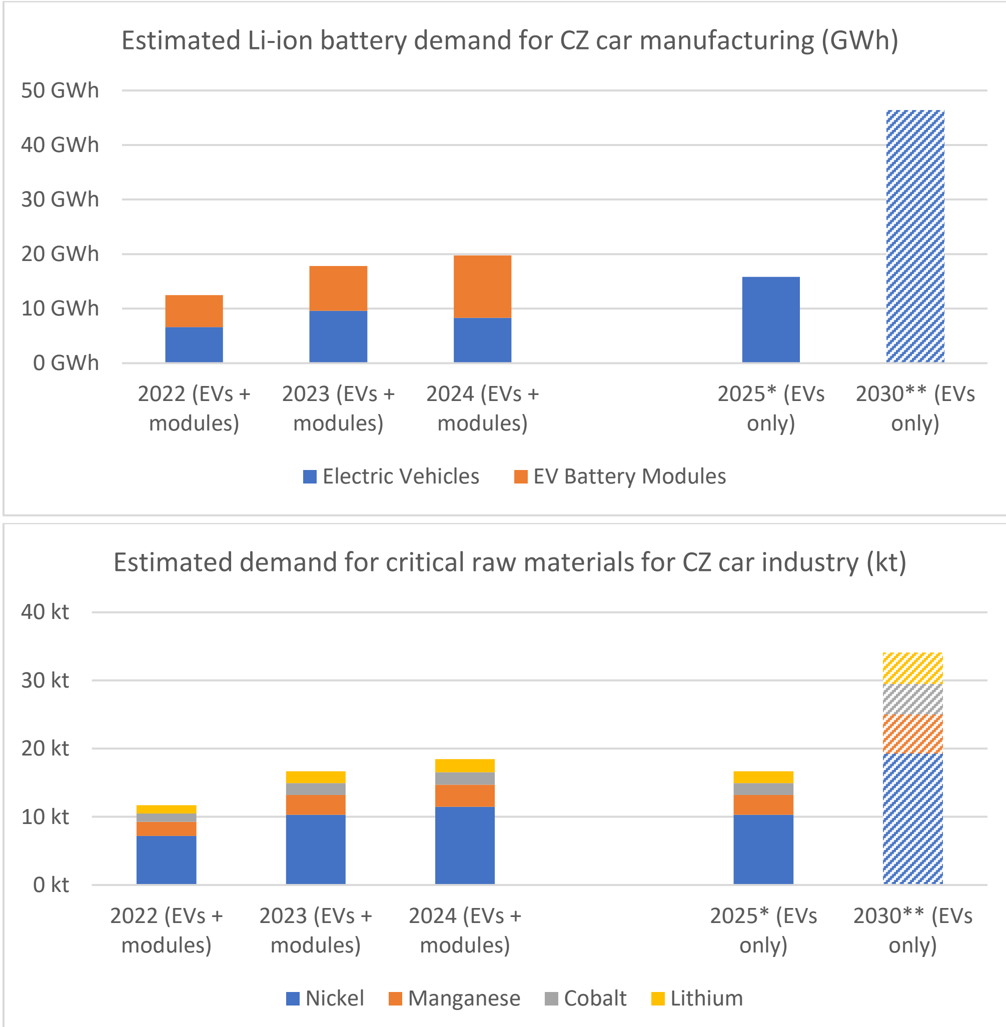
Between 2022-2024, demand for batteries directly installed into EVs gradually increased, reflecting the slow rise in BEV and PHEV production. Total demand still grew in 2024, but more batteries were exported as modules rather than finished vehicles. Between 2022-2024, battery module production accounted for about 50% of demand. In 2024, demand reached 7-9.5 GWh for complete vehicles and 8.5-14 GWh for battery modules, which combined corresponds to 1,3% of global EV battery production.[18] In comparison, battery energy storage systems (BESS), generated a much lower demand of only 0.5 GWh in 2023-2024.[19] This shows that the automotive sector continues to be the main driver for Li-ion battery demand.

EV production in 2025 has nearly doubled compared to 2024 (see Fig.6), doubling also direct demand. As production figures for battery modules are not available throughout the year, we cannot estimate the indirect demand for 2025 since part of the production feeds directly into EV production instead of export. In our 2030 model scenario, direct demand will reach around 46 GWh (upper and lower estimate: 38-54 GWh). However, this is subject to considerable uncertainty over the speed of electrification, the ratio between BEVs and PHEVs, and their respective battery capacities. Our estimate uses existing EV battery capacities to simulate the 2030 scenario, but other studies expect an increase of around 20-30% by 2030.[20] Taking that into account, battery demand for EVs alone would likely surpass 55GWh by 2030.

Next, we calculate the demand for critical raw materials (in pure form) for carmakers in Czechia. We use the chemistry stated by researchers per OEM and model (NMC 721 for Škoda and VW and NMC 622 for Hyundai)[21] and the specific material demand of different cathode materials to calculate the demand for Lithium, Nickl, Manganese and Cobalt.[22] In our 2030 scenario, we assume a 25% share of LFP batteries in the Czech car production, which is generally consistent with other studies, which model an LFP market share of 20-35% in Europe by 2030.[23] We do not account for other chemistries in our estimate.

[17] Škoda, Škoda Auto produces one millionth battery system for Volkswagen Group vehicles, 4 December 2024. https://www.skoda-storyboard.com/en/press-releases/skoda-auto-produces-one-millionth-battery-system-for-volkswagen-group-vehicles/
[18] Autovista24, How many EV batteries were produced globally in 2024?, 31 March 2025. https://autovista24.autovistagroup.com/news/how-many-ev-batteries-were-produced-globally-in-2024/
[19] Autota, Czechia's BESS set for growth, 10 October 2025. https://auroraer.com/company/press-room/czechias-bess-set-for-growth-aurora-forecasts-5-year-payback-and-15-irr-for-2026-assets
[20] Shafique M., et al. Global material flow analysis of end-of-life of lithium nickel manganese cobalt oxide batteries from battery electric vehicles. 2023 https://pmc.ncbi.nlm.nih.gov/articles/PMC9972231/; Eyal, L., et al. Electrifying road transport with less mining, ICCT, December 2024. https://theicct.org/wp-content/uploads/2024/12/ID-206-–-Battery-outlook_report_final.pdf
[21] Cobalt Institute. Cobalt Conference, Zurich Switzerland, 17-18 May, 2022. https://www.cobaltinstitute.org/wp-content/uploads/2022/05/Cobalt-Conference_Presentations-Day-1.pdf; Sevdari, K., et al. Overview of EV battery types and degradation measurement for Renault Zoe NMC batteries. IEEE. 2024. https://doi.org/10.1109/REST59987.2024.10645453
[22] Maisel, F., et al. A forecast on future raw material demand and recycling potential of lithium-ion batteries in electric vehicles. Resources, Conservation and Recycling, 2023. https://doi.org/10.1016/j.resconrec.2023.106920.
[23] Eyal, L., et al. Electrifying road transport with less mining A global and regional battery material outlook, ICCT, December 2024. https://theicct.org/wp-content/uploads/2024/12/ID-206-–-Battery-outlook_report_final.pdf; Di Vincenzo, J., et. al. Localised battery value chains in Europe – How strong is the announced political support?, P3 Group, 2024. https://www.p3-group.com/wp-content/uploads/2024/06/P3-Whitepaper-Battery-Value-Chains-Europe.pdf

Fig.9 Estimated demand for Li-ion batteries and CRMs for Czech car manufacturing



Source: Own calculation based on Škoda/Hyundai Annual reports 2024, 2023, 2022 and press releases.

Based on our model, demand for all four CRMs grew by around 50-60% in 2022-2024, reaching 11.5kt (Ni), 3.2kt (Mn), 1.8kt (Co) and 1.9kt (Li) in 2024. Please note that battery-assembly data is not available for 2025 and 2030, so the amounts are not comparable with previous years. In 2025-2030, demand for CRMs is estimated to double while total Li-ion capacity demand will triple. This shows that even a 25% share of LFP batteries in the mix could substantially reduce CRM needs. In this scenario, in 2030, direct demand for CRMs will reach 19.4kt (Ni), 5.7kt (Mn), 4.5kt (Co) and 4.5kt (Li). However, if Czech-based OEMs continue to produce battery modules for export, it could be up to twice as high.

For comparison, the Cinovec project is projected to produce 26kt of lithium carbonate annually (4.9kt of pure lithium),[24] which would cover the lithium needs of Czech car manufacturing in our projected 2030 scenario. The Chvaletice manganese project aims to produce around 50kt of manganese a year.[25]

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[24] Cyrani, P. Cinovec lithium extraction and processing project, ČEZ, 12 September 2022. https://mpo.gov.cz/assets/cz/stavebnictvi-a-suroviny/surovinova-politika/vyzvy-seminare-a-informace-ze-sveta-nerostnych-surovin/2022/9/06-Pavel-Cyrani-CEZ.pdf

[25] Euro Manganese Inc. The Chvaletice Manganese Project, February 2022. https://ekonomickydenik.cz/nejdriv-lithium-ted-mangan-zasoby-kovu-v-polabi-maji-byt-loziskem-strategickeho-vyznamu/

4. Automotive sector as a driver for decarbonisation

With close to 250 million cars in the EU and 285 million motor total in 2023,[26] road transport accounts for the majority of transport emissions, or about 20% of EU total.[27] Despite growing demand for road transport,[28] exhaust emissions are expected to fall thanks to improved energy efficiency and electrification of the fleet. Compared with ICE vehicles, BEVs eliminate all exhaust emissions, while PHEVs eliminate emissions during their electric driving phase. The carbon footprint of EVs therefore depends on the electricity mix in the country they are operated in and the energy mix used in the production of the main materials and components.

For Czechia, BEVs are estimated to reduce emissions by 46% compared to petrol equivalents and 39% compared to diesel if the same car model in different powertrain is used (assuming the 2019 electricity mix to power the EV).[29] This includes full life cycle emissions from the production, operation and disposal of the vehicle. The production of BEVs is 40-70% more emission-intensive compared to ICEs depending mostly on the battery size, but after around 32,000 km of operation, a BEV is already on par with an ICE and has a lower overall carbon footprint thereafter. This is thanks to the fact that energy conversion even in fossil-powered electricity plants is more efficient than an internal combustion engine. So even in countries with a higher share of fossil-powered electricity, like Poland,[30] a BEV would still have lower total emissions after around 48,000 km of operation.

Beyond this point, emissions can be reduced by introducing more low-carbon electricity sources for charging and by sourcing less carbon-intensive materials. With EVs set to overtake and eventually replace ICEs while countries introduce more renewable and low-carbon electricity sources, the focus of discussions is increasingly shifting from exhaust emissions towards full environmental impacts of the vehicle throughout its life cycle. With 11.4 million cars produced in the EU in 2024 (about 15% of global production),[31] the EU automotive sector's demand is key for many energy-intensive and critical raw materials (CRMs). The speed of electrification also impacts demand as companies switch aluminium to offset the battery weight and require more copper for electric wiring or CRMs used in batteries.

4.1. Aluminium – production and supply

In 2023, 3.35Mt of aluminium were used by the European automotive sector,[32] which is around 25% of the total 13.2Mt aluminium demand in the EU.[33] Around 54% of the demand today is met by imports into

[26] European Automobile Manufacturers' Association, Report – Vehicles on European roads 2025, 29 January 2025. https://www.acea.auto/publication/report-vehicles-on-european-roads-2025/.
[27] Hannah Ritchie, Cars, Planes, Trains: Where Do CO_2 Emissions from Transport Come From?, Our World in Data, October 2020. https://ourworldindata.org/co2-emissions-from-transport.
[28] EEA, Road Transport, Modified 11 October 2024. https://www.eea.europa.eu/en/topics/in-depth/road-transport
[29] Jaššo, K., et al. Ecological impact of vehicles: A comparative study within the Czech Republic and other Visegrad 4 countries. Renewable and Sustainable Energy Reviews, 2025, https://doi.org/10.1016/j.rser.2024.115059.
[30] In 2019, the share of coal-powered electricity generation reached 74%, gas accounted for 9%. Wysokenapiece.pl, Electricity production in Poland lowest in a decade. The smallest share of coal in history, 31 January 2020, https://wysokienapiecie.pl/en/26023-electricity-production-lowest-decade-smallest-share-coal-history/.
[31] ACEA. Economic and Market Report: Global and EU Automotive Industry – Full Year 2024. March 2025. https://www.acea.auto/files/Economic_and_Market_Report-Full_year_2024-rev.pdf.
[32] Fastmarkets. European Automotive Aluminium Demand Set to Slow – Fastmarkets Analysts. Fastmarkets Insights. https://www.fastmarkets.com/insights/european-automotive-aluminium-demand-set-to-slow-fastmarkets-analysts/.
[33] Metal Packaging Europe et al. Joint Call for Aluminium Value Chain Action on the SMAP. October 2025. https://www.metalpackagingeurope.org/wp-content/uploads/2025/10/Joint-call-for-aluminium-value-chain-action-on-the-SMAP.pdf.

the EU, while recycling accounts for 39%, primary aluminium production in the EU has steadily declined over the past two decades from 3Mt in 2008 to less than 1Mt in 2023, accounting for the remaining 15%.[34] The biggest importers of unwrought aluminium to the EU are Norway and Iceland with 1.4Mt and 0.8Mt of imports in 2023, while China and Turkey supply more processed products.[35] There are only 20 primary aluminium smelters in Europe today (9 of those in the EU), there are about 220 aluminium recycling plants, most of which are small and medium-sized companies (SMEs).[36]

An average vehicle today contains about 230kg of aluminium, which is projected to grow to around 256kg by 2030, with BEVs using up to 281kg on average.[37] Today, aluminium is responsible for around 20-30% of embedded emissions of an ICE and around 10-20% for a BEV.[38] However, the relative contribution of aluminium on the overall vehicle footprint is expected to grow as much of the demand is still covered by emission-intensive primary production. Secondary cast alloys are used for engine blocks and pistons, while frames, bumpers and closures use pure alloys made mostly from primary aluminium.[39]

Aluminium production is a highly energy-intensive process and its carbon footprint largely depends on the energy mix used to produce it. While Chinese coal-powered production generates up to 20t CO2 per tonne of aluminium,[40] some European producers are able to get below 4t CO2 using mostly hydro-power.[41] The average carbon footprint of primary aluminium production in Europe is 6.6t CO2 compared with imported aluminium with a carbon footprint of 13.2t CO2.[42] The carbon footprint of imported aluminium has increased in recent years as import flows are shifting away from Russia, which relied on hydro-power, to regions with more carbon-intensive energy sources in Asia and the Middle East.

In comparison, recycled aluminium has a carbon footprint of just 0.5t CO2 per tonne of aluminium, but is dependent on the availability of aluminium scrap.[43] Producers and the metal packaging association are therefore calling for trade measures to restrict the export of scrap by means of export fees or duties and ensure its sufficient availability. However, the recycling industry is arguing that 75-80% of recycled

[34] European Aluminium. Aluminium Industry. Accessed 10 October 2025. https://european-aluminium.eu/about-aluminium/aluminium-industry/.

[35] World Bank. World Integrated Trade Solution (WITS): EU Imports of HS 76 (Aluminium) and subcodes, 2023. https://wits.worldbank.org/trade/comtrade/en/country/EUN/year/2023/tradeflow/Imports/partner/ALL/product/76.

[36] European Aluminium. Net Zero by 2050: Science-Based Decarbonisation Pathways for the European Aluminium Industry. November 2023. https://european-aluminium.eu/wp-content/uploads/2023/11/23-11-14-Net-Zero-by-2050-Science-based-Decarbonisation-Pathways-for-the-European-Aluminium-Industry_FULL-REPORT.pdf.

[37] Ducker Research & Consulting, Aluminum Content in Cars: Assessment 2022 and Outlook 2026, 2030 – Public Summary, April 2023. https://european-aluminium.eu/wp-content/uploads/2023/05/23-05-02Aluminum-Content-in-Cars_Public-Summary.pdf

[38] McKinsey & Company, The race to decarbonize electric-vehicle batteries, 7 February 2023. https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/the-race-to-decarbonize-electric-vehicle-batteries

[39] Peng, T., et. al. Life-Cycle Energy Consumption and Greenhouse Gas Emissions Analysis of Primary and Recycled Aluminum in China. Energy Procedia 158, 2019. https://doi.org/10.1016/j.resconrec.2023.107370

[40] Alupro UK. Carbon Footprint Fact Sheets. https://alupro.org.uk/sustainability/fact-sheets/carbon-footprint/

[41] Hydro. Recycled aluminium helps reduce the carbon footprint of electric vehicles. 19 March 2024. https://www.hydro.com/us/global/about-hydro/stories-by-hydro/recycled-aluminum-helps-reduce-the-carbon-footprint-of-electric-vehicles/ hydro.com

[42] European Aluminium. Environmental Profile Report 2024, July 2025. https://european-aluminium.eu/wp-content/uploads/2025/07/Environmental-Profile-Report_2024-V20.pdf

[43] Metal Packaging Europe. Joint Call for Aluminium Value Chain Action on the SMAP. October 2025. https://www.metalpackagingeurope.org/wp-content/uploads/2025/10/Joint-call-for-aluminium-value-chain-action-on-the-SMAP.pdf

aluminium is already processed in the EU and the sector is at its capacity, while net exports of scrap from the EU only reached around 0.6-0.7Mt in 2023-2024.[44]

There are no primary aluminium production plants in Czechia, but there are several smaller companies in the sector, at least 7 recycling plants, 2 extrusion plants and 1 rolling plant.[45] Czechia therefore depends on aluminium imports for further processing and use. In 2024, Czechia imported 900kt of aluminium and aluminium products, while exporting 490kt, with more than 90% of both trade flows being EU-internal.[46] The domestic consumption surpassed 410kt, of which an estimated 260kt is consumed by the Czech automotive sector (as calculated in the previous chapter). Between 2020-2024, net import of aluminium and its products grew by 80kt, driven mainly by an uptick in unwrought aluminium (+50kt) and aluminium plates and sheets (+60kt) while a few other categories of products went down slightly, which corresponds to an uptick in demand we would expect based on our estimates in the previous chapter.

The recycling rate of aluminium in the European automotive sector today is around 90-95%.[47] However, a large part of this includes aluminium, which is downcycled to a lower standard and cannot be re-used in high-quality applications, including cars. As much as 40% of the coils purchased by automakers end up as production scrap (i.e. offcuts or pre-consumer scrap), which is mixed with other types scrap instead of being recycled to same-grade quality, resulting in a loss of value.[48] Post-consumer scrap from end-of-life vehicles can also be re-used in high quality applications, but the vehicles are often shredded instead of dismantled, resulting again in low-quality mixed scrap. These factors, along with growing demand for aluminium in general, increases demand for primary aluminium with a higher carbon footprint.

Mega-casting also allows manufacturers to bring down not only production costs, but also emissions, mainly from using lower-carbon aluminium alloys.[49] According to estimates by Volvo, this could reduce CO2 emissions by 35%.[50] Other emission reduction is also possible thanks to the reduced need for welding the individual parts together.

To reduce the carbon footprint of aluminium in cars, it is crucial to maximise its recycling potential from both production and end-of-life vehicles (ELVs) and avoid contamination, which degrades the quality of scrap. This can be achieved by separating specific auto sheet alloys during scrap collection in partnerships between automakers and recyclers, such as in the case of Ford and Novelis.[51] This is a cost-effective, because it maintains the high-value of automotive aluminium.

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[44] EURIC. Aluminium scrap export restrictions won't solve the trade and energy concerns underpinning the crisis faced by EU aluminium producers. Press release, 24 June 2025. https://euric.org/resource-hub/press-releases-statements/aluminium-scrap-export-restrictions-wont-solve-the-trade-and-energy-concerns-underpinning-the-crisis-faced-by-eu-aluminium-producers

[45] European Aluminium. A Strong, Sustainable & Complete European Value Chain. https://european-aluminium.eu/about-aluminium/aluminium-industry/

[46] Own calculation based on: Eurostat Comext, HS76 and subchapters.

[47] European Aluminium. "Enabling the Circular Economy with Aluminium." November 7, 2022. https://european-aluminium.eu/blog/enabling-the-circular-economy-with-aluminium/.

[48] Novelis. Recycled Content Whitepaper. May 2023. https://novelis.com/wp-content/uploads/2023/05/Novelis-Recycled-Content-Whitepaper.pdf.

[49] Bühler Group. Bühler unveils its megacasting solution Carat 840 to customers for the first time in Europe. June 13, 2023. https://www.buhlergroup.com/global/en/media/media-releases/buehler_unveils_itsmegacastingsolutioncarat840tocustomersforthef.htm

[50] European Aluminium, Enabling the Circular Economy with Aluminium, November 7, 2022. https://www.duckercarlisle.com/wp-content/uploads/2022/11/Mega-Casting-Whitepaper-May-2022-1.pdf

[51] Novelis. Recycled Content Whitepaper. May 2023. https://novelis.com/wp-content/uploads/2023/05/Novelis-Recycled-Content-Whitepaper.pdf.

The ELVR is crucial in setting out the requirements for circular design of vehicles, including the mandatory dismantling of certain parts and components before shredding. According to the European Aluminium association, aluminium scrap would ideally be classified into 10 categories based mainly on impurities to allow effective sorting and re-cycling of ELV material, but at the least, they suggest the division into cast and wrought alloys.[52] The deployment of new technologies may also help with post-shredding sorting.

To meet the growing demand for aluminium, primary production with lower carbon intensity should be incentivized. The Carbon Border Adjustment Mechanism (CBAM), which is set to start in January 2026, should be the main tool to create a level-playing field for producers in Europe and elsewhere with very different carbon intensities. However, there is a risk of circumvention given that some categories of semi-finished or finished aluminium products are not included in its scope.[53]

4.2. Steel – production and supply

In 2024, the EU steel industry produced around 130Mt of steel,[54] Around 27Mt were imported from outside the EU (mainly from Turkey, South Korea, India, Vietnam, Taiwan and China), while EU exports were close to 17Mt. The car industry accounted for 20% of the demand for steel (26Mt per year), second only to the construction sector (53Mt). An average car in the EU is estimated to contain about 800kg of steel,[55] which results in about 25-35% of an ICEs embedded emissions and 15-20% for BEVs.[56] For Czechia, the average steel content tends to be higher (around 920kg in 2024) given the overall higher weight of cars produced in the country.

Steel is currently produced through two main routes. The traditional blast furnace-basic oxygen furnace (BF-BOF) process reduces iron ore into iron using coal and oxygen, which is converted into steel. This process is highly carbon-intensive and can only use a limited share of steel scrap. The alternative electric arc furnace (EAF) route melts scrap using electricity and can, in principle, run almost entirely on recycled steel (up to 60% for high-grade steel).[57] A third option, hydrogen-based direct reduced iron (H2-DRI), reduces iron ore using hydrogen (instead of natural gas or coal), which is then melted in an EAF. If powered by low-carbon electricity, the H2-DRI-EAF route can cut emissions sharply and allows higher scrap use. Some DRI plants today already use a mix of natural gas and hydrogen,[58] but fully hydrogen-powered plants

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[52] European Aluminium. Position paper on ELVD revision. 30 November 2023. https://european-aluminium.eu/wp-content/uploads/2023/12/2023-11-30-European-Aluminium-position-paper-on-ELVD-revision-rev4.pdf

[53] European Aluminium. Assessment of European CBAM Regulation – Executive Summary. May 2022. https://european-aluminium.eu/wp-content/uploads/2022/10/22-05-31-cru_assessment-of-european-cbam-regulation_executive-summary.pdf

[54] European Steel Association (EUROFER). European Steel in Figures 2025. 23 June 2025. https://www.eurofer.eu/assets/publications/brochures-booklets-and-factsheets/european-steel-in-figures-2025/European-Steel-in-Figures-2025_23062025.pdf

[55] International Council on Clean Transportation. Improving automotive steel recycling for a circular economy. March 2025. https://theicct.org/publication/improving-automotive-steel-recycling-for-a-circular-economy-mar25/

[56] McKinsey & Company, The race to decarbonize electric-vehicle batteries, 7 February 2023. https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/the-race-to-decarbonize-electric-vehicle-batteries

[57] Nucor, 2022 Recycled Content Averages for Nucor Steel Mill Products 2022. March 2023. https://assets.ctfassets.net/aax1cfbwhqog/7Ma2avTxQFdBEwFCITrHkC/cf43e0dc63ce91831b842a0e0f8c2fab/Recycled_Content_Letter_Mill_Products_RY2022.pdf

[58] Danieli & C. HBIS producing DRI using more than 60% hydrogen. 1 June 2023. https://www.danieli.com/en/news-media/news/hbis-producing-dri-using-more-60-hydrogen_37_818.htm

at a larger scale are still yet to be deployed. Stegra, the European frontrunner in H2-DRI, plans to produce 7Mt of steel per year at full production capacity.[59]

The average EU emission intensity of BF-BOF process is 2.08t CO2 per tonne of steel, compared with 1.85t for fully gas-powered DRI-EAF route, H2-DRI-EAF would produce a tonne of steel with less than 0.1t CO2, and an EAF using scrap would result in 0.7t CO2.[60] In the EU, 44% of the total steel production is made in EAFs, but only 6% of scrap-based EAF route is used for the production of new cars.[61] Most steel suppliers of European carmakers have a similar average emission intensity of between 2-2.2t CO2, including the biggest European steel producers ArcelorMittal and Thyssenkrupp.[62] Czech-based OEMs also source many materials locally. Hyundai is also known for importing components from Korea to supply its factories, which is clear from Fig.4 on the import of car parts. The vertically integrated company sources much of its steel from Hyundai Steel, which operates a large fleet of EAFs, resulting in only 1.35t CO2.[63] However, this alone does not guarantee that their cars produced in Europe are made with scrap-based steel.

While the availability of steel scrap exceeds the needs of the automotive sector, its use is limited due to strict requirements for low level of impurities. In particular, automotive-grade steel requires a residual copper content of less than 0.15%, whereas the average steel scrap copper content is around 0.4%.[64] And instead of re-cycling steel in a closed-loop system, the typical sorting and processing methods lead to downcycling steel, where scrap is added to primary steel production.

Deep-dismantling end-of-life vehicles before shredding can reduce copper content in scrap steel to 0.09% and below the threshold for automotive-grade flat steel products.[65] As part of a large-scale trial on 300 ELVs to assess the cost-effectiveness of the method, manual dismantling resulted in an extra 1.6kg of copper wires per vehicle removed in 7 minutes where the extra labour costs (in France, where the study took place) were fully offset by the sale of higher-quality scrap steel and the additional copper recovered. According to the study, copper content could theoretically be reduced down to 0.04% using post-shredder removal technologies. However, all steel scrap is currently classified using the European steel scrap standard E40, which has a copper-content threshold of 0.25%, but which is often surpassed in practice, so creating a new market for high-quality steel scrap will require introducing a new technical standard E40+ with a lower copper-content.

Aside from dismantling, advanced automation in waste processing is also emerging as a promising solution. This is the approach used by Germany’s TSR Recycling, which has developed a new type of scrap, TSR40, at its Duisburg facility. TSR40 is a highly homogeneous material with very low copper content

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[59] Stegra, Homepage. Accessed 20 October 2025. https://stegra.com/
[60] International Council on Clean Transportation (ICCT). Green Steel Supply. September 2024. https://theicct.org/wp-content/uploads/2024/09/ICCT-Green-Steel-Supply.pdf
[61] Transport & Environment. Green steel in cars briefing July 2024. July 2024. https://www.transportenvironment.org/uploads/files/Green-steel-in-cars-briefing_July-2024.docx.pdf
[62] International Council on Clean Transportation (ICCT). Green steel for automakers US Europe. September 2024. https://theicct.org/publication/green-steel-automakers-us-europe-sep-24/
[63] Greenpeace. Auto steel report 2023 – Greenpeace. 2023. https://www.greenpeace.org/static/planet4-eastasia-stateless/2023/05/e45b70a3-auto_steel_report_2023_-greenpeace.pdf
[64] European Commission – Circular Economy Platform. Car to car Steel final report. March 2025. https://circulareconomy.europa.eu/platform/sites/default/files/2025-03/IMT_Car-to-car_Steel_final.pdf
[65] Institut Mobilités en Transition. Car to car Steel. 2025. https://institut-mobilites-en-transition.org/en/publications/car-to-car-steel/

(below 0.1%), reduced levels of other contaminants and could be used for setting the E40+ standard. Through modern sorting, shredding, and optical separation, TSR greatly reduces variations in composition and particle size, thereby preventing problems in subsequent metallurgical processing.[66]

TSR Recycling has also established close partnerships with metallurgical and automotive companies such as the Voestalpine and Mercedes-Benz,[67] while Volkswagen has partnered up with the steel producer GMH Group.[68] These partnerships allow material to flow back within the same region: scrap from production is returned to the smelters, where it is processed into high-quality steel which is reused in the production of new cars. This closed-loop model is an example of technical and logistical synergies that can contribute to emission reduction and material self-sufficiency.

Furthermore, modern cars have much more electronics compared to their predecessors, so the average copper content has nearly tripled over the past 20 years. New internal combustion vehicles now contain around 20 kg of copper, while electric vehicles can contain up to 80 kg. At the same time, the quality of primary copper sources is declining as less profitable deposits are being mined. IEA projects a potential 30% shortfall of copper by 2035 due to rising costs of primary sourcing.[69] This creates growing pressure not only on the value of high-quality copper, but also on the need to retain as much copper as possible within the circular economy, both in quantity and quality.

Creating a market for green steel will not only require a sufficient supply of high-quality scrap steel, but also demand. With relatively high value of cars compared to the cost of materials, the 'green premium' for vehicles produced using green steel could be as low as 1% of the retail price.[70] Introducing limited green steel content requirements (i.e. 20-30%) could help create a functioning market for decarbonised steel, which in turn would incentivize steel producers to switch to EAF routes. However, there is currently no commonly agreed definition of green steel which would provide a uniform standard and incentivize the rollout of low-carbon steel. There are already some, such as the low-emission steel standard (LESS), but they are not universally accepted and different steelmakers continue to use different standards.[71]

Meanwhile, some car producers in Europe have adopted voluntary recycled steel targets, signalling to steelmakers their demand for green steel, including Volvo which aims at 25% of recycled steel by 2025, BMW at 50% by 2030, with Mercedes-Benz and BMW also signing agreements with H2 Green Steel to establish a steel scrap supply chain.[72] Volkswagen Group will source lower-carbon steel from German steelmaker Salzgitter, who is planning to gradually cut emissions by more than 95% by 2033.[73] The

[66] TSR Recycling GmbH & Co. KG. TSR40 Product Overview. https://www.tsr.eu/en/products/tsr40/

[67] Voestalpine. Voestalpine, Mercedes-Benz and TSR launch showcase project in circular economy. 14 May 2024. https://www.voestalpine.com/group/en/media/press-releases/2024-05-14-voestalpine-mercedes-benz-and-tsr-launch-showcase-project-in-circular-economy/

[68] Prognos. Sustainable end-of-life vehicle recycling. https://www.prognos.com/en/project/sustainable-end-life-vehicle-recycling

[69] International Energy Agency (IEA). World Energy Outlook 2025. https://iea.blob.core.windows.net/assets/1438d3a5-65ca-4a8a-9a41-48b14f2ca7ea/WorldEnergyOutlook2025.pdf

[70] Energy Transitions Commission. Steel Demand Report. July 2021. https://www.energy-transitions.org/wp-content/uploads/2021/07/2021-ETC-Steel-demand-Report-Final.pdf

[71] Low Emission Steel Standard (LESS). Homepage. Accessed 20 October 2025. https://lowemissionsteelstandard.org/

[72] Ricardo Energy & Environment. The use of Green Steel in the Automotive Industry.8 April 2024. https://www.transportenvironment.org/uploads/files/ED18758-TE-Final-report_To-PUBLISH.pdf

[73] Autovista 24. VW inks green steel deal as it focuses on sustainable supply chains. 23 March 2022. https://autovista24.autovistagroup.com/news/vw-inks-green-steel-deal-as-it-focuses-on-sustainable-supply-chains/

agreement also includes establishing a closed-loop recycling system for steel at VW Group's main plant in Wolfsburg. Stellantis and recycler Galloo also announced an end-of-life recycling program, aiming at 40% green materials in new vehicles by 2030 and net zero by 2038.[74] But overall, the announced agreements will only account for 9% of the total automotive steel demand in 2030.[75] Plus, many of the planned steel decarbonisation projects have been put on hold or postponed so it remains uncertain whether these commitments are credible.[76]

This is also the case for the currently only operational Czech steel producer, Třinecké Železárny, who recently put on hold their 1 bn € investment plan to replace one of their two BF-BOFs with an EAF, citing lack of financial support from the government compared to other European steelmakers. Their annual production has been stable between 2021-2024 at 2.4Mt of steel per year, which resulted in the 2.6Mt of CO2 emissions.[77] Around one third of their production is used by the automotive sector.[78] The second major Czech steelmaker, Liberty Ostrava, went bankrupt in 2024 and only recently finalised its ownership transition and restarted operations, but it remains unclear whether the new owner intends to also restart primary steel production.[79]

With Czech steel production at an all-time-low in 2024, net imports of steel reached 3.6 Mt of steel, whereas total demand reached 5.5Mt,[80] of which an estimated 1.4Mt were used by car manufacturers. Meanwhile, net exports of steel scrap grew considerably in the last decade, from less than 1.3Mt in 2016 to more than 2.3Mt in 2024.[81] Currently, Czech steel production already uses up to 30% of scrap steel in the BF-BOF production route,[82] which amounts to 0.8Mt of scrap annually at current production rates. However, the availability of scrap is expected to worsen as historical stock of steel scrap are gradually depleted and steel products extend their service life.[83]

To sustain future EAF production, Czechia may need to consider options to keep steel scrap in the country as steelmakers switch to EAF production and the commodity becomes more valuable. However, while historic stock of steel scrap may feed into the production of lower-grade steel, higher-grade automotive steel will require creating closed-loop systems of scrap collection and recycling between carmakers, ELV processors and steel producers.

[74] Stellantis. Stellantis and Galloo to form joint venture for end-of-life vehicle recycling. June 2023. https://www.stellantis.com/en/news/press-releases/2023/june/stellantis-and-galloo-to-form-joint-venture-for-end-of-life-vehicle-recycling

[75] Ricardo Energy & Environment. The use of Green Steel in the Automotive Industry.8 April 2024. https://www.transportenvironment.org/uploads/files/ED18758-TE-Final-report_To-PUBLISH.pdf

[76] GMK Center. Major pause in EU steel industry decarbonization projects. 8 October 2025. https://gmk.center/en/posts/major-pause-in-eu-steel-industry-decarbonization-projects/

[77] Třinecké Železárny. Konsolidovaná výroční zpráva 2024. https://www.trz.cz/assets/uploads/vyrocky/TZ_CZ_VZ2024.pdf

[78] Forbes Česko. Automotive padá ale i tak budeme v zisku říká šéf chřenkových železáren. 30 January 2025. https://forbes.cz/automotive-pada-ale-i-tak-budeme-v-zisku-rika-sef-chrenkovych-zelezaren/

[79] Hospodářské noviny, Pecinovy firmy mohou převzít Liberty Ostrava. 17 September 2025. https://archiv.hn.cz/c1-67788980-pecinovy-firmy-mohou-prevzit-liberty-ostrava

[80] Ocelářská Unie. Statistiky za rok 2024. 6 June 2024. https://www.ocelarskaunie.cz/statistiky-za-1-ctvrtleti-roku-2024/

[81] Own calculation based on Eurostat Comext, HS7204.

[82] Ocelářská Unie. Ze staré haly nové auto – proč ne. 18 September 2019. https://www.ocelarskaunie.cz/ze-stare-haly-nove-auto-proc-ne/

[83] INCIEN. Risk barriers and priorities for maximising the production and consumption of recycled steel. May 2024. https://incien.org/wp-content/uploads/2024/05/INCIEN-Risk-barriers-and-priorities-for-maximising-the-production-and-consumption-of-recycled-steel.pdf

With an estimated capacity of 5-5.5Mt per year,[84] Czechia could become an important regional player in ELV processing. Around 180,000 end-of-life vehicles are scrapped each year in one of the 500+ official ELV processing plants.[85] However, less than 100 of those facilities are operational, oftentimes lacking skilled workers and detailed information on vehicle composition due to insufficient cooperation with automakers that would allow them to maximise the recovery of materials.[86] Furthermore, the average car in Czechia is 16.4 years old (second-oldest in Europe after Greece), but when only counting vehicles, which are regularly used, the average age is between 12.7-13.8 years.[87] This suggests that many older cars in Czechia could be still registered, but are in fact no longer operational. In 2022, the total weight of ELVs in Czechia amounted to 176kt, but 215kt of material were recovered and reused, resulting in a recovery and reuse rate of 117%.[88] Rates above 100% indicate that ELV treatment plants have unused stocks of material to process. With the right processing, this could result in over 150kt of automotive-grade steel scrap.

Like their European counterparts, Czech steel producers face difficulties on domestic, European and global markets. With a 25% import tariffs on steel and aluminium into the US having started in March 2025 and doubled to 50% in June,[89] global steel producers are re-directing their US sales to other markets (including Europe). The introduction of the EU steel quota and tariffs has generally been welcomed by the Czech steelmakers, but their main concerns continue to be high electricity prices and its availability, the end of free allocations under the emission trading system, lack of financing for steel decarbonization projects, sufficient feedstock of scrap steel and the risk of CBAM circumvention, among other things.[90]

4.3. Batteries – production and supply

With continued electrification of the European fleet, the carbon footprint of manufacturing batteries is also increasingly relevant. An electric vehicle (EV) generates about twice as much during the production phase compared with a conventional ICE. With comparable emissions from the vehicle body, a typical EV battery production results in over 7t CO2, or between 40-60% of the BEV's total embedded emissions.[91]

The mining and refining of the critical raw minerals (CRMs) and the production of anode and cathode materials are highly energy-intensive and using renewable energy can significantly improve the batteries' carbon footprint. The sourcing of materials and battery technology also affect its carbon footprint. An NMC-622 battery produced using the EU average energy-mix in 2022 would have a carbon footprint of 78kg CO2/KWh, but only 64kg CO2 in Sweden, 85kg in Germany, 76kg in Hungary and 109kg in Poland,

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[84] Ibid.
[85] Autovraky-MŽP. Přehled autovraků v regionu. https://autovraky.mzp.cz/autovrak/overview/wrecks-in-region
[86] Odpadové fórum. Recyklace autovraků na rozcestí: Příležitost pro průmysl, nebo další alibi pro nečinnost? May 2025. https://www.odpadoveforum.cz/cz/stranka/archiv/rocnik-2025/5-2025/555/
[87] CEBIA. Starší osobních aut provozovaných dosahuje 13,79 let. https://www.cebia.cz/novinky/tiskove-zpravy/stari-osobnich-aut-ktera-jsou-provozovana-dosahuje-13-79-let
[88] Eurostat. End-of-life vehicle statistics. Data extracted in November 2024. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=End-of-life_vehicle_statistics
[89] Euractiv. EU to hike steel duties to 50% in push for US tariff concessions. 8 October 2025. https://www.euractiv.com/news/eu-to-hike-steel-duties-to-50-in-push-for-us-tariff-concessions/
[90] Ocelářská Unie. Otevřený dopis budoucí vládě České republiky – akční plán pro české ocelářství. 17 September 2025. https://www.ocelarskaunie.cz/otevreny-dopis-budouci-vlade-ceske-republiky-akcni-plan-pro-ceske-ocelarstvi
[91] McKinsey & Company, The race to decarbonize electric-vehicle batteries, 7 February 2023. https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/the-race-to-decarbonize-electric-vehicle-batteries

and 105kg CO2 if made in China.[92] However, Poland is switching away from coal-powered electricity very fast (from 70% share in 2022 to 54% in 2024), so its carbon intensity today would be somewhat lower.[93]

China dominates EV and EV battery supply chains with over 75% in global battery production and 70% of global EV production.[94] It is also the single largest importer of batteries to Czechia as shown in Fig.4. Poland is the biggest battery cell producer in Europe, accounting for 125GWh of capacity or about 60% of EV battery production in 2023, ahead of Hungary (37.5GWh) and Germany (23.4GWh).[95] All three countries are also major suppliers for the Czech automotive sector. According to available information, Hyundai sources its batteries from LG Energy Solutions in Poland,[96] while Škoda, aside from LG also uses batteries from the Chinese battery giant CATL.[97]

EU gigafactories currently have a combined capacity of 300GWh, which is set to grow to 0.8 to 1.1TWh in 2030.[98] CATL, the biggest producer of batteries globally, is set to start manufacturing at its new 100GWh factory in Hungary from 2026.[99]

While battery production plants are being built across the region, similar projects by Volkswagen or Samsung in Czechia have either been scrapped or at least postponed citing lower EV adoption rates.[100] Despite a limited supply of end-of-life batteries and no production waste as feedstock, there are several ongoing projects on developing battery recycling in Czechia.[101] Currently, many end-of-life lithium batteries are exported to recycling facilities in Poland, Germany or Belgium.[102] Previously, many end-of-life batteries in Europe were shredded and exported as 'black mass' for recycling, largely to Asia. But in March 2025, the European Commission update its List of waste codes in line with the Waste Shipment Regulation, classifying 'black mass' as a hazardous waste, which should help retain more of critical raw

[92] Transport & Environment. Battery carbon footprint position paper. April 2023. https://www.transportenvironment.org/uploads/files/2023_04_Battery_carbon_footprint_position_paper-1.pdf

[93] Ember. Poland – Country and regions overview. Last Updated: 10 Apr 2025. https://ember-energy.org/countries-and-regions/poland/

[94] International Energy Agency (IEA). The battery industry has entered a new phase. 5 March 2025. https://www.iea.org/commentaries/the-battery-industry-has-entered-a-new-phase
International Energy Agency (IEA). Global EV Outlook 2025 – Trends in the electric car industry. 14 May 2025. https://www.iea.org/reports/global-ev-outlook-2025/trends-in-the-electric-car-industry-3

[95] Strategic Perspectives. Poland – Strategic cleantech hub for Europe. December 2024.https://strategicperspectives.eu/wp-content/uploads/2024/12/StrategicPerpectives-Poland-strategic-cleantech-hub-for-Europe-1.pdf

[96] Zdopravy.cz. Hyundai spustil výrobu nové Kony Electric, na vývoji se podíleli i nošovičtí inženýři.11 August 2023. https://zdopravy.cz/hyundai-spustil-vyrobu-nove-kony-electric-na-vyvoji-se-podileli-i-nosovicti-inzenyri-171261/;

[97] VTM Živě. Škoda má novou továrnu na baterie pro Enyaq, Volkswagen uvažuje, že v Česku postaví gigafactory na bateriové moduly. 21 May 2022. https://vtm.zive.cz/clanky/skoda-ma-novou-tovarnu-na-baterie-pro-enyaq-volkswagen-uvazuje-ze-v-cesku-postavi-gigafactory-na-bateriove-moduly/sc-870-a-216515/default.aspx

[98] ElectricDrives.tv. Europe now has 30 EV battery gigafactories in operation. 22 July 2025. https://electricdrives.tv/europe-now-has-30-ev-battery-gigafactories-in-operation/; Fraunhofer ISI. Forecasting the ramp-up of battery cell production in Europe: A risk assessment model. 28 April 2025. https://www.isi.fraunhofer.de/en/blog/themen/batterie-update/batterie-zell-produktion-europa-hochlauf-risiko-bewertung-gescheiterte-projekte.html

[99] Reuters. Chinese battery maker CATL expects Hungarian production start by early 2026. 7 September 2025. https://www.reuters.com/business/autos-transportation/chinese-battery-maker-catl-expects-hungarian-production-start-by-early-2026-2025-09-07/

[100] Euractiv. Volkswagen rejects Czech gigafactory location citing low demand for EV batteries. 2 November 2023. https://www.euractiv.com/section/politics/news/volkswagen-rejects-czech-gigafactory-location-citing-low-demand-for-ev-batteries/; Novinky.cz. Samsung stavbu gigafactory v Česku odložil. 20 March 2025. https://www.novinky.cz/clanek/ekonomika-samsung-stavbu-gigafactory-v-cesku-odlozil-40513907

[101] Dekonta. Recyklace lithiových baterií. Accessed 20 October 2025. https://www.dekonta.cz/cs/recyklace-lithiovych-baterii/

[102] Ekolist.cz. Asociace pro akumulaci energie: současný stav sběru a recyklace baterií v ČR – chybí tu velkokapacitní zařízení.17 June 2025. https://ekolist.cz/cz/publicistika/nazory-a-komentare/asociace-pro-akumulaci-energie-soucasny-stav-sberu-a-recyklace-baterii-v-cr.chybi-tu-velkokapacitni-zarizeni

materials within Europe.[103] This will reduce the EU's dependence on mining for primary sources of CRMs, but cannot substitute primary production given the growing demand for critical minerals.

According to IEA estimates, supply of most nickel, cobalt, graphite and rare earths is expected to catch up with projected demand growth, but there may be a shortfall of lithium driven by rapid demand growth.[104] In the Critical Raw Materials Act (CRMA), the EU set out ambitious targets by 2030 of at least 10% domestic mining, 40% processing and 25% recycling to cover its CRM demand, while supply for any CRM from a single should be no more than 65%. At the same time, the Net-Zero Industry Act (NZIA) sets a target of 40% domestic manufacturing in clean technologies (including batteries) to meet its deployment needs.

The Commission also designated 47 strategic projects in the EU for the mining, processing and recycling of CRMs under the Critical Raw Materials Act (CRMA) and 13 projects outside the EU.[105] This, however, caused significant opposition in some countries, like the proposed lithium mining site in Serbia.[106] Two of these strategic projects are located in Czechia – the manganese extraction project in Chvaletice and the lithium mining in Cínovec. But despite growing demand for lithium, the uncertainty over its price on global markets is making it difficult to assess whether the project will be economically viable in the long-run, with mining only expected to start in 2028.[107]

[103] European Commission. Battery-related waste codes update set to boost circular economy. 5 March 2025. https://environment.ec.europa.eu/news/battery-related-waste-codes-update-set-boost-circular-economy-2025-03-05_en
[104] International Energy Agency (IEA). World Energy Outlook 2025. https://iea.blob.core.windows.net/assets/1438d3a5-65ca-4a8a-9a41-48b14f2ca7ea/WorldEnergyOutlook2025.pdf
[105] European Commission, IP_25_864, 25 March 2025. https://ec.europa.eu/commission/presscorner/detail/en/ip_25_864; European Commission, IP_25_1419. 4 June 2025. https://ec.europa.eu/commission/presscorner/detail/en/ip_25_1419
[106] Mašina.rs. The EU's strategic mistake. 21 October 2025. https://www.masina.rs/eng/the-eus-strategic-mistake/
[107] Newstream.cz. Bílé zlato ztrácí lesk – vyplatí se kutat lithium pod Cínovcem? 25 January 2024. https://www.newstream.cz/trhy/bile-zlato-ztraci-lesk-vyplati-se-kutat-lithium-pod-cinovcem

5. EU and Czech policy context

As outlined in the European Climate Law, the EU aims to achieve climate neutrality by 2050.[108] Such an ambitious decarbonization strategy needs to cover all carbon-intensive sectors of the economy, including energy supply, industry, transport, housing and agriculture. Emissions in most of these areas have dropped in the last three decades and the EU's emissions fell by 36% between 1990 and 2023 as a result.[109] However, transport emissions increased and in 2022, they represented 29% of the EU's emissions, 26% more than in 1990.[110]

In line with its climate goals, the EU set out a target to reduce transport emissions by 90% by 2050.[111] With road transport accounting for 20% of total EU emissions,[112] the EU has set fleet-wide CO2 emission reduction targets of 55% for newly sold cars and 50% for new vans from 2030 and a 100% reduction target from 2035 to incentivize the shift towards clean mobility.[113] In May 2025, the CO2 emission targets were softened to give car producers more flexibility by averaging 2025-2027 emissions. And subsequently, the Commission launched a review of the CO2 emissions, initially set for 2026, and European automakers are demanding more flexibility in meeting the 2030 and 2035 target, citing slow EV uptake.[114]

At the same time, 2025 has been a challenging for the European automotive industry. Following the start of the second Trump presidency, the US administration applied a 25% tariff on cars and automotive components – before the EU and the US negotiated a framework agreement, which brough the tariffs down to 15%.[115] And European automakers are facing fierce Chinese competition not just in Europe, where the Commission imposed countervailing duties on the import of subsidised Chinese EVs, but increasingly also in third markets.

In January 2025, the Commission launched a series of Strategic dialogues with different industrial sectors to help safeguard their competitiveness. The strategic dialogue with the automotive sector resulted in the aforementioned averaging of CO2 targets, but also the Automotive Action Plan, which promised to bring forward a number of key initiatives to boost the European automotive sector. The Automotive Action Plan highlights the need for a rapid approval of the ELVR, the expansion of technological capacity for pre- and post-recycling treatment and the introduction of sustainability and durability criteria for new vehicle components. The Commission is expected to present the automotive package by the end of the year 2025.

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[108] European Union. Regulation (EU) 2021/1119 establishing the framework for achieving climate neutrality. https://eur-lex.europa.eu/eli/reg/2021/1119

[109] European Environment Agency (EEA). Total greenhouse gas emission trends. Accessed 20 October 2025. https://www.eea.europa.eu/en/analysis/indicators/total-greenhouse-gas-emission-trends

[110] European Environment Agency (EEA). Transport and mobility – in-depth topic. Accessed 20 October 2025. https://www.eea.europa.eu/en/topics/in-depth/transport-and-mobility

[111] European Commission. The European Green Deal – COM (2019) 640 final. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2019%3A640%3AFIN

[112] Ritchie, H. Cars, Planes, Trains: Where Do CO2 Emissions from Transport Come From?, Our World in Data, October 2020. https://ourworldindata.org/co2-emissions-from-transport.

[113] European Union. Regulation (EU) 2019/631 – CO2 emission performance standards for new passenger cars and light commercial vehicles. https://eur-lex.europa.eu/eli/reg/2019/631

[114] ACEA. ACEA reiterates need for realistic reform of cars and vans CO_2 reduction policy. 22 October 2025. https://www.acea.auto/press-release/acea-reiterates-need-for-realistic-reform-of-cars-and-vans-co2-reduction-policy/

[115] Euronews. US drops tariffs on EU cars to 15 percent. 25 September 2025. https://www.euronews.com/business/2025/09/25/us-drops-tariffs-on-eu-cars-to-15

In the following section, we explore the EU and Czech policy measures linked to the area of low-carbon materials and circularity, in the areas of circular design, end-of-life processing of vehicles and waste management.

5.1. End-of-Life Vehicle Regulation

To promote the circular design and production of vehicles, the European Commission put forward a proposal for the End-of-Life Vehicle Regulation (ELVR) in July 2023.[116] The Regulation is now being finalized in trilogues. It will replace the End-of-Life Vehicles Directive and the 3R Type Approval Directive (reusability, recyclability and recoverability), which obliges car manufacturers to consider the dismantling, reuse and recovery of materials when designing and producing a vehicle to ensure that 85% of the vehicle weight is reusable or recyclable and 95% is reusable or recoverable.

The Directives have resulted in better collection of end-of-life vehicles (ELVs), helped reduce the content of hazardous substances and increased the ELV recycling to around 85% of the materials they contain.[117] However, metal waste continues to be mostly shredded instead of sorted, resulting in poor quality of scrap. Varying transposition of these Directives into national rules also lead to differences in the treatment of ELVs depending on where the vehicle is placed on the market. In addition, there is a persistent problem of 'missing cars.' Of the 10.4 million vehicles deregistered in the EU in 2019, only 6 million ELVs were properly treated in the EU, 1 million were exported outside the EU and the whereabouts of the remaining 3.4 million were unknown, presumably also exported or disposed of illegally.[118]

The EU market for secondary materials in the automotive industry remains limited, with barriers to functioning recycling markets and fully utilizing economies of scale. The ELVR therefore introduces measures to support a secondary market for automotive parts and components, encouraging the circular use of spare parts. It introduces Extended Producer Responsibility schemes to provide financing for mandatory waste treatment, incentivising recyclers to improve the quality of recycled materials from end-of-life vehicles. As the Regulation should be directly applicable and there will be no transposition time, it is crucial to fully understand the potential impacts the ELVR may have on the sector. The ELVR also comes after 15 major EU carmakers were fined 458 mil. € in March 2025 for engaging in anticompetitive behaviour in the vehicle recycling sector, agreeing amongst themselves not to pay dismantlers for processing ELVs, which has led to under-utilization of materials, which could otherwise be recovered.[119]

The ELVR requires car manufacturers to provide instructions for dismantlers on how to replace and remove parts and components during use and end-of-life stage of a vehicle. In that regard, a vehicle passport and a circular strategy should be required. However, following the amendments in the legislative process, the circularity strategies should not be not established for each vehicle type, but only at the level

[116] European Commission. Proposal for a Regulation on circularity requirements for vehicle design and on management of end-of-life vehicles, COM(2023) 451 final. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52023PC0451.

[117] European Commission. Questions and Answers: End-of-Life vehicles, 13 July 2023. https://ec.europa.eu/commission/presscorner/detail/en/qanda_23_3820

[118] Publications Office of the European Union. Study to support the impact assessment for the review of Directive 2000/53/EC on end-of-life vehicles. June 2023. https://op.europa.eu/en/publication-detail/-/publication/2fa7e161-2083-11ee-94cb-01aa75ed71a1/language-en

[119] European Commission. Commission fines car manufacturers and association €458 million over end-of-life vehicles recycling cartel. Press release, 1 April 2025. https://ec.europa.eu/commission/presscorner/detail/en/ip_25_881

of vehicle category (Council) or manufacturer (Parliament).[120] This might prevent dismantlers from receiving key information on how to dismantle different components and what materials they contain.

In addition to maintaining the 85/95% circularity requirements, the ELVR establishes minimum recycled content requirements for plastics (15% and gradually increasing to 25%). According to the Parliament, by two years after entry into force, the Commission should also adopt a minimum target for recycled steel, aluminium and its alloys, following a feasibility study.

The ELVR also tackles the problem of missing vehicles and the distinction between used vehicles and ELVs. It aims to prevent the export of end-of-life vehicles outside the EU by improving the separation of used cars and ELVs, enhanced their digital tracking and improve the enforcement of these rules. The ELVR should be gradually extended to cover new vehicle categories, such as motorcycles, lorries, and buses.

As such, the ELVR should provide a harmonized framework to improve legal certainty, allowing markets to deliver the necessary investments in the production and end-of-life treatment of vehicles. By streamlining the two Directives into one proposal, the ELVR effectively mirrors the design requirements for reusability, recyclability and recoverability and the target rates for reuse, recovery and recycling.

Some Member States' national parliaments have voiced concerns regarding the ELVR additional regulatory hurdles for the automotive industry, including major producers, such as Germany, Italy and Czechia.[121] However, the proposal can significantly help to improve the functioning of recycling markets by setting material quality standards and incentivizing more circular solutions.

The key will be to motivate vehicle manufacturers and ELV processors to work together to allow a free flow of materials back into production and a greater recovery rate. In order to become more efficient, the number of ELV processors needs to be reduced and a control system put in place. A fundamental change should be brought about by Extended Producer Responsibility (EPR), which the proposal schedules for introduction three years after entry into force. The vehicle manufacturer should thus take responsibility for the collection of ELVs, their reuse, treatment and recycling.

The efficient and environmentally friendly management of scrapped vehicles is also to be supported by a vehicle disposal certificate for the final de-registration of the vehicle. Financial incentives for taking vehicles to authorised facilities could also reduce poor quality treatment. And for recycling outside the EU, "equivalent" conditions for the treatment of ELVs in third countries need to be properly defined.

Mandatory removal of certain parts that are not suitable for reuse or repurposing should not lead to additional costs and environmental impacts, so as not to undermine the uptake of advanced post-scrapping and recycling technologies. Minimum quality requirements should be set for material fractions with economic or strategic value, regardless of whether or not dismantling occurs prior to shredding (e.g. for flat steel or basic sub-fractions of aluminium alloys).

For the efficient processing of materials such as steel, aluminium, copper and others, it is advisable to prioritise dismantling over shredding and incorporating advanced automated technologies to enable

[120] European Parliament. Revision of EU rules on end-of-life vehicles and type-approval of motor vehicles. 24 October 2025. https://www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/file-revision-of-eu-rules-on-end-of-life-vehicles-and-type-approval-of-motor-vehicles

[121] IPEX.eu. COM-2023-0451 – Proposal document (IPEX record). Accessed 20 October 2025. https://secure.ipex.eu/IPEXL-WEB/document/COM-2023-0451

recognition of material composition and impurities. A key benefit is the reduction of contamination - for example, the reduction of copper content in scrap steel - while increasing the recovery of valuable materials. High-quality sorted materials enable reuse even in more demanding applications, including automotive steel.

5.2. Other EU legislation relevant to the automotive industry

Aside from tailpipe emissions, the CO2 emission Regulation requires the European Commission to set out a methodology for the calculation of the full life-cycle CO2 emissions of passenger cars and light commercial vehicles by the end of 2025.[122] This is expected to be done via standardized Environmental Product Declarations (EPDs), namely the EN 15804 standard, which contains information about the Global Warming Potential (GWP) values. Lowering the GWP values can be achieved by reducing the use of linear components in vehicle production and increasing their circularity, notably for products which traditionally have the highest GWP values, such as aluminium, steel and batteries.

The recently adopted Battery Regulation[123] regulates the life cycle of all batteries and introduces recycling efficiency targets (e.g. 65% in 2025 and 70% in 2030 for lithium batteries), material recovery rates (Co, Cu, Pb, Ni 90% by 2027/95% by 2031; Li 50% by 2027/80% by 2031), mandatory levels of minimum recycled content (Co 16%, Li 6%, Ni 6%), collection targets for EV batteries (51% by 2029, 61% by 2032) and includes design requirements for EV batteries to be removable and replaceable by 2027. By 2027, it also requires manufacturers, producers, importers and distributors of batteries in EU to provide a battery passport, which will enhance transparency, traceability and sustainability throughout the battery life cycle by providing information about its performance, environmental impact and the origin of its materials.

The Critical Raw Minerals Act [124](CRMA) aims to increase and diversify the supply of critical raw materials to mitigate the risks of supply chain disruptions by enhancing the mining, refining, processing, and recycling capacity in Europe, strengthening the circularity and sustainability of CRMs, and diversifying their imports. The CRMA also aims by 2030 to increase domestic mining to 10%, domestic processing to 40% and domestic recycling to 15% of EU demand, while also ensuring that not more than 65% of each material comes from a single non-EU country.

The new Carbon Border Adjustment Mechanism[125] (CBAM) will effectively phase-in a carbon tax for imported goods from January 2026. It will initially cover basic materials, such as steel or aluminium, but will not apply to all finished products, which may include some types of vehicle components.[126] In the long run, the CBAM may be extended to other areas covered by the EU Emission Trading System (ETS), helping

[122] European Union. Regulation (EU) 2019/631 – CO2 emission performance standards for new passenger cars and light commercial vehicles. https://eur-lex.europa.eu/eli/reg/2019/631

[123] European Union. Regulation (EU) 2023/1542 concerning batteries and waste batteries. Official Journal. https://eur-lex.europa.eu/eli/reg/2023/1542

[124] European Union. Regulation (EU) 2024/1252 establishing a framework for ensuring a secure and sustainable supply of critical raw materials. Official Journal. https://eur-lex.europa.eu/eli/reg/2024/1252

[125] European Union. Regulation (EU) 2023/956 establishing a carbon border adjustment mechanism. Official Journal. https://eur-lex.europa.eu/eli/reg/2023/956

[126] European Commission. Carbon Border Adjustment Mechanism (CBAM) Questions and Answers. Last updated on 17 December 2024. https://taxation-customs.ec.europa.eu/document/download/013fa763-5dce-4726-a204-69fec04d5ce2_en?filename=CBAM_Questions%20and%20Answers.pdf

keep the EU automotive industry competitive while also promoting the use of lower-carbon technologies in manufacturing outside the EU.

The Waste Shipment Regulation also regulates the shipment of end-of-life vehicles, which are considered hazardous waste, with 'black mass' from shredded Li-ion batteries also added to the list in March 2025.[127] The EU also recently passed the new Euro 7 Regulation, which (aside from exhaust emissions) regulates tyre abrasion, brake particle emission and battery durability.[128]

5.3. Czech legislative and policy framework

The current framework for the end-of-life management and recycling of vehicles in the Czech Republic is based on the End-of-life and 3R Type Directives, which are transposed into Czech law in a number of legal and sublegal texts.[129] This includes most notably Act No. 541/2020 Coll., on waste ('Waste Act'), Act No. 542/2020 Coll., on end-of-life products ('Products Act') and Act. No 56/2001 Coll., on the Conditions of Operation of Vehicles on Roads.[130] These laws are regularly updated and where necessary, complemented by sublegal norms, including the Decree No. 153/2023 Coll., on the approval of roadworthiness of vehicles and technical conditions for the operation of vehicles on roads and Decree No. 345/2021 Coll., on the details of the management of end-of-life vehicles.[131] These laws would need to be updated once the ELV Regulation enters into force and makes parts of the Czech laws redundant.

The key national policy document for promoting increased recycling and use of secondary raw materials is the Secondary Raw Materials Policy, which is being updated by the Ministry of Industry and Trade and went through a public consultation process in early 2024, but is still yet to be adopted.[132] By updating the secondary raw materials policy, the Ministry of Industry and Trade aims to address issues such as global climate change, obligations stemming from European legislation in the field of climate protection and the international trend of transition towards more circular economy.[133]

The Action Plan Circular Czechia 2040 covers years 2022-2027 with a view until 2040, but does not provide specific measures on circularity of steel, aluminium or batteries in the automotive industry.[134] It indicates

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[127] European Union. Regulation (EU) 2024/1157 on shipments of waste. Official Journal. https://eur-lex.europa.eu/eli/reg/2024/1157

[128] European Union. Regulation (EU) 2024/1257 on type-approval of motor vehicles. Official Journal. https://eur-lex.europa.eu/eli/reg/2024/1257

[129] European Union. National transposition measures communicated by the Member States concerning: Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of life vehicles. Accessed 20 October 2025. https://eur-lex.europa.eu/legal-content/EN/NIM/?uri=CELEX:32000L0053

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that circular solutions in hard-to-abate industries should be analysed and possibly funded as part of an 'implementation plan' of the European Commission's Circular industrial technologies roadmap which came out in 2023.[135] It is unclear whether this 'implementation plan' has since materialized. The wording of the document was also criticised by the industry association of the Czech Republic when it came out in 2022 as not providing sufficient support to circularity in relation to those hard-to-abate industries.[136]

The Action Plan on the Future of the Czech Automotive Industry from 2017 focuses on three main trends for the future of automotive: e-mobility, autonomous vehicles and digitalisation.[137] However, it does not include any provisions on circular solutions for steelmaking or battery value chains and is largely outdated by now. The National Clean Mobility Action Plan, on the other hand, was recently updated.[138] One of its focus points is simplifying the regulatory framework to enable second-life and recycling of EV batteries, while also aligning national legislation with the EU Battery Regulation.

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6. Conclusion

This study shows that the competitiveness of the Czech automotive industry will be shaped not only by electrification but also by the country's ability to secure, process and circulate low-carbon materials at scale. Czechia is a significant automotive producer, with 1.45 million vehicles manufactured in 2024 and a 12.7 percent share of EU output, but its material base remains exposed. The shift to electromobility increases this pressure. Under our 2030 scenario, where electrification reaches 60 percent of production, Czech carmakers will require around 46 GWh of batteries and roughly double today's demand for lithium, nickel, manganese and cobalt. Electrification also raises aluminium demand by more than 40% compared with 2021, while steel use remains relatively stable at 1.3-1.4 Mt due to rising vehicle weight. This shows which inputs will become more difficult to secure and where policy support will be needed.

Our analysis also shows that current Czech material flows are not fully aligned with these future needs. The country exports a net 2.3 Mt of steel scrap annually, but imports much of its automotive-grade steel, aluminium and batteries. Domestic steelmaking capacity is limited, with major transitions to electric arc furnaces delayed and dependence on higher-carbon primary inputs persisting. Aluminium follows a similar trend, with Czechia importing over 400kt of net aluminium and aluminium products in 2024. At the same time, the recycling system does not yet produce the quality of scrap needed for low-carbon alloys. Fragmentation, limited deep-dismantling and weak links between recyclers and OEMs prevent the creation of high-quality feedstock. Evidence suggests that better dismantling and sorting could reduce copper content in scrap steel from 0.4 percent to below 0.1 percent, enabling closed-loop recycling for automotive-grade applications. This will become more important as copper content in EVs could be up to four times higher compared with ICEs and there could be a shortfall of its supply as soon as 2035.

Several EU policy developments reinforce the importance of addressing this gap. The End-of-Life Vehicle Regulation, in its final legislative stage, will introduce dismantling obligations, minimum recycled-content requirements, vehicle passports and Extended Producer Responsibility. The Battery Regulation adds binding recovery and recycled-content targets for critical raw materials, along with a battery passport and strict traceability. The Critical Raw Materials Act and CBAM will influence access to strategic inputs and increase the value of low-carbon metals and local processing. The Ecodesign for Sustainable Products Regulation will introduce performance requirements for materials such as steel and aluminium from 2026-2027 onwards. And the Waste Shipment Regulation has already tightened controls on exports of 'black mass' from shredded batteries and will strengthen digital tracking. These developments point to a European market that will rely more heavily on high-quality secondary materials in the years ahead.

Czechia does not yet have a coherent strategy for securing low-carbon materials for its automotive sector. Strategies such as Circular Czechia 2040 and the Secondary Raw Materials Policy lack concrete measures for steel, aluminium or battery value chains. ELV processing remains structurally under-capacitated and under-incentivised, even though it offers a valuable source of material. The absence of large-scale, high-purity sorting and recycling infrastructure risks forcing Czech industry to depend on more carbon-intensive imports when EU policy increasingly rewards lower-carbon supply chains. Without coordinated support for deep-dismantling, scrap upgrading, battery recycling and low-carbon metal production, Czechia will continue exporting low-value scrap and importing higher-value materials.

At the same time, European manufacturers have to face Chinese competitors, who are gaining market share in Europe and in third-country markets, and new US tariffs, which increase costs and add uncertainty for export-oriented firms. Some OEMs have reacted by arguing that the EV market is slowing and calling for weaker 2030 and 2035 CO2 standards. But weaker CO2 standards would soften the demand signal that drives investment into low-carbon materials, since slower electrification reduces the need for recycled batteries, weakens incentives to switch from primary to low-carbon steel and aluminium, and makes long-term offtake agreements for domestic recycling and processing less likely. This will increase dependence on higher-carbon imports and reduce the incentives to develop European material supply chains. For Czechia, clear targets and predictable regulation remain important for investment decisions across materials and recycling. And it is crucial to take a more strategic view of not just car manufacturing, but the wider industrial ecosystem around it.

To maintain its position in European automotive value chains, Czechia will need to strengthen its low-carbon material base. This includes improving the quality of ELV material recovery, supporting domestic processing of strategic materials, aligning national strategies with EU steps and providing clear policy signals for steel, aluminium and batteries. If these steps are taken, Czechia can secure the materials required for an electrified fleet, reduce exposure to external risks and retain more value in its industrial system. If not, the country risks losing competitiveness in one of its most important economic sectors.

Annex 1. Estimates of the rate of electrification by 2030

Source	Estimate of EV share in EU sales by 2030	Date	Link
EV Volumes	62.3%	September 2025	https://autovista24.autovistagroup.com/news/is-there-hope-for-ev-markets-across-the-world/
BloombergNEF	52%	June 2025	https://about.bnef.com/insights/clean-transport/electric-vehicle-outlook/
IEA	close to 60%	May 2025	https://www.iea.org/reports/global-ev-outlook-2025
BMI	35%	April 2025	https://www.forbes.com/sites/neilwinton/2025/04/26/europes-ev-sales-accelerate-but-long-term-eu-mandates-look-demanding/
Schmidt	54.0% (Western Europe)		
Inovev	35%		
Jefferies	35%	January 2025	https://www.forbes.com/sites/neilwinton/2025/01/09/european-ev-sales-resuming-growth-but-too-slowly-for-eu-2030-targets/
Center of Automotive Management	40-50%		
European Parliament Research Service	60-80% / 55-60% (Cutting-edge Europe / Slow electrification)	November 2024	https://www.europarl.europa.eu/RegData/etudes/IDAN/2024/762873/EPRS_IDA(2024)762873_EN.pdf

OEM	Announced target for EVs by 2030	Date	Link
Škoda	70% share of EVs on EU sales	November 2023	https://www.skoda-auto.cz/novinky/novinky-detail/2023-11-14-skoda-auto-predstavila-na-vystave-e-salon-elektrifikovane-novinky-i-svuj-pohled-na-cistou-mobilitu
Hyundai	60% share of EVs on global sales	September 2025	https://www.just-auto.com/news/hyundai-targets-annual-sales-of-5-5-million-vehicles-by-2030/
Toyota	> 150.000 new vehicles produced in CZ (BEV + hybrids)	November 2025	https://www.info.cz/zpravodajstvi-a-komentare/cesko-toyota-investice-rozhovor

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