German Environment Agency

21. November 2025

AutoRess Factsheet 6: Repair and remanufacturing: Challenges in the transition to e-mobility and recommended measures

Results from the project 'Resource efficient and circular electric cars' (AutoRess) - FKZ 3722 57 101 0

Recommended measures

Design phase

The EU legal framework should establish high standards for component standardisation and modularity. Current electric vehicle designs often impair repair and remanufacturing. Repairable design focuses on improving durability and repairability of vehicles and their parts and shall be set in the legal framework. Such designs involve a high level of standardization and component modularity, especially for vehicle batteries. Increased standardisation and similar designs of electric vehicle (EV) batteries can significantly reduce process costs for remanufacturing, allowing automatization to be introduced and making batteries more suitable for a wider range of vehicle types and applications.

Introducing a repairability score for vehicles on a national level. The aim of this measure is to enable consumers to make an informed purchase decision and to encourage manufacturers to improve repairability of their products. It is recommended that a repairability score for vehicles, especially EVs, be introduced at least at the national level. This would allow repairability of vehicles to play a greater role in consumer assessments such as those carried out by ADAC. In addition to considering spare part availability and ease of disassembly, the score should also reflect costs and expenditures for more complex repairs to enable an assessment of their feasibility even for older vehicles.

Use phase

'Right-to-Repair'. This aftermarket initiative mandates vehicle manufacturers with providing affordable access to software, information such as maintenance manuals, repair instructions and exploded-view drawings as well as spare parts for a set period after production ends. This would support legitimate remanufacturing activities and shall be set in national legal frameworks as the responsibility of producers.

Mandatory access to used parts. Operators of maintenance and repair services must offer customers the option of having their vehicle repaired with used, remanufactured or refurbished parts and components, as well as offering to repair the vehicle using new parts. This is in line with the voluntary incentive of Art. 33 of the proposal for the End-of-Life Vehicles Regulation (ELVR), which is mandatory for Member States.

Recommended measures

End-of-life phase

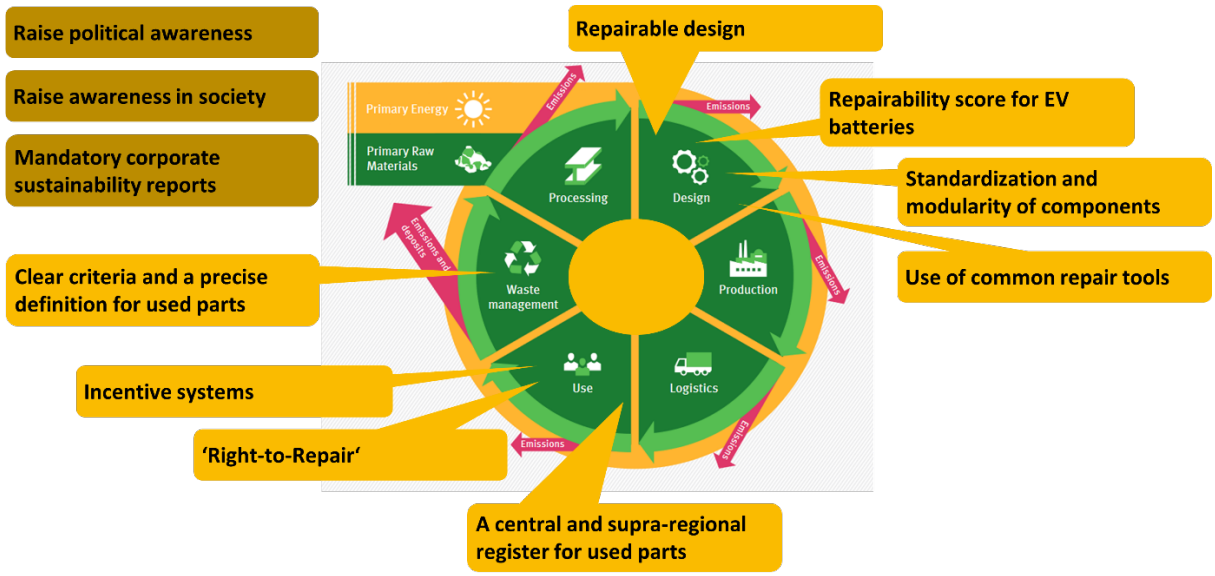
Clear legal status for reused parts. To promote a circular economy, the legal framework must clarify that parts and components from end-of-life vehicles that are suitable for reuse or remanufacturing may not be considered waste.

Improved traceability and quality of reused parts. To combat illegal activities, all used and remanufactured parts must be traceable via a label with the vehicle identification number and operator details and accompanied by a warranty.

These measures should preferably be introduced in the ELV Regulation.

The chart below (Figure 1) illustrates the recommended as well as other selected measures applicable to repair and remanufacturing, which are allocated to the different stages of a vehicle's life cycle(s). Cross-cutting measures are not allocated to any phase and are marked in dark yellow.

Figure 1: Overview of measures at different stages of the life-phase.



Source: own illustration

Benefits

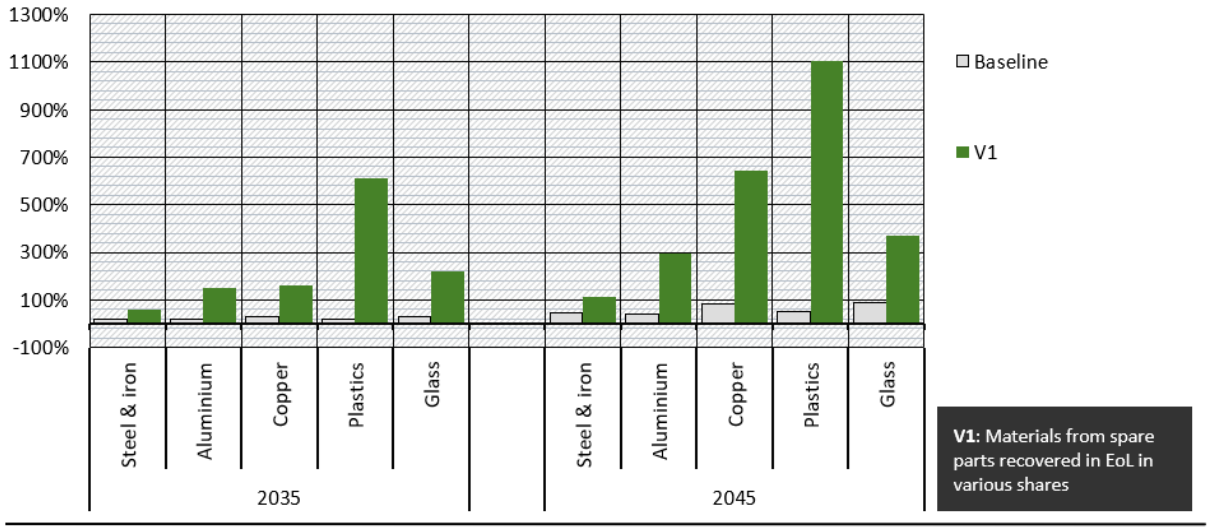
A longer service life is particularly desirable from an **environmental** point of view and is a fundamental building block of a circular economy. Repair and remanufacturing achieve the highest possible level of energy and material recycling at the end of a product's life. As EVs also tend to have a higher demand for critical raw materials, it has become even more important to extend the lifetime of vehicles to support European Union independence with critical raw materials.

Over the life cycle of a vehicle, the higher initial purchase costs of EVs are offset by the lower running costs compared to conventional internal combustion engine vehicles. This is limited by the lifetime of the vehicle. Therefore, extending the service life would increase the **financial benefits** of EV vehicles for users.

Remanufactured original parts are subject to the **same quality guidelines** as new original parts. The warranty is also the same. Remanufacturing gives consomers access to reconditioned original parts at a **lower price** in comparison to new replacements.

The graph below (Figure 2) shows the material savings from spare parts and components (excluding batteries) expected to be recovered from vehicles at the end of life (EoL) in 2035 and 2045, compared to 2025. The foreseen savings are based on the estimated share of materials recovered from dismantled parts and components from EoL vehicles over the modelling period. For instance, it is assumed that the proportion of aluminium from reused parts will increase to 20% by 2040, up from 7% in 2025. The proportion of plastics is expected to increase by 8%, rising from the current level of 1%. Detailed descriptions and assumptions can be found in the project's final report.

Figure 2: **Material savings from recovered in EoL spare parts and components compared to 2025.**



Source: own illustration

Background information

Repairing and remanufacturing vehicle components extends their service life and thus the functional life of vehicles. There is no need to purchase new items for repair, meaning that the demand for primary raw materials (including critical raw materials) is reduced and production-related greenhouse gas (GHG) emissions and waste are avoided.

The increased **digitalisation** of vehicles already impacts repair and remanufacturing. Components are increasingly shifting from mechanical to electro-mechanical parts, and digitalisation is adding complexity with more electronic parts. Additionally, business models are incorporating more digital elements, impacting repair and remanufacturing practices and prospects.

The shift to **electric vehicles** presents both challenges and opportunities for the repair and remanufacturing market. The EV transition will require medium- to long-term investment and R&D in EV component remanufacturing. Certain similar parts and components of combustion engine vehicles and EVs (e.g., brakes) will continue to be repaired and remanufactured, though their design and wear patterns may change (e.g., due to regenerative braking). In sum, these changes will likely move repairs from local workshops to centralized repair and

remanufacturing facilities, requiring specialized skills and tools. This shift also necessitates reskilling the workforce, especially concerning high voltage batteries and electronic issues.

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