German Environment Agency

29. October 2025

AutoRess Factsheet 9: Improving Automotive Plastics Circularity – Technical and Legal Priorities

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

This factsheet outlines measures to improve the circularity of plastics in the automotive sector, aligning with sustainability goals and the proposed End-of-Life Vehicles (ELV) regulation.

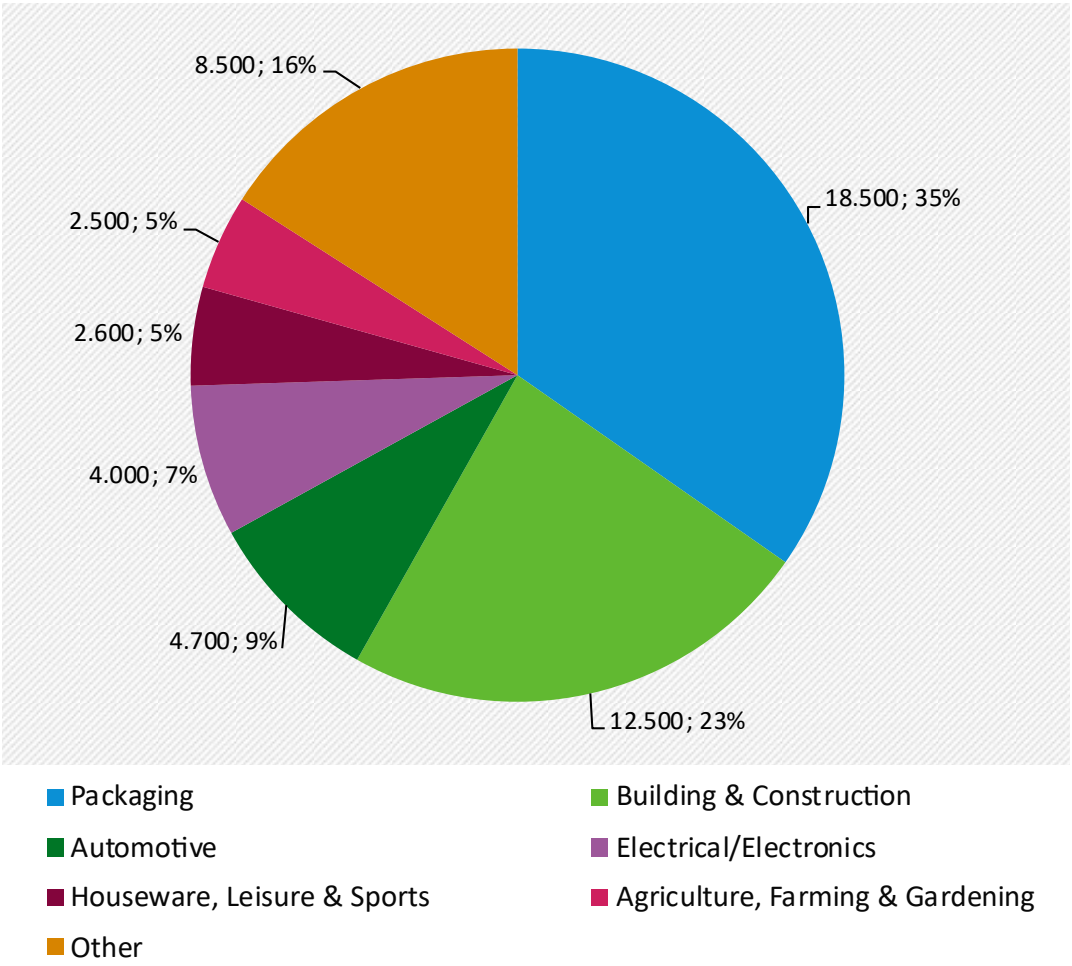
Key Measures

- **Mandate Recycled Content Targets for Plastic Materials**: Require at least 25% recycled content in automotive plastics (post-consumer recyclates, excluding biobased materials, Article 6 of ELV regulation proposal) to reduce demand for primary resources. Incentives should prioritize plastic recyclates from end-of-life vehicles in order to close the material loop. If a target is set for bio-based plastics, this should be set in addition to the recycled content target and only include bio-based waste in order to ensure investment security for both recycling and bio-based materials.
- **Set Minimum Plastic Recycling Rates**: Introduce a minimum recycling rate of 30% for plastics in the automotive sector (Article 34 of ELV regulation proposal) to reduce greenhouse gas emissions and virgin material use. Waste management operators should achieve an annual recycling rate of at least 30 % of the total weight of plastics in end-of-life vehicles, reducing the need for new plastics.
- **Promote Design for Recycling:** Mandate that original equipment manufacturers (OEMs) design plastic components for easy removal and highly recyclable material combinations provide detailed instructions for dismantling and replacement. This ensures efficient recycling and supports circular economy principles.
- **Invest in Advanced Recycling Technologies:** Encourage industry and government investment in the investigation and capacity building of post-shredder technologies to improve the quality of recycled plastic outputs. Expanded research and infrastructure will enhance recycling efficiency and material recovery.

1 Background

Around 9 % of the plastics consumption in Europe comes from the automotive sector.

Figure 1: Plastics consumption per sector in the EU27+3 in %



Amounts calculated by given shares and the total amount of 53.3 Mio.t
Source: Own figure Oeko-Institut; data from Plastics Europe 2024[1]

The proportion of plastics in the total weight of vehicles heavily depends on the type of drive, vehicle model and manufacturer. Between today and two decades ago, the proportion of plastic in new cars has increased, leading to a large difference in the amount of plastic between ELVs and new cars. Currently the plastic share in a passenger car ranges from 14 to 18%. In absolute figures, the proportion by weight is between 190 and 360 kg per car in the commercial sector.[2] In 2023, 110 kilo tonnes (7.7%) of the plastic processed in the automotive sector had secondary sources (sourced from byproducts or waste), however only a small fraction of this came from cars at the end of their life. The recycling rate for plastics (post-consumer waste) from the

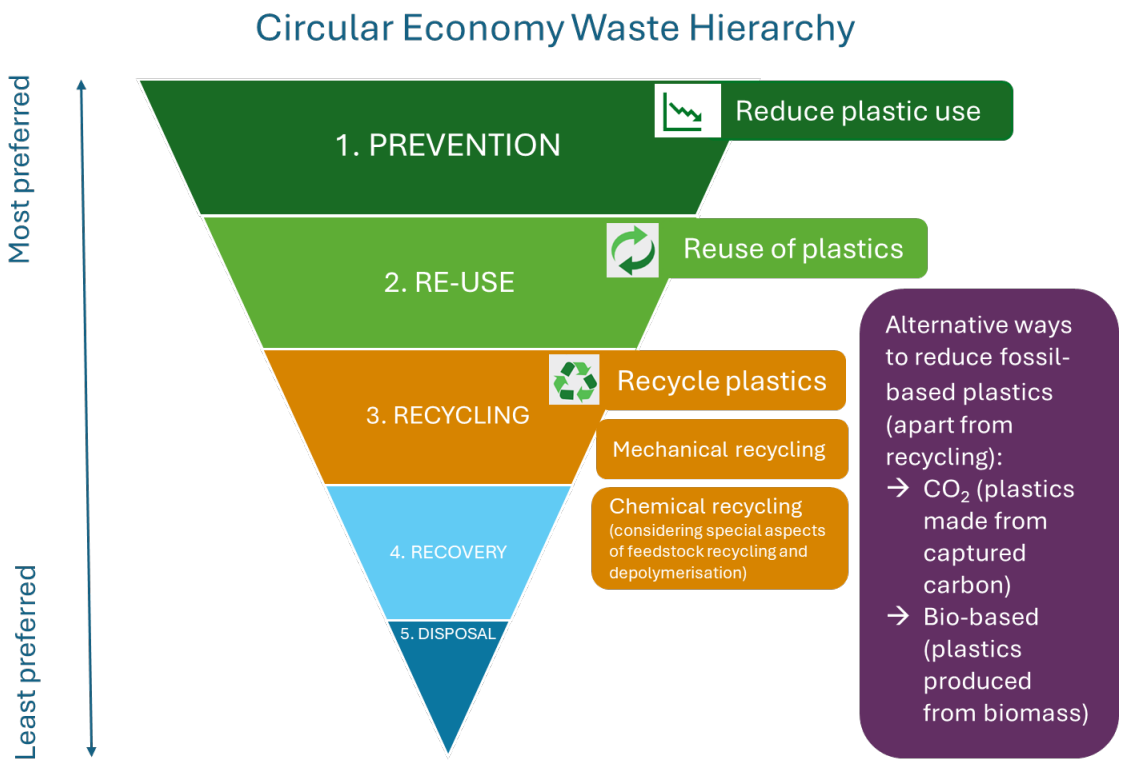
[1] Plastics Europe (2024: The Circular Economy for Plastics. A European analyses. March 2024; https://plasticseurope.org/knowledge-hub/the-circular-economy-for-plastics-a-european-analysis-2024/

[2] Maury, T.; Nacef, N.; Torres de Matos, C.; Antonopoulos, I.; Nessi, S.; Pierri, E.; Baldassarre, B.; Garbarino, E.; Gaudillat, P.; Mathieux, F. (2023): Towards recycled plastic content targets in new passenger cars and light commercial vehicles. JRC Publications Repository, European Comission. DOI: 10.2838/834615 https://publications.jrc.ec.europa.eu/repository/handle/JRC129008 (11.09.2025).

vehicle sector overall was just 13.8%, not all used again for new vehicles.[3] Recycled plastics for vehicles do not only come from ELVs, but from other sectors like the packaging sector (e.g. PET from single-use plastic bottles used for textiles in a car). This is incongruent with the objectives of the packaging sector.

In accordance with the waste hierarchy, the recycling of plastics is of paramount importance subsequent to the reduction and reuse of plastics. The recycling process can be divided into two different categories: mechanical and chemical recycling. Mechanical recycling is preferable to chemical recycling, as chemical recycling involves higher energy consumption and higher losses, and thus higher CO_2 intensity compared to mechanical recycling.[4] However, in the context of chemical recycling, it is imperative also to differentiate between the processes according to their outputs. Depolymerisation is a process which produces specific monomers and oligomers directly. In comparison with thermochemical processes such as pyrolysis, which produce raw materials that must undergo further processing before becoming monomers again, this method is preferable as it is a more efficient use of material. In addition to the recycling of materials, the use of alternative materials to reduce CO2 emissions in the production of plastics and de-fossilize the value chain is also being discussed. However, as new material is produced, this is not part of the waste hierarchy and must be considered separately.

Figure 2: Waste hierarchy with the focus on plastics in the AutoRess project



Source: Own figure Oeko-Institut

[3] Lindner, C.; Schmitt, J.; Hein, J.; Fischer, E. (2024): Stoffstrombild Kunststoffe in Deutschland 2023 – Zahlen und Fakten zum Lebensweg von Kunststoffen. Kurzfassung der Conversion Studie, Conversio Market & Strategy GmbH, Mainaschaff/Germany. S. S. 13. https://www.vci.de/ergaenzende-downloads/kurzfassung-stoffstrombild-2023.pdf (11.09.2025).

[4] Möck, A.; Bulach, W.; Betz, J. (2022): Climate impact of pyrolysis of waste plastic packaging in comparison with reuse and mechanical recycling, Commissioned by Zero Waste Europe and the Rethink Plastic alliance (Hg.), 23. September 2022. https://zerowasteeurope.eu/wp-content/uploads/2022/09/zwe_2022_report_climat_impact_pyrolysis_plastic_packaging.pdf (18.08.2025)

2 About the plastics aspects in focus of the project

2.1 Mechanical recycling

This recycling process should be the first choice for most plastics. During mechanical recycling, in contrast to chemical recycling, the chemical bonds within polymer chains (predominantly carbon-to-carbon bonds) remain (mostly) intact. Therefore, it is energy efficient and has high yields. For higher recycling rates, pre-sorting is a top priority in order to achieve homogeneous input streams and to be able to utilise mechanical recycling methods.

2.2 Chemical recycling

Chemical recycling refers to various processes that transform polymeric waste by altering its chemical structure, converting it to its constituents (e.g. monomers, oligomers) or hydrocarbons and chemical agents as basis for new plastics. This can be achieved by different processes using a combination of heat and pressure in an oxygen deprived environment which are referred to as depolymerisation, pyrolysis and gasification. The differences between 'feedstock recycling' (where the products are basic chemicals) and 'depolymerisation' (where the products are monomers) need to be considered. Chemical recycling is characterised by higher energy requirements and higher losses and therefore a higher CO_2-intensity compared to mechanical recycling.

2.3 Plastics produced from biomass

Plastics made from biomass feedstock only serve a very niche market so far. Reasons for this are mostly the higher price compared to fossil-based plastics and lacking incentive. The share of biomass in plastics production will not increase if there is no legal obligation or other form of encouragement.

2.4 Plastics made from captured carbon

The processes to produce plastics from CO_2 are still under development and do not yet have been applied in the car sector in the EU. Similar to plastics made from biomass feedstock, this will not change as long as there is no regulation to support this.

 Further details can be found in the final report in Chapter 3.10.

2.5 Plastics recycling in the list of criteria for a resource-efficient and circular vehicle

The measures to promote use of recycled plastics in vehicles are also included in the criteria for a resource-efficient and recyclable vehicle (see Factsheet 3: „Vision of a resource-efficient vehicle“). Here, a certain target for recycled content is specified in line with the end-of-life vehicle regulation currently under discussion and for various ambition levels. According to this, the proportion of recyclates from post-consumer recycling should be 25% from 2030. Converted to the current consumption of 1,420 kilotonnes of plastics in the automotive industry in Germany[5], this corresponds to an absolute value of around 355 kilotonnes of required recyclates. It is also proposed that in future 25% of this (i.e. 6.25% of the total quantity) must come from closed-loop recycling. This means that a proportion of around 89 kilotonnes must be

[5] Lindner, C.; Schmitt, J.; Hein, J.; Fischer, E. (2024): Stoffstrombild Kunststoffe in Deutschland 2023 – Zahlen und Fakten zum Lebensweg von Kunststoffen. Kurzfassung der Conversion Studie, Conversio Market & Strategy GmbH, Mainaschaff/Germany. S. S. 13. https://www.vci.de/ergaenzende-downloads/kurzfassung-stoffstrombild-2023.pdf (11.09.2025).

obtained from end-of-life vehicles and processed for use in new vehicles. The remainder can come from open recycling, i.e. from other areas such as electrical and electronic waste or packaging:

- Minimum target for recycled content: 25 % post-consumer recycled material; thereof 25 % closed loop
- Eco-labelling: 30 % post-consumer recycled material, thereof 25 % closed loop

Further details on the criteria are provided in the final report (chapter 4).

According to several experts, shredder technology is a necessary and economical method for shredding end-of-life vehicles and separating them into secondary material streams. However, it is **questioned whether the shredder light fraction is at all suitable for high-quality reprocessing; in fact, the stream of dismantled materials is much more in demand to use directly as spare parts or to recycle as an easier to handle waste stream**.

In general, further investment should be made in research into post-shredder technologies in order to optimize the quality of the output fractions, as dismantling will not be an economical solution for all parts. Furthermore, the importance of design for recycling is emphasised, which includes highly recyclable material combinations. Furthermore, components should be easily mechanically removable and that step should also be economically worthwhile.

Imprint

Publisher

Umweltbundesamt
Wörlitzer Platz 1
06844 Dessau-Roßlau
Tel: +49 340-2103-0
buergerservice@uba.de
Internet: www.umweltbundesamt.de
/umweltbundesamt.de

Editorial office

UBA Subject Advisors
Section I 2.2 Pollution Abatement and Energy Saving in Transport
Martin Kortschack
Section III 1.2 Extended Producer Responsibility - Electrical Equipment, Vehicles and Batteries
Regina Kohlmeyer

DOI

https://doi.org/10.60810/openumwelt-8451

Completion: 10/2025

Authors, Institutions

Dr. Johannes Klinge, Oeko-Institut

Based on the final AutoRess report. All AutoRess documents are published on http://umweltbundesamt.de/themen/verkehr/ressourcenschonung-im-verkehr

Project partners: Oeko-Institut, ifeu gGmbH, Mehlhart Consulting, team ewen GbR

Project long title: Motor vehicles in support of sustainable resource use and circularity: Instruments and measures to reduce the demand for raw materials in the transport sector through circular economy in parallel with an energy transition in transport

FKZ-number: 3722 57 101 0