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A circular battery plan for Europe

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KEY MESSAGES

1. Europe has a narrow window to close the battery loop; it requires to build local capacities along the full supply chain before 2030[1]. Without precursors of Cathode Active Materials (pCAM), Cathode Active Materials (CAM), Anode Active Materials (AAM) and cell manufacturing in Europe, the recycling business case remains very fragile. This is due to the very economics of recycling, which are conditioned to the existence of both (i) feedstocks (in the short term, scrap from gigafactories) and (ii) downstream European demand for recycled materials. Europe must therefore localise industrial know-how and innovation capacity along the value chain to de-risk high-quality recycling, as well as to unlock economies of scale which determine the viability of recycling plants. The forthcoming Circular Economy Act (CEA) and next Multiannual Financial Framework (MFF) offer a decisive window to build a coherent architecture to support a circular economy.

DIAGNOSTIC

2. Closing the battery loop requires to deploy measures around six mutually reinforcing pillars::

- **Pillar 1. Establish a taxonomy.** It should differentiate recycling activities and identify vital segments of a genuine EU localized circular economy, in order to tailor policy measures accordingly. Current market structures favour low-value pre-treatment activities (shredding, trading, and exporting black mass) over domestic hydrometallurgical refining and upstream segments (i.e. pCAM and CAM manufacturing). Without intervention that distinguishes recycling activities, Europe risks remaining an intermediary in the value chain rather than capturing the environmental, industrial, and strategic benefits of circularity.
- **Pillar 2. Internalise end-of-life costs.** Apply harmonised accounting provisions obligations tied to Extended Producer Responsibility (EPR), so that recycling costs are embedded in OEM decision-making from the design stage (and not deferred to Producer Responsibility Organisations' (PRO) contributions). Ultimately, it is important to spark an internal dialogue between finance and engineering divisions along with an incentive to consider the best practices and choices in terms of battery design, chemistry, accessibility and reparability or in terms of business model attached to the battery component lifespan, and guarantees that the system is financially solvent over the long run.

1 2030 is the target year for 25% of the EU's domestic consumption of CRMs to be supplied by recycling in the CRMA, as well as a key date to reduce dependencies according to the ResourceEU Action plan.

IDDRI

- **Pillar 3. Trace and retain feedstock.** Improve black mass classification and apply degressive black mass export quotas or progressive restrictions differentiated by chemistry, as it is a prerequisite for any bankable hydrometallurgical investment. To mitigate circumvention risks, a Joint Research Centre (JRC) mandate should include a dedicated enforcement design, specifying: the competent authorities responsible for export controls, the customs verification procedures to be applied at exit points, and the reporting obligations for exporters. The newly established Critical Raw Materials (CRM) Centre can play a key role to ensure material retention and financial de-risking.
- **Pillar 4. Secure domestic offtake.** Condition support to pCAM and CAM producers to offtake contracts with EU recyclers. The Battery Regulation should be amended to embed recycled-content rules with EU-origin incentives, creating a secured lead market.
- **Pillar 5. Bridge the investment gap.** Use targeted and earmarked funding in the future MFF for the battery supply chain and for battery recycling, including instruments such as OPEX support, de-risking private capital.
- **Pillar 6. Develop a harmonised battery reparability index.** Mandate the JRC to develop a harmonised battery repairability index by 2028 in the CEA, before complex designs prevent repairability.

RECOMMENDATIONS

3. Local circularity capacity building can catalyze credible and renewed industrial cooperation with international partners. Building genuine local circularity is not a push for autonomy but an enabler of credible cooperation and a level playing field. For instance, Clean Trade and Investment Partnerships (CTIPs) can shape new trade relations with partner countries. Yet, if Europe does not succeed in mastering the industrial and technological know-how of each segment of the value chain, it cannot guarantee offtake and therefore be a credible trade partner. To provide a concrete example of cooperation enabled by improved circularity policy: if Europe successfully tracks and restricts black mass exports, derogations and exemptions can be granted through the CTIP framework, while granting priority to EU producers at a negotiated price before exports. To contribute to the de-risking of EU value chains, refined battery-grade materials or pCAM produced from exported black mass originating from the EU (or an equivalent volume) could be counted as stock-piled or enter a hedging system guaranteed for European value chains security.

ACRONYMS

AAM - Anode Active Materials
CAM - Cathode Active Materials
CAPEX - Capital Expenditure
CEA - Circular Economy Act
CRMA - Critical Raw Materials Act
CRM - Critical Raw Materials
CTIPs - Clean Trade and Investment Partnerships
EPR - Extended Producer Responsibility
EVs - Electric Vehicles
HS - Harmonised System
IAA - Industrial Accelerator Act
JRC - Joint Research Centre
LFP - Lithium Iron Phosphate (lithium ferrophosphate)
MFF - Multiannual Financial Framework
NMC - Nickel Manganese Cobalt
NZIA - Net Zero Industry Act
OEMs - Original Equipment Manufacturers
OPEX - Operational Expenditure
pCAM - Precursor Cathode Active Materials
PROs - Producer Responsibility Organisations

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1. DIAGNOSIS: THE STATE AND STAKES OF A CIRCULAR EUROPEAN BATTERY VALUE CHAIN

1.1. What is at stake?

2026 marks a pivotal moment for Europe's battery sector. Gigafactories are beginning their ramp-up phase and EV adoption is accelerating (first quarter 2026 BEV sales were up a further 30% year-on-year, putting Europe on track for one in three new cars sold being electric by end-2026[2]). In such a rapidly evolving context, the choices made now on regulation, investment and industrial policy determine whether Europe will be able to set its own rules on circularity or depend on third-country supply chains in the long run.

For Europe, three critical imperatives are tied to developing a circular battery value chain (**Diagram 1**).

DIAGRAM 1. Three critical imperatives

ENVIRONMENTAL

Reducing pressure from extractive models; foster reuse, preventing waste tourism; enabling high-quality recycling over downcycling.

Key questions: how to avoid downcycling, support high quality recycling and avoid «waste tourism», incentivise eco design and repairable batteries?

SOVEREIGNTY

Safeguarding access to critical raw materials and reducing strategic dependencies, particularly on China to ensure a level playing field

Key questions: how to leverage and give value to Europe's urban mine, how to bridge a structural competitiveness gap with Asia?

ECONOMIC

Ensuring that European industry remains resilient to supply shocks and can sustain the economics of the green transition.

Key questions: which financial and regulatory tools can be used and which actors should be prioritised? how to strengthen the business model of recycling in Europe and ensure secondary CRMs are competitive against primary?

1.2. Why is capacity along the full value chain required to close the loop?

Diagram 1 reveals significant interlinkages within the battery value chain, which point to one unequivocal reality: Europe must build capacity sequentially but across the full battery value chain to enable local circularity. The IEA's Energy Technology Perspectives 2026 report[3] details that even where non-Chinese capacity exists across most of a value chain, a single bottleneck step is often enough to make the whole chain unviable. Therefore, battery recycling, refining, pCAM, CAM, AAM and cell manufacturing cannot be assessed in isolation: the absence or weakness of any one segment raises costs and undermines the business case for all the others. Achieving full-chain circularity thus requires coordinated support and dedicated tools at every stage, especially where dependencies are most acute[4].

Without the emergence of an integrated model covering everything from active material production to recycling, and ensuring control over supply flows, the European battery industry will remain an "assembly sector," structurally dependent on Chinese technologies and supplies.

1.3. Recycling stages and infrastructure gaps

Diagram 2 also reveals that the EU battery recycling chain splits into two structurally distinct stages:

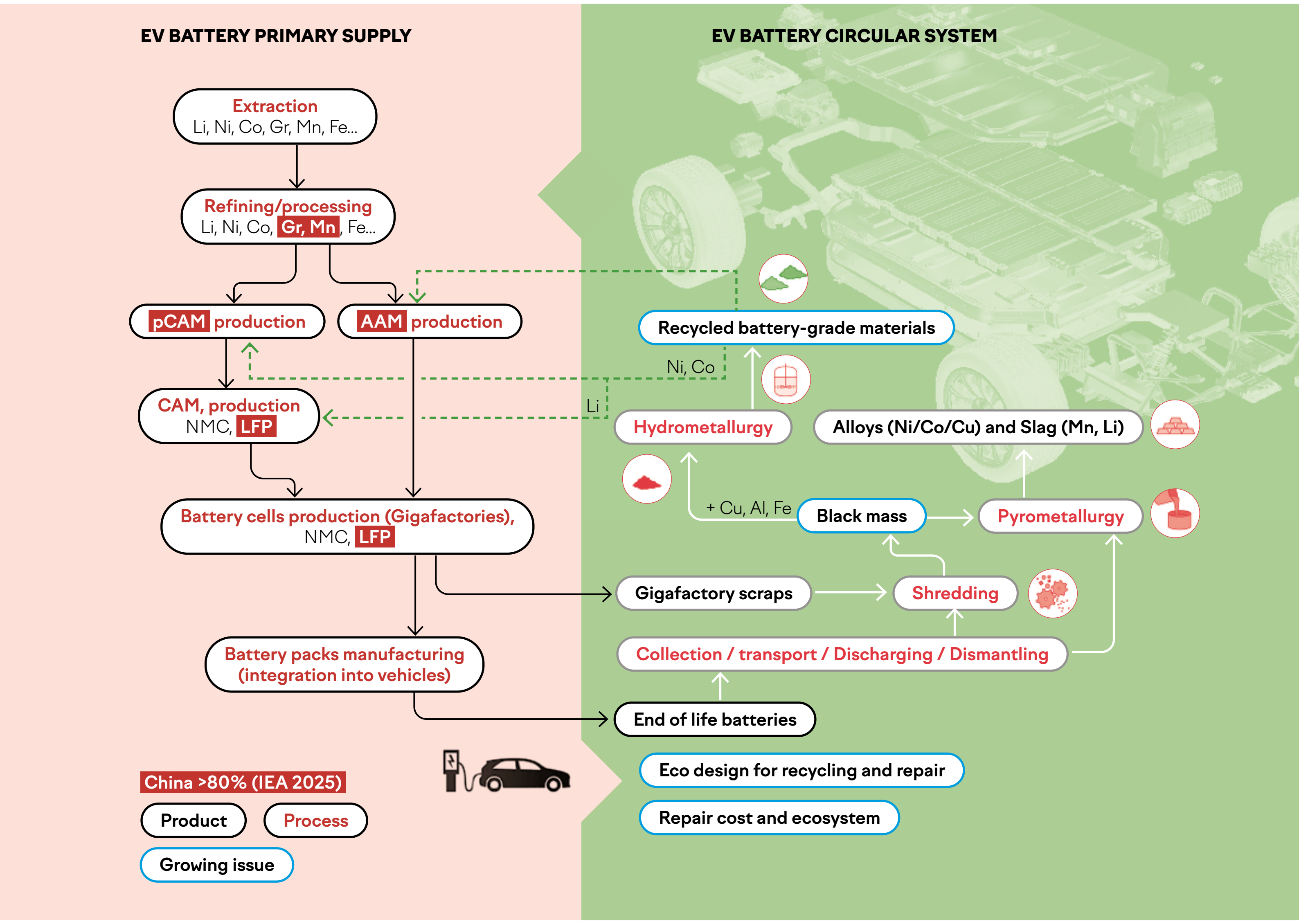
- Stage 1: Mechanical pre-treatment/"Spoke" Shredding and physical separation producing black mass.
- Stage 2: Hydrometallurgical refining/"Hub": chemical processing of black mass to recover battery-grade metal salts (lithium carbonate, cobalt sulphate, nickel sulphate, manganese sulphate) suitable for re-entry into active materials for cathode and anode.

2 https://www.iea.org/news/close-to-30-of-cars-sold-this-year-are-set-to-be-electric-as-countries-and-consumers-respond-to-energy-crisis

3 https://www.iea.org/reports/energy-technology-perspectives-2026

4 https://institut-mobilites-en-transition.org/en/publications/eu-battery-ecosystem-2/

DIAGRAM 2. **Representation of the EV battery value chain**



While "spokes" projects are well distributed across Europe, there are not enough "hubs" to absorb European black mass supply. **Europe produces significant battery waste but lacks the sovereign capacity to process it, exporting both material value and strategic autonomy.** As highlighted in a CEPS report[5], national strategies in Japan, India, or Australia are increasingly directing public funding and policy frameworks toward the recovery of specific critical materials rather than broad, undifferentiated recycling. (See **Box** page 6).

1.4. What is the magnitude of investments required to build circular infrastructures in Europe?

The gap between spoke overcapacity and hub undercapacity is partly due to a fundamental asymmetry in barriers to entry between these different stages. Pre-treatment requires low CAPEX investment and limited technology hurdles, with many players developing small factories under 10 kt/year black mass production capacity[6]. The subsequent hydrometallurgical steps are more complex and require higher CAPEX investment, higher OPEX and high technological competences. A paper estimates that chemically treating one kg of black mass costs approximately €23 in CAPEX, around 5 times less than the CAPEX of pre-treatment facilities (although the input is not the same)[7], which is consistent with industry data. For instance, based on the 2022 Primobius engineering cost studies[8], the CAPEX of shredding was

5 https://cdn.ceps.eu/2026/03/2026-01-ERCC-BATRAW-D7.8.pdf

6 https://rechargebatteries.org/wp-content/uploads/2025/03/RECHARGE-Black-Mass-Whitepaper.pdf

7 https://www.sciencedirect.com/science/article/pii/S0956053X25003733

8 https://wcsecure.weblink.com.au/pdf/NMT/02693032.pdf

BOX. DIAGNOSIS: URGENCY TO ADDRESS GAPS IN CIRCULAR INFRASTRUCTURES

Pre-treatment/shredding/production of black mass: Europe's pre-treatment capacity is actually well above its current feedstock volumes, in fact there is significant overcapacity at this stage. As of early 2026, Europe's operational pre-treatment capacity stood at roughly 8 times less than China's. This gap has narrowed since 2022, when the factor stood at 11.5x.[1]

Black mass exports/leakage: There is a clear lack of data and traceability of black mass flows. According to industry experts, an estimated 80% of European black mass leaks out of the EU, largely flowing to Asian refiners.[2] A recent trade flow analysis estimated that Europe was the top exporter of black mass between January and August 2025, exporting 98,653 tons of black mass.[3]

Material recovery/black mass refining capacity/hydrometallurgy capacity: Europe's critical weakness and need lies further downstream, in refining capacities, where European capacity is a little under 3, 000 tonnes and is already being outpaced by feedstock volumes. In contrast, China has 57 times Europe's hydrometallurgy capacity in early 2026, and the Chinese market is significantly under supplied[4].

Offtake and lead markets for recycled materials: Europe's recycled battery material supply chain has a critical missing link at the refining-to-pCAM and CAM stages. Beyond two commercial-scale pCAM facilities in Europe, the pipeline of planned projects remains fragile, contingent upon offtake commitments from gigafactories.

Second-life for batteries and reuse: Second-life applications face an economic challenge: Chinese LFP cells for stationary storage hit record low in 2025, a price point that repurposed European batteries, with their additional testing and reassembly costs, struggle to match. The long-term viability of second-life storage depends heavily on first-life battery costs, which continue to fall. Given this structural uncertainty, this policy brief focuses on the recycling loop, where the policy gap is most immediate.

Battery repair: while consumer-due and critical to EV adoption, is at a test and learn phase, compromised by new designs of battery packs that hinder access to modules and cells. Design heterogeneity compounds this: disassembly is still performed manually across the industry, and pack architectures vary so widely that some require up to 80% more effort to dismantle than others, directly affecting repair economics.[5] The trend in terms of battery design (accessibility, dismantling and hazardous substances) is worsening in that regard.

1 Benchmark Minerals Intelligence 2025

2 https://www.ifri.org/fr/etudes/la-fuite-de-la-black-mass-europeenne-dune-boite-noire-un-recyclage-strategique

3 https://pfa-auto.fr/wp-content/uploads/2026/06/260605-PFA-DGE-Battery-Recycling-2-Webinaire-VF4-S.pdf

4 Benchmark Minerals Intelligence 2025

5 https://www.sciencedirect.com/science/article/pii/S2589004221007550

around ~$5,700/tonne of annual capacity while hydrometallurgy CAPEX sat at ~$22,800/tonne of annual capacity (for a facility with a capacity of 12,000 tonnes/year). The same ratio also extends to OPEX: pre-treatment OPEX sits at around €1.3/kg of battery material, while it stands at roughly €4.7/kg of black mass hydrometallurgical treatment[9].

These numbers enable to deduct an order of magnitude of the investments required for Europe to develop hydrometallurgy capacity. Fraunhofer ISI (Q2 2025)[10] projects European battery returns (end of life and production scrap) at ~270,000 tonnes per year by 2030. Applying a blended black mass yield of 45-50% (the lower end reflecting the rising share of LFP chemistry, projected to represent 49% of European demand by 2030[11]) implies 120,000-135,000 tonnes/year of black mass to refine against under 3,000 tonnes/year of current European hub operational capacity in early 2026[12]. **Bridging that hydrometallurgy gap requires approximately €2.7-3.1 billion in CAPEX for hubs by 2030**, compared to ~€1 billion for spoke capacity that is already largely announced. For private capital to flow towards this specific refining segment, public support should contribute to its de-risking.

Europe also faces a structural cost disadvantage that CAPEX alone does not capture that will need to be bridged by public production support. As per a recent study,[13] hydrometallurgical recycling of NMC cells in France costs 70% more than in China; for LFP cells, the gap reaches 67%. The cost differential is driven in part by additional labour and energy costs, higher environmental compliance requirements, and dismantling and transport costs. This means that even a fully built European hub fleet would operate at a cost disadvantage relative to Asian competitors without sustained OPEX support.

The policy implication is that public instruments must address both the upfront investment gap through CAPEX de-risking, and the ongoing operating cost gap through targeted OPEX support mechanisms, particularly for the ramp-up phase where recycling economics are weakest and Chinese competition most intense.

1.5. Business models as an underlying cause of infrastructure gaps and of a black mass leakage

Beyond the abovementioned factors, the mismatch between overcapacity in shredding and undercapacity in hydrometallurgy is rooted in the economics of the two dominant recycling business models:

Buy-sell model, in which recyclers purchase battery waste streams, process them, and sell recovered materials on open commodity markets, absorbing full exposure to price volatility and feedstock risk. This is intrinsically linked to how black mass is priced: as a discounted proxy for its contained metals, based on the market valorisation coefficients. For instance, NMC black mass trades at ~50% of LME (e.g. ~2,990 €/t for NMC 523 in Feb 2025 on the Chinese market considering 8-10% Co and 25-27%Ni)[14]. The price of LFP is determined by its lithium content price coupled with market dynamics, for example for LFP black mass with 4-5%Li at ~60% of contained Lithium Carbonate Equivalent (~1,664 €/t)[15]. The discount coefficient fluctuates with market conditions, meaning black mass inherits the full volatility of underlying metals. The equilibrium is structural: black mass price and recycling cost must match virgin material costs, so any collapse in lithium or cobalt prices directly crushes recycling economics. It explains why European pre-treaters are incentivised to sell to the highest bidder, currently outside the EU, further discouraging the long-term investment commitments that European refining capacity requires.

Service-based or tolling model, in which recyclers act as service providers within a loop: processing waste on behalf of battery producers or OEMs, who retain ownership of the underlying resources, to supply active material producers. Recyclers receive a tolling fee, stabilising revenues and shifting material price risk upstream to producers. Examples of such industrial closed loops already exist in South Korea, with major actors such as SK On (battery producer) and EcoPro (CAM producer).

Only the tolling model is structurally aligned with genuine local and structurally aligned with EPR, as it creates a mutual liability across the value chain: material ownership is maintained across the value cycle, supply is anchored within contractual producer relationships, and metal price volatility is absorbed by the producer rather than the recycler. The buy-sell model is riskier: (1) it is based on material-rich chemistries (and can become non profitable as chemistries evolve) and (2) can lead to sovereignty yields only if regulatory intervention compensates for what market logic will not spontaneously produce: mandatory black mass retention within the EU and strong recycled content incentives.

The consequence of buy-sell dominance is a lock-in risk: as long as most revenues are captured through black mass trading, there is no sufficient incentive for any actor to commit to the CAPEX and long-term contracts that hydrometallurgical investment requires, especially considering the numbers outlined in section 1.4. Policy must ensure that market signals reinforce, rather than undermine, the case for investing in European refining capacity.

9 https://www.sciencedirect.com/science/article/pii/S0956053X25003733

10 https://www.isi.fraunhofer.de/en/blog/themen/batterie-update/batterie-recycling_europa_kapazitaeten_bedarf_update_2025.html

11 https://www.mckinsey.com/features/mckinsey-center-for-future-mobility/our-insights/battery-2035-building-new-advantages#/

12 Benchmark Minerals Intelligence

13 https://pfa-auto.fr/wp-content/uploads/2026/06/260605-PFA-DGE-Battery-Recycling-2-Webinaire-VF4-S.pdf

14 https://pfa-auto.fr/wp-content/uploads/2026/06/260605-PFA-DGE-Battery-Recycling-2-Webinaire-VF4-S.pdf

15 https://pfa-auto.fr/wp-content/uploads/2026/06/260605-PFA-DGE-Battery-Recycling-2-Webinaire-VF4-S.pdf

2. SIX CONCRETE RECOMMENDATIONS FOR AN EU CLOSED-LOOP BATTERY VALUE CHAIN

Against the backdrop described in Section 1, this policy brief identifies 6 key pillars with concrete measures to deploy:

- Pillar 1 establishes a clear classification (i.e., taxonomy) to differentiate "recyclers", identify vital segments of a genuine EU localized circular economy and tailor policy measures accordingly.
- Pillar 2 ensures the cost of recycling is integrated to producers' costs and creates accountability tied to EPR obligations via harmonised obligations on accounting provisions.
- Pillar 3 retains the feedstock, it is the prerequisite for any domestic refining investment, because no hydrometallurgical project is bankable without visibility and predictability on black mass access.
- Pillar 4 creates the demand that gives recyclers their offtake certainty and closes the loop, including by supporting intermediary segments' development and addressing the competitiveness gap with Asia.
- Pillar 5 sits underneath all pillars as the financial enabler, de-risking each pillar where the market gap is too large for private capital alone.
- Pillar 6 mandates the development of a harmonised battery reparability index in the CEA. (**Diagram 3**).

Pillar 1: A taxonomy to differentiate between recycling activities and tailor policy and support

A taxonomy to differentiate recycling activities and actors (pre-treatment and hydrometallurgy) is relevant to ensure that incentives and funding effectively contribute to a genuine circular economy, rather than value-leaking one.

More precisely, it enables to direct funds towards the hydrometallurgy segment and to address the current under-capacity in high-value infrastructures.

Policy recommendation

1. Therefore, it is recommended that **the EU formalises the distinction between black mass production from downstream material recovery activities through a dedicated taxonomy in the CEA.** This should be established from the CEA's entry into force to enable policy instruments - funding, state aid, offtake incentives, permitting prioritisation - to be directed specifically toward the refining segment, where critical materials are recovered and where Europe's leakage problem is most acute.

Pillar 2: The need for harmonised provisioning rules along with EPR obligations to de-risk and anticipate the future cost of recycling

The Battery Regulation[16] establishes EPR and requires producers to finance the collection, transport, treatment, and recycling of batteries they place on the market. Yet the regulation leaves critical financial assumptions (battery lifespan, second-life share, degradation rates, recycling costs by chemistry, future material prices) up to producers to determine, and therefore entirely unharmonized. The formal review of the text is planned for 2031, which is too late to address such pressing issues.

Three reasons why harmonised provisioning rules tied to EPR are essential:

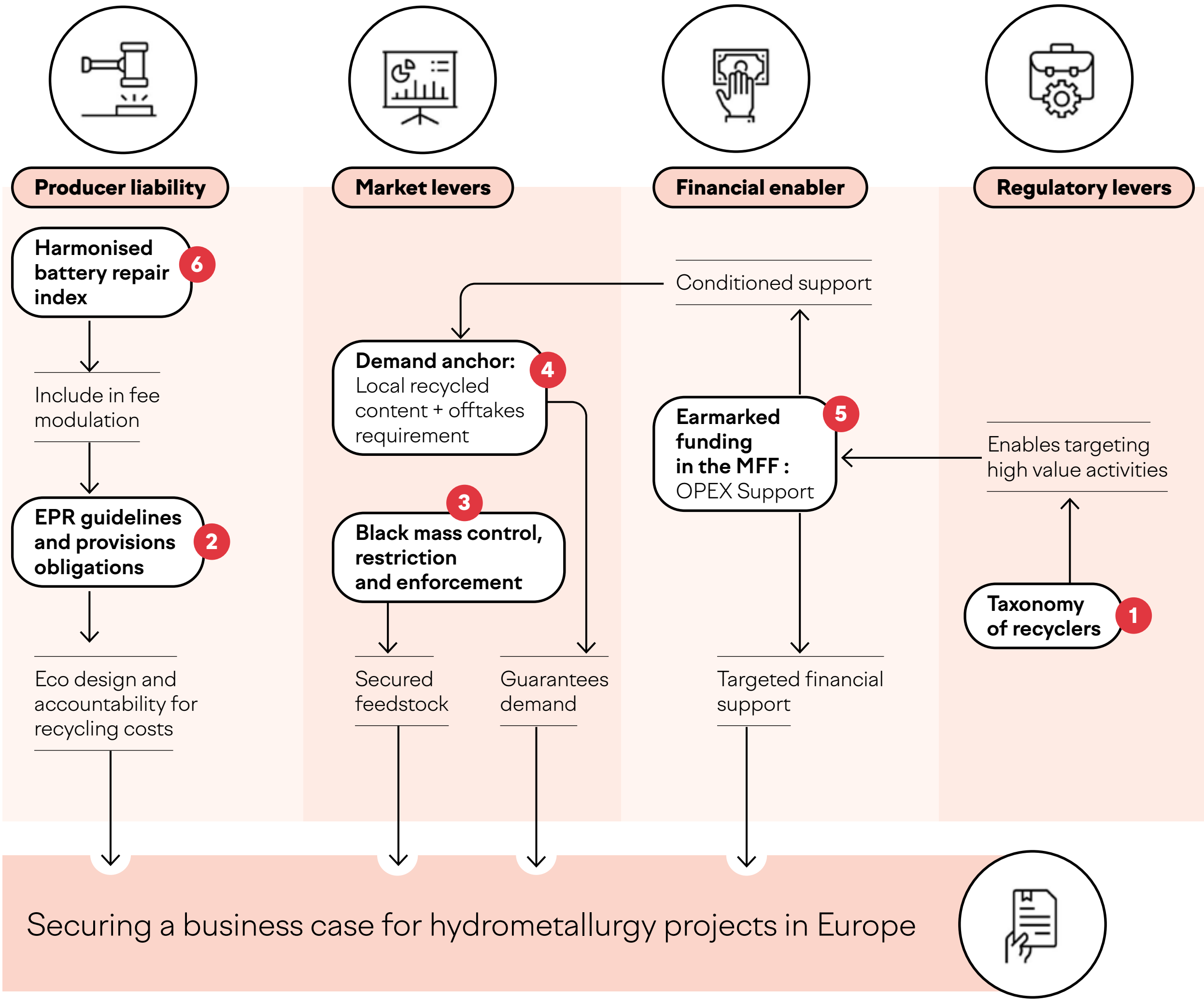
- **Heterogeneity obscures systemic risk.** Accounting practices for end-of-life obligations remain widely inconsistent across OEMs and the PROs they contract with, limiting comparability and undermining investor confidence. A recent IMT/EY study17 estimated that recycling batteries placed on the European market may cost automakers more than €1 billion per year, to be provisioned from 2026. Yet no common framework governs how this liability is calculated or disclosed.
- **The current financial equation and economics of PROs is temporary and structurally misleading.** As an example, in France, eco-contributions are collected at point of sale by PROs while recycling costs materialise 10-20 years later; generating an apparent surplus that masks a growing future liability. This apparent financial comfort rests on conditions that will not persist: material-rich NMC chemistries, black mass export routes, and still-limited end-of-life volumes. As LFP penetration deepens18 (a chemistry 30% cheaper to produce but commanding structurally lower recovered material values) the surplus will invert, exposing the economic fragility of today's models.
- **Without accounting provisioning, eco-design is not properly incentivised within OEMs vehicle development process.** When end-of-life costs are not financially integrated, they carry no weight during vehicle development, the phase where choices on battery chemistry, pack architecture, and repairability are made. The subject defaults to in-market commercial teams with no upstream accountability. Standardised provisioning attaches a quantified liability to these choices from the outset, forcing the conversation upstream and transforming a compliance instrument into a lever for eco-design. Only if financial, commercial and engineering

16 https://eur-lex.europa.eu/eli/reg/2023/1542/oj Article 56-58

17 https://institut-mobilites-en-transition.org/en/publications/towards-a-standardized-accounting-framework-for-ev-battery-recycling-provisions/

18 https://www.iea.org/reports/

DIAGRAM 3. Six pillars to support a circular economy for the battery value chain



divisions share the same stakes in the battery lifespan economics (through a proper shared provisioning exercise) the short-term cost cutting approach and the long-term financial liability can be confronted within the company.

Hence, the **design of robust standardized accounting provisions mechanisms to internalise this cost is essential.**

Policy recommendations

2. Mandate harmonised provisioning assumptions and guidelines across producers through a delegated act to be adopted by Q4 of 2027 so the first reporting year can be 2028, covering hypotheses on battery lifespan, second-life share, gross recycling cost per tonne by chemistry. LFP batteries should attract higher eco-contributions reflecting their lower intrinsic recycling value, while batteries with easier disassembly should benefit from fee reductions, embedding design-for-recycling and design-for-repair incentives directly into the EPR fee structure. These measures do not require new legal architecture; they extend and operationalise obligations already encoded in Article 57 of the EU Battery Regulation.

3. The JRC or Commission should consider the creation of an intertemporal reserve fund to which producers (individually or through PROs) provide a % of eco-contributions. It can be used either to finance cost and treatment of orphan batteries if any (OEM failing or disappearance from the EU market) or to support EU Strategic Projects (industrial, circularity...). It may take the form of an obligation imposed on Member States.

4. Mandate the JRC to scope the circumvention risk posed by non-EU producers and propose enforceable safeguards to address it by Q4 2027, in coordination with

the harmonised EPR guidelines. Non-EU OEMs' offshore provisions offer no guarantee of availability when recycling costs fall due. The CEA should require non-EU producers to either provision through a dedicated European subsidiary or secure equivalent coverage through contractual liability transfer to a European entity.

5. Leverage the CEA to ensure cross-border consistency through harmonised national EPR schemes. The above measures are only as effective as the uniformity of their implementation. The CEA should therefore mandate convergence of national EPR schemes across Member States, ensuring that provisioning obligations, fee structures, and enforcement standards do not fragment along national lines preserving the integrity of the single market.

Pillar 3: Ensure control and transparency over feedstocks: black mass and pre-black mass forms export restrictions

Black mass leakage (around 80% according to industry experts[19]) undermines investment in European hydrometallurgical capacity and the economics of this dynamic are compounding: it signals that local hydrometallurgy will not materialise, reinforcing the incentive to export black mass. Without intervention, market signals alone will not redirect these material flows.

Policy recommendations

6. Establish a dedicated, harmonised quality-differentiated[20] classification for black mass under Chapter 26 of the Combined Nomenclature by Q3 2026, providing legal certainty, enabling consistent enforcement, and ensuring that material flows can be tracked, controlled, and attributed within a coherent regulatory perimeter. Multiple and conflicting Harmonised System (HS) classifications for black mass currently coexist across Member States; this fragmentation directly undermines the enforcement of EU waste shipment rules and allows high-value fractions to leave the EU via reclassification. Furthermore, production scrap upstream of the black mass stage is inconsistently classified across Member States and can be exported as "intermediate material" outside waste shipment controls - the HS reform and JRC mandate should explicitly close this gap.

7. Mandate the JRC to prepare the technical foundations (timeline and mechanisms) for a delegated act on progressive black mass export restrictions by Q2 2027 in the CEA, after its classification as "hazardous waste" enters into force in September 2026[21]. The delegated act should: (i) apply differentiated timelines by chemistry (NMC, LFP, mixed); (ii) be calibrated against the ramp-up of hydrometallurgical capacity in Europe, with quotas tightening as domestic refining absorbs available volumes; (iii) cover both end-of life and production-scrap-derived material, including pre-black-mass forms (electrode scrap, defective cells/modules). Critically, the JRC mandate should include a dedicated enforcement design component, specifying the competent authorities responsible for export controls, the customs verification procedures to be applied at exit points, and the reporting obligations for exporters. Without this, export restrictions risk being circumvented through reclassification or routing via third countries.

8. Assign the CRM Centre a material retention, financial de-risking and compensation role, drawing on three mandates: (i) its matchmaking platform to connect domestic pre-treaters with hydrometallurgical refiners; (ii) potential set up of a price floor mechanism to provide transitional price stabilisation for pre-treaters absorbing the cost of redirected flows; and (iii) its CRM Financing Hub to de-risk investment in domestic processing capacity.

9. An additional option to secure feedstocks would be to condition financial support for gigafactories in the future MFF on sourcing contracts to shred and chemically treat their battery scraps with European recyclers identified as positive contributors according to the taxonomy.

Ultimately, such strengthened control and transparency can be a catalyst for cooperation with international partners. To provide a concrete example: if Europe successfully tracks and restricts black mass exports, derogations and exemptions for exports can be granted through the CTIP framework, while granting priority to EU producers at a negotiated price before exports. To contribute to the de-risking of EU value chains, refined battery-grade materials or pCAM produced from exported black mass originating from the EU (or an equivalent volume) could be counted as stock-piled or enter a hedging system to support Europe's economic security.

Pillar 4: Securing lead markets for European recycled materials: a protective shield and insurance for future offtake

Closing the loop in Europe requires a domestic market for locally recovered materials to enable hydrometallurgy recyclers to secure offtake agreements and raise private capital. For NMC batteries, pCAM is the pivotal intermediate between refined battery metals and new cells; for LFP batteries, the equivalent step sits at the CAM level. It is precisely here that European industrial sovereignty is most exposed. A credible

19 https://www.ifri.org/fr/etudes/la-fuite-de-la-black-mass-europeenne-dune-boite-noire-un-recyclage-strategique

20 distinguishing black mass grades by key parameters relevant to downstream refining: nickel/cobalt content, fluoride and chloride residues, copper/aluminium contamination, and chemistry segregation (NMC vs. LFP vs. mixed).

21 Commission Delegated Decision (EU) 2025/934 of 5 March 2025 amending Decision 2000/532/EC as regards an update of the list of waste in relation to battery-related waste.

circular strategy must therefore explicitly include the implantation of pCAM and CAM capacity needed to transform both virgin and secondary materials in Europe.

Policy recommendations

10. Condition public financial support in the MFF for pCAM (NMC) and CAM (LFP) public financial support on sourcing contracts with EU-based recyclers that must cover a minimum % of their sourcing. Any public support extended to pCAM or CAM producers can be made contingent upon binding offtake agreements with EU-based recyclers. This conditionality transforms industrial support into a structural demand anchor for the European recycling chain, ensuring that public investment generates a pull effect across the entire closed loop.

11. Amend Article 8 of the Battery Regulation through the CEA to embed local sourcing provisions within the recycled content methodology. Recycled content targets are only strategically meaningful if the recycled material is processed and refined within Europe, a distinction the current framework does not adequately capture.

12. Mandate the JRC in the CEA to conduct an impact study of the cost and timeline of these two measures by Q4 2027, ahead of the MFF, based on a public consultation.

13. Include a future criterion for Union-origin for recycled materials in the IAA Union-origin definition. Add a new milestone and requirement (e.g., aligned with the 2031-2036 recycled content targets of Article 8 of the Battery Regulation) to the union origin criteria for vehicles to include a criterion on EU-origin CAM and pCAM with a % of recycled materials.

In the short term, the proposed measures may indirectly affect the price of electric vehicles (EVs), but this impact amounts only to making visible an end-of-life liability that was already being deferred. Furthermore, Union-origin criteria in the IAA anticipate such added cost by pairing it with support schemes that bridge the competitiveness gap.

Pillar 5: Locking-in structural funding in the next MFF for the battery value chain

The policy measures outlined in the preceding pillars (EPR provisioning reform, black mass retention, pCAM and CAM implantation, recycled content conditionality) share a common prerequisite: they require large-scale, long-duration investment that current EU funding instruments are structurally unequipped to deliver. The Battery Booster Facility provided useful short-term support for cell manufacturers, but expires before 2028, creating a predictable and serious structural funding gap precisely as the sector enters its most capital-demanding phase.

The European Competitiveness Fund introduced in the future MFF (2028-2034) is the only EU budgetary instrument capable of providing the predictability, scale, and multi-year commitment horizon that this investment requires.

Policy recommendations

14. Confirm the new legal basis for EU-level production support under Article 18 of the EU Commission European Competitiveness Fund[22]. Article 18 "Production ramp up actions" should provide the legal foundation for EU-level OPEX support and offtake guarantees for cell manufacturing, battery recycling (hydrometallurgy), and pCAM and CAM production, ensuring that support is EU-wide in reach, conditioned on circularity criteria, and insulated from the distortions of uncoordinated national state aid.

15. Earmark dedicated envelopes within the European Competitiveness Fund (€234 billion allocated in total in the European Commission's initial proposal[23]) to battery circularity including high-value hydrometallurgy, as well as cell, module, pCAM, CAM and AAM manufacturing, especially for industrial scale-up.

Pillar 6: Repairability as a strategic lever: closing the inner loop

Circular economy strategies have overwhelmingly focused on recycling and end-of-life recovery. Yet, the inner repair loop is one of the highest-value interventions available: it preserves embedded material value, reduces demand for virgin inputs, lowers costs for consumers, and builds the local service ecosystems that underpin public acceptance of EVs. The urgency is growing: as battery architectures become more complex (e.g. cell-to-pack integration, structural bonding potted electronics) repairability is more and more jeopardised. The result is a market trajectory that increases lifecycle costs, forecloses second-life pathways, and embeds circularity failures at the design stage, precisely where they are most costly to reverse.

Policy recommendations

16. Mandate the JRC to develop a harmonised battery repairability index or standards, benchmarking existing national and sectoral approaches (including the French index under development), with a view to establishing a standardised EU methodology by 2028.

22 https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52025PC0555

23 https://commission.europa.eu/strategy-and-policy/eu-budget/long-term-eu-budget/eu-budget-2028-2034_en

17. **Integrate repairability scores into the Battery Passport as a mandatory disclosed parameter from 2028**, enabling downstream actors, fleet operators, and public procurement authorities to factor repairability into purchasing decisions.

18. **EPR fee modulation under Article 57 of Regulation (EU) 2023/1542 should explicitly reward repair-friendly designs through reduced eco-contributions**, embedding design-for-repairability incentives directly into the producer responsibility framework.

Together, these measures would transform repairability from a voluntary design choice into a regulated, measurable, and financially consequential parameter across the European battery value chain, placing Europe as a leader in that regard.

3. TENTATIVE TIMELINE FOR THE SEQUENCING AND DURATION OF THE FULL PACKAGE OF RECOMMENDATIONS

This timeline outlines the need for a coherent, sequenced and coordinated approach to deploy the measures detailed above.

2026

- September 2026 - Black mass classification as "hazardous waste" enters into force
- Q3 2026 - Publication of the EU Commission proposal of the CEA
- Q3 2026 - Establishment of a specific HS waste code for black mass flows
- Q4 2026 - Commission assigns oversight to the CRM Centre to sequence and monitor implementation across all six pillars

2027

- Q1-Q2 2027 - Introduction of a taxonomy of recycling activities
- Q2 2027 - JRC mandate to prepare technical foundations for black mass export restrictions delegated act
- Q4 2027 - EPR strengthening
  - Delegated act on harmonised provisioning assumptions and guidelines across producers
  - JRC mandate to scope circumvention risk by non-EU producers and propose enforceable safeguards
- Q4 2027 - Impact study on local sourcing provisions and recycled content methodology (within 12 months of the CEA mandate)

2028

- 2028 - Repairability
  - Repairability index/standards EU methodology to be established by JRC
  - Repairability scores integrated into Battery Passport as mandatory parameter
- 2028 - First reporting year under harmonised provisioning rules, to be provisioned in 2029. Inclusion or repair index as a fee-modulation parameter
- 2028 - Delegated act on progressive black mass export restrictions adopted, based on JRC technical foundations (Q2 2027); differentiated entry into force by chemistry

2028-2034

- Battery Booster Facility expires (funding gap starts) -> European Competitiveness Fund MFF period - Dedicated envelopes for battery circularity including high-value hydrometallurgy, cell, module, pCAM, CAM and AAM manufacturing scale-up
- 2029-2030 - Commission proposal to amend Article 8 of the Battery Regulation to embed local sourcing provisions within the recycled content methodology, ahead of the 2031 formal review
- 2031 - Formal review of EU Battery Regulation (Article 94)
- 2031-2036 - Entry into force of local recycled content targets under amended Article 8 of the Battery Regulation
- 2031 - Conditions on pCAM and recycled materials for Union-Origin criteria in the IAA

CONCLUSION

Altogether, these six recommendations constitute a coherent and complete regulatory and financial architecture for the circular battery value chain, one in which high-value recycling segments receive targeted support, EPR provisions generate the baseline financial discipline, black mass retention anchors feedstock flows, recycled content conditionality creates the demand signal, and MFF instruments bridge the residual competitiveness gap with Asian players and guarantee strategic industrial necessity. Repairability, an often overlooked yet critical lever for consumer trust in EVs is ensured.

Importantly, these measures are mutually reinforcing: none delivers its full effect in isolation, and sequencing matters as much as content. Strengthening EPR obligations without retaining black mass leaves the feedstock offshore. Retaining black mass without building domestic pCAM demand leaves refined recycled material without a buyer. Building pCAM without MFF funding leaves the competitiveness gap unbridged. Signalling a credible, time-bound implementation roadmap is therefore the critical condition for de-risking private investment: without it, each pillar remains necessary but insufficient.

The window to build this architecture is narrow: investment decisions being made today will determine whether European hydrometallurgical and pCAM and CAM capacity materialises at the scale required when end-of-life battery volumes surge in the early 2030s.

A circular battery plan for Europe

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