Electric vehicle batteries



What will it take for Europe to build a sovereign industry and accelerate the electrification of cars ?

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The present article has been produced based on interviews conducted with industry players across the European battery value chain, sector experts and academics, documentary research, regulatory texts, and Sia analysis. Observations and conclusions reflect current market dynamics and discussions.

Executive Summary:

Europe seeks to massively electrify its economy and enact a resilient transition away from fossil fuels. As the European automotive market shifts towards electrification, building up local electric vehicle (EV) value chains becomes highly strategic.

Within the EV, the battery is the most valuable component of the vehicle, representing ~30-40% of total vehicle cost, and the heart of the value chain. Two types of EV batteries currently cover the market: Nickel-Manganese-Cobalt (NMC) and Lithium-Iron-Phosphate (LFP). NMC offers longer autonomy, while LFP is the cheaper alternative, with a shorter driving range. China dominates production for both battery types: it holds a near-monopoly in LFP, mainly supplying Chinese and emerging markets, and a strong position in NMC, together with South Korea, supplying European demand.

To reduce its heavy dependence on Asia, particularly China, from refined critical material supplies to manufacturing capacity, the European Union (EU) has set out to build a network of local battery gigafactories. The industrial strategic focus is on NMC, driven by stronger European demand for this technology. So far, operational gigafactory capacity has reached 309 GWh per year across the EU, equivalent to roughly 5.2 million vehicles assuming an average battery capacity of 60 kWh, and a further 635 GWh per year is planned. Projects are also emerging in pCAM and CAM midstream value chain stages and recycling. But the industry has faced difficulties scaling up: a highly complex production process coupled with challenges in mastering expertise, higher labour costs, stricter regulations, and Chinese competitive pricing.

In support of its ambition to reindustrialise the region and develop strategic sectors, the EU is introducing tailored regulations. The 2023 Battery Regulation and the 2024 Critical Raw Materials Act (CRMA) have already entered into force. The Battery Regulation supports downstream battery recycling, while the CRMA aims to secure upstream material supply.

Currently under negotiation, the EU Commission's Industrial Accelerator Act (IAA), proposed in March 2026, aims to fill the mid-downstream policy gap, where dependence on Asia is particularly acute. The IAA proposes four main mechanisms: "Made in EU" requirements, foreign investment provisions, streamlined project permitting and local-content rates for the rest of the vehicle. These levers could provide a significant push to help the sector develop its mid and downstream value chain locally.

However, several unresolved policy tensions could undermine the IAA's intended impact, including:

- pCAM (precursor cathode active material) production, a key stage of the value chain, is not covered by the regulation.
- Cost-based derogations allow Member States to waive EU-origin requirements where European options cost 20-30% more. This risks overuse by car manufacturers, weakening the investment signal.

- There is misalignment across stakeholders on which countries count as “Made in EU” for public procurement and support schemes.

If well-calibrated, EU regulations could help build a local derogations value chain and reach competitiveness.

The sovereign and resilient electrification of cars in Europe requires regulatory support, but success will depend on the convergence of several conditions: will Europe master technological know-how quickly enough to reach competitiveness and meet booming EV demand? Will other battery technologies, including LFP and other emerging alternatives, sway demand in Europe? These are the key issues and challenges addressed in this document.

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1. While demand for LFP batteries is expected to grow, propelled by technological progress and cost efficiency, European EV market remains NMC-centred.

Most EV batteries currently on the market are lithium-ion based, i.e. using lithium as the electrolyte. Lithium-ion batteries are built around two electrodes: an anode, typically made of graphite, and a cathode. Graphite anodes are relatively mature and standardised technologies, although they remain key for battery performance and supply-chain security. The cathode chemistry, by contrast, has a particularly strong influence on a battery’s driving range, cost, lifetime and safety. It therefore generally represents the main source of technological differentiation and a major strategic component of the battery cell. Two main technologies co-exist depending on the type of cathode materials used:

- Nickel-Manganese-Cobalt (NMC) and
- Lithium-Iron-Phosphate (LFP).

NMC is prized for its longer driving range and better performance in cold temperatures, **while LFP is the cheaper alternative, about 40% cheaper than NMCs on average in 2025[1], offering less driving range, with a 20-30% performance gap**[2], as presented in Figure 1 below.

	NMC	LFP
Cathode components	Nickel, Manganese, Cobalt	Lithium, Iron, Phosphate
Range	High energy density, therefore higher driving range	Lower energy density and range (20-30%)
Lifetime	1,500–2,500 cycles	2,000–3,500 cycles
Production costs	Higher costs due to use of critical raw materials	~20-30% cheaper than NMC as of today
Thermal stability	Lower stability	Higher stability
Cold temperature suitability	Better performance in cold weather conditions	Lower performance in cold weather conditions

Figure 1: Comparison of NMC and LFP batteries’ characteristics

[1] Electric vehicle batteries – Global EV Outlook 2026 – Analysis - IEA
[2] Powering the EU's future: Strengthening the EU battery industry

Different historic geographic market demand preferences exist for the two technologies: NMC in Europe and the US, LFP in China and emerging markets, mostly in Asia.

The premium NMC is the most widely used in Europe and the United States, with car models such as BMW i4, Mercedes EQE, or Renault ZOE in Europe, and Tesla models in the US. NMC is particularly valued by consumers for its higher driving range.

Suited to mass consumption, LFP batteries dominate emerging and Chinese markets, where heavy subsidies sustain demand in line with massive domestic production.

However, **while China has prioritised LFP to drive down EV costs on its national market, Europe is now also shifting toward it — though NMC is here to stay**, as Figure 2 illustrates.

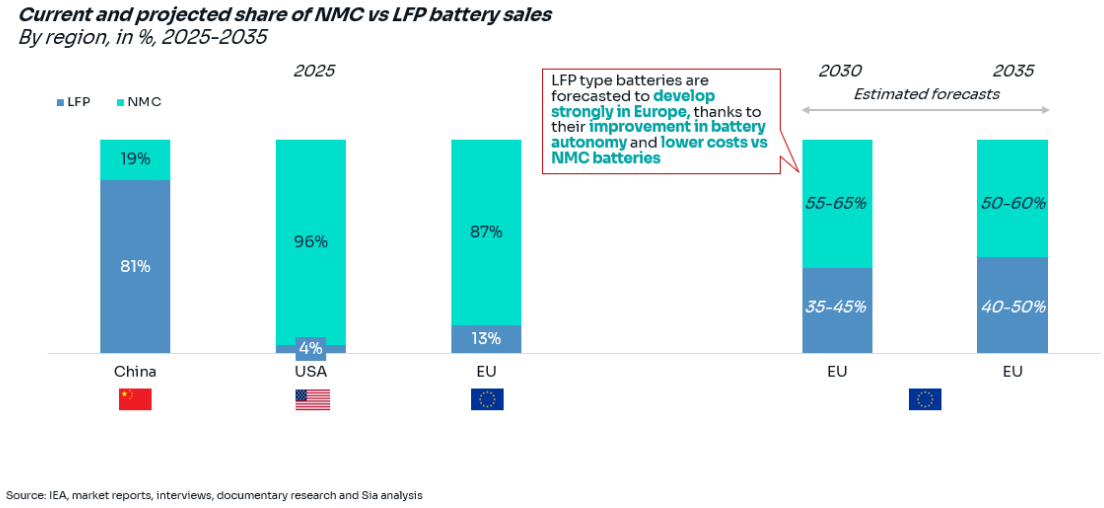


Figure 2: Overview of current NMC and LFP sales market shares in China, the USA and EU, and projected split of the two technologies in Europe

LFP technology is also gaining ground in Europe, backed by its faster charging potential and non-critical material use (iron and phosphate, avoiding nickel and cobalt) which results in greater supply chain control. In addition, LFP batteries have now reached a performance level suitable for entry-level to mid-market cars, with a competitive price-to-range ratio attractive for mass consumption, as seen with LFP-powered models like Dacia's Spring, or Volkswagen's Cupra Born.

With these technological improvements, **LFP batteries are expected to represent ~50% to 60% of all EV batteries in the EU in 2035 according to market experts, against ~13% in 2025**.

The Stellantis-CATL LFP battery gigafactory project launched in Spain to answer growing demand on this segment illustrates this evolution. Yet NMC remains the predominant battery chemistry in Europe and accounts for the largest share of projects under development. **The two technologies are expected to coexist, with LFP covering the mass-**

market segment and NMC the more premium segment. In this context, the EU is seeking to localise the NMC value chain to support the resilient electrification of the car industry.

On the production end, China dominates for both LFP batteries, and to a lesser extent NMC batteries, with national industrial giants like CATL. Battery component refining is geographically concentrated in China or partner countries (see previous Sia article), and more critically, China possesses the complex technological know-how. **In 2025, China held a quasi-monopoly in LFP cathode materials and battery cells production, and a strong position in NMC, with 66% of cathode materials and 60% of battery cells production, as shown in Figure 3 below. South Korea, the other major NMC producer, accounted for nearly a third of critical NMC cathode material product.**

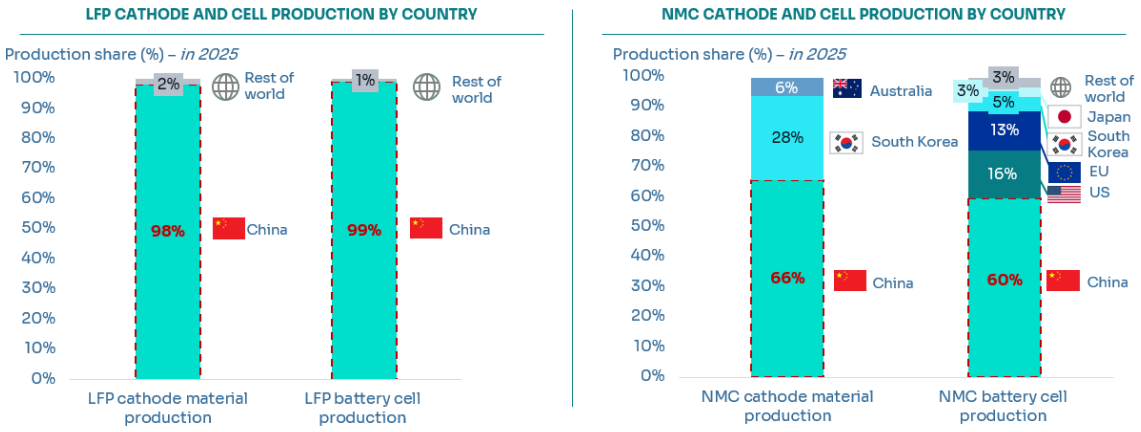


Figure 3: LFP and NMC battery production by country (2025)

As a result of dominant production capacity, **Chinese producers sold near ~75% of EV batteries (LFP and NMC) globally in 2025. China held over ~50% of European market share**, via both exports and Chinese production sites in Europe[3]. Consequently, South Korean producers' European market share has been declining from ~78% in 2022[4] to ~30% in 2025[5].

2. The development of a European battery production supply chain is centred on NMC technology and is progressing step by step, reflected by the announced projects covering the NMC value chain

Stronger European market demand for NMC batteries drives Europe's strategic focus on NMC development.

Reliance on NMC critical materials sourced abroad highlights the importance of building European battery recycling capacities. **As shown in Figure 4 below, recycling aims to enable a closed-loop system, offsetting a limited access to raw materials and reducing dependence on third countries, particularly China, or nascent mines in Europe.**

[3] Electric vehicle batteries – Global EV Outlook 2026 – Analysis - IEA
[4] South Korea's Battery Industry Faces Challenges - Korea Economic Institute of America
[5] Korean battery makers rethink Europe strategy as China gains ground - The Korea Herald

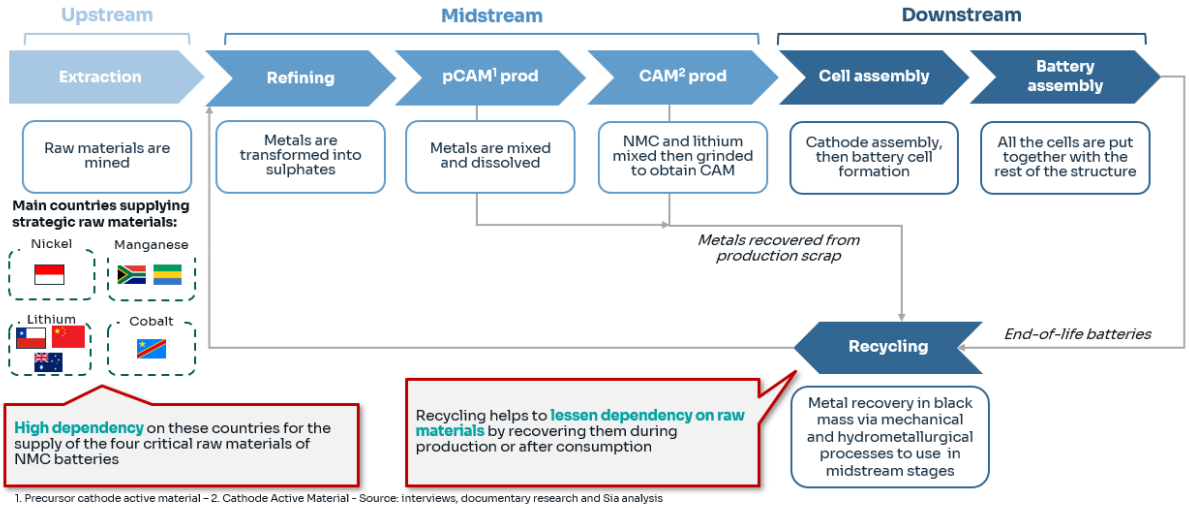


Figure 4: NMC value chain from extraction to a final product

NMC battery production involves multiple technically demanding stages, making individual processes difficult to master and end-to-end value-chain integration even more challenging (appendix 1).

Recycling projects, including mainly mechanical pre-treatment and hydrometallurgy, are developing in Europe. The transformation of the battery into black mass and hydrometallurgy are well-established technologies in Europe, sustained by experience in other sectors (mining, mineral processing etc.).

Several recycling projects are operational, such as the plants managed by Umicore in Belgium since 2011, BASF and Mercedes-Benz in Germany since 2024, while others are still under construction like Neomat's plant in France. **To date, black mass refining projects**

account for a total operational capacity of ~ 57,5 kt/y. However, that is still less than 26% of the average total announced capacity by 2030, as seen in Figure 5 below.

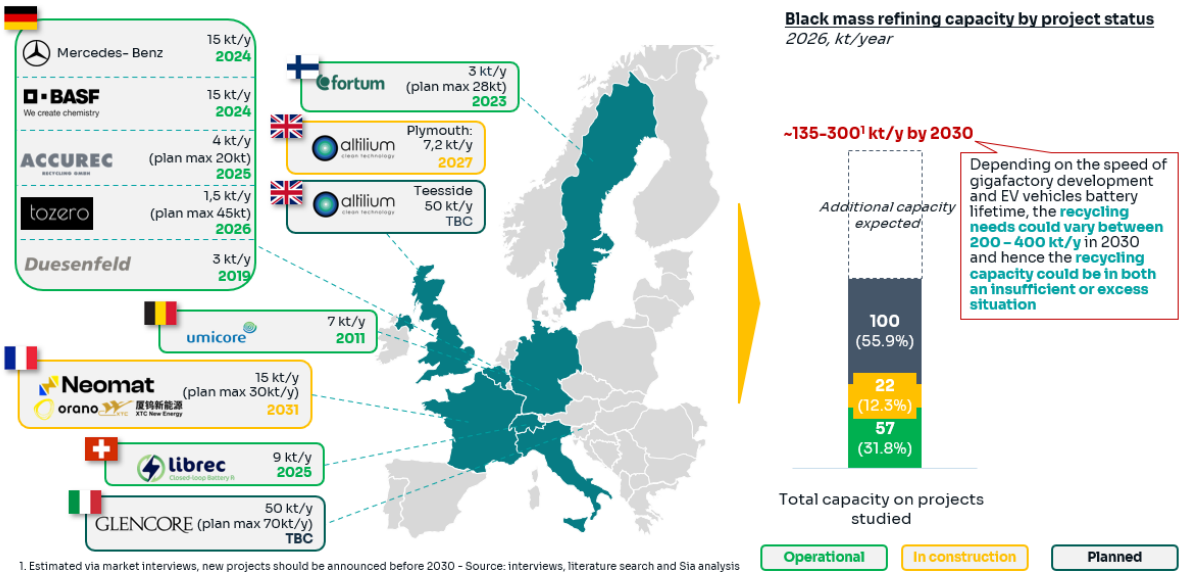


Figure 5: Map of European black mass refining projects

The recycling sector faces several challenges:

- Being able to accurately characterize and quantify the **battery's composition** to enable its recycling.
- **Building sufficient pCAM** – precursor Cathode Active Material - capacity to value the recycled metals. pCAM is a critical stage of the production chain, determining battery performance characteristics. Currently, there is a leakage of most of the black mass exported to Asia, particularly to South Korea, due to the lack of processing capacity in Europe[6].
- Meeting **manufacturer industrial specifications**: some manufacturers are not able to handle recycled CAM – Cathode Active Material - because a single impurity, from cells' size to its shape, could affect the battery quality.

In the long run, while black mass refining projects are developing, **uncertainty remains on the balance between refining capacity and demand on the medium to long term**. The market could either face oversupply or shortage. Currently, announced project refining capacity for lithium black mass sits between 135 and 300 t/y in 2030 against an anticipated recycling demand of 90 t/y. Depending on the uptake of electric cars, the speed of gigafactory development and EV battery lifetime, the recycling needs may vary between 200 and 400 t/y in 2030.

[6] Under EU environmental rules, exporting hazardous waste outside of the OECD is restricted. But since South Korea is an , it remains an export destination and benefits from the institution's simplified waste exchange framework. As a result, black mass is massively exported out of Europe and into South Korea, driven by aggressive bidding due to Korean overcapacity and heavy reliance on imports to feed processing capacities.

Significant gigafactory capacities, mostly NMC, were announced in recent years across the EU, led by Hungary and Poland, followed by France and Germany. **Operational projects have announced a capacity of 309 GWh per year, equivalent to roughly 5.1 million vehicles** assuming an average battery capacity of 60 kWh**,** while a further additional 635 GWh per year are planned, equivalent to about 10,6 million vehicles, as Figure 6 **Erreur ! Source du renvoi introuvable.**shows below.

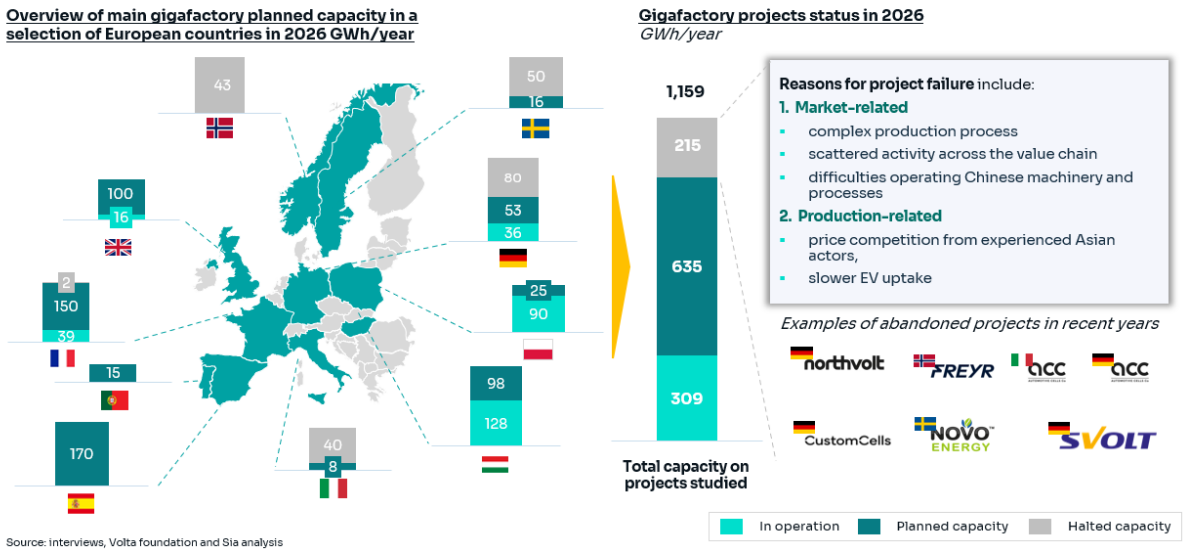


Figure 6: Gigafactory projects recorded in Europe as of 2026, broken down by country into total operational, planned, and halted capacity

Hungary & Poland are the two most advanced European countries in terms of installed gigafactory capacity. The two eastern-European countries have a target operational capacity of 128 and 90 GWh per year respectively, and a planned capacity of 98 and 25 GWh per year (+76.6% and +27.8%). Substantial Asian investment is backing their cell production projects: Hungary has attracted funds from the Chinese industry giant CATL and Poland from South Korean group LG.

France also benefits from active gigafactories with a current target production capacity of 39 GWh/year. In France, the two main gigafactory projects were launched in 2023 by ACC, a joint venture formed by Stellantis, Mercedes-Benz and TotalEnergies, and in 2025 by Verkor, in partnership with Renault Group. ACC's initial capacity is projected at 13 GWh per year, while Verkor's stands at 16 GWh, roughly equivalent to 483,000 EVs once fully ramped-up. Neither is producing at that level yet, and current output is far from meeting domestic demand which reached 363,130 EVs sold in 2025[7]. Both groups recorded production delays, with Verkor's 18 months delivery disruptions prompting its main investor and client Renault to resort to Europe-based South Korean LG Group for supply. ACC, however, recently recorded significant progress: in September 2026 it reached a

[7] France's EV Market in 2025: Renewed Momentum and a Growing Fleet | European Alternative Fuels Observatory

production level equivalent to powering 5000 EVs, nearly as much as its entire output in 2025, and expects to reach a monthly production of 10,000 batteries in 2027.

While ACC and Verkor are planning on scaling up, other projects are under construction, with a total planned capacity of about 150 GWh per year.

While projects are developing, European gigafactories are under pressure: most are operating below announced targets, and others are shutting down, with 215 GWh gigafactory capacity having already been halted. In 2025, the Swedish lithium-ion battery producer Northvolt declared bankruptcy, after accumulating $8 billion of debt.

The **battery manufacturing process remains highly complex**, with little room for error, **making it a tough industry for new entrants to quickly break into**. Asian competitors benefit from longer experience in the battery space, having gradually built-up robust expertise over time. Chinese producer CATL started with iPod and computer batteries back in 1999. European manufacturers are still developing the technological expertise required for large-scale production. This leads to elevated scrap rates, common the first few years of production, compared to more experienced Asian counterparts. On average in 2025, gigafactory scrap rates reportedly ran below 10% in China, against 30% to 40% elsewhere[8].

Chinese competitive cell pricing further challenges the economics of European cell manufacturing, where production costs were about 50% higher than in China in 2025[9]. This is explained by the smaller scale of European factories along with higher component costs, lower automation and higher scrap levels.

An average of 125 workers produce 1 GWh of battery in Europe against 35 workers in China[10].

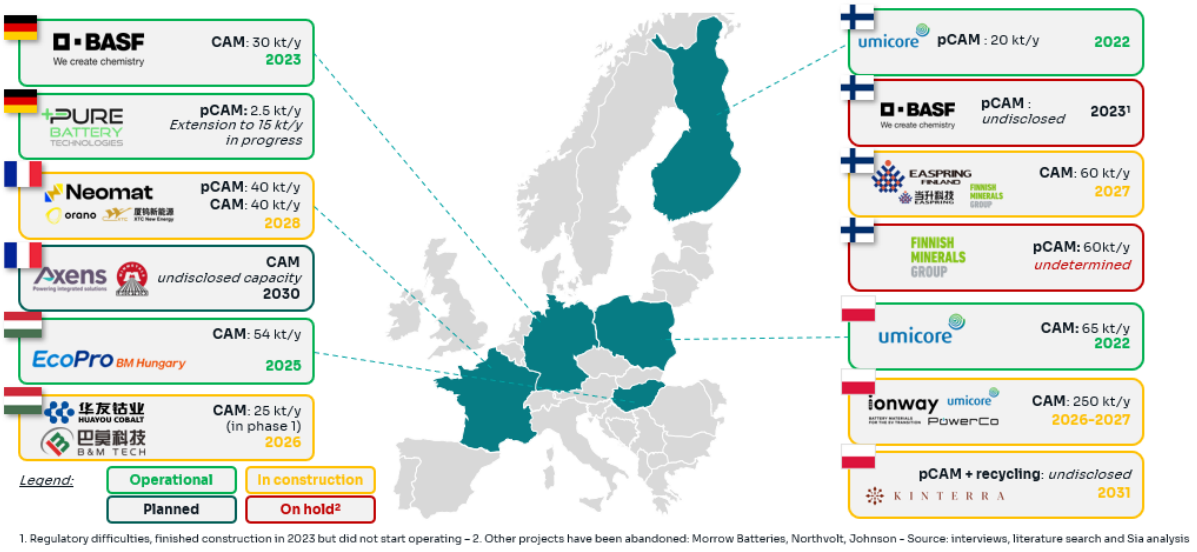
Production challenges, higher labour costs, stricter regulations in Europe and overall limited economies of scale drive **European cell prices on average higher than in China**.

Up until recently, Europe was more focused on gigafactory development than pCAM and CAM production given China's more advanced and established technological capabilities in this area.

Several pCAM and CAM projects are now emerging across Europe, announced by key industry players including BASF in Germany, Umicore in Poland, Neomat and Axens in France, and Easpring in Finland. Some projects are developing under joint ventures and integrating both pCAM and CAM stages of production.

To date, at least 13 projects have been announced with a ~586 kt total planned capacity per year, as presented in Figure 7.

[8] Why Europe is losing the gigafactory race to China | Mobility Global
[9] Electric vehicle batteries – Global EV Outlook 2026 – Analysis - IEA
[10] Europe's leading advocates for clean transport & energy | T&E



1. Regulatory difficulties, finished construction in 2023 but did not start operating – 2. Other projects have been abandoned: Morrow Batteries, Northvolt, Johnson – Source: interviews, literature search and Sia analysis

Figure 7: Overview of announced pCAM and CAM projects in Europe

Yet, manufacturing equipment is still largely sourced from China, and the processes are difficult to calibrate, with quality and yields highly sensitive to the slightest change in production parameters, such as humidity levels.

On top of this, European projects must **adapt processes to stricter local environmental regulations**, contend with structurally higher production costs, and face visa constraints when seeking to bring the experienced engineers needed for the ramp up phase.

A significant share of active projects (5 out of the 13 presented on the map above), include **joint ventures with Asian partners**. These partnerships provide support in operating production facilities, managing equipment and adapting processes to local conditions. **In this context, the CATL-Stellantis LFP gigafactory brought in 1,000 technicians from China, supported by the Spanish government issuing visas, to enable a production start in 2027**. Partnerships with Asian companies are increasing and should help with technological transfer and accelerate the ramp up of industrial operations.

Overall, the battery value chain is progressively taking shape in Europe: projects across the entire production chain are being developed and some are already operating. Yet the market still faces challenges including acquiring technological expertise, scaling up, countering the shortage of skilled workers, and reaching price competitiveness. The current landscape suggests that market forces alone are insufficient to anchor a local value chain. Europe is therefore strengthening its regulatory framework through legislative initiatives designed to structure and accelerate its development.

3. Regulation is a key requisite to accelerate the development of a European value chain and strengthen Europe's autonomy in the battery sector.

Through three main regulations, the 2023 Battery Regulation, the 2024 Critical Raw Material Act, and the recently proposed Industrial Accelerator Act, the EU is seeking to support the battery value chain, from upstream stages to recycling capacities. Support tailored to the industry's challenges could provide a significant boost. **The proposed IAA targets the mid-downstream stages of the value chain. Although critical, these stages had yet to receive regulatory focus. By filling this policy gap, the text aims to expand the legislative coverage of the whole battery value chain, as Figure 8 illustrates.**

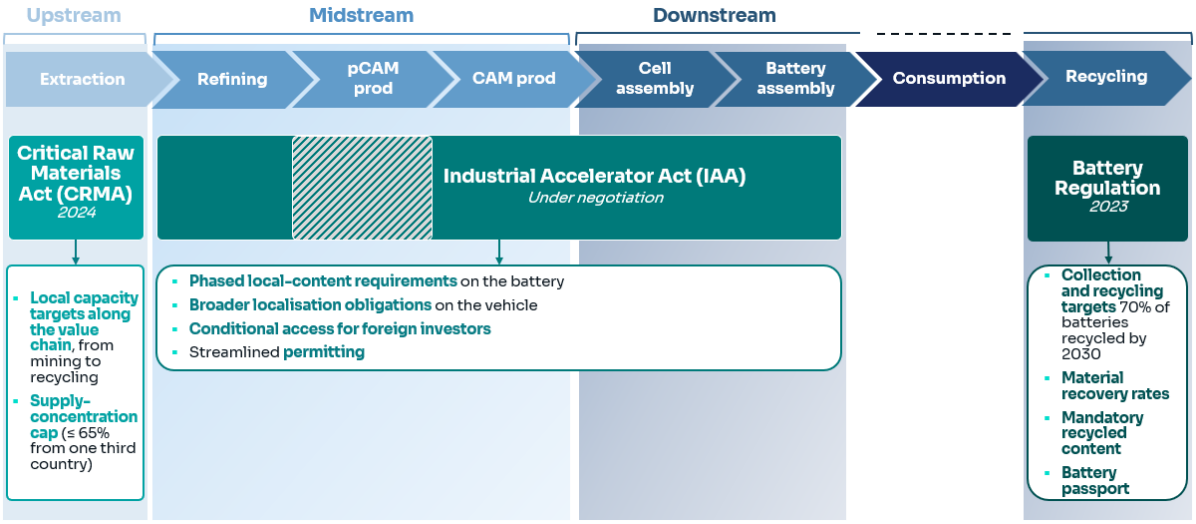


Figure 8 : Overview of the 3 European regulations covering the EV batteries' value chain

3.1. The battery regulation 2023/1542, focusing on the downstream end of the value chain through mandatory recycling rates and the battery passport

Enacted in 2023, the Battery Regulation focuses on the downstream end of the value chain, incentivizing battery recycling through mandatory rates and the battery recycling passport (appendix 2). The EU is positioning recycling as a lever to compensate for limited European raw material extraction capacities. Recycling is also expected to strengthen technical expertise and production processes.

Overall, the Battery Regulation seems well-received with some reservations:

- **Uncertainty remains over the timeline** of still-missing delegated acts, which complicates industrial planning.
- **Compliance and financial burden** which is perceived as **disproportionate for small and medium enterprises** and new entrants.
- The level of transparency required by the battery passport triggers **confidentiality concerns** for battery producers, especially regarding commercially sensitive data on cell chemistry and supplier relationships.
- Concerns persist around the **confidentiality of commercially sensitive data** especially regarding data on cell chemistry and supplier relationships for battery manufacturers, sitting between upstream suppliers and car makers.

- **Non-interoperable frameworks**, such as China's proposed digital product passports, risk forcing the industry to duplicate efforts to meet costly overlapping requirements.
- **Audit capacity** is seen as insufficient and often described as a bottleneck (cf. EU Roundtable_event report.pdf).

3.2. Critical Raw Material Act (CRMA), aiming to strengthen critical raw material supply but expected effects currently remain unclear

Alongside the Battery Regulation, the EU seeks to strengthen its critical material supply through the 2024 CRMA (appendix 2), anticipating and mitigating recycling uncertainties. The CRMA aims to reduce dependence on China by boosting European material extraction and diversifying import sources.

So far, policy effects remain unclear, as the EU is heavily reliant on material imports. Additionally, opening a mine is a long-term, uncertain commitment that may take decades and requires intensive investment. Under the CRMA, the EU has championed 47 local upstream strategic projects, representing an estimated total investment of €22.5 billion. For example, French company Eramet launched the lithium extraction and processing project Ageli in Alsace. With its strategic status obtained in 2025, the project benefits from streamlined permitting and funding access.

Progress towards European independence will take time, but complementing recycling efforts with mining projects could help reach upstream targets for securing raw material supply.

3.3. The Industrial Accelerator Act, a key piece of legislation focusing on mid-downstream production stages, still under discussion

On 4th March 2026, the European Commission presented the IAA as a legislative proposal, currently under negotiation between the European Parliament and the Council. While the Battery regulation focused on the end link of the battery supply chain, the IAA seeks to boost demand for EU-made products, strengthening the midstream stages of the value chain i.e. refining; CAM production; cell assembly; battery assembly. **IAA leverages 4 main mechanisms, shown in Figure 9, to jointly strengthen EU battery manufacturing**: "made in EU" requirements, accelerated permitting procedures, foreign investments provisions and local-content threshold for EV components.

The IAA's main objective is to **raise the share of manufacturing in European GDP from 14.3% (2024) to 20% (2035)**, covering energy-intensive industries, net-zero technologies and the automotive industry.

Amending and building on the 2024 Net-Zero Industry Act (NZIA), the IAA introduces an explicit **"Made in EU" preference in public procurement and support schemes** for strategic sectors, including batteries. From the IAA's entry into application anticipated in 2027, at **least three key battery components**, including the cell, must be manufactured in the EU. In 2030, the target will be raised to **five components**, including the cell, CAM and Battery Management System.

"Made in EU" derogations can be used when requirements result in 25 to 30% additional costs, as they may lead to competition issues, technical incompatibility, or major

production delays. Small EVs benefit from more flexibility with less strict requirements: EU assembly and either at least 70% of non-battery local content or at least three local battery components.

The proposal includes **faster permitting mechanisms** to accelerate industrial projects: single digital access points to facilitate procedures, and permitting timelines caped at 18 months to ensure speed.

In addition, the legislation proposes **a 70% local-content threshold for the vehicle's non-battery components**. It also includes mandatory green steel, and tax incentives for company cars, accounting for 60% of new sales.

Finally, the IAA introduces **foreign-investment provisions**, primarily geared towards China. For any investment above €100 million involving a partner from a country holding more than 40% of global manufacturing capacity in the sector concerned, the investor must meet at least 4 out of 6 following conditions:

- 49% ownership cap
- joint-venture structure
- know-how transfer
- minimum 50% local workforce
- R&D investment in Europe
- share of components sourced locally

In targeting the midstream stages of the battery value chain, the IAA's ambition is to complement the Battery Regulation, which only addresses the end of the supply chain. The IAA provides incentives to produce in Europe and transfer technology rather than only assemble.

The regulation proposal is **expected to bring an impulse to support project development**. Streamlined permitting should help accelerate industrial projects, union-origin requirements should contribute to building lead markets for batteries, and foreign investment conditions should strengthen resilient local value chains.

4. **The IAA faces unresolved tensions and trade-offs that require calibration to effectively reach expected market impacts.**

As introduced in Figure 9 below, policy success will depend on addressing several structural constraints:

IAA proposed measures	Benefits	Risks
"Made in EU" requirements	Build lead markets for batteries	• **pCAM exclusion** perpetuating black mass exports out of Europe • Loose **cost-based derogation clause** loophole • Inconsistent **"made in Europe" definition**
Accelerated permits	Help accelerate industrial projects' development	
Foreign investments provisions	Strengthen resilient local value chains	**Balance openness to useful foreign investment**
Local-content threshold for non-battery EV components	Strengthen EU automotive value chains against value migration to Asia	Possible **increase** of overall **EV cost**

Figure 9: The Industrial Accelerator Act's expected impacts

- First, **pCAM remains a critical blind spot**. pCAM represents over 50% of the value of the battery cell[11], yet remains outside the scope of components subject to thresholds. Its exclusion undermines efforts to build a closed-loop EU recycling sector: without sufficient pCAM production capacity in Europe, exports of black mass to Asia will persist.
- Second, **the 20-30% cost-based derogation risks overuse, limiting regulation impact.** An origin requirement can be waived if the cost overrun of acquiring goods, services or works exceeds a threshold of between 20% and 30%, depending on the product and instrument, whether public procurement or support schemes[12]. With production costs higher in EU, this clause could become an easy way for car manufacturers to bypass the regulation, weakening the intended investment signal of the regulation.
- Third, **the "Made in Europe" clause remains a point of misalignment between countries, with some favouring a more exclusive approach to others**. As it currently stands, for public procurement, countries in the WTO's Agreement on Government Procurement (e.g., South Korea, Canada, Japan, Turkey, Norway, the UK) would be treated as equivalent. For support schemes, only free trade agreements and customs-union countries will qualify, explicitly excluding China and the United

[11] IAA will ensure most EVs sold in Europe will have batteries... | T&E
[12] The IAA proposal doesn't define how the estimated cost differences are measured. Costs are based on objective and transparent data and may be presumed by contracting authorities and contracting entities to be disproportionate (IAA proposal, article 11).

States. Depending on what is agreed, this could impact the end objective of creating a localised European production.

- Finally, an **overly restrictive Foreign Direct Investment (FDI) framework could block investments that would otherwise bring genuine technology transfer**. Of total announced European gigafactory production capacity over the decade, 43% come from Asian producers, mainly China[13]. Imposing know-how transfer requirements on China could also fuel diplomatic tensions, potentially resulting in restricted access to upstream value chain links dominated by China.

Recent EU debates have been shaped by the newly proposed joint Franco-German political position (appendix 3) which includes less ambitious IAA requirements for local battery production. Proposed thresholds for battery cells fall well below the EU's projected production capacity for 2028 and 2030. If adopted, it would send a weak signal for investment in additional European production capacity.

While the European battery industry is gaining momentum, its scale-up will depend on a combination of prerequisites: a tailored regulatory push mainly through the IAA, sufficient industrial capacities, sustained local demand, and the development of recycling to close the production loop.

Europe has already begun localising battery production, with projects emerging across most of the value chain. However, to help overcome some of the industry's difficulties, particularly around local midstream production capacity and technological transfer, a well calibrated legislative push is necessary to accelerate its development.

If adjusted, the current EU legislations, both implemented and under discussion, could provide a significant impulse to project development, facilitate technology transfer, and create demand through EU sourcing requirements despite higher prices in Europe. The EU Battery Regulation already structures the downstream value chain, targeting recycling and traceability. The CRMA targets the upstream part of the value chain, pushing for EU sovereignty over strategic material supply. The proposed IAA aims to structure the midstream, cell, CAM, and battery management systems, and steer foreign investment towards technology transfer.

Addressing some of the identified loopholes in the IAA remains a key factor in ensuring legislation's ability to effectively support the sector. The impact of the legislation will depend on: whether pCAM is included in local component thresholds, the level of the cost-based derogation, and how tightly "made in Europe" is defined. Without sufficient refining and pCAM capacity in Europe, the recycling loop the Battery Regulation organises will keep feeding refiners located outside Europe, mainly South Korea. By closing its gaps, the IAA can boost the competitiveness and resilience of the European battery value chain.

Yet, other factors will be critical in the sector's development, including: the pace of EV adoption, the health of the European automotive market and the sector's ability to align their timelines.

Meanwhile, key questions remain open-ended:

[13] Battery cell production in Europe: In which countries will European manufacturers dominate – and where do international companies want to gain a foothold? - Fraunhofer ISI

- Will Europe master technological know-how quickly enough to reach competitiveness and meet booming EV demand?
- How will other emerging battery technologies (i.e. LFP, sodium-ion, solid-state batteries) impact European demand and industrialisation strategies?
- And finally, will European NMC production value chain ever be independent from raw materials' sourcing thanks to sufficient volumes of recycled end-of-life batteries?

Appendices

Appendix 1: NMC value chain from extraction to final product

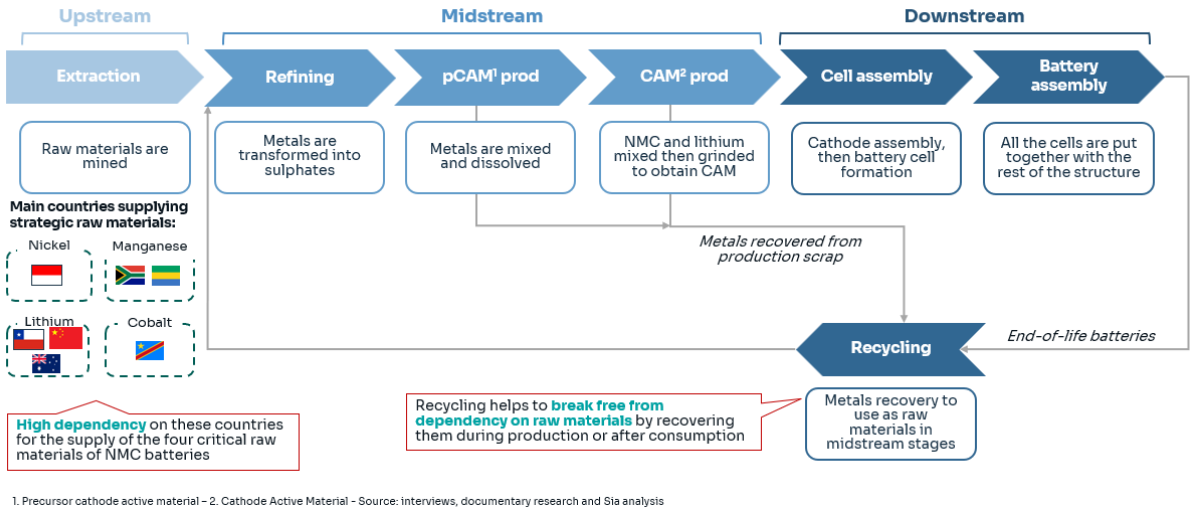


Figure 10 : NMC value chain from extraction to a final product

Extraction

The NMC upstream value-chain covers the mining of four critical raw materials[14]:

- nickel, largely in Indonesia (63.3%);
- manganese, in South Africa (37.3%) and Gabon (23.2%)
- lithium, mostly in Australia (35.2%), China (22.3%) and Chile (19.3%)
- cobalt, in the Democratic Republic of Congo (66.5%).

Refining

Once mined, the nickel, manganese, and cobalt are refined, separated from the rock and transformed into sulphates so they can be mixed. Lithium is transformed to lithium carbonate of hydroxide. While the metal ore is found in the countries mentioned above, refining capacities remain dominated by China (94.6% Manganese; 78.4% cobalt; and nickel 31.3%; most of the remaining nickel refining capacity is in Indonesia, where Chinese industrial groups, such as Tsingshan Holding Group, operate in joint ventures).

pCAM production

The pCAM (precursor Cathode Active Material) and CAM (Cathode Active Material) stages are critical in cell making because they strongly influence battery properties. Many innovations, aimed at improving driving range and charging performance for example, are developed during these production phases.

At the pCAM stage, nickel, manganese and cobalt salts are mixed and co-precipitated to produce precursor particles with the target NMC composition. The relative proportions of

[14] 2024 data: Beyond NMC batteries: Supply chain issues for emerging battery technologies – Global Critical Minerals Outlook 2025 – Analysis - IEA

these metals directly influence the properties of the cathode and of the battery cell. For example, NMC 811 (nickel, manganese, cobalt 8:1:1 ratio) offers higher energy density but generally lower thermal stability, whereas NMC 622 (nickel, manganese, cobalt 6:2:2 ratio) provides a greater trade-off between energy density, thermal stability, safety and cycle life.

CAM production

During the CAM production stage, grains of NMC are mixed with lithium via multiple heating processes. After cooling down, the obtained powder is grinded to obtain CAM. CAM can be doped with aluminium to improve thermal stability. CAM is then assembled with aluminium to make the cathode.

Cell assembly

The cathode, anode and electrolyte are subsequently assembled to form a battery cell. The cell is then put together with the rest of the structure, constituting the entire battery.

Recycling

Finally, end-of-life batteries are dismantled and shredded via hydrometallurgy or smelting processes into black mass, dark powder material containing the valuable materials. Black mass is then treated and recycled into new batteries, supporting a closed-loop value chain.

Appendix 2: EU battery-related regulations

EU Battery Regulation (2023):

Battery Regulation's targets are phased through 2036, starting with material recovery rates, followed by recycled content thresholds, as shown below in Figure 11.

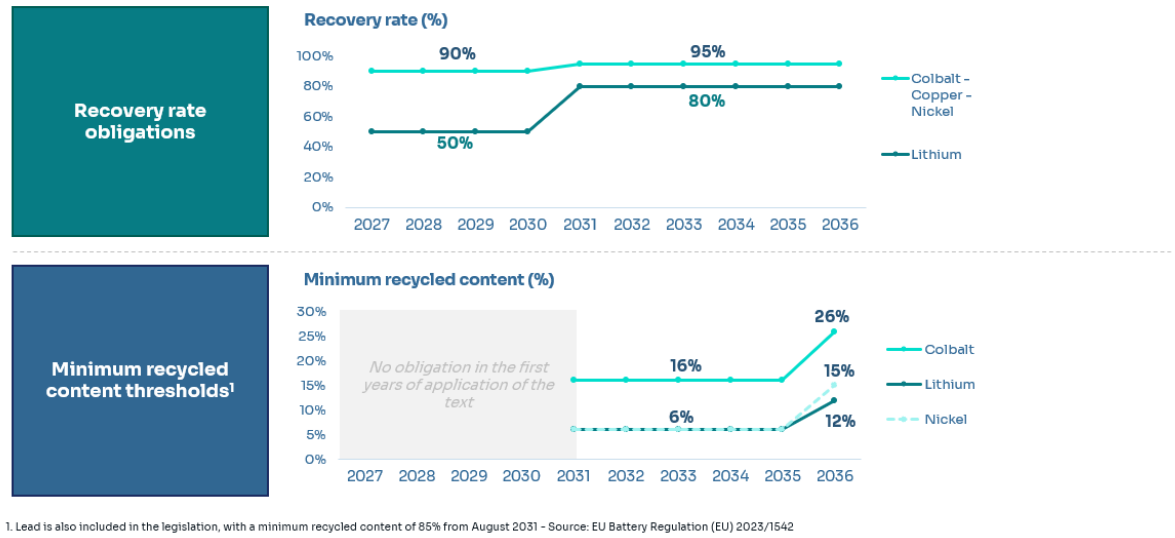


Figure 11: Battery Regulation recycling targets

1. Article 59 – recycling rates

The Battery Regulation aims to gradually strengthen the system-level recycling efficiency. By the end of 2030, facilities will be required to recycle 70% of a battery's total weight. Recovery rates mandated for cobalt, copper, nickel will reach 90% by the end of 2027 and 95% end of 2031. 50% of lithium will have to be recycled by the end of 2027, and 80% by the end of 2031 as presented below. While minimum recovery rates will help structure Europe's recycling value chain, hydrometallurgy is the only technology able to recover lithium at such high rates and should be favoured by the obligation.

2. Recovery rates and minimum recycled content obligations set by the Battery regulation 2023/1542:

Starting in August 2028, producers must declare the share of recycled battery materials, with binding thresholds starting in August 2031, with 16% cobalt, 6% lithium, 6% nickel and increasing in August 2036, with 26% cobalt, 12% lithium, 15% nickel. While manganese is also a critical material, it is not subject to specific rates because of its abundance. These thresholds implicitly create captive demand for recycled materials, indirectly pulling demand for local refining and CAM production. Europe needs to build the CAM capacity to absorb them, otherwise recovered metals are exported and reimported as finished cathode material.

3. Article 77 – battery passport[15]

From February 2027, the battery passport will be mandatory for EV batteries, Light Means of Transport (LMT) batteries for small EVs, and certain industrial batteries.

The legislation tackles a major recycling challenge by enhancing transparency on battery composition. Prior to the EU directive, standardising battery recycling was complex due to the wide range of battery chemistries and limited information on each battery composition. The legislation will oblige information on battery chemistry, performance and recycled content to be disclosed. However, as the legislation only applies to new batteries, and these will not reach the recycling stage for another 10 to 15 years[16], the existing issues are likely to persist until then.

Critical Raw Materials Act (2024):

- By 2030, 10% of the EU's annual consumption of strategic raw materials, including cobalt, nickel, lithium, and manganese, must be mined locally.
- 40% of the metals must also be processed within Europe,
- 25% of the materials must come from recycling
- Reliance on a third country cannot exceed 65%

[15] The entry into force on 18th February 2027 is confirmed, however the delegated act on the carbon-footprint calculation methodology (PEFCR) is still awaiting political decision although not really affecting the recycling push

[16] Electric vehicle batteries – Global EV Outlook 2026 – Analysis - IEA

Appendix 3: Implications of the Franco-German Agreement on the 16th of October 2026 Automotive Package for the European Battery Industry – Preliminary Analysis

On the 16th of October 2026, France and Germany announced a joint political position intended to advance European negotiations on the future of the automotive industry. This position proposes both to **relax climate targets** and to introduce **European preference** measures to support the sector considering competition stemming from China.

The Franco-German text must still be negotiated with the other Member States and the European Parliament. If approved, it will be incorporated into both the revision of the CO_2 emission standards for cars and the new European preference rules under the Industrial Accelerator Act (IAA).

The Franco-German agreement is the outcome of a compromise between the two countries:

Germany would secure a reduction in the planned phase-out of CO_2 emissions from new cars: a 90% reduction by 2035 compared with 2021, rather than the current 100% target. The agreement would therefore remove the obligation to offset the remaining 10%, as proposed by the European Commission. Additional flexibilities would also be introduced to help manufacturers meet their emissions targets. France had initially supported the existing target of 100% zero-emission cars by 2035, alongside other countries such as Spain, in order to protect investments already committed to electrification.

German manufacturers could therefore continue producing certain hybrid and internal-combustion-engine vehicles after 2035. This would give them more time to address the effects of Chinese competition in the European market and US tariffs.

In exchange for this concession, France would secure a strict "Made in EU" principle for electric-vehicle components, including batteries. The European preference scheme would aim to prevent European plants from becoming mere assembly sites for Asian components. Germany had initially advocated for a broader "Made in EU" scope, including partner countries such as Morocco and Türkiye.

Only vehicles actually manufactured in the EU would be eligible for European subsidies and public procurement. The requirements imposed under the European preference scheme would be phased in until 2034, as shown in Figure 12:

	Non-battery components produced in Europe	Battery components produced in Europe	
2028 - 2029	Min 70 %	**Min 10 %**	3 main components principaux, including cells
2030 - 2032	Min 70%	**Min 20 %**	3 main components principaux, including cells
2032 - 2034	Min 70%	**Min 70 %**	5 components, including cells, CAM, and BMS

Figure 12: Minimum production thresholds in Europe by period, for non-battery components and battery components

The Franco-German proposal on European preference for batteries is less ambitious than the IAA proposal announced in March 2026. The latter would require, from 2027 onwards, at least three key battery components, including the cell, to be manufactured in the EU; from 2030 onwards, this would increase to five components, including the cell, cathode active materials (CAM), and the battery management system.

The adoption of the main provisions of the Franco-German agreement is likely, given the joint influence of France and Germany on the European Commission and other Member States. The main point of disagreement remains the definition of "Made in EU", which Nordic countries and the Netherlands consider overly protectionist.

The impact of the Franco-German agreement on batteries therefore plays out on two fronts.

First, the relaxation of carbon-emission rules and the continued sale of certain hybrid and internal-combustion-engine vehicles after 2035 could reduce future demand for electric vehicles, and therefore for batteries.

The *Institut Mobilités en Transition* estimates that, under current legislation, electric cars would account for 52% of new vehicle sales in 2030 and 100% in 2035. Under the Franco-German agreement, electric cars would account for only 40% of new sales in 2030 and 72% in 2035. Without a strong regulatory push for electric vehicles, manufacturers could therefore be more likely to favour hybrid vehicles, resulting in lower battery demand.

Second, European preference would provide much stronger protection for vehicle assembly in Europe than for battery production in Europe.

The battery is the most strategic element of the value chain, accounting for around 30–40% of a vehicle's total cost. Once the 10% battery threshold is met, a car assembled in Europe, even if fitted with a battery made predominantly of Chinese cells, could qualify for the "Made in EU" label and associated benefits in 2028. The incentives for the investments needed in the value chain would therefore be very limited. **In our view, there are three main reasons why the proposed protection is insufficient:**

First, the **threshold is not sufficiently stringent**. More than 50% of the cells used in electric vehicles sold in the EU were already produced in Europe in 2025[17] and announced European production capacity for 2028 and 2030 far exceeds the proposed threshold. Set at 10% for batteries, this threshold would therefore not encourage manufacturers to source more cells produced in Europe, which are more expensive than those imported from Asia. By comparison, Transport & Environment estimates that the stricter requirements initially proposed under the IAA could potentially increase European battery demand by 34% as early as 2027, compared with a scenario without such requirements. The resulting uncertainty over demand would weaken investment in additional production capacity across the value chain. According to T&E, without guaranteed offtake, European gigafactories could face a risk of underutilisation amounting to 164 GWh of capacity in

[17] 19-11-2026_IAA_Briefing | T&E

2027, equivalent to around 2.3 million vehicles, and 254 GWh in 2030, equivalent to 3.6 million vehicles.

Furthermore, **the gradual increase in thresholds appears slow.** Battery-production momentum could build too late for the EU to ultimately catch up. By 2032–2034, the competitiveness gap with China could have widened to such an extent that it may become impossible to close.

Finally, like the IAA**, the Franco-German agreement does not cover cathode active material precursors (pCAM).** This strategic segment of the production chain, which accounts for more than half of a cell's value, is currently largely dominated by China.

Without guaranteed European demand, local pCAM capacity would struggle to develop. The consequences for recycling would be significant. Nearly 60%[18] of European "black mass", the powder containing materials obtained from shredding production scrap and end-of-life batteries, is exported outside the EU. Without sufficient local pCAM production, European recycling would continue to supply refiners, predominantly in China and South Korea, rather than providing feedstock for European plants. **This situation would not contribute to securing Europe's long-term access to critical materials, as it would maintain substantial dependence on refining and processing capacity located outside the European Union.**

By protecting the location where vehicles are manufactured, while at this stage giving more limited attention to where batteries are produced, Europe would help preserve its automotive industrial capacity. However, this approach could limit the strengthening of its, even partial, autonomy from China in strategic segments of the value chain, particularly access to critical materials and cell production.

The flexibility granted to manufacturers to market certain hybrid and internal-combustion-engine vehicles after 2035, if not accompanied by sufficiently strong incentives for battery production in Europe, could weaken the signal sent to stakeholders across the electric-vehicle value chain. This risk arises at a particularly sensitive time for the European battery industry.

[18] Europe's waste creates value elsewhere | T&E

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