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Engineering Rapid Automotive Materials Sustainability (e-RAMS): Upstream conditioning of ELV scrap for high-quality steelmaking

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Steel decarbonisation is accelerating an infrastructural shift from Basic Oxygen Furnaces to scrap-based Electric Arc Furnace steelmaking. This shift places far greater reliance on post-consumer scrap streams, particularly end-of-life vehicles (ELVs), which supply 1.5-2 Mt of scrap annually in the UK and 8-9 Mt across Europe. Blending high-grade automotive steels with mixed co-materials can result in residual concentrations beyond specification thresholds, forcing downgrading into lower-value products and eroding material efficiency and decarbonisation potential.

While copper remains the dominant tramp element in ELV scrap, less attention has been given to nickel and tin despite their distinct accumulation behaviour in high-scrap EAF systems. Neither element is removed by standard pre-processing, so even modest concentrations persist through multiple recycling cycles. Small additions of tin can trigger hot shortness and intergranular cracking, while unintended nickel pick-up alters hardenability and transformation behaviour in low-carbon strip grades.

The e-RAMS project evaluates whether upstream removal of Ni- and Sn-bearing components can viably improve ELV scrap quality before shredding. Laboratory sampling and XRF screening across multiple makes and models identified a consistent set of contributors: exhaust sections, door-striker plates, turbocharger housings and related parts typically contained 7-13% Ni, while electrical fuse prongs and soldered connectors contained 40-42% Sn. These findings guided intervention trials at two Authorised Treatment Facilities (ATFs), where targeted component removal was applied to 20 vehicles per site to capture variation in business models, layouts, tooling and workforce practices.

A business-as-usual batch of 20 ELVs was also processed. All 60 vehicles were subsequently shredded at an industrial partner, producing three scrap streams that underwent assay melting and composition analysis. Based on these data, system-level modelling was carried out to examine cumulative Ni and Sn aggregation in ferrous scrap under a bounded UK scenario in which similar dismantling interventions are widely adopted. The modelling indicates that targeted removal of a limited family of Ni/Sn-bearing components could materially slow the long-term build-up of these residuals in EAF-based steels and extend the viable window for high-recycled-content automotive grades before specification limits are reached.

Overall, the results show that one to two hours of additional dismantling time per ELV, focused on a small family of high-impact components, can deliver meaningful improvements in melt chemistry with limited operational disruption. By linking dismantling practices with furnace-level metallurgy and long-term residual management, the study aligns with EEC 2026 and EMECR 2026 priorities on scrap quality, alloy control, circularity and resource-efficient steelmaking.

Speaker Country

United Kingdom

Speaker Company/University

Coventry University

Primary author: AHMADINIA, Masoud (Coventry University)

Co-authors: Dr KHASRAW, Darbaz (Coventry University); Mr HUTCHINSON, Matthew (Coventry University); Dr KHAFAGA, Ahmed (CU Coventry); Mr GEORGE, Shone (Coventry University); Prof. SPOONER, Stephen (Coventry University)

Presenter: AHMADINIA, Masoud (Coventry University)

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