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IMPACT ASSESSMENT REPORT

ANNEXES 1 TO 6 to the IMPACT ASSESSMENT REPORT

Accompanying the document

Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

on circularity requirements for vehicle design and on management of end-of-life vehicles, amending Regulations (EU) 2018/858 and 2019/1020 and repealing Directives 2000/53/EC and 2005/64/EC

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ANNEX 1: PROCEDURAL INFORMATION

1.1 Lead DG, Decide Planning/CWP references

The preparation of this file was led by DG Environment (ENV), under a co-lead/coordination with DG Internal Market, Industry, Entrepreneurship and SMEs (GROW) and supported from DG Joint Research Centre D.3 European IPPC Bureau (JRC.D.3).

The file essentially comprises a revision of Directive 2000/53/EC on end-of-life vehicles[1] ("ELV Directive") and Directive 2005/64/EC on the type-approval of motor vehicles with regard to their reusability, recyclability and recoverability[2] ("3R type-approval" Directive), which links the requirements on the placing of the market of new vehicles with the provisions of the ELV Directive.

This revision takes into account the two evaluations that were performed for the two legal instruments and incorporates as many as possible of those recommendations that have resulted from those evaluations. In addition, the objective of the combined review of the ELV Directive and its mirror 3R type-approval Directive is to update the two instruments to be able to deliver the key objectives of the European Green Deal and Circular Economy Action Plan and to update both legislations to make them fully operational as described in Section 2 (below).

Since this file comprises two combined sub-initiatives, they were included under a single entry in DECIDE/Agenda Planning database, as follows:

Commission proposal for the revision EU legislation on end-of-life vehicles	PLAN/2020/8644

1.2 Organisation and timing

This joint review of the EU rules on end-of-life vehicles and the 3R type-approval Directive is a deliverable under the European Green Deal[3], the Zero Pollution Action Plan[4], the Circular

[1] Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of life vehicles (OJ L 269, 21.10.2000, p. 34–43).
[2] Directive 2005/64/EC of the European Parliament and of the Council of 26 October 2005 on the type-approval of motor vehicles with regard to their reusability, recyclability and recoverability and amending Council Directive 70/156/EEC (OJ L 310, 25.11.2005, p. 10–27).
[3] COM(2019) 640 final https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52019DC0640
[4] COM(2021) 400 final https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021DC0400&qid=1623311742827

Economy Action Plan[5] (CEAP) and has strong links to the revised in May 2021 Industrial Strategy for Europe[6], which in turn built on the 2020 Industrial Strategy.[7]

The **Inception Impact Assessment Roadmap** was published on 22 October 2020 with a feedback period until 19 November 2020[8].

Following the conclusions of the evaluation of the EU rules on end-of-life vehicles, which revealed the operational inconsistencies between the ELV Directive and the 3R type-approval Directive, the DG ENV and DG GROW decided to carry a joint review of the two legislations.

A 14 week **open public consultation,** held between 20 July 2021 and 26 October 2021, was published on the Commission EUSurvey website[9].

The Inter Service Steering Group (ISSG) for the Impact Assessment was set up by the DG Environment. It included the following DGs and services: CLIMA (Climate Action), COMP (Competition), CONNECT (Communications Networks, Content and Technology), ENER (Energy), ESTAT (Eurostat), GROW (Internal Market, Industry, Entrepreneurship and SMEs), INTPA (International Partnerships), JRC (Joint Research Centre), MOVE (Mobility and Transport), NEAR (Neighbourhood and Enlargement), RTD (Research and Innovation), SG (Secretariat-General), SJ (Legal Service), TAXUD (Taxation and Customs Union) and TRADE (Trade).

The ISSG has been consulted regarding, and has given input to, key deliverables from the support study, and the joint draft Impact Assessment report on the ELV Directive and 3R type-approval Directive prior to its submission to the Regulatory Scrutiny Board (RSB). This was the case notably at two ISSG meetings which took place on 1 December 2022 and 24 January 2023.

1.3 Consultation of the Regulatory Scrutiny Board (RSB)

An informal upstream meeting with the RSB took place on 28 February 2021.

After final discussion with the ISC, a draft of the impact assessment was submitted to the RSB on 15th February 2023 and discussed at a meeting with the RSB on 15h March 2023.

Following the negative opinion of the RSB from 15 March 2023, changes were made to the IA in order to reflect the recommendations of the Board. The table below presents an overview of the RSB's comments and how these have been addressed.

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[5] COM(2020) 98 final https://eur-lex.europa.eu/resource.html?uri=cellar:9903b325-6388-11ea-b735-01aa75ed71a1.0017.02/DOC_1&format=PDF
[6] COM(2021) 350 final https://ec.europa.eu/info/sites/default/files/communication-industrial-strategy-update-2020_en.pdf
[7] COM(2020) 102 final https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1593086905382&uri=CELEX%3A52020DC0102
[8] End-of-life vehicles – revision of EU rules (europa.eu)
[9] https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12633-End-of-life-vehicles-revision-of-EU-rules/public-consultation_en

Table 1.1a: How RSB comments of the first opinion have been addressed

RSB comments	How addressed
Main findings	
B(1). Objectives: the report needs to clarify relation of the specific objectives with the general objective of contributing to the competitiveness of the automotive sector	The impact assessment report has been changed, so that the contribution of the initiative to the competitiveness of the automotive sector is no longer included among the general objectives of the initiative. As the initiative will however have a number of positive impacts on the competitiveness and resilience of this sector, a new section 8.3 on this point has been added.
B(2)Definition of problems: the report is not clear on the key policy choices and the robustness of the evidence informing these choices.	Clarifications have been added in section 2 on the definition of the problems and their interrelationships, and in section 8 (as well as in Annex 4) on the interrelationships and synergies between the options contained in the preferred policy package. This responds to the second point raised by the RSB and "point for improvement" C(2). The evidences on the robustness of the choices build on a comprehensive IA support study by Oeko-Institut as well as dedicated studies by the JRC on plastics and CRMs and extensive consultation with stakeholders. This is described in Annex 4. A summary table specifying all measures per policy option in a single overview, their inclusion in the preferred package as well as implementation dates, has been added to section 5.2.
B(3) Data analysis: The level of quantitative analysis on the extension of scope of the ELV legislation is not proportionate to the scale of the expected impacts. The report does not sufficiently assess the impacts on competitiveness of affected EU sectors, international partnership countries and the enforcement capacities of Member States.	New data and analyses have been added throughout the text concerning the extension of the scope of the current legislation to new vehicles. This is particularly the case for the quantification of the economic and environmental impacts of the preferred option (see in particular sections 6.2.6 and 6.3.6). This is based on new estimates, stemming from dedicated work by the Oeko-Institut on this issue. In addition, a new section has been added in appendix 15 on the relevance of measures to extend the scope of recovery of critical raw materials (CRM). This new section has been prepared by the JRC based on a recently completed study (made available after the first submission). The total administrative burden has been better presented per operator and reduced due to some double counting of one-offs as yearly costs in the tables of the contractor. The detailed tables in the appropriate template are included in Annex 3. No 'one-out' costs are identified. The recurring and one-off costs are consistently presented for the policy options. New elements were provided on the impacts of the proposed export measures on importing countries, based in particular on the contributions of INTPA (see section 8.6 and annex 8, section 7.2.4) - the costs of the export measures enforcement and other public authorities are quantified in Section 8.2 and Annex 8.
B(4) Comparison of different policy	The analysis on the comparison of the effectiveness and efficiency

RSB comments	How addressed
options: the report does not clearly compare the different policy options in terms of effectiveness and efficiency. It does not sufficiently demonstrate that the preferred combination of options is the most proportionate and best performing one.	of the options has been considerably reinforced in the impact analysis report (see section 7.2), as well as the demonstration of the performance of the preferred package of options (section 8.2). It includes a cost-benefit analysis in line with the Better Regulation Guidelines incorporating costs for the extended scope as well as the cost-effectiveness assessment moved from the annexes to the main text. The choice of the preferred option for recycled content for steel has been amended and clarified, i.e. by specifying that future legislation will not directly set a mandatory target level but that there should be an empowerment for the Commission to lay down such a target based on a dedicated feasibility study (see section 8.1).
What to improve (comments summarised)	
C(1). The report needs to define important terms and concepts, provide a structured and clear set of general and specific objectives that support competitiveness and enhance EU sectors. The specific objectives must be precise and measurable to track progress and success	The definitions of ELVs have been added in section 1.2, the general legal context is described (also in section 1.2) and some terms clarified, like the scope of the L-category vehicles. As indicated above, the expected impacts on the competitiveness of the automotive industry are presented in a dedicated section 8.3. In order to ensure better measurement of progress and success, the specific objectives have been formulated more precisely (see section 4.2), to allow for an assessment of the performance of the preferred package of options in the future.
C(2). The report should clearly outline policy options and specify if the policymaker can prioritize specific issues by selecting a limited set of interventions from various areas, leading to alternative combinations of measures. Additionally, the report should evaluate and compare these alternatives against the baseline for effectiveness, efficiency, and proportionality.	The specific features and interlinkages between the problems and associated objectives have been described more in details in section 2.1, stressing the importance of treating them in a consistent and mutually supportive manner. The interplay between each best performing option and their synergies is also explained in more details in sections 8.1 and 8.2. This provides policy makers with additional information on the rationale for the preferred package. The impact assessment identifies a set of problems, as well as objectives and options designed to address each of these problems separately, with a dedicated assessment of their impacts. This provides clear information for policy makers on all problems and ways to address them. Based on the methodology foreseen in the Better Regulation Guidelines, the report shows that the preferred package of options is the best performing one to address all problems, both individually and taken together, in view of their synergies. In that regard, and in line with the Better Regulation Guidelines, alternative combinations of options have not been assessed in the report, but the information that is contains on each option could be used by policy makers to evaluate alternative solutions.
C(3) The report needs to clarify why EU-wide Extended Producer Responsibility schemes were not considered and how banning the	Regarding the choice to discard the option of individual and/or collective EU-wide Extended Producer Responsibility schemes, additional explanations have been provided in the revised version of the report and in Annex 7.3.5). This measure is discarded mostly

RSB comments	How addressed
export of vehicles aligns with the waste hierarchy. It should also explain the environmental impact of this ban, specifically the increased number of vehicles left in the EU requiring ELV disposal.	for subsidiarity reasons as it would represent a direct intervention at the EU level on the organisation and governance of the waste management sectors and operators which are currently dealt with by Member States. The existence of national vehicles registers and the absence of EU financial and human resources to assume new tasks linked to the running and supervision of EU EPR schemes also make this option unrealistic in the current context. With regard to setting requirements for export vehicles that can still be used in third countries, the report has been complemented with data exposing the environmental and road safety consequences of the current patterns of export of used vehicles from the EU, where no distinction is made between roadworthy and non-roadworthy vehicles. The export measures are justified by the need to address the EU environmental footprint linked to such practices, consistent with the EU environmental policy, as reflected notably in the EU Zero Pollution Action Plan. This is also supportive of efforts at global level and by importing countries for trade in cleaner and safer used vehicles. These measures are not inconsistent with the EU waste policy as they will avoid that the dismantling of a large number of used vehicles originating from the EU takes place in substandard conditions at the end of their life (which associated pollution risks linked for example to informal recycling of lead-acid batteries). The report provides also more information on the environmental impacts of these measures in the EU, including quantified estimates on increased vehicle quantities used that would be subject to ELV treatment in the EU, as described in Section 8.6 and Annex 8, Section 7.2.4.
C(4). The report needs to improve the impact analysis by ensuring that the quantitative analysis matches the expected impacts. It should quantify the costs and benefits of extending the scope of the ELV legislation, and if this is not possible, explain why and discuss the quality of available evidence. The report should clarify how much of an evidence-based decision can be made based on available information and what the risks are if cost estimates are absent.	The revised report now includes a more detailed and better quantified analysis of the costs and benefits associated with options for extending the scope of ELV legislation. Where quantification has not been possible or proportionate, the report explains why and provides a qualitative assessment of the options at stake.
C(5). The report needs to enhance its impact analysis. It should be transparent about the impact on competitiveness, particularly for the automotive sector, and clarify the total costs of the preferred option	The revised version provides an enhanced analysis of the impacts of the various options analysed. It contains notably more information on the impact of the preferred package on the competitiveness of the automotive sector. The total costs resulting from the preferred option for EU vehicle manufacturers and other operators have also been clarified, including quantitative estimates

RSB comments	How addressed
for EU vehicle manufacturers. The report should also assess the impact on international partner countries and evaluate if an export ban would reduce mobility options, particularly for vulnerable groups, or result in trade diversion with potentially polluting vehicles imported from other third countries. Additionally, the report should assess the impact on Member States' enforcement capacities and clarify how.	and qualitative assessments of non-quantified costs and as costs per vehicle detailed further in the Annexes. Regarding impacts on international partner countries, the report has been completed with case studies data from countries which have been imposing strict and comprehensive import measures for many years already (see section 8.4 and Annex 7.2.4). The report also assesses, as part of the administrative burden, the impact on Member States' enforcement capacities and clarified how the administrative burden is estimated, taking into account the One In, One Out approach.
C(6).The report should analyse and explicitly present the distribution of impacts and show who will benefit from this initiative and who will bear the costs, taking into account that the overall net benefit of the initiative is critically linked to credited CO2 savings.	The revised version contains an analysis of the distribution of impacts among stakeholders, explicitly presenting who will benefit and bear the costs of the initiative (with a breakdown of the expected costs and benefits for each group). The report integrates the CO_2 savings as part of the overall monetised benefits of the preferred package.
C(7). The report should provide a clear comparison of options, mainly in terms of effectiveness and efficiency. It should present the cost-benefit analysis (net impacts and Benefit Cost Ratios) for each option (and relevant combinations thereof) to allow for a solid comparison of options which in turn can support the selection and justification of the preferred set of measures. The total net impact and Benefit Cost Ratio of the preferred option should be presented. The comparison should bring together all monetised and non-monetised impacts – economic, environmental and social. The integration of environmental benefits in the analysis should be transparent and consistent.	The revised version of the report includes a cost-benefit ratio analysis for each option, as well as a more developed assessment of their effectiveness, coherence and proportionality and the underlying assessment. The total net impact and the benefit-cost ratio of the preferred option are also presented in Section 8.5. The environmental benefits are explained and, except when this was not possible, quantified. Additionally, the revised report includes a comparison of all monetised and non-monetised impacts, including economic, environmental and social impacts.
C(8).The report should improve the explanation of its methodological approach and the analytical clarity throughout. All the key assumptions and data should be explained. The report should present the aggregated and disaggregated estimates in a way that it is clear how the figures relate to one another.	The report now provides a more detailed explanation of the key assumptions and data used in the analysis. It also presents aggregated and disaggregated estimates in a concise manner, making it easier to understand the relationship between the numbers. In addition, the Annexes to the report present all estimates in a disaggregated manner with greater granularity, making it easier to understand how the figures relate to one another. The report

RSB comments	How addressed
References to the supporting study and presentation need to be improved.	explains all key assumptions and data used in the analysis, providing readers with greater transparency and ensuring that the report's conclusions are based on sound evidence. The supporting study and other supporting document are presented in Annex 4 and referred to throughout the document, when the measures proposed or the analysed impacts are based on these document.

Resubmission

A revised Impact Assessment was submitted to the Regulatory Scrutiny Board on 28th of April 2023. The Regulatory Scrutiny Board (RSB) of the European Commission assessed the revised Impact Assessment and issued a positive opinion with reservations on the 16th of May 2023.

The Board's main findings were the following and these were addressed in the final impact assessment report as indicated below in Table 1.1b.

Table 1.1b: How RSB comments of the second opinion have been addressed

RSB comments	How addressed
Main findings	
(1) The report should explain the differences between used vehicles, waste and vehicles without a roadworthiness certificate and carry this differentiation throughout the text.	Differences are explained in Section 2.3.2. of the IA report and Annex 6.4.2. in particular analysing the regulatory failures related to the waste, used vehicles and the distinction with ELVs, the relevance of the roadworthiness certificate.
It should better demonstrate that requiring a roadworthiness certificate for exporting used cars is the best option in view of other potential available alternative measures (e.g. based on age of the vehicle).	Importance of use of the roadworthiness certificate was clarified in the Section 2.3.2 of the impact assessment report, by explaining that the roadworthiness certificate is an essential part of the EU regime designed to ensure that vehicles are kept in a safe and environmentally acceptable condition during their use. Directive 2014/45/EU specifies the minimum elements which have to be tested, in order for a vehicle to obtain a certificate. While these requirements are a condition for a vehicle to be used on EU roads, a prerequisite for a vehicle to have a valid roadworthiness certificate is considered to be the best option in regulating export of used vehicles without creating additional administrative burden, as it builds on already available documentation.
It should clarify if different roadworthiness requirements are set by different Member States and if this would influence the internal market for exporting used vehicles to third countries.	As it is explained in Section 2.3.2, Directive 2014/45/EU sets minimum mandatory elements which have to be tested, in order for a vehicle to obtain a roadworthiness certificate. Therefore, the mandatory scope of roadworthiness requirements is harmonised at the EU level. Additionally, each Member State shall recognise the roadworthiness certificate issued by other Member State, in accordance with Directive 2014/45/EU, which thus ensures the smooth functioning of the

RSB comments	How addressed
	internal market.
It should explain why the applicable regulations of the recipient country are not deemed sufficient in determining whether an export should be permitted.	Additional clarifications have been added to the sections describing the problems and drivers on the issue (Section 2.3.1. and Annexes 6.4.1, 7.2.4. under the description of M21 - export requirements for used vehicles linked to roadworthiness certificate). The text explains why the regulations of the recipient countries are not deemed sufficient, which is mostly related to the situation that currently there are no global standards or consolidated import requirements that would be commonly applied by the recipient countries. There are destination countries which are currently not requiring vehicles to meet certain safety standards, such as the presence of airbags. Furthermore, the enforcement by the third parties of adopted import requirements is not always effectively ensured compromising the quality of used vehicles imported into the region, resulting in negative consequences on the environment, health, and road safety, as well as additional costs. These facts prove the necessity to establish a mechanism on stetting binding requirements for used vehicles which are subject to be exported from the EU to third countries, including the non-OECD countries. An additional measure describing these alternatives is added to the list of discarded measures (M47a).
(2) The report should discuss the (global) environmental footprint of discarding vehicles as waste by banning their export that could still be used in third countries where different legal requirements and standards allow this. It should demonstrate how this is compatible with the waste hierarchy and if a potential better end-of-life treatment of the vehicle in the EU outweighs the impacts resulting from the extension of its lifetime when further used in third countries from a lifecycle perspective. The report should better demonstrate the coherence with the European Commission circular economy strategy and action plan.	The coherence of export measures with the CEAP, including their contribution to the implementation of the 'waste hierarchy' has been substantiated in the Section 8.6 of the IA report, as well as Annex 7.2.4., where the comprehensive background information is provided on the challenges global trade of used vehicles, and the actions taken by the import countries to mitigate negative consequences associated with the export of used vehicles, with the aim to continue receiving used vehicles that could be placed in service for further use on the market of third country.
(3) The report should better justify the difference in approach for setting targets for recycled content for steel compared to the measure proposed for setting targets for aluminium and Critical Raw Materials. It should explain how the envisaged feasibility studies will subsequently inform the impact assessment and comparison of alternative targets and related policy choices when	The differences between the two feasibility studies is explained in Annex 7.2. for M10 respectively M11 and in the main SWD in Section 5.2.2. The study for steel focuses at the technical feasibility to determine an appropriate target level, whereas the study for other material has a wider scope in assessing wider economic feasibility elements.

RSB comments	How addressed
preparing the corresponding implementing measures.	
(4) The report should better explain why the option of EU-level Extended Producer Responsibility (EPR) is discarded while Member State level EPR is required given the EU-wide, cross-border, nature of the motor vehicle market.	There is a difference between a **single** EU wide EPR scheme triggering various subsidiarity and feasibility concerns, versus cross-border EPR supporting measures that facilitate EU wide coordination between schemes. The justification for the discard is sufficiently specified with the three main arguments listed on page 36. An additional reference to the reasons for discarding the related M48 in Section 5.3 is added to the description in Annex 7.3.6 to improve traceability.
(5) The report should be clearer on the distributional impacts, in particular on who is likely to benefit from the estimated CO2 credits as their final allocation seems to be instrumental in identifying how the different categories of stakeholders, including consumers, will be affected by the preferred policy package.	Except for the recycled content related GHG savings of PO2 and the financial relevance for the future functioning of CBAM, the other GHG savings cannot be attributed unambiguously to individual economic operators and not be reflected in currently existing financial instruments. More consistent use of the terms 'GHG savings' when credits are not directly attributable versus 'avoided CO_2 taxation under ETS' when they can be attributed financially is improved in the report in Section 7.1 and 7.2, the Glossary (link to ETS framework) and footnote 147 are improved accordingly. The approach to monetise the external costs related to total GHG savings as 'societal benefits' is in line with the BRG instructions for the Cost-Benefits Approach following the externalisation of costs in the DG MOVE handbook.
(6) The assumptions and calculations of the administrative costs should be clarified and better presented, including those related to the 'one in, one out' approach. The tables in Annex 3 on the administrative costs should come with more explanation and cross-reference with the estimates presented elsewhere.	The assumptions related to the administrative costs are moved from Annex 3 to Annex 8.3 following the overview tables describing each individual cost element. Some minor changes are included in these table for administrative costs that are not in the scope of the OIOO approach. Administrative costs for non-preferred options are displayed separately for consistency in detail for the total costs per economic operator and policy option in Annex 8.3. A compact table is added to Section 8.5 specifying the sum of costs under the OIOO approach as well as a quantitative estimate of the effect of streamlining information via digitalisation and alignment with existing reporting practices.
The Board notes the estimated costs and benefits of the preferred option in this initiative, as summarised in the attached quantification tables.	

1.4 Evidence, sources and quality

To support the analysis of the different options, the European Commission awarded a **support contract** to external experts. The consortium of consultants comprised: Oeko-Institut e.V. (Consortium Lead) with Rambøll Management Consulting A/S and the supported by the Mehlhart Consulting[10]. Evidence was compiled from the evaluation reports of the ELV Directive[11] and the targeted evaluation of the 3R type-approval Directive, which was carried out in parallel to the impact assessment and presented in a dedicated Annex 11 of this document. Additional supporting evidence was as well as retrieved via specific desk studies and data collection performed, feeding into the overall impact assessment work.

Further information is given regarding the evidence bases compiled by the external consultants in the following annexes:

1. Annex 2 (Stakeholder consultation synopsis)

The external consultants worked in close cooperation with the European Commission throughout the different phases of the study, and partly in consultation with one another throughout the process, particularly in the latter stages of assembling a coherent evidence base and in assessing, screening and adjusting policy measures and options.

2. Technical report of the Joint Research Centre (JRC)

The Joint Research Centre (JRC), the European Commission's science and knowledge service, produced a dedicated technical report on recycled plastic content targets in new passenger cars[12], which results have been directly included into the overall impact assessment of the current review. The work consists in an analysis of data and knowledge on plastics contained in vehicles, current and future practices and on evaluating capacity of the recycling industry to produce adequate quality and quantity of recycled plastics from end-of -life vehicle sources. The objective was to assess technical barriers and opportunities for further uptake of recycled plastics in vehicle. Finally, this study aimed to produce technical proposals for mandatory recycled plastic content targets (with associated levels), and link them with pros, cons and potential implications. These policy options were analysed within a dedicated Section 6 of the Impact Assessment and then discussed in view of their potential integration within the review of the ELV Directive and 3R type-approval Directive. In addition, a second JRC study was produced targeting specific measures related to increased CRM recovery, in alignment with the recently adopted CRM Act[13].

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[10] Baron, Y.; Kosińska-Terrade, I.; Loew, C.; Köhler, A.; Moch, K.; Sutter, J.; Graulich, K.; Adjei, F.; Mehlhart, G.: Study to support the impact assessment for the review of Directive 2000/53/EC on End-of-Life Vehicles by Oeko-Institut, June 2023.
[11] SWD(2021) 60 final.
[12] Maury, T., Tazi, N., Torres De Matos, C., Nessi, S., Antonopoulos, I., Pierri, E., Baldassarre, B., Garbarino, E., Gaudillat, P. and Mathieux, F., Towards recycled plastic content targets in new passenger cars, EUR 31047 EN, Publications Office of the European Union, Luxembourg, 2022, ISBN 978-92-76-51784-9 (online), doi:10.2838/834615 (online), JRC129008.
[13] N. Tazi, M. Orefice, C. Marmy, Y. Baron, M Ljunggren, P Wäger, F. Mathieux, Initial analysis of selected measures to improve the circularity of Critical Raw Materials and other materials in passenger cars, EUR 31468 EN, Publications Office of the European Union, Luxembourg, 2023, ISBN 978-92-68-01625-1, doi: 10.2760/207541, JRC132821

In 2022, the **Fit for Future Platform (F4F) adopted** an opinion[14] regarding joint revision of the End-of-life vehicles directive and the directive on the 3R type-approval of motor vehicles making the following suggestions:

- Suggestion 1: Consider a digital vehicle passport including details on used materials
- Suggestion 2: Refine the definitions for end-of-life vehicles and used vehicles/ parts of vehicles
- Suggestion 3: Consider full digitalisation of the registration system and (2) installation of a central registration system and/or interoperable systems or ensuring the compatibility and coordination of the registration systems across and within Member States
- Suggestion 4: Enforce the certificate of destruction (COD) necessary for deregistration and implement a systemic differentiation between temporary and permanent deregistration
- Suggestion 5: Improve implementability of the ELV-Directive's requirements through a reward system for deregistration and/or dismantling
- Suggestion 6: Ensure coherence with other legislation, e.g., the Batteries Directive
- 2006/66/EC and the REACH Regulation
- Suggestion 7: Improve compliance and enforcement possibilities through more realistic targets, common methodologies, and increased producer responsibility

The Commission has considered the findings and suggestions of the F4F opinion, and majority of them translated them into set of concrete measures. These namely include extended use of digital means (Vehicle Environmental Passport – suggestion 1), alignment of recycling definitions with the Waste Framework Directive and setting mandatory criteria that would help distinguishing ELVs from used vehicles (suggestion 2), improve interoperability between national vehicle registers with the aim to address the problem "missing vehicles" (suggestion 3), increasing functionality of COD by clarifying its linkage with vehicle de-registration as well adding additional information to vehicle registers (suggestion 4). Setting penalties and inspection requirements partially correspond to suggestion 4, while suggestion 6 on better coherence with sectoral legislation, e.g. Batteries Regulation[15], has been addressed in measures considering future regulatory approaches on substances of concern in vehicles. The package of preferred option extensively covers the elements proposed in the suggestion 6, notably setting mandatory used of recycled content, setting material specific targets (e.g. plastic, glass). Impact assessment also considers the suggested ways to improve EPR, monitoring and the overall enforcement of the advanced ELV treatment requirements (removal of parts before shredding). These suggestions are considered to best address the stakeholder concerns and comply with subsidiarity, feasibility, proportionality, effectiveness, efficiency and effectiveness criteria. In cases, where suggestions or some elements of these suggestions could not fulfil these criteria, they were not included in the policy options. Such cases mainly concern the aspects related to subsidiarity and feasibility constrains, for

[14] https://commission.europa.eu/system/files/2022-12/Final opinion 2022_SBGR2_05 ELV_rev.pdf
[15] Regulation of the European Parliament and the Council of [date] 2023 concerning batteries and waste batteries, amending Directive 2008/98/EC and Regulation (EU) 2019/1020 and repealing Directive 2006/66/EC (OJ L […]).

example, establish the EU wide Deposit Refund System for vehicles, central EU vehicle registration system, setting financial premiums. The full F4F report is presented in the dedicated Annex 5 of the Staff Working Document.

ANNEX 2: STAKEHOLDER CONSULTATION (SYNOPSIS REPORT)

2.1 Objectives of the consultation

The Commission completed an evaluation of the Directive 2000/53/EC on end-of-life vehicles (ELV Directive)[16] in 2021[17]. Following up on the evaluation, the European Commission initiated work on an impact assessment in support of a review of the ELV Directive. In view of the links between the ELV Directive and the Directive 2005/64/EC on the type-approval of motor vehicles with regard to their reusability, recyclability and recoverability[18] ("3R type-approval" Directive), a joint review of both Directives was be carried out. The purpose of the impact assessment was to gather and analyse evidence to support review of the EU legislation on end-of-life vehicles. It involved verifying the existence of a problem, identifying its underlying causes, assessing whether EU action is needed, and analysing the advantages and disadvantages of available solutions[19].

The objective of the consultation process was to ensure that stakeholders' views are sought on all key impact assessment aspects. All inputs (data, information, etc.) from the consultation have been incorporated into the impact assessment at appropriate points and will also be taken into consideration in the resulting legislative proposal.

It aimed to collect information from stakeholders in relation to the various problem areas and the measures proposed for achieving the objectives defined for each area and their likely impacts. This information has complemented the information and data gathered through other sources (e.g., literature review, existing policy and position papers, Eurostat data and other statistical data sources, etc.) and supported the analysis of the problem areas, the identification of options addressing the objectives of the review, as well as the analysis of their impact.

Mapping of stakeholders

The review of the ELV and 3R Type-approval Directives affects a broad spectrum of stakeholders, as requirements for sustainable products in the automotive sector and sound management of waste from ELVs are of relevance for all stakeholders involved in the

[16] Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of life vehicles (OJ L 269, 21.10.2000, p. 34–43).
[17] SWD(2021) 60 final.
[18] Directive 2005/64/EC of the European Parliament and of the Council of 26 October 2005 on the type-approval of motor vehicles with regard to their reusability, recyclability and recoverability and amending Council Directive 70/156/EEC (OJ L 310, 25.11.2005, p. 10–27).
[19] https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12633-End-of-life-vehicles-revision-of-EU-rules/public-consultation_en

automotive value chain (designers, producers and their suppliers, retailers, consumers, repairers, waste handlers, recyclers).

Therefore, a dedicated mapping was carried out to ensure that all relevant stakeholders are identified and consulted in a structured way, especially in the context of targeted consultation actions. For the public consultation and subsequent consultation activities, stakeholders from relevant groups have been contacted in the context of preparation of the study supporting the Commission Impact Assessment.

Stakeholder groups relevant to this public consultation were identified as follow:

a) **International governance bodies** such as UNEP, the Secretariat of the Basel Convention, etc.;

b) **Government experts from all Member States**, particularly environmental agencies/Ministries, registration and type-approval authorities, inspection services, market surveillance bodies, etc.;

c) **Associations and individual enterprises of the various sectors**:

- Vehicle and parts manufacturers – automobile industry actors, main suppliers;
- Treatment operators – garages, ATFs, dismantlers, shredders, recyclers;
- National EPR organisations;
- Steel, aluminium, copper and plastic producers;
- Insurance sector;

d) **Environment non-governmental organisations** (for waste management, pollution, circular economy etc.) and consumer organisations;

e) **Experts** (academics, research institutes) for waste management, pollution, circular economy etc.

2.2 Consultation and method tools

A variety of methods and tools have been applied to ensure a comprehensive and well-balanced consultation process, including the following:

- Publication of the **inception impact assessment**: to gather first reactions by stakeholders on the outline of the initiative (22 October 2020)[20]. The feedback period was open until 19 November 2020 and 61 contributions were received;
- A dedicated **support study**: this has been carried out by an external consultant, and made an important contribution to the preparatory work. The study has been examining different policy options and measures by providing key environmental, social, legal and economic expertise, data and analysis.
- A 14 week **open public consultation,** held between 20 July 2021 and 26 October 2021, was published on the Commission EU Survey website[21]. This open public consultation

[20] https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12633-End-of-life-vehicles-revision-of-EU-rules_en

covered the key subjects and elements addressed in the impact assessment (i.e. problem definitions, drivers, problems and consequences, possibility to extend the scope of the ELV Directive; design for circularity aspects; setting of separate reuse/ material specific-recycled content targets; ways to address the issue of missing vehicles; illegal export of ELVs and used vehicles; possible policy options and their likely environmental, social and economic impacts etc.). The questionnaire contained both closed and open questions. Close questions with multiple-choice answers were used where possible (yes/no, ranges of expected impacts, etc.) to allow statistical evaluation of the results. For some areas, in particular to collect data, open questions were necessary. These general questions were supplemented by more detailed questions targeting stakeholders with specialised knowledge on the subject. These responses are in detailed provided in the separate document[22].

- **Targeted consultation:** In a form of email correspondence and personal interviews, this consultation method was used to:
  - collect data and initial views about feasibility of certain measures;
  - confirm and validate final assumptions and results of the study; or
  - collect missing data.

Throughout the assessment, the areas where data is missing or where impacts exist that are uncertain but may significantly influence the final results needed to be identified. From this analysis, specific stakeholders were consulted for filling the information gap and further refining the results.

Where necessary, stakeholders have been approached in a format of emails with the request to provide written answers to certain questions or to substantiate claims shared in the first consultation stages. Contact has been conducted on *ad hoc* basis as specific aspects arise.

Additionally, up to twenty **personal interviews** took place in three stages. Most of these were performed between the online public consultation (OPC) and the stakeholder workshop. A few were performed before the end of the OPC and others followed the workshop.

All interviews were documented; interviewees asked to confirm or adjust the interview results and to specify if the interview may be used as a source.

Stakeholder workshop: A two-day workshop 24-25 March 2022, held after the public consultation, provided a forum to discuss particular aspects of the assessment related to the defined problem areas and measures attributed to the policy options.
During the workshop, open discussions with stakeholders allowed to collect views and discuss conflicting perspectives. Workshop discussions and results were documented. Stakeholders has two weeks following the workshop to submit additional information and data to substantiate their views.

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[21] https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12633-End-of-life-vehicles-revision-of-EU-rules/public-consultation_en

[22] https://circabc.europa.eu/ui/group/636f928d-2669-41d3-83db-093e90ca93a2/library/ecb8ebdf-6a62-4986-886a-a79685f76c05/details?download=true

The results of all the activities were in detail summarised and presented in the following sections of this synopsis report.

Table 2.1 Overview of different methods of the consultation strategy

What	Public feedback[23]	Online public consultation (OPC)	Targeted consultation	Stakeholder workshop	Consultation of Member States	Follow up consultation activities after the workshops
How	No specific format of feedback required, additional written contributions possible	Online Questionnaire Survey with the possibility to provide additional written contributions	Web conference interviews	2-day online meeting	Ad-hoc survey and 1-day meeting	Written feedback on the content presented in the workshop and written exchange
Why	To explain the approach and invite them to contribute	To validate/obtain data and information and to gain opinions on more detailed/specific aspects	To validate/obtain data and information and to gain opinions on more detailed/specific aspects	To discuss specific aspects, validate findings, gather additional evidence	To inform MS on measures and policy options, to discuss specific aspects, gather additional evidence and experiences from MS	To gather evidence that was requested in the workshop, to ask clarification questions on feedback, opinion and information provided, to request additional data
Who	All stakeholders	Specific stakeholder groups	Selected key stakeholders from specific stakeholder groups	Specific stakeholder groups	Representatives / Experts of MS authorities	Targeted stakeholders
How data / information was used in the impact assessment	Information used to structure the OPC questionnaire, to provide an initial overview of interested stakeholders	Identification of opinions of stakeholder groups; participating stakeholders were invited to the stakeholder workshop; for stakeholders invited to the targeted consultation, identify topics to which the study team expected the interviewed stakeholder to contribute.	Validate assumptions, understand the situation of selected key stakeholders, information used for identification of measures and policy options for reviewing the ELV Directive, information used for the impact analysis of measures.	Information used for revising the measures and policy options for reviewing the ELV Directive, information used for the impact analysis of measures.	Learn from experiences of MS-specific legislation already addressing problems targeted in the review of the ELV Directive and with regards to the measures proposed on EU level	Used for the impact analysis of measures

2.3. Stakeholder consultation

2.3.1. 2.3.1. Overview of open public consultation

Questions concerning various problem areas were presented in the form of a questionnaire which was divided into two sections. The first section, comprising of ten questions, was

[23] https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12633-Revision-of-EU-legislation-on-end-of-life-vehicles

addressed to the general public, including those not familiar with the ELV Directive and the vehicle sector. The second section contained thirty more specific questions and focussed on those who had specific knowledge and interest in the vehicle sector. Nevertheless, the entire questionnaire was open for participants to express their views.

The questionnaire was made available in all the EU official languages between 20 July 2021 and 26 October 2021 (14 weeks). To maximise the response rate, a link to the questionnaires was placed on the Waste Policy pages within the EUROPA Website[24], and a number of organisations were also contacted directly and asked to help disseminate the link.

In total, 208 respondents filled in the questionnaire during the consultation period. 199 (95%) specified that they had specific knowledge and interest in the vehicle sector. In the group of citizens and consumer NGOs, only 5 participants indicated not having specific knowledge of relevance.

57 stakeholders submitted a written contribution to further elaborate on their views.

Of the total participants, 69 requested their contribution to remain anonymous. The rest, which accounted 67%, agreed to the publication of all information of their contribution. Around 54% of participants were aware that their organisations were listed in the EU transparency register, while on the other hand, 95 of the participant organisations did not provide information on their status in the transparency register.

In the following sections, there is a quantitative analysis for the survey answers where predetermined answers were given. The factual summary of the "general questions" of the questionnaire is available in the 'Have your say' portal[25]. The responses to the more specific questions have been taken into consideration as part of the impact assessment process and summarized in the further sections of the annex, including the contributions received during a targeted consultation.

Participation by the SMEs

In total, 208 stakeholders participated in the open public consultation[26] (OPC conducted between 20 July 2021 and 26 October 2021). 199 (95%) specified that they had specific knowledge and interest in the vehicle sector. Classifying by size, 59 stakeholders identified themselves as large companies with 250 or more employees and comprised almost 1/3 of all participants. 130 of all stakeholders identified themselves as belonging to micro, small or medium (SMEs) companies, which total share was equal to 62.5%. 19 participants or 9.13% of stakeholders did not provide the answer on the size of organization they represent.

More information about the consultation with SMEs is provided in Annex 13.

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[24] http://ec.europa.eu/environment/waste/index.htm

[25] https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12633-Revision-of-EU-legislation-on-end-of-life-vehicles/public-consultation_en

[26] https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12633-End-of-life-vehicles-revision-of-EU-rules/public-consultation_en

2.3.2. 2.3.2. Survey in relation to 3R type-approval Directive

A 3R type-approval Directive-specific survey was conducted with stakeholders on this subject in proximity to interviews (see section before). The survey was developed similarly to the interview questionnaires for consulting three different stakeholder groups: OEMs, technical services, and type approval authorities. For all three groups, questions on the link to the ELV Directive, on the process of type approval and on possible future amendments were identical, a stakeholder group-specific set of questions was added to each one. The questionnaire was agreed on and is available to the European Commission.

The survey was distributed to OEMs through requesting the association ACEA to send the survey questionnaire to its members. The European Commission assisted in sending the questionnaire to type approval authorities. The survey was also forwarded to type approval technical services that had been initially identified but not interviewed.

Four Member States participated (3 provided the filled-out survey, 1 provided short input per email), and one OEM send a confidential contribution. Additional information was received from three more organizations/stakeholder groups

- one position paper (from ACEA),
- one interview in the main study was used to get specific information on the 3R type-approval Directive (UN ECE/UNEP), and
- one e-mail with additional explanatory information was received, in relation to the information provided in one of the specific interviews (from MS representatives from France).

In the round of written feedback in April 2022 (follow-up after the workshop in March 2022), a further written contribution from Germany was received.
Based on the indication of a lot of stakeholders, most of the information cannot be cited in this report as information has been provided on a confidential basis or interview documentations have not been confirmed by interviewees.

The positions of stakeholders are summarised in chapter 2.5.6.

2.3.3. 2.3.3. Overview of the targeted stakeholder consultation

A targeted consultation (interviews) was held starting in November 2021. The phase was split into two rounds of interviews:

1. The **main study interviews** held in the period from 3 November to 3 December 2021. In this round, the consultants conducted 20 interviews, see the list of interviewed organizations. One additionally invited stakeholder (ANEC BEUC) did not participate due to the questions being too technical for the stakeholder group they represent. The group of stakeholders that participated in the main study interviews consisted of automotive manufacturers for cars, lorries, vans, buses and motorcycles (n=3), suppliers of materials and (second-hand) components (n=6), stakeholders involved in the management of ELVs (n=7), and individual other stakeholders including a Producers Responsibility Organisation, a registration and international authority, a stakeholder representing insurance companies, and environmental NGOs.
2. **Interviews held in relation to the 3R type-approval Directive** in the period from 17 December 2021 to 7 February 2022. The invited group of stakeholders consisted of

automotive manufacturers (n=5), type approval technical services (n=3), type-approval authority / market surveillance (n=2), international authorities and one stakeholder conducting dismantling trials. Inputs were obtained from 8 out of 12 invited stakeholders.

The consultation phase was organised as follows: The interviews were distributed internally according to the focus of the respective associations or stakeholders and the work focus of the experts. The interviewees were initially contacted indicating the goal and scope of the study. When no answer was received, reminders were sent. Date and time for the interview were agreed on and consultants provided a web conference tool. An interview guideline was sent to the stakeholders in advance of the meeting. Due to the extent of the main study questionnaire, it was accompanied by an indication of the sections to which the study team expected the interviewed stakeholder to contribute. Other sections were included for transparency, and the interviewees could also contribute to the questions therein. Often, answers were received with specification of topics of interest for the stakeholders. In some cases, stakeholders responded to topics additional to those planned for the interview. Only in some cases, the whole questionnaire was subject of the interview. Protocols of results were prepared after the interview and sent for approval to the respective interview partner. Together with the approval, consultants asked for the permission to cite answers given in the interview in the study report. If rejected, information was not included in the report.

Table 3.2 Stakeholders invited to main study interviews, dates of interview and indication of the sections to which the study team expected the interviewed stakeholder to contribute.

#		Scope	Hazardous substances	Design 4 circularity	Coherence (3RD)	Recycling definition	Reuse target	Material recycling targets	Data accessibility	EPR	Missing vehicles	Illegal export	Reporting: vehicle fleet	Repoorting: reuse recycling
1	European Automobile Manufacturers' Association (ACEA)	x	x	x	x		x	x	x	x	(x)	(x)	x	
2	ACEM	x	(x)	(x)	(x)	(x)	(x)	(x)	(x)	(x)			(x)	(x)
3	Renault	x	x	x		x	x	x	x			x		
4	European Automotive Suppliers (CLEPA)	x	x	x	(x)				x					
5	Eurometaux		x	x		x		x	x	x				
6	Eurofer		x	x		x		x	x	x				
7	Automotive Parts Remanufacturers Association (apra)	(x)	x	x	(x)		x		x	(x)				
8	European Ferrous Recovery and Recycling Branch (EFR), a branch of the European Recycling Industries' Confederation (EuRIC)	x	x	x	(x)	x	x	x*	x	x				x
9	European Federation of Glass Recyclers (FERVER)			x	(x)	x		x		x				x
10	European Plastics Recycling		x	x	x	(x)		x	x	x				x

	Branch (EPRB), a branch of the European Recycling Industries' Confederation (EuRIC) together with Plastics Recyclers Europe (PRE)													
11	EGARA	(x)		x	(x)		x	x	x	x				x
12	Auto Recycling Nederland (ARN)	(x)		x	(x)	x	x	x	x	x				x
13	INDRA	(x)		x	(x)		x	x	x	x				x
14	Spanish national association for recycling of industrial vehicles (ANERVI)/ Spanish ATF Association (AETRAC)	x		(x)	(x)	x	x	x	x	x				x
15	Association of European Vehicle and Driver Registration Authorities (EReg) & EUCARIS	(x)									x	x	x	
16	UN Economic Commission for Europe (UNECE) United Nations Environment Programme (UNEP)		x		x						x	x	x	
17	MAIF (insurance company, France)						*x*			*x*	*(x)*	*(x)*		
18	European Environmental Bureau (EEB), ECOS, Transport and Environment (TE), FoE Germany, DUH	x	x	x			x	x		x	x	x		
19	ANEC BEUC - The European Consumer Organizations	x		x			x		(x)					
20	The European Tyre and Rubber Manufacturers' Association (ETRMA) and Recycling Association (ETRA)		(x)	x	(x)	x		x	x	x				x

Approved interview documentations were gathered and distributed within the study team in order to use input of all interviews for developing the measures in further detail and assessing related impacts. The input from the targeted consultation has been taken into consideration for the preparation of initial results and the development of initial measures that were presented at the sectoral stakeholder meetings as well as the MS meeting (see sections below).

Though in most cases stakeholders gave their consent to cite information provided through the interviews, confirmed interview documentation is not intended for publication itself. The documentations are among the material that was provided to the European Commission.

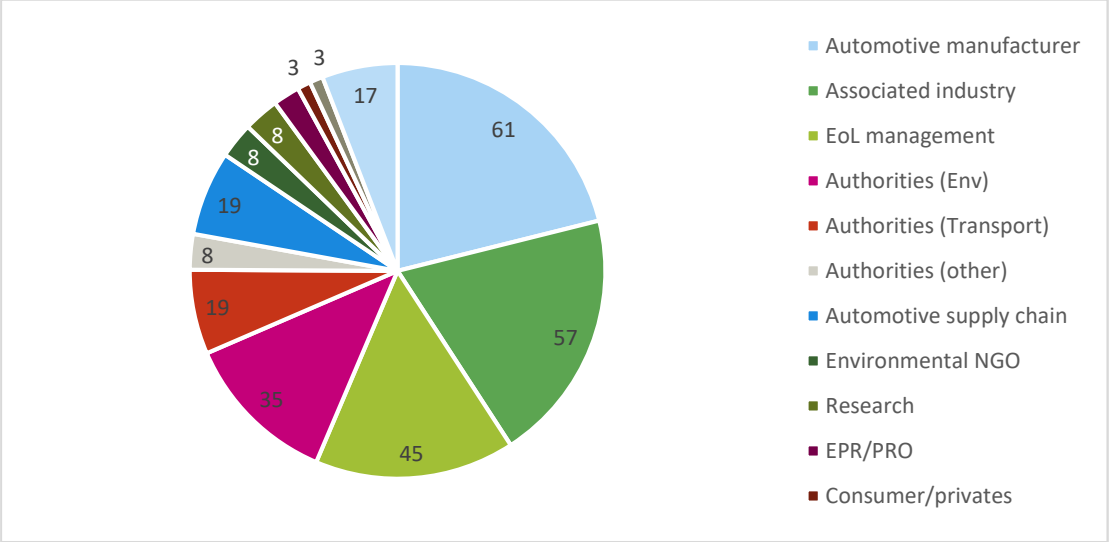
2.3.4. 2.3.4. Stakeholder Workshop on 23-24 March 2022

In cooperation with the Commission, the contractor prepared a stakeholder workshop and a meeting with experts from the Member States (see the chapter on "consultation of Member States" below). All meetings were organised as web conferences. Stakeholder contacts from the targeted consultation were provided by the consultants. Further selection of invitees was done by the European Commission, e.g., participants of the open public consultation. Associations were invited, but, in comparison to the targeted consultation, more individual companies were present. The contractor prepared material to inform participants on the contents of the meeting which were send around to invited stakeholders beforehand. At the

meeting, the contractor gave an input (presentation) on the current situation in relation to the problems, the measures under consideration, initial results and topics for discussion.

The meetings were structured according to the topics. The agenda is provided below. Meetings were facilitated by the consultant's team members; minutes were prepared of each meeting.

Figure 3.1 Overview of composition of stakeholder registered for the workshop (n=289)



Note: The category of "automotive manufacturers" includes manufacturers of all types of vehicles, incl. motorcycles, vehicles accessible to disabled people, caravanning industry, to name some. / The category of "associated industry" includes, among others, all (secondary) raw material-related industry stakeholders. / (*) The numbers relate to the registrations for the workshop. Due to changing audience during and last minute requests before the workshop, it was not possible to analyse the composition of stakeholders in relation to their actual participation. Source: Own compilation

Possibilities of participation in the meeting:

- To gather input from a larger audience of stakeholders, and additional interaction tool (app called *Slido*) was used during the workshop to survey the views of the participants on certain aspects. Slido questions were answered by participants in the course of the presentations of the consultants or in the days following the workshop.
- For oral contributions, stakeholders could write in the chat the essence of their comment and wait to be requested to speak.
- After the workshop, all participants had two weeks to submit additional information and data to substantiate their views.

For each of the topics, the consultants took into account aspects that were discussed in the meetings, and where (updates of) data was provided, e.g., in relation to the material composition of L-type approved vehicles, these were feed into the calculation of impacts for the final report.
The parts of the documentation of the stakeholder workshop not intended for publication and provided solely to the EC include:

- Participants list;
- Minutes of the meeting;

- Documentation of the chat of the online meeting; and
- Slido results.

2.3.5. 2.3.5. Consultation of Member States

The consultation of Member States consisted of two elements:

a) Ad hoc survey

A questionnaire for Member State Experts was prepared covering the four topics:

- Management of Shredder Light Fraction (SLF) and Shredder Heavy Fraction (SHF),
- Fees or taxes to support recycling of ELVs,
- Extended Producer Responsibility (EPR) System,
- Waste management of other types of vehicles.

The questionnaire was sent out to the MS in February with most MS sending answers prior to the workshop, and a few (2-3) sent afterwards. Answers to the questionnaire were provided by 15 Member States, namely Lithuania, Belgium, Ireland, Estonia, Slovakia, Greece, Malta, Finland, Croatia, Spain, France, Czech Republic, the Netherlands, Sweden, and Germany. Additional documents were received from Belgium only.

As for the processing of the data, it is to be said that no statistical evaluation of responses was made, but responses are exemplarily summarized for two of the four topics as follows. Where information from the survey is used in the main report, it is referenced, and all questionnaires are available to the EC.

Management of Shredder Light Fraction (SLF) and Shredder Heavy Fraction (SHF). In 6 MS, the disposal of untreated SLF/SHF in landfills is prohibited. 4 MS prohibit the disposal in landfills of fractions from post shredder treatment (PST). 4 MS (in case of BE only Flanders) allow to consider untreated SLF for the purpose of road construction, within which 3 consider it as recycling. Selected detailed responses showed that some countries defined certain criteria for acceptance of waste at the landfill that have to be fulfilled (e.g., POP content in the residues or that the residues intended to landfill cannot be recycled of incinerated anymore). BE (Flanders) allows the disposal in landfills of fractions from PST, however the costs for disposal are higher than the costs for recycling or thermal treatment. Some countries admitted that due to a disposal ban in their countries the recycling rates of ELVs increased.

Waste management of other types of vehicles. In ES, FR, CZ, BE (Flanders), and LT the waste management of **motorcycles** is governed by specific national legislation. This is not the case in SK, EL, MT, FI, HR, NL, DE, SE, and IE. In ES, CZ, BE (Flanders), and LT waste management of **lorries** is governed by specific national legislation. This is not the case in SK, EL, MT, FI, HR, FR, NL, DE, SE, IE. Of those that do not have specific national legislation, several countries (HR, FI, EL, NL, DE) indicated that the treatment of motorcycles and lorries is ensured and/or environmental permits for facilities are requested through general waste legislation. Additional information on waste management of other types of vehicles was provided by 4 MS (LT, BE, CZ, DE).

b) Member State Workshop on 31 March 2022

In cooperation with the Commission, the contractor prepared a Member State Representatives workshop in addition to the stakeholder workshop (see above). The meeting was organised as web conferences. The same material as for the stakeholder workshop was distributed among MS representatives to inform participants on the contents of the meeting beforehand, also,

representatives of the Member States were invited to participate in the stakeholder workshop. Thus, assuming that Member States representatives could inform themselves in the stakeholder workshop as well as with the provided information, at the meeting, the contractor gave a very short additional input (presentation) the problems, the measures under consideration, and topics for discussion.
The meeting was structured according to the topics. Additional three presentations were held by Member State representatives from France, Belgium and the Netherlands. The agenda is reproduced below. Meetings were facilitated by the consultant's team members; minutes were prepared and provided to the European Commission.

2.3.6. 2.3.6. Follow-up after the workshop and ad-hoc consultation

Discussions during the stakeholder workshop left open several questions and stakeholders were asked to provide information on certain topics at the end of each meeting. 39 representatives for different associations and stakeholder groups have submitted additional information.
In addition to other consultation stages, several stakeholders were consulted individually in terms of specific aspects of interest for the consultants. The information provided was used for the impact analysis of measures and policy options.

2.4. Key positions of stakeholders on specific topics

2.3.7. 2.4.1. Circularity

Design for circularity

Statistical OPC

On the question if there should be an obligation on vehicle manufacturers to improve circularity characteristics of a vehicle during the design phase, all groups of stakeholders agreed in over 50% to this question. Support was the lowest (51 %) in the category of the automotive manufacturers, where almost 25% did not support this option. The highest support was registered by environmental NGOs (100%), waste management operators (93%) and public authorities (86%).

For more details please refer to "Analysis of open public consultations" (Oeko-Institut e. V. 2022).

Written OPC

Ten contributions mention the topic of (eco-)design specifically. One of the focus topics is the design for dismantlability which various stakeholders would like to see promoted through the new regulation (VEOLIA[27], EEB[28], Federec[29], INDRA[30], FNADE[31]) whereas others have objections or comments, such as:

[27] Veolia Environnement S.A., branded as Veolia, is a French transnational company with activities in three main service and utility areas traditionally managed by public authorities – water management, waste management and energy services https://www.veolia.com/en
[28] The European Environmental Bureau (EEB) https://eeb.org/
[29] Fédération des entreprises du recyclage / FEDEREC https://federec.com/fr/

- ‘life cycle approach more efficient to promote circularity than imposing design requirements’ (Volvo[32]);
- ‘dismantling provisions must not impair the essential targets of safety, comfort, environmental performance such as fuel/electricity consumption, costs etc’ (Plastics Europe); and
- ‘solutions on eco-design therefore should not be solely based on manual separation/sorting’ (EuRIC) stating that PST sorting should be taken into account.

- Design for circularity could be supported by sensor-based technology (ECI) and free knowledge sharing and discussion between recyclers and manufacturers (EuRIC, FNADE; see also under ‘data availability’).

Eco-Design is mentioned in combination with the 3R type-approval Directive by EuRIC in terms of merging ELV Directive and 3R type-approval Directive; and by Federec and INDRA with regards to ‘practicability checks’ of recyclability under the 3R type-approval. Volvo suggests that ‘ELV Directive should focus instead on requiring OEMs to have a strategy to cover the 3 Rs’, which is already part of the provisions of Art. 6 of 3R type-approval Directive.

Another focus is on the means of eco-design to phase out hazardous substances mentioned by VEOLIA. Other stakeholders mentioned hazardous substances under the topics of ‘data availability’, in combination with recycled content targets or with regards to ‘coherence’.
Individual aspects include ethical sourcing as part of material decisions in eco-design (ECI), less different polymers (‘there are currently 39 different types of basic plastics and polymers used to make an automobile’, and a proposal from FEAD to limit the use of non-recyclable materials based on The Plastics Industry Trade Association, 2016).
It should be noted that in their contributions some stakeholders consider recycled content targets as part of the 3R targets and some connect the recycled content targets with the topic of (eco-) design.

Interviews

Regarding non-recyclable materials, the vehicle manufacturing sector generally pointed out the benefit of using such materials for light weighting due to the benefits during the use phase in terms of CO_2 emissions reduction. Stakeholders representing the waste phase referred to the obstacle that large amounts of such materials pose for achieving targets but were against their prohibitions, explaining that this would affect innovation, whereas proven materials would increase in use and at some point suffice to develop manufacturing (with less beneficial ones being used shortly and then abandoned).

ATFs referred to the phenomenon of locking components with digital keys (e.g., window wiper motor, injector, inverter, mirror, window motor, navigation, etc.) as a problem, explaining that it is an obstacle for reuse as a component removed without the key will not be reusable. The information does not have to be free but the price should not be prohibitive for

[30] INDRA is an automotive recycler and a forerunner in the trade https://www.indra.fr/en/international/leader-en-france-recyclage-automobile
[31] La FNADE est l'organisation professionnelle représentative des industriels de l'environnement https://www.fnade.org/fr
[32] https://www.volvocars.com

reuse practices of ATFs. This is understood to particularly affect establishments that work with multiple vehicle models and brands and that do not have contracts with specific OEMs. Vehicle manufacturers on the other side claim that the locks are of importance for the safety of vehicles, anti-theft and provision of the data could disclose proprietary. It is not clear what type of data would be at risk. Components that are interchangeable between models and brands were also raised as a type of component where OEMs are reluctant to provide data (e.g., when the same supplier provides multiple vehicles models and brands with the same component) an where this can have an effect on the ability to reuse parts.

As for IDIS, ATFs said that it contained a lot of information but that the level of detail is not always sufficient to support dismantling. Information is not available through IDIS for parts with reuse potential (the objective of IDIS is to support quick dismantling – ensuring that the component remains functional is not always in line with this objective). Though OEMs say that such data can be accessed under the RMI (Repair and maintenance information systems of the OEMs – each is individual to a certain OEM) ATFs complain about the cost of such data. Here too, the information does not have to be free but the price should be fair to encourage dismantling for reuse.

Some stakeholders state that the 3R type-approval Directive calculation is too theoretical, recommending requiring OEMs to also specify how certain parts can be dismantled. The calculation should also reflect the ease or difficulty of recycling a part that would be a separate Annex of depending on whether it is a mono-material of not.

Workshop

During the workshop the issue of compliance of automotive manufacturers with diverse regulations was brought up (ACEA). Thus, new regulations should consider the other compliance demands, in particular for passenger safety and environmental protections. Vehicles typically comply the existing regulations on the day that they are brought to the market. The changes in regulations that happen during the vehicle lifetime can be covered by post-shredder technologies.

The idea to combine the ELV aspects from the ELV Directive and the 3R type-approval Directive into a single regulation was also encouraged (ECOS[33]). Additionally, it was proposed to bring the EU ELV legislation to the level of the United Nations when looking at lifecycle provisions (UNECE[34]).

Definitions

Statistical OPC

Most stakeholders (56%) agreed or agreed strongly that the ELV definition for **recycling** should be aligned to that of the WFD as this would support a higher level of material recovery. Aside from the automotive producers that were mainly neutral, the majority in all stakeholder categories supported an alignment. Only 3% disagreed with this statement, however there was also a large share of stakeholders that were neutral (40 individuals) or that

[33] https://ecostandard.org/
[34] https://unece.org/

did not have an opinion (31 individuals) making for a total of 40% together with those that did not specify an answer (13 individuals).

Status of parts to be recycled/**remanufactured** must be clearly distinguished from waste and benefit from same conditions as spare parts. EU should establish a harmonized definition of waste and non-waste for reuse/remanufacturing purpose.

Written OPC

Coherence with the WFD is referred to in a general way (WEEE AUDITS[35]; CRM Alliance[36]) or by pointing out specific needs, e.g., to exclude backfilling from the definition of **recycling** (FNADE) or the need for harmonized definitions of waste and recycling in order to prevent distortions of competition due to different national implementation (FORS[37]). Also, consistency with the landfill directive is mentioned (Plastics Europe[38]). Definition of when a car becomes an **ELV** was also raised (Febelauto[39]) also in the context of vehicles export (FEDEREC[40]), where it should be required to present a valid technical control certificate to authorize their export.

Interviews

It is generally agreed that the definition of **recycling** should be aligned with the WFD to exclude backfilling. Many stakeholders do not expect that this will change the achievability of the 3R targets as backfilling operations are not so common and do not cover all downcycling operations. This is particularly understood to be relevant for glass, which is mainly considered recycled through the post-shredder mineral fraction.

The need to align the definition of **reuse** with the WFD was raised in relation to the later reference to "preparing for reuse". Changes to the definition could affect what is considered waste and what is considered a product and need to look into how they work with the definition of "end-of-waste" to ensure that obstacles are not created for shipments of used or remanufactured parts. A definition for **remanufactured** components should also be introduced to strengthen how such parts are perceived in comparison to reused ones and to ensure that remanufacturing practices fulfil minimum requirements.

A few stakeholders raised the need to define ELVs as compared to **second hand** vehicle so that the differences between these two categories are clearer and easier to enforce for customs authorities to prevent illegal exports.

Workshop

As shared by a car manufacturer representative (Renault), the current legal definition of a new product does not allow inclusion of **remanufactured parts**. This means that a new vehicle currently, in legal terms, may not contain remanufactured elements; the entire vehicle must be made new, though perhaps using recycled materials. This legal issue is not specific to

[35] https://weee-forum.org/
[36] The Critical Raw Materials Alliance (CRM Alliance) https://www.crmalliance.eu/
[37] https://www.fors-online.org.uk/cms/
[38] https://plasticseurope.org/
[39] https://www.febelauto.be/
[40] https://federec.com/

vehicles. However, from a technical perspective, remanufactured vehicle parts are certified as equivalent in functionality and reliability/safety/etc. to new parts and could therefore be acceptable for use in new vehicles. This legal limitation restricts the sale of remanufactured vehicle parts to the repairs market. Also, there is anyway a limited feedstock of remanufactured parts because the long vehicular lifetime means that the current ELVs do not offer many parts for remanufacture. Additionally, the term and definitions of remanufactured parts should be included in the 3R type-approval Directive.

A definition of differentiating between **pre- and post-consumer** plastics would be helpful as well as applicable definitions of 'open-loop', 'closed-loop', etc.
In Belgium, each total technical loss means the vehicle is an **ELV**, regardless of the price of repair in the home country or elsewhere. However, total economic loss is not considered in the definition of an ELV; such vehicles may be exported from Belgium as damaged vehicles without any special conditions.

Separate Reuse target

Statistical OPC

46% of the participants either agreed or strongly agreed with the implementation of a reuse target separately from the recycled target. This included all environmental NGOs, most waste operators (53% of the category) and most public authorities (68% of the category). 22% disagreed or disagreed strongly with this option, with the automotive manufacturing sector most often providing these answers (51% of the category).

On the question on which measures would contribute to increase the reuse of vehicles parts, the most common answers were: obligation for repair shops to offer customers used spare parts as an alternative to new ones, obligation for ATFs to remove certain parts of ELVs before shredding to help increase reuse, obligation for car manufacturers to enable (e.g. the ATFs) unlocking parts so that they can be reused and dismantled, and obligation for car manufacturers to provide the dismantling centres (ATFs) with information about which parts can be used as identical parts in other models of the manufacturer or even other brands.

Written OPC

When asked to explain their views, the most common views in support of a separate reuse target were that reuse is higher up in the EU waste hierarchy than recycling, also supporting circularity. Others explained that before a part is recycled it could be reused. Specific targets were explained to allow monitoring reuse, in relation to the "quantity of pieces reintroduced in the market" (an indicator of eco-design, and percentage of reuse and repairability) and as an indicator of the "efficiency of treatment operations of the authorized centres".

Of those that disagreed with such measures it was explained that reuse was mainly economically motivated (if no one needs a particular spare part it's better to recycle). Though reuse was stated to be important, as reuse is market driven it was questioned if targets would increase the amount of reuse. It was also said that vehicles that are recycled are often too old (20 years) for re-use of parts as well as mentioning that this was also the case for vehicles after a crash. Though reuse is said to be practiced commonly by ATFs, one stakeholder explained that it may not be reported to "avoid reporting taxable income in the ATFs".

Additionally, separate reuse target worsening quality and safety risks witnessed in the informal refurbished vehicles market. Reuse and recycling should be considered as on par equivalents if separate targets for each were to be created.

Interviews
Regarding reuse, many stakeholders spoke against the idea of separate targets for reuse and recycling, explaining that fulfilment of the one may have negative effects on the other. Obligatory dismantling to promote the reuse of parts was explained to create significant costs while not guaranteeing that the level of reuse would actually increase. ATFs explained that they need flexibility to look at the demand on the market and respond through deciding what components to reuse and which ones not to. This was due to fluctuations in the demand for reused components but also in the quality of components of some models. The example was given (EGARA[41]) of the engine, where some models may have frequent malfunctions, in which case ATFs would avoid their reuse as a minimum guarantee could not be ensured. In some models, malfunctions are very rare, so that dismantling for reuse would result in the engine being stored for years, also creating large costs. Rather ATFs explain that measures should be considered that increase the demand for reused parts, with ATFs than following suit to ensure sufficient supply.

Workshops
Participants commented that decisions concerning remanufacturing are of high relevance in a circular economy, with such processes being essential for encouraging recycling. However, it is not recommendable to strictly consider reuse targets for aspects that may not have market options; ELV parts should not be required to be removed before shredding where there is no market for reselling such parts. It could be useful to consider environmental issues, market forces and overall demand in the recommendation.

A target for reuse/ remanufacturing of parts could potentially be helpful. However, it is necessary to consider the traceability of parts to know which ones would at all be suitable for reuse (as opposed to remanufacturing). It can be noted that the age of a used part may be much younger than the vehicle in which it is found. Safety should in particular be considered, especially for parts relating to vehicle safety, as was specified by one Member State.

Setting material-specific recycling targets

Statistical OPC
The most common answer to this question (31 participants or 15%) supported the view that the establishment of material-specific recycling targets would increase the separate recycling of materials addressed by targets, their quality and revenues from sale of such materials while also increasing the costs of recycling. 12% (24 participants) answered that this would increase separate recycling and secondary material quality while also increasing costs. The same share of participants estimate that such targets would only increase the recycling costs. From 47 respondents in the automotive manufacturing sector, 72% (34 individuals) stated that this

[41] https://egaranet.org/

would increase costs, while 51% (24 individuals) stated that it would increase separate recycling of materials. An increase in separate recycling was supported by all environmental NGOs, 85% (5 individuals) of which also supported that it would increase the quality of recycled materials. Public authorities supported the four options similar, with between 15 and 11 individuals (68-50%) indicating the various options. Waste management operators most often indicated that this measure would support separate recycling of materials (71%) but also increase the costs (60%).

The vast majority (64%) of stakeholders agreed that material-specific recycling targets have an impact on innovation. This was the most common answer in all stakeholder categories with most categories showing 60-70% agreement. Only 8% were against this, while the rest did not have an opinion (23%) or did not answer (5%).
The most common answer to this question was either no answer (79 individuals or 38%) or that material specific recycling targets would lead to an increase in high quality recycling, in innovative recycling opportunities and processes and in innovative eco-design of products (59 individuals or 28%). The distribution of answers was quite similar among stakeholder categories.

Written OPC
When asked to provide detail on answers, one stakeholder stated that "Targets for the entire vehicle proved to be effective. Splitting the target into different material-specific ones should be done only for improving the quality of recycling and the effectiveness of the directive. They should not be legally binding". Against the measure it was said that "some materials are recoverable but without any outlet / market".

Materials mentioned in the context of specific material recycling were the Platinum Group Metals (PGMs). For glass and plastics, it was mentioned that the costs of recycling are higher than revenues while for electronic components it was assumed that revenues were possible. In some cases, it was stated that this would allow a greater separation of certain materials prior to shredding, like plastics.

Stakeholders provided also further details on the question on "how material-specific recycling targets would impact innovation" and introduced negative (e.g. documentation/monitoring will be impossible: volume flows in tonnes range, versus quantities in milligram range to be documented; limits the use new materials, e.g., non-recyclables like carbon fibre composite, until a viable solutions has been developed and implemented in Europe) as well as positive sides (e.g.: increase of development of post-shredding technologies as well as processing technologies of secondary raw materials, increase use of secondary raw materials).

Interviews

When asked about the option of introducing separate material targets for recycling, many stakeholders explained that it was difficult to comment on the targets proposed as whether a specific value was achievable depended on how the targets were measured

(EUROMETAUX[42]). If recycling is to be measured based on the actual material that is included in the composition of a specific vehicle or based on a theoretical value would make a big difference. Whether reporting is on the total inputs of a materials, the amount sent by operators for recycling or the amount that is actually recycled affects the achievability of a target. Also, for some materials like aluminium, there are big differences in the total content between models. Luxury cars will have higher amounts but are also more often exported, so that an average value may be difficult to fulfil. For steel it was explained that 90% is already achieved. The rate could be increased, however every marginal increase from this level will also increase the costs significantly. On tyres, views were raised that the market is still very much developing in terms of recycling options. Some outlets could be considered to increase the total recycling, but have low acceptability with MS (e.g., rubber turf for playgrounds and sport fields).

Workshop

Material-specific recycling targets should be seen as an addition to the common targets. The MS mainly report data from dismantlers, shredders and ATFs, data which is collected from different points in the recycling process. Ultimately, the recycling quota of the MS is reported, not dismantling rates (Swedish EPA).

Recycled content targets

For key positions of stakeholders on a recycled content target content for plastic please refer to the respective report by the EC Joint Research Centre.

Statistical OPC

There was one question on other materials (other than plastics) for which a recycled content target should be considered in the OPC. Though a few materials were mentioned in this respect by about a third of stakeholders (e.g., aluminium, glass, REE but also platinum group metals and steel), a larger share of stakeholders (45%) did not provide input, indicating the answers “none”, “no opinion” or just skipping the question altogether.

Interviews

Regarding recycled content for other materials, for most metals it was explained that recycling was already quite high, and that a recycled content target would not change this much but rather create competition between (high quality) uses, which will not result in resource savings. Recycled content targets should only be considered where there is a market failure. Positive views were raised for plastics and in some cases for glass and tyres, where high quality recycling is low and where secondary raw materials are less common for use in vehicles

Vehicle data accessibility

[42] https://eurometaux.eu/

Statistical OPC

In the OPC, when stakeholders were asked to specify what kind of information producers should provide free of charge to ATF, a large number of stakeholders (41%) specified all of the available options, namely, information on:

- where dismantled components can be reused (which vehicle or brands, models and types);
- how to correctly remove parts with digital components and how to appropriately prepare them for reuse/ installation;
- the duration / effort for obligatory depollution;
- the duration / effort for dismantling components for reuse.

There was furthermore strong agreement (over 70%) that manufacturers should provide such information in a fair and non-discriminatory manner and at reasonable prices (if any) to all ATFs. Stakeholders were also asked to indicate whether vehicle manufacturers should be obliged to provide information on the content of certain substance groups to support plastic recycling. Here there was a diversity of answers, with a third having no opinion, but also with large support for information obligations on flame retardants (66%), plasticisers (49%) and stabilisers (46%).

Written OPC

Stakeholders emphasised the importance of access to information on vehicle contents for dismantling and safe treatment of vehicles. Though some stakeholders stressed the need for data at model level, in some cases mentioning IDIS. The option to develop a Digital Product Passport was also mentioned as well as the option to use a Radio-frequency identification (RFID) or a QR code.

Interviews

ATFs raise the difficulties that they experience with the availability of various data types. IDIS was said to include a lot of information however stakeholders of this sector complain that the level of data is not homogenous for all models and makes and that the amount of data on how to dismantle specific parts is not always sufficient to support the process. Availability to data on components that are locked with a digital key is problematic. Though data is understood to be made available by OEMs for a cost, ATFs explain that there is no harmonised system and rather that ATFs need to register for multiple systems, each with separate costs. For facilities dismantling vehicles of multiple brands (and also for repair shops) this makes the use of such data prohibitive as the costs paid for access will depend on how often a system is accessed. Access to data on the contents of hazardous substances may be available through the SCIP database[43], but this is not practical to support removal of relevant parts during dismantling. Data is not available as to the contents of hazardous

[43] SCIP is the database for information on **S**ubstances of **C**oncern **I**n articles as such or in complex objects (**P**roducts) established under the Waste Framework Directive (WFD), see https://echa.europa.eu/scip.

substance at the level of the specific component in a specific model (except data on mercury in components that need to be removed or lead in Pb-acid batteries). This is a problem for example for substances that are prohibited by the POPs Regulation (e.g., DecaBDE) resulting in the need to send plastics with a risk of containing such materials to incineration as the level of content cannot be determined during dismantling for each material part separately.

Workshop

The concern was raised that if the method for making data available to ATFs is in the form of a digital product passport (DPP), this would probably not work for all the 250 million vehicles on the road, that will take several decades to be treated. Either ATFs would not have data for these or IDIS will have to continue working even if it is not any more the solution and no new information is introduced. Also, in relation to the option of a DPP, it was mentioned that a single system would need to be developed, rather than having multiple DPP for the vehicle.

2.3.8. 2.4.2. Hazardous substances

Statistical OPC

The OPC had two questions on hazardous substances. The first on whether the revised ELV Directive should ban hazardous substances in vehicles, taking into account that restrictions on hazardous substances are also specified in other pieces of EU legislation (notably REACH). 66 of the responding stakeholders (32%) were of the view that all substances in vehicles should be regulated in the future under chemicals regulation. The same amount indicated that substances prohibited under ELV legislation should remain there, but that future prohibitions should be addressed under chemical legislation. In practice this would mean that for future prohibitions, 64% of stakeholders would prefer regulation under chemical legislation than under ELV legislation. Only 20% (41 individuals) were of the opinion that substances in vehicles should continue to be regulated under ELV legislation. For waste management operators, public authorities, environmental NGOs and dealers and repair shops the distribution between these answers was similar. Automotive producers had a stronger tendency to support the options where chemical legislation would be used for future prohibitions as opposed to the ELV Directive. The situation was similar for citizens and their organizations and “others”. Only 6% had no opinion or did not provide an answer.

To the second question, on which, if any, additional criteria for evaluating exemptions from the list of substance prohibitions would be necessary, the answers were quite variable. This is however also due to the fact that 7 different criteria were proposed as possible answers aside from “none” and “other”. Most combinations were indicated 1-2 times, in some cases having support of 6-9 stakeholders. The most common answers were to indicate all criteria (46 individuals or 22%), none (30 individuals or 14%), no answer (28 individuals or 13%) and the “Criterion on comparison of the use of the restricted substance with that of available substitutes in terms of environmental and health impacts (15 individuals or 7%)”. All other combinations received less support.
Asked to provide additional detail, stakeholders stated that:

- No exemption to the list of substance prohibitions in the ELV Directive, except for limited transition, if needed. Substances meeting the criteria for CLP[44] & SVHC[45] under REACH should be banned. The ELV Directive should allow for additional chemicals to be banned,
- The prohibitions and Annex II of ELV Directive need to be aligned with other EU legislations (REACH, RoHS, Batteries) concerning hazardous substances (3 stakeholders),
- impossible to give a "single" answer to this incredibly complicated question: as for flame retardant: you prefer the vehicle burn, or the people are exposed to a possible endocrine disruptor chemical? the answer is not technical, it is political (courage).

Other criteria mentioned:

- CO_2 footprint assessment (2 stakeholders),
- To check whether the use of the substance creates a risk impossible to manage or prevents recycling,
- Full life cycle consideration for the existing substance & substitute (2 stakeholders),
- Balanced approach for chemicals management, climate aspects and circularity (2 stakeholders),
- Technical and economic feasibility (2 stakeholders).

Interviews

Many stakeholders when asked about the options of having all prohibitions under one legislation (ELV or REACH), did not really consider this option. Though certain stakeholders prefer REACH for (further) substance restrictions (material suppliers and recyclers), they explain that they would rather leave the exemptions for the four heavy metals under ELV legislation as the review mechanism is already established. Vehicle manufacturers were the only ones that clearly favoured the alternative of having all restrictions under ELV. Though some general statements were made as to costs of the exemption process or the environmental benefit that accrued so far from the prohibition of the 4 heavy metals, these were not quantified or e.g. explained in relation to how costs break down in to specific activities.

Written OPC

With regards to the prohibition of hazardous substances, coherence with REACH and CLP Regulations are mentioned in support of less hazardous substances (Anonymous, FNADE, Swedish Government), reminding to the current obligation for reporting in the SCIP database[46] to assist recyclers with understanding if SVHCs are present or not is also relevant here (FNADE; Plastics Europe), for the assessment of hazardous substances, uses and exposure as established for the risk assessment under REACH should be considered (Plastics Europe).

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[44] Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006 (OJ L 353, 31.12.2008, p. 1–1355).

[45] Substances of Very High Concern (SVHC).

[46] SCIP is the database for information on Substances of Concern In articles as such or in complex objects (Products) established under the Waste Framework Directive (WFD) https://echa.europa.eu/scip

Workshop
The discussion on the hazardous substances part was surprisingly vivid.
Some participants stressed in the chat that they prefer REACH as central legislation for substance restrictions because REACH became a robust legal instrument and that this horizontal legislation should be referred to in all product legislation that restrict the use of substances due to risks. Also the coherence issue was noted to avoid different interpretations of legislative text or different content of definitions.

On the other hand, it was argued that so far REACH restriction barely covers chemicals in products as until now this only appears for textiles and PAH in rubber. A participant from NGOs claimed that substances that meet the criteria for SVHC under REACH and meet the CLP criteria should be prohibited in the new ELV Regulation for supporting a toxic-free environment policy purpose. Other participants however reminded that the "hazard" approach does not sufficiently support "a true circular economy" as contaminants might always remain in materials that are however embedded in the solid material and no health problem occurs. For this reason, the participant reminded to the risk approach, with exposure scenarios, which, in the case of a vehicle is relatively easy to define.

Besides, various participants reminded the difficulty of the time span until vehicles reach their end-of-life that makes the information on chemicals difficult ("How should the recycler and the automotive manufacturer know if they can use the material in a new car?" – "If you start now a digital product passport etc. the result will (perhaps) be visible/useful in 20 years.") To solve this problem it was proposed to define specific exemptions not only for spare parts but also for recycling material. Participants argued that though this would not be in line with the aim of a non-toxic environment of chemicals strategy for sustainability, there is a risk that material will not be recycled because of legal risk or additional burden, which makes the circular business unprofitable.

2.3.9. 2.4.3. Collection / Missing vehicles

Statistical OPC
That a charge applicable to the owner during periods of temporary de-registration would help ensure that owners follow their obligation to report any change of ownership or export to the authority was strongly supported by environmental NGOs, waste operators and public authorities. Only 11% were against this measure, mostly represented by consumers and their organizations who would also be the most negatively affected by such a measure. A vast majority agreed that better traceability should be established between the EU Member States' registration systems on a legal status of a vehicle until its final deregistration. Including a roadworthiness test as a condition was considered by the largest number of stakeholders as an appropriate measure to overcome the problem of 'illegal exports' of ELVs and of exports of ELVs as used vehicles. Compliance with certain environmental criteria was the second most favoured, followed by conditions on maximum age or on maximum mileage. Among 14 different options for reducing the number of missing vehicles, over half of the participants (52%) indicated a combination of at least 6 of the various options which shows the high support for the implementation of additional measures to reduce the problems related with missing vehicles. A total of 46 participants (22%) did not provide an answer, 17 of which were from the automotive producing sector.

Results of a stakeholder consultation held in the course of the study on the ELVs of unknown whereabouts (Mehlhart et al. 2017) can provide additional insights as to the pros and cons of the various options. Due to former public consultations on the aspect of vehicles of unknown whereabouts, exported vehicles and collection, this OPC did not put a strong focus on this topic, but only asked the questions summarized above. To display a comprehensive stakeholder feedback on the topic, the OPC results from a study in 2016 can be found in the following box:

Excurse: Open Public Consultation in 2016

The `Public consultation on potential measures to improve the implementation of certain aspects of Directive on end-of-life vehicles, with emphasis on vehicles of unknown whereabouts´ was open for twelve weeks from 29 June to 21 September 2016.

The objective of this public consultation was to receive the views of stakeholders concerned with the topics of the consultation.

The online survey covers 6 topics below:

1. Keeping track of vehicles within the EU (intra EU trade);
2. Methods to achieve more complete reporting on extra EU export and ways to distinguish between exporting ELVs vs. used vehicle;
3. Enforcement techniques to reduce illegal dismantling of ELVs at dealers and repair shops (garages) and actions to improve ATF compliance;
4. Public awareness and incentives for ELV tracking and environmental risks;
5. Aspects to improve coverage and data quality when reporting on ELVs (possible revision of the Commission Decision 2005/293/EC);
6. Persistent Organic Pollutants (POPs) and ELVs.

According to the conclusion from the OPC in 2016[47], "there is a broad and joint understanding among all stakeholders that the current procedures need further improvement to keep track of vehicles and to strengthen the requirement to issue and present a CoD. This applies for the provision of evidence on the vehicles fate during a temporary de-registration and also applies for fines to owners which do not provide statement of whereabouts for such temporary de-registered vehicles.

Most of the stakeholder support the implementation of economic incentives for instance fees or refund systems to ensure that ELVs are delivered to ATFs. Only car manufacturers and importers oppose such economic incentives.

With regard to the extra EU export of used vehicles (some of them possibly to be considered as ELV) the proposal to make Correspondents Guideline No 9 legally binding, many stakeholders oppose this proposal. Several stakeholders argue that the current version is difficult to apply and adjustments are needed before making the stipulations legally binding. Also, the approach to ban the extra EU export of used vehicles was not supported by the stakeholders. Instead, the stricter enforcement of inspections (when exporting) cooperation between IMPEL, police and customs authorities and the adjustment of reporting on waste shipment found strong support by all stakeholders.

With regard to the fight against illegal treatment within the EU the majority of stakeholders acknowledged the need for action in particular the need for national/ regional

[47] Mehlhart et. al (2017).

authorities to perform regular inspections of the sector (not only ATF and shredders but with a broader scope for garages, repair shops and spare part dealers) to identify illegal operations. Comments expressed the concern that improved burden to ATF only might even cause adverse effects (more illegal operator) and inspections should carefully focus to support legal operating facilities.
The proposal to establish minimum requirements for such inspection activities is less supported and partly rejected by the car manufacturers and importers. Again, proposals to establish economic incentives to strengthen the legally operating sector are opposed by the car manufacturers and importers. The proposal to improve the reporting mechanism when issuing a CoD and upon arrival of an ELV at ATFs or shredder facilities was in general supported, including the establishment of electronic notifications to the registration authorities.
Supporting public awareness for the management of ELVs is considered as relevant by the stakeholders. While penalties to car owners not fulfilling their duties are supported by the vast majority of stakeholders, incentives based on funds/ deposits are again opposed by the car manufacturers and importers.
All replies of the stakeholders to the manyfold questions in details can be found in the mentioned report "Assessment of the implementation of Directive 2000/53/EU on end-of-life vehicles (the ELV Directive) with emphasis on the end-of-life vehicles of unknown whereabouts[48]" published by the EC in 2017.

Written OPC
The topic was of high interest for stakeholders providing written input. Of 57 contributions, 15 contained information or opinion on vehicles of unknown whereabouts, 13 on (de-)registration, and additional 6 on reporting. Contributions on these topics were received from all stakeholder groups.

Workshop
Topics discussed at the workshop following the presentation of the consultants on the topic of missing vehicles were:

- The suitability of road-worthiness test where various stakeholders have different opinions on details of the use of such test, however, it is seen a "key question";
- ELV registration competencies, e.g., a Member States representative pointed out that EU-wide information exchange (database) on CoDs accessible by the EU registration authorities would be an effective tool, industry agreed. It was clarified that EUCARIS, the data exchange mechanism for vehicle data in Europe, does already have a CoD-message in place to exchange the CoD-info across Member States. EUCARIS is used by many EU Member States, however the CoD-message is currently not being used;
- vehicles deregistration, e.g., in relation to the limitations of temporary deregistration, harmonized rules, and automotive industry requested that an automatic deletion from the registration systems after seven years for example like in some MS should not be

[48] Mehlhart et. al (2017).

continued. Recyclers pointed out to the responsibilities of insurance companies and total technical loss status, but also the definition of an ELV compared to used vehicles

In general, many stakeholders engaged in the debate. Many of the stakeholders participating in the debate shared perspectives and experiences from MS, e.g. from Sweden or Germany (MS representatives), the Netherlands (stakeholders engages in repair and dismantling and EPR), Belgium (representative of the EPR system) or Latvia, Poland, France etc. (recyclers). Further, a representative of the Dutch EPR said that a good cooperation between the Ministry of Environment and Ministry of Infrastructure/transportation (etc.) is key […] to be able to monitor ELVs. Another idea presented by stakeholders were 'massive citizens information about legal way to dispose your ELV' (recycler + manufacturers).

2.3.10. 2.4.4. EPR System

Statistical OPC

In the OPC, most stakeholders argued that in order to ensure a high quality of recycling, it is necessary to compensate ATFs for their dismantling efforts, which are not economically viable under the current conditions. This was mainly supported by environmental NGOs and consumer organizations, waste management operators, public authorities, and citizens but also a fair share of automotive producers (32%). When asked in more detail, 56% of all stakeholders agreed that producers should compensate the ATFs for their dismantling efforts and for appropriate treatment and disposal of these wastes. Here, waste management operators were the most prominent in their support of this aspect.

Written OPC

A few written contributions addressed Extended Producer Responsibility aspects, some only as a simple need that has to be implemented and others with more elaboration. Several stakeholders explained the purpose of an EPR scheme to be to affect the design of products so that they result in less negative environmental impacts. Others see the EPR scheme mainly as a funding opportunity to e.g. to balance costs for dismantling in particularly when secondary materials are more expensive than virgin materials, to boost investment in high-quality PST through economic incentives. One stakeholder raised the concern that the creation of an EPR monopoly dominated by producers could end up limiting the free and fair competitiveness of the current network of dismantlers and shredders.

Interviews

Waste management operator look at the establishment of an EPR positively, in particular where it is necessary to support the financing of components of materials that need to be dismantled and treated in a way that is not economical. Though EPRs exist for some MS, a difficulty was raised that they are usually run by OEMs without involving ATFs in their management. The difficulties in managing funds for a European EPR were raised in light of the frequent exports between countries and also the different costs that waste management results in each country that would make setting a single fee for an EPR fund at EU level tricky.

Workshop
Participants commented that there are concerns about what entity has authority over EPR schemes. A few stakeholders mentioned that funds have not shown big advantages to support the economic feasibility of ATFs and stated that the processes that ATFs should treat vehicles and then producers have to cover negative market value vehicles is the direction that the EPR should develop, with it being established in the Directive. In contrast it was mentioned that funds were effective in compensating unprofitable labour (material dismantling), allowing the dismantler to compete more effectively with the illegal sector and being less dependent on enforcement. A few stakeholders raised the aspect of the CoD and the need for more enforcement to lower illegal exports leading to less vehicles being treated in the EU. The EPR was mentioned as an option to address the problem of cars going to other continents and not just for ensuring financial feasibility of ELV treatment.

2.3.11. 2.4.5. Scope of the ELV Directive

Statistical OPC
For almost all stakeholder categories participating in the OPC, over 50% of the individual answers were in favour of extending the Directive to additional vehicles. The highest support of this option was given by environmental organizations (100%), public authorities (90.9%) and waste management stakeholders (85.7%). On the question which additional vehicles should be included into the scope of the ELV Directive, the majority was in favour of adding motorcycles and lorries with a higher preference for lorries from the waste management operators and a higher preference for motorcycles from the manufacturers.

Avoidance of environmental harms to the environment thanks to minimum requirements for end-of-life treatment, increased resource recovery and increased recyclability were the top 3 important advantages of extending the scope of the ELV Directive largely supported by all stakeholder categories. Individual stakeholders explained that including them in the scope would increase the supply of recycled materials and lead to better dismantling, that heavy vehicles are exported to a larger extent than cars and reuse of spare parts is not as developed. And illegal vehicle dismantling, and unfair competition take place. This should be dealt with in the legislation. One third had no opinion on disadvantages of the scope extension. The most supported individual answers were that “These other vehicles (e.g., motorcycles and lorries) have features which are different from the vehicles covered by the ELV Directive, so that the provisions of the ELV Directive are not adapted to these other vehicles” (62 individuals or 30%) and “Higher burdens for SMEs” (48 individuals or 23%). Answers were distributed relatively evenly between the various categories. The stakeholders themselves relativised their statements on disadvantages when asked to detail: Though, “motorcycles are small, so it will be a lot of work for a very small amount of materials”, and “trucks [lorries] are big and require specialised facilities for dismantling”, stakeholders say that “recycling facilities are suitable for all of the ELV Directive scope”. “Today these vehicles [it is not clear which] are already treated in authorized facilities even if they are not covered by the scope of the Directive.” Or: “The ELV Directive change will result in some system changes and investment costs. It however involves an investment for the future. If the demand for recycled material is successfully established, it will pay itself back.”

More than one third of the stakeholders did not have an opinion on / did not know the areas where compliance for motorcycles and/or lorries would be difficult, and 15% said there are

none. About 20% support that the following measures may be difficult to comply with: Material-specific recycling targets (45 individuals or 22%), reuse target (47 individuals or 23%), and recycled content target (38 individuals or 18%).

Written OPC

Various stakeholders from the motorcycles sector contributed additional information: ACEM emphasises that the sector consists of many SMEs that have no experience with the requirements of the current ELV Directive. Besides the quantitative results from a survey on the numbers of recycled motorcycles in Finland, SMOTO[49] brings forward the concern that the common reuse practices could be undermined by the perceived focus of the current ELV Directive on recycling rather than reuse. An anonymous stakeholder (motorcycle manufacturer) proposes non-reusable parts for motorcycles in addition to those listed in Art. 8 of the 3R Type approval Directive for M1 and N1[50]. FORS (a Polish recycling association) speaks for the practice of certificates of destruction for end-of-life motorcycles. A recyclability target is preferred whereas recycled content targets and reuse targets are explicitly not recommended for motorcycles (EUROFER[51]).

For lorries, the Swedish Government considers it important to distinguish between light and heavy-duty vehicles. If lorries were included, the Czech Ministry of Environment sees "problems in their size and different composition of materials". Generally, for new vehicles in scope, the regulation should prevent the phenomenon seen for missing vehicles, i.e., the avoidance of the EU end of life treatment requirements (Swedish Governmental Agencies).

Six contributions focus on historic cars and motorcycles. Current practice of exempting historic cars should be pursued.

Interviews

Relevant interviewees are ACEA and ACEM presenting the manufacturers of lorries and L-type approved vehicles, and ANERVI[52]/AETRAC[53], EuRIC[54] and EGARA[55] representing the EoL stakeholders. To describe the status quo of the dismantling of lorries, the main messages in the interviews were that lorries are not just bigger cars, that depollution is in practice in some MS, that lorry recycling infrastructure is different in different Member States, and that ATFs that can manage a lorry also manages trailers. As for the status quo of EoL treatment of motorcycles, it was noted that reuse is important, that L-type approved vehicles have no chassis which is relevant for the definition of what is an ELV. Then, a very small number of L-type approved vehicles are returned to recyclers, and that there is no statistics on motorcycles, e.g., no separate waste code, right now.

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[49] https://smoto.sg/

[50] Wheel suspension (front / rear) incl. triple clamp, swing arm and all damping parts, handle bar, all kind/material of rims, sub-frame, all kind/material of fuel tank.

[51] https://www.eurofer.eu/

[52] https://www.anervi.com/

[53] https://www.aetrac.es/

[54] https://www.euric-aisbl.eu/

[55] https://egaranet.org/

In relation to potential regulation covering additional vehicles, the clear message was sent that vehicles different to M1 and N1 vehicles require specific rules, e.g., that the same 3R targets could not apply, and that these vehicles potentially require different exemptions from heavy metal restrictions (or new substance restrictions).

Workshop
Views differed on exemptions for hazardous substances in additional vehicle categories. Vehicle manufacturers were in favour of a category specific Annex II, i.e., to review the application of existing Annex II bans per vehicle category. The issue was also brought up in relation to multi-stage built vehicles, incl. wheelchair accessible vehicles. There is also a difficulty if more than one vehicle category applies to a vehicle.

Stakeholders broadly support that it is currently not recommended to apply the 3R type approval Directive to multi-stage built vehicles.
In the workshop, various participants of all stakeholder groups commented on the presented data and/or provided additional data (on the calculation of the fleet of motorcycles and lorries, on actual fleet data from Spain and Germany). ACEA is currently performing a study on lorry, with results expected at a later stage.

A representative from the European Environmental Bureau (Environmental NGO) stated that, if the scope of these Directives is currently being discussed, the discussion should not be limited to a scope for only on-road vehicles.

2.3.12. 2.4.6. 3R Type-Approval and its relation to the ELV Directive

Current situation. Questions were asked to understand better the role of type-approval technical services', the type-approval authorities' and the OEMs' in the process of type-approvals in general as well as the special part of the 3R type-approval in particular. Because this is more for the understanding of the current situation, the answers are not summarised here.

Effectiveness. Type approval authorities state that the Directive generally facilitates the achievement of the 3R targets. This is also supported by OEMs. However, this is not supported with data. Stakeholders are of different opinion in relation to whether the 3R Directive facilitates "high-quality" recycling. There is no systematic monitoring or studies that compare between the targets reported in type approval declarations of OEMs for specific vehicle models and between their actual performance at end-of-life. Quantitative feedback is scattered.

The number of 3R Type Approvals performed per Member State varies largely:

- Some have not performed any type-approvals since Directive 2005/64/EC came into force (e.g., Latvia, Finland) but do report on Regular TAs for second stage of N vehicles. Some perform 3R type-approvals regularly (6-9 per annum).
- One authority estimated the costs for the process at "< 0.25 years FTE per each 3R type approval"
- Some Member States collect fees for the type-approval and some do not – amount also depends on certificate type (0-600 €).

- 3 of 5 Member States agreed that the 3R type-approval should cover all stages of multi-stage vehicles (2 did not answer the question)

A second cluster of question was asked around the possible future amendments of the ELV Directive. In general, little to no input is provided on impacts of introducing certain measures proposed to be changed in the 3R Directive. One stakeholder is of the opinion, that the scope of the 3R type-approval should be extended to include additional vehicles.

On the merge of ELV Directive and 3R Directive. Of the interviewed stakeholders, one is of the opinion that there is a missing link and missing references between 3R Directive and ELV Directive. Member States that perform 3R type-approvals were against a merge with ELV. At least, two times China was provided as an example where one legal instrument is in place, however, the European market would be more diverse according to stakeholders. Looking at the stakeholder groups that provided their input on this topic, it should be noted that the stakeholders rarely take the perspective of the end-of-life. An ACEA position paper refers to the positions of the automotive industry in relation to the merge of 3R type-approval Directive and ELV Directive: ACEA "call[s] for the current legal framework to be maintained." Rather than focusing on recyclability, they would like to see their engagement in the field of emission reductions during the use phase, i.e., strategies focusing on light weight, acknowledged framing it Design for Sustainability.[56] Another argument put forward (stakeholder shall not be named) is that currently, the responsibilities are distributed, i.e., recyclers fulfil the ELV Directive and manufacturers fulfil 3R type-approval Directive requirements. A merge of the Directives producing a legislation with joint responsibilities could increase innovation times and create longer discussion processes.

[56] ACEA wants to "point out that, for the necessary new and innovative materials for achieving the ambitious goals of targeted carbon neutrality by 2050, there might not yet be available appropriate recycling technologies for vehicles on an industrial scale" (ACEA, 2022).

ANNEX 3: WHO IS AFFECTED AND HOW?

This annex sets out the implications of the preferred policy package for all affected groups of stakeholders. It describes the actions that public authorities and economic operators might need to take in order to comply with the obligations under the revised legislation and indicates the expected costs and benefits to be incurred in complying with new obligations. Where quantitative information is not available, the overview on the nature and costs and benefits is provided.

3.1 Introduction

The stakeholders affected by the initiative are listed below.

Vehicle producers: they have traditionally been involved in facilitating the collection of ELVs across the EU (in line with the obligations set out in the ELV Directive). They also have to demonstrate to the type-approval competent authorities that new vehicle types comply with the provisions of the 3R TA Directive and the ELV Directive relating to recyclability, re-usability and recoverability and the restrictions of hazardous substances. Some vehicle producers have taken voluntary initiatives to promote the use of remanufactured components or the incorporation of recycled materials in new models. Overall, however, vehicles producers have not made the transition to a circular economy a priority in their overall sustainability strategies. They would be affected by measures aiming at changing the design and production of new vehicles (especially obligations linked to the use of recycled materials, the provision of information on the composition of vehicles to the dismantling and recycling sector and the development of circularity strategies), as well as by measures designed to increase the responsibility of producers in the collection and treatment of ELVs, especially through the establishment or reinforcement of EPR schemes. Producers of motorcycles and of lorries have until recently paid limited attention to the potential offered by the transition to a circular economy for their sector. The new legislation will strengthen the cooperation between the car manufacturers and the ATFs. For instance, the vehicle manufacturers would be required to provide ATFs with detailed instructions for the dismantling and disposal/recycling/reuse of all components of a vehicle type. These instructions will be submitted to the type approval authorities during type approval and be made available through the existing methodologies related to Repair and Maintenance Information (RMI). Furthermore, Manufacturers will have to make this information accessible to the relevant operators of the vehicle engaged into the end-of-life treatment.

Suppliers of vehicle producers: the suppliers of components and parts for the automotive industry have been affected by the restrictions on the use of hazardous substances set out in the ELV legislation. They would be affected by any new provisions affecting the design and production of vehicles.

Dismantlers: there are approximately 12,000 “authorised treatment facilities” in the EU, which are on the frontline for the dismantling of ELVs. Most of them are SMEs. Some are integrated in bigger units and companies which also comprise shredding activities. Some of them also have contractual links with car producers. They receive ELVs from their last owners, carry out their depollution and remove the most valuable parts and components. They

make most of their business in the commercialisation of these parts removed and the sale of depolluted ELVs to shredders. Many of them also deal with "used vehicles" that they purchase and sell inside or outside the EU. They are directly affected by the provisions of the ELV Directive on collection, treatment and depollution, as well as on recycling/re-use and recovery targets. While they have to abide by the EU requirements, they face competition (both to receive ELV but also when selling spare parts) from the informal sector which collect ELVs and dismantle them in less environmentally sound manner.

Shredding/recycling companies: there are a few hundred[57] companies in the EU active in the sorting, shredding and processing of ELVs and waste fractions resulting from ELVs. Most of them are linked to large waste companies. They buy depolluted ELVs from ATFs, sell the resulting sorted and shredded materials to industries using secondary materials as feedstock in their production processes and send residual waste to landfills or incineration with energy recovery. Such companies are not evenly equipped with modern technologies, some of them having invested in "post-shredding technologies" allowing to better sort and decontaminate materials mixed during the shredding process, while other rely on more basic technology. They have traditionally been focusing on the commercialisation of ferrous and non-ferrous scrap, which are by far the most profitable waste fractions from ELVs. A large share of this metal scrap is exported outside the EU. Some of them however have been investing in plastics recycling and have called for the establishment of recycled content obligations for these materials in new vehicles to support their activities.

Industries relying on scraps as feedstock for their production: scrap/secondary materials from shredding companies are incorporated in the production processes of large industries (steel, aluminium, copper or plastics industries) which see them as an important feedstock for their decarbonisation. They have been calling for higher quality of materials which could replace primary materials and save additional amount of energy and greenhouse gas emissions.

Repair shops and garages: this group of stakeholders is composed of SMEs which would be affected mostly by measures impacting the purchase and selling of used parts and components. They are indeed important actors in the market of spare parts: this is the case both of new spare parts, which they buy from vehicle manufacturers or spare part suppliers and used spare parts stemming from ATFs or other garages. Measures dedicated to support reuse of remanufactured and used parts would enlarge the supply of used parts to these stakeholders but could also generate additional administrative burden for them compares to the baseline scenario.

Companies involved in the export of used vehicles: most companies exporting used vehicles outside the EU are SMEs. This is the case of some garages or ATFs which sell used vehicles as part of their regular business activities. There are also companies which exercise exclusively these activities, buying used cars from garages, insurance companies or individual

[57] See the supporting study for the impact assessment, which refers to data collected in 2014 according to which 350 shredders are established in the EU. According to Eurostat, there are shredders equipped for ELVs in all EU Member States except Luxembourg and Malta.

owners, and organising their export to non-EU countries. They will be affected by the measures designed to ensure a better control on the interdiction to export ELVs outside the OECD, as well as by the new measures governing the export of used vehicles (only authorised upon presentation of a roadworthiness certificate). The companies specialised in the export of used cars will be the most affected. They would incur costs linked to the obligation for them to carry out roadworthiness tests for vehicles which are currently exported after the certificate has expired. In addition, they are likely to see a decrease in revenues linked to a reduction in the export of used vehicles which do not meet the conditions to obtain a roadworthiness certificate. They would then have to sell these vehicles as ELVs to ATFs in the EU, at a much lower price than what they could have obtained for exporting them.

Insurance companies: insurance companies are amongst the largest owners of ELVs, which own on average 14% of ELVs obtained from their customers after accidents[58]. A few of these companies have adopted an ambitious approach based on circular economy considerations, but the majority of them have so far shown little interest in this dimension and are mostly interested in getting the highest prices for the ELVs and used vehicles that they sell, often in bulks in auction sales.

EU Consumers/citizens: EU consumers and citizens have little information to date on the environmental stakes linked to the design, production and end-of-life treatment of vehicles. This is partly due to a lack of proactive information on this issue by the automotive industry[59]. Consumers might be affected by changes in EU legislation to improve the re-use, remanufacturing and recycling of vehicles, which could lead to an increase in the price of new vehicles. Changes designed to boost the market for used spare parts might on the other hand lower the prices of these parts, to the benefits of consumers who have to change parts (for example during repair operations), as used parts are usually considerably cheaper than new parts.

Non-EU stakeholders: non-EU stakeholders are mostly affected by the export from the EU of used vehicles and ELVs, which constitute an important supply for the automotive market in some countries, especially on the African continent.

Society as a whole: the challenges linked to the implementation of the ELV and 3R type-approval Directives are also relevant to the society as a whole, in as much as they can greatly help reducing the environmental footprint and associated harm to the environment linked to the production and end-of-life treatment of vehicles. The transition of the sector to a circular economy would also bring with it considerable environmental gains.

- **Administrations in the Member States**: different national administrations in the Member States are responsible for the implementation of the ELV and 3R type-approval directives (from environment Ministries or agencies, type-approval authorities, market surveillance authorities, inspection services and customs) authorities. They would be

[58] In Extenso Innovation Croissance, Alice Deprouw, Déborah Gaillard, Arthur Robin. Ademe, Éric Lecointre. Octobre 2021. Automobiles – Données 2019 – Rapport annuel. 110 pages.
[59] Despite the provisions in Article 9(2) on this point in the ELV Directive.

affected by the adoption of new measures, which will create additional burden linked to the reporting on new data and information, as well as the implementation and enforcement of new obligations for economic actors. For instance, upon entry into effect of the new legislation, the competent authorities of the Member States will have increased responsibilities in two fronts: 1) ensuring the market surveillance of newly type-approved vehicles; 2) monitoring, reporting on the overall performance of ATFs and other corresponding actors of the automotive sector through implementing reporting obligations.

3.2 Summary of costs and benefits

Table 3.1 Overview of benefits

I. Overview of Benefits (total for all provisions, compared to a "business as usual baseline") – **Preferred Option - in 2035**		
Description	Amount	Comments
Direct benefits - materials		
Materials recycled at higher quality (in addition to baseline)	+5,400 ktons	Total amount: this covers materials used as recycled content, treated at higher quality and collected more.
Plastics used as recycled content in new vehicles	+710 ktons	Post-consumer plastics used in new vehicles
Materials reused, removed and recycled at higher quality (current vehicle scope)	+2,300 ktons	Steel: Reuse +600 ktons; Recycled +860 ktons; Aluminium: Reuse +120 ktons; Recycling +330 ktons Copper: Reuse +15 kton; Recycled +82 ktons Glass: Recycled +160 kton Plastics: Reused +87 kton; Recycled +160 kton CRMs - REEs: Recycled +2.4 kton
Materials collected and treated more	+1,900 ktons	Steel: +1,550 ktons Aluminium: +240 ktons Copper: +31 ktons Plastics: + 60 ktons Platinum in catalysts: +7 tons
Materials reused, removed and recycled at higher quality from extended scope	+510 ktons	Motorcycles: + 57 ktons Heavy-duty vehicles: + 450 ktons
Direct benefits – Economic revenues (in current value)		
Revenues from improved collection and recycling	+2,400 million EUR	Total value of revenues and avoided costs for materials used as recycled content, treated at higher quality and collected more.
Plastics used as recycled content in new vehicles	+600 million EUR	Post-consumer plastics used in new vehicles: shredders and PST operators

Materials reused, removed and recycled at higher quality (current vehicle scope)	+1,380 million EUR	ATFs: +110 million EUR (net revenues) Shredders/ PST operators: +1,090 million EUR Recyclers: +170 million EUR
Materials collected and treated more	+360 million EUR	ATFs: + 328 million EUR Shredders/ PST operators: +29 million EUR
Materials reused, removed and recycled at higher quality from extended scope	+81 million EUR	ATFs: + 42 million EUR Recyclers: +39 million EUR
GHG savings (- = reduction)	-12,300 kton CO2eq	Production share only: Plastics recycled content: -310 kton CO2eq Reuse and recycling: -4,540 kton CO2eq Increased collection: -6,350 kton CO2eq Scope extension: -1,120 kton CO2eq
Energy savings plastics recycled content (- = reduction)	-7,300 GWh (plastics)	Plastics recycled content -4.5 million barrels of oil eq.
Reduced air pollution emissions, plastics recycling	+13	Reduced decease incidences due to particulate matter
ELVs collected and treated more	+3.8 million vehicles	+3.2 million for N1,M1; +0.6 million for scope extension. Includes 1.1 million vehicles more from illegal/ informal treatment EU, in total 65% less low value used vehicles and ELVs exported less for N1,M1
Export reduction used vehicles + ELVs	-2.1 million vehicles	
Indirect benefits		
Additional EU jobs	+22,100	Of which: Manufacturers: +7,200 SMEs: ATFs and shredders: +14,200
Improved resource efficiency	Not quantified	Manufacturers
Reduced environmental externalities of mismanaged waste and health risks in third countries	Not quantified	Reduced offer of second-hand vehicles in 3rd countries" expected with 2.1 million vehicles and "increase in prices of second hand vehicles in 3rd countries". Improved quality of vehicles exported with a valid roadworthiness. Many importing countries are taking measures to ban the import of second hand cars over a certain age, or below certain emission levels.
Lower amounts of landfill	Not quantified	Waste management sector
Improved recycling rates vehicles	+5%	Based on improved recycling definitions, main benefits are improved recycling quality

Lower repair costs from 2nd-hand spare parts	Not quantified	Vehicle owners, reduced costs by avoiding new spare parts. Rough estimation is a 50% lower parts costs on average, very dependent on the type of parts and age of the vehicle
More legitimate income	Not quantified	Waste management sector
Increased tax revenue	Not quantified	Member States
Administrative cost savings related to the 'one in, one out' approach*		
Not applicable	Not applicable	Not applicable

For more details per policy option and for 2030 and 2040, see Annex 8.

With respect to one out costs, there are no 'one out' costs included. There is however, potentially reduced administrative burdens not included as a result of the aimed digitalisation of vehicle registration documents facilitating the exchange of information between Member States on their registers. This line is worth up to 1 EUR per vehicle and thus 9.8 million EUR of recurrent savings when fully implemented. It benefits ATFs in particular due to more streamlined issuing and tracking of CoDs. The saving is however not included for this impact assessment as it results primarily from the general digitalisation of the national vehicle registration system under DG MOVE's impact assessment[60] of the roadworthiness package and Directive 2014/46/EU on vehicle registration documents.

Table 3.2 Overview of costs

II. Overview of costs – Preferred option, compared to a "business as usual baseline", all values in million EUR, in 2035, current value							
		Citizens/Consumers		Businesses		Administrations	
		One-off	Recurrent	One-off	Recurrent	One-off	Recurrent
Design circular PO1	Direct administrative costs			Manufacturers: 2.370	Manufacturers: 5.20; ATFs, shredders 0.16	EC: 0.200	Type approval: 0.014; market surveillance 0.191
Recycled content plastics and steel PO2	Direct adjustment costs			Plastic recyclers capacity investment: 690	Manufacturers: 392, Recyclers 284		
	Direct administrative costs				Manufacturers 0.24		

[60] https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13132-Vehicle-safety-revising-the-EUs-roadworthiness-package_en

Recycling PO3	Direct adjustment costs				ATFs: 491 Shredders/ PST operators: 1,230 Recyclers: 83		
	Direct administrative costs				ATFs: 16.2 Shredders/ PST operators: 12.9 Recyclers: 2.52		MS waste authorities 0.043
Collection and EPR (PO4,5)	Direct adjustment costs		Reduced export value: 151		Specialised export car dealers: 523		
	Direct administrative costs				Manufacturers: 32.1	MS waste authorities 1.35	MS waste, 4.87; MS vehicle registration 16.6; EC: 0.850
Scope extension PO6	Direct adjustment costs				Specialised exporters HDV: 51; ATFs: 39		
	Direct administrative costs		Private vehicle owners (L3e-L7e): 2.331	Manufacturers L: 0.056; Manufacturers HDV: 0.026	Manufacturers: 0.016, ATFs: 10.4; HDV vehicle owners: 0.574		MS waste authorities 0.280
Costs related to the 'one in, one out' approach (in million EUR)							
Total	Direct adjustment costs	n.a.	n.a.	n.a.	n.a.		
	Indirect adjustment costs	n.a.	n.a.	n.a.	n.a.		
	Administrative costs (for offsetting)	0	2.331	2.452	79.720		

Detailed recurrent and one-off costs per measure and policy option are provided in Tables 8.29 to 8.37 in Annex 8.3.

3.3 Relevant sustainable development goals

Figure 3 visualises the contribution of the policy options to the SDGs. On the left-hand 'design and production' side of the diagram, policy options **PO1** and **PO2** contribute mostly to sustainable innovations (SDG9), responsible consumption and production with a lower environmental footprint (SDG12) and climate action (SDG13). The collection and recycling options **PO3** and **PO4** contribute to the same SDGs and to less pollution water and air pollution (SDG14 and SDG15) to a lesser extent. PO5 will improve partnerships for the goals (SDG17).

Figure 3.1 Contribution of the Regulation to the SDGs

As demonstrated in the figure, the implementation of the preferred option of the joint revision of the ELV and 3R type-approval directives will make a significant contribution to the United Nations' Sustainable Development Goals, promoting responsible consumption and production, decent work and economic growth, industry, innovation and infrastructure, and climate action. More detailed description is provided in the table below.

Table 3.8 Overview of relevant SDGs

III. Overview of relevant Sustainable Development Goals – Preferred Option		
Relevant SDG	**Expected progress towards the Goal**	**Comments**
SDG no. 9 – Industry, innovation and infrastructure	The revised guidelines will promote the use of cutting-edge technologies and services, leading to increased innovation in the automotive industry and improved infrastructure for the automotive recycling sector. The use of advanced technologies and services in the automotive sector (e.g. development of PST, improvement of sorting operations) will contribute to the development of smart industry, innovation and infrastructure.	Representing 27% of the region's total R&D investments, the automotive industry is Europe's largest R&D investor. In 2021, Automotive R&D investment (EU) was equal to 58.8 billion Eur. The new requirements will increase the investment need, e.g. recycled content for plastic is estimated to have a need to boost recycling capacity by 69 million EUR by 2035.

SDG no. 12 – Responsible consumption and production	The implementation of the new legislation will increase the reusability, recyclability and recoverability of vehicles and their components, thus promoting more responsible and sustainable consumption and production practices throughout the automotive value chain. More precise and stricter European end-of-life rules, focusing on the reuse of spare parts and high-quality treatment, will require that end-of-life vehicles are treated efficiently and that their parts are reused or recycled in wherever possible. Clearer requirements for 3R type-approval of vehicles (e.g. disassembly requirements, adoption of a circularity strategy, use of recycled content) will ensure that vehicles are designed in a more sustainable way, to reduce their environmental impact.	The implementation of the preferred measures will result in additional 5.4 million t of materials recycled at higher quality or reused than today. 350 tons of rare earth permanent magnet materials would be separately collected for reuse and recycling in 2035, which would contribute greatly to the EU efforts for strategic autonomy for CRMs. That will also allow better quality secondary materials to be available on the market. Incentives to support reuse of spare parts will make the vehicle maintenance to be more affordable by a roughly 50% of lower costs depended on the model, type.
SDG no. 13 – Climate action	Setting a comprehensive EU wide legal framework that covers design, production and end-of-life treatment of vehicles will reduce the environmental footprint of vehicles throughout their lifecycle, contributing to efforts to mitigate the effects of climate change. The major contribution is expected though the reduced dependence of primary materials and mandatory uptake of recycled content in manufacturing new vehicles. This shift will accelerate the decarbonisation of automotive industry which is one of the biggest contributors to CO_2 emissions.	The production of vehicles and their components involves energy-intensive processes requiring large amounts of energy, which is often generated from the burning of fossil fuels, leading to GHG emissions. The transportation of components also results in additional emissions. Implementation of the new legislation will result in annual reduction of 12.3 million tons of CO2-eq in 2035. (10.8 million tons in 2030 to 14.0 million tonnes in 2040), key for the decarbonisation of the automotive industry. These CO_2 savings represent 2.8 billion EUR when monetised.
SDG no. 14 – Life below water	The new legislation is expected to contribute to SDG14 in several ways: Conservation of marine life and ecosystems: SDG14 aims to conserve and sustainably use the oceans, seas and marine resources. The initiative emphasizes the importance of reuse, recovery and recycling of end-of-life vehicles. Clearer requirements for depollution and disposal of end-of-life vehicles, as well as stricter regulations on the export of used cars in working order from the EU to third countries will reduce the risks pollution of water and ecosystems. Resource conservation: the new legislation will help conserve resources by encouraging the reuse and recycling of end-of-life vehicles, increasing the secondary use of spare parts and reducing dependence on raw materials. Increased use of recycled materials and improved quality of ELV processing will address the triggers	Today, the problem of "missing vehicles" leads to illegal dismantling in the EU or illegal export outside the EU. In all cases, the treatment of ELVs and the recovery of materials from these ELVs do not comply with the requirements and cause environmental damage, such as oil spills, improper treatment of refrigerants or improper disposal of hazardous substances. and components for better recycling quality. Successful enforcement of export requirements is expected to prevent 2.1 million unroadworthy (not-roadworthy) vehicles from being not exported from the EU to third countries. In total 65% less low value used vehicles and ELVs will be exported than today. These

	of climate change and its effects on marine life and ecosystems.	initiatives address the problems presented in UNEP report[61] where a significant part of the used vehicles exported to African countries do not meet Euro 4/IV emissions standard, i.e., they are older than 15 years, and do not have a valid roadworthiness certificate. They present a serious risk of polluting the environment and for road safety.
SDG no. 15 – Life on land	All the measures of the preferred option aiming to collect more ELVs and to improve the treatment conditions will contribute to the protection of biodiversity, ecosystems, water quality. Reduction of air pollution: Old and highly polluting vehicles emit high levels of air pollutants such as nitrogen oxides, particulate matter, and greenhouse gases. By regulating export of such vehicles, the levels of air pollution in non-EU countries will be reduced, protecting the environment and preserving life on land. These measures will also help to protect wildlife and their habitats. This is particularly important in areas where the impact of air pollution on the environment is already significant.	Support for local communities: By reducing the EU's external pollution footprint resulting from the export of poor-driving vehicles, the new rules will help local communities and improve road safety and overall quality lives of people living in the most vulnerable third. countries.
SDG no.17 – Partnerships for the goals	The implementation of the measures will promote collaboration between different actors from governments to automotive industry and ELV operators that will contribute to the achievement of common environmental and sustainability objectives. The most intensive cooperation is expected in the implementation of the ERP requirements. This will involve sharing best practices, technology and knowledge, as well as developing new partnerships to support sustainable production and consumption practices in the automotive industry. Accordingly, enforcement of EU export requirements for the used vehicles will boost partnerships both intra- and extra-EU.	For a smooth implementation of EPR requirements, Member States will be required to designate an independent competent authority ("clearinghouse") to monitor producers' compliance with mandatory requirements for end-of-life treatment of ELVs. It will ensure the dialogue between vehicle manufacturers and ELV operators in the assessment of the compensation of costs related to mandatory treatment operations, e.g. collection, depollution, dismantling and recycling of ELVs.

[61] https://www.unep.org/resources/report/global-trade-used-vehicles-report

ANNEX 4: ANALYTICAL METHODS

4.1 Main sources

This impact assessment relies on a multitude of sources, including the evaluation of the ELV Directive, evaluation of the 3RTA Directive (see separate Annex), a literature review, an open public consultation, targeted interviews with a number of stakeholders from Member States, industry and non-governmental organisations, and a two-day stakeholder workshop.

Three studies are particularly carried out to support this impact assessment:

- a comprehensive IA support study by Oeko-Institut[62], which includes a custom-made impact assessment model for the purpose of this revision,
- a study by the Commission Joint Research Centre (JRC) entitled "*Towards recycled plastic content targets in new passenger cars*"[63],
- a JRC study focusing particularly on critical raw materials in vehicles[64].

This Annex provides information on the analytical methods used to identify and screen the measures described in this impact assessment, as well as for assessing their environmental, social and economic impacts.
In the following sections, the individual tables summarise the main environmental and economic impacts for each of the policy options. The main year of comparison is 2035 and the number of collected ELVs expected to derive in that year from the model calculation. In most cases such calculations are based on all types of ELVs, in specific cases only the relevant share of specific types of EVs (ICE, EV, hybrids and plug-in hybrids) are covered due to different assumptions and relevancies for the different vehicle categories.

For the environmental impacts, net global warming potential and the amounts of materials recovered (in addition) are chosen as the main categories to summarise results. Some of the measures target an improvement in the quality of materials recycled from vehicles and not just an increase in quantity.

The different recycling qualities have a financial significance which is captured in the calculation of revenues from recycled material. Data for other years are available in Annex 8 – Summary of costs and benefits. In the tables below, when referring to monetary impacts, the minus symbol is used when a cost is referred to (a negative monetary impact) and a plus when a revenue is referred to (a positive monetary impact).

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[62] Baron, Y.; Kosińska-Terrade, I.; Loew, C.; Köhler, A.; Moch, K.; Sutter, J.; Graulich, K.; Adjei, F.; Mehlhart, G.: Study to support the impact assessment for the review of Directive 2000/53/EC on End-of-Life Vehicles by Oeko-Institut, June 2023
[63] Maury, T., Tazi, N., Torres De Matos, C., Nessi, S., Antonopoulos, I., Pierri, E., Baldassarre, B., Garbarino, E., Gaudillat, P. and Mathieux, F., Towards recycled plastic content targets in new passenger cars, EUR 31047 EN, Publications Office of the European Union, Luxembourg, 2022, ISBN 978-92-76-51784-9 (online), doi:10.2838/834615 (online), JRC129008
[64] N. Tazi, M. Orefice, C. Marmy, Y. Baron, M Ljunggren, P Wäger, F. Mathieux, Initial analysis of selected measures to improve the circularity of Critical Raw Materials and other materials in passenger cars, EUR 31468 EN, Publications Office of the European Union, Luxembourg, 2023, ISBN 978-92-68-01625-1, doi: 10.2760/207541, JRC132821.

4.2 Structuring of measures and options

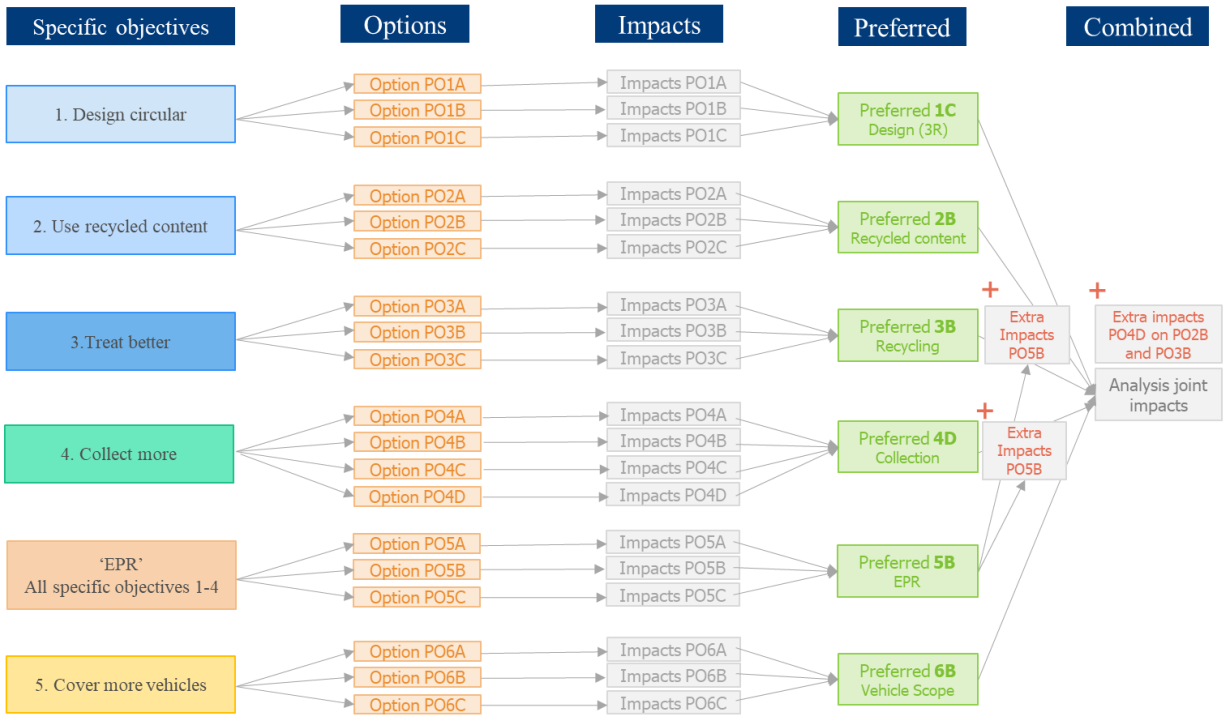
2.3.13. 4.2.1 Identification and screening of measures

In line with the Commission better regulation guidelines[65], the identification and screening of measures analysed in this impact assessment have been done on the basis of the criteria described below. The application of these criteria to the measures assessed to meet the various objectives of this revision is presented in detail in the IA support study by the Oeko-Institut.

2.3.14. 4.2.2 Structuring of options and impacts calculation order

The Better Regulation Guidance (BRG), tool #16 on the structuring of options is followed.

Figure 4.1 Structuring of options and calculation of joint impacts



While there are links between the 5 specific objectives plus the EPR supporting objectives, they respond to specific problems, have distinct features and denominators, and affect different stakeholders. It has therefore been chosen for this impact assessment to first treat all 5 specific objectives plus the EPR one **as if they are unrelated** (in line with the BRG Tool#16 - Figure 1b approach). For each of these problems, specific objectives and options are developed (in section 5), their impacts assessed (in section 6) and compared (in section 7), and finally the best performing option selected for each problem (section 8.1). However, in view of the links between these problems and options, the preferred package of option also

[65] Source: Better Regulation toolbox Tool #16, Textbox page 114 – 115

takes into account the synergies between them, especially the amplification effects linked to the additional ELVs collected under PO4 and the incentives provided through the EPR schemes under PO5. These synergies are also calculated when presenting the combination of the overall impact of the preferred package (section 8.2).The collection and EPR options PO4 and PO5 determine the amount of materials available for treatment (PO3) and the recycled amounts for the availability of materials for the recycled content target (PO2). They are therefore computed in that sequence. After selecting the preferred option for EPR, the influence of this on the other preferred options for collection and recycling is first determined individually **as an amplification to the preferred options**. After this step, the joint impacts, in particular the influence of increased collection **that multiplies the effect of improved treatment** are determined as illustrated in above Figure 4.1. Following this logic throughout is selected as the most careful way to prevent 'circular references'. In all relevant tables, this two-step aggregation of joint impacts is labelled first as 'preferred – individual' versus secondly as 'preferred – combined'.

The preferred package of options therefore takes into consideration the interlinkages between problems and options, is based on a careful balance in that respect and provides the most efficient, effective and consistent solution to all identified problems. The elements contained in section 7 on the comparison of options provide an assessment of each option and allow to perform calculations for a large number of combinations of options, which could be alternative to the preferred package. This impact assessment report does not provide for the assessment of the impacts of such alternative combinations of options, as this would not be proportionate and not required under the Commission better regulation guidelines. However, the information provided in section 7 is sufficiently comprehensive and transparent to allow stakeholders and policy-makers to perform such assessment, for example if they consider than one objective should be given higher importance compared to another one. As indicated above, the preferred package of options takes into consideration the interlinkages between problems and options and is based on a careful balance in that respect, so that alternative choices for a preferred option would not be as effective and efficient as the proposed preferred package.

4.3 Analysis of impacts

The economic, environmental and social impacts of the proposed measures were assessed in line with the better regulation guidelines.

4.3.1 Datasets

The methodology used to assist in the determination of impacts uses both quantitative data and analytical tools.

Data on the current and projected vehicle production and on the number of vehicles becoming ELVs are key in that regard. The initial life cycle stages of resource extraction, material processing and vehicle assembly were aggregated to the common process of 'vehicle production'. Thus, the mass flows start with the 'sales' stage which includes the carbon footprint of the vehicle production (e.g. carbon footprint, x ton of CO2eq per vehicle; material footprint, such as for example x kg copper per vehicle). The vehicle life cycle ends with recycling and recovery of secondary materials.

The model covers a period up to the year 2035. Results for the fleet of vehicles are available for the years 2020 to 2035. Not extending the modelling period beyond 2035 seems sensible in view of the unpredictable technical possibilities and developments, especially in the development of the vehicle fleet. As a starting point for comparison – mainly for developing, checking and adapting modelled vehicle mass flows – the time series used went back to the year 2009 for all applications except for ICEVs which have been modelled back to 1990. The most recent data from ACEA are available for the reference year 2020. The future perspective is based on data from the Euro 7 impact assessment[66].

For each individual life cycle stage, the mass flows are differentiated into the relevant engine types of ELVs. The following engine types are addressed in the model: Internal combustion engines (ICEs), battery electric vehicles (BEVs), Hybrid electric vehicles (HEVs) and Plug-in-Hybrid electric vehicles (PHEVs). Passenger cars with other propulsion systems, such as fuel cell vehicles (FCEV), were excluded from this study, as only very few of these vehicles are expected to be in use during the period considered in the scenarios. In the context of this study, natural gas vehicles are treated as ICEs as they are based on the same principles using a different fossil fuel. FCEV are comparable to BEVs since they also contain a battery and an electric motor, resulting in a very roughly comparable resource demand (when excluding the fuel cell itself).

4.3.2 Vehicle composition data

To model the material composition of passenger cars, data from JRC-RMIS[67] on the composition of passenger cars was used, supplemented by data from the Greet model (Argonne 2021). The percentage composition was calculated down to the average weight of ELVs in the EU according to Eurostat.

Table 4.1 Material composition of End-of-life vehicles (passenger cars) in kg after depollution[68].

Material	ICEV	HEV	PHEV	EV
Steel	653	660	621	642
Cast Iron	101	101	96	16
Wrought Aluminium	40	58	76	108
Cast Aluminium	79	91	93	77
Copper	14	20	23	35
Magnesium	5	5	5	1
Manganese	8	8	8	7
Glass	24	21	22	26
Average Plastic	159	129	143	166
Rubber	41	34	38	39
Glass-Fibre-Reinforced Plastic	9	4	5	5
Others	5	6	7	14

[66] Aeris Europe: Euro 7 Impact Assessment: The outlook for air quality compliance in the EU and the role of the road transport sector. 2021. Online available under https://aeriseurope.com/papers-and-articles/euro-7-impact-assessment-the-outlook-for-air-quality-compliance-in-the-eu-and-the-role-of-the-road-transport-sector/

[67] https://rmis.jrc.ec.europa.eu/apps/veh/#/p/viewer

[68] Source: Calculated with data from JRC-RMIS and Argonne 2021 and average weight according to Eurostat

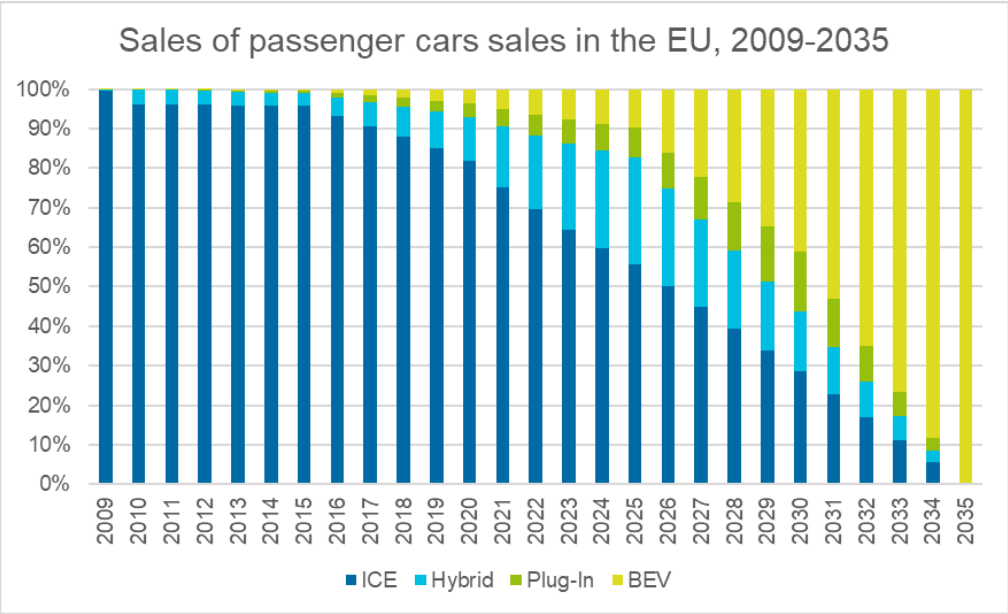
Total	1,137	1,137	1,137	1,137

The model delivers mass flows based on the development of different types of vehicles. It includes passenger cars with a variety of different propulsion types (internal combustion engine (ICE), hybrid electric vehicles (HEV), plug-in hybrid electric vehicles (PHEV) and battery electric vehicles (BEV). Furthermore, the model also includes light commercial vehicles, heavy commercial vehicles and buses. The fleet model for all vehicles is based on the model used for the Euro 7 impact assessment[69]. The data were supplemented by additional information from other sources. The overall development has been cross-checked with scenarios used by the JRC.

4.3.3 Number and types of vehicles entering and leaving the fleet

The table below shows the sales of passenger cars in the EU split by propulsion types according to statistical data from ACEA and the predicted forecast according to Euro 7 impact assessment.

Figure 4.2 Sales of passenger cars in the EU (2009-2035)[70]



Since this only covers the fraction of newly registered vehicles, the vehicle stock had to be modelled. To cover the accurate number of vehicles in the stock, the model takes into account all registrations dating back to 1990 based on ACEA data (ACEA 2009-2019, OICA 2020).

The figure below shows the development of the stock of passenger cars in the EU split by propulsion types.

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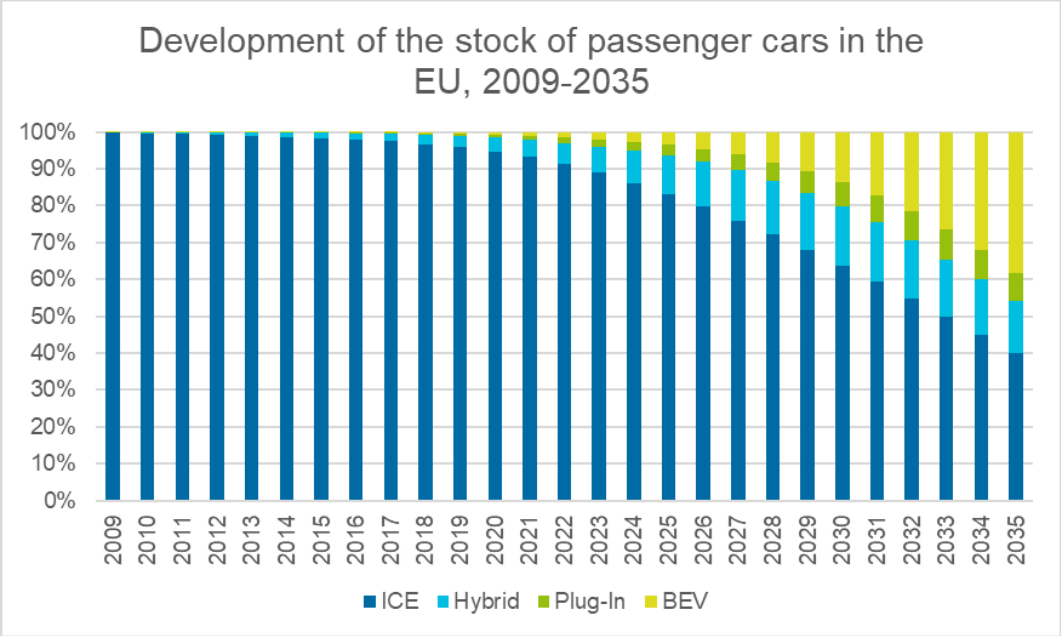
[69] Aeris Europe: Euro 7 Impact Assessment: The outlook for air quality compliance in the EU and the role of the road transport sector. 2021. Online available under https://aeriseurope.com/papers-and-articles/euro-7-impact-assessment-the-outlook-for-air-quality-compliance-in-the-eu-and-the-role-of-the-road-transport-sector/

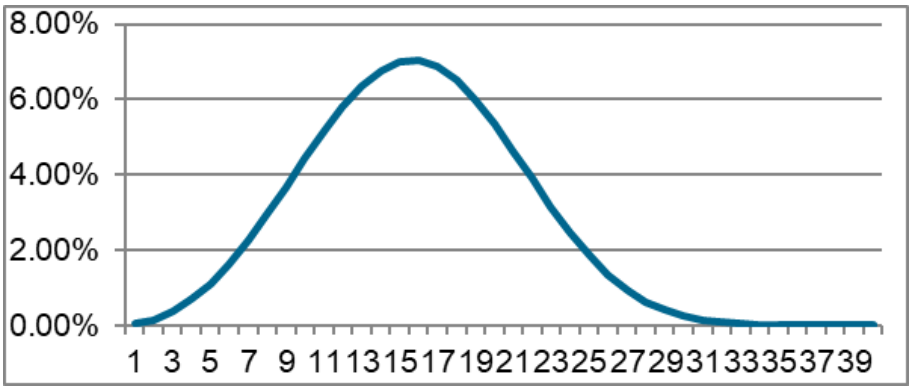
[70] Source: Own calculation on the basis of data from Aeris Europe 2021 and ACEA 2021

Figure 4.3 Development of the stock of passenger cars in the EU[71]



In order to determine the volumes of ELVs, it is necessary to estimate the duration of the use phase of the vehicles. To describe the probability of a vehicle reaching its end-of-life, a Weibull distribution has been used. Since no long-term data on the lifetimes of EVs are currently available, estimates based on literature, interviews with the automotive industry and own expert judgement have been used to determine reasonable assumptions for the lifetime of EVs (Ricardo 2015, Møller Andersen 2008, Buchert et al. 2017, Buchert et al 2019, Mehlhart et al. 2017). The figure below depicts the curve used for ICEs, EVs, PHEVs and HEVs. The distribution shows the probability of the number of years after which a newly registered vehicle reaches its end of life. Accordingly, e.g. 14% of all vehicles that have been registered 15 years ago will reach the EoL.

Figure 4.4 EoL Weibull distribution for vehicles[72]



[71] Source: Own calculation on the basis of data from Aeris Europe 2021 and ACEA 2021
[72] Source: Own representation

The model calculates the volumes of ELVs for each year based on the lifetime distribution shown above. This represents the total volume of ELVs available for collection. The total volume available for recycling in the case of ELVs is reduced due to some losses. There are two main types of losses. Firstly, export losses and secondly, unknown whereabouts.

In the assessment report of the ELV directive, Mehlhart et al. (2017) pointed out that in 2014 app. 12 million vehicles were estimated to become ELVs in the EU, 51% of which were reported. App. 10 % of the used vehicles were exported (outside the EU) and 39 % had unknown whereabouts. It is assumed that half of the unknown were exported to non-Community countries and half were dismantled within the EU without reporting. This assumption leads to an estimated export rate of 35 % which has been used for the baseline for HEVs and PHEVs since these vehicles are similar to ICEVs. BEVs, on the other hand, are expected to be exported to a lesser extent, since they require a charging infrastructure which is not available in all countries outside the EU. Hence, the export rate applied for used BEVs is 10 %. The figure below shows the development of ELVs available for recycling in the EU split by split by propulsion types.

Figure 4.5 Development of ELVs available for recycling in the EU[73]

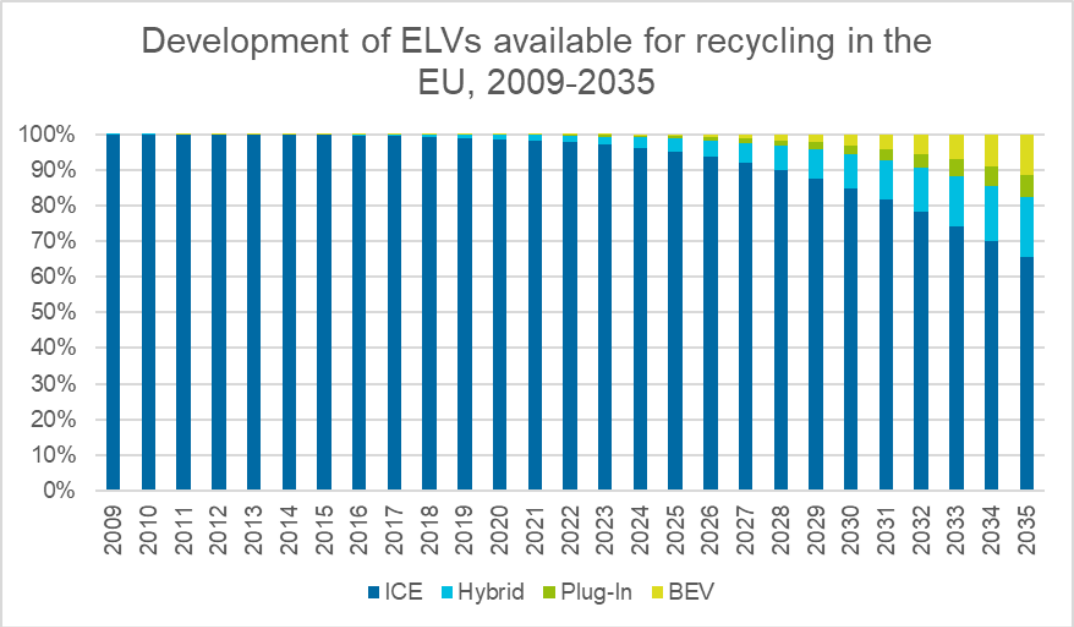


Table 4.2 ELVs available for treatment (PTW, lorries, buses, trailers)

Category	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
L	1,336,572	1,362,667	1,388,348	1,413,449	1,437,763	1,461,075	1,483,176	1,503,903	1,523,145	1,540,863	1,557,104
M2,M3	28,061	28,449	28,822	29,182	29,527	29,859	30,177	30,483	30,780	31,070	31,359
N2,N3	212,025	216,992	222,048	227,193	232,418	237,708	243,023	248,291	253,441	258,410	263,158
O	1,007,722	1,039,377	1,072,220	1,106,517	1,142,498	1,180,362	1,220,275	1,262,369	1,306,737	1,353,423	1,402,422

[73] Own calculation on the basis of data from Aeris Europe 2021 and ACEA 2021

Source: Calculated as M1 and N1 ELVs based on stock data from the PRIMES model for lorries and buses, calculated based on Eurostat and linear forecast according to development from 2015-2019 for trailers; calculated based on Eurostat using the trend in the EU Reference Scenario for PTW.

These numbers build the baseline for the analysis of the impacts for the policy options on scope extension. For L-category vehicles it is assumed that a) the major share is already currently taken back by dealers and then either sent to shredders or to dismantlers for further treatment, and b) the major share is not subject to exports at their EoL, i.e. there are no additional vehicles being treated at ATFs. For lorries and buses it is assumed that a) the majority of the above numbers is already treated in ATFs and b) they are subject to exports, i.e. only the share of EoL lorries and buses which will not get a roadworthiness certificate for export anymore will be new / in addition be treated at ATFs under policy option PO6.

The following methodology was applied to assess the share of vehicles which might not pass the future requirement of a valid roadworthiness certificate under PO6B:

The vehicle categories 870422, 870423, 870432, 871639xx and 8702 were assessed at the level of the 8-digit CN-codes with the following approach (for more details, see Oeko-Institut Impact Assessment support study[74]):

1. Identification of the average value of the intra EU trade with new vehicles per CN code.

2. Definition of a function on the share of non-eligible vehicles, depending on the distance to the average value of a new vehicle as displayed in the Figure 2 1.

3. Calculation of the number of non-exportable vehicles with the above function.

4. Estimation for the economic impact.

4.3.4 Recycling

Since the model includes detailed information related to material compositions of the different vehicles, it allows for the estimation of recycling potentials. The recycling of the end-of-life vehicles is modelled in different steps: depollution, dismantling, shredding, post-shredder technologies (PST) and material specific recycling processes. The steps of depollution, dismantling and shredding were modelled using data from Sander et al. (2020). The PST was calculated using data from JRC. The following table shows the efficiency rates for different materials that have been used in the model. In the second column ('Recycling rate (ASR + PST)') recovery rates from shredder (ASR) and post shredder treatment (PST) from literature and interviews are given for different materials. In the third column ('Recycling rate (specific process)') recovery rates for the materials specific recycling processes are given, e. g. the recovery rate for steel recycling in an electric arc furnace. The percentages refer to the input that goes into the shredding process and the specific recycling process, respectively, not to the original composition of the ELVs. The efficiency rates here only include those quantities that were recovered as material, not of those quantities where, for example, glass was used for backfilling or aluminium was used as a reducing agent in steel recycling.

Table 4.3 Efficiency rates for different materials in ASP + PST and specific recycling processes[75]

[74] Baron, Y.; Kosińska-Terrade, I.; Loew, C.; Köhler, A.; Moch, K.; Sutter, J.; Graulich, K.; Adjei, F.; Mehlhart, G.: Study to support the impact assessment for the review of Directive 2000/53/EC on End-of-Life Vehicles by Oeko-Institut, June 2023

Material	Efficiency rates (ASR + PST)	Efficiency rates (specific process)
Steel	99%	88.0%
Cast Iron	99%	88.0%
Wrought Aluminium	85%	94.5%
Cast Aluminium	85%	94.5%
Copper	85%	76.3%
Glass	0%	99.5%
Average Plastics	24%	95.0%
PP	40%	95.0%
PUR	0%	95.0%
Nylon	0%	95.0%
PE	40%	95.0%
ABS	37%	95.0%
PET	0%	95.0%

In the case of reused parts, an environmental credit is calculated based on the environmental burdens of primary production of the corresponding material.

4.3.5 Data and scenarios for the whereabout of (used) vehicles

To assess the impacts of the diverse measures addressing the aspect of "missing vehicles" the IA support study of Oeko-Institut distinguishes different categories of whereabouts as follows:

A. ELVs directed to ATFs and subsequently to shredders and reported by ATFs and MS (ATF, reported)
B. ELVs directed to ATFs and subsequently to shredders but not reported (ATFs, not reported)
C. ELVs directed to non-ATFs and subsequently to shredders, not reported (non-ATF)
D. Used Vehicles exported (extra EU) and reported accordingly (Export, reported)
E. Used Vehicles exported (extra EU) but not reported (Export, not reported)
F. ELVs exported (extra EU), not reported (ELVs export, not reported)
G. Missing vehicles = B) + C) + E) + F)

The following table displays the assumptions for the current situation (last data available for 2019) and the assumptions for the scenarios.

The total ELVs arising in Column 4 are taken from the sales of passenger cars in the EU (2009-2035)[76] and the EoL Weibull distribution for vehicles both displayed above. The 7 columns to the right of the table display the changes (shift) in % points compared to the percentage points for the current situation.

The environmental impacts are calculated with the data displayed for the material composition of the different types of vehicles and the environmental impacts and in the subsequent section.

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[75] Recycling rates ASR: own estimations according to data from Sander et al. 2020; PST: JRC 2021; Recycling efficiency rates of the specific recycling process according to ecoinvent 3.8
[76] Source: Own calculation on the basis of data from Aeris Europe 2021 and ACEA 2021

Table 4.4 Vehicle fleet data, options refer to Impact Assessment study[77]

	Year		total ELV arising	A) ATF, reported	B) ATFs, not reported	C) non-ATF	D) Export, reported	E) Export, not reported	F) ELVs export, not reported	missing vehicles	check	A	B	C	D	E	F	M
Data + assumptions regards the share for different reasons for "missing vehicles"	2019	10^6 (EL)Vs	10.50	6.1	0.9	0.9	1.0	0.9	0.9	3.4	10.5	58.1%	25.0%	25.0%	9.5%	25.0%	25.0%	32.4%
			100%	58.1%	8.1%	8.1%	9.5%	8.1%	8.1%	32.4%	100.0%							
												Shift in percentage points						
Baseline change of domestically collected & reported ELVs by ATFs	2025	10^6 (EL)Vs	12.39	7.2	1.0	1.0	1.2	1.0	1.0	3.9	12.4							
				58.5%	7.9%	7.9%	9.9%	7.9%	7.9%	31.6%	100.0%	0.4%	-0.2%	-0.2%	0.4%	-0.2%	-0.2%	-0.8%
	2030	10^6 (EL)Vs	12.41	7.3	1.0	1.0	1.3	0.9	0.9	3.8	12.4							
				59.2%	7.8%	7.8%	10.1%	7.5%	7.5%	30.7%	100.0%	1.1%	-0.3%	-0.3%	0.6%	-0.6%	-0.6%	-1.7%
	2035	10^6 (EL)Vs	12.85	7.6	1.0	1.0	1.3	1.0	1.0	3.9	12.8							
				59.4%	7.7%	7.7%	10.2%	7.4%	7.4%	30.4%	100.0%	1.3%	-0.4%	-0.4%	0.7%	-0.7%	-0.7%	-2.0%
	2040	10^6 (EL)Vs	13.77	8.2	1.1	1.1	1.4	1.0	1.0	4.1	13.8							
				59.6%	7.7%	7.7%	10.3%	7.3%	7.3%	30.1%	100.0%	1.5%	-0.4%	-0.4%	0.8%	-0.8%	-0.8%	-2.3%
Policy Option 3A	2025	10^6 ELVs	12.4	7.3	1.0	1.0	1.2	1.0	0.9	3.8	12.4							
				59.1%	7.8%	7.8%	10.0%	7.8%	7.3%	30.9%	100.0%	1.0%	-0.3%	-0.3%	0.5%	-0.3%	-0.8%	-1.5%
	2030	10^6 ELVs	12.4	7.5	0.9	0.9	1.3	0.9	0.8	3.6	12.4							
				60.1%	7.6%	7.6%	10.5%	7.6%	6.6%	29.4%	100.0%	2.0%	-0.5%	-0.5%	1.0%	-0.5%	-1.5%	-3.0%
	2035	10^6 ELVs	12.8	7.8	0.9	0.9	1.4	0.9	0.8	3.6	12.8							
				61.1%	7.3%	7.3%	11.0%	7.3%	5.8%	27.9%	100.0%	3.0%	-0.8%	-0.8%	1.5%	-0.8%	-2.3%	-4.5%
	2040	10^6 ELVs	13.8	8.7	0.9	0.9	1.6	0.9	0.6	3.5	13.8							
				62.9%	6.9%	6.9%	11.9%	6.9%	4.5%	25.2%	100.0%	4.8%	-1.2%	-1.2%	2.4%	-1.2%	-3.6%	-7.2%
Policy Option 3B	2025	10^6 ELVs	12.4	7.5	0.9	0.9	1.2	0.9	0.9	3.6	12.4							
				60.6%	7.6%	7.6%	10.0%	7.1%	7.1%	29.4%	100.0%	2.5%	-0.5%	-0.5%	0.5%	-1.0%	-1.0%	-3.0%
	2030	10^6 ELVs	12.4	7.8	0.9	0.9	1.3	0.8	0.8	3.3	12.4							
				63.1%	7.1%	7.1%	10.5%	6.1%	6.1%	26.4%	100.0%	5.0%	-1.0%	-1.0%	1.0%	-2.0%	-2.0%	-6.0%
	2035	10^6 ELVs	12.8	8.4	0.8	0.8	1.4	0.7	0.7	3.0	12.8							
				65.6%	6.6%	6.6%	11.0%	5.1%	5.1%	23.4%	100.0%	7.5%	-1.5%	-1.5%	1.5%	-3.0%	-3.0%	-9.0%
	2040	10^6 ELVs	13.8	9.4	0.8	0.8	1.6	0.6	0.6	2.8	13.8							
				68.1%	6.1%	6.1%	11.5%	4.1%	4.1%	20.4%	100.0%	10.0%	-2.0%	-2.0%	2.0%	-4.0%	-4.0%	-12.0%
Policy Option 3C	2025	10^6 ELVs	12.4	6.7	0.5	0.5	1.8	1.4	1.4	3.9	12.4							
				54.1%	4.1%	4.1%	14.5%	11.6%	11.6%	31.4%	100.0%	-4.0%	-4.0%	-4.0%	5.0%	3.5%	3.5%	-1.0%
	2030	10^6 ELVs	12.4	8.3	0.9	0.9	1.2	0.6	0.6	2.9	12.4							
				67.1%	7.1%	7.1%	9.5%	4.6%	4.6%	23.4%	100.0%	9.0%	-1.0%	-1.0%	0.0%	-3.5%	-3.5%	-9.0%
	2035	10^6 ELVs	12.8	9.0	0.8	0.8	1.1	0.5	0.5	2.7	12.8							
				70.1%	6.6%	6.6%	8.5%	4.1%	4.1%	21.4%	100.0%	12.0%	-1.5%	-1.5%	-1.0%	-4.0%	-4.0%	-11.0%
	2040	10^6 ELVs	13.8	9.9	0.9	0.9	1.0	0.5	0.5	2.8	13.8							
				72.1%	6.6%	6.6%	7.5%	3.6%	3.6%	20.4%	100.0%	14.0%	-1.5%	-1.5%	-2.0%	-4.5%	-4.5%	-12.0%

[77] Baron, Y.; Kosińska-Terrade, I.; Loew, C.; Köhler, A.; Moch, K.; Sutter, J.; Graulich, K.; Adjei, F.; Mehlhart, G.: Study to support the impact assessment for the review of Directive 2000/53/EC on End-of-Life Vehicles by Oeko-Institut, June 2023

	Year		total ELV arising	A) ATF, reported	B) ATFs, not reported	C) non-ATF	D) Export, reported	E) Export, not reported	F) ELVs export, not reported	missing vehicles	check	A	B	C	D	E	F	M
Data + assumptions regards the share for different reasons for "missing vehicles"	2019	10^6 (EL)Vs	10.50	6.1	0.9	0.9	1.0	0.9	0.9	3.4	10.5	58.1%	25.0%	25.0%	9.5%	25.0%	25.0%	32.4%
			100%	58.1%	8.1%	8.1%	9.5%	8.1%	8.1%	32.4%	100.0%							
												Shift in percentage points						
Preferred Policy Option	2025	10^6 ELVs	12.4	6.8	0.6	0.3	2.0	1.3	1.3	3.5	12.4							
				55.1%	5.1%	2.1%	16.5%	10.8%	10.3%	28.4%	100.0%	-3.0%	-3.0%	-6.0%	7.0%	2.8%	2.3%	-4.0%
	2030	10^6 ELVs	12.4	9.6	0.5	0.5	0.8	0.6	0.4	2.0	12.4							
				77.1%	4.1%	4.1%	6.5%	4.6%	3.6%	16.4%	100.0%	19.0%	-4.0%	-4.0%	-3.0%	-3.5%	-4.5%	-16.0%
	2035	10^6 ELVs	12.8	10.5	0.4	0.4	0.7	0.5	0.3	1.6	12.8							
				82.1%	3.1%	3.1%	5.5%	3.6%	2.6%	12.4%	100.0%	24.0%	-5.0%	-5.0%	-4.0%	-4.5%	-5.5%	-20.0%
	2040	10^6 ELVs	13.8	11.7	0.3	0.3	0.9	0.4	0.2	1.2	13.8							
				85.1%	2.1%	2.1%	6.5%	2.6%	1.6%	8.4%	100.0%	27.0%	-6.0%	-6.0%	-3.0%	-5.5%	-6.5%	-24.0%
additional effects from the combination with	2025	10^6 ELVs	12.4	7.1	0.8	0.3	2.0	1.1	1.0	3.3	12.4							
EPR elements				57.6%	6.6%	2.6%	16.0%	8.8%	8.3%	26.4%	100.0%	-0.5%	-1.5%	-5.5%	6.5%	0.8%	0.3%	-6.0%
	2030	10^6 ELVs	12.4	9.8	0.7	0.6	0.8	0.3	0.2	1.8	12.4							
				79.1%	5.6%	4.6%	6.5%	2.6%	1.6%	14.4%	100.0%	21.0%	-2.5%	-3.5%	-3.0%	-5.5%	-6.5%	-18.0%
	2035	10^6 ELVs	12.8	10.9	0.5	0.4	0.6	0.3	0.2	1.3	12.8							
				84.6%	3.8%	2.8%	5.0%	2.1%	1.6%	10.4%	100.0%	26.5%	-4.3%	-5.3%	-4.5%	-6.0%	-6.5%	-22.0%
	2040	10^6 ELVs	13.8	12.1	0.3	0.2	0.8	0.2	0.2	0.9	13.8							
				88.1%	2.3%	1.3%	5.5%	1.6%	1.1%	6.4%	100.0%	30.0%	-5.8%	-6.8%	-4.0%	-6.5%	-7.0%	-26.0%

4.3.6 Scope extension

The methodology for the scope extension is described in a dedicated Annex to the IA support study by Oeko-Institut.

4.4 Modelling environmental impacts

The environmental assessment is based on a life cycle approach. The entire life cycle of vehicles is taken into account: from the extraction of primary resources and energy sources, the production of the vehicles to the recycling processes of the ELVs and disposal of materials at the end of the life cycle.

A full range of impacts and thus a relevant share of the results of the policy options are directly linked and proportional to the mass flows. This applies especially to environmental impacts. Some economic data are as well directly linked to mass flows depending on the policy options that are selected for assessment.

The main environmental impact category that is given as a default by the model is the global warming potential (GWP in t CO2eq) (CO2-equivalents = CO2eq).

A further 10 environmental impact categories can be called up via the model, including e.g. acidification potential, ozone layer depletion, photochemical oxidation or eutrophication. These impacts are linked to individual life cycle stages of the mass flows. Other life cycle stages with relevant environmental impacts are 'recycling' and a comparison of the production of primary and secondary materials (e.g. steel, aluminium, copper, plastics and glass).

LCA studies and LCA databases are the source for the calculation of the environmental impacts.

4.4.1 LCA data

The calculation of the environmental impacts of ELVs takes into account different life cycle stages, including upstream processes. Results are generated according to different environmental impact categories. The calculation presented in this study is based on the ecoinvent database (ecoinvent 3.8)[78], the "openLCA" (openLCA 2022) LCA tool[79] and further literature data. The quantification of environmental impacts of ELVs focuses on material production (incl. upstream processes such as mining and further processing, regardless of whether inside or outside the EU) and the recycling of the end-of-life vehicles.

The following sections describe the applied methodology and main assumptions used for quantifying the environmental impacts of vehicles. Although much literature is available addressing the environmental impacts of ELVs, its usability for the present calculation is limited for various reasons, including:

- the level of detail is not sufficient to extract relevant data;
- different functional units are applied;

[78] ecoinvent database, version 3.8, released on 21st September 2021, Online available on https://ecoinvent.org/, Last check on 10 Febrary 2023

[79] Online available on https://www.openlca.org/, Last check on 10 February 2023

- relevant input factors are not compatible to the scope of the present calculation; and/or
- results are given in aggregated parameters instead of individual impact categories.

A full range of environmental impacts is directly linked to the mass flows in the model. The total environmental impacts are proportional to the mass flows and are calculated via the model for the different policy options. The main environmental impact category that was evaluated via the model and addressed in the report is climate change (global warming potential GWP in kg CO2-eq.).

4.4.2 Environmental impact categories

A further 10 environmental impact categories can be called up via the model:

- Abiotic depletion potential of mineralic resources (ADPelem. in kg Sb eq.)
- Abiotic depletion of fossil fuels (ADP in MJ)
- Acidification (AP in kg SO2 eq.)
- Eutrophication potential (EP in kg PO4---eq.)
- Fresh water aquatic ecotoxicity (FAET in kg 1,4-DB eq.)
- Human toxicity (in kg 1,4-DB eq.)
- Marine aquatic ecotoxicity (MAET in kg 1,4-DB eq.)
- Ozone layer depletion potential (ODP in kg CFC-11 eq.)
- Photochemical oxidation (POCP in kg C2H4 eq.)
- Terrestrial ecotoxicity (TET in kg 1,4-DB eq.)

The primary production of vehicles was calculated from the material composition of the vehicles with data for the primary production of these materials and the energy and material demand for the manufacturing of the vehicles.

The recycling was calculated from the energy and material demand for the recycling process and the refining of the recovered materials. Credits for the recovered materials were given for the avoided primary production.

The data for the primary production and the recycling was taken from the LCA database ecoinvent 3.8 and specific LCA studies and supplemented by information from the stakeholder surveys.

Detailed results of the calculations are presented for selected impact categories in the tables below.

Table 4.5 LCA data: Primary production of materials I[80]

Impact category	Unit	Steel	Stainless Steel	Cast Iron	Wrought aluminium	Cast aluminium	Copper	Glass	Rubber	Carbon Fiber-Reinforced Plastic	Glass Fiber-Reinforced Plastic	PTFE	Silicon
Abiotic depletion	kg Sb eq	3.4E-05	1.6E-04	5.9E-06	1.9E-05	1.9E-05	2.4E-03	8.3E-06	4.9E-05	2.2E-04	3.5E-05	2.3E-04	2.5E-05
Abiotic depletion (fossil fuels)	MJ	1.9E+01	4.6E+01	1.8E+01	1.8E+02	1.8E+02	6.8E+01	1.0E+01	7.4E+01	8.9E+02	5.8E+01	1.3E+02	4.5E+01
Acidification	kg SO2 eq	7.3E-03	2.4E-02	6.3E-03	1.1E-01	1.1E-01	1.0E-01	8.4E-03	1.3E-02	4.0E-01	1.8E-02	5.5E-02	1.2E-02
Eutrophication	kg PO4--- eq	3.8E-03	7.6E-03	2.7E-03	2.7E-02	2.7E-02	3.8E-01	1.1E-03	3.8E-03	1.2E-01	5.7E-03	1.4E-02	4.0E-03
Fresh water aquatic ecotox.	kg 1,4-DB eq	6.0E+00	1.5E+01	1.4E+00	1.4E+01	1.4E+01	7.7E+02	2.5E-01	1.3E+00	3.6E+01	1.5E+00	7.8E+00	1.7E+00
Global warming (GWP100a)	kg CO2 eq	2.1E+00	4.4E+00	1.8E+00	1.9E+01	1.9E+01	6.5E+00	9.7E-01	2.7E+00	8.3E+01	3.9E+00	1.3E+02	2.9E+00
Human toxicity	kg 1,4-DB eq	3.2E+00	7.7E+01	1.6E+00	1.2E+01	1.2E+01	1.2E+03	3.7E-01	1.8E+00	3.2E+01	4.7E+00	3.0E+01	1.6E+00
Marine aquatic ecotoxicity	kg 1,4-DB eq	7.0E+03	1.7E+04	2.7E+03	5.6E+04	5.6E+04	8.7E+05	1.4E+03	2.9E+03	1.1E+05	4.4E+03	2.6E+05	7.4E+03
Ozone layer depletion (ODP)	kg CFC-11 eq	9.2E-08	1.9E-07	8.7E-08	5.8E-07	5.8E-07	4.0E-07	9.3E-08	5.3E-07	2.0E-06	3.5E-07	4.3E-03	1.9E-06
Photochemical oxidation	kg C2H4 eq	9.5E-04	1.1E-03	8.1E-04	6.7E-03	6.7E-03	2.0E-03	2.7E-04	7.0E-04	1.8E-02	1.1E-03	4.4E-03	7.1E-04
Terrestrial ecotoxicity	kg 1,4-DB eq	2.3E-03	7.5E-02	6.6E-02	3.5E-02	3.5E-02	1.5E-01	6.6E-04	3.8E-03	2.5E-01	5.6E-03	2.0E-02	5.1E-03

Table 4.6 LCA data: Primary production of materials II

Impact category	Unit	ABS	Liquid Epoxy	GPPS	HIPS	HDPE	LDPE	LLDPE	Nylon 6	Nylon 66	PC	PET	PP
Abiotic depletion	kg Sb eq	2.8E-06	5.5E-05	4.4E-07	4.4E-07	1.4E-05	1.4E-05	1.5E-05	6.5E-05	3.0E-06	1.7E-06	3.7E-05	1.4E-05
Abiotic depletion (fossil fuels)	MJ	8.7E+01	8.0E+01	7.8E+01	7.8E+01	7.1E+01	7.3E+01	7.0E+01	1.0E+02	1.1E+02	9.2E+01	6.8E+01	7.3E+01
Acidification	kg SO2 eq	1.3E-02	1.7E-02	1.1E-02	1.2E-02	7.8E-03	8.7E-03	7.5E-03	3.0E-02	2.9E-02	2.5E-02	1.1E-02	7.6E-03
Eutrophication	kg PO4- eq	2.2E-03	6.9E-03	9.4E-04	9.9E-04	2.0E-03	2.6E-03	2.0E-03	6.8E-03	7.7E-03	2.5E-03	3.1E-03	1.9E-03
Fresh water aquatic ecotox.	kg 1,4-DB eq	4.7E-01	3.6E+00	6.8E-01	6.7E-01	6.3E-01	7.5E-01	6.4E-01	3.0E-01	2.5E-01	2.2E-01	1.2E+00	6.1E-01
Global warming (GWP100a)	kg CO2 eq	4.5E+00	4.6E+00	3.6E+00	3.6E+00	2.3E+00	2.5E+00	2.2E+00	9.1E+00	8.1E+00	8.1E+00	3.1E+00	2.3E+00
Human toxicity	kg 1,4-DB eq	4.1E-01	8.0E+00	3.5E-01	3.8E-01	8.4E-01	9.4E-01	9.8E-01	4.6E-01	4.2E-01	4.2E-01	2.1E+00	7.9E-01
Marine aquatic ecotoxicity	kg 1,4-DB eq	1.6E+03	4.7E+03	3.7E+03	3.6E+03	1.5E+03	1.9E+03	1.4E+03	1.4E+03	1.1E+03	9.0E+02	2.7E+03	1.4E+03
Ozone layer depletion (ODP)	kg CFC-11 eq	7.5E-08	6.5E-07	2.9E-09	3.4E-09	5.2E-08	4.7E-08	6.0E-08	1.2E-08	7.4E-09	1.7E-08	1.0E-05	3.9E-08
Photochemical oxidation	kg C2H4 eq	7.5E-04	2.3E-03	7.5E-04	7.3E-04	6.8E-04	1.4E-03	5.6E-04	1.4E-03	1.4E-03	1.4E-03	6.8E-04	4.4E-04
Terrestrial ecotoxicity	kg 1,4-DB eq	1.3E-03	6.4E-03	5.4E-04	6.7E-04	1.5E-03	2.1E-03	1.5E-03	9.6E-04	7.0E-04	2.7E-02	4.0E-03	1.3E-03

Table 4.7 LCA data: Primary production of materials III

Impact category	Unit	PUR Flexible Foam	PUR Rigid Foam	PVC	Zinc	Magnesium	Nickel	Platinum	Gold	Silver	Tin	Brass	Palladium
Abiotic depletion	kg Sb eq	1.4E-05	6.8E-05	3.7E-05	1.5E-03	5.2E-05	2.2E-03	3.6E+00	6.1E+01	8.5E-01	2.7E-02	9.4E-03	8.9E-01
Abiotic depletion (fossil fuels)	MJ	8.2E+01	9.8E+01	5.0E+01	3.1E+01	1.1E+03	2.3E+02	1.0E+06	5.7E+05	5.8E+03	1.2E+02	8.0E+01	1.9E+05
Acidification	kg SO2 eq	2.2E-02	2.6E-02	8.9E-03	2.2E-02	2.3E-01	1.8E+00	4.1E+03	3.8E+02	4.9E+00	9.8E-02	3.4E-01	2.0E+03
Eutrophication	kg PO4- eq	5.5E-03	1.1E-02	3.2E-03	1.3E-02	1.6E-01	6.4E-02	4.5E+02	5.8E+02	4.8E+00	9.1E-02	1.1E-01	6.9E+01
Fresh water aquatic ecotox.	kg 1,4-DB eq	1.5E+00	3.0E+00	1.3E+00	1.2E+01	2.9E+01	1.6E+02	2.8E+05	7.5E+05	5.6E+03	8.1E+01	1.9E+02	5.0E+04
Global warming (GWP100a)	kg CO2 eq	5.2E+00	5.0E+00	2.4E+00	2.7E+00	4.5E+01	1.8E+01	6.9E+04	4.9E+04	5.0E+02	1.0E+01	6.6E+00	1.3E+04
Human toxicity	kg 1,4-DB eq	9.7E-01	4.2E+00	1.8E+00	1.1E+01	8.3E+01	1.2E+02	2.3E+05	6.7E+05	4.9E+03	6.8E+01	3.4E+02	3.9E+04
Marine aquatic ecotoxicity	kg 1,4-DB eq	6.6E+03	7.1E+03	2.8E+03	3.6E+04	6.6E+04	1.5E+05	3.9E+08	1.2E+09	7.3E+06	9.2E+04	2.3E+05	6.6E+07
Ozone layer depletion (ODP)	kg CFC-11 eq	2.6E-08	8.2E-07	1.1E-06	1.7E-07	5.9E-06	1.7E-06	3.3E-03	2.9E-03	5.2E-05	5.8E-07	9.8E-07	3.0E-03
Photochemical oxidation	kg C2H4 eq	1.0E-03	4.9E-03	5.0E-04	7.1E-04	3.4E-02	8.5E-02	1.4E+02	1.2E+01	1.6E-01	2.9E-03	1.3E-02	7.9E+01
Terrestrial ecotoxicity	kg 1,4-DB eq	5.5E-03	1.4E-02	3.8E-03	1.8E-02	4.1E-02	3.1E-01	2.5E+02	9.7E+02	3.8E+00	7.4E-02	2.2E-01	4.6E+01

Table 4.8 LCA data: Secondary production of materials

Impact category	Unit	Steel	Aluminium wrought alloy	Aluminium cast alloy	Glass	HDPE	PET	Platinum
Abiotic depletion	kg Sb eq	1.1E-05	1.9E-04	7.5E-05	4.2E-08	7.0E-06	6.1E-06	7.2E-01
Abiotic depletion (fossil fuels)	MJ	6.6E+00	3.6E+01	6.4E+01	1.6E-01	4.7E+00	8.0E+00	2.0E+05
Acidification	kg SO2 eq	2.6E-03	1.6E-02	3.0E-02	3.5E-05	1.9E-03	2.5E-03	1.5E+02
Eutrophication	kg PO4--- eq	1.6E-03	7.2E-03	8.4E-03	5.8E-05	4.1E-03	2.3E-03	4.1E+01
Fresh water aquatic ecotox.	kg 1,4-DB eq	1.9E+00	5.0E+00	3.3E+00	1.1E-02	2.1E+00	8.1E+00	9.4E+04
Global warming (GWP100a)	kg CO2 eq	6.4E-01	3.5E+00	4.2E+00	1.4E-02	4.9E-01	8.2E-01	1.8E+04
Human toxicity	kg 1,4-DB eq	1.5E+00	4.3E+00	3.7E+00	7.5E-03	1.4E+00	1.6E+00	8.4E+04
Marine aquatic ecotoxicity	kg 1,4-DB eq	2.3E+03	1.1E+04	6.0E+03	2.4E+01	9.5E+03	4.2E+04	6.4E+07
Ozone layer depletion (ODP)	kg CFC-11 eq	4.8E-08	1.7E-07	2.1E-06	1.2E-09	3.7E-08	6.6E-08	1.6E-03
Photochemical oxidation	kg C2H4 eq	1.4E-04	2.8E-03	1.4E-03	1.4E-06	1.2E-04	1.5E-04	8.8E+00
Terrestrial ecotoxicity	kg 1,4-DB eq	2.3E-03	2.1E-02	5.6E-02	3.4E-05	1.2E-02	4.9E-03	6.6E+01

4.4.3 Data for the modelling of environmental impact from coolants

According to the EU ELV rules, ELV must be depolluted and inter alia the coolants for air conditioning must be separated to avoid that the coolant is discharged to the air. As the coolants are very volatile, this requires special extraction systems. If only a limited number of vehicles is depolluted it is economically not viable to invest in such extraction systems. A German study assessed the potential impact and concluded that the coolant R12 (with a GWP100 of 10.890 CO2eq), which was phased out the latest 1995, are not relevant anymore. However, the coolant R134a (phased out the latest in 2017) is relevant[77].

1) Global warming potential (GWP-100) of the air conditioning cooling agent R134a: 1,430 kg CO2eq
2) Average filling of a vehicle with R134a at the end-of-life: 0.6 kg per vehicle
3) Vehicles placed on the market and share of new vehicles equipped with R134a.[81] The time series ends in 2021 as the application of R134a is phased out.

Table 4.9 GWP impacts of air conditioning coolant removal

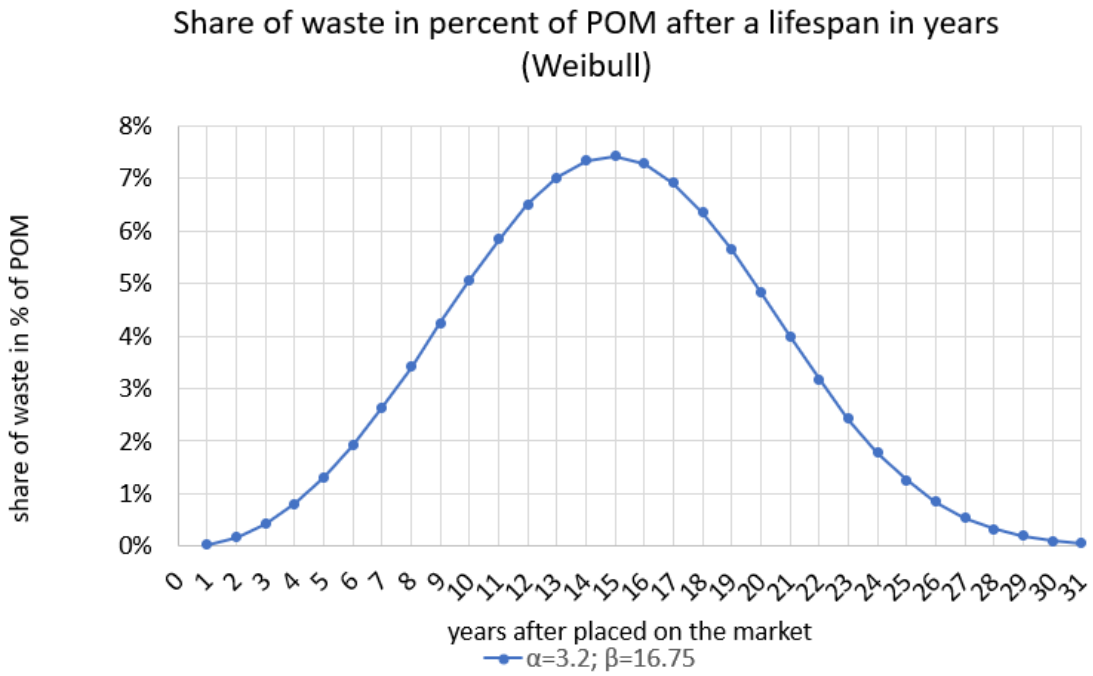
	total,M1,+,N1,PoM	Share,R134a
1991	12,591,233	25.7%
1992	12,701,341	25.7%
1993	10,061,079	25.7%
1994	10,632,622	31.7%
1995	10,687,789	37.8%
1996	11,401,688	43.9%
1997	11,908,142	50.0%
1998	12,852,409	56.1%
1999	13,667,723	62.2%
2000	13,296,470	68.3%
2001	13,126,889	74.3%
2002	12,578,688	80.4%
2003	13,337,197	86.5%
2004	13,613,138	92.6%
2005	13,652,647	94.2%
2006	14,374,710	95.7%
2007	14,474,905	95.8%
2008	13,409,195	95.9%
2009	13,368,260	96.0%
2010	12,667,065	96.1%
2011	12,651,986	96.6%
2012	12,636,906	97.0%

[81] Source: Zimmermann, T.; Sander, K.; Memelink, R.; Knode, M.; Freier, M.; Porsch, L.; Schomerus, T.; Wilkes, S.; Flormann. P. (2022): Auswirkungen illegaler Altfahrzeugverwertung, [Impacts of illegal treatment of ELVs]. Texte 129/2022; Publisher: Umweltbundesamt, Dessau, Germany, November 2022; ISSN 1862-4804;

2013	12,621,827	93.7%
2014	12,606,748	90.4%
2015	12,591,668	66.3%
2016	12,283,340	42.1%
2017	11,975,012	22.9%
2018	11,666,683	3.6%
2019	11,358,355	2.3%
2020	11,050,026	0.0%
2021	11,791,238	0.0%

4) Weibull parameters for the lifetime of a vehicle (same as for the other model calculations)

Figure 4.6 Lifetime distribution of vehicles



5) Loss rate for the different destinations of the vehicle

As addressed in other sections (on "missing vehicles") we distinguish different locations where the vehicles become an end-of-life vehicle. We distinguish the following cases:

With

A) ELVs directed to ATFs and subsequently to shredders and reported by ATFs and MS

B) ELVs directed to ATFs and subsequently to shredders but not reported

C) ELVs directed to intra-EU non-ATFs and subsequently to shredders, not reported

D) Used Vehicles exported (extra EU) and reported accordingly

E) Used Vehicles exported (extra EU) but not reported

F) ELVs exported (extra EU), not reported

As outlined in the German report mentioned earlier[77] it is expected that a certain proportion of the coolant from the air-conditioning system of ELVs is not extracted in accordance with the regulations but is released uncontrolled to the air.

Transposing these assumptions to the 6 categories above, we consider for the calculation of the impact that the following share of coolant is not extracted in accordance with the regulations but is released uncontrolled to the air (=loss rate)

Destination where vehicles become ELVs and their loss rate

(A) ELVs directed to ATFs: 10%

(B) ELVs directed to ATFs but not reported: 70%

(C) ELVs directed to intra-EU non-ATFs: 70%

(D), (E) and (F): extra EU export: 100%

6) The above-mentioned data / assumptions are finally combined with the total numbers of ELVs directed to the 6 different destinations as calculated for the different scenarios under "missing vehicles".

4.5 Modelling the economic impacts

4.5.1 Main indicators

The main indicators used for the modelling of the economic impacts are the following:

For the economic impacts on ATFs the following aspects are of relevance under the current depollution and dismantling requirements:

- revenues of components and spare parts removed by Authorised Treatment Facilities (ATFs) for re-use or recycling,
- revenues for recyclates and the remaining hulk of ELVs sent by ATFs to shredders,
- costs for management of ELVs including the (current) obligatory depollution and dismantling management,
- cost for ATFs to buy ELVs

These aspects are assessed in detail in a German report, published in 2022[82]. For the EU Impact assessment, the IA support study of the Oeko-Institut did not refer to the separated cost and revenues but refers to the aggregated profit of 200 € per each ELV treated at ATFs. As the sources refer to the conditions in Germany, the situation might differ in other EU Member States. However, the mentioned profit is, in absence of other data, considered for the entire EU. As the size of the ATFs is very diverse no impacts of "economies of scale" are considered.

The IA support study of the Oeko-Institut further assumed that the profits of exporting used vehicles are higher compared to the profits from ELV treatment. In absence of qualified sources an estimated profit for the exporter of 400 € per exported used vehicle is considered.

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[82] Zimmermann, T.; Sander, K.; Memelink, R.; Knode, M.; Freier, M.; Porsch, L.; Schomerus, T.; Wilkes, S.; Flormann. P. (2022): Auswirkungen illegaler Altfahrzeugverwertung, [*Impacts of illegal treatment of ELVs*]. Texte 129/2022; Publisher: Umweltbundesamt, Dessau, Germany, November 2022; ISSN 1862-4804

Regards the economic impacts for shredders the IA support study of Oeko-Institut considers a profit 20 € per ton additional ELVs directed to shredders in the EU, with the assumption that a depolluted and dismantled ELV has a weight of 700 kg.

The dismantling of Batteries from EV falls under the obligation of ATFs and is regulated under the ELV legislation and not under the Battery Regulation[83]. Considering that each of the 12,000 ATFs will sooner or later need training in handling of high-voltage batteries, such training, including missed work time, easily costs each ATFs more than €5,000, which would add up to € 60 million for the entire EU. Considering that such training needs to be completed in a period of 5 years and taking into account 63 million new passenger cars registered in the previous 5-year period (2017 – 2021) this would account for around 1 € per each new vehicle in that period. Other trainings e.g. regards the separation / dismantling of additional parts is not considered in the economic impact assessment,

The economic impacts from the more extensive dismantling and separation are built upon analysis of economic impacts for various materials: steel, copper, aluminium (cast and wrought), glass, plastics, and electric and electronic components (EEC). The analysed economic impacts in Oeko-Institut's IA support study considered inter alia the following parameters:

4.5.2 *Revenues for spare parts removed by ATFs for reuse or separate recycling;*

- Revenues for recyclates (shredders/PSTs, and recyclers);
- Dismantling costs (labour cost) for additional manual dismantling;
- Investment costs by all relevant economic actors (except for plastics, qualitative analysis).

The economic impacts were analysed qualitatively and quantitatively. The following table provides an overview of the quantitative analysis of economic impacts that was performed for each material in Oeko-Institut's IA support study.

Table 4.10 Economic impact categories

Impact category	**Material**			
	Steel, Copper, Aluminium	Glass	Plastic	EEC
Change in revenues (decrease or increase) for recyclates				
ATFs	x	x	x	x (also for reuse sales)
Shredder/PSTs	x	x	x	
Recyclers	x	x	x	
Dismantling costs (labour costs) at ATFs	x	x	x	x
Operating costs at shredder/PSTs			x	
Compounding costs at recyclers			x	

[83] Regulation of the European Parliament and the Council of [date] 2023 concerning batteries and waste batteries, amending Directive 2008/98/EC and Regulation (EU) 2019/1020 and repealing Directive 2006/66/EC (OJ L […]).

Investment costs			x	

All quantitative analysis were done for baseline and further scenarios developed for each material separately. These scenarios considered different routes of treatment of materials as well as shares (in %) of total material stream. All considered routes of treatment were:

- In components for reuse/remanufacturing
- Recycled material of potentially higher-quality (directly recycled, no shredding)
- Dismantled --> shredded --> recycled (not relevant for copper, plastics, and EEC)
- Shredded --> recycled (no dismantling) (not relevant for cast aluminium)
- Recovery (backfilling in case of glass and energy recovery in case of aluminium, or for plastics and EEC either backfilling or energy recovery)
- Recycled removed copper from steel scrap (relevant only for copper)
- Losses/process inefficiencies

For the analysis at hand, the model developed for this study specifies the tonnage of each analysed material that will be contained in ELVs to be collected in years: 2025, 2030, 2035, and 2040. These calculations also consider a weight of each material per vehicle depending on the type of vehicle. Based on above calculations and the assumed shares for each route of treatment for material, the tonnage of analysed material treated in different routes for each scenario/policy option was calculated.

The calculations of revenues for ATFs, shredders/PSTs, and recyclers considered the tonnage of analysed material treated in different routes for each scenario multiplied by the unit price of the analysed material. For aluminium and glass, different unit prices based on the recyclate quality were used in the calculations. In the qualitative analysis of Oeko-Institut's IA support study, it was noted that increased quality of recyclates resulted in a unit price increase. Obtained results, which can be found in the Final Report, refer to a baseline scenario and express the difference of revenues compared to the baseline scenario. Below is a table that contains all assumed unit prices for recyclates of the analysed materials.

Table 4.11 Economic impacts, price of recyclates and reusable parts

Material	**Unit prices (in Euro/tonne)**	
	Recyclates	Reuse sales
Steel	187.08[84]	
Copper	6,286[79]	
Aluminium		
Cast	967.39[79]	
Wrought	1,160.87[85]	
Glass		
For ATFs	10.00[86]	
For shredder/PSTs	10.40[87] 1,50[88]	

[84] https://www.letsrecycle.com data for 2021, calculated averages converted to €
[85] 20% higher price assumed for wrought Al alloy than for Al alloy cast
[86] Unit price of glass sold by ATFs to recyclers directly
[87] Unit price for recycled material after shredding (not backfilled)
[88] Unit price for output from shredders

For recyclers	18.32[89]	
Plastics	400.00[93]	
Inverter (EEC)	10.35[90]	12.20[86]

The calculation of dismantling costs[91] for steel, copper, aluminium, and EEC was based on time required for dismantling of selected parts and the costs of an hour work or unit. As already stressed above, the model developed for the Oeko-Institut's IA support study, specifies the amount of ELVs to be collected in years: 2025, 2030, 2035, and 2040. Based on these values and the assumed shares for each route of treatment for material, the number of dismantled parts for each scenario/policy option was calculated. For steel, aluminium, and copper, to calculate dismantling costs, removal of an engine was considered92. Additionally for copper, the removal of cables was calculated93. For the analysis of these costs for EEC the removal of inverter was considered.

The calculation of dismantling costs for plastics and glass based on the total mass of these materials in ELVs collected in years: 2025, 2030, 2035, and 2040.

The following tables contains unit costs for dismantling (labour costs at ATFs) as well as additional unit costs at shredder/PSTs and recyclers.

Table 4.12 Dismantling costs

Route of treatment	**Material (various units)**			
	Steel, Copper, Aluminium (€/hour)	Glass (€/ tonne)	Plastic (€/ tonne)	EEC (€/ unit)
Dismantling costs at ATFs	51,00[94]	223,00[95] 49,00[96]	80,00[97]	2,20[85]
Operating costs at shredder/PSTs			110,00[93]	
Compounding costs at recyclers			300,00[85]	

[89] https://www.letsrecycle.com data for 2021, calculated averages converted to €
[90] Optimierung der Separation von Bauteilen und Materialien aus Altfahrzeugen zur Rückgewinnung kritischer Metalle (ORKAM); Groke, M.; Kaerger, W.; Sander, K,; Bergamos, M.; Umweltbundesamt 2017
[91] For steel, copper, and aluminium expressed as labour costs
[92] In the calculations dismantling time of engine to the steel and aluminium scenarios are allocated 50:50 and time for deep-dismantling of engines is allocated 33:33:33 to Fe:Cu:Al scenarios. Additionally, the percentage of dismantled and deep-dismantled engines variate among scenarios and depends also on the vehicle's type. Allocation of calculated dismantling time to three materials allows avoiding double counting. Also, dismantling times vary for components removed for reuse (20 min) and for recycling (10 min).
[93] 12 minutes were assumed for removal of cables.
[94] Base on the information from EGARA.
[95] Costs of dismantling per vehicle for the ATF
[96] Costs of post shredder recycling per vehicle for the ATF
[97] Maury, T., Tazi, N., Torres De Matos, C., Nessi, S., Antonopoulos, I., Pierri, E., Baldassarre, B., Garbarino, E., Gaudillat, P. and Mathieux, F., Towards recycled plastic content targets in new passenger cars, EUR 31047 EN, Publications Office of the European Union, Luxembourg, 2022, ISBN 978-92-76-51784-9 (online), doi:10.2838/834615 (online), JRC129008

4.6 Modelling the social impacts

Regards the employment the following indicators are applied:

- 1.5 FTE per 1000 additional ELVs treated at ATFs (at current dismantling conditions)
- Additional job positions calculated for ATFs for increased dismantling of parts and components (for enhanced dismantling and separation at ATFs).
- The calculations of additional jobs for ATFs considered additional number of parts removed from an ATFs prior shredding assumed for each scenario/policy option. For instance, the calculations for steel, aluminium, and copper scenarios/policy options were based on the removal of engines and time required to remove them.
- Additional job positions calculated for recyclers to operate new machines required by shredder/PST (for enhanced separation at recyclers).

Employees will be needed for the operation of new machines in shredder/PST and additional employees for hand picking/sorting in shredder facility. In Europe there are about 300 shredders/PST. It is expected that relevant investments would be done by facilities from middle up to big size, thus not in all existing facilities. There is no precise data on shredder/PST and also if shredders have a PST in house, therefore rough assumptions are done: 60% of existing plants are middle or bigger size, for the new technological solutions there will be need for 2 employees that could operate new machines. It would mean that for scenarios/policy option, in which investment in new technologies are planned, would be required in total to hire additional 360 employees.

4.7 Methodological approach for recycled content plastics

The analysis is based on the JRC plastics recycled content study[98]. The main scenarios included in the study are displayed in Table 4.13.

Table 4.13: Main scenarios evaluated for proposed targets for minimum recycled plastics content in new vehicles sold (Options 3 series) compared to newly type approved (Option 4 series) of the JRC study[99].

	All new vehicles sold (M1)			**Newly type approved vehicles (N1 and M1**	
Application date	**JRC3a**	**JRC3b**	**JRC3c**	**JRC4b**	**JRC4c**
2030	6%	*15%*	*25%*	**25%**	**30%**
2035	10%	*20%*	*30%*	25%	30%

[98] Maury, T., Tazi, N., Torres De Matos, C., Nessi, S., Antonopoulos, I., Pierri, E., Baldassarre, B., Garbarino, E., Gaudillat, P. and Mathieux, F., Towards recycled plastic content targets in new passenger cars, EUR 31047 EN, Publications Office of the European Union, Luxembourg, 2023, ISBN 978-92-76-51784-9 (online), doi:10.2838/834615 (online), JRC129008.

[99] Maury, T., Tazi, N., Torres De Matos, C., Nessi, S., Antonopoulos, I., Pierri, E., Baldassarre, B., Garbarino, E., Gaudillat, P. and Mathieux, F., Towards recycled plastic content targets in new passenger cars, EUR 31047 EN, Publications Office of the European Union, Luxembourg, 2022, ISBN 978-92-76-51784-9 (online), doi:10.2838/834615 (online), JRC129008

4.7.1 Literature review

Literature research is first performed to compile relevant secondary data dealing with the use of plastics in vehicles, the structure of the value chain of virgin and recycled plastics, as well as on the quantitative (*i.e.* mass) and qualitative (*i.e.* polymer types) properties of the material flows within.

Hence, general statistics proposed by the professional associations such as PlasticsEurope or ACEA are analysed, providing a first overview of the characteristics of plastics materials embedded in cars. In addition, technical or impact assessment studies funded by the European commission or professional associations and related to the ELV directive are also analysed because of the direct link with the scope of the present work. This is also the case of "position papers" released by professional organisations to present their views on revision of the ELV directive or EU plastics strategy. In addition, more generic scientific literature such as peer-reviewed scientific articles and specialized website pages are also consulted to complement the data previously collected when needed.

The Circular Plastics Alliance (CPA) deliverables[100] are also providing valuable inputs to understand the current state of play and untapped potential of recycled plastics uptake, offering a specific focus on the automotive sector *via* its dedicated working group. The following available reports were careful analysed and used to enrich the knowledge and datasets gathered:

i. CPA, 2020. Work plan on state of play collection and sorting - Automotive working group. *(CPA, 2020)*
ii. CPA, 2021. Guidance on Waste Definitions. (CPA, 2021a)
iii. CPA, 2021. Roadmap to 10 Mt recycled content by 2025, untapped potential report (CPA, 2021b)
iv. CPA, 2021. Work plan on recycled content - Automotive WG (draft version). *(CPA, 2021c)*
v. CPA, 2022. Supporting greater uptake of recycled plastics in Europe: Circular Plastics Alliance's assessment of the legal, economic and technical requirements and solutions. *(CPA, 2022)*

However, it should be noted that the CPA pursues a different goal compared to the current work carried out in the frame of the revision of the ELV directive. Indeed, CPA initiative is based on industry voluntary pledges within various sectors to reach 10 million tonnes of recycled plastics in 2025, which correspond to a short-term development. Hence, the CPA outcomes offer technical elements to feed the current reflection on the feasibility and ambition level of potential recycled content target for plastics materials within revision of the ELV directive. In other words, CPA results constitute a first step, but are not sufficient to anticipate what could be the situation in the current decade and beyond dealing with both (i) plastics demand for automotive manufacturing and (ii) ELV and plastic waste treatment operations

[100] CPA commitments and deliverables are publicly available on: https://ec.europa.eu/growth/industry/strategy/industrial-alliances/circular-plastics-alliance/commitments-and-deliverables-circular-plastics-alliance_en

and recycling processes. Therefore, the goal of the current study is to provide robust insights about which quantity of recycled plastic materials is suitable to integrate in new cars. Such uptake is regulated thanks to recycled plastic content target policy measure. The evaluation of the uptake potential of recycled plastic by the automotive value chain is performed through supply-demand balance, life cycle-based methodology and an economic assessment.

4.7.2 Selected approach for stakeholders' targeted consultations

One important objective of the present study is to consolidate data and knowledge regarding production and integration of high-quality recycled plastics in new vehicles. For such purpose, it is proposed to enrich data collected in the literature or through the CPA initiative by contacting several experts and key industrial players in the field, following the approach initially presented in Mathieux and Brissaud (2010). This experts' elicitation process allows to reach a finer understanding of stakeholders' interactions within this industrial ecosystem as well as to gather their views on the current and future practices dealing with recycled plastics uptake in the sector. This consultation appears as an important step when assessing the feasibility to set recycled content targets (and associated threshold values) for plastics in new vehicles, by getting first hand feedback also from front-runners.

Consequently, the present study proposes to collect primary data through semi-structured interviews with relevant stakeholders along the value chain described below (see §2.3 of the JRC study). It includes some selected vehicle manufacturers (OEMs), parts and components direct suppliers of the automotive manufacturers (Tier 1), plastics compounders and recyclers which supply the primary and secondary plastics raw materials (Tier 3 suppliers). Independent experts and industrial sector associations are also covered in the scope of the consultation.

The goal of such consultation is to understand the industrial state of play dealing with plastic recycling in the automotive sector and gain knowledge regarding both qualitative and quantitative data (facts and figures) from a wide panel of stakeholders who may have contradicting views on this topic.

4.7.3 Identification of relevant stakeholders (front-runners and professional associations)

The author team developed interview-guide material for each category of stakeholder (see Annex 1 of the JRC study. Questionnaires sent to stakeholders during the targeted consultation). This written document includes a written list of questions related to the value chain, the quantitative and qualitative features of its material flows, the drivers and barriers, as well a preliminary sketch of the value chain based on the literature sources.

First, we focused our consultation on companies identified as front-runners, *i.e.* companies previously involved in large-scale research projects and/or having already announced ambitious public commitments in the field of plastic recycling / use of recycled plastics (see section §2.2.2 of the JRC study). This recognised front-runner position in the field allows to anticipate what could be the situation of the overall sector in the near future (between 5 and 7 years). For such stakeholders, two hours of bilateral guided discussions are carried out including also validation of some assumptions and forecasts made for the system under study.

Going further, broader consultations, *i.e.* participatory interactive workshops, were organized with the relevant industry associations and a panel of their members to capture a representative state of play of the sector regarding the integration of recycled plastics in vehicles. In other words, the exercise allows to understand the average position of a sector and its degree of preparedness to anticipate a potential change in the legislation. It is also seen

as an appropriate way to collect consensual views on the current practices and "averaged" quantitative data which can be used to design a *baseline scenario*.

These workshops were organised during 2.5-3 hours. First, it is proposed a presentation by the JRC team about the current context, the goal and scope of the present study and the expectations in term of qualitative and quantitative inputs to be collected during this consultation (or for potential sensitive topics during follow-up discussions). Then, the representative of the association and some volunteers within the panel present their positions on the following topics followed by an open discussion with the JRC.

i. Current practices regarding recycled plastic integration *(quantity/type of polymers etc.)* and outlook *(2025? 2030?)*

ii. What make further integration of pre/post recycled plastics challenging? *(e.g. qualification process for plastic parts; sourcing, lead times, and technical constraints)*

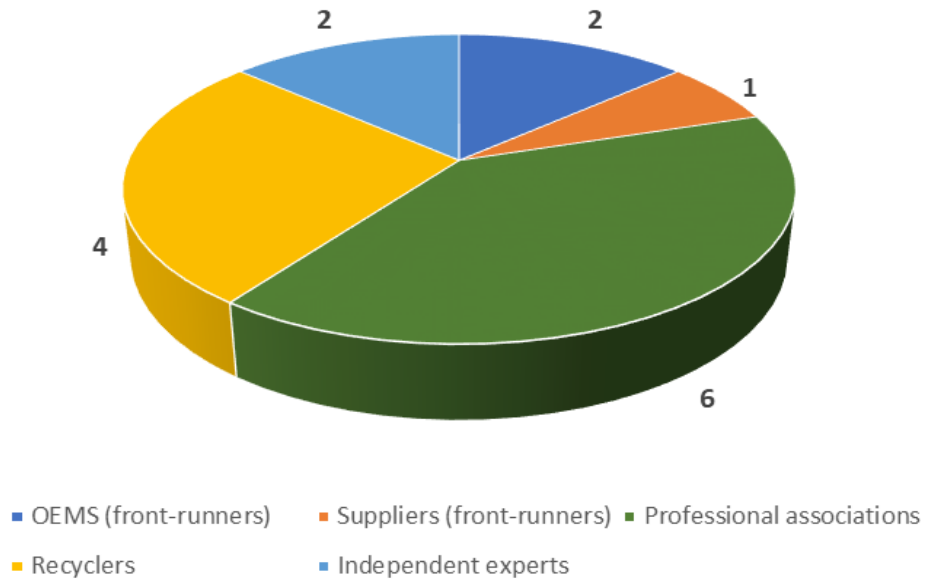
iii. Reliable audit/traceability *scheme (e.g. potential contribution of IMDS, close loop in automotive or intersectoral exchange, EU/non-EU sourcing)*

Each session lasts around 40 minutes with a good balance between presentations and discussions involving members of the panel, association and JRC teams. The workshop ends by a wrap-up and follow-up session managed by both the representative of the association and the JRC team.

4.7.4 Interviews state-of-play

During the study timeline, we interviewed a number of representative stakeholders during at least a 2h session of semi-structured interviews or during half day sectoral workshops with professional associations. Several follow-up discussions, data collection and validation took place with some stakeholders. The list of typical questions sent beforehand to the stakeholders are detailed in Annex 1. The distribution per type of stakeholders is also presented in Figure 3. Despite the pandemic conditions, the study also benefited from the visit/analysis of an ELV plastic recycling plant.

Figure 4.7: Distribution of the selected stakeholders for bilateral discussions



4.7.5 Adaptation for plastics recycling content to fit within the type-approval framework

After the initial JRC study focusing on the entire fleet of vehicles placed on the market, the importance of integrating the recycled content target within the EU type approval (TA) legislative framework was highlighted. Because the TA procedure addresses environmental properties of the vehicles placed on the EU market, and because it already addressed circularity aspects through the recyclability, reusability and recoverability provisions (Directive 2005/64/EC), it is likely to be an appropriate and effective instrument to implement the recycled plastics targets provisions. Therefore, additional scenarios were added to base the target solely on newly type-approved vehicles from a certain data and then while more and more type approvals are granted more steadily increase the uptake of plastics recycled content in new vehicles production. The resulting additional scenarios are displayed in Table 4.14.

The chapter 5 of the JRC report describes the policy options proposed to increase recycled plastics uptake in new vehicles. These options series **1,** 2 and 3 are developed at vehicle level, in line with the description of the criteria ⑥ described in chapter 5 (scope of application for the potential targets). As showed in Annex 8.1.2, the environmental and recyclability provisions of the TA apply to passenger cars (M1 category), and light commercial vehicles (N1 category). Consequently, the N1 category is additionally included in the scope of the analysis and this will modify the amount of recycled plastics demand (demand side) as well as the amount of ELV to be collected and treated in ATF (production side of ELV plastic recyclates). The policy options thus apply to an updated fleet model of newly registered vehicles gathering N1 and M1 categories, presenting a new dynamic regarding the penetration of BEV within the fleet of newly registered vehicles and also providing an increased amount of ELV to be collected per year.

Besides, the harmonisation of the potential recycled content targets with TA procedure implies an important change in the modelling of the recycled plastics demand. In Chapter 5 of the JRC study, the target compliance is applied to all new vehicles sold at a given year. The use of the type approval legislation for recycled content targets (i.e., making the target applicable to new vehicle types brought into the EU market after a certain date) delays the compliance of a certain share of the newly registered vehicles fleet. Indeed, it is estimated that a period of 6 to 7 years is on average needed to renew or launch a new type approval for which the compliance with environmental provision should be proven only after the application date of the measure. This should postpone by several years the demand in term of plastic recyclates, while allowing more flexibility to car manufacturers to align with the provisions.

4.7.6 Material & Methods

This section highlights how the additional option 4 series are impact assessed, focusing on materials flow modelling (and associated supply/demand balance of recycled plastics) that is largely updated. It further compiles estimates regarding environmental and economic impacts, through an adaptation of the modelling of chapter 5 of the JRC study

a) Identification of relevant new targets thresholds considering the Type approval instrument

In line with what has been developed in section §5.1.3, new thresholds are defined for the year 2030. The application date of the target for 2030 implies that all new types approved vehicles in 2030 and beyond will need to comply with a minimum recycled plastics content. Analysis of recent records show that the **type-approval procedure** is usually distributed over **a certain period** (typically 6 years per type on average), that will delay the full compliance of the newly registered fleet. It has been decided to keep a **unique mandatory threshold** for the first application year, i.e., from 2030 onward. To do so, the options, numerated **"Opt.4" keeps similar levels (a,b,c) of recycled plastics compared to the options 3** previously defined for 'All new vehicles sold' fleet (see Table A5.1). This approach allows greater flexibility for manufacturers to perform their product planning, while maintaining a comparable level of overall ambition in the long run (e.g., in 2035). The date of introduction of the first target (2030) allows sufficient lead time for vehicle type developments.

In absolute value, Option 4.b (TA2030 - 25%) represents an intermediate case compared to previous 3.b and 3.c options in term of demand for recycled plastics while option 4.c (TA2030 - 30%) corresponds to the previous option 3.c in 2035.

b) Definition of archetypes and fleet renewal dynamics

The features of the TA procedure and the time needed to generalise provisions should be captured in the growth of recycled plastics content within the fleet of newly registered vehicles. An annual growth rate is applied to the reference value for the year 2022, i.e., 2.5% recycled plastic content in vehicles. **The average lifetime of a TA for M1 and N1 type is assumed to be 6 calendar years**, meaning that, if the target is introduced in 2030, a vast majority of newly registered vehicles will comply with "option 4" target only by 2035.

To capture the diversity of situations among the OEMs, already described in section 4.2 of the JRC study, seven archetypes have been defined according to the time that each car manufacturer will take to fulfill the targets (each one with a given annual growth rate). For each year, the average recycled plastics content for new vehicles registered is computed.

Among the archetypes, a **normal distribution** is applied to characterise the dynamics of the fleet regarding the compliance with the target. This **baseline scenario** represents the case where most of the manufacturers act following the *archetypes 3* and *4* (each one representing 34% of the fleet of newly registered vehicles). Front-runners (*archetypes 1* and *2*) represent 16% of the fleet while the remaining 16% covers less advanced manufacturers (*archetypes 5* and *6*). The considered distribution among archetypes is depicted in Figure A5.1 for baseline, early adoption and late adoption scenarios in the JRC study.

Based on these scenarios modelling, **weighted averages** for baseline, early and late adoption (with weight being the share of each archetype) are then calculated to obtain S-curves representing the **average recycled plastics content of newly registered vehicles** for each TA policy option (4.a, 4.b., 4.c.). The results are presented in section §A5.3.a) of the JRC study.

c) Application to an extended fleet model including passenger cars (M1) and light commercial vehicles (N1)

In the main body of the JRC study, the fleet model used to forecast annual newly registered vehicles focuses exclusively on the M1 category, i.e., passenger cars. Since the TA and the

ELV directives also cover the light commercial vehicles, **the N1 category is included** in the scope of the assessment of this annex. This represents a notable change in terms of vehicles covered with an increase by ca. 5% of the number of vehicles included in the scope. With an average weight of 1800 kg out of which the share of plastics is 13%, an average amount of plastics of 234 kg per each N1 vehicle is assumed. The total mass of plastics per vehicles for other categories remains the same: 208 kg for ICEV and hybrid, 204 kg for BEV.

In addition, the share of the zero emission vehicles within the fleet is updated to reach 100% of the vehicles sold in 2035. This is in line with the new 'zero emission vehicles' policy objective agreed under the EU 'Fit for 55' legislative framework.[101]

To estimate the quantity of recycled plastics demand in the EU, the number of vehicles manufactured in the EU (not the number of newly vehicles sold) should be considered. We estimated that 30% of the sales come from vehicles manufactured outside the EU (and thus does not enter in the EU plastics demand calculations) while 46% of the vehicles manufactured in the EU are exported.[102] Based on these figures and the expected number of sales in the coming years, a system of equations is set up to forecast the total number of EU vehicles manufactured each year until 2035. It is found that the amount of manufactured vehicles equals 1.3 times the number of vehicles sold in the EU annually, i.e., 19.3 million in 2030 and 19.5 million in 2035 (vs. 14.9 and 15.0 millions of EU sales respectively).

Finally, the forecast for **the ELV collection number is updated** to be aligned with the baseline of the impact assessment of the ELVD revision. This baseline proposes a total ELV collection of 9.6 million in 2035. A linear regression is applied to link this number with the current amount of collected ELV, estimated to be 7.08 million. The estimated production of recycled plastics coming from ELV sources is then computed by multiplying the amount of ELV with the plastic recycling rate after dismantling, similarly to the calculations presented in section 5.2.1 and Figure 19. **Three recycling rates** are applied to estimate the quantity of ELV recycled plastics produced, i.e., 18%; 26%; and 35% corresponding respectively to: *(i)* the average scenario (AES), *(ii)* the front-runner's scenario (FRS), both already used in section §3.3.1 of the JRC study and *(iii)* the case where a 35% mandatory recycling rate is applied after dismantling.

4.8 Methodological approach for recycled content steel

The analysis of impacts of setting a steel recycled content builds on the Oeko-Institut impact assessment support study[103] related to problem definition and drivers, technical constraints in the recycling of steel and the types, numbers and compositions of vehicles in the EU fleet.

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[101] EC press release (28/10/2022) - Zero emission vehicles: first 'Fit for 55' deal will end the sale of new CO2 emitting cars in Europe by 2035 (https://ec.europa.eu/commission/presscorner/detail/en/ip_22_6462)
[102] ACEA pocket guide 2020/21, average trade datasets on the 2015-2019 period: https://www.acea.auto/files/ACEA_Pocket_Guide_2020-2021.pdf
[103] Baron, Y.; Kosińska-Terrade, I.; Loew, C.; Köhler, A.; Moch, K.; Sutter, J.; Graulich, K.; Adjei, F.; Mehlhart, G.: Study to support the impact assessment for the review of Directive 2000/53/EC on End-of-Life Vehicles by Oeko-Institut, June 2023

This work is complemented with analysis of the economic and environmental impacts when more post-consumer scrap would be included into new vehicle production.

For this, the following main modelling assumptions and data sources of Table 4.15 apply.

Table 4.14 Modelling assumptions and sources

Parameter	Value	Source
Steel weight% in new vehicles	**56%**	- Baron, Y.; Kosińska-Terrade, I.; Loew, C.; Köhler, A.; Moch, K.; Sutter, J.; Graulich, K.; Adjei, F.; Mehlhart, G.: Study to support the impact assessment for the review of Directive 2000/53/EC on End-of-Life Vehicles by Oeko-Institut, June 2023 - Driving down the impurity levels: See Slide 13, ELV dismantled+shredder to 0.10% - Arcelor Mittal - IARC 5.07.2022 Scrap for Decarbonized Steels presentations - JRC Raw Materials Information System: https://rmis.jrc.ec.europa.eu/apps/veh/#/v/components
Share of long products in ELV steel	**21%**	- Driving down the impurity levels: See Slide 13, ELV dismantled+shredder to 0.10% - Arcelor Mittal - IARC 5.07.2022 Scrap for Decarbonized Steels presentations - RMIS - Raw Materials in Vehicles (europa.eu)
Average weight new vehicle	**1.4**	- Driving down the impurity levels: See Slide 13, ELV dismantled+shredder to 0.10% - Arcelor Mittal - IARC 5.07.2022 Scrap for Decarbonized Steels presentations
1 ton of crude long steel requires	**1.10**	per ton of ELV scrap
1 ton of crude flat steel requires	**1.07**	per ton of ELV scrap

The GHG savings are estimated per ton of **high-quality scrap utilised better by taking the difference** between the impacts per ton of the EAF scrap compared to the average global production mix which is increasingly expected to decarbonise over time.

Table 4.15 Environmental impact assumptions and sources

Environmental impacts (ton of CO_2 per ton of crude steel)	**2025**	**2030**	**2035**	**2040**
Average global production mix	**2.04**	**1.78**	**1.59**	**1.49**
EAF scrap	**0.43**	**0.43**	**0.43**	**0.43**
Source:	- Making net-zero steel possible, an industry backed, 1.5C aligned transition strategy - The mission possible partnership, page 54 and 55			
Production share%				
EAF scrap	29%	30%	31%	32%
EAF -DRI H2 50%	0%	6%	7%	9%
EAF-DRI natural gas	10%	4%	2%	0%
BOF - DRI melt	0%	5%	9%	13%
BF - DRI H2	0%	9%	16%	22%
BF – Best Available Technology	19%	23%	27%	20%
BF Average 2020	43%	23%	9%	5%

Source:	- Making net-zero steel possible, an industry backed, 1.5C aligned transition strategy - The mission possible partnership

For the economic assessment, the costs for improving scrap utilisation are estimated to be below other conversion investments. The highest share of costs are related to the improvement of scrap quality that are already covered under the policy options 3 and not taken into account here to avoid double counting. Additional sampling costs however, are connected to verification and included as specified below. The 'revenues' side would specifically relate to reduced future ETS compliance costs. For 2035 when free allowances under ETS have phased out, the conservative estimate for the external costs per ton of CO_2eq is taken for this 'revenue potential'.

Table 4.16 Economic impact assumptions and sources

Economic impacts				
Avoided ETS costs	**2025**	**2030**	**2035**	**2040**
Default scenario: Low	84	108	**132**	156
Medium	142	185	227	269
High	266	344	421	498
Source:	European Commission, Directorate-General for Mobility and Transport, Essen, H., Fiorello, D., El Beyrouty, K., et al., Handbook on the external costs of transport: version 2019 – 1.1, Publications Office, 2020, https://data.europa.eu/doi/10.2832/51388			
Sampling costs shredders	8 EUR/ ton			
Source:	- R. Su, A. Assous, Starting from scrap, the key role of circular steel in meeting climate goals, Sandbag study - Improve the EAF scrap route for a sustainable value chain in the EU Circular Economy scenario, ESTEP, 2021			

Table 4.17 Shifts in the energy mix per production route

Energy mix global production	**Electricity**	**Nat. gas**	**H_2**	**Coal**	**Iron ore**
per ton of crude steel	**MWh**	**m3**	**ton**	**ton**	**ton**
EAF - scrap	0.600	15	-	0.020	0.08
EAF - DRI H_2 50%	0.680	120-151		0.020	1.66
EAF- DRI natural gas	0.680	240-300	0.024	0.020	1.66
BOF - DRI melt	-	158		0.235	1.22
BF - DRI H_2	-		0.024	0.235	1.22
BF – BAT 2020	-			0.470	1.22
BF - Average	-			0.635	1.22
Sources	- R. Su, A. Assous, Starting from scrap, the key role of circular steel in meeting climate goals, Sandbag study, page 52 - Z. Fan, S.J. Friedmann, Low-carbon production of iron and steel: Technology options, economic assessment and policy, Joule 5, 829-862, April 21, 2021, Elsevier Inc. - Making net-zero steel possible, an industry backed, 1.5C aligned transition strategy - The mission possible partnership, page 54 and 55				

Conversions to MWh	m3 natural gas to MWh	0.011	MWh
	ton to MWh	33	MWh
	ton coal to MWh	2.46	MWh

With above values, per ton of high-quality scrap utilised better, the following shift in the (fossil fuel) energy replacements compared to the global production mix are computed. Obviously, the EAF scrap route means more electricity demand and reduced demand in the other energy types dependent on the production mix changing over time.

Table 4.17 Shifts in the energy mix per ton of scrap utilised better

Energy type	**2030**				**2035**				**2040**			
Electricity	+0.51	MWh	+0.51	MWh	+0.51	MWh	+0.51	MWh	+0.51	MWh	+0.51	MWh
Natural gas	-23.61	m3	-0.25	MWh	-29.68	m3	-0.31	MWh	-34.27	m3	-0.36	MWh
Hydrogen	-0.004	ton	-0.14	MWh	-0.006	ton	-0.20	MWh	-0.007	ton	-0.25	MWh
Coal	-0.40	ton	-0.98	MWh	-0.33	ton	-0.81	MWh	-0.29	ton	-0.71	MWh
Iron ore	-1.20	ton			-1.19	ton			-1.19	ton		
Making net-zero steel possible, an industry backed, 1.5C aligned transition strategy - The mission possible partnership, page 54 and 55												

4.9 Methodological approach for the CRM assessment – JRC

The methodological approach for the CRM assessment is included in Annex 15.1

4.10 EPR and compliance cost scenarios

The proposed measures would generate important transfer of revenues and costs between the different actors in the supply chain. They have been estimated to the extent that this is possible with a detailed assessment on which economic actor would be expected to bear the costs and, or valorise the revenues, but this depends on a range of variables.

This is the case especially for the calculation of the economic impact linked to the adoption of measures on “extended producer responsibility” under the preferred option (**PO5B**). The implementation of measures under **PO4C** aimed at improving high quality recycling and a higher recovery of waste, is likely to increase the operating and investment costs of dismantlers and shredding operators. When these costs offset the revenues for these operators, EPR schemes would require that vehicle manufacturers compensate them via appropriate financial support.

Projections have been made in this impact assessment on the additional costs for manufacturers generated by the “EPR-related” measures. The costs would depend on the profitability of dismantlers and shredders, which will be determined to a large extent by:

1. The evolution of prices of components and spare parts removed by Authorised Treatment Facilities (ATFs) for re-use or recycling, the evolution of prices of recyclates (notably compared to virgin products),
2. The value of the remaining hulk of ELVs sent by ATFs to shredders, as well as by the investments needed and economies of scale realised by ATFs, shredders and recyclers. Due to reduction in revenues from dismantled materials at ATFs, the value of remaining hulks is accounted for the economic impact tables presented in Annex 8.2.

The two other main costs for vehicle manufacturers would be linked to the measures on recycled content for plastics and steel (**PO2B**), and to a lesser extent for the measures the circular design of vehicles (**PO1C**).

3. For plastics recycled content, the main elements affecting these future 'rebalances' are the value of plastic recyclates where it assumed that due to increased availability, two-thirds of the revenues are for the recyclers and one-third for the manufacturer due to improved economies of scale and related price reductions.
4. A similar situation applies to the costs and revenues for improving ELV steel scrap quality. The sampling costs are attributed to the shredders, whereas the revenues are expected to be shared between the steel industry and the shredders.

Finally, a significant effect related to the reduction of revenues from used vehicles at exporters and increased number of vehicles collected and dismantled at ATFs.

5. Some of the revenue potential will be recovered by increased sales of spare parts and the material value that ATF will pay out to the car dealers involved.

Based on these 5 elements, a sensitivity analysis is conducted to understand better which cost and revenues levels per actor are possible, as specified in below Table

The projections have taken into account situations ranging from one where all the costs linked to the new measures on waste treatment would be passed on from the dismantlers/shredders to the vehicle manufacturers (in which case the contribution by vehicle producers to EPR schemes would be in the order of 41€/vehicle) to the other scenario where these new costs for dismantlers and shredders would all be offset under normal market conditions (in which case the contribution by vehicle manufacturers would be around 5€/vehicle, linked to measures designed to increase the collection of ELVs essentially).

Table 4.18 Sensitivity analysis EPR compliance cost range

Expected cost/ revenue redistribution (2035, compared to baseline)			
Revenues plastic recyclates	**Min**	**Default**	**Max**
To recyclers	40%	67%	100%
To manufacturers (price rebalance)	**100% - value above**		
Costs steel recycled content	**Min**	**Default**	**Max**
Steel industry (cost HQ scrap)	25%	50%	75%
Manufacturers (premium RC steel)	**100% - value above**		
Revenues steel recycled content	**Min**	**Default**	**Max**
Shredders (revenues HQ scrap)	25%	50%	75%
Steel industry (reduced process cost)	**100% - value above**		
Reduced revenue dismantled hulks	**Min**	**Default**	**Max**
Reduced revenue ATFs	80%	90%	100%
Reduced costs shredders	**100% - value above**		
Revenues improved vehicle collection	**Min**	**Default**	**Max**
To ATFs	0%	75%	100%
Remains with car dealers	**100% - value above**		

It should be noted that the impact will differ between Member States, notably between those which have already advanced EPR schemes (like the Netherlands, where producers paid a fee of 22.5€/vehicle in 2023 and 30€ in 2022 to the competent PRO) and those for which have not set up any particular EPR mechanism. The contributions of vehicle manufacturers will be expected to be higher in Member States which have not set up any EPR scheme so far. The differences in costs between the Member States could not be quantified. A detailed sensitivity analysis per member state is however not feasible due to lack of detailed information.

ANNEX 5: FIT FOR FUTURE PLATFORM OPINION

Topic title	Revision of the end-of-life vehicles directive and the directive on the type-approval of motor vehicles
	AWP 2022[104].
	Directive 2000/53/EU on end-of-life vehicles[105] and Directive 2005/64/EC on 3R type-approval[106]. *Legal reference*
Date of adoption	05 December 2022
Opinion reference	2022/SBGR2/05
Policy cycle reference	þ Contribution to ongoing legislative process
	CWP 2022, Annex II[107], revision of the end-of-life vehicles Directive and the Directive on the type approval of motor vehicles with regard to their reusability, recyclability and recoverability *Commission work programme reference*
	The revision will promote a more circular approach by linking design issues to end-of-life treatment, considering rules on mandatory recycled content for certain materials of components and improving recycling efficiency. The merging of the two Directives into a single instrument, covering the whole life-cycle of the automotive sector, would provide legal clarity to economic operators and administrations, compared to the current situation which relies on a fragmented approach: cars are covered by Directive 2005/64/EC when they are put on the market, while end-of-life cars are covered by Directive 2000/53/EC. A move to online tools and the use of digital solutions would help to reduce avoidable administrative burden, notably related to the reporting obligations or other procedures, e.g. vehicle (de-) registration and notification systems. In this regard, the revision of the Directive will aim to improve the operational feasibility and implementation of the Directive, and optimize administrative burden through better

[104] AWP 2022, https://cor.europa.eu/en/our-work/Pages/Fit-for-Future-opinion-on-End-of-life-vehicles-and-3R-type-approval.aspx

[105] Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of life vehicles - Commission Statements (OJ L 269, 21.10.2000, p. 34–43).

[106] Directive 2005/64/EC of the European Parliament and of the Council of 26 October 2005 on the type-approval of motor vehicles with regard to their reusability, recyclability and recoverability and amending Council Directive 70/156/EEC (OJ L 310, 25.11.2005, p. 10–27).
https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32005L0064&qid=1643133503005

[107] European Commission, Annexes to the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Commission work programme 2022. Making Europe stronger together (COM(2021) 645 final).

		use of digital solutions and coherence with other sectoral policies and legislation based on a life-cycle approach. Planned adoption: Q2, 2023
	☐	Contribution to the (ongoing) evaluation process
		- *Title of the (ongoing) evaluation*
		No
	☐	Included in Annex VI of the Task force for subsidiarity and proportionality
		No
	☐	Other
		No
Have your say: Simplify!	*No relevant suggestions on this topic have been received from the public.*	

5.1. Suggestions summary

Suggestion 1:	Consider a digital vehicle passport including details on used materials
Suggestion 2:	Refine the definitions for end-of-life vehicles and used vehicles/ parts of vehicles
Suggestion 3:	Consider full digitalisation of the registration system and (2) installation of a central registration system and/or interoperable systems or ensuring the compatibility and coordination of the registration systems across and within Member States
Suggestion 4:	Enforce the certificate of destruction (COD) necessary for deregistration and implement a systemic differentiation between temporary and permanent deregistration
Suggestion 5:	Improve implementability of the ELV-Directive's requirements through a reward system for deregistration and/or dismantling
Suggestion 6:	Ensure coherence with other legislation, e.g., the Batteries Directive 2006/66/EC and the REACH Regulation
Suggestion 7:	Improve compliance and enforcement possibilities through more realistic targets, common methodologies, and increased producer responsibility

5.2. Short description of the legislation analysed

The Directive 2000/53/EU on end-of-life vehicles[108] (ELV) aims to prevent waste from vehicles and at the reuse, recycle end-of life vehicles and their components to reduce the disposal of waste and the improvement in the environmental performance of all of the economic operators involved in the life cycle of vehicles. While harmonising environmental requirements, the Directive also seeks to ensure the smooth operation of the internal market and to avoid distortions of competition in the EU through an EU-wide framework in order to ensure coherence between national approaches. Since its adoption in 2000, the Directive has not undergone any substantial revision.

Directive 2005/64/EC on the type-approval of motor vehicles is the main piece of EU legislation linking the design of new vehicles and their reusability, recyclability and recoverability[109]. It lays down administrative and technical rules to ensure that a vehicle's parts and materials may ultimately be reused, recycled and recovered as much as possible. It makes sure that the reused components do not cause any safety or environmental risks. This legislation applies to new models and models already being produced of cars and light commercial vans to be placed on the EU market. It requires that manufacturers recommend strategies in place to properly manage the reusability, recyclability and recoverability requirements of the legislation.

Further sources of evidence:

- Have your say[110]
- Legislative framework website[111].
- Public consultation[112].
- Evaluation SWD of the on end-of-life vehicles directive[113].
- RegHub consultation on the implementation of the end-of-life vehicles Directive[114].

5.3. Problem description

Existing evidence suggests the following issues:

The production of vehicles has undergone significant changes since the adoption of the Directive 20 years ago. These transformations have been influenced by the increasing use of

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[108] Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of life vehicles (OJ L 269, 21.10.2000, p. 34–43).
https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32000L0053&qid=1643133192245

[109] Directive 2005/64/EC of the European Parliament and of the Council of 26 October 2005 on the type-approval of motor vehicles with regard to their reusability, recyclability and recoverability and amending Council Directive 70/156/EEC (OJ L 310, 25.11.2005, p. 10–27).
https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32005L0064

[110] European Commission, Have your say, End-of-life Vehicles, https://environment.ec.europa.eu/topics/waste-and-recycling/end-life-vehicles_en.

[111] European Commission, Have your say, End-of-life Vehicles, https://environment.ec.europa.eu/topics/waste-and-recycling/end-life-vehicles_en.

[112] European Commission, End-of-life Vehicles – revision of EU rules, https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12633-Revision-of-EU-legislation-on-end-of-life-vehicles/public-consultation_en.

[113] European Commission, Commission Staff Working Document, Evaluation of Directive (EC) 2000/53 of 18 September 2000 on end-of-life vehicles (SWD(2021) 60 final),
https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=SWD:2021:0060:FIN:EN:PDF.

[114] European Committee of the Regions, *Fit for Future opinion on End-of-life vehicles and 3R-type approval* https://cor.europa.eu/en/our-work/Pages/Fit-for-Future-opinion-on-End-of-life-vehicles-and-3R-type-approval.aspx.

new technologies and components in cars, such as plastics, carbon fibre or electronics, causing specific challenges for their recovery and recycling from ELVs.

Based on stakeholders' consultation[115], the evaluation reports that with regard to regulatory burdens or complexities, the most common response[116] on this point concerned **the overlaps between the ELV Directive and Batteries Directive**, as collection and recycling of batteries is already regulated by the latter. **Burdensome reporting** was another issue highlighted by some Authorised Treatment Facilities (ATF) due to the existing duplicated reporting obligations at the national level.

Respondents also specifically asked **to simplify the reporting obligations deriving from the ELV Directive by using online tools**.
Secondly, changes were also proposed in **the vehicle (de-) registration and notification systems,** with the suggestion that vehicle registrations could be cancelled directly by authorised dismantlers, which would reduce the workload for authorities and represent an effective measure to reduce the number of untracked exports and unregulated ELVs.

Findings of the survey on the administrative specific costs contribute also to the overall assessment of the administrative burden[117]. Although the responses received vary between Member States and should be treated with caution, the data collected show the tendency that companies, e.g., recyclers and ATFs, on average spend more resources on technical compliance than other stakeholder types. It also appears that public authorities seem to have higher costs across most categories, but particularly for data collection, and technical compliance.

The digitalisation of procedures linked to the implementation of the ELV Directive can potentially contribute to reducing administrative burden. However, regarding the other aspects, there is no clear evidence that the ELV Directive leads to unnecessary administrative burden or complex procedures for stakeholders, including private sector and public authorities.

Regarding coherence, **there are also fairly numerous of discrepancies between the ELV Directive and other pieces of legislation**. For example, the definitions of the terms "reuse" and "recycling" are different in the ELV Directive and in the Waste Framework Directive (WFD). The Waste Shipment Regulation establishes the rules governing the transboundary movement of waste vehicles, which are classified as "hazardous waste" for shipments inside and outside the EU. There is however a difficulty in distinguishing between a "used vehicle" and an "ELV" for export purposes. This is not specifically defined by the legal instruments, but guidance documents, such as the Waste Correspondents' Guidelines No 9[118] on waste

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[115] European Commission, End-of-life vehicles – evaluating the EU rules, https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/1912-End-of-life-vehicles-evaluating-the-EU-rules_en.
[116] It should be noted however that the majority of stakeholders who were consulted in the course of the evaluation did not know (52%), with a relatively even split between yes (35%) and no (33%).
[117] Stakeholders were asked to provide information on their hours and costs necessary to administer ELV Directive issues, including data collection, reporting, monitoring and technical compliance issues.
[118] European Commission, Environment, Waste Shipments, https://environment.ec.europa.eu/topics/waste-and-recycling/waste-shipments_en.

vehicles, have been developed. **These guidelines have however proven difficult to use in practice**. Another guidance document on the end-of-life vehicles provides the general rule on clarifying the links of the ELV Directive with the Directive on Waste Electrical and Electronic Equipment (WEEE) and the RoHS Directive on restriction of the use of certain hazardous substances in electrical and electronic equipment: "if the ELV Directives applies, the WEEE and RoHS Directives are not applicable". Clearer distinction on defining which components are under the scope of the ELV Directive and which are under the scope of the RoHS/WEEE Directives would facilitate an ELV operator in attributing devices or parts of them to the correct waste stream.

In some instances, **the wording used in the Directive 2005/64/EC on the type-approval of motor vehicles with regard to their reusability, recyclability and recoverability lacks precision and leaves room for interpretation**.

(**Source**: ELV Evaluation[119])

While embracing the objectives of the ELV Directive, the respondents **to the RegHub consultation consider an update necessary**, due to, e.g., changes in vehicle production (e.g., the use of new technologies and components), the **increased production and use of electric vehicles**, **remaining unsolved problems like the handling of the certificate of destruction (COD)** or a **de facto absence of an extended producer responsibility for car manufacturers** in many Member States. In line with the evaluation's findings, **missing vehicles and illegal dismantling in unauthorised treatment facilities are a persistent problem and still constitute a major issue for the development and competitiveness of the authorised waste treatment sector** and require new solutions to enable high-quality recycling.

Many respondents agree that **the current ELV does not reflect sufficiently the importance of manufacturing components and materials in a way that they are easier to dismantle, reuse, recycle, and recover, and further to limit the use of non-recoverable components and hazardous substances**. Only if design requirements ensure that the respective components can be removed, recycled, and/or reinstalled (in particular regarding **electronics currently being blocked**), can ATFs effectively work and increase their revenue and viability. The creation of recovery/disposal value chains is another prerequisite.

The large majority of respondents to the RegHub consultation expect a revision of Directive 2005/64/EC (3R type approval) and Directive 2000/53/EC on end-of-life vehicles to **clarify definitions of reusability, recyclability, and recoverability** and align them with the ELV Directive and eventually increase legal certainty, transparency and avoid misinterpretation of provisions.

The **absence of reliable and comparable data** is seen as a major hurdle to appropriately determine both targets i.e., for recycling and recovery, and measures to counteract the

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[119] European Commission, Environment, End-of-life vehicles: evaluation of the ELV Directive published, https://environment.ec.europa.eu/news/end-life-vehicles-evaluation-elv-directive-published-2021-03-16_en.

phenomenon of missing vehicles and illegal export and dismantling. A common EU methodology for the calculation of the reuse and recycling targets is therefore largely supported, because it can avoid misinterpretation and create more reliable and realistic benchmarks and processes. According to the respondents, the **current regulation by Decision 2005/293/EC is not precise enough, manipulatable, and would need to be transposed into a reviewed ELV Directive**.

Most respondents would further support the Commission's proposal for direct cancellations of vehicle registrations by ATFs, given a solution is found for temporary deregistered vehicles' verifiable whereabouts, for which the last holder/owner should remain responsible. Moreover, **only if final de-registrations are linked to an obligation to hand over to an ATF, direct cancellation makes sense** (finally deregistered vehicle = waste). Another caveat is made with regard to vehicles deregistered for export: here, ATFs are not involved and some respondents argue, that therefore the final deregistration should remain with the vehicle registration authority.

Most respondents support a harmonised and **fully digitalised deregistration process to simplify the flow of information** and eventually lead to a creation of a European database that makes vehicle tracking possible and thereby tackling the issue of missing vehicles. They further advocate a harmonisation and digitalisation of CODs in order to increase their enforcement and make illegal dismantling more difficult across the EU.

Regarding the coordination with other legislation, the respondents underline the need to harmonise limit values and definitions in order to prevent contradictions, delineate responsibilities for market authorities, facilitate controls and enforcement, and simplify waste assessment.

Beyond the aforementioned levers to lift administrative burden and facilitate the implementation of the ELV, the RegHub respondents have made suggestions on how **an updated ELV Directive could be better aligned with core environmental principles such as the polluter-pays principle and the principle of waste hierarchy**. These measures are believed to address market and regulatory failures, increase the overall implementability of the Directive, better support the objectives of a circular economy, increase the viability of ATFs, adapt to new (technological challenges), and decrease burden in the long run:

- Adapt recycling and recovery targets to actual recoverability, and introduce material-specific targets – both taking into account new vehicle types and technologies;
- Introduce a European harmonised Extended Producer Responsibility (EPR);
- Privilege the use of materials in the vehicle design that increase the recyclability and durability of vehicles.

(**Source**: RegHub consultation[120]**)**

[120] European Committee of the Regions, *Fit for Future opinion on End-of-life vehicles and 3R-type approval*, https://cor.europa.eu/en/our-work/Pages/Fit-for-Future-opinion-on-End-of-life-vehicles-and-3R-type-approval.aspx.

The Fit for Future Platform has acknowledged the issues raised by the legislation concerned as follows:
Despite an overall positive assessment of the ELV Directive's objectives and implementation after more than 20 years, it is considered not to be future proof and therefore requiring an update in line with technological change, economic and environmental requirements, as well as in alignment with sectoral legislation.

The current Directive, guideline and practices do not sufficiently provide for clarity, transparency and comparability regarding definitions, targets, and methodologies. Moreover, the harmonisation and digitalisation of tools and processes, such as vehicle (de-)registration, and exchange of information between waste management operators and licensing authorities, including on certificates of destruction, is not complete, which makes the management of end-of-life vehicles burdensome. Insufficient information by vehicle manufacturers about materials and components used in vehicles contributes to the economic unviability of authorised treatment facilities. Current obligations to include recyclability and durability criteria in vehicle design and production are also not conducive to achieving ELV objectives and improve recyclability, recoverability and reusability of end-of-life vehicles.

The focus of the review should therefore be on the clarification, harmonisation and extension of existing definitions, targets and methodologies across Member States and in alignment with sectoral legislation. It should provide more clarity and transparency about vehicle composition and recyclability, in particular for waste management operators and authorities.
Likewise, such clarity and transparency are needed for the deregistration of end-of-life vehicles, in order to be able to tackle the problem of missing vehicles and illegal dismantling. The inclusion of reviewed and new recycling and recovery targets, as well as an incentive system to improve waste reduction and recovery along the life cycle of a vehicle, from design to production to recovery, should be aimed at to effectively address new challenges.

The merge of Directive 2005/64/EC (3R type approval) and Directive 2000/53/EC on end-of-life vehicles was announced in the Commission Work Programme 2022 with a public consultation having taken place in summer/autumn 2021. While this opinion makes suggestions for the regulatory content, it does make any suggestions regarding a possible merge of the Directives.

5.4. Suggestions

Suggestion 1: Consider a digital vehicle passport including details on used materials

Description: In recent years, new vehicles have become increasingly difficult to dismantle and recycle as new substances are being used and the different parts of those vehicles as well as the way they are built into the vehicle have become more complex. Yet, dismantlers are still being provided only insufficient and legally uncoordinated information by vehicle manufacturers (for instance in most Member States via the IDIS-System [International

Dismantling Information System])[121] regarding the presence, localisation, composition and re-use potential of components in ELV and regarding the presence of (hazardous) materials hampering high quality recycling.[122][123]

Therefore, it is recommended to consider a mandatory digital "vehicle passport" that automobile manufacturers have to provide to dismantling facilities for every new vehicle model that enters the market and in line with the applicable requirements of related regulation, such as the expected EU battery regulation.[124] Similar procedures as for the repair and maintenance information in Annex X of the Regulation (EU) 2018/858 could be considered. This "vehicle passport" should include detailed information on the presence and localisation of vehicle parts and materials used as well as notices regarding their recyclability and references to parts for re-use.[125] Such "product passports" already exist for other products (cf. EU Ship Recycling Regulation or Proposal for Eco-design for Sustainable Products Regulation), especially technological devices, and have become common practice in these product areas.[126]

In order to keep possible additional administrative burdens (e.g., through ICT-development) at acceptable levels, it is important to analyse the expected impacts of the vehicle passport on manufacturers, registration authorities, and other stakeholders in advance, and to develop any suggested system based on the experiences made with the existing systems, such as IDIS for dismantling, IMDS/GADSL/SCIP for material declarations/ SVHC declarations or individual platforms for tracking spare part availabilities (Catena-X, B-parts from individual groups of manufacturers). The simplification and reduction potential could be achieved through a targeted extraction of key information from existing platforms to respective end-users (consumers, garages, dismantlers, shredders, etc.) with different data needs.

Expected benefits: The electronic provision of such information would firstly facilitate the dismantling, re-use and recycling of vehicles and thus lower the costs of these measures. This would first and foremost decrease the burdens for dismantling facilities linked to the identification of the different materials used in the specific car type, their location inside the vehicle and the connections between the different vehicle components. Hence, the vehicle passport will lead to an easier and accelerated dismantling and recycling procedure. While the passport will increase the burdens for vehicle producers and the administration in terms of enforcing this passport, it will potentially also reduce some of the burdens for the administration in terms of the enforcement and control regarding the attainment of recycling goals by vehicle producers and dismantling facilities.

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[121] Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the implementation of Directive 2000/53/EC on end-of-life vehicles for the periods 2008-2011 and 2011-2014, 27.02.2017, (COM/2017/098 final), p. 5.
[122] Tesla response to European Commission Inception Impact Assessment: Revision of Directive 2000/53/EC on end-of-life vehicles, Nov. 2020.
[123] RegHub consultation on the implementation of the end-of-life vehicle Directive, 2022.
[124] ELV IA: Improve circularity in the design, production and end-of-life treatment of vehicles (objective 2), 03.2022, p. 89.
[125] European Environment Bureau feedback to the to the EU's road map the review of the End-of-Life Vehicles Directive, 19 November 2020, p. 4.
[126] European Environment Bureau feedback to the EU's road map the review of the End-of-Life Vehicles Directive, 19 November 2020, p. 4.

The information provided would also allow more re-use and recycling and namely more "high-quality" recycling, preserving valuable materials. This would then not only have a beneficial economic impact due to the materials and components retrieved but also environmental benefits.

Suggestion 2: Refine the definitions for end-of-life vehicles and used vehicles/ parts of vehicles

Description: One of the largest issues with regards to the implementation of the ELV-Directive has been the illegal export of vehicles outside of the EU that are within the scope of the ELV-Directive and therefore should be disposed of within EU borders.[127][128] Amongst others, one of the central issues here has been the false labelling of end-of-life vehicles as "used vehicles" in order to bypass the provisions of the ELV Directive.[129]
In order for authorities to have a clear guidance on which vehicles should be allowed for export as "used vehicles" and which vehicles should be prohibited from getting exported as "end-of-life vehicles", the definitions for these categories should be specified, as it has already (at least partially, but not legally binding) been done in the Correspondents' guidelines No. 9 on the disposal of ELV, adopted by the Member States,[130] which however are not deemed sufficient.[131][132]

Special attention should be given to export situations in which the differentiation between vehicle 'labels' is not straightforward (e.g., hobby cars vs. end-of-life vehicles), but requires additional measures to properly supervise ELV vehicles. The implementation in Italy can be considered a favourable example for such differentiation: While the Highway Code[133] allows deregistration for exports only if the vehicle complies with the Periodical Technical Inspection (PTI) and if no order for an extraordinary PTI has been issued by policy authorities, special cases, such as an owner selling a vehicle in another country, can be settled if the owner proves the re-registration in that country by submitting a copy of the corresponding registration certificate.

Likewise, a revised Directive should provide clear definitions for "re-use" and "preparing for re-use", since these are essential regarding the re-use of parts of ELVs and determine whether parts for re-use are put newly on the market and need to fulfil the respective requirements.

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[127] Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the implementation of Directive 2000/53/EC on end-of-life vehicles for the periods 2008-2011 and 2011-2014, 27.02.2017, (COM/2017/098 final), p. 10.
[128] RegHub consultation on the implementation of the end-of-life vehicle Directive, 2022.
[129] Umweltbundesamt: Altfahrzeuge; German Environment Agency: Scientific opinion paper: Effectively tackling the issue of millions of vehicles with unknown whereabouts, 2020, p. 10.
[130] Umweltbundesamt: Altfahrzeuge; Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the implementation of Directive 2000/53/EC on end-of-life vehicles for the periods 2008-2011 and 2011-2014, 27.02.2017, (COM/2017/098 final), p.12, 13.
[131] Assessment of the implementation of Directive 2000/53/EU on end-of-life vehicles (the ELV Directive) with emphasis on the end of life vehicles of unknown whereabouts, December 2017, p. 19, 60.
[132] RegHub consultation on the implementation of the End-Of-Life Vehicle Directive, 2022.
[133] Art. 103 of the Highway Code (Legislative Decree 285/92).

Regarding damaged vehicles, it should be ensured that technically repairable vehicles and parts of vehicles can only be resold to automotive professionals. (Parts of) vehicles that cannot be technically repaired must be sold for destruction to approved centres.

Expected benefits: This would lead to more certainty with regards to which cars have to be kept within EU borders for public authorities and potentially simplify administrative processes.[134]

Countries outside of the EU, in which those vehicles are generally sold and disposed of, will benefit from a stricter EU export policy in two ways, if the latter is accompanied by a stricter supervision of exports of used vehicles and spare parts: First, a reduced intake of (parts of) inappropriately dismantled end-of-life vehicles, will reduce the number of disposed of vehicles and consequently the level of pollution caused by environmental dumping. Second, a reduction of the use of older, often more polluting, vehicles in the destination countries would reduce the level of air pollution in those countries[135]

Furthermore, the materials retrieved from those end-of-life vehicles stopped from export can be reused within the EU which leads to their value staying within the EU as well.[136]

Suggestion 3: Consider full digitalisation of the registration system and (2) installation of a central registration system and/or interoperable systems or ensuring the compatibility and coordination of the registration systems across and within Member States

Description: Currently, the degree of digitalisation of the registration system for vehicles varies between countries and still has not been fully achieved. This issue is also linked to the lack of a central common registration system and/or lack of compatibility and full coordination between the existing registration systems.[137] This leads to challenges occurring for vehicle owners and public authorities, especially when a car needs to be re-registered or deregistered in another region or Member State and the registration information is not available.[138] Such obstacles may lead to vehicle owners forgoing the deregistration procedure altogether and also to mistakes and system malfunctions happening regarding the registration and deregistration.[139]

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[134] Umweltbundesamt: Altfahrzeuge; Stakeholder opinion Czech Republic;
[135] Umweltbundesamt: Altfahrzeuge; German Environment Agency: Scientific opinion paper: Effectively tackling the issue of millions of vehicles with unknown whereabouts, 2020, p. 6.
[136] Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the implementation of Directive 2000/53/EC on end-of-life vehicles for the periods 2008-2011 and 2011-2014, 27.02.2017, (COM/2017/098 final), p.12.
[137] German Environment Agency: Scientific opinion paper: Effectively tackling the issue of millions of vehicles with unknown whereabouts, 2020, p. 7.
[138] Assessment of the implementation of Directive 2000/53/EU on end-of-life vehicles (the ELV Directive) with emphasis on the end of life vehicles of unknown whereabouts, December 2017, p. 58.
[139] German Environment Agency: Scientific opinion paper: Effectively tackling the issue of millions of vehicles with unknown whereabouts, 2020, p. 8.

The lack of digitalisation and coordination thus makes it difficult in some cases to determine a vehicle's status with certainty, which also facilitates the illegal dismantling and disposal of vehicles at unauthorized treatment centres and the export to countries outside of the EU.[140] Therefore, it is recommended, that the Commission analyses the advantages and disadvantages of a common EU digital registration system[141] and thoroughly assesses its impacts. Should the expected administrative burden for setting up a central system exceed its expected benefits, it should at least be ensured that the different Member States' registration systems are made compatible with each other and/or are being coordinated, e.g., by harmonising the terms, data, and impact of de-registration and by requiring a harmonised digital registration of information to enable the EU-wide exchange of information, e.g., by using the EUCARIS-System,[142] and expanding the e-CoC concept.

Expected benefits: While these adaptations will require additional administrative efforts in the beginning, from a long-term perspective they will simplify the administrative work and decrease the administrative burden that is linked to the registration process, as seen in Portugal or Italy, where a central digital registration system is already in place.[143] In Italy, registration procedures both for export and scrapping are fully digitised and allow authorities and qualified private companies to access a fully telematic registry.[144]

With these improvements regarding the registration and deregistration process, these procedures will be more time-efficient and thus will also present an advantage to car owners that want to re- or deregister their vehicle in another Member State.

Moreover, this would allow for better control of the vehicles' status and strengthen the ability of enforcement authorities to carry out more stringent checks on compliance. This would potentially decrease the loss of vehicles as it would improve the vehicles' traceability.[145] This again would help against the loss of raw materials that could otherwise be recycled in the EU (as seen above).

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[140] European Environment Bureau feedback to the EU's roadmap the review of the End-of-Life Vehicles Directive, 19 November 2020, p. 1.

[141] Tesla response to European Commission Inception Impact Assessment: Revision of Directive 2000/53/EC on end-of-life vehicles, Nov. 2020.

[142] German Environment Agency: Scientific opinion paper: Effectively tackling the issue of millions of vehicles with unknown whereabouts, 2020, p. 7; Oeko-Institut e.V., Institute for Applied Ecology: Assessment of the implementation of Directive 2000/53/EU on end-of-life vehicles (the ELV Directive) with emphasis on the end of life vehicles of unknown whereabouts, December 2017, p. 17.

[143] Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the implementation of Directive 2000/53/EC on end-of-life vehicles for the periods 2008-2011 and 2011-2014, 27.02.2017, (COM/2017/098 final), p. 11.

[144] Legislative Decree No. 98/2017 establishes the "Single Registration and Ownership Document"; services are provided through a telematic motorist information point.

[145] Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the implementation of Directive 2000/53/EC on end-of-life vehicles for the periods 2008-2011 and 2011-2014, 27.02.2017, (COM/2017/098 final), p. 10.

Suggestion 4: Enforce the certificate of destruction (COD) necessary for deregistration and implement a systemic differentiation between temporary and permanent deregistration

Description: In most Member States, the deregistration is currently handled by public authorities while the dismantling is carried out by private dismantling facilities. At the same time, not all countries require the vehicle's last owner to provide a COD upon deregistration, which is serving as a proof that the vehicle has been properly dismantled, as it is required by the directive. This is due to the circumstance that some countries (e.g., Germany) do not differentiate between short-term deregistration and final deregistration or deregistration for final disposal or other purposes.[146]

Thus, due to the lack of coordination, a destructed car is not necessarily also deregistered (which some Member States, e.g., Portugal, have tried to avoid by setting up a tax that only is dropped if the car is properly deregistered),[147] and a deregistered vehicle does not necessarily need to be destructed, leading to uncertainty regarding the vehicles' status.[148]

Hence, it is recommended, that the Member States should be required to implement a system that requires every car owner to provide a COD issued by an authorized dismantling facility before permanent deregistration[149][150] and, therefore, if not already practiced, systematically differentiate between temporary and permanent de-registration.[151] Such system could further be harmonised across the EU, because otherwise an illegal dismantling shadow economy in one Member State may undermine the efforts in another Member State.

In order to decrease the workload for authorities regarding the vehicle deregistration, make it more effective and easier to enforce, the use of digitalised CODs and the strengthening of internet-based exchanges between the vehicle registration authority and the recovery facilities are seen as indispensable.[152]

In addition to the differentiated process for deregistration, Member States could be encouraged to introduce systems of incentives that ensure that a vehicle's status is known and that temporarily deregistered vehicles are re-registered with specified time-limits. Depending

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[146] German Environment Agency: Scientific opinion paper: Effectively tackling the issue of millions of vehicles with unknown whereabouts, 2020, p. 9, 10.
[147] Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the implementation of Directive 2000/53/EC on end-of-life vehicles for the periods 2008-2011 and 2011-2014, 27.02.2017, (COM/2017/098 final), p. 10.
[148] Tesla response to European Commission Inception Impact Assessment: Revision of Directive 2000/53/EC on end-of-life vehicles, Nov. 2020; German Environment Agency: Scientific opinion paper: Effectively tackling the issue of millions of vehicles with unknown whereabouts, 2020, p. 6, Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the implementation of Directive 2000/53/EC on end-of-life vehicles for the period 2014-2017, 30.01.2020, (COM/2020/33 final), p. 10.
[149] Tesla response to European Commission Inception Impact Assessment: Revision of Directive 2000/53/EC on end-of-life vehicles, Nov. 2020; German Environment Agency: Scientific opinion paper: Effectively tackling the issue of millions of vehicles with unknown whereabouts, 2020, p. 8.
[150] RegHub consultation on the implementation of the end-of-life vehicle Directive, 2022.
[151] German Environment Agency: Scientific opinion paper: Effectively tackling the issue of millions of vehicles with unknown whereabouts, 2020, p. 9.
[152] RegHub consultation on the implementation of the end-of-life vehicle Directive, 2022.

on the national situation, such system may – besides de-registration time-limits – include measures such as reporting duties for car owners, or rewards for deregistration and dismantling (see suggestion 5).[153][154] Other examples for incentives for vehicle owners to properly return end-of-life vehicle to ATFs, include the linking of the COD for an end-of-life vehicle to the insurance premium (as in place in the Czech Republic) or to specific taxes (e.g., road taxes in Spain).[155]

In the absence of incentives, vehicle owners might bypass the destruction obligation by temporarily deregistering an end-of-life vehicle, not having to fear any follow-up on the re-registration. The introduction of such measures should follow common guidelines to be introduced by the European Commission in order to assure a coherent treatment of temporarily deregistered vehicles. Provisions regarding time limits for temporary deregistration should be designed in a way that the administrative burden for registration authorities is kept to a minimum.

Direct vehicle deregistration by ATFs can be envisaged if it can be ensured that final deregistration is equivalent with the handing-over to a recovery facility (i.e., deregistered vehicle = waste).[156]

Expected benefits: This would ensure that only dismantled cars are permanently deregistered and that authorities have an oversight on the vehicles' status, i.e. whether it has been destructed or just temporarily deregistered.

In the latter case of temporary deregistration, the reporting duties of car owners on the vehicle's status and limitation of the time period, during which a vehicle can be temporarily deregistered, can act as a tool for public authorities to control the implementation of the ELV-Directive's objectives but also to ensure the tracking of vehicles even after deregistration. Likewise, can a system of (dis-)incentives encourage timely reregistration and increase the number of vehicles actually dismantled in line with the ELV Directive.

With the deregistration procedure thus being designed more comprehensively by better streamlining the vehicle (de)registration procedures with the ELV specific provisions, this would potentially discourage car owners from illegally selling their end-of-life vehicles or letting them be dismantled at unauthorized dismantling facilities. Hence, it would also have a positive environmental and economic (due to the materials' values) impact.

Suggestion 5: Improve implementability of the ELV-Directive's requirements through a reward system for deregistration and/or dismantling

Description: With one of the biggest challenges in the implementation of the ELV-Directive being the loss of end-of-life vehicles due to illegal exports or illegal disposal,[157] it has been

[153] German Environment Agency: Scientific opinion paper: Effectively tackling the issue of millions of vehicles with unknown whereabouts, 2020, p. 9.
[154] RegHub consultation on the implementation of the end-of-life vehicle Directive, 2022.
[155] EuRIC (2022) EuRIC Position Paper: EPR schemes for ELV.
[156] RegHub consultation on the implementation of the end-of-life vehicle Directive, 2022.

observed that financial incentives have helped increase the number of cars dismantled and deregistered and therefore have helped with the implementation of the ELV-Directive.[158][159]

There are two major ways in which Member States have created such financial incentives, one being the introduction of rewards for dismantling (e.g. the "Abwrackprämie" (=scrapping premium) in Germany and similar initiatives in France, Italy and Spain in 2008/09[160]) and the other one being a reward system for the deregistration for example in Portugal and Denmark.[161] If scrapping premiums are used, they should be designed in a way that ELV recyclers are not passed over and put at a disadvantage compared to shredder companies, i.e. that the provisions allow the transfer of end-of-life vehicles to parts recyclers.

Negative financial incentives for non-compliance with current regulations, such as fines for last owners/holders who dispose of their vehicle illegally or transfer only incomplete end-of-life vehicles to ATFs, and penalties for illegal dismantlers might be considered as well.[162] Therefore, it is recommended that the Commission encourages Member States to establish such reward systems for deregistration and/or dismantling, taking into account the country-specific situation.[163] A potential reward system for dismantling could include the condition that the reward is used for more sustainable transportation alternatives (including electric cars), while a reward system for deregistration could be such that charges are levied for the duration of the temporary deregistration, which should be lifted if the car is permanently deregistered.

Expected benefits: This will potentially reduce the number of vehicles that are being illegally exported or disposed, thus improve implementability of the ELV-Directive.[164] With the incentive to dispose of vehicles correctly, a reward system will also have environmental benefits due to proper recycling in authorised facilities and economic benefits due to the materials recovered.[165]

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[157] European Environment Bureau feedback to the EU's roadmap the review of the End-of-Life Vehicles Directive, 19 November 2020, p. 1.
[158] RegHub consultation on the implementation of the ELV Directive 2022: All of the respondents agree or rather agree that financial incentives such as insurance premiums or fines help enforce the certificate of destruction.
[159] RegHub consultation on the implementation of the end-of-life vehicle Directive, 2022.
[160] Umweltbundesamt: Altfahrzeuge; Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the implementation of Directive 2000/53/EC on end-of-life vehicles for the periods 2008-2011 and 2011-2014, 27.02.2017, (COM/2017/098 final), p. 7.
[161] Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the implementation of Directive 2000/53/EC on end-of-life vehicles for the periods 2008-2011 and 2011-2014, 27.02.2017, (COM/2017/098 final), p. 10, 11.
[162] RegHub consultation on the implementation of the End-Of-Life Vehicle Directive, 2022.
[163] Cf. propositions by German Environment Agency: Scientific opinion paper: Effectively tackling the issue of millions of vehicles with unknown whereabouts, 2020, p. 7; Oeko-Institut e.V., Institute for Applied Ecology: Assessment of the implementation of Directive 2000/53/EU on end-of-life vehicles (the ELV Directive) with emphasis on the end of life vehicles of unknown whereabouts, December 2017, p. 118.
[164] As seen in Portugal, cf. Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the implementation of Directive 2000/53/EC on end-of-life vehicles for the periods 2008-2011 and 2011-2014, 27.02.2017, (COM/2017/098 final), p. 10.
[165] RegHub consultation on the implementation of the end-of-life vehicle Directive, 2022.

Suggestion 6: Ensure coherence with other legislation, e.g., the Batteries Directive 2006/66/EC and the REACH Regulation

Description: Currently, treatment facilities are subject to various different provisions stemming from different directives with some of their obligations being redundant or not well aligned in certain constellations, e.g., regarding the Batteries Directive and the ELV-Directive in the case of electric vehicles.[166] With the growth of the electric vehicle market, the revision of the ELV-Directive should therefore be closely aligned with the revision of the Batteries Directive.[167]

Likewise, a revision of the ELV Directive should take into account inconsistencies and gaps currently found with regard to the REACH Regulation. In this context, special attention should be given to ensure the re-use of parts from the circular economy. While a merging of the two legislations is considered difficult, for at least limit values regarding the hazardousness of waste should be consistent.[168]

It is therefore recommended, to examine the reporting obligations imposed by related directives and find a clearer differentiation with regards to the applicability of the directives in order to avoid doubled reporting obligations.[169] Moreover, contradictory definitions, limit values and targets should be assessed and streamlined.[170]

Expected benefits: This will significantly increase definitory clarity, decrease the workload with regards to reporting obligations and thus potentially lead to reporting obligations being complied with more frequently. Consistent definitions and limit values will also facilitate controls and enforcement for market surveillance authorities and simplify waste assessment with regard to its hazardousness.

Suggestion 7: Improve compliance and enforcement possibilities through more realistic targets, common methodologies, and increased producer responsibility

Description: The current design of the ELV Directive leaves the treatment of end-of-life vehicles behind its possibilities. While country-specific circumstances need to be taken into account and accurate cost-benefit analyses need to be the basis of any revision that includes new procedures and measures, some adjustments could be considered in order to sharpen the targeting of the Directive and to address situations of market and regulatory failure. Such opportunities can currently be identified with regard to better definitions, better specifications for pre-treatment removal and post-treatment shredding, minimum quality requirements, recycled content targets, and material-specific targets for some materials. If cost-effective

[166] Input from stakeholders; Tesla response to European Commission Inception Impact Assessment: Revision of Directive 2000/53/EC on end-of-life vehicles, Nov. 2020.
[167] European Environment Bureau feedback to the EU's road map the review of the End-of-Life Vehicles Directive, 19 November 2020, p. 4.
[168] RegHub consultation on the implementation of the end-of-life vehicle Directive, 2022.
[169] Input by stakeholders.
[170] RegHub consultation on the implementation of the end-of-life vehicle Directive, 2022.

solutions are found, they can help to reduce the currently disproportionate regulatory burden faced by ATFs, and ultimately to achieve reuse, recycling and recovery targets in line with the polluter pays principle and the principle of waste hierarchy.

Common definitions and methodologies can enable more realistic targets and improve recycling and recovery

In the absence of a common methodology for the calculation of reuse and recycling targets, a desirable cross-EU comparison of results and performance regarding the achievement of ELV targets is impossible.[171] A common methodology could further inform a more realistic and reliable setting of benchmarks and processes. The current regulation of calculation methods in Decision 2005/293/EC is considered not to be precise enough and therefore manipulatable. It is therefore recommended to propose a common methodology in a reviewed Directive 2000/53/EC.[172]

A common definition of Post Shredder Treatment (PST) in the revised Directive could have advantages, because standardised separation and clearly defined treatment processes after shredding, leave less room for different interpretations, and eventually improve recovery and reduce environmental impact, e.g., by better management of 'fluff'.[173] Likewise, a minimum PST quality requirement on how to perform a shredder campaign – taking into account sectoral and country specific conditions – can improve recycling quality. A common definition of PST and common methodologies must not hinder innovation and competitiveness of ATFs with regard to shredding and post-shredding technologies, and should leave sufficient room to account for national conditions.[174] Test shreddings on randomly selected vehicles carried out in accordance with the Directive's provision could not only inform a common methodology as such, it could also help to review and establish standards for both combustion and electric vehicles.[175]

Expected benefits: To introduce a binding common methodology for the calculation of reuse and recycling targets makes target values more transparent, realistic and achievable. It is thus expected to facilitate benchmarking and increase compliance with ELV targets.
A common definition of PST and a common methodology on how to perform a shredder campaign is expected to facilitate and improve recovery and reduce environmental impact, if it can be ensured that national conditions are taken into account and if new dismantling obligations are informed by comprehensive cost-benefit analyses.

Adapted and more realistic recycling targets can improve dismantling and high-quality recycling
The adaptation to technological development, including the increasing production and use of electric vehicles, the potential introduction of new vehicle types into the reviewed ELV Directive, and the continuous introduction of new (hazardous) substances to the vehicle

[171] RegHub consultation on the implementation of the end-of-life vehicle Directive, 2022.
[172] RegHub consultation on the implementation of the end-of-life vehicle Directive, 2022.
[173] RegHub consultation on the implementation of the end-of-life vehicle Directive, 2022.
[174] EuRIC (2022) EuRIC Position Paper: EPR schemes for ELV.
[175] RegHub consultation on the implementation of the end-of-life vehicle Directive, 2022.

production process, as well as the economic necessity to recover critical raw material, make a review of recycling targets necessary.[176]

As mentioned before with regard to common calculation methods for recycling targets, any change or the creation of new (material-specific) targets should be based on reliable data and tests for different vehicle types, investigating the balance of materials and products, as well as the cost of management. To account for differences across Member States, varying fleet age and the actual capacity of dismantlers have to be considered, when determining calculation and finally targets.[177]

It is therefore recommended to review the currently existing combined reuse and recycling targets based on weight and introduce material-specific targets, i.e., for low-volume critical raw material, where manageable and based on real data. To enable compliance, country-specific conditions have to be taken into account and waste management facilities should be supported to ensure their sustainability and competitiveness.
Further, to contribute to higher rates of reuse parts to make the removal of vehicle parts before shredding mandatory under the revised Directive for a list of components that can be updated is largely supported by the RegHub network.

Expected benefits: A higher contribution to circular economy objectives, more realistic targets, and material-specific targets based on real data will increase compliance, improve dismantling and separation, enable the recovery of critical raw material and overall increase high-quality recycling.

Including recyclability and durability criteria in vehicle design can facilitate dismantling and lift implementation burden from ATFs

The principle of waste hierarchy favours waste prevention as most effective mean to reduce negative impact and improve resource efficiency. Vehicle manufacturers are in a good position to prevent waste, when designing their vehicles, taking into account criteria favouring the recyclability and durability of materials and components. Vehicles currently on the market are less and less easy to reuse, recycle and recover, because such criteria are not sufficiently respected. The extensive use of electronic components and the development of proprietary software or hardware also has repercussions on the vehicle design and risks to hamper cross-brand services including dismantlement. This contributes substantially to the economic unviability of ATFs, difficult and insufficient recovery, and to higher levels of pollution.

In line with the polluter-pays principle, it is therefore recommended to consider the creation of incentives for vehicle manufacturers to comply with eco-design criteria, including through the introduction of a European harmonised Extended Producer Responsibility (EPR), specifically tailored to end-of-life vehicle recycling. Such measure could include a financial contribution of vehicle manufacturers to compensate the average loss per vehicle for ATFs,

[176] RegHub consultation on the implementation of the end-of-life vehicle Directive, 2022.
[177] RegHub consultation on the implementation of the end-of-life vehicle Directive, 2022.

with a particular focus on concepts that are not economically viable (e.g., plastics, glass, batteries)[178]. Should EPR schemes be considered for the revision of the ELV Directive, it should be ensured that well-functioning recycling processes are not disrupted. Existing effective relationships between manufacturers and ATFs should not be jeopardised by new requirements[179]. Further discussions could also consider the role of circular VAT rates, favouring the repair and reuse of (parts of) vehicles.

Furthermore, the suggested "vehicle passport" will only have real consequences, if the materials and components used are actually removable, reusable, recyclable and recoverable. Therefore, it is suggested to introduce design requirements and liability schemes that further facilitate dismantling and improve waste management. Modular design, standardisation, higher recovery rates, and use of recycled material and reuse of components should be encouraged, including by the setting of (new) targets, such as recycled content targets.
Additional measures such as mandatory life cycle analyses, where appropriate, for each vehicle and the obligation to ensure that only such materials, for which a reuse or recycle value chain is in place, are being used, can support this.

Expected benefits: All measures are expected to incentivise vehicle manufacturers to produce better recyclable vehicles, i.e., by using less heterogenous components and improving removability, and invest more resources to develop more sustainable products and processes. Both, design requirements and financial contributions by manufacturers, will facilitate the work of ATFs, reduce their costs and increase their revenues from better management.

[178] RegHub consultation on the implementation of the end-of-life vehicle Directive, 2022; EuRIC (2022) EuRIC Position Paper: EPR schemes for ELV.
[179] EuRIC (2022) EuRIC Position Paper: EPR schemes for ELV.

ANNEX 6: PROBLEMS AND DRIVERS

6.1. Introduction

The Impact Assessment addresses four main problem areas, which are partially inter-related:

1. The design and production of new vehicles do not sufficiently contribute to the ambitions of the Green Deal for a climate-neutral, clean and circular economy **("design"** problem area);
2. The treatment of vehicles at the end of their life is suboptimal compared to its potential to contribute to a climate-neutral, clean and circular economy (**"end-of-life treatment"** problem area);
3. An important share of vehicles subject to the ELV Directive are not collected to be treated in sound environmental conditions in the EU, contributing to the EU external pollution footprint in third countries (**"collection"** problem area);
4. There is no EU level playing field for the design, production and end-of-life treatment of vehicles which are outside the scope of the ELV Directive, resulting in a situation where the contribution of these vehicles to the objectives of the Green Deal and circular economy objectives is under-exploited (**"scope"** problem area).

Presentation of the problems, drivers and consequences has been framed taking into account the further structuring of the policy options, as some of these options are directly related to a single main problem, whereas others are indirectly related to multiple problems, especially in the case of extension of vehicle category scope and extended producer responsibility.

Figure 6.1 Overview of problems, drivers and consequences

Problems	Drivers	Consequences
Lack of integration of circularity in design and production	**Market failures:** - Externalities of primary raw materials not priced in at design. - Use of new and difficult to recycle materials - Limited availability of secondary raw materials of sufficient quality to meet modern standards - Lack of financial incentives to increase recycled content **Legislative failures:** - Imprecise formulation of ELV requirements - Imprecise and theoretical 3RTA requirements - Lack of adequate dismantling information - Inconsistent and outdated hazardous substance restrictions	Increased dependency on primary raw materials and limited decarbonisation potential in supply chains
Lack of quality and quantity in reuse and recycling at end-of-life treatment	**Market failure:** - High costs for dismantling and economies of scale - Costly PST treatment of automotive shredder residues - Lack of quality of ELV scraps like steel and aluminium - Lack of incentive to provide targeted dismantling information **Regulatory failure:** - Too 'broad' ELV definition of recycling allowing backfilling - Lack of reuse incentives	Insufficient reuse and recycling and loss of valuable resources Damage to the environment and human health from unsound treatment
'Missing vehicles' cause environmental impacts	**Market failure:** - Higher revenues from informal and illegal treatment activities - Higher revenues export used vehicles than EU recycling **Regulatory failure:** - Lack of traceability ELVs - No systemic exchange of registration information - Insufficient monitoring and enforcement - Guidelines used vs. waste vehicles non-legally binding	35% of total vehicles are "missing" causing loss of resources and pollution in third countries.
No EU level playing field to improve circularity for trucks, buses + motor-cycles	**Market failure:** No economic incentives to improve design **Regulatory failure:** Lack of clarity on responsibilities **Market failure:** Information availability **Regulatory failure:** motorcycles, trucks, buses, lorries 'not in scope'	Restrained circularity potential of vehicles currently out of scope

The aim of the following sections of this Annex is to provide a descriptive overview of the problem areas, key drivers, developments and their interlinkages

6.2. Problem area No.1: Lack of integration of circularity in vehicle design and production

This is a dedicated section to overview all the relevant circularity specific problems emerging in the automotive sector that prevent the design, production of road vehicles be consistent with the levels of recycling and reuse necessary to contribute to the ambitions of the Green Deal to create a climate-neutral, clean and circular economy.

The evaluation of the End-of-Life Vehicle Directive and the 3R type-approval Directive[180] identified areas where the current legislation lies behind in terms of promoting a truly circular approach for the automotive sector due to the missing links between design and end-of-life treatment stages. Therefore, this review is looking into the shortcomings of both the End-of-Life Vehicle Directive and its mirror type approval Directive on vehicle reusability, recyclability and recoverability, which prescribe the requirements for the vehicle placement on the market with the rules for the end-of-life.
The following subsections provide an overview of the core circularity-related problem areas, their key drivers and consequences.

6.2.1 What is the key problem?

The EU is among the world's biggest producers of motor vehicles. The automotive sector provides direct and indirect jobs to 13.8 million Europeans, representing 6.1% of total EU employment. In 2021, 12 million motor vehicles (cars, vans, lorries, buses) were manufactured in the EU and 11.5 million were placed on the EU market[181]. **The production of new vehicles represents a significant impact in terms of use of raw materials. Europe's automotive sector is responsible for 19% of the demand of the EU's steel industry (over 7 million tonnes/year[182]), 10% of the overall consumption of plastics (6 million tonnes/year[183]), as well as a significant share of the demand for aluminium (42% for all transport equipment, around 2 million tonnes/year[184]), copper (6% for automotive parts[185]), rubber (65% of the production of general rubber goods[186]) and glass (1,5 million tonnes of flat glass produced at the EU[187]).**
The electrification of the automotive sector, combined with the increasing integration of electronics in vehicles, will lead to a growing use of copper, critical raw materials including rare earth elements. Rare earth elements (REEs) are mainly used for permanent magnets in EVs (average weight of 1-2 kg of permanent magnets per EVs), platinum group metals (PGMs) for catalytic converters (77% use share in autocatalysts) and printed circuit boards, gallium for lighting equipment and integrated circuits, magnesium (50% use share in automotive sector) and

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[180] published in March 2021 https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/1912-End-of-life-vehicles-evaluating-the-EU-rules_en
[181] https://www.acea.auto/figure/key-figures-eu-auto-industry/
[182] More information available at: https://www.eurofer.eu/publications/economic-market-outlook/economic-and-steel-market-outlook-2022-2023-third-quarter/
[183] Based on JRC study report on recycled content of plastics in the vehicles.
[184] https://rmis.jrc.ec.europa.eu/uploads/CRM_2020_Factsheets_critical_Final.pdf
[185] https://rmis.jrc.ec.europa.eu/uploads/CRM_2020_Factsheets_non-critical_Final.pdf
[186] More information available at: https://www.etrma.org/rubber-goods/
[187] More information available at: https://glassforeurope.com/the-sector/key-data/

niobium (23% use share in automotive steel) for metal alloys, and natural rubber for production of tyres. Electric and electronic systems in vehicles also contain e.g., precious metals, gallium, tantalum, and REE.

The market demand has also resulted in a steady rise in sales of Sport Utility Vehicles (SUVs). SUVs represented around 40% of annual car sales of vehicles in Europe in 2020, compared to 10% in 2010[188]. SUVs are heavier than conventional cars and their production requires the supply of a higher amount of primary materials, which increases considerably their environmental footprint. The relevance of these aspects is also recognised in terms of fuel efficiency. As noted in the EEA report on Monitoring CO_2 emissions from passenger cars and vans in 2018[189], an increase in sales of Sport utility vehicles (SUVs) was observed in recent years. In Europe, one out of three cars newly registered in 2018 were SUVs. Compared to regular cars (as hatchback or sedan), SUVs are typically heavier and have more powerful engines and larger frontal areas – all features that increase fuel consumption. On the broader terms, the EU is on the track to strengthen the CO_2 emission reduction requirements[190]. These should incentivise an increasing share of zero-emission vehicles being deployed on the Union market whilst providing benefits to consumers and citizens in terms of air quality, strengthening energy security and efficiency, and the associated energy savings, as well as ensuring that innovation in the automotive value chain can be maintained. Within the global context, also the EU automotive chain is seen as a leading actor in the on-going transition towards zero-emission mobility.

All these considerations led to the fact that the production of vehicles represents a considerable environmental footprint, primarily due to the GHG emissions linked to the energy required for the extraction and processing of primary materials such as coal and iron ore (for steel), bauxite (for aluminium), copper or oil (for plastics). The extraction and processing of metals represent about 10% of global greenhouse gas emissions globally[191]. In the EU, the steel industry represents 5% of CO_2 emissions while the aluminium industry accounts for 2% of global CO_2 emissions. The EU consumption linked to the raw material supply chains also has a social impact in third countries and is deemed to account for 14% of imported GHG emissions[192].

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[188] More information is available at:https://www.iea.org/commentaries/growing-preference-for-suvs-challenges-emissions-reductions-in-passenger-car-market, https://www.iea.org/commentaries/carbon-emissions-fell-across-all-sectors-in-2020-except-for-one-suvs https://www.iea.org/commentaries/carbon-emissions-fell-across-all-sectors-in-2020-except-for-one-suvs, and https://www.eea.europa.eu/publications

[189] https://www.eea.europa.eu/publications/co2-emissions-from-cars-and-vans-2018

[190] See the EP position on the Commission Proposal for a Regulation of the European Parliament and of the Council amending Regulation (EU) 2019/631 as regards strengthening the CO_2 emission performance standards for new passenger cars and new light commercial vehicles in line with the Union's increased climate ambition (PE-CONS No/YY - 2021/0197(COD)).

[191] https://www.resourcepanel.org/reports/global-resources-outlook

As indicated in https://www.iea.org/reports/iron-and-steel-technology-roadmap "Among heavy industries, the iron and steel sector ranks first when it comes to CO_2 emissions, and second when it comes energy consumption. The iron and steel sector directly accounts for 2.6 gigatonnes of carbon dioxide (Gt CO_2) emissions annually, 7% of the global total from the energy system and more than the emissions from all road freight.1 The steel sector is currently the largest industrial consumer of coal, which provides around 75% of its energy demand. Coal is used to generate heat and to make coke, which is instrumental in the chemical reactions necessary to produce steel from iron ore".

[192] See UN Sustainable Development Solutions Network report: Tracking forced labour, accidents at work and climate impacts in the EU's consumption of fossil and mineral raw materials (2022), available at https://irp.cdn-website.com/be6d1d56/files/uploaded/56690-1%20-%20SDSN%20Study%20-%20v3.pdf

The dependence on primary materials is also making the supply chain for the automotive industry more vulnerable, compounding the challenges observed recently with disruptions for semi-conductors or magnesium and the hike in energy prices consecutive to the war in Ukraine.
While the automotive industry is undergoing profound changes towards climate-neutrality when it comes to the use phase of vehicles through the electrification of the vehicle fleet, it is only starting to embrace the full transition to a circular economy. This aspect is however central for the efforts of the automotive industry to move towards the decarbonisation of their production process. In the current situation, the integration of circular models in the design, production and end-of-life stages of the vehicle lifecycle remains insufficient to attain the objectives of the Circular Economy Action Plan to "*promote more circular business models by linking design issues to end-of-life treatment, consider rules on mandatory recycled content for certain materials, and improve recycling efficiency*". As a result, millions of tonnes of resources (including CRMs) are lost for the environment and the economy.

Closely linked to this problem is that of the use of hazardous substances in vehicles and its component parts. A large variety of chemicals, some of them classified as hazardous, are used in vehicles to provide different functionalities to coatings, alloys, electrical and electronic components, lubricants, hydraulic fluids and rubber, plastic, composite and textile elements used in the different parts that ultimately constitute a vehicle. Depending on their nature, use and location in the vehicle such hazardous substances can potentially pose a risk during vehicle manufacture and its subsequent service life and will remain therein once the vehicle reaches its end-of-life. The presence of such substances in materials that result from the disassembly, shredding and subsequent processing of the different vehicle fractions can pose a risk to the operators involved in the recycling operations and, if they remain present in the recovered materials (e.g. recovered alloys, plastic, etc) may make them unsuitable for their use as secondary raw materials. This is due to risks in their subsequent processing and use and from commercial and reputational risks that make them unattractive to the market due to quality and legal constraints brought about by the presence of these substances.
The presence of hazardous substances, especially of substances of concern[193], in vehicles and in the materials subsequently recovered from them, may hinder the circularity of materials in vehicles, reducing their uptake into the economy and can potentially be a risk to human health and the environment during their whole life cycle. In turn this can have clear consequences in terms of adverse human and environmental health effects (due to exposure / releases of substances) and reduce the amounts of materials recovered from vehicles, thereby putting greater stress on primary resources, requiring additional waste disposal capacities and increasing the overall amount of greenhouse gas emissions typically associated to the use of primary materials (which have to replace material that would otherwise be recycled).

6.2.2 What are the key problem drivers?

The **drivers** for this problem are a combination of market and regulatory failures which result in a lack of integration of circularity in the design and production phase of vehicles.

- *Market failure - the price of primary materials is not competitive to the price of secondary materials*

[193] As defined in Article 2(28) of the Commission proposal on a Regulation establishing a framework for setting ecodesign requirements for sustainable products. COM(2022) 142 final.

The prices of primary materials do not integrate the environmental externalities linked notably to their extraction and processing and have been usually lower than the prices of secondary materials due to economies of scale. Competitive price of recycled vs. virgin is highly dependent on the oil price which also hinder investments. Integration of recycled plastics is often considered as less straightforward by the automotive stakeholders due to the potential difference in mechanical or aesthetics properties and substances composition between virgin and recycled materials. The automotive industry has therefore not been incentivised to change its supply chain to source its products from recycled materials. The lack of demand for secondary materials from the automotive industry has in turn not encouraged the recycling sector to invest and increase the supply and quality of recyclates for their integration into new vehicles.

– *Market failure - insufficient quality and market availability of secondary materials*

The automotive industry relies heavily, for the production of new vehicles, on the supply of primary raw materials and uses very little recycled materials. One reason is that the automotive industry requires materials like steel or aluminium alloys with a high level of purity and/or specific properties, which are not commonly available from recycling processes. Primary raw materials are also often cheaper and produced in larger volume that recyclates. The incorporation of recycled materials in new vehicles depends on the ability to guarantee a stable supply for suitable quality and volume of materials. Absence of legally mandatory recycled content targets for vehicles at the EU level have also contributed to this situation. This is the case for plastics, which explains why the share of recycled plastics used by the automotive sector is very low (2-3% on average[194]), where uptake of the recyclates is carried primarily on voluntary basis.

– *Regulatory failure - the current EU rules have not been effective enough to improve the eco-design of vehicles*

Regulatory requirements have focused on the use phase of vehicles (rather than production and end-of-life stages). In addition, the growing use of new techniques to assemble parts (typically gluing elements instead of using screws) makes their disassembly more challenging and costly when vehicles reach the end of their life. It also hampers recycling as it prevents the division of shredded elements. **On the other hand, the provisions in the ELV Directive[195] on the design of cars to facilitate dismantling, re-use, remanufacturing and recycling, as well as the uptake of recycled materials, are too vague and general**. The most ambitious, specific and measurable provisions of the ELV Directive concern the "waste stage" of the vehicle, rather than its design and production. Article 4(1) obliges the Member States to take certain actions contributing to waste prevention, however, it is not clear how they should encourage vehicle manufacturers at the EU level to design and produce new vehicles which take into full account and facilitate the dismantling, reuse and recovery, in particular the recycling, of end-of-life vehicles, their components and materials. Moreover, the EU rules do not explain if they aim to ensure how the actions taken by the manufacturers should be coordinated and harmonized at the EU.

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[194] Average recycled content for post-consumer materials in vehicle ranges from 2 to 3% of the total mass of plastics). However, this range can reach 6% to 8% for some front-runner OEMs. More information available at Maury, T., Tazi, N., Torres De Matos, C., Nessi, S., Antonopoulos, I., Pierri, E., Baldassarre, B., Garbarino, E., Gaudillat, P. and Mathieux, F., Towards recycled plastic content targets in new passenger cars, EUR 31047 EN, Publications Office of the European Union, Luxembourg, 2022, ISBN 978-92-76-51784-9 (online), doi:10.2838/834615 (online), JRC129008.

[195] Article 4(1)(b) and (c)

The provisions in the 3R type-approval Directive also lack precision and leave room for interpretation. Article 6(3) of the Directive states: *"For the purpose of paragraph 1, the manufacturer shall recommend a strategy to ensure dismantling, reuse of component parts, recycling and recovery of materials. The strategy shall take into account the proven technologies available or in development at the time of the application for a vehicle type-approval."* Generally, the manufacturer submits the strategy for dismantling etc. during the preliminary assessment. Certificate of compliance, granted during the type-approval process, shall describe this strategy recommended by the manufacturer (Article 6(5)). For this purpose, a 'strategy' is defined as a large-scale plan consisting of coordinated actions and technical measures to be taken as regards dismantling, shredding or similar processes, recycling and recovery of materials to ensure that the targeted recyclability and recoverability rates are attainable at the time a vehicle is in its development phase. Though, the 'strategies of the vehicle manufacturers are approved by type approval authorities', in practice this strategy does not go beyond commitments to certain strategic goals of the company and is not specific to the vehicles to be type approved. There are no explicit requirements as to the content of the strategy, except for that it "shall take into account the proven technologies available or in development at the time of the application for a vehicle type-approval". The reference to proven technologies "in development" also creates some uncertainty as to the fact that these technologies will be available when the cars in question will become ELVs. Therefore, the effectiveness of the current provisions of the 3R type-approval Directive setting the obligation for the manufacturers to "recommend the strategy" is not clear enough to prove the compliance of a vehicle with the design related requirements prior the vehicle placement on the market.

3R-type-approval Directive is not effective enough to demonstrate that vehicles placed on the market are reusable, recyclable and recoverable, particularly when it comes to (i) verifying that the reuse, recycling and recovery targets in ELV Directive are met and (ii) incentivising a more sustainable vehicle design and production. For example, the definitions of "reusability", "recyclability" and "recoverability" in 3R type-approval Directive refer to the "potential" for "reusability", "recyclability" and "recoverability"[196]. Potential recycling is quite different from actual recycling (which takes place for the vehicles concerned many years later) and it is not clear how this potential is calculated. Overall, the verification of how car manufacturers meet their obligations on "reusability", "recyclability" and "recoverability" is largely built on an ISO standard which contains very limited elements and does not take into account the degree of development in recycling technologies. Declarations on fulfilment of the reuse, recycling and recovery targets submitted by vehicle manufacturers and checked by approval authorities, through the technical services/competent bodies, as part of the 3R Type Approval process do not reflect the achievable rates of these targets at end-of-life. In this regard, the evaluations of the ELV Directive and 3R Type-approval Directive have found minor inconsistencies between the two legislations.

According to Article 6(1) of Directive 2005/64/EC "Member States shall not grant any type-approval without first ensuring that the manufacturer has put in place satisfactory arrangements and procedures, in accordance with point 3 of Annex IV, to manage properly the reusability, recyclability and recoverability aspects covered by this Directive. When this preliminary

[196] See article 4 of the Directive.

assessment has been carried out, a certificate named 'Certificate of Compliance with Annex IV' (hereinafter the certificate of compliance) shall be granted to the manufacturer".

The Directive 2005/64/EC provides a number of obligations that need to be complied with by the Member States and car manufacturers on how to demonstrate that new models comply with the relevant obligations under EU law on reusability, recyclability and recoverability. Current calculation requires the specification of the vehicle material breakdown to separate materials (e.g., glass, metals, etc.) and also an estimation of the share of material that is reusable, recyclable, recoverable or both. For this purpose, a component part is "considered as reusable, recyclable or both based on its dismantlability, assessed by: accessibility, fastening technology, and proven dismantling technologies". A part is considered recyclable based on its material composition, and proven recycling technologies. This does not differentiate however between different qualities of recycling. Thus, for example, as observed in the case of glass used in vehicles, the existing method enables referring to glass towards the calculation of recyclability as in principle it can be dismantled and there are techniques that would allow its recycling. However, in practice, glass is usually separated from other materials through shredding activities, leading to only a low-quality recycling (e.g., backfilling) being possible.

To conclude whether a material is recyclable, as specified in the ISO, OEMs use a list of "proven recycling technologies". In line with the ISO 22628: 2002, technologies that have been successfully tested on a laboratory scale or above are considered to be "proven". The list is managed by the automotive association. The ISO standard refers to additional lists of "proven technologies for fastening" and "proven technologies for dismantling". OEMs probably have an idea of relevant technologies; however, such lists are not used in the type-approval process to conclude on the dismantlability of a part and its potential for reuse. The reuse of parts is not considered towards the calculation and in that sense though it can be concluded that the process may facilitate recycling and recovery, it is not clear why it is assumed to facilitate reuse. Though the 3R type-approval process requires manufacturers to specify recycled amounts separately, it does not require a differentiation between qualities of recycling (high quality vs. downcycling). Insofar it cannot be considered effective in facilitating recycling of components and material parts to their highest recycling potential. For instance, Article 6(5) of the 3R type-approval Directive clarifies that competent bodies acting in the name of type-approval authorities and issuing a Certificate of compliance for a manufacturer, need to "[…] describe the strategy recommended by the manufacturer […]". Annex I(8) of the 3R type-approval Directive further requires that Type approval authorities checking the 3R calculation in a type approval submission "shall ensure that the data presentation form referred to in point 2 [the completed Annex A to standard ISO 22628: 2002] is coherent with the recommended strategy annexed to the certificate of compliance referred to in Article 6(1) of this Directive." Though the latter article seems to clarify that the strategy needs to apply at least in part at vehicle level, according to stakeholders [197]strategies developed by manufacturers in this respect are quite general. Manufacturers explain that the information provided in such strategies on the dismantling of vehicle components at EoL is different from dismantling information provided to IDIS and quite general in nature. However, the information provided to IDIS only concerns components addressed under Annex I (3 & 4) of the ELV Directive and in consequence dismantling of other materials and components is not always

[197] Stellantis 2022; VW/Porsche 2022.

economically feasible and thus not necessarily performed. This affects the level of circularity of vehicles.

In addition, there is no reporting obligation for the Member States and the Commission on the implementation of the 3R type-approval Directive and no regular monitoring has been carried out on this point. Therefore, it is not completely clear to what degree the way that the end-of-life requirements are linked to the 3R type-Approval Directive supports the placement on the market of vehicles that will fulfil the waste management obligations. Another important regulatory failure is that, while the overall type-approval framework has been considerably strengthened in 2018 in the aftermath of the 'dieselgate' with a focus on controlling emission standards, the 3R type-approval Directive has not yet been amended to reflect these changes, leaving significant legal uncertainties.

Another example on the insufficient link between the aims of the ELV Directive and Directive 2005/64/EC is the fact that the latter considers that "tyres should be considered as recyclable" for the purpose of calculating the recyclability of cars. There is no justification for this consideration, while available data show that, despite the potential, a large part of end-of-life tyres are actually not recycled. Declarations on fulfilment of the reuse, recycling and recovery (3R) targets submitted by vehicle manufacturers and checked by approval authorities (through the technical services/competent bodies) as part of the 3R type-approval process do not always reflect the achievable rates of the 3Rs at end-of-life. It shows that the current 3R type-approval process, as the procedural tool, lacks dynamic link with the ELV Directive and the flexibility to adjust to the changes of the legislation, such as increase the ambition level of targets, introduction of material specific recycling targets, etc. It shows that the current mechanism would not be able to guarantee a market surveillance of the vehicles not being able to comply with the development of the EU legislation.

– *Regulatory/market failures – Lack of incentives to uptake secondary materials in manufacturing new vehicles*

There is no obligation in EU law that financial incentives are provided to manufacturers when they design vehicles which contain recycled materials or are composed of materials and parts which can be easily repaired, dismantled, re-used, remanufactured or recycled[198]. The aspects of repairability, remanufacturing, reusability and recyclability are not considered so far in the of the Green Public Procurement criteria for road transport[199].
It is also relevant to the increased use of lightweight materials, such as composite plastics, carbon-fibre, and fibre- reinforced materials, often used to reduce the vehicle weight with the aim to curb the CO_2 emissions in use, are not addressed in the ELV Directive. With the trend towards lightweight materials, this could even further affect the achievability of the circularity targets.
The 3R type-approval Directive does not sufficiently differentiate between non-recyclable and recyclable materials. De facto this allows vehicles making use of high volumes of non-recyclable to be placed on the market for which currently the EU is lacking recycling capacities.

[198] Such incentives are being established at the EU level for batteries and packaging, based on the provisions of the waste framework Directive (Article 8a) on the "modulation of fees" foreseen for "extended producer responsibility schemes", in line with the polluter pays principle set out in Article 191(2) of the Treaty on the Functioning of the European Union (TFEU).
[199] Commission Staff Working Document: EU green public procurement criteria for road transport; SWD (2021) 296 final; Brussels, 18.10.2021.

– *Regulatory and behavioural failures – insufficient information on dismantling*

Decisions taken during the design phase of a vehicle have a direct impact to the material recovery levels of an end-of-life vehicle. This relationship between the two stages is acknowledged by the ELV Directive, which Article 4(1), first, requires manufacturers to produce the vehicles with the aim to facilitate their dismantling – one of the most decisive criteria determining the potential and actual levels of reuse, recycling and recovery of the end-of-life vehicles and their parts. However, the problem is that current provisions do not explain on how manufacturers should apply these obligations. This lack of clarity in decision making at the early stage of designing and assembling a vehicle has a significant impact on low quality of end-of-life treatment. Article 8 of the ELV Directive provides some guidelines by obliging the producers *to "use component and material coding standards, in particular to facilitate the identification of those components and materials which are suitable for reuse and recovery".* Commission Decision 2003/138/EC[200] specifies which nomenclature of ISO component and material coding standards should be used for identification of certain plastic and rubber parts. However, as in the case of Article 8, the decision only requires identification of some material parts (plastic and rubber). While this information may facilitate identifying the parts of a certain composition and above a certain size, it does not facilitate their dismantling in terms of time and tools required for supporting this process.

– *Regulatory failure – inconsistent and outdated provisions to restrict hazardous substances in vehicles*

The ELV Directive, in its Article 4, requires vehicle manufacturers, in liaison with material and equipment manufacturers, to limit the use of hazardous substances in vehicles and to reduce them as far as possible from the conception of the vehicle onwards, so as in particular to prevent their release into the environment, make recycling easier, and avoid the need to dispose of hazardous waste. These generic provisions are embodied into specific limitations established for four substances (lead, mercury, cadmium and hexavalent chromium) and their associated exceptions in Annex II of the Directive. There is no defined or established mechanism in the Directive to restrict further substances in vehicles and no other substances have been limited in vehicles since the adoption of the Directive in September 2000.

Consequently, there are no specific means in the Directive to address the adverse effects of additional hazardous substances in vehicles, beyond the four substances already regulated. Furthermore, the purpose of the Directive, as regards hazardous substances, as explained in its recital 11 and its Article 4, is that of reduction and control of hazardous substances in vehicles, in order to prevent their release into the environment, to facilitate recycling and to avoid the disposal of hazardous waste. The approach in the ELV Directive is not in line with the current life cycle thinking embedded in the Circular Economy Action Plan and in the Chemicals Strategy for Sustainability, which requires a full life-cycle approach in chemicals management (through one or several legislative tools) and where impacts on human health, and not only on the environment, have to be addressed.

[200] Commission Decision 2003/138/EC of 27 February 2003 establishing component and material coding standards for vehicles pursuant to Directive 2000/53/EC of the European Parliament and of the Council on end-of-life vehicles (Text with EEA relevance) (notified under document number C(2003) 620)

6.2.3 How would the problem evolve?

New automotive technologies will continue to develop impacting the design and production of the vehicles. Transition to circularity of the sector is based on the voluntary initiatives taken by the frontrunners. It leads to another circularity weakening prognosis upon which the incentives, to design and produce vehicles in a way which limits the use of primary materials and prefers secondary ones, will remain limited and fragmented. As a result, the dependency of the automotive industry on the use of primary materials would remain high while use of secondary materials is expected to be limited due to the absence of material specific targets on the EU rules. As regards the concrete material streams, there is expected to be a high competition of metals in the market of secondary materials, due to the increased demand linked to the more intensive production of e-vehicles. Without setting recycled content targets, demand for recyclates in cases where there is no market e.g. plastic, will not be stimulated.

E-mobility[201] is expected to experience significant and rapid growth over the coming decades leading to 45% of the total fleet share by 2035[202]. The presence of CRMs used in vehicles are expected to increase proportionally. This growth and changes of the fleet composition will come with a number of additional challenges for the repair, dismantling, recycling and recovery of the materials, including composite ones. The current framework of the ELV Directive and 3R-type-approval Directive will not be able to ensure the sustainability and competitiveness of the future vehicles and the development of e-mobility value chains, in the context of the circular economy, addressing the social, environmental and health impacts generated, in particular given the expected growth in demand. Therefore, over time, the contribution of the circular economy objectives of reuse, repair and recycling is expected to decrease.

These areas of problems are also highlighted in the findings of F4F platform, signalling that recently, new vehicles have become increasingly difficult to dismantle and recycle as new substances are being used and the different parts of those vehicles as well as the way they are built into the vehicle have become more complex[203]. With the intensive electrification of vehicles and the expected increase in the use of electric components and parts, restricted access to the locked parts in the future will lead to a limited availability of valuable materials to be retrieved from these parts and components. Yet, dismantlers will continue being provided a limited information by vehicle manufacturers[204] regarding the presence, localisation, composition and re-use potential of components in ELV and regarding the presence of (hazardous) materials hampering high quality recycling. Moreover, the digitalisation potential, such as development of digital product passport will remain unexploited in this area, thus maintaining the burden for dismantling facilities in identifying of the different materials used in the specific car type, their location inside the vehicle and the connections between the different vehicle components.

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[201] EVs, Hybrid EVs, Fuel Cell Evs..

[202] Based on the fleet modulation provided in the Commission Euro 7 proposal.

[203] For more information see Suggestion 1 of F4F opinion: https://cor.europa.eu/en/our-work/Pages/Fit-for-Future-opinion-on-End-of-life-vehicles-and-3R-type-approval.aspx

[204] E.g. through IDIS-System [International Dismantling Information System Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the implementation of Directive 2000/53/EC on end-of-life vehicles for the periods 2008-2011 and 2011-2014, 27.02.2017, (COM/2017/098 final), p. 5.

It means that without the intervention, the current regulatory framework would not be sufficient to adapt future trends and development of the electrification of road transport, as an integral part of the Clean Mobility package[205] and the Commission's ambition to decarbonise the EU economy, improve the competitiveness of strategic value chains in the context of "Fit for 55" package[206] to enable the automotive industry to contribute to the EU increased climate ambition for 2030 and climate neutrality target for 2050.

6.3. Problem area 2: Lack of quality and quantity in reuse and recycling at end-of-life treatment

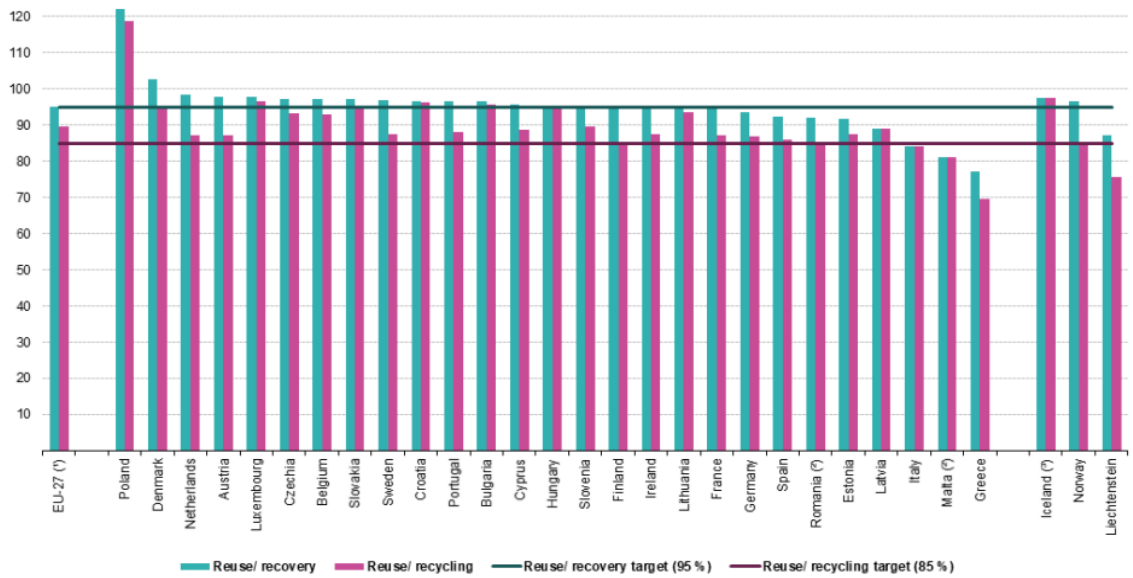
6.3.1 What is the problem?

The management of vehicles reaching the end of their life does not currently take place in optimal conditions. Based on the reports from the Member States, about 6,1 million ELVs (58%) are reported as collected at ATFs in the EU every year, representing 6,9 million tonnes of waste[207]. Based on the average material composition of ELVs, this represents a material flow of 66% (4 million tonnes) of ferrous metals, 11% (0,7 million tonnes) of non-ferrous metals, 2% (0,1 million tonnes (glass)) and 14% (1 million tonnes[208]) of mixed plastics[209].

Article 7 of the ELV Directive sets out 85% target for the re-use and recycling and 95% target for re-use and recovery of ELVs. Member States reports show a high degree of compliance with both targets at EU-level: 88% for the reuse/recycling and 94% for re-use/ recovery based on an average weight of an ELV.

Figure 6.2 Reuse/recovery and reuse/recycling rate for end-of-life vehicles, 2019

[205] https://ec.europa.eu/commission/presscorner/detail/en/ip_19_6279
[206] More information on the package is available at: https://ec.europa.eu/commission/presscorner/detail/en/IP_21_3541
[207] in 2019, the average weight of an ELV was estimated 1137 kg (based on Eurostat data and report by Member States for 2019), to be compared with the average vehicle weight in the EU of 1300 kg (CPA, 2020; ICCT Europe, 2020: average weight calculation based from around 1100 kg corresponding to small vehicle to around 1750 kg for an average upper-medium segment vehicle.
[208] collected at the authorized treatment facilities (ATFs).
[209] These figures exclude tyres, battery casings and the plastic sheathing of wiring harnesses.



Note: Countries are ranked in decreasing order by reuse/recovery.
(1) Eurostat estimate.
(2) 2018 data instead of 2019.
(3) 2017 data instead of 2019.
Source: Eurostat (online data code: env_waselvt)

While overall statistical reporting shows a positive trend, a significant amount of materials from end-of-life vehicles (ELVs) is still being sent to landfills or incinerated, generating negative environmental externalities. The share of spare parts and components from ELVs which are re-used or remanufactured remains very low.

The management of plastic waste from ELVs poses particular challenges. The share of plastics in the composition of vehicles has considerably increased, and today range from 14 to 18% of the total weight of new passenger cars. This increase is linked to the attempts by the automotive industry to reduce the greenhouse gas emissions linked to the use of vehicles, through a decrease in the weight of the materials contained in vehicles, and the replacement of heavy ones like steel with lightweight ones like plastics. **Only 19% of plastics or 0,2 million tonnes from ELV is currently going to recycling and 0.1 million tonnes effectively recycled, while around 0.8 million tonnes of plastic waste ends up every year in landfills (40%) or is sent to waste-to-energy facilities (41%).** Carbon fibres and most of all, glass fibres reinforced plastics are other lightweight materials more and more integrated in new vehicles, and which cannot currently be recycled. In addition to this, **the generalisation of electronics in new vehicles also poses considerable challenges when vehicles reach the end of their life, as most of the critical raw materials including rare earth elements that they contain are currently not recycled[210].** Finally, **while the recycling rates of metals like steel (88%) or aluminium (95%) from ELVs are high, the quality of the scrap is often suboptimal due to contamination with other materials during the shredding process** (typically high level of copper content in steel scrap and unsorted aluminium alloys with zinc, copper, silicon and magnesium alloying elements accumulating in cast aluminium).

[210] This is also the case of other CRM (e.g. niobium or magnesum) that are integrated as alloying elements in basic metals (steel or copper) and are not currently targeted in the recycling processes.

Beyond its environmental impact, the **suboptimal management of waste from ELVs represents a loss of resources for the industry in the EU, either because waste is not recycled back into the economy (especially for plastics or glass) or because the quality of the scrap is often too low (especially for steel and aluminium)**, so that it cannot be used for future applications, low carbon production and requires the mixing with an important share of primary raw materials when it is further processed.

6.3.2 What are the problem drivers?

The potential for higher quantity and quality of materials from ELVs to be re-used, remanufactured and recycled remains underexploited, due to the following regulatory, market and behavioural failures:

– *Regulatory failure - definitions are not aligned with the sectoral legislation*

The definition of "recycling" in the ELV Directive is broader than the definition of recycling which applies to all other types of waste, pursuant to the Waste Framework Directive. Indeed, "backfilling[211]" is accounted for as recycling under the ELV Directive, which is not the case under the later Waste Framework Directive. In some Member States, considerable amounts of wastes from ELVs, especially inerts, glass particles, mixed plastics, rubbers, fibres and textiles are destined to backfilling, which is accounted as recycled.
While the Waste Framework Directive distinguishes between 'reuse' and 'preparing for reuse', the ELV Directive establishes its own definition of 'reuse'. Under Article 2(6) of the ELV Directive 'reuse' means any operation by which components of end-of-life vehicles are used for the same purpose for which they were conceived.

The Waste Framework Directive (WFD)[212] (Article 3(13)) adopts a different approach. Here '**re-use**' means any operation by which products or components that are not waste are used again for the same purpose for which they were conceived. Therefore, the WFD includes a definition for "Preparing for re-use" as checking, cleaning or repairing recovery operations, by which products or components of products that have become waste are prepared so that they can be re-used without any other pre-processing. The ELV Directive does not provide the definition on "preparation for reuse", which means that components of a vehicle that has reached the waste phase are reused. There is a lack of clear definition on the status of these components as if they shall be considered as waste or not. If yes, the definition of "reuse" according to ELV Directive is not aligned with the WFD, thus the components that have reached the waste phase can be used for reuse, whereas in the WFD this is enabled through their "preparing for reuse". Components that are considered as waste, their shipment for re-use or remanufacturing is more challenging (e.g., higher transport costs, higher administrative burden).

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[211] The Waste Framework Directive defines backfilling as "any recovery operation where suitable non- hazardous waste is used for purposes of reclamation in excavated areas or for engineering purposes in landscaping. Waste used for backfilling must substitute non-waste materials, be suitable for the aforementioned purposes, and be limited to the amount strictly necessary to achieve those purposes".
[212] Consolidated text: Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives (02008L0098 — EN — 05.07.2018 — 003.002).

Removal of parts from ELVs prior to shredding is a precondition for increasing their rate of reuse of. It also supports higher quality recycling notably, in cases where it is not feasible to recycle a certain fraction after shredding (e.g., neodymium magnets) or where such recycling is limited in the quality of secondary raw material that it can achieve due to a high level of impurities (e.g., aluminium). The ELV Directive sets out minimum technical requirements for treatment of ELVs to promote reuse and recycling (Article 6(1) and (3) and Annex I(4)) that are not sufficiently precise and thus have limited effect on reuse·, the list of parts/materials to be removed before shredding is rather limited. Stakeholders have mentioned additional parts for which removal prior to shredding enables reuse or higher quality recycling. These are primarily the electric components which have become prevalent in supporting new functions and boosting performance of a vehicle. However, current legislation does not contain clear requirements, for instance, obliging such components, as printed circuit boards, be removed from the vehicle prior to shredding as it is required for example under the Waste Electric and Electronic Equipment (WEEE) Directive. Moreover, electric components are often intensive in various valuable and critical raw materials and their recycling would likely improve were they removed and sent to separate treatment or reuse.

Due to the lack of legal clarity, a decision to remove certain parts is rather motivated by different economic considerations, such as market prices for materials, available dismantling equipment and labour costs, but not the fact the functionality of a part itself.

- *Regulatory/market failures - no incentive for economic operators to increase the re-use and remanufacturing rates of spare parts from used vehicles or ELVs*

The ELV and 3R type-approval Directives do not contain specific provisions designed to boost the re-use of such parts, as re-use is considered together with recycling (for example there is a joint "re-use and recycling" target) and they do include definitions for (preparing for) remanufacturing and clarity on the 'end-of-waste' status of reused, repurposed or remanufactured parts. The absence of definitions creates an unlevel playing field which penalises the market for used spare parts. The low market demand for used/remanufactured spare parts is also due to the absence of clear guarantees on their traceability and safety, as well as the limited interest by most economic operators to adapt their business models and stop relying on new parts and in case remanufactured, the provision of a limited warranty for its second use.

It means that a vehicle part will be removed and offered for reuse only if the market demand is met and external costs including dismantling, verification, tests, labour, storage and handling do not exceed profit of selling used part on the market. This explains why the price of used components cannot cover the costs of dismantling and any operations which are essential to enable reuse/remanufacturing.

As in the case of secondary materials, today reuse, remanufacturing is carried mainly by the frontrunners. For example, BMW claims that *"by choosing remanufacture – the industrial processing of used parts to bring them up to the same standards as new parts – over the manufacturing of new parts, reductions of 85 percent of the raw material and 55 percent of energy can be made"*[213].

[213] See:https://www.bmwgroup.com/en/responsibility/sustainable-stories/popup-folder/circular-economy.html

Though various components have a high potential for re-use and remanufacture, ATFs (as also repair shops and garages) will only dismantle and prepare for reuse components for which they observe there to be a sufficient market demand. In some cases, the demand is related to the quality of a component (e.g., there is low demand for components that have very few malfunctions as they do not need to be repaired and for components that have many malfunctions as the ATF cannot guarantee minimum warranty). But for most components, demand could be increased by ensuring that consumers are aware of the option of reused and remanufactured components as alternatives to new ones and as to their related advantages (reduced costs).

As part of its Circular Economy legislation[214], France established an obligation to increase the demand for reused/remanufactured components in 2018: car repair shops must make an offer to repair a vehicle with used components in parallel to the offer to repair it with new components.
There are also a few examples of insurance companies, which voluntarily opted for a proactive policy for a sustainable management of ELVs. This includes, for example, the establishment of partnerships between an insurance company in France and a network of qualified ATF and repair companies, to increase application of reused/remanufactured components. For this purpose, the insurance company has been requesting every partner to systematically dismantle economically irretrievable vehicles older than 8 years and vehicles technically irretrievable (i.e., classified by the insurance company as a "total loss" after an accident). Dismantled used components from these vehicles can then be proposed by the company to its insurance policy holders to repair their vehicles in cases that the repair is performed under an insurance policy. The procedure assumes that the partners dismantle mainly economically valuable components. Since the majority of irretrievable vehicles are vehicles after collision accidents, the insurance company mainly deals with components such as bodywork, doors, and optical elements. Since 2012, the insurance company managed to increase the application of used components systematically every year, so that the initial target to repair 10 % of the 300,000 insured vehicles with re-used components by 2022 was already achieved in 2020. Aside from the environmental benefits of this practice, it has additional economic and social advantages, as it allows offering lower insurance policy costs to vehicle owners that agree to repair their cars with used spare parts (in cases of insured repairs).

Currently, there are no legal restrictions on the online sales of used components. Lack of such restrictions promotes illegal facilities, since the used components from non-legal operators can be offered for sale at lower prices than those offered by authorised facilities[215]. The EU law does not set the basis to take incentives and take enforcement measures towards protecting legal operators. This is in particular relevant for online sales, when the used components are not only sourced from licensed ATFs[216]. It results in competition of alternative markets, where same components are offered on the market by un-authorised dismantlers at lower prices than those of ATFs.

- *Regulatory failure – reporting of Members States on their reuse and recycling targets is not harmonised*

Provisions in the ELV Directive are not material-specific and measurable. In addition, **the methodology to calculate that the recycling/re-use targets are met is not sufficient to provide**

[214] https://www.legifrance.gouv.fr/codes/article_lc/LEGIARTI000032226565/2018-01-19)
[215] ATFs must comply with the ELV minimum standards which increases the operating costs of such facilities.
[216] Example between the UK authorities and eBay: Environment Agency joins forces with eBay to stop illegal vehicle breakers

clear evidence that the recycling rates have been effectively achieved. This is firstly due to shortcomings in the reporting foreseen in Commission Decision 2005/293/EC[217]. Lack of sufficiently clear reporting obligations undermined the effectiveness of the ELV Directive by hindering the proper monitoring the implementation of re-use, recycling and recovery targets by the relevant economic actors across the Member States. For instance, the quality reports that accompany the Eurostat standard questionnaire for Member States on the quality and validity of the data are voluntary. As a result, the content of these reports varies across the Member States, creating a barrier for the Eurostat to validate the data.

Another reason is that this methodology has not been adapted to reflect the improvements introduced at the EU level for other waste streams[218], designed to ensure that only waste which enters recycling is counted towards the achievement of the targets. There is no clear methodology under the ELV Directive that ensures that losses of materials which occur before the waste enters the recycling operation, for instance due to sorting, shredding or other preliminary operations, are excluded from the calculation of recycling rates. The current ELV Directive allows two different calculation methods which cause significantly different amounts of reuse reported by the Member States. Member States not using the metal content assumption (MCA) shall calculate reuse on the basis of the subtraction method, while Member States using the MCA shall determine reuse (excluding the metal components) on the basis of declarations from the authorised treatment facilities. The reuse of metal components will not be displayed separately if the MCA is applied but reported together with the metals recycled. In result, it is not possible to compare the reuse between Member States applying the MCA and MS that do not. As the target is also a combined target for recycling and reuse, the Member States are not encouraged to support (or even monitor) reuse separately (as it should be when following the waste hierarchy). As the Member States do not report on the treatment capacities (in particular the information of post shredder treatment (PST) plants would be needed), it is also not possible for the EC to assess if the reported data on recycling rates is valid or not. In some cases, Member States report high recycling rates without having PST plants. However, without PST plants it is difficult (or even not possible) to achieve such high recycling rates. Lack of sufficiently clear reporting obligations undermined the effectiveness of the ELV Directive by hindering the proper monitoring the implementation of re-use, recycling and recovery targets by the relevant economic actors across the Member States.

– *Regulatory/behavioural failures - insufficient information requirements for the vehicle manufacturers on presence, localisation, composition of materials and re-use potential of parts/ components*

The ELV and 3R type-approval Directives do not either sufficiently incentivise car manufacturers to provide dismantling information on car components and materials that would facilitate ATFs, garages and repair shops to identify, locate and dismantle valuable spare parts and components. The provisions on this point in Article 8 of the ELV Directive, and their implementation by the car manufacturers, are often seen by the dismantling sector as too limited, notably as the information might not be free of charge and do not contain user-friendly

[217] Commission Decision 2005/293/EC of 1 April 2005 laying down detailed rules on the monitoring of the reuse/recovery and reuse/recycling targets set out in Directive 2000/53/EC of the European Parliament and of the Council on end-of-life vehicles.
[218] See especially Article 11a of the Waste Framework Directive for municipal waste, as well as Article 6a of Directive 94/26 of the Packaging and Packaging Waste Directive.

instructions. The fact that some parts installed in cars cannot be re-used as they are locked with digital keys is another factor mentioned by dismantlers impeding their re-use or re-manufacturing. While the EU rules have attempted to contribute to improve transparency of the information needed for dismantling, it did not affect design and production of a vehicle, with the aim to ease the reuse, recycling and recovery of the parts and materials. Moreover, localisation of materials and access to the information still remains restricted. These aspects influenced the current situation where only metal and metallic components (such as catalytic converters and batteries) are almost 100% reused and/or recycled. Meanwhile, a higher share of non-metallic components, (e.g. glass, tyres and most plastics) are directed to energy recovery or disposal. The share of re-use is only 12,5%[219].

To bridge the aspects on design and dismantling of a vehicle, the car industry established the International Dismantling Information System (IDIS). Under this platform, 26 manufacturers with 79 brands and 3477 models and variants use IDIS to provide dismantling information free of charge to around 7000 registered users (e.g. ATFs) in 31 languages in 40 countries on components that need to be dismantled according to Annex I, section 3 and 4 of the ELV Directive[220]. In addition to it, producers are also required to provide the information on repair and maintenance information (RMI) to promote the reuse of parts and components. Under the EU "RMI Regulations"[221] it obliged independent operators to grant an easy, restriction-free and standardised access to vehicle RMI.

However, it is important to note that the ELV Directive does not oblige the producers to provide such information free of charge. Stakeholders from the repair and dismantling sectors, as well as those involved in the sale of spare parts, have been complaining of a lack of transparency from the car manufacturing side with regard to the characteristics of components in cars, as the car manufacturers often invoke commercial or confidentiality reasons to limit in practice the sharing of this information. Investigation by the European Commission concluded *"The key issues involve challenges for repairers when accessing RMI directly from OEM websites. The wide variation in user interfaces and software incompatibilities cause great inconvenience to users, particularly occasional users or repairers that service many different brands"*[222]. Divergent interpretation by stakeholders of certain aspects has also been identified as an additional shortcoming. Because of this investigation, the requirements that were previously in the RMI Regulations have been consolidated and are now detailed under Article 61 of Regulation 2018/858/EU[223]. This change is aimed to ensure easier access and use of RMI information by independent operators, which had struggled in the past as information was provided "piece by piece" affecting its comprehension

[219] ADEME (2020): Rapport Annuel de l'Observatoire des Véhicules Hors d'Usage – Données 2018.
[220] See further detail under IDIS Webpage: https://www.idis2.com/index.php, last viewed 28.10.2021.
[221] Regulation (EC) No 715/2007 and Commission Regulation (EC) No 692/2008 of 18 July 2008 implementing and amending Regulation (EC) No 715/2007 of the European Parliament and of the Council on type-approval of motor vehicles with respect to emissions from light passenger and commercial vehicles (Euro 5 and Euro 6) and on access to vehicle repair and maintenance information, OJ L 199, 28.7.2008, p. 1.
[222] Report from the Commission to the European Parliament and the Council on the operation of the system of access to vehicle repair and maintenance information established by Regulation (EC) No 715/2007 on type approval of motor vehicles with respect to emissions from light passenger and commercial vehicles (Euro 5 and Euro 6) and on access to vehicle repair and maintenance information (COM/2016/0782 final).
[223] Regulation (EU) 2018/858 of the European Parliament and of the Council of 30 May 2018 on the approval and market surveillance of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles, amending Regulations (EC) No 715/2007 and (EC) No 595/2009 and repealing Directive 2007/46/EC.

and usability. In this respect, Article 61 specifies that *"Independent operators shall have access to the remote diagnosis services used by manufacturers and authorised dealers and repairers".* This obligation is not understood to require the provision of such information for-free. In consequence, as in the past, the producers provide ATFs with access to RMI with the same approach as for any independent operator (e.g. of a repair garage), i.e. at a cost. Such conditional access to the relevant information is often factor for some ATFs to promote removal and reuse of parts, due to the incurred additional costs. It weakens the possibility to open the full potential of the vehicle circularity.

Increased amount of the electric and electronic equipment in a vehicle, insufficient access to data is also a relevant problem for economic operators, such as repair shops, ATFs, as these parts are coded and locked by the manufacturers. This limits reuse potential of these components. In a study performed by EGARA[224], 20-35 of dismantled pieces were identified as impossible to be used despite being suitable for multiple models and makes.

- *Market and regulatory failures – high-quality end-of-life treatment of ELVs is not profitable*

It is currently not profitable in most Member States to recycle from ELVs materials like plastics and glass, as well as precious metals from electronic components. Economies of scale and incentives to promote better quality of scrap are lacking. Similarly, spare parts like bumpers, dashboards and windshields are not re-used or remanufactured. The cost for their dismantling is high and not covered by the revenues from their sales. As a result, authorised treatment facilities, which receive ELVs from their last owners and carry out their depollution, do not remove these materials or parts before forwarding depolluted ELVs to shredders. ATFs are almost all SMEs which make most of their business in the commercialisation of the most valuable spare parts removed from ELVs and the sale of depolluted ELVs to shredders. Their economic viability is fragile and they would not be able to absorb new costs linked to additional dismantling operations. Most of them are not equipped (for example through access to digital marketplaces) to reach out a wide range of customers, which limits the market for these sparts.

For shredder companies, usually also SMEs, the shredding process will generate low or negatively valued residue fractions that are either landfilled, incinerated with energy recovery, or used for backfilling without recovery of remaining metal content. This is except for those countries where sophisticated "post shredding technologies" (PST) is in place which allows for the segregation, separation and recovery of these materials. Here again, the investment costs and competing recycling routes providing lower quality but also lower gate fees, represent a barrier to further development of PST technologies. Without investment security and cost compensation, PST technologies are not fully deployed throughout the EU.

The same impediments prevent ferrous and non-ferrous metal materials from ELVs from being recycled into high quality steel or aluminium scrap. Many shredders are operated flexibly to treat mixed scrap and to realise economies of scale. These unsorted operations and a widespread practice not to remove components like engines and gear-boxes despite the requirement in Annex I of the ELV Directive lead to subsequent contaminations of copper in

[224] See EGARA's contribution to the inception impact assessment (road map).

steels and difficult to sort aluminium alloys, which advanced PST treatment or subsequent treatment of these ELV scraps cannot overcome.

There is no regulatory intervention which would allow to overcome the market failure described in the points above. Especially, **the ELV Directive does not specify that car manufacturers should contribute financially to the costs linked to the dismantling, re-use, remanufacturing and recycling of materials and components from ELVs.** This is in contrast also to what applies in the EU for other sectors, like batteries, electric and electronic equipment and packaging, where "extended producer responsibility" (EPR) schemes explicitly include the financing by producers of the waste management phase of their products. The Waste Framework Directive also makes it clear that, when EPR schemes are established, they should cover inter alia the costs necessary to meet waste management targets. The absence of legal obligations under the ELV Directive on this issue is all the more problematic as the automotive industry has traditionally been reluctant to provide, on a voluntary basis, financial support to the waste management phase of vehicles. In March 2022, the Commission carried out inspections at the premises of automotive companies and associations of such companies, based on concerns that several of them may have violated antitrust rules and colluded to agree not to provide any financial support to the dismantling and recycling sector. The investigations on this case are ongoing[225].

There is no offset mechanism for the mandatory ELV treatment costs. The provisions in the ELV Directive on the producers' responsibility for the management of ELVs are limited when compared to the obligations for producers in other sectors to contribute financially to the waste management phase of their products, pursuant to the Waste Framework Directive and other EU waste legislation (for example electric and electronic equipment or packaging).
Currently, "shared responsibility" is applied across the Member States, where producers demonstrate (either individually or jointly in a PRO) the compliance with the requirement that ELVs are taken free of charge back from the consumer by contracts with ATFs confirming the free take back. Details of contracts with ATFs, e.g. whether there is compensation for ATFs, are usually not disclosed. Different stakeholders emphasized that the free take back declarations are issued by ATFs without or with minimal compensation for the ATFs. This system is based on the assumption that it is economically feasible to comply with the requirements of the ELV Directive without cost compensation by producers. Moreover, different levels of costs associated with the ELV collection and treatment at the national level encourage trade of the used vehicles approaching the end-of-life stage both intra-EU and extra-EU.

The current system is not future-proof and currently only economically viable recycling is conducted[226]. In addition, the system is exposed to strong competition of the illegal sector. Furthermore, even for materials which are accounted as fully or nearly fully recycled under the ELV Directive (steel and non-ferrous metals), there is no incentive to perform high-quality recycling, such as ensuring that steel or aluminium scrap from shredding contain minimum levels of contamination by other metals (i.e. copper). This reduces the value of such steel or aluminium scrap and the possibility to use them in a number of applications.

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[225] See: https://ec.europa.eu/commission/presscorner/detail/en/ip_22_1765
[226] Reuse of parts (and sells for remanufacturing) contribute to the profits of ATFs.

The market conditions therefore do not allow to internalise the costs linked to high quality recycling and re-use of materials from ELVs and the current EU regulatory framework does not address this problem either.

Currently there is no harmonised approach at the EU level ensuring the financial profitability of a full scare and high–quality recycling and re-use of materials, parts and components from ELVs. It is closely linked to the fact that the EPR schemes are generally set up at national level addressing mainly products purchased and consumed in a given country. However, end-of-life treatment of vehicles is labour intensive and a further complication results that EPR fees taking into account different cost structures. In the meantime, national EPR schemes for ELVs are not suit to cover collection, depollution and dismantling costs of those ELVs which final treatment occurs in another Member State than the one where a vehicle was originally placed on the market and the EPR fees paid. National EPR schemes would require uniform rules and a transfer system to cover the expenses for the processing of ELVs that are collected in a MS where they have not been placed on the market as new car.

Different cost coverage requirements have been adopted by the Member States linked to the implementation of the ELV Directive, either through the establishment of fees paid to the administration or the establishment of producer responsibility scheme in almost a half of all the Member States. These measures are mostly focusing on the basic obligations under the ELV Directive, e.g. collection of ELVs and their delivery to ATF. They do not address the costs linked to the compliance of obligations linked to the dismantling and recycling/re-use of materials, parts and components of ELVs.

In some situations, dismantling information is provided by manufacturers for a fee, in others it is provided freely to certain actors or not at all. The main difficulty in the current situation is related to certain data not always being accessible to ATFs which could facilitate an increase in reuse or recycling were the data available. In some cases, this is a result of a lack of harmonisation or of certain actors not making use of platforms already available.
Moreover, end-of-life treatment of new generation type of vehicles, i.e. electric vehicles, includes the removal and storage of end-of-life batteries, requires special training, knowledge and specialized infrastructure for the ATFs leading to additional financial burden. These aspects, related to the change of the vehicles produced, e.g., weight, material composition.
Therefore, today the problem the lack of profitability of the dismantling/recycling sector is the most prevailing. It jeopardises the attainment of the objectives of the ELV Directive and would be an obstacle to the attainment of more ambitious targets designed to ensure a higher recovery of all materials in ELVs and a better quality of the recyclates stemming from their recycling.

6.3.3 How would the problem evolve?

The current design of the ELV Directive leaves the treatment of end-of-life vehicles behind its possibilities, as explained in F4F opinion[227]. Under the business-as-usual scenario, insufficient reuse and material recycling of end-of-life vehicles in the EU would evolve over the next decades, continuing to bring environmental, economic and social concerns.

[227] For more information, see Suggestion 7 of F4F opinion.

The sub-optimal treatment of end-of-life vehicles would in particular contribute to the loss of valuable secondary resources in the context of the circular economy, such as plastics, metals and CRMs. The current design of the ELV Directive leaves the treatment of end-of-life vehicles behind its possibilities.

EU and its Member States would continue to implement and enforce the requirements set out in the ELV Directive, which will be remain of the generic manner and will not be aligned with the sectoral legislation. In this sense, the ELV Directive will maintain only minimum targets of reuse, recycling and recovery based on weight criterion and recycling definition covering 'backfilling'. The expected changes in the design of vehicles, increasing the amounts of plastics and materials with unclear recyclability with a view of reducing weight can be expected to change the balance between the share that is reused and recycled and that recovered or even worse landfilled. Achieving the reuse and recycling target of 85% is expected to become harder in the following years. While some Member States may attempt introducing individual regulation to ensure higher levels of reuse and recycling, it is expected that others will have an increasingly harder time complying with the current targets.

The low quality and quantity of end-of-life treatment of vehicles can also have negative economic costs, as it can lead to the loss of valuable resources that could instead be recycled or reused. If the current situation continues, currently disproportionate regulatory burden faced by ATFs will remain, as discussed in the F4F platform opinion[228]. It will become challenging in particular, as the ELV Directive does not set out clear requirements of the extended producer responsibility (EPR), how the costs deriving from mandatory treatment operations, e.g. depollution, removal of parts and components, including batteries, would need to be compensated. Therefore, the absence of specific provisions in the ELV Directive on the responsibility of producers will further hamper the transition of the automotive sector to a circular economy. The economic viability of the ELV dismantling/recycling sector will remain fragile and hardly allow them to meet the current targets on recycling and re-use set out in the ELV Directive without providing any additional economic incentive for ELV treatment higher up in waste hierarchy, which also addresses the quality aspect of secondary materials. There will remain a limited interest for car manufacturers to consider the recyclability/re-usability of the materials that they are using for the production of vehicles, nor on the quantity and quality of recycling fractions like steel, aluminium and copper, electric and electronic equipment (EEC).

6.4. Problem area 3: 'Missing vehicles' cause environmental impacts

6.4.1 What is the problem?

While around 6.1 million ELVs (58%) are reported to be treated according to the ELV Directive every year, **it is estimated that around 32% of de-registered vehicles, i.e., approximately 3.4 million units per year, are of unknown whereabouts (so-called "missing vehicles") and 1 million units exported for reuse (10%)**. Despite numerous studies on this problem, it is challenging to estimate the proportion of these vehicles gone missing due to "administrative problems" (insufficient traceability) or because they have been illegally treated in the EU or illegally exported outside the EU. It can however be assumed that a considerable amount of ELVs are illegally treated in the EU or illegally exported from the EU to third countries. In such cases,

[228] Ibid.

the treatment of ELVs and the recovery of materials from these ELVs would not happen according to the requirements set out and are likely to generate environmental damages like oil spillage, unsound treatment of refrigerants, removal of hazardous substances and of components for higher quality of recycling. This represents unfair competition and economic losses for authorised treatment facilities, which have to abide by the EU rules. This also means that a share of these vehicles would be treated outside the EU and that the materials they contain would not be re-used or recycled back into the EU economy, thereby representing a loss of resources which are important for the supply of the EU industry and for reducing its environmental footprint through the use of recyclates instead of primary resources. Illegal dismantling and export of ELVs are also feeding criminal networks involved in environmental crime and a potential carrier for smaller hazardous waste and other illicit items.

The export of used vehicles also raises important environmental and public health challenges.

As reported by UN Environmental Programme[229], between 2015 and 2018, 14 million used vehicles were exported worldwide. 70 % were destined to low- and middle-income countries, especially to Africa, receiving the largest share (40%) of all those used vehicles and having the highest road traffic fatalities, at an alarming 246,000 deaths each year. The African vehicle fleet is set to grow five times by 2050, and the road safety impacts are likely to rise exponentially[230]. Globally, LDVs fleet is expected to double by 2050 and 90% of this growth will mainly take place in non-OECD countries, which import mainly used vehicles. Without harmonised regional, global regulations on the quality to control these vehicles, the trade leads to increased pollution and climate emissions, high energy consumption and operating costs, and most importantly, weakening road-safety in the receiving countries. Despite these negative trends, most developing countries today have limited or no regulations on governing the quality and safety of imported used vehicles and rules which do exist are often poorly enforced. Equally, few developed countries have enforced restrictions on the export of used vehicles[231].

The question is well addressed in the communication on "Pathway to a Healthy Planet for All EU Action Plan: 'Towards Zero Pollution for Air, Water and Soil'"[232]:"end-of-life vehicles (ELVs), which are hazardous waste and cannot be exported to non-OECD countries, are often labelled as used cars and illegally exported. This leads to serious pollution threats caused by their unsound management. **The EU is the biggest exporter of used vehicles worldwide. In 2020, the number of used vehicles exported from the EU to 3rd countries amounted to 870,000, at a value of € 3.85 billion.** The most important destinations are Africa, Eastern Europe, Central Asia and the Middle East. To address the situation, the EU is committed to further partner with key countries to fight waste trafficking and facilitate intra- and inter-regional cooperation, with a view to reduce the EU external pollution footprint. A recent study[233] on the quality of used vehicles carried out by the Dutch Ministry of Infrastructure and Water Management shows that a significant part of the used vehicles exported to African countries is of similar age as end-of-life vehicles recycled in the Netherlands. Most of them do not meet Euro 4/IV emissions standard, i.e. they are older than 15

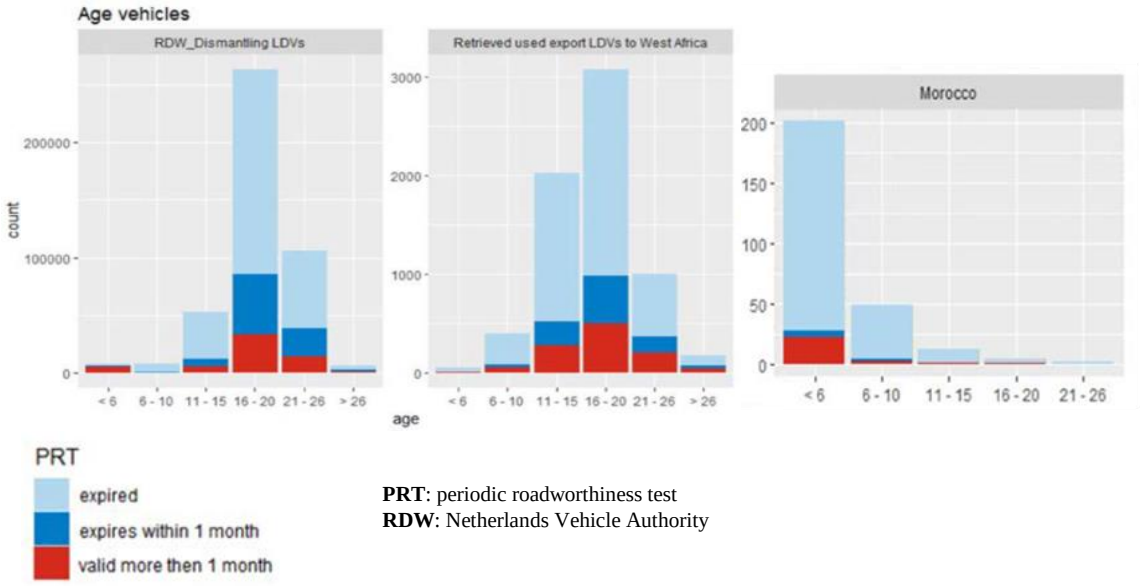
[229] https://www.unep.org/resources/report/global-trade-used-vehicles-report
[230] According to the UNEP report, more than 90% of road crashes take place in developing countries.
[231] Global Trade in Used Vehicles Report | UNEP - UN Environment Programme
[232] COM(2021) 400 final,
[233] https://www.ilent.nl/documenten/rapporten/2020/10/26/rapport--used-vehicles-exported-to-africa

years. The findings from this study, based on their sample, show that most used vehicles exported today outside the EU do not have a valid roadworthiness certificate.

The Dutch study[234] assessed the characteristics of end-of-life vehicles (ELVs) in the Netherlands as well as used vehicles exported to 12 West African countries for the period 2017-2018. The study found that for both groups, ELVs and exported vehicles, the maximum age range was between 16 and 20 years old. This contrasts with Morocco, where the youngest vehicles are imported due to a five-year age limit and the requirement of Euro 4 vehicle emission standards for used vehicle imports, which was introduced in 2011.
The study also revealed that only a minority of used vehicles exported, including the youngest ones, had a valid technical inspection certificate for more than a month.
In 2017-2018, about 14% of ELVs treated in the Netherlands had a roadworthiness certificate valid for more than one month, while this share was slightly higher at 15.5% for vehicles exported to countries in West Africa.

The findings of the study suggest that used vehicles share similar characteristics, meaning that around 85% of these vehicles leaving the EU market may not, due to different reasons, have valid roadworthiness certificates, thereby posing serious environmental and safety concerns in the destination countries, despite od the fact that they are not technically fit to be on the EU roads[235].

Figure 6.3 Age of dismantled (LDVs) versus retrieved vehicles exported to West Africa[236]



PRT: periodic roadworthiness test
RDW: Netherlands Vehicle Authority

[234] Netherlands Human Environment and Transport Inspectorate, Ministry of Infrastructure and Water Management (2020): Used vehicles exported to Africa: A study on the quality of used export vehicles
[235] For more information see Chapter 6.5.1.3, Baron, Y.; Kosińska-Terrade, I.; Loew, C.; Köhler, A.; Moch, K.; Sutter, J.; Graulich, K.; Adjei, F.; Mehlhart, G.: Study to support the impact assessment for the review of Directive 2000/53/EC on End-of-Life Vehicles by Oeko-Institut, June 2023
[236] Source: Netherlands Human Environment and Transport Inspectorate, Ministry of Infrastructure and Water Management (2020): Used vehicles exported to Africa: A study on the quality of used export vehicles
Data: combined Customs and RDW. © ILT-IDlab

It is clear from this study and other sources that most used vehicles exported from the EU to African countries are polluting the environment and present a high risk for road safety. While there is no direct evidence that second-hand EU vehicles cause road accidents, there is data suggesting that an increase in the age of vehicles is linked to an increased risk of accidents. According to a UNEP study[237], the risk of a crash increases by 7.8% with each additional year of vehicle age. It is also observed, that used vehicles often have compromised roadworthiness and crashworthiness due to age, wear and technical design. Informal character of the used vehicle trade further perpetuates the import of vehicles with mechanical and safety defects[238]. It is in particular relevant to some import markets, such as Somalia, not requiring vehicles to meet certain safety standards, such as the presence of airbags or compliance with crashworthiness criteria. It proves the availability of increasing evidence on the links between road safety and used vehicles.
As documented by the UN Environmental Programme[239], to address these problems, a growing number of countries and regional organisations[240] have adopted in recent years legislation to restrict the import of used vehicles, based on their age or compliance with air emission limits (Euro emissions). This is the case for the majority of the countries to which used vehicles are exported from the EU.

6.4.2 What are the problem drivers?

The **drivers** for this problem are a mix of regulatory and market failures resulting in (i) a lack of traceability (ii) insufficient enforcement and (iii) the absence of considerations linked to roadworthiness and environmental protection when used vehicles are exported from the EU.

- *Market failures – higher revenues from informal and illegal treatment activities and export of vehicles to non-EU countries*

There are **economic incentives for insurance companies, dealers and private owners of ELVs to sell them on online market places or directly to non-authorised treatment facilities or export them in contravention of EU rules: they will obtain higher prices than if they have to deliver them to authorised treatment facilities, which have to abide by the requirements of the ELV Directive** for the treatment of these vehicles and are subject to social security, employment and other fiscal charges (unlike the informal sector). In certain cases, such vehicles are sold as their documents are used to provide stolen vehicles a new ID or for tax fraud purposes. The informal sector will typically dismantle and not fully depollute the vehicle and sell the most profitable spare parts, after which the remainder of the vehicles will be sold to a shredder or exported.

When it comes to used vehicles, an important driver for their export outside the EU is the steady demand in developing countries, associated with the high prices that exporters of such vehicles can obtain compared to what they could gain with selling them in the EU. This does not necessarily mean that exported used vehicles are in poor condition or are low value. There is a large demand for four-wheel drive (4WD) or high-cubic capacity used vehicles in good condition

[237] For more information see: https://www.unep.org/resources/report/global-trade-used-vehicles-report
[238] Alloweg, Hayshi and Hirokazu (2011)
[239] https://www.unep.org/resources/report/global-trade-used-vehicles-report
[240] For example, the Economic Community of West African States (ECOWAS[8]) adopted on 5 September 2020 a Directive limiting the import of used vehicles to those with a minimum Euro 4/IV emission standard. The age limit for importing vehicles into the ECOWAS region is 5 years for light duty vehicles, two-wheel motor vehicles, tricycles and quadricycles and 10 years for heavy-duty vehicles.

that do not meet EU emission standards and are exported, for example, because of emission taxes in Europe or because they are banned from access to Europe's urban centres. At the same time, cheap used vehicles fulfil a critical function by providing affordable mobility to low-income populations around the world and any gap in this market will be rapidly filled by imports of used vehicles from third developed economies, in particular from Asia and the United States of America. By making the necessary repairs and retrofitting, used vehicles are not necessarily ELVs and, by exporting them, they can be given a longer life so contributing to the global circular economy, while meeting minimum EU safety, emission and pollution requirements. However, today practices show these requirements are often disrespected, and instead of contributing to the global circular economy, large share of the imported used vehicles from the EU actually contributes to the domestic environmental and human health problems, thus enlarging the EU external pollution footprint.

– *Regulatory failures – insufficient traceability of ELVs*

The obligation to record and report ELVs is not clearly attributed to stakeholders and public authorities. The ELV Directive states that the last owner of a vehicle shall be issued a "certificate of destruction" (CoD) when he delivers it to an authorised treatment facility (ATF). There is however no clear obligation for the last owner or the authorised treatment facility to transmit this CoD to the registration authorities where the vehicle was registered. As a result, the vehicle registration authorities are not promptly informed about the fact that a car is not any more operating and shall not be accounted into the national fleet. Moreover, the actual vehicle status becomes officially undefined and can be exposed for the following informal treatment (e.g. selling, illegal export). There is no requirement either for the shredding facility which receives ELVs after their depollution at an ATF to verify that a CoD has been issued as a result. To address this problem, some Member States have adopted specific incentives or rules to ensure that ELVs delivered to ATFs are confirmed to be shredded by the shredding companies as a verification reported to the relevant administrations. They have been focusing on encouraging the last owners to deliver their vehicles to ATFs and report the corresponding CoD to the administration, in the forms of "pay out scheme" where a premium is granted upon presentation of the CoD to the competent authorities or linking the end of the payment of registration taxes or insurances to the final verification of the CoD for the corresponding vehicle.

– *Regulatory failure – no systemic exchange of vehicle registration information*

In addition, the fact that a vehicle is "de-registered" from a national vehicle register does not always mean that it has become an ELV, as the issuance of a CoD is not the only ground here where vehicles get deregistered subject to the national legislation. Such fragmentation creates a regulatory failure creating consequences at the EU level. Some Member States allow vehicles to be "temporarily de-registered", for example when they are off the road, so as not to be subject to registration taxes. Other conditions include export to another country, migration of the vehicle together with the owner to another EU country or theft. Therefore, the total number of ELVs reported by the Member States cannot be assumed to correspond to the number of deregistered vehicles. There is no obligation for the Member States to indicate in their register the motives for which a vehicle has been de-registered, which leads to a situation where the fate of a large number of de-registered vehicles remains unknown.

The fact that a large number of used vehicles are shipped throughout the EU renders the traceability of ELVs even more challenging. The ELV Directive and the EU legislation on registration documents and roadworthiness are not designed to track properly what happens to these vehicles when they reach the end of their life. There is in particular no

systematic exchange of information between vehicle registration authorities which would ensure that the Member State of previous registration of a vehicle is systematically informed when such vehicle is recycled and a CoD has been issued in another Member State. Although the authorities of the Member States of last registration should have the information available about it being an ELV based on the Article 3a of Directive 1999/37/EC[241], today this information is not always updated and correspond to the actual situation of the vehicle concerned.

– *Regulatory failure – non-legally binging nature of guidelines distinguishing used vehicle vs. waste vehicle*

The absence of clear and legally binding criteria on the distinction between used vehicles and ELVs makes enforcement of the requirements of the ELV Directive very challenging. Specific guidelines[242] were developed by the Waste Shipment Correspondents to assist enforcement and customs authorities in implementing the rules on the export of ELVs, and especially to distinguish between ELVs and used cars. These guidelines are however non-binding and often considered too complicated to apply in practice by enforcement agencies. The illegal sector widely exploits this grey area around the distinction between used vehicles and ELVs. Only vehicles which are considered as waste are subject to the requirements of the ELV Directive, while used vehicles can be commercialised without any restrictions. Even economic actors in the formal sector (for example insurance companies which own a large share of accidented vehicles which might, or not, qualify as ELVs and usually sell them in bulk through auction sales) do not always make the effort to properly check if the vehicles that they sell are ELVs, as it remains more profitable for them to sell them as used vehicles. This is a problem both for ELVs sold in the EU and ELVs exported outside the EU (as "used vehicles" can be exported without restrictions, while shipments of ELV are regulated under the waste shipment regulation, which prohibits especially their export outside the OECD). The effect is that many ELVs are illegally exported to third countries.

The absence of legal provisions preventing the **export from the EU of used vehicles** which are not roadworthy makes it possible to ship used vehicles to third countries, despite the fact that such vehicles are not authorised to be driven on EU roads. In addition, while, as indicated above, a large number of third countries have established or announced rules governing the import of used vehicles, there is no provision in the EU legislation which would require EU inspection and customs authorities to take these import requirements into consideration when authorising the export of used vehicles. There is no mechanism either which would direct these authorities to cooperate with the authorities in the import countries to make sure that used vehicles are only exported from the EU in line with the conditions laid out by these third countries.

– *Regulatory failures – insufficient enforcement*

There are no specific provisions in the ELV Directive requiring the Member States to carry out **inspections or take enforcement actions** to ensure that its provisions are properly implemented, or to establish penalties against breaches of the requirements set out in the Directive. There is little monitoring on how the Directive is enforced and the illegal treatment and the illegal export of ELVs do not feature as priorities in the strategies laid out by enforcement and customs authorities against environmental crime. Some initiatives are taken on a voluntary basis by the Member

[241] Council Directive 1999/37/EC of 29 April 1999 on the registration documents for vehicles (OJ L 138, 1.6.1999, p. 57).
[242] Correspondents' Guidelines No 9 on shipment of waste vehicles: https://ec.europa.eu/environment/pdf/waste/shipments/correspondents_guidelines9_en.pdf

States, but there is no coordinated approach at the EU level designed to improve enforcement of the rules under the ELV Directive.

6.4.3 How would the problem evolve?

Not addressed, a range of regulatory and market drivers would continue to contribute to the phenomenon of "missing vehicles". For the baseline scenario it is estimated that the situation of 30% to 40% missing vehicles, i.e. 3 to 4 million vehicles, will persist without any major improvement. It means that there will be no mechanism in place needed to ensure if all ELVs are directed to authorised treatment facilities (ATFs), nor to improve cross-border traceability of vehicles. Such scenario is also supported by the reasoning provided in F4F opinion, highlighting that today not all Member States require the vehicle's last owner to provide a COD upon deregistration, which is serving as a proof that the vehicle has been properly dismantled in accordance with the ELV Directive. This is due to the circumstance that some Member States do not distinguish the reasons between short-term deregistration and final deregistration of a vehicle or deregistration for final disposal or other purposes. Therefore, lack of coordination and exchange of information between Member State vehicle registration authorities will persist. Moreover, there will be no EU wide incentives or obligations for a last owner of a vehicle to deregister a destructed vehicle[243].

No improvement is either expected in the area of the export of used vehicles to non-EU countries deepening the EU external pollution footprint. If no actions are taken at the EU level, a significant share of vehicles exported to extra-EU countries will remain under characteristics similar or equivalent to ELVs. Accordingly, the countries receiving the used vehicles form the EU will become more and more affected as the concerns of environment, road safety, air pollution risks will continue to grow, including the material losses of potential recyclables, negative economic and social impacts for the formal sector, when vehicles are not directed to legal treatment facilities. While environmental and social risks exist for the countries of destination, cases of illegal export from the EU will also affect Member States of origin, causing financial violations.

6.5. Problem area 4: Lack of EU level playing field to improve circularity in the design, production and end-of-life treatment of lorries, buses and motorcycles

6.5.1 What is the problem?

The ELV and 3R type-approval Directives apply to passenger and some three-wheel vehicles (M1), as well as to light commercial vehicles (N1). Around 85 % of 323 million vehicles registered in the EU fall within the scope of ELV Directive[244]. 15% of these vehicles are therefore not covered, representing around 52 million vehicles (powered two- and three wheelers (PTW), lorries and buses)[245] By mass, this represents 35% of registered vehicles, or 191 million tonnes. The average sum of materials from powered two- and three wheelers (PTW), busses and lorries that became waste in 2019 can be estimated to amount to more than 4.13 million tons. The

[243] For more information see Suggestion 4 of Fit4Future platform: https://cor.europa.eu/en/our-work/Pages/Fit-for-Future-opinion-on-End-of-life-vehicles-and-3R-type-approval.aspx

[244] 76 % Passenger cars (M1 type) and 9 % lorries (N1 type).

[245] It should be noted that this impact assessment does not address the situation of e-bikes, ships, planes, trains, agricultural and non-road mobile machinery (NRMM, T-approved), and military purposes & space. These vehicles are non-road vehicles, with the exemption of non-type approved (electric) bicycles. They are subject to specific regulations, e.g., for e-bikes or ships, or the series in which they are produced are very small, e.g., trains or NRMM. Also, their type-approval is separate to that of road vehicles and in particular does not address objectives of the 3R type-approval.

vehicles excluded from the ELV and 3R type-approval Directives are currently not subject to any specific requirement when it comes to eco-design and their waste phase (waste prevention, collection, treatment and recycling). Although the general provisions from the Waste Framework Directive apply to end-of-life vehicles which are not covered by the ELV Directive, their effect is limited, as they do not contain requirements which are specifically tailored to these vehicles.
The consequences of this exclusion are the following:

- no guarantee on the environmentally sound management of the waste stemming from end-of-life vehicles outside the scope of the legislation,
- no legal incentive for the re-use or recycling of large volume of materials (steel, iron, aluminium, copper, plastics, glass…) stemming from such waste,
- no legal incentive to increase the design for circularity of the vehicles in question,
- risk of a fragmentation of the EU market as individual Member States take individual measures to address the end-of-life stage of the vehicles concerned.

The data and information available on the end-of-life treatment of powered two- and three wheelers (PTW), busses and lorries in the EU is more limited than the information for M1-N1 vehicles. They show that an important number of used lorries and (to a lesser extent) used buses are exported from the EU to third countries, in particular in the developing countries, where the price is an important factor, creating demand for the trade in used HDVs with some remaining useful economic life. It is also noted that despite efforts to promote circular economies through formal HDV scrapping programs in the top exporting countries, including EU, there are reported cases of illegal shipments of end-of-life vehicles to low-income markets, resulting in a material loss for the circular economy objectives of these countries. Since 2015, the EU has exported around 75,000 buses and about 898,000 lorries outside Europe. For every single used bus shipped, 12 used trucks are exported from the EU. The top destinations for EU exports are West Africa and the Eastern Europe, Caucasus, and Central Asia, matching the trade supply chain of used light-duty vehicles[246].

There is a market for the re-use and remanufacturing of spare parts from lorries and that there are authorized treatment facilities in some Member States which are able to dismantle lorries, in addition to passenger cars.

When it comes to two- and three wheelers, data available show that that there is a specialized market for spare parts, but that there is only a limited number end-of-life motorcycle which are dealt with by authorized treatment facilities, although they would be able to dismantle them without particular extra investments or training.

The data collected for this impact assessment also shows that **at least 7 Member States have adopted various types of legal provisions governing the end-of-life stage of lorries, buses or motorcycles.** Many of them have especially established a requirement that these vehicles should be delivered to an ATF at the end of their life. These provisions remain far less far-reaching than the provisions applying to M1-N1 vehicles pursuant to the ELV Directive. It also presents the risk of fragmenting the EU market and does not anyway represent an efficient approach as economic actors willing to escape national rules could decide to get their vehicles dismantled in another EU Member State with less or no requirements on this phase.

[246] https://www.unep.org/resources/report/global-trade-used-vehicles-rep

Overall, the integration of circularity in the business model of producers of vehicles outside the scope of the ELV and 3R type-approval Directives largely relies on the market situation, as well as on voluntary actions by some economic actors wishing to be more ambitious than their competitors on this aspect and different regulatory interventions in some Member States. As a result, the potential of a very large share of the automotive sector to contribute to the ambitions of the Green Deal for a climate-neutral, clean and circular economy remains unexploited.

6.5.2 Problem drivers

– *Regulatory failures – different national legal regimes*

The main driver for the problem exposed below is the exclusion of powered two- and three wheelers (PTW), lorries and buses from the scope of the ELV and 3R type-approval Directives. This choice was made by the co-legislators when the ELV Directive was adopted in 2000. More than twenty years after this adoption, this has led to a situation where there is no transparency on the degree of circularity of the sectors concerned and that they are not incentivised to go beyond a "business as usual" scenario.
The fact that some Member States have taken an initiative and set out national rules covering the end-of-life stage of vehicles that are currently not in the scope of the EU legislation, is a sign that the current limited scope is considered as sub-optimal. Many Member States require that the sound treatment of PTWs and/or lorries is ensured and/or environmental permits for facilities are requested through specific legislation[247].

For example, the information provided by France and Spain regarding their experience in dealing with different categories of vehicles shows some similarities and differences.
In France, there is no specific economic analysis on treatment costs, however, there is evidence that the reuse of parts can be particularly important for L-category vehicles. In addition, these vehicles have a content of metal similar to that of passenger cars, making their treatment potentially profitable, because the intrinsic value linked to the material content is significant. However, it is unclear to what extent this applies to quadricycles, and the market for reusing quadricycle parts is less documented.

In Spain, the requirements for ATFs to handle both LCVs and LCVs/L-category vehicles are the same, including de-registration of vehicles in connection with the CoD condition. As for the differences, there are specific certification requirements for personnel who work with electric and hybrid vehicles. In terms of reporting requirements, the same procedures apply to ATFs that deal with L/HDV vehicles and LCVs, as both are required to submit annual reports on managed waste. The documents proving the treatment of an ELV vary depending on the type of vehicle. LDVs require a certificate of destruction, while for other types of vehicles, ATFs must issue an environmental treatment certificate. This separation of certificates allows more effective control and monitoring of the treatment process according to vehicle category.

Belgium (Flanders) and the Czech Republic have similar regulations for ATFs that handle both LCVs and VLDs. Both countries require the same environmental permits and processing

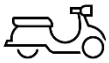
[247] This is the situation at least in Spain, France, Flanders/Belgium, Lithuania, Italy, Hungary, Netherlands and Germany.

conditions for all types of vehicles, but there are additional permit requirements for passenger cars and vans, in terms of meeting recycling targets. There are no specific training or certification requirements for personnel who work with HDVs or end-of-life HDVs. The legal requirements regarding depollution, disposal and storage are consistent for all the types of vehicles mentioned. Belgium issues CoD destruction only for the treatment of end-of-life passenger cars and light vans up to 3.5 tonnes, however, there is no de-registration requirement for the owner of any type of vehicle, the ATF system automatically includes the vehicle's VIN in the national registration system which registers these VINs separately. In the Czech Republic, a separate approach is taken where a CoD is issued for both HDVs and motorcycles, and the responsibility for de-registration of the vehicle lies with the owner regardless of its type. There is no data collected on the costs and benefits of mandatory ATF treatment for different stakeholders. The costs may outweigh the benefits in some cases. However, Member States pointed out that the costs and benefits associated with the treatment of each vehicle vary considerably due to several factors such as the feasibility of reusable parts, the costs of secondary raw materials, energy expenditure, among others, which makes it difficult to achieve final product conclusions in this area. A diverse array of national regulations on end-of-life treatment across the EU Member States creates certain risks related to fragmentation of the EU internal market.

Market drivers – difficulty in identifying and controlling treatment operators

A common feature for PTW and Heavy-Duty Vehicles is the importance of the market for used spare parts and the associated potential to retrieve such parts from end-of-life vehicles. This potential is however not fully exploited. In addition, the fact that the informal sector plays an important role in the treatment of end-of-life PTW and HDVs presents environmental challenges, as this treatment is not operated under conditions ensuring a proper depollution of the vehicles and represents unfair competition for other operators which comply with higher standards.
More information is provided below on the respective situation for PTW and HDVs.

Problems and drivers per vehicle category

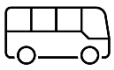


PTW (powered two- and three wheelers): the end-of-life and repair business is dominated by small companies or individual operators, with a minimum regulatory control over their activities. Estimates are available on the number of PTW becoming waste every year, as well as their material composition. For most categories of PTW, the mass fraction of re-usable spare parts is higher than for passenger vehicles and, when it comes to the material composition of PTW, most of them contain a share of metal comparable to the share of metals in passenger cars. There is therefore an important potential for re-using spare parts from end-of-life PTW. In view of the presence of many different actors in the manufacturing, repair and end-of-life treatment of such vehicles, and of the absence of information requirements in national or EU legislation, it is not possible to quantify with a sufficient degree of granularity the current market for the re-use and recycling of parts and components from PTW. It can be assumed though that the share of the informal sector in the dismantling of PWT and the commercialisation of spare parts is non-negligible. Export of used PWT on the other hand is relatively limited, when compared to used passenger cars or lorries.

Lorries: The design and structure of lorries, as well as the types of parts that they contain, differ from those in M1-N1 vehicles. They also usually have a longer lifetime than M1-N1 vehicles. This has an impact on the treatment of end-of-life lorries. Treatment facilities require specific infrastructure, storage, tools, technologies and knowledge to treat them properly . This is done either in specialised facilities, or in facilities that also perform

the treatment of end-of-life M1-N1 vehicles. One key difference is that, while the de-polluted body of the M1-N1vehicles are shredded as a whole, this is not always possible for HDVs, which are dismantled further.

An important characteristic of the sector is the considerable share of used lorries that are shipped between EU Member States, as well as exported from the EU to third countries (up to 75%). This represents an important market, with used lorries shipped out of the EU especially after they have reached a certain age or milage to be used further in third countries, where they finally reach their waste stage.



Buses: Compared with trailers and lorries, the fleet of buses registered in the EU is smaller. The material composition of buses is different, as they contain more glass (from windows) and textiles (from seats) than in any other vehicle category. This is creating specific challenges at the dismantling and treatment stages of these vehicles. Compared to lorries, the relative share of used buses exported is also lower but it remains overall quite significant (~34%).

(Semi-)Trailers: In terms of the entire fleet, trailers account for less than 6% by unit, but ~18% by weight. The variability of these vehicles is high, the material composition also varies greatly depending on the trailer type. Little is known about the end-of-life treatment of trailers. Export trade statistics show that ~ 75,000 trailers are exported per year (~8% of expected ELVs). This is a rather small share, compared to other vehicles presented above. Therefore, it is concluded that there is a large mass of materials from trailers for which there is currently no information available about their design and end-of-life stage. It is therefore unclear to what extent the circular economy potential is exploited.

6.5.3 How would the problem evolve?

Non-inclusion of vehicle types other than M1 and N1 from the scope of the ELV Directive will hinder establishing a fully-fledged EU legal framework of vehicles. Without a proper regulatory framework, it would not be feasible to build coherence between national approaches and streamline obligations of national authorities and economic operators in setting up systems for the collection, treatment and recovery of all end-of life vehicles. Such regulatory gap would lead to twofold problems: 1) creating favourable conditions for the risk of damage to the environment and human health associated with the mismanagement of the vehicles that are not covered by the EU harmonized rules on the end-of-life vehicles; 2) continuous loss of material resources from the share of vehicles not covered under the ELV and 3R type-approval directives, accounting for around 52 million vehicles with 159 million tonnes by weight, thus putting aside certain streams of the automotive sector from the circular economy transformation.

It would also have negative impact on the pace of technological progress linked to a more circular design and efficiency in end-of-life treatment of 15% of remaining vehicles without a regulatory support at the EU level. It remains unclear whether the market would be addressing design-for-recycling in a sufficient manner. Otherwise, the EU will not be able to take into account/rely contributions from the whole vehicle sector to the achievement of the targets set out in the EU Green Deal and the Circular Economy Action Plan.