Achieving Circular Flow for EV Batteries in UK

MAY 2026

MARKET FORMING INTERVENTIONS FOR LOW-CARBON AND RESOURCE EFFICIENT INNOVATIONS

Sustainability is our business

Contents

This project addresses the barriers to accelerating market uptake of low carbon and resource efficient innovations

- The UK is home to a **fertile innovative ecosystem,** resulting in a wide range of novel **low-carbon, resource-efficient** materials, products and circular business models across many industry sectors.
- However, innovators face **economic, technical and organisational barriers**, reinforced by weak market demand and limited market-forming support.
- **Without targeted interventions** to stimulate demand, de-risk investment and align supply chains, high-potential innovations may not commercialise.
- Innovate UK (UKRI) and DESNZ funded this project to research **market-forming interventions (MFIs)** for the **automotive, chemicals and built environment** sectors.
- The project builds on existing research to define MFIs that drive growth, unlock private capital, enhance competitiveness and strengthen supply-chain resilience while supporting a **net-zero, circular economy**.
- The work was delivered by a combined consulting team between **October 2025 and March 2026.**

- **This report presents the findings of the project. The views and recommendations expressed are those of the authors and do not reflect official policy or government position.**
- This report concentrates on the **automotive sector,** specifically addressing **circular EV battery value chains**
- The project involved comprehensive engagement with stakeholders including automotive OEMs, vehicle and battery recyclers, battery repurposers, salvage yards, insurers, automotive material producers, and academics; however, no individual stakeholders are identified or attributed within the report.

This report has been prepared by:

ERM EigenVentures SCOPE 3 PEER GROUP

Funded by:

UKRI Department for Energy Security & Net Zero

The project was delivered in four distinct phases, with stakeholder engagement throughout, resulting in the identification of potential Market Forming Interventions

Project approach

This project was delivered in four distinct phases:

1. **Sectoral analysis and targeting** – prioritisation of innovative product, or service for intervention design within the sector. Identification of demand-side barriers for selected innovation.
2. **Defining Market Forming Intervention (MFI) types and enablers** – development of an "MFI toolkit" and understanding of suitability of MFIs to address different demand-side barriers
3. **MFI and enabler prioritisation** – shortlisting of suitable MFIs/enablers for design
4. **MFI and enabler design** – development of MFI/enabler design brief

Stakeholder engagement was critical throughout each phase of the project.

The detailed methodology, including the prioritisation of EV battery circularity, can be found in the Appendix.

What is an MFI?

Within the context of this project, an MFI is defined as a potential demand-side measure that seeks to accelerates the adoption of novel or alternative innovations or business models to reduce carbon emissions.

What are demand barriers?

When considering innovative materials, technologies or services, there are often significant barriers associated with supply-side (e.g. technology readiness). However, demand is not always forthcoming, even for innovations that are market-ready. This project focussed on unlocking **demand barriers** which have been categorised as:

- **Standards:** inability to describe in quantifiable and verifiable terms the innovation.
- **Value Perception:** Lack of regulation/policy incentives; too high price premium; lack of quantifiable non-financial benefits.
- **Demand Delivery Ecosystem:** Lack of necessary physical/technology infrastructure.
- **Disincentives:** Existing regulation, concerns on technology lock-in.

Please refer to the Appendix for more details on MFIs.

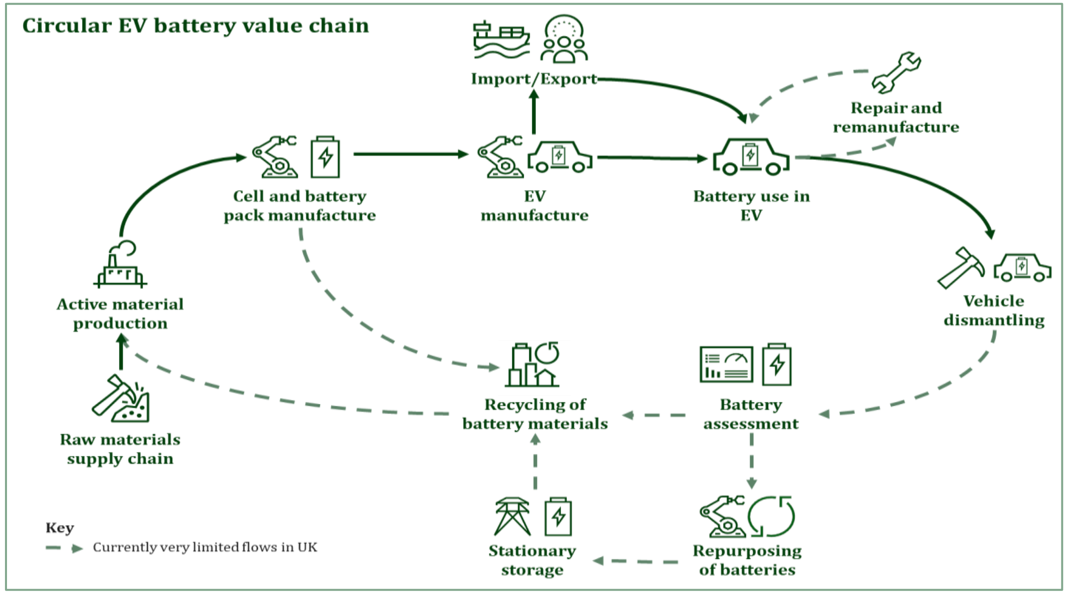
ERM

The automotive workstream focused on the opportunity to create a functioning and sustainable end-of-life EV battery value chain in UK

Low carbon and resource efficiency can apply to many areas of the automotive sector, with options to use less material, use sustainable materials or apply circular principles. The greatest area of unmet need and UK opportunity was found to be applying circularity in batteries, especially as battery electric vehicles (EVs) are rapidly increasing, but few have yet reached end-of-life. There are expectations of large quantities of EVs beginning to reach end-of-life in the next 5 – 10 years.

Batteries are a high value, potentially hazardous, electrochemical system with a material supply chain upstream. Once battery cells are manufactured into packs, installed in EVs and enter service, there are four potential fates for batteries*:

1. Repair of individual battery cells – *this is technically hard, but desirable where safe*
2. Remanufacture of battery packs into packs for use in other vehicles – *desirable where safe and viable, with some potential to scale up from low levels in UK*
3. Repurposing of battery packs for use in stationary storage applications - *desirable where safe and viable, but not well-understood and only practised to a small extent*
4. Recycling of batteries into new battery materials and other products – *essential regardless of 1-3, but limited by capacity in UK and also blocked by poor practice*



The project considered whether market-forming (demand-pull) or system-enabling interventions would be best for the UK, and found that two areas of enabling activity would be best to create a functioning, sustainable and future-ready system:

- Accelerate standardisation of end-of-life EV battery processes, which potentially supports #2, #3 and #4
- Address EV battery end-of-life stockpiling, which mainly supports #4

**It should be noted some batteries don't make it to proper treatment (e.g. leakage, informal reuse, non-compliant behaviour, used vehicle exports)*

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Eleven Automotive low carbon and resource efficient automotive (EV) innovation areas were evaluated

Areas evaluated were based on a foundation of research conducted by the Department for Energy Security and Net Zero (DESNZ)

Theme	Innovation Areas	Examples
Use less material	**Increased battery energy density**	Increased energy density at cell-level through novel battery chemistries and/or at pack-level through innovative pack design, e.g. structural battery packs.
	Increased power density of motors	Reduced use of rare earth metals through increased power density and alternative motor design
	Vehicle lightweighting	Use of alternative, lightweight materials *e.g. composites, high performance steels, aluminium*, and design of overall vehicle for lightweighting.
Use low carbon material	**Low carbon battery manufacture**	Less energy intensive manufacture, *e.g. dry electrode coating*, or use of renewable electricity.
	Low carbon materials	Use of alternative or lower embodied carbon materials, *e.g. green steel, biomaterials.*
Circular business models	**Repair and maintenance**	Design for repair, and repair and maintenance systems.
	Leasing and as-a-service models	Business models to lease materials, components, and whole vehicles.
	Second life battery business models	Repurposing of EV batteries, use in second life, and design for remanufacture.
	Battery recycling	Recovery of battery key minerals, *e.g. lithium, nickel, cobalt, manganese,* and use of recycled materials in new batteries.
	Magnet recycling	Recovery of rare earth metals from motor magnets, and use of recycled materials in new motors.
	Body parts recycling	Recovery of materials from vehicle body parts, including polymers, composites, and metals, and use of recycled materials.

ERM

Each innovation area was scored against evaluation criteria – EV battery circularity was identified as highest priority

Scoring used a 5-point scale with 5 being most suitable for intervention targeted and 1 being the least suitable

Theme	Innovation Areas	Environmental Factors		Market Factors			Economic Factors				Innovation Factors		
		Carbon reduction potential	Energy and/or Material efficiency gains	Policy and standards alignment	Impact on UK sector resilience	Stakeholder appetite, demand signals and domestic scale for MFI	Investment mobilisation potential	Market size and growth potential - domestic and export	Cost-saving potential	UK Job creation and skills development potential	UK innovation availability, maturity and scalability	Perceived innovator barriers to scale	Existing incentive structures for MFIs
Use less material	Increased battery energy density	4	4	4	3	4	5	4	3	3	3	4	
	Increased power density of motors	4	4	4	3	4	4	4	3	3	4	3	
	Vehicle lightweighting	3	5	4	2	3	4	4	2	3	4	4	
Use low carbon material	Low carbon battery manufacture	4	4	3	2	3	3	4	3	3	2	4	3
	Low carbon materials	5	3	3	2	4	5	4	2	3	4	4	
Circular business models	Repair and remanufacture	3	3	1	3	1	1	3	3	3	2	2	
	Leasing and as-a-service models	3	3	2	3	2	4	3	3	3	3	2	
	Second life battery business models	3	4	4	5	4	3	4	4	3	4	4	4
	Battery recycling	4	4	5	5	4	4	5	3	3	4	4	4
	Magnet recycling	4	4	4	5	3	4	4	4	3	3	4	3
	Body parts recycling	4	4	5	5	4	4	5	4	3	3	4	3

ERM

Non-negotiables

Prioritised Innovation Area/s for intervention targeting

Battery recycling and repurposing provides an opportunity to establish a resilient battery supply chain, create jobs, and support the UK's automotive industry [1/2]

What is the innovation being demanded?

- As the automotive sector transitions to battery electric vehicles (BEVs), implementing a circular economy for batteries at end-of-life must be prioritised.
- **Battery recycling** considers both the **recovery of critical materials** from end-of-life batteries and the re-use of materials in new batteries.
- **Repurposing EV batteries** for **second-life in stationary storage** at end-of-life in vehicles introduces an intermediate step before materials recovery.
- EV batteries can also be **repaired and remanufactured** to prolong utilisation.
    - This is expected to become a common offer as BEV adoption increases, and so does not require significant intervention.

What are the demand drivers?

1. **Waste management:**
    - As the uptake of BEVs in the UK accelerates, there will be a **high volume of batteries reaching end-of-life** in vehicles that must be managed.
2. **Growth of the UK EV manufacturing industry:**
    - At the same time, the **automotive sector** in the UK is transitioning to the manufacture of BEVs, creating a **high demand for new batteries** and an **ambition to establish UK-based battery manufacture**.
    - The **recovery of critical materials from recycling of end-of-life EV batteries** can be used for the manufacture new batteries.
3. **UK energy system needs**
    - There is also a growing **demand for batteries for stationary storage** to meet the needs of an increasingly renewable energy system.
    - **Repurposed end-of-life EV batteries** can be used for stationary storage instead of new.

Battery recycling and repurposing provides an opportunity to establish a resilient battery supply chain, create jobs, and support the UK's automotive industry [2/2]

What is the opportunity for the UK?

- As set out in the UK Battery Strategy, Modern Industrial Strategy, Critical Minerals Strategy, and Gigafactory Commission, batteries are a critical part of a decarbonised energy system in the UK.
    - Current battery value chains are highly concentrated and the UK is **vulnerable to supply chain shocks and geopolitical events**.
    - Recycling and repurposing provide an opportunity for **resilient domestic supply of battery materials** and **battery packs for stationary storage** respectively. The APC estimate that secondary battery materials could meet up to **20% of the UK's automotive battery demand by 2035** (approx. 13 GWh of material).[5]
- The UK government sees the establishment of **UK battery manufacturing as key to supporting the automotive sector** (directly employing 132k people[2]) as it transitions to BEVs, and provides an **opportunity for further high-skilled, advanced manufacturing jobs.**
    - Commercial recycling capabilities is a significant opportunity to provide a resilient supply chain to battery manufacturers.[2] The government has set a target of meeting 20% of critical minerals (not just battery materials) demand through recycling.
- Manufacture of batteries using recycled materials enables **compliance with EU Battery Regulation obligations** on recycled material content and to meet rules of origin requirements for trade, critical as 80% of the vehicles made in the UK are exported globally, largely to the EU.[2]
- Use of recycled materials in the manufacture of new batteries or the use of repurposed end-of-life batteries in second-life applications provides the opportunity to **lower the embodied carbon of the battery,** but quantification is highly use case dependent – see appendix slide**.**
- The UK Government are reviewing producer responsibility and placing on the market requirements for batteries. As part of this, consistency with the requirements of the EU Batteries Regulation in Great Britain is being considered

Sources: 1 - UK battery strategy , November 2023; 2- Modern Industrial Strategy, and Advanced Manufacturing Plan, June 2025; 3 - Critical Minerals Strategy, November 2025; 4 - UK Gigafactory Commission, Britain's Battery Future, January 2026,; 5 - Advanced Propulsion Centre UK, Automotive battery recycling landscape with the UK and EU perspective, December 2025;

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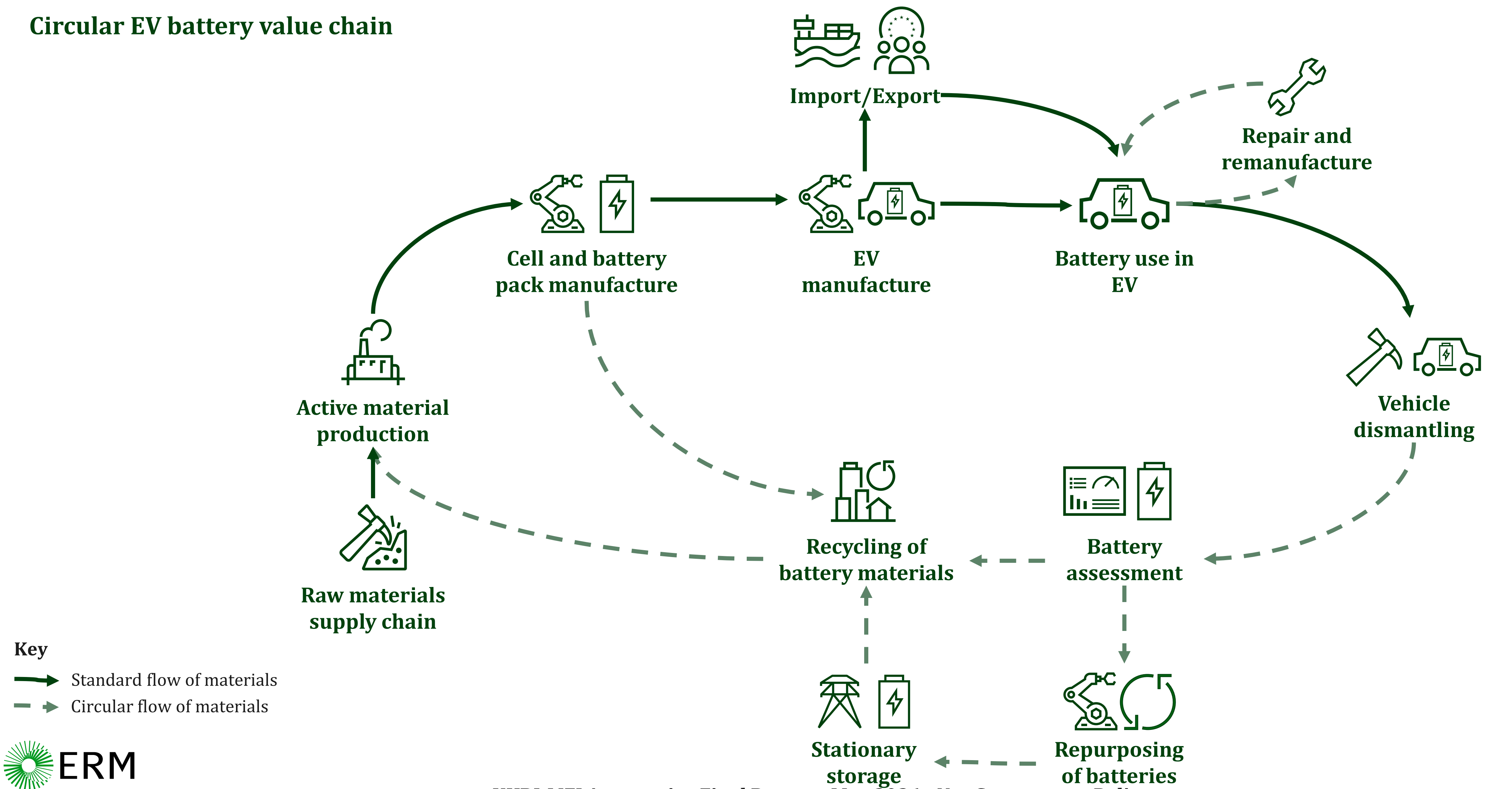
A circular value chain in the UK for EV batteries requires co-ordination between dismantlers, recyclers and repurposers, battery manufacturers, and vehicle OEMs



Existing **direct and indirect interventions** support battery circularity, including innovation funding and strategic aims

Further detail on the existing intervention mapping can be found in the Appendix

Interventions	Battery Remanufacture and Repurpose	Battery Recycling
Direct	• Direct, targeted tools for the UK second-life EV battery market are currently limited and strongest in early-stage innovation (prizes/challenges, R&D grants), such as through the Faraday Battery Challenge/Battery Innovation Programme, with some standards in place (BS EN 18061, PAS 706x) and industry activity in the RECOVAS project.	• The Faraday Battery Challenge/Battery Innovation Programme, the Advanced Propulsion Centre and critical-minerals funds back R&D, pilot plants and commercial scale-up across the battery value chain, including whole-life strategies and recycling projects such as ReLiB, CALIBRE and RECOVAS. • Mandatory producer-responsibility rules and the Waste Batteries and Accumulators Regulations ban landfill or incineration of EV batteries.
Indirect	• Most economic levers (subsidies, tax reliefs, capacity auctions, blended finance, public procurement) support the broader battery / storage ecosystem rather than second-life specifically – second-life projects can participate but are not singled out and have limited advantages. • EV battery circularity and recycling projects are also eligible for Advanced Propulsion Centre (Drive35) funding, although focus is on industry transformation at large. • The UK has several ecosystem / knowledge-building mechanisms that indirectly support second-life: (i) the UK Battery Strategy Taskforce and broader strategy emphasis sustainable and circular battery value chains, including reuse and repurposing (ii) The Critical Minerals Strategy stresses circular economy approaches and recovery of critical materials (iii) Government-commissioned and Faraday-funded research (e.g. the OPSS second-life safety study and Frontiers/UK-based reviews of second-life policy pathways) builds the evidence base for future regulation and business models. These measures improve the enabling environment but do not yet constitute strong, targeted market-creation instruments.	• Strategically, the Vision 2035 Critical Minerals Strategy aims for 20% of UK critical-minerals demand to be met from recycling and highlights midstream processing and recycling as areas to scale. • EU has targets for recycled content in batteries of 16% cobalt, 6% Lithium and 6% nickel by 2031 and 26%, 12%,15% respectively by 2036. With EU being the main market for many UK OEMs this will stimulate demand for recycled battery content in the UK. • EV battery circularity and recycling projects are also eligible for Advanced Propulsion Centre (Drive35) funding, although focus is on industry transformation at large. • Similar to battery remanufacturing and repurposing, the UK Battery Strategy Taskforce and broader strategy emphasises sustainable and circular battery value chains
Gaps/ Emerging	• Extended Producer Responsibility rules exist but do not yet clearly allocate responsibilities in second-life and no price support or supporting warranty mechanism are in place to manage risk and perceived performance and safety risk	• New blended-finance and guarantee instruments are emerging: UK Export Finance's Critical Goods Export Development Guarantee and related products provide up to 80% loan guarantees to critical-mineral suppliers, while National Wealth Fund and APC co-funding crowds in private capital for capital-intensive recycling and refining projects. • Ongoing Standards work led by BSI under the Faraday programme underpins future design-for-recycling requirements.

Demand for recycling and repurposing of waste EV batteries is currently hindered by low volumes, stockpiling, and lack of widely-accepted standards

The lack of certainty about the guaranteed volume of EV waste batteries is a significant barrier to meeting demand drivers, along with the lack of standardised and widely-used end-of-life processes, including dismantling and state of health evaluation.

Further detail on the barrier mapping can be found in the Appendix.

Stockpiling and value perception

Stockpiling contributes to a reduction of EV waste battery volume.

- Stockpiling can also be driven, in part, by the higher cost to recycle vs. temporarily storing waste EV batteries with the expectation of higher value in the future. High recycling costs are exacerbated by the lack of domestic processing capabilities, leading to the export of waste batteries for processing.
- Stockpiling is also being fuelled by the perception that the value of waste EV batteries will soon rise or should be higher, either due to their repurposing as stationary storage or for the critical materials contained within.

End-of-life EV battery standards

Lack of standardised and widely used end-life battery processes leads to treatment uncertainty and a lack of clear end-of-life options, as well as safety concerns.[1]

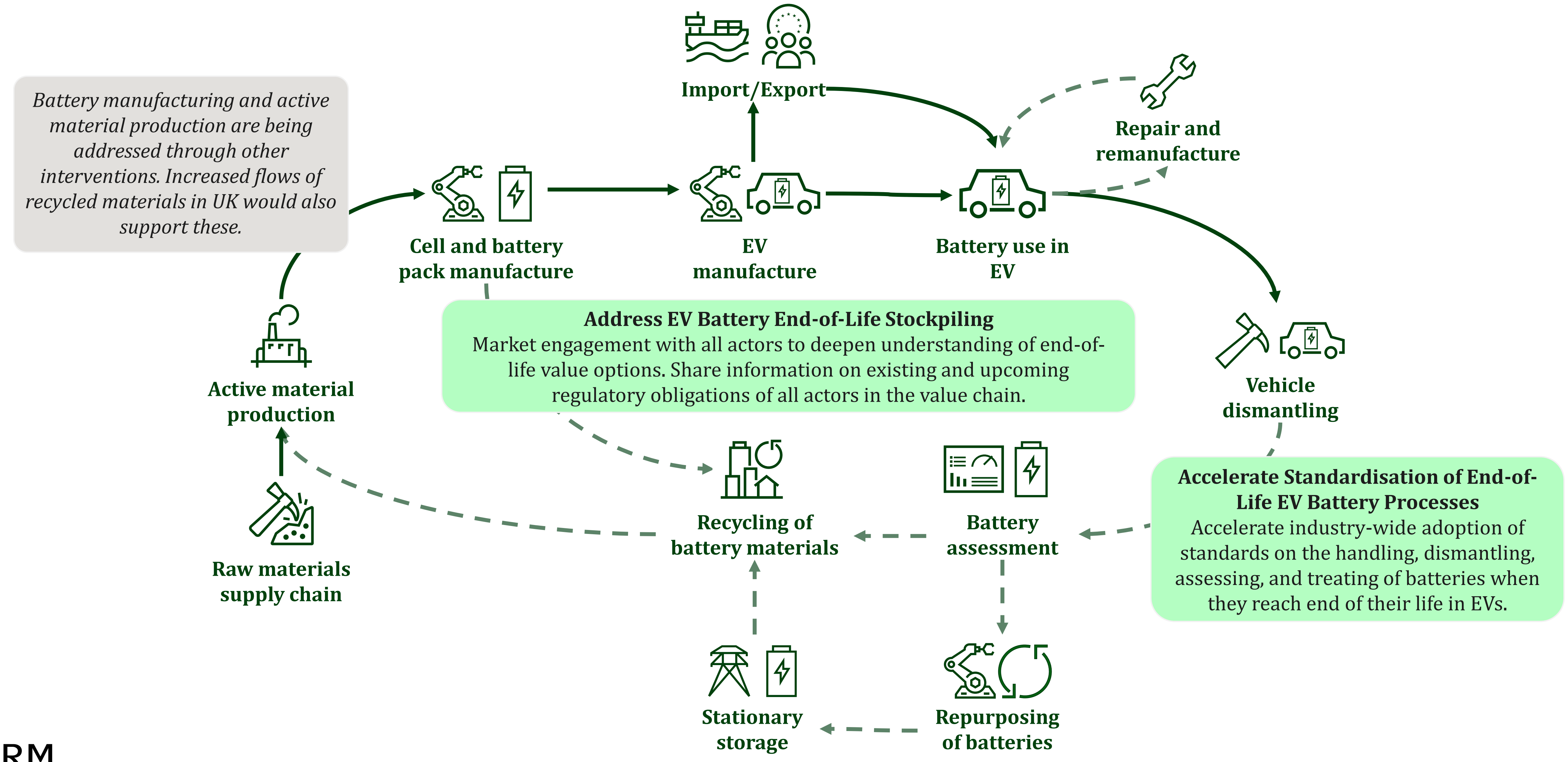
- Standards for the safe handling and dismantling of waste EV batteries
- Standardised state of health measurement and safety assessment for second-life

Domestic source of battery materials

- The lack of domestic end-of-life battery processing and recycling capability supports the export of waste batteries.
- It also creates a security of supply risk for the automotive industry's transition to EVs, as it inhibits the growth of domestic EV battery manufacture, forcing the sourcing of critical materials on an external market.

1 – Example of comprehensive end-of-life battery management standards in China set out on this slide

Enabling actions could help unlock the safe flow of EV batteries at end-of-life



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Safe flow of end-of-life EV batteries could be enabled by accelerating standards and raising awareness of existing obligations and market realities

As set out in the previous chapter, two enabler activities were identified based on the barrier and existing intervention mapping and discussion with stakeholders. These enabler activities are set out below, with expected outcomes and impacts described over the following slides.

Enabler Activity 1	**Accelerate standardisation of end-of-life EV battery processes, including safe handling, dismantling, assessing safety and state of health** • Review of existing end-of-life management standards, incl. adoption barriers and gaps. • Review of standards should align with regulations, with potential for future reforms considered.
Enabler Activity 2	**Address stockpiling by combatting incorrect value perceptions and ensuring understanding of end-of-life options and regulatory requirements across actors** • Market engagement campaign to address end-of-life EV battery stockpiling • Information campaign on existing and upcoming regulatory requirements

The enabler activities could provide a safe flow of EV batteries for repurposing as well as a source of recycled valuable materials

Outcomes

Enabler 1: Accelerate Standardisation of End-of-Life EV Battery Processes

Industry-wide adoption of standards (either new or updated standards) to dismantle, handle, assess, and treat end-of-life EV batteries, through:

- Industry alignment on pathway to standards adoption, including any identified further enabling actions.
- Fit for purpose standards and alignment with the UK's regulation on treatment of EV batteries at end-of-life to simplify compliance.

Enabler 2: Address EV Battery End-of-Life Stockpiling

Increased flow of EV batteries to repurposers and recyclers when removed from vehicles, as a result of:

- Industry-wide understanding of the value generation options for end-of-life EV batteries, including where the value can be accessed and how much value can be expected.
- Deep understanding across stakeholders of regulatory requirements of all actors in the value chain, particularly as the UK's regulations on batteries are reformed.

Impact

Maintained confidence in EVs through unlocked safe flow of end-of-life EV batteries to repurposers and recyclers

Increased use of repurposed batteries in stationary storage applications, and remanufactured and repaired batteries.

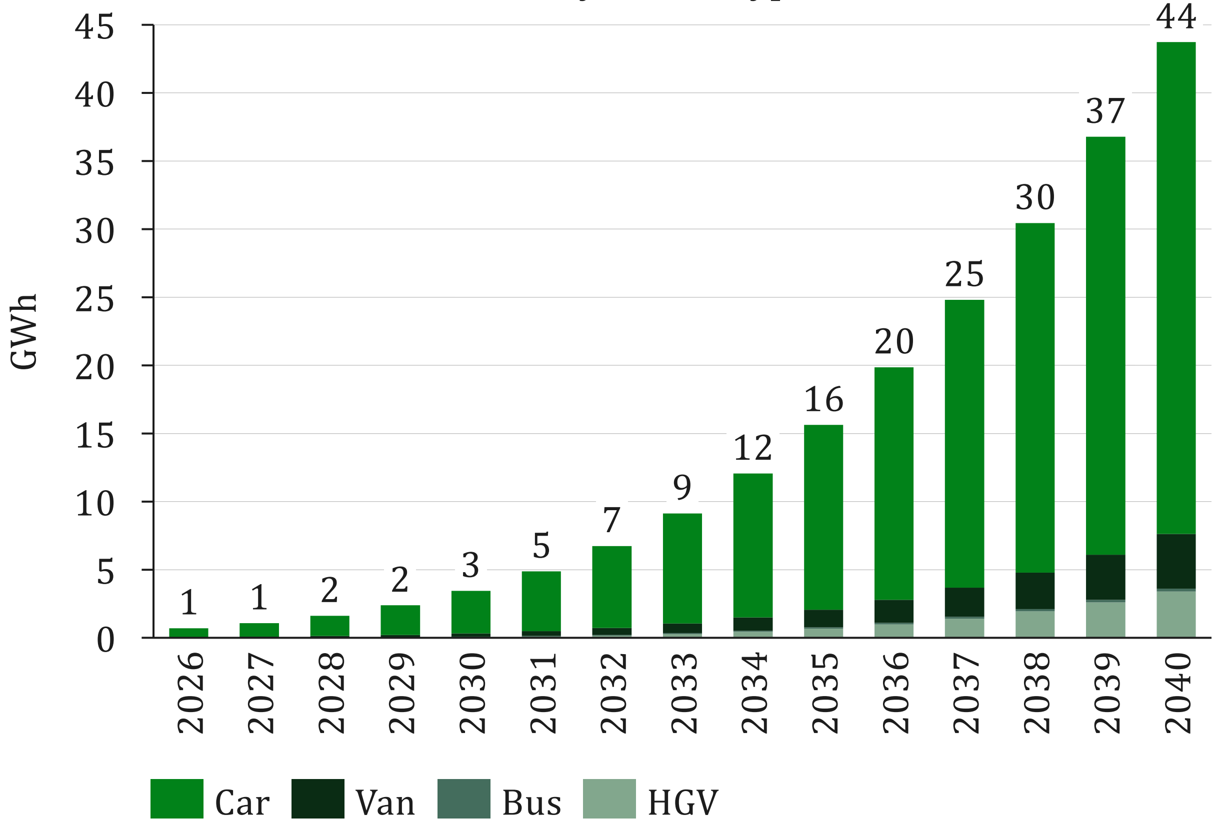
Increased demand for recycling and production of recycled battery-grade materials.

Growing EV uptake will support a predictable pipeline of end-of-life batteries in the UK

Rapid growth in end-of-life EV batteries creates a repurposing and recycling opportunity

- Considering the forecast electrification of vehicles in the UK and assumptions on vehicle scrappage rates, the annual BEV scrappage stock, by vehicle and battery type, [1] batteries reaching end-of-life in the UK can be estimated
  - This is shown in the figure on the right.
- As early generations of battery-electric vehicles begin to retire, the volume of end-of-life batteries increases steadily through the 2030s
  - This is primarily derived from cars but with an increasing proportion of Vans, Buses, and HGVs.
- This creates a large and increasingly predictable pipeline of batteries that could be repurposed or recycled.

Total annual capacity (GWh) of batteries from BEVs reaching end-of-life, by vehicle type[1]



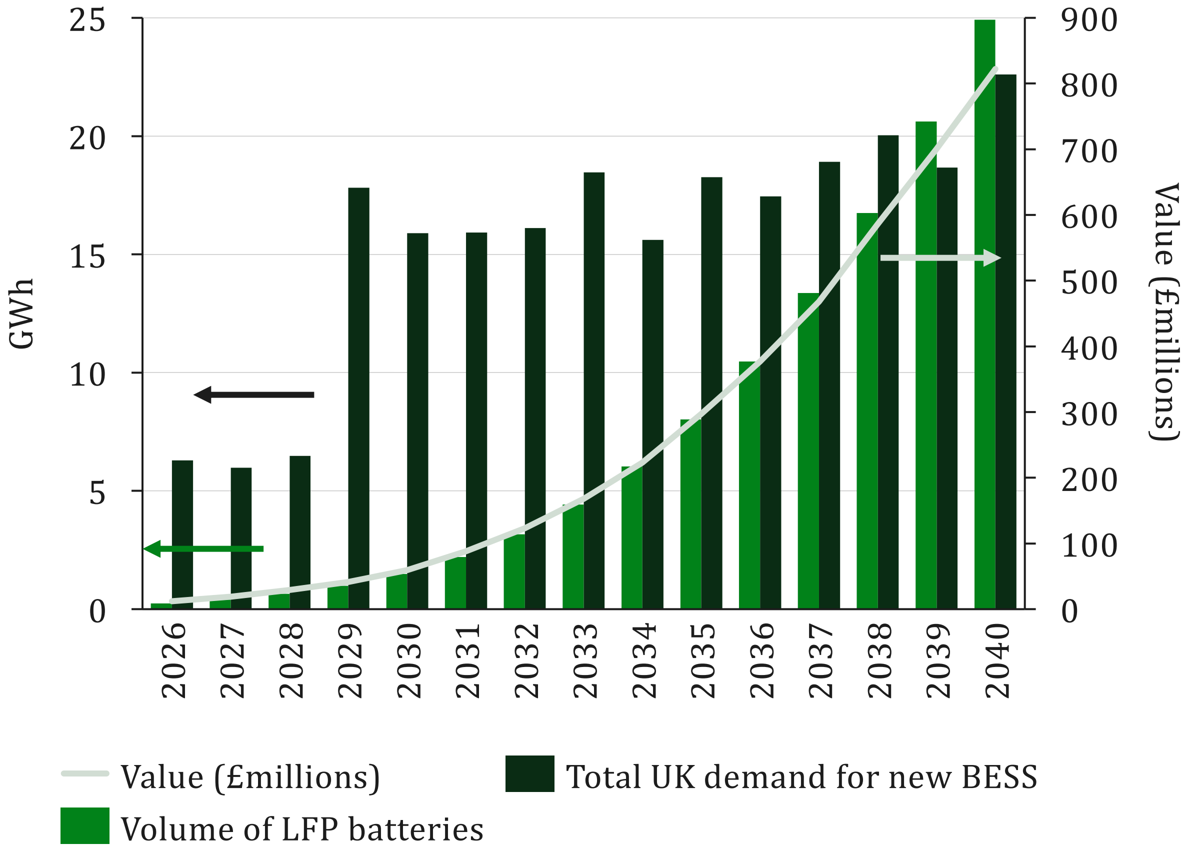
1: Modelling assumptions can be found in the Appendix

Repurposing could capture significant value especially from end-of-life LFP batteries with an annual BESS value of over £800million in 2040

Repurposed LFP batteries could be a key feedstock for BESS

- LFP batteries are well-suited to Battery Energy Stationary Storage (BESS), given their typically lower energy density and material content value than NMC batteries, which have better recycling economics. For this illustrative analysis, it is assumed that only LFP batteries are suited to BESS.
- As LFP batteries reach the end of their first life in BEVs, a growing volume of LFP batteries will become available for repurposing.
  - Our analysis (shown, right) shows end-of-first-life LFP battery capacity increasing steadily through the 2030s, reaching around 25 GWh per year by 2040.
  - For comparison, this pipeline will exceed the predicted total demand for BESS by 2040.[3]
- If suitable for repurposing for second-life use, this capacity would represent an attractive economic opportunity, with an estimated BESS value of these battery volumes reaching up to £822 million per year by 2040[1].
  - This is the value of purchases and potentially imports[2] avoided by UK BESS companies. Note that the actual price that BESS system manufacturers may be prepared to pay for repurposed LFP batteries may be lower than these levels so caution should be used in attributing a value directly to repurposed batteries.

Total annual volume of LFP batteries reaching end-of-life and the equivalent value of BESS, with total UK demand for new BESS[3,4]



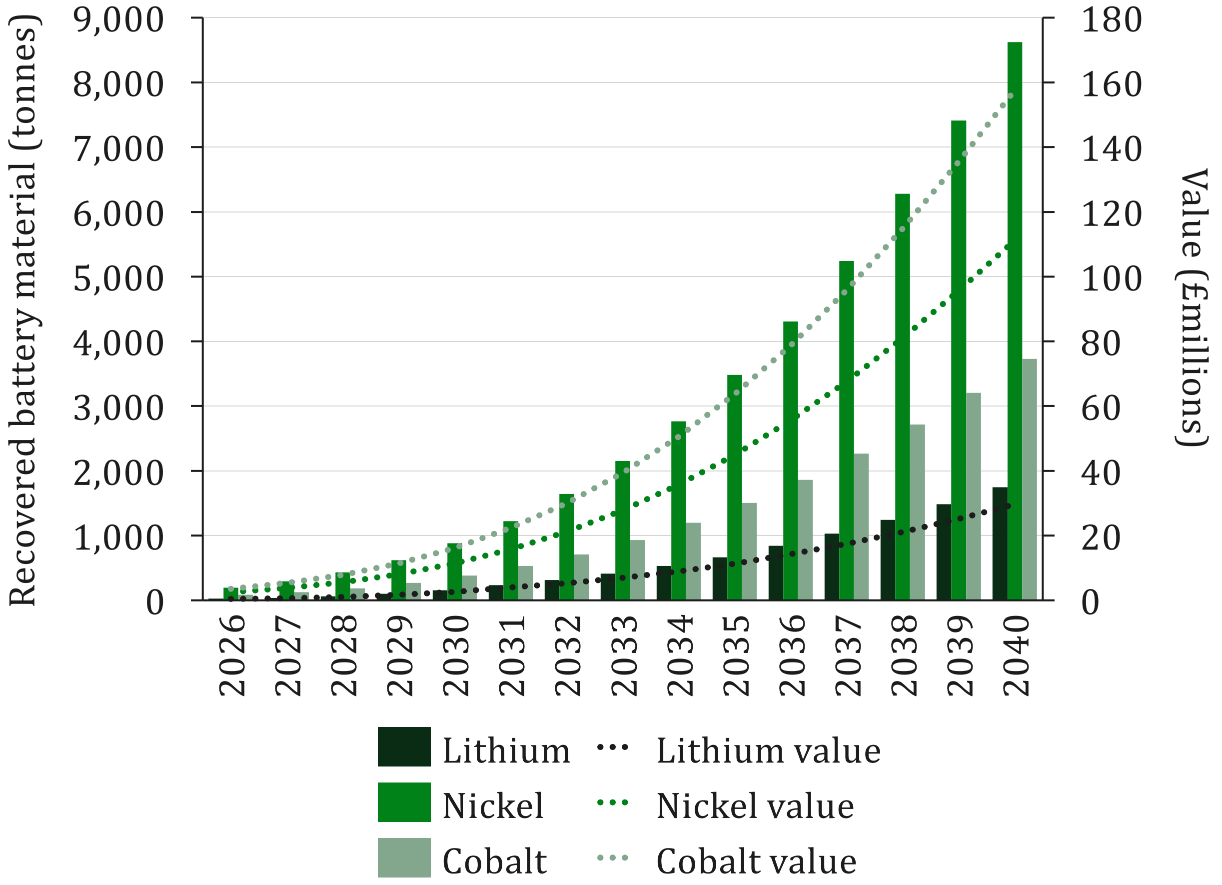
1: The total value for the second-life LFP batteries based on ERM modelling of the value (£/kWh) of battery packs for stationary storage using LFP battery pack cost estimate from BNEF 2025 and applying NREL ATB's Advanced scenario utility-scale energy storage system cost reduction curve.
2. Currently BESS deployed I the UK is all imported, though industrial strategy underlines the importance of UK manufacturing
3: Total UK demand for new BESS based on ERM modelling using forecast installed capacity data from Modoenergy and assuming regular augmentation. This includes BESS units with durations between 1 to 8 hours.
4: Modelling assumptions can be found in the Appendix and battery chemistry mix is based on BNEF Global EV Outlook 2023

Recycling end-of-life batteries could provide a valuable domestic source of critical materials

Recycling volumes and material recovery could also scale up significantly over time

- Following first- and potentially second-life use, batteries are assumed to enter recycling, enabling the recovery of valuable critical materials.
  - Currently the highest value materials are lithium, nickel and cobalt.
- Assuming second-life (repurposed) batteries operate for 10 years before entering recycling, the volumes of recovered lithium, nickel and cobalt are projected to rise sharply through to 2040, as shown in the figure[1].
  - The values (based on current commodity values) show these same trends. This highlights the opportunity of expanding domestic recycling capacity.
- Even with second-life use, expected end-of-life material recovery reinforces the case for investing in UK recycling infrastructure, strengthening supply chain resilience and reducing dependence on imported critical raw materials.

Total annual volume and value of recovered metals from vehicle batteries in the UK[2]



1: Total capacity recovered following a battery's second-life assumes a recycling rate for each battery material. Modelling assumptions can be found in the Appendix and battery chemistry mix is based on BNEF Global EV Outlook 2023

2: Forecasted values for recovered materials are based on current commodity prices reported by Daily Metal Prices (March 2026) – Lithium: £16.96/kg, Nickel £12.90/kg and Cobalt £42.28/kg.

Unlocking the flow of end-of-life EV batteries to repurposers and recyclers offers significant financial and other value to UK economy

Impacts	**Maintained confidence in EVs through unlocked safe flow of end-of-life EV batteries to repurposers and recyclers**	**Improved resource efficiency through increased use of repurposed batteries in stationary storage applications, and remanufactured and repaired batteries**	**Improved resource efficiency through increased demand for recycling and production of recycled battery-grade materials**
Quantitative value	• Zero unsafe stockpiling of batteries • Zero non-compliant sale of batteries	• Approx. 1.5 / 8 / 25 GWh of LFP batteries available for repurposing in 2030 / 2035 / 2040. Equivalent cost of new (potentially imported) BESS is £60 / 300 / 820 million in these years, which repurposed batteries may substitute • *GHG savings can be associated with using repurposed batteries for BESS, but these are highly dependent upon assumptions[2]*	• Approx. 11 / 43 / 115 kilotonnes of EV batteries available for recycling in 2030 / 2035 / 2040. Minimum viable processing scale for recycling plant profitability estimated as 10 kilotonnes p.a.[1] so approx. 1 / 4 / 10 plants required • Approx. £30 / 120 / 300 billion of recovered lithium, nickel and cobalt (at current commodity prices) available in 2030 / 2035 / 2040 • *GHG savings can be associated with recycling, but these are highly dependent upon assumptions[2]*
Qualitative value	• Safe flow of potentially hazardous batteries to professional handlers • Battery condition well-understood and most appropriate fate applied (repair, remanufacture, repurpose, recycle) • EVs recognised by consumers as sustainable at end-of--life	• Avoided imports of new BESS • Secure onshore supply chain and skills for battery repair, remanufacture and repurposing • Expected CO2 emissions reduction, although quantification is use-case dependent as discussed in the Appendix	• Values underpin business cases for UK investments in battery recycling and in midstream processing of battery materials • Retains battery materials in UK in line with Critical Minerals Strategy • Expected CO2 emissions reduction, although quantification is use-case dependent as discussed in the Appendix

Source: 1 – APC, Automotive battery recycling landscape with the UK and EU perspective, December 2025
Source 2 – Discussion of GHG savings from BESS and recycling are shown here

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Enabler 1: Accelerate standardisation of EV battery end-of-life processes

OUTCOME Accelerate the industry-wide adoption of standardised end-of-life EV battery processes by vehicle dismantlers, recyclers, and repurposers, to unlock the safe flow of end-of-life EV batteries to repurposers and recyclers, increase the use of repurposed, remanufactured, and repaired batteries, and increase demand for battery recycling. To achieve this, the following actions should be taken:

Proposed Activities

1.1 Review of existing EV battery end-of-life management standards

1.1 Proposed Activity Requirements

- There are existing UK standards on handling, dismantling, assessing, and treating batteries when they reach the end of their life in EVs, including BS EN 18061:2025 and PAS 7060/1. However, these standards are not widely adopted by industry. There are international examples of comprehensive end-of-life EV battery management standards, including China (see appendix).
- Stakeholders across the value chain, including vehicle dismantlers, EV battery repairers, EV battery remanufacturers, EV battery recyclers, EV battery repurposers, insurers, vehicle OEMs, policymakers, and standards bodies should be convened to carry out a detailed review of these standards. The stakeholders should be convened by an industry association, such as the Association of British Insurers (ABI), with the process modelled after the development of the ABI's Salvage Code of Practice, which categorises damaged vehicles according to their repairability.
- This review could include a series of workshops to discuss why the standards have not been adopted and develop actionable next steps, with the below key agenda items:
  - Mapping standard requirements to each stakeholder, following the vehicles' life cycle;
  - Gaps or required developments to the standards (e.g. consideration of battery casings as well as cells);
  - Enforcement requirements, such as licensing;
  - Industry association support on data collection required to comply with standards;
  - Requirements to mitigate excessive financial burden on small companies, particularly small salvage yards and vehicle dismantlers;
  - Complementary needs from the regulatory framework, to be considered in the following activity

1.1 Activity Outputs

1. Recommended developments to the standards to address gaps and adoptability.

2. Outline of the steps needed for standards adoption by industry and responsible actors, including:

- Recommended enforcement pathway;
- Any other enabling actions required from industry bodies, such as data collection support;
- Recommended actions to mitigate excessive financial burden on small companies, particularly small salvage yards and vehicle dismantlers;
- Consideration of knock-on consumer impacts.

3. Recommendations on complementary needs from the UK's regulatory framework, which will be considered in the following activity.

Enabler 1: Accelerate standardisation of EV battery end-of-life processes

OUTCOME Accelerate the industry-wide adoption of standardised end-of-life EV battery processes by vehicle dismantlers, recyclers, and repurposers, to unlock the safe flow of end-of-life EV batteries to repurposers and recyclers, increase the use of repurposed, remanufactured, and repaired batteries, and increase demand for battery recycling. To achieve this, the following actions should be taken:

Proposed Activities	1.2 Proposed Activity Requirements	1.2 Activity Outputs
1.2 Review alignment of standards with proposed updates to UK battery regulation.	• The UK government is reviewing the current UK batteries regulations, including consideration the EU batteries regulation 2023/1542 (EUBR). EUBR includes requirements relating to state of health and expected lifetime as well as on separate collection and treatment requirements for EoL batteries. • The existing standards on the handling, dismantling, assessing, and treating of batteries when they reach the end of their life in EVs (BS EN 18061:2025 and PAS 7060/1) should be aligned with the regulatory framework on batteries in the UK. Stakeholders involved in this project were supportive of alignment. • In parallel with 1.1 above, government could consider alignment between end-of-life standards and regulation. This may include recommended changes to standards and/or the explicit inclusion of standards in updated UK regulation.	**4. Recommendations to ensure alignment between regulatory framework and standards.** • Recommended developments to the standards; • Recommended changes to the battery regulation.

Enabler 2: Address EV battery end-of-life stockpiling

OUTCOME Establish deep understanding across stakeholders of the value generation options for end-of-life EV batteries and of the regulatory requirements on each actor to increase the transfer EV batteries to repurposers and recyclers when removed from vehicles, unlocking the circular flow of EV batteries, increasing the use of repurposed, remanufactured and repaired batteries, and increasing the demand for battery recycling. To achieve this, the following actions should be taken:

Proposed Activities

2.1 Market engagement campaign to convene vehicle end-of-life actors and battery recyclers and repurposers, to address knowledge gaps around battery end-of-life value

2.1 Proposed Activity Requirements

- There is insufficient transfer of batteries from vehicle end-of-life dismantlers to actors able to remanufacture, repurpose, or recycle EV batteries. This is driven in part by a lack of understanding of the end-of-life options for batteries when removed from EVs and the associated value, which may lead to misperceptions about value.
- A market engagement campaign should be carried out by industry associations, such as the Vehicle Recyclers' Association (VRA), in partnership with government to share information with stakeholders, including vehicle dismantlers, EV battery repairers, EV battery remanufacturers, EV battery recyclers, EV battery repurposers, vehicle insurers, and vehicle OEMs.
- The market engagement campaign should carry out tailored and targeted communication with the key stakeholders, highlighting end-of-life EV battery options, risks, standards (as accelerated by Enabler 1), and recommendations to avoid high financial burden on small companies, such as small salvage yards and vehicle dismantlers.
- The market engagement campaign should also convene stakeholders to establish a clear network of vehicle dismantlers and end-of-life EV battery treatment providers, and to create a forum to share information and best practice.
- The market engagement campaign should also work with end-of-life EV battery treatment providers to establish a regularly updated source of market data on the price of end-of-life EV batteries, considering key factors such as battery chemistry, state of health, and quality.

2.1 Activity Outputs

5. Targeted communication campaign with vehicle dismantlers, EV battery repairers, EV battery remanufacturers, EV battery recyclers, EV battery repurposers, vehicle insurers, and vehicle OEMs, highlighting end-of-life EV battery options, risks, standards, and recommendations to avoid high financial burden on small companies, such as small salvage yards and vehicle dismantlers. Deliver by webinars, press adverts, publications as appropriate.

6. Network of vehicle dismantlers and end-of-life EV battery treatment providers, including a forum to share information and best practice.

7. Regularly updated source of market data on the price of end-of-life EV batteries by key category, including chemistry, state of health, and quality.

Enabler 2: Address EV battery end-of-life stockpiling

OUTCOME Establish deep understanding across stakeholders of the value generation options for end-of-life EV batteries and of the regulatory requirements on each actor to increase the transfer EV batteries to repurposers and recyclers when removed from vehicles, unlocking the circular flow of EV batteries, increasing the use of repurposed, remanufactured and repaired batteries, and increasing the demand for battery recycling. To achieve this, the following actions should be taken:

Proposed Activities

2.2 Information campaign on existing and upcoming regulatory requirements

2.2 Proposed Activity Requirements

- The UK government is reviewing the current UK batteries regulations, including consideration the EU batteries regulation 2023/1542 (EUBR). EUBR includes requirements relating to state of health and expected lifetime as well as on separate collection and treatment requirements for EoL batteries.
- Any reform of the regulations should be accompanied by updated guidance setting out existing and upcoming requirements on each actor in the value chain, including vehicle dismantlers, EV battery repairers, EV battery manufacturers, EV battery recyclers, EV battery repurposers, vehicle insurers, and vehicle OEMs.
- An information campaign carrying out targeted and tailored communication with each key actor, would ensure that they are aware of and understand the existing and upcoming obligations they are subject to and the obligations of all other actors in the supply chain. The communication would benefit from providing guidance on where to access support if obligations are not being met by other actors.

2.2 Activity Outputs

8. Targeted and tailored communication with vehicle dismantlers, EV battery repairers, EV battery remanufacturers, EV battery recyclers, EV battery repurposers, vehicle insurers, and vehicle OEMs, ensuring that they are aware of and understand:

- Existing and upcoming obligations that they are subject to;
- Existing and upcoming obligations that all other actors are subject to;
- Guidance on where to access support if obligations are not being met by other actors.
- For some stakeholders there may be potential to combine with the campaign in 2.1 above

All enabling activities require external inputs, in particular participation of stakeholders across the value chain

Sggested Input Requirements

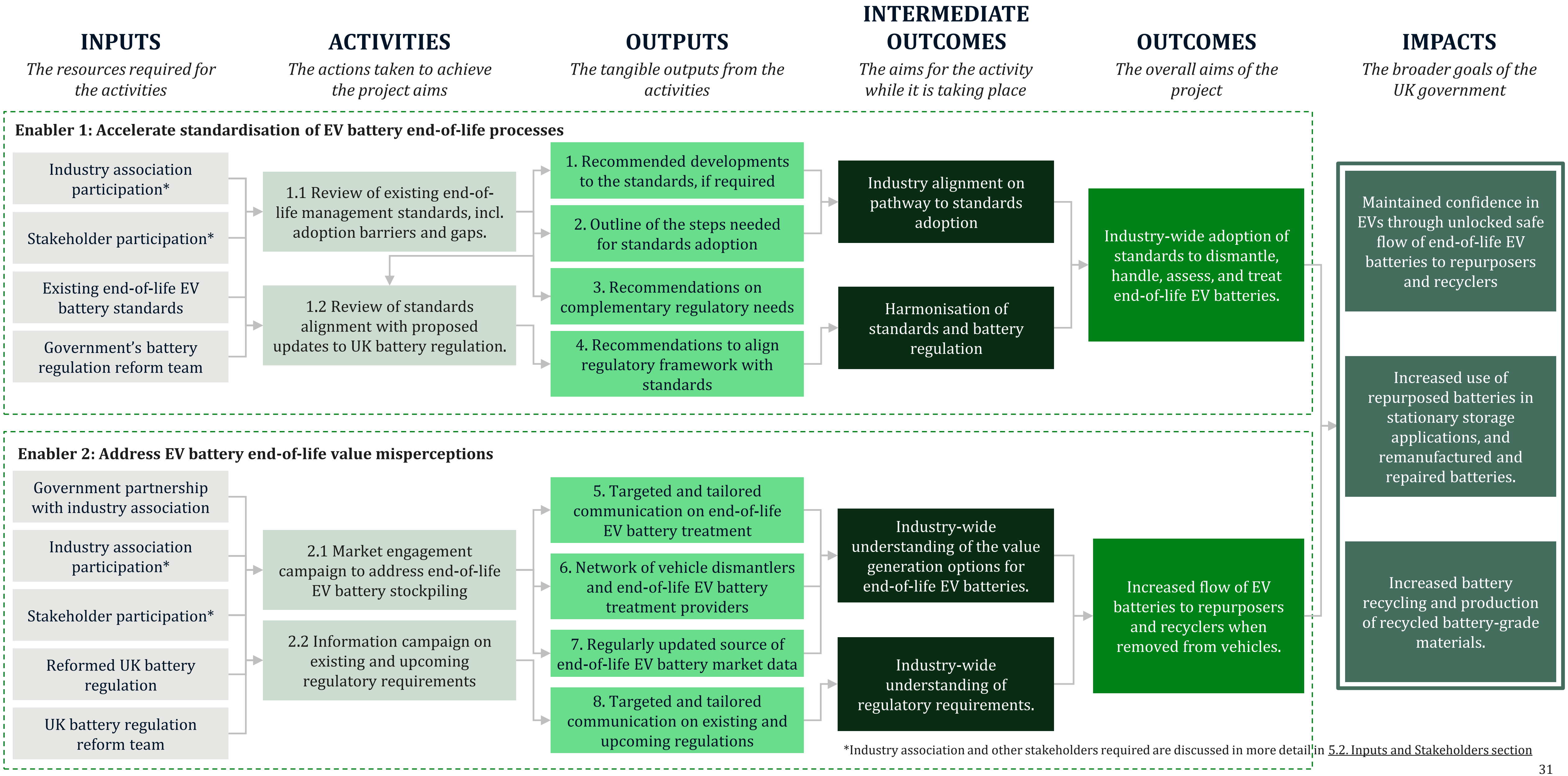
Industry association participation	Industry associations will be required to convene stakeholders for both Enabling Activities, such as the ABI to accelerate standardisation and the VRA to carry out the information campaign to tackle stockpiling.
Government partnership with industry association	Industry bodies are likely to require government support to convene stakeholders for enabling activities, in particular for the market engagement campaign in Enabler Activity 2.1.
Stakeholder participation	All activities require participation of stakeholders, including vehicle dismantlers, EV battery repairers, EV battery remanufacturers, EV battery recyclers, EV battery repurposers, insurers, and vehicle OEMs. Enabler Activity 1 will also need standards bodies.
Existing end-of-life EV battery standards	Enabler Activity 1.1 will review existing UK standards on the handling, dismantling, assessing, and treating batteries when they reach the end of their life in EVs, including BS EN 18061:2025 and PAS 7060/1
Government stakeholders	The team within government responsible for battery policy could consider alignment with standards and regulations as part of any future regulatory reform.

Key risks associated with identified MFIs that should be mitigated

Risk	Description	Mitigation
Smaller actors left out	SMEs, particularly in the vehicle salvage business may struggle to adopt regulations and standards, making them financially fragile.	Identification of requirements to mitigate excessive financial burden during Activity 1, and support from industry associations.
Hidden poor practice	Increased regulation could drive poor practice underground where it is hard to detect and safety may be worse.	Consideration of including compliance within licensing requirements, to allow for easier monitoring. Steps to mitigate burden (see above).
Challenging recycling economics	The economics of recycling for some battery chemistries (e.g. LFP) may remain challenging, regardless of whether the systems is flowing safely.	Recycling obligations mean that responsible actors will have to pay for recycling if needed. Increased volumes and ongoing innovation support will improve economics,
Challenging repurposing economics	The economics of repurposing batteries for stationary storage may be challenged by the availability of low-cost new batteries imported from outside of the UK.	Adoption of end-of-life battery treatment standards and ongoing government strategy will place additional value on repurposed batteries compared to new.
UK battery active material production	A flowing recycling system would only serve offshore battery active material manufacturers if no UK offtakers are established.	UK government is prioritising establishment of UK-based battery active material manufacture.
	Chemistry of batteries recycled in UK may not match the requirements of UK battery manufacturers, resulting in material flowing offshore anyway.	UK government is prioritising establishment of UK-based LFP battery manufacture alongside existing NMC manufacture. Government could consider export restrictions to ensure recycled materials remain within Europe even if exported.

Contents

A Logic Framework has been developed to summarise the proposed interventions



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Contents

Overview: MFI Toolkit Approach

This Market Forming Interventions (MFI) Toolkit outlines the process used during this research to 1) identify and prioritise innovation area(s) that would benefit from an MFI 2) match specific MFIs types to address innovation demand-side barriers 3) design an MFI concept.

Definitions

1. **Innovation Type:** a new or significantly improved product or service that addresses user problems in a novel way.
2. **Innovation Demand Barriers:** obstacles that prevent new products or services from being adopted.
3. **Market Forming Intervention (MFI):** Measure(s) that seek to accelerate the adoption of replacement innovations.
4. **MFI Enabling Factor:** a standard, policy, financial or business factor necessary for an MFI to be successful.

Categories of Demand Barriers

Innovation adoption barriers have been categorised into the following:

1. **Standards:** inability to describe in quantifiable and verifiable terms the innovation.
2. **Value Perception:** Lack of regulation/policy incentives; too high price premium; lack of quantifiable non-financial benefits.
3. **Demand Delivery Ecosystem:** Lack of necessary physical/technology infrastructure.
4. **Disincentives:** Existing regulation, concerns on technology lock-in.

Categories of MFIs

The 13 specific MFI types have been categorised into the following:

1. **Regulation & Lower Cost:** Encourage adoption of desired solutions by lowering costs or penalising status quo options.
2. **Demand Aggregation:** Consolidate buyers to create predictable demand, reduce market uncertainty, and enable scaling.
3. **Direct Financial Support:** Reduce upfront costs and risks through different financial mechanisms.
4. **Price Support:** Provide predictable revenue or bridge cost gaps between new and incumbent solutions.

The MFI Toolkit: a four-phase approach was used to select priority innovation areas for MFI/enabling activity concept design

Phase 1:
- Prioritising sectoral "innovations" for MFI targeting
- Map demand drivers and barriers to innovation uptake
- Map relevant sector stakeholders
- Validate findings through sector-surveys and Working Group 1

Phase 2:
- Assess innovation/s suitability for MFI (Framing Questions)
- Map MFI types and suitability characteristics
- Map existing UK and global MFIs
- Shortlisting MFI options

Phase 3:
- Map prioritised MFI to innovation demand drivers and barriers
- Define required MFI and enabler activity to unlock barriers
- Identify stakeholder requirements for MFI activity

Phase 4:
- Establish the logic framework for MFI and enabler activity
- Establish MFI governance and delivery roadmap
- Quantify potential impact and define measurement metrics
- Deliver concept and mobilise

1. Innovation targeting and barrier mapping
2. Define MFI Types and Shortlist Options
3. MFI prioritisation against sector barriers
4. Designing MFI

Working Group 1 (WG1)
- Align on innovations for MFI targeting and design
- Prioritise demand-side barriers to address through MFI development

Working Group 2 (WG2)
- Confirm demand barriers and enablers for innovation/s
- Review and prioritise MFI options and enabler activity for concept development

Working Group 3 (WG3)
- Align on MFI requirements
- Validate scope and structure of MFI/enabler activity
- Define stakeholder engagement requirements for activity

Working Groups: Cross Government-Industry workshop engagement to codevelop MFI/enabler activity.

Phase 1 (1/2): Innovation types were prioritised for MFI targeting using 12 evaluation criteria of a structured Prioritisation Framework

Environmental Factors	Energy and/or Material efficiency gains	MWh saved or efficiency gains per unit of output; tonnes of raw material avoided, recycled, or substituted
	Carbon reduction potential	Absolute $MtCO_2e$ reduction achievable within the subsector
Market Factors	Policy and standards alignment	Fit with current UK Industrial Strategy, Net Zero Strategy, sectoral roadmaps, codes and regulatory frameworks
	Stakeholder appetite, demand signals and domestic scale for MFI	Willingness of industry offtakers, financiers, policymakers and innovators to engage in collaborative MFIs
	Impact on UK sector resilience	To international supply-chains disruptions, price-shocks, energy costs etc.
Economic Factors	Market size and growth potential - domestic and export	Sector/subsector value, demand forecasts, and growth rate
	Investment mobilisation potential	Public and private capital attracted by subsector innovations
	Cost-saving potential	Estimated savings for firms and UK consumers through adoption
	UK Job creation and skills development potential	Direct and indirect employment supported
Innovation Factors	UK innovation availability, maturity and scalability	TRLs of available solutions, readiness for commercialisation, and scale-up potential, sufficient solutions to support MFI and market development).
	Perceived innovator barriers to scale	Strength and type of innovation barriers e.g. tech lock-in, infrastructure gaps, financing hurdles, market fragmentation, low offtake willingness
	Existing incentive structures for MFIs	Presence of subsidies, standards, CfDs, or other supportive measures that could complement MFIs

Phase 1 (2/2): This considered four key Non-Negotiables to select the targeted innovation type

Non-negotiables

Environmental Factors
- Energy and/or Material efficiency gains
- 1 Carbon reduction potential (non-negotiable)

Market Factors
- 2 Policy and standards alignment (non-negotiable)
- 3 Stakeholder appetite, demand signals and domestic scale for MFI (non-negotiable)
- Impact on UK sector resilience

Economic Factors
- 4 Market size and growth potential - domestic and export (non-negotiable)
- Investment mobilisation potential
- Cost-saving potential
- UK Job creation and skills development potential

Innovation Factors
- UK innovation availability, maturity and scalability
- Perceived innovator barriers to scale
- Existing incentive structures for MFIs

Rationale for non-negotiables

1. The **carbon reduction** achievable through adoption of the innovation must be able to deliver substantive impact on carbon reporting metrics and enable offtakers to meet current or future reporting standards within the next 2–5 years.

2. The innovation area should be aligned with the **UK government Industrial Strategy, Sectoral Roadmaps and spending priorities**, for MFIs to be implementable within the next 2-5 years.

3. There is both a **strong local industry appetite** and an **urgent need for adoption** of the innovation area within the next 2–5 years, driven by supportive interventions, evolving policy mandates, competitive pressures, and market disruptions.

4. There should be a **sufficient domestic and export market size, or growth opportunity** to justify the establishment of an MFI.

Phase 2 (1/2): Framing Questions were then used to assess the suitability and nature of prioritised innovation types for MFI development

Framing Questions		
Type of innovation	Product or process? Does a definition of what "it" is exist, (preferably in the form of a standard with certification scheme)?	Prioritise innovations that have an agreed upon standard and associated certification scheme.
Maturity	If product, what Technology Readiness Level (TRL)? If process, how long in existence?	There are MFIs best suited for early-stage innovations (TRL 6 or below) and later stage (TRL 6 and above). Segment innovations into early or late stage.
Substitution/Disrupter	Is the innovation replacing something already there (i.e. "green" steel) or is it disrupter (brand new with no existing demand)?	Majority of govt. MFIs have been utilised to support replacement innovations. Prioritise replacement innovations.
User	Are users UK, international or both? Can you list specific companies who are users or who benefit directly?	Leverage existing user base for feedback via industry workshops.
Motivation & Need	Why are the users adopting this product/process? What need of theirs is it meeting?	Prioritise innovations that meet user motivations and needs. Understanding motivations of current users assists in understanding barriers to adoption of replacement innovations.
Existing policy/regulatory impact	Are there regulations and/or policies that support or detract from this product or process? Intentionally or unintentionally?	Understand the policy landscape to identify existing policies to leverage and ones that serve as disincentive.
Risk	How is the risk of the product/process covered, i.e. grants, subsidies, insurance?	Prioritise innovations where there are existing mechanisms to mitigate the adoption risk.

Phase 2 (2/2): MFI Types were defined and a shortlist of options developed

There are **13 MFI types** to stimulate the demand for ***substitution (replacement)*** and/or ***disruptive*** innovations**.** Key to identifying the most suitable MFI for a specific innovation is understanding the innovation's existing demand barriers. When potential MFIs have been linked to an innovation, one should consider:

- Are there any necessary enabling factors that will influence the potential success of the MFI?
- Do the demand barriers benefit from a govt. sponsored MFI or is the private sector capable of addressing these?

MFI Category	MFI Type	Description
Regulation and Lower Cost	1. Regulations and/or Policy requirements	Legal requirements compelling market behaviour
	2. Government (National/Local) Subsidies	Govt. monies to support R&D, production, and/or deployment that usually do not have to be repaid
	3. Government (National/Local) Tax Incentives	Tax credits or reliefs that lower cost
	4. Government (National/Local) Tax Disincentives	Taxes or levies on existing activity to shift market demand to alternative
Demand Aggregation	5. Buyers Clubs (Aggregated Demand)	Aggregation of buyers behind one contract to increase demand for product/service
	6. Public Procurement (Framework/Bulk Procurement)	Government's use of preferences and/or award weighting within its own procurements
	7. Double-sided Auction	Intermediary signs a long-term offtake agreement with supplier and resells, via auctions, to buyers with govt funds used to cover gap between supplier and buyer price.
	8. Offtake Agreements	Long-term contract guaranteeing purchase of supplier's future output
	9. Advanced Market Commitments	Specific type of offtake agreement for products in prototype/demo stage
Direct Financial Support	10. Blended Finance (Philanthropy/Public/Private Funding)	Combining concessional (public & philanthropy) funds with private funds to reduce risk
	11. Prizes/challenges (private or public sector to fund or procure new materials/products)	Public call for innovations to solve industry challenges, potentially combined with grant offer
	12. Support for solution Guarantees and Insurance	Instruments to mitigate performance or credit risk
Price Support	13. Contract for Difference (or other Price Support Mechanisms)	Guarantees price and revenue per unit by covering the difference between market and strike price (or within a range e.g. cap-and-floor)

Phase 3 (1/5): MFIs were prioritised based on their suitability to address sector-specific demand-side barriers to scaling innovations

There are innovation adoption barriers for demand, supply or both. This Toolkit is focussed on identifying demand-side barriers, including *enabling factors*, which are barriers that, if not addressed, greatly decrease the likelihood of an MFI's success. One of the most common enabling factor barriers is the lack of standards, since they are essential to defining what is being demanded.

Standards

- Lack of accepted standard differentiating the innovation from existing product/process. Includes standards covering production processes and safety considerations.

Value perception

- **Policies/Regulations**: lack of regulations or policy requirements for innovation
- **Price competitiveness:** innovation priced higher than existing product/process with no quantifiable alternative business benefit. Competition between existing recycled vs. potential repair/reuse/remanufacture financial gains.
- **Non-financial benefits:** lack of accepted mechanism to account for benefits (carbon reduction, book & claim).

Demand delivery ecosystem

- **Infrastructure (including technology and/or material dependencies):** lack of physical infrastructure to acquire, store, utilise and/or dispose of innovation (disposal particularly relevant when required). Inability to access technologies and/or material inputs needed for production/use/disposal of innovation.
- **Volume and timing:** inability to address risk associated with guaranteed volume and timing of delivery.

Disincentives

- **Policies/Regulations**: existing policies that hinder the demand; frequently unintended.
- **Innovation cycle:** concerns about technology lock-in (e.g. methanol/ammonia for maritime shipping) and changes in recycling infrastructure investment (e.g. silicon-based or thin-film-based solar panels)

Phase 3 (2/5): An MFI Suitability Matrix was developed to identify under which circumstances the different types of MFI are best applied

MFI Category: Regulation and Lower Cost

Category	Market-Forming Intervention	Description	When most suitable	When less suitable
Regulation and Lower Cost	**Regulations and/or Policy Requirements**	Legal requirements compelling market behaviour	**Best once credible alternatives are available, but adoption needs rapid scaling.** Creates assured demand, levels the playing field, and drives widespread industry compliance.	Less suitable for early-stage technologies that cannot yet meet regulatory requirements, or for solutions still under R&D.
	Government (National/Local) Subsidies/Loans	Govt. monies to support R&D, production, and/or deployment that usually do not have to be repaid	**Best for early- to mid-stage technologies where cost is the dominant barrier**. Highly suitable when capital intensity is high, first-of-a-kind facilities are needed, or production costs are significantly above incumbent benchmarks. Effective at accelerating adoption and de-risking scale-up.	Less suitable for mature, commercially competitive solutions where costs are already comparable to incumbents, as subsidies may distort market pricing and reduce incentives for efficiency.
	Government (National/Local) Tax Incentives	Tax credits or reliefs that lower cost	**Most suitable when technologies are technically proven but not yet cost-competitive**. Works well where tax relief can close a moderate cost gap and stimulate adoption without requiring direct subsidies. Encourages corporate investment in low-carbon upgrades and innovation.	Less suitable for very early-stage prototypes lacking revenue or profitability, as tax incentives require a tax liability to benefit from.
	Government (National/Local) Tax Disincentives	Taxes or levies on existing activity to shift market demand to alternative	**Best for shifting demand away from incumbents once viable alternatives exist**. Suitable when behavioural change is needed across large markets and when cost penalties can make low-carbon options comparatively more attractive.	Less suitable when low-carbon alternatives are not commercially available, as disincentives could lead to unintended cost or supply issues without feasible substitutes.

Phase 3 (3/5): An MFI Suitability Matrix was developed to identify under which circumstances the different types of MFI are best applied

MFI Category: Demand Aggregation

Category	Market-Forming Intervention	Description	When most suitable	When less suitable
Demand Aggregation	**Buyers Clubs (Aggregated Demand)[1]**	Aggregation of buyers behind one contract to increase demand for product/service	**Best where fragmented demand prevents suppliers from investing in new capacity**. Creates a strong, credible, bankable demand signal needed to unlock financing and scale early-commercial low-carbon products.	Less suitable when demand is already sufficient, or the market is highly concentrated, as aggregation adds complexity without additional benefit.
	Public Procurement (Framework/Bulk Procurement	Governments use of preferences and/or award weighting within its own procurements	**Most effective when early market demand is insufficient to justify investment**. Suitable when public sector volume can anchor supply, build confidence for private buyers, and normalise emerging low-carbon solutions.	Less suitable for immature technologies not yet compliant with procurement requirements, or in markets where public demand is too small to influence private adoption.
	Double Auctions / Competitive Bidding Mechanisms	Intermediary signs a long-term offtake agreement with supplier and resells, via auctions, to buyers with govt funds used to cover gap between supplier and buyer price.	**Best for early-mid stage technologies with variable availability and price premiums**. Works when performance specifications are clear and price competition can drive down subsidy needs over time.	Less suitable for early-stage or prototype technologies lacking sufficient capacity or performance certainty to bid competitively.
	Purchase Agreements (PPAs / Offtake Agreements)	Long-term contract guaranteeing purchase of supplier's future output	**Best for mid-late stage technologies where the main barrier is immediate availability and supply manufacturing investments.** Provides supply side the bankability needed for financing production capabilities.	Less suitable for very early-stage prototypes or high-risk pilots, as buyers may not commit without performance or supply certainty.
	Advance Market Commitments (Prototype/Demo Stage)	Specific type of offtake agreement for products in prototype/demo stage	**Best for prototype or demonstration technologies that need assurance of future demand.** Reduces market uncertainty and incentivises developers to invest in commercial readiness and certification.	Less suitable for mature technologies already commercially proven, as AMCs provide limited additional value.

ERM

[1] See an overview of buyers clubs from Mission Possible Partnership - Link

Phase 3 (4/5): An MFI Suitability Matrix was developed to identify under which circumstances the different types of MFI are best applied

MFI Category: Financial Support

Category	Market-Forming Intervention	Description	When most suitable	When less suitable
Direct Financial Support	**Blended Finance (Philanthropy/Public/ Private Funding)[1]**	Combining concessional (public & philanthropy) funds with private funds to reduce risk	**Optimal for high-risk, capital-intensive, or first-commercial deployments**. Suitable when private finance is reluctant due to technology, commercial, or scale-up risk. Unlocks private investment and accelerates demonstration-to-commercial transition.	Less suitable for low-risk, mature projects that can be financed commercially, as blending may be unnecessary and administratively complex.
	Prizes/challenges (private or public sector to fund or procure new materials/products)	Public call for innovations to solve industry challenges, potentially combined with grant offer	**Best for early R&D or prototype phases where market pathways are unclear**. Stimulates high-risk, high-reward innovation and draws talent/ideas into new solution areas. Effective where conventional funding mechanisms are too risk-averse.	Less suitable for technologies that are commercially ready, as prizes do not provide sufficient scale or market demand.
	Support for solution Guarantees and Insurance	Instruments to mitigate performance or credit risk	**Best where the key barrier is investor or lender risk perception**, not technical viability. Supports capital access for new low-carbon production capacity and reduces the risk premium associated with unproven technologies or business models.	Less suitable for low-risk, mature technologies where traditional finance is sufficient; adds unnecessary cost and complexity.

[1] See for example, "Practical tools for Blended Finance Fund design" - Link

Phase 3 (5/5): An MFI Suitability Matrix was developed to identify under which circumstances the different types of MFI are best applied

MFI Category: Price Support

Category	Market-Forming Intervention	Description / Mechanism	When most suitable	When less suitable
Price Support	**Contract for Difference (or other Price Support Mechanisms)[1]**	Guarantees price and revenue per unit by covering the difference between market and strike price (or within a range e.g. cap-and-floor)	**Most effective where operating costs for products remain structurally higher than incumbents**. Provides predictable revenue streams that enable investment and accelerate commercial deployment.	Less suitable for low-cost mature solutions, as guaranteed price support may distort competition and reduce incentive for efficiency improvements.

[1] See an overview of energy CfDs- Link

Contents

The operational model for the programme applies a Logic Framework approach to define inputs, activities, outputs and intermediate outcomes

The operational model has been developed by applying a Logic Framework, as shown on this slide.

The components of the Logic Framework are defined below.

INPUTS	ACTIVITIES	OUTPUTS	INTERMEDIATE OUTCOMES	OUTCOMES	IMPACT
The resources required for the activities	The actions taken to achieve the project aims	The tangible outputs from the activities	The aims for the activity while it is taking place	The overall aims of the project	The broader strategic goals

Contents

Existing interventions which help support second life battery business models: Second Life Battery Business Models – Direct Support

MFI Category	MFI Type	Commentary
Direct Financial Support	Prizes/ challenges (private or public sector to fund or procure new materials/ products)	• The **Advanced Propulsion Centre** funds net zero innovation R&D and scale-up in the automotive sector including EV battery circularity (with access to £4bn funding to 2035 through Drive35) - **RECOVAS** supports EV battery collection and decisions on repair, reuse or recycling, resulting in EMR opening its Birmingham facility in 2024 which will have the capacity to test for reuse or repair, or process batteries ready for shredding, handling more than 2,000 tonnes of batteries per year. • UK government funds battery R&D, reuse and recycling projects through programmes such as the **Faraday Battery Challenge**. These include projects on end-of-life EV batteries, repurposing and recycling (e.g. **RELIB**, "re-juice/reuse/recycle" **ABLE**, **Batt2TheFuture** (complete)) • There are challenge-type instruments explicitly focused on second-life batteries. For example, UKRI projects like **Batt2TheFuture** (complete) and **Cranfield's electric-bus second-life system** have been funded to develop sorting and repackaging processes for second-life packs. **Innovate UK's GA-iX "Innovative Solutions for Second Life Batteries"** challenge sought solutions for second-life Li-ion batteries (although outside of UK). • This funding is continued through £452m of allocated funding to the **Battery Innovation Programme** to 2030**.**
MFI Enabling Factor Activity	Directly undertaking or facilitating standard(s) development	• Through the **Faraday Battery Challenge Standardization Programme**, BSI has published **PAS 7060/7061/7062** on safe, environmentally-conscious EV battery design, handling and manufacturing, explicitly aiming to optimise reuse and recycling. • In 2025 the UK adopted **BS EN 18061:2025**, the British implementation of **EN 18061**, which sets steps, conditions and protocols for safe repair, reuse and preparation for repurposing of EV battery modules and packs – a standard specifically written for second-life and repurposed EV batteries. • These standards reduce technical and safety uncertainty for second-life operators and buyers.

ERM

Existing interventions which help support second life battery business models: Second Life Battery Business Models – Indirect Support [1/2]

MFI Category	MFI Type	Commentary
Regulatory & Lower Cost	Govt. National/Local Tax Incentives	• There are **no tax incentives that specifically target second-life EV batteries**. However, general measures apply: UK "green taxes and reliefs" and capital allowances support low-carbon investments broadly, and recent VAT changes extend reduced VAT/relief to more domestic battery storage installations, including standalone systems, which can include second-life where compliant. Standard R&D tax relief and "full expensing" for plant and machinery (highlighted in the advanced manufacturing / battery policy response) also apply to companies developing second-life technologies.
	Regulations (mandatory) incentivising material, technology or circular business model adoption	• UK still operates under **Waste Batteries and Accumulators Regulations 2009** and ELV rules, which impose extended producer responsibility (EPR) and require collection and recycling of batteries but were drafted pre-EV and leave second-life responsibilities and safety testing largely unaddressed. The **UK Battery Strategy** recognises the need for better end-of-life management and commits to consultations and a call for evidence on collection rates and regulatory levers to incentivise reuse, repurposing and domestic recycling infrastructure, and to adopt international standards for reuse/repurposing. Legal commentary confirms Defra's intention to review and update the end-of-life battery regime under EPR. So **EPR-type regulations exist but are not yet well-tuned to second-life**, with reforms in progress.
Demand Aggregation	Public Procurement (including framework and/or bulk procurement)	• Several **local authorities** have procured second-life BESS for public buildings and hubs: **West Suffolk Council** and **Suffolk County Council** have installed Connected Energy systems built from second-life Renault Kangoo batteries at the **Mildenhall Hub** and **The Hold** to optimise solar, EV charging and grid services. At central level, the **Crown Commercial Service Demand Management & Renewables Framework (RM6314)** lets public bodies procure BESS within broader decarbonisation services but does **not specifically prefer second-life batteries**. Such procurement helps indirectly (second-life is allowed to compete) but there is **no national mandate or widespread framework dedicated to second-life**.
	Auctions/ Competitive Bidding Mechanisms	• UK Capacity Market (T-1, T-4) auctions are technology-neutral and have awarded large volumes of 10–15-year contracts to battery storage, with BESS dominating recent T-4 auctions and securing the majority of newbuild agreements. BESS projects like Coalburn 1 (500 MW) combine capacity contracts with optimisation agreements. Second-life BESS can in principle participate on the same terms, however while the auctions **do not distinguish or favour second-life assets** versus new-battery storage the first review stage of the first window has been carried out and **none were second life**. There may be a second window in the future.

Existing interventions which help support second life battery business models: Second Life Battery Business Models – Indirect Support [2/2]

MFI Category	MFI Type	Commentary
Direct Financial Support	Prizes/ challenges (private or public sector to fund or procure new materials/ products)	• Announced in 2025, **DRIVE35** will provide £4bn for R&D, scale-up and transformation of the auto industry through zero emission technology to 2035, which will include battery circularity and recycling. Funding is delivered through industry bodies/initiatives like the Advanced Propulsion Centre and Battery Innovation Programme.
	Blended Finance (philanthropy/ public/ private funding)	• UK battery storage in general is benefiting from **blended public–private investment**, which second-life projects could tap into. The **National Wealth Fund** has teamed with Equitix and Australia's Aware Super to invest £500m in Eelpower's UK battery storage platform, mixing sovereign and private capital to scale storage projects. Related UKRI funds co-financed industry R&D and demonstration across low-carbon technologies, including storage and batteries. These instruments **are not targeted at second-life batteries**, but they could de-risk projects that choose to use them.
Price Support	Contract for Difference (or other price support mechanisms)	• The government and Ofgem are introducing a cap-and-floor scheme for Long Duration Electricity Storage (LDES). A detailed consultation and policy framework has been published, and a Technical Decision Document and Ofgem financial model/handbook were issued in 2024–25. The scheme is technology-neutral within LDES and could in principle support some long-duration electrochemical storage, **but typical second-life EV BESS (1–4 h systems) are likely outside its focus, and there is no UK CfD-style price support dedicated to second-life batteries.**

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Existing interventions which help support second life battery business models: Battery Recycling – Direct Support [1/2]

MFI Category	MFI Type	Commentary

Regulatory & Lower Cost	Govt. National/Local Subsidies	• **Advanced Propulsion Centre and Automotive Transformation Fund** funds R&D, pilots and scale-up across the battery value chain specifically including recycling:
		  • **RECOVAS** (EMR, Bentley, BMW, Jaguar: aims to provide a standardised and reliable route for recycling and repurposing the lithium-ion batteries in vehicles)
		  • **Mint Innovation/JLR** : Black mass refining at demo scale

	Regulations (mandatory) incentivising material, technology or circular business model adoption	• **The Waste Batteries and Accumulators Regulations** make collection and recycling compulsory, ban landfill/ incineration of EV batteries, and place producer-responsibility costs for collection, treatment and recycling on producers. Government has signalled consultations on updated battery regulations under the Environment Act, including potential separate recovery targets for cobalt, lithium and nickel, and minimum recycled-content requirements in new batteries. • **The Critical Minerals Strategy** sets goals for 10% of UK critical-minerals demand to be met from domestic production and 20% from recycling by 2035. • **EU has targets** in place for recycle content in batteries of 16% cobalt, 6% Lithium and 6% nickel by 2031 and 26%, 12%,15% respectively by 2036

Existing interventions which help support second life battery business models: Battery Recycling – Direct Support [2/2]

MFI Category	MFI Type	Commentary
Direct Financial Support	Prizes/ challenges (private or public sector to fund or procure new materials/ products)	• **Battery Innovation Programme (BIP)** - £452m from April 2026-2030 to accelerate battery research, innovation and manufacturing scale-up as part of the Advanced Manufacturing Sector Plan – delivered through the Faraday Institute, Innovate UK, and the UK Battery Industrialisation Centre. Objectives include 1) optimise battery technologies to make them cheaper, better performing, fully sustainable and recyclable, and 2) capture sovereign capabilities in next generation batteries, for example solid-state, lithium-sulfur and sodium-ion • The **Faraday Battery Challenge** (2017-2025, £610m) (precursor to the BIP) is structured as a series of themed competitive “challenge” calls, with funding open to projects on battery recycling and circular design. • Recent Faraday/Innovate UK rounds and the UK Battery Strategy implementation have awarded multi-million-pound packages to consortia tackling battery-recycling bottlenecks. Examples: The **ReLiB** project (UKRI funded £18m UoBirmingham plus collaborators - basic research into Li recycling, ongoing); **CALIBRE** (UKRI funded Johnson Matthey/ Nissan project exploring battery recycling supply chain, complete 2022),
	Support for solution guarantees and insurance	• UK Export Finance’s new **Critical Goods Export Development Guarantee** and existing **Critical Minerals Supply Finance** provide up to 80% government guarantees on loans to critical-mineral suppliers, allowing UK firms (including recyclers and midstream processors) to finance new plants or long-term supply contracts while de-risking lenders. Note: level of export can be quite low and hence supports domestic market as well.

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Existing interventions which help support second life battery business models: Battery Recycling – Indirect Support

MFI Category	MFI Type	Commentary
Regulatory & Lower Cost	Govt. Federal/Local Tax Incentives	• **No tax credits specifically targeted at battery-materials recovery or recycled cathode materials**. • Generic UK R&D tax relief, capital allowances and full-expensing apply to recycling R&D and new processing plants.
	Directly undertaking or facilitating standard(s) development	• **BSI's Faraday Battery Challenge standards programme** and subsequent **Battery-Standards Roadmap** (published 2021) are currently **investigating PAS documents and guidance** on health, safety, environmental performance and "design for recycling" in battery manufacture.
Demand Aggregation	Buyers Clubs (aggregated demand)	• **No buyers' club specifically committing UK manufacturers to purchase recycled battery materials** was identified. • However, the **Critical Minerals Strategy** proposes working with industry on a "**demand aggregation platform"** to map their demand for critical minerals across the UK, potentially allowing for aggregated procurement mechanisms in future including recycled battery metals.
	Purchase Agreements/Long duration off-take	• **No government-backed offtake scheme or pooled purchasing commitment** for recycled critical materials was identified. • Mechanisms are emerging but not yet systemic. e.g. 1) **Altilium and HELM AG** have signed MoUs expected to lead to offtake and tolling agreements for recycled lithium produced in the UK; 2) OEM-backed recycling projects (RECOVAS, Mint Innovation with JLR) imply future offtake for recovered metals.
Direct Financial Support	Blended Finance (philanthropy/ public/private funding)	• APC's Automotive Transformation Fund / DRIVE35 co-fund projects with industry equity and debt for EV-battery manufacturing/ recycling (Mint Bioming demo). National Wealth Fund and UK Export Finance open to supporting capital-intensive critical-mineral projects and crowd in private capital.

Contents

Key barriers to the demand for and implementation of battery circularity in the UK across circularity areas include:

Barrier type	Barrier	Repair/ reman.	Repurp.	Recycle
Value Perception / Disincentives	Lithium-ion battery chemistry is diverse and rapidly evolving. This leads to difficulty in developing cost-effective processes, in particular for repair, remanufacture, and repurposing. There may also be a mismatch between the demand for materials for chemistries manufactured in the UK, and the chemistries of available end-of-life (EOL) EV batteries, due to import/export dynamics.	●	●	●
Value Perception	Value of end-of-life batteries is not well understood and uncertain. Currently payment (gate fee) is required for recycling of batteries, and likely to remain the case as LFP batteries become more prevalent due to lower material value. Remanufacturing and repurposing may lead to revenues but they are likely to be small. Chosen EOL circularity option may be context dependent. Significant difference between battery pack value expected at EOL by vehicle recyclers and willingness to pay by recyclers, repurposers, and remanufacturers, or take back by auto OEMs. This leads to stockpiling.	●	●	●
Disincentives	Increasingly, battery packs are not being designed for easy dismantling, driving up the cost and complexity.	●	●	●
Delivery ecosystem	Issues or delays at collection of EVB from vehicle breakers can lead to some stockpiling.	●	●	●
Delivery ecosystem	Without full battery circularity there will be leakage of batteries to overseas. This requires a full suite of end-of-life options, including repair, remanufacture, repurposing, and recycling (full process from shredding to material recovery). A fully circular onshore system also requires onshore demand for critical minerals e.g. pCAM and CAM production.	●	●	●
Delivery Ecosystem	Pre-enabler for all aspects of battery circularity includes collection, triage (incl. accurate assessment of battery state of health and understanding of error states), and dismantling. UK does not have sufficient capacity for this, and this is complicated and costly to set up.	●	●	●
Delivery Ecosystem	OEMs do not provide access to battery management software (to protect IP, or because they do not have full access from battery manufacturer) meaning that pack and cell condition cannot be readily diagnosed	●	●	●
Delivery Ecosystem	OEMs require large-scale solutions that are able to ingest very high volumes of waste. Low appetite for supporting the scale-up of currently niche solutions.	●	●	●

Key: ● High significance ● Medium significance ● Not significant

ERM

Other barriers to the demand for- and implementation of battery circularity for individual circularity areas include:

Barrier type	Barrier	Repair/ reman.	Repurp.	Recycle.
Value Perception	Focus on recycling targets and recovery of critical minerals inadvertently disincentivises remanufacturing and repurposing. Currently very limited incentive to ‘do the right thing’ and maximise battery circularity, instead easier and more attractive to purchase a new battery rather than repairing or buying 2nd life.	🟡	🔴	⚪
Standards	Currently no established standard to certify second-life battery safety, leading to reluctance to invest and/or insure.	⚪	🔴	⚪
Disincentives	A lot of smaller li-ion batteries (e.g. from hybrids) already reaching end-of-life but difficult to repurpose economically.	⚪	🔴	⚪
Standards/ Delivery Ecosystem	Uncertainty about producer responsibility when it comes to repurposing of batteries in the UK (n.b. in the EU, responsibility is transferred to the repurposer).	⚪	🔴	⚪
Value Perception	High capital cost to scale up battery recycling facilities. Not attractive to scale ahead of demand.	⚪	⚪	🔴
Value Perception/ Disincentives	Currently difficult to economically recover less valuable materials, such as lithium or graphite. This will become more prevalent with a shift to LFP battery chemistries.	⚪	⚪	🔴

Key: 🔴 High significance 🟡 Medium significance ⚪ Not significant

Barriers with more moderate impact but still hinder the implementation of battery circularity include:

Barrier type	Barrier	Repair/ reman.	Repurp.	Recycle.
Value Perception	It is currently commercially more attractive to ship waste overseas, despite the high transport costs. For example, there is already a large feedstock of non-EV waste batteries that are shipped overseas for processing. It may be difficult to compete with an existing, cost-effective option.	Medium significance	Medium significance	Medium significance
Disincentives	Safety concerns and complexity related to the transport and storage of waste batteries makes it costly and inhibits decisions on investment in waste battery management. Also leads to unregulated/ unofficial market for end-of-life batteries, posing safety concerns.	Medium significance	Medium significance	Medium significance
Value Perception	Consumer confidence is essential for adoption, including trust in repaired and repurposed battery packs.	Medium significance	Medium significance	Not significant
Disincentives	Permitting process for recycling facilities can be prohibitively lengthy.	Not significant	Not significant	Medium significance
Delivery Ecosystem	The current EV parc is small, and therefore repair is not yet as priority. However, repair will become more important and prevalent over the next few years.	Medium significance	Not significant	Not significant

Key: High significance Medium significance Not significant

Case study: China's comprehensive regulation on end-of-life battery management includes national standards for dismantling, handling, and assessment

China has strong regulation to manage EV batteries at end-of-life, encompassing **full life-cycle supervision** and **traceability**,[1] **extended producer responsibilities**,[2] and requirements for **treatment and recycling.**[4] Specific regulations also include a requirement for **EVs to be scrapped with the battery still installed** to prevent uncontrolled battery flows[2] and **national standards** for dismantling, assessment and treatment (deep-dive below).

Deep-dive: China's national standards for dismantling, assessment and treating end-of-life EV batteries

There are 22 national standards that govern end-of-life EV battery management,[4] setting out processes for the safe and responsible handling.

Standards governing dismantling:

- Safe **dismantling procedures**, including **discharge before dismantling**, **battery cooling** requirements and temperature monitoring, isolation procedures, and use of specific **tools**, **PPE** and **workstations**.
- Safe **handling procedures**, including dismantling order, identifying **hazardous units** (e.g. bulging cells, leakage, or thermal damage), **sub-component labelling** requirements, and procedures for **handling damaged or unstable** cells.
- These are accompanied by a requirement for manufacturers to provide detailed **disassembly instructions** when batteries enter the market.[3]

Standards for assessment and testing:

- Standard to define test methods to measure **residual energy**, ensuring the battery is in a **safe condition** to continue to processing. However, China lacks a nationally enforced state of health definition.

Sources: 1 - https://english.www.gov.cn/news/202601/16/content_WS6969df0cc6d00ca5f9a089c0.html ; 2 - https://cnevpost.com/2026/01/16/china-mandates-ev-batteries-remain-with-vehicles-scrapping/ ; 3 - https://battery-tech.net/battery-markets-news/china-unveils-new-ev-battery-recycling-oversight-rules/ ; 4 - https://carnewschina.com/2026/01/16/china-implements-strict-ev-battery-recycling-rules-for-2026/

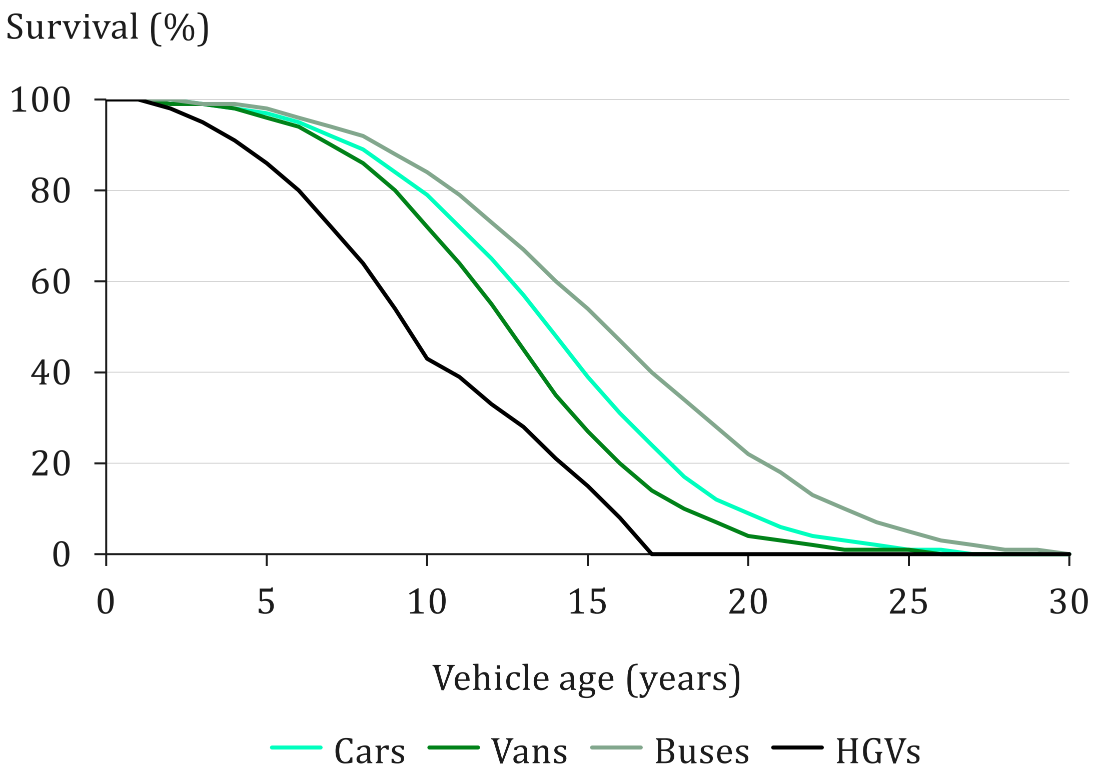
Contents

A4. Barrier Mapping

Assumptions: Impact analysis was based on assumed scrappage rates of BEVs and ERM modelling of BEV stock

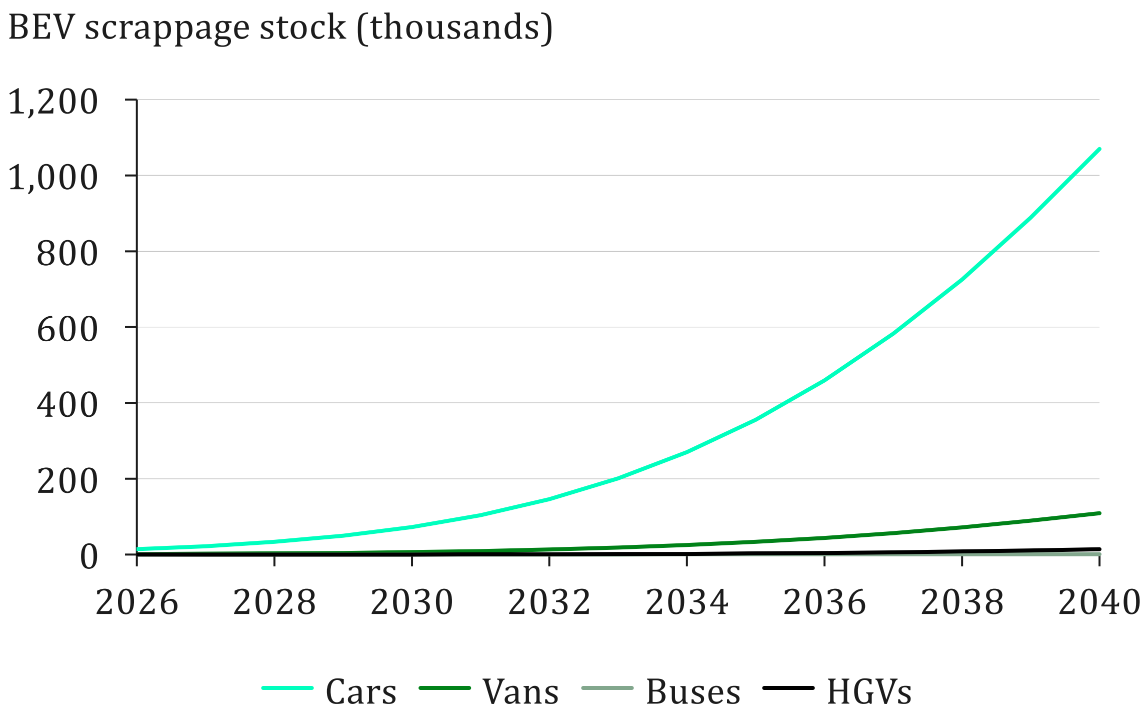
BEV scrappage rates

Vehicle scrappage considers the proportion of vehicles that survive at a given age. Each vehicle type will have a different scrappage rate curve. This is summarised in the figure below.[1]



BEV scrappage stock

Applying the BEV scrappage rates to the BEV stock, annual scrappage stock can be estimated. This is summarised in the figure below.[1]



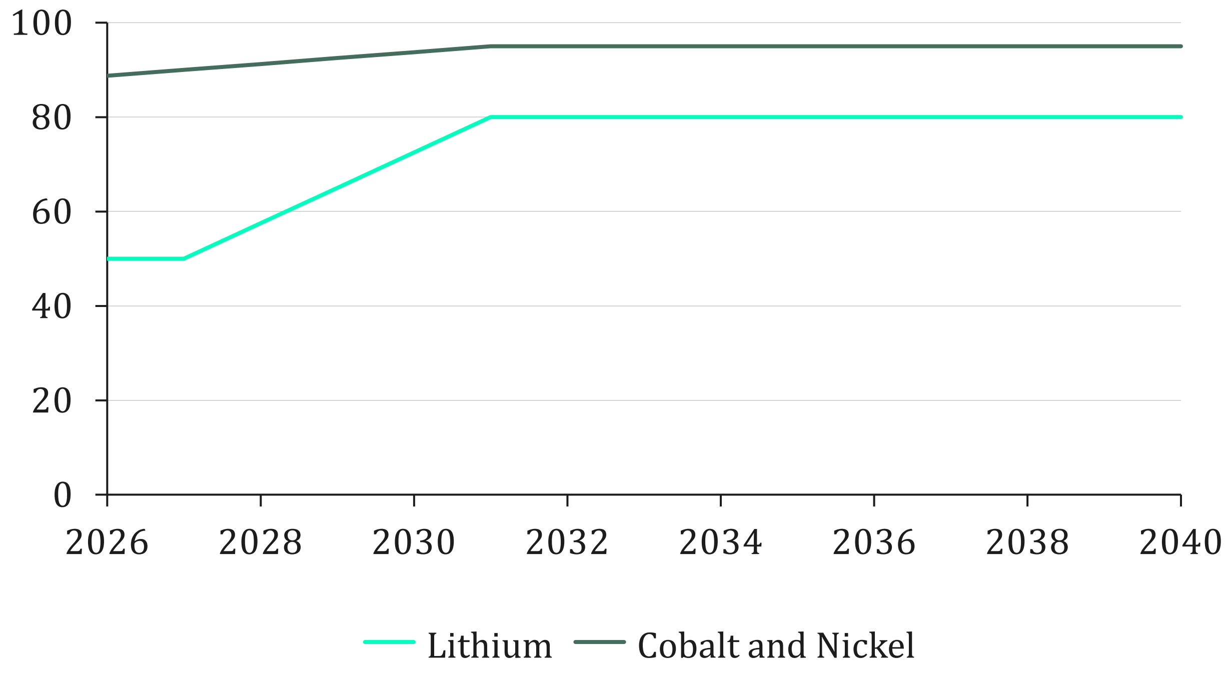
1. Survival rates used for extracting scrappage for cars, vans and HGVs is based on internal stock modelling by ERM. For buses, this was estimated from data published by Climate Exchange.

Assumptions: Impact analysis additionally assumed the below annual recycling efficiencies and average battery sizes

Recycling efficiency

The figure below shows the minimum material recovery rates for 3 of the key battery materials, in line with EU Battery Regulation[1].

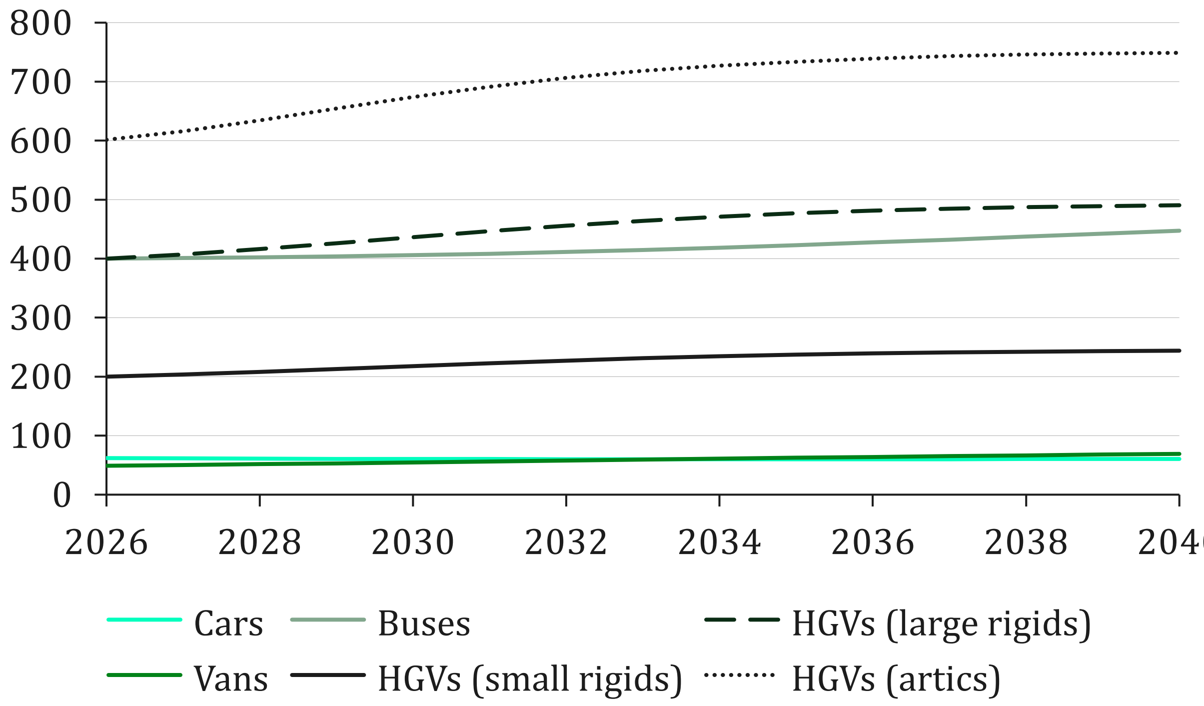
Recycling efficiencies (%)



Average battery sizes of scrapped BEVs

From estimated scrappage stocks, the average battery size can be estimated, as summarised in the figure below.

Average battery size for scrapped vehicles (kWh)



1. EU Battery Regulation (EU) 2023/1542.

Reported emissions savings from battery EoL can differ significantly depending on second-life use case and LCA boundary choice and recycling conditions

Emissions savings can be reported for both repurposing and recycling, but only with substantial caveats. Over-simplification risks obscuring the key drivers and undermining the credibility of the analysis.

Second-life batteries

LCA boundaries

Depending on the LCA boundaries chosen in a study, the emissions saving can vary significantly.

In a ***battery-centred LCA study***, the battery is assessed across its EV first life and stationary second life, with most manufacturing emissions allocated to the first life. When impacts are expressed per kWh delivered over the combined lifetime, extending battery use substantially dilutes manufacturing emissions. Studies report carbon-intensity reductions ca. 50% per kWh relative to single-life use[1,2]. This demonstrates circular-economy benefits but does not reflect the emissions impact of deploying a BESS today.

By contrast, an ***application-centred LCA*** compares two identical BESS systems, one using a new battery and one using a second-life battery. Here, manufacturing emissions are either excluded from second life or partially shared between first and second use. Emissions savings are therefore much smaller and highly dependent on assumptions. For example, Richa et al. (2017) report around 12–46% lower GHG emissions, with results sensitive to battery lifetime, efficiency, and how emissions are allocated[1,3].

Second-life battery use cases

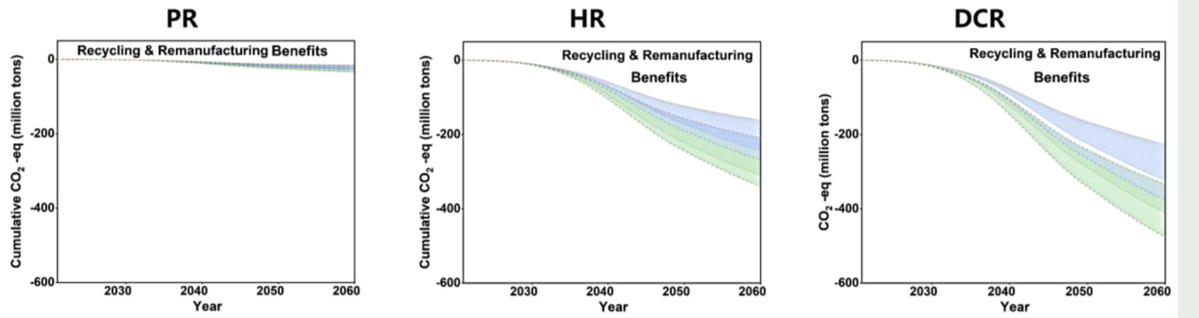
Even with a consistent boundary, use case of the second-life battery can determine emissions saving.

In **low-cycling applications**, avoided manufacturing emissions dominate and second-life batteries show clear benefits; Yang et al. (2019)[1,4] report ca. 20% GHG reductions compared to lead-acid batteries. In **high-cycling applications,** such as load shifting, operational losses become dominant. Using the same infrastructure, Yang et al. (2020)[1,5] find that second-life batteries can perform worse than new batteries due to lower round-trip efficiency, minimising the emissions saving benefits.

Battery recycling

Evidence shows that reported emissions savings from battery recycling vary depending on recycling method and location.

In a study by Jiang et al. (2025)[6], **total life-cycle carbon reductions differ depending on the recycling pathway applied**. When recycling and reuse are combined, cumulative carbon emissions reductions vary between pyrometallurgical recycling (PR), hydrometallurgical recycling (HR) and direct cathode recycling (DRC). This demonstrates that recycling technology choice alone can shift reported emissions savings significantly.



The study further shows that emissions outcomes depend on where recycling takes place and which primary material production is being displaced, with much larger savings reported when recycled materials replace high-carbon mining and refining routes. As a result, recycling-related emissions savings vary widely and cannot be captured by a single generic value without clearly specifying the recycling method, plant location, and material counterfactual. Overall, battery recycling can deliver meaningful emissions savings, but the scale of these savings is highly context-specific.

1: Dong et al. (2023), https://doi.org/10.1016/j.isci.2023.107195
2: Jannesari et al. (2019), https://doi.org/10.1016/j.rser.2019.109413, Ahmadi et al. (2015), https://doi.org/10.1007/s11367-015-0959-7
3: Richa et al. (2017), https://doi.org/10.1007/s11367-015-0942-3
4: Yang et al. (2022), https://doi.org/10.1016/j.resconrec.2020.104713
5: Yang et al. (2022), https://doi.org/10.1016/j.est.2022.105823
6: Jiang et al. (2025), https://doi.org/10.1038/s41598-025-86250-1

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