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IMPACT ASSESSMENT REPORT

ANNEXES 10 TO 15 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

{COM(2023) 451 final} - {SEC(2023) 292 final} - {SWD(2023) 255 final} - {SWD(2023) 257 final}

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ANNEX 10: LEGAL ENVIRONMENT

10.1 Legal Basis

Discussions on waste from ELVs dating back to the 1970s focussed on the concerns caused by the illegal disposal of hazardous waste and the difficulties to treat plastic waste derived from ELVs. Increasing quantities of plastic waste were found in the Light Shredder Residues (LSR) and, due to its limited compacting characteristics, used a large amount of volume within landfills. Incineration of plastic waste was also challenging as it required pre-treatment operations. The treatment of exhaust gas of waste incinerators was less developed at that time. In addition, other environmental and health risks, such as contamination of the metal scrap with heavy metals, raised public concerns. All these factors determined the primary objective of the ELV Directive, to minimise the impact of ELVs on the environment and to improve the environmental performance of all the economic operators involved in the life-cycle of vehicles, as defined in Article 175 of the Treaty establishing European Community[1]. Article 7(4) of the ELV Directive tasked the Commission to propose an amendment to the type-approval Directive[2] and promote European standards relating to design for dismantling, recoverability and recyclability of vehicles. As a result, Directive 2005/64/EC on the type-approval of motor vehicles with regard to their reusability, recyclability and recoverability (3R type-approval Directive) was adopted in 2005[3]. Based on the internal market legal base (Article 95 TEC[4]), the 3R type-approval Directive constitutes one of the separate directives within the framework of the EU vehicle type-approval system which was originally established by Council Directive 70/156/EEC and which is now covered by the type-approval Regulation (EU) 2018/858[5]. Article 7(4) of Directive 2000/53/EC required that the measures to be adopted have to be incorporated into the vehicle type-approval procedure. It is a basic principle of EU type-approval legislation that Member States do not prohibit, restrict or impede the placing on the market, the registration or the entry into service of vehicles, systems, components or separate technical units that comply with the requirements of EU type-approval. To safeguard a consistency of rules between placing a product on the market and the disposal of that product, a single binding set of EU rules is necessary.

It is therefore necessary that the legislative proposal replacing ELV and 3R type-approval Directives is based on Article 114 of the TFEU, which is the appropriate legal basis for measures that aim to establish or ensure the functioning of the internal market. This is essential as it is designed to set out requirements which govern the placing of vehicles on the EU market. Harmonised rules are necessary to ensure that all goods placed on the EU market comply with similar conditions and that manufacturers can rely on a type approval issued by

[1] TEC; in the current legal state, the wording corresponding to Article 175 TEC is expressed in Article 192 TFEU.
[2] Council Directive 70/156/EEC of 6 February 1970 on the approximation of the laws of the Member States relating to the type-approval of motor vehicles and their trailers (OJ L 42, 23.2.1970, p. 1–15).
[3] OJ L 310, 25.11.2005, p. 10.
[4] In the current legal state, the wording corresponding to Article 95 TEC is expressed in Article 114 TFEU.
[5] OJ L 151, 14.6.2018, p. 1.

one Member State for the entire Internal Market. This is line with the overall regulatory framework on type-approval for motor vehicles.

The change compared to the ELV Directive, which was based on the environmental empowerment of Article 175 TEC (Article 192 TFEU) is justified as this proposal also regulates the design aspects of vehicles and the free circulation.

The choice of Article 114 TFEU as a legal basis allows to build environmental-related requirements as the core elements of conditions on the type-approval and thereby the placing on the EU market of vehicles. It follows other examples of legislative proposals tabled by the Commission recently, which also aim at covering in one single instrument sustainability/circularity requirements applying to the whole lifecycle of products, like the proposal for a Batteries Regulation, proposal for a Regulation on Eco-design for Sustainable Products and the proposal for a Regulation on Packaging and Packaging Waste.

10.2 Articulation with other EU policies and legislations

The 3R type-approval Directive is the main EU-level instrument dealing with vehicles design for recycling, re-use and recovery, and the ELV Directive regulates the requirements of vehicles end-of life. There are also provisions on vehicles or provisions which are relevant for vehicles in other EU legislation. Table 10.1 below lists and compares specific aspects of the different initiatives, showing their interaction, with the ELV and 3R type-approval revision.

Table 10.1: Comparison of the ELV and 3R type-approval revision with specific aspects of other EU initiatives

1	**Critical Raw Materials (CRM) Act[6] and CRM Communication[7]**
Legislative or non-legislative?	CRM Act: Legislative, mandatory. Status: Commission proposal for a Regulation was adopted on 16 March 2023. CRM Communication: Non-legislative.
Brief description	The aim of the CRM Act is to ensure EU the access to a secure and sustainable supply of critical raw materials in order to allow the EU to achieve its climate and digital ambitions. The proposal aims to strengthen different stages of CRMs value chains, diversify the EU imports to reduce strategic dependencies, improve EU capacity to monitor and mitigate risks of disruptions to the supply of CRMs, and improve circularity and sustainability. The proposal lays down list of critical raw materials and strategic raw materials as well as the methodology for their review. It establishes a framework to select and implement strategic projects eligible for streamlined permitting processes and having a simplified access to financial opportunities. The act develops a mechanism for coordinated monitoring of CRMs supply chains and provides measures to mitigate

[6] Proposal for a Regulation of the European Parliament and of the Council establishing a framework for ensuring a secure and sustainable supply of critical raw materials and amending Regulations (EU) 168/2013, (EU) 2018/858, 2018/1724 and (EU) 2019/1020 (COM/2023/160 final).

[7] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: A secure and sustainable supply of critical raw materials in support of the twin transition (COM(2023) 165 final).

	supply risks, such as obligations for large importers and manufacturers to regularly audit their supply chains and facilitate the joint purchases of strategic raw materials. The proposal focuses also on CRMs circularity, addressing in particular permanent magnets, for which it envisages detailed information obligations. It also empowers the Commission to establish in the future recycled content targets for certain CRMs include in these magnets via delegated acts. The proposal enables Member States to adopt and implement specific measures aim at circularity, particularly with respect to waste streams with high CRM recovery potential. The CRM Communication lays down actions to be taken in areas of development of standards of CRMs-related industrial processes, education and training, research and innovation projects, financing CRM-related activities as well as establishing cooperation with partners to strengthen supply chains of these materials. It recognises the need to incentivise CRMs recycling by commercialisation of efficient recycling technologies, designing products containing CRMs so that these materials can be easily removed or accessed and requiring provision of information on CRMs and their location in certain products. The Communication specifically announces that the Commission will revise the ELV Directive to include specific requirements for design and end-of life treatment of vehicles focusing on CRM recovery. It also states that the Commission should provide recommendations to Member States in order to improve the separate collection of consumer electronics rich in CRMs, consider introduction of measures promoting substitution of CRMs in new products and review waste legislation in order to, where relevant, establish specific rules of CRMs recovery from certain product categories.
Interaction with the ELV and 3R type-approval revision	The presence of CRMs used in vehicles are expected to increase due to their electrification, therefore the new legislative proposal replacing ELV and 3R type-approval Directives will be one of the key legal acts relevant from the CRM perspective. The ELV Directive already contains provisions related to recovery and recycling of CRMs from end-of life vehicles. Its revision aims to strengthen recovery and recycling, by, inter alia, developing requirements effectuating design for dismantling and design for recycling, as well as to address the end-of life phase by reinforcing collection of ELVs and their recycling. Both proposals will address the issues related to CRMs present in vehicles and their components, in particular providing information on their presence in order to improve CRMs recycling and subsequent use of recycled materials in new products. The CRM Acts establishes requirements related to certain types of permanents magnets[8] present in selected products, including motor vehicles. Operators placing vehicles containing such magnets on the market are obligated to mark them with label specifying type of magnets contain in them, and, in the future, also to provide digitalized information on the weight, location and chemical composition of all individual magnets, presence of coatings, glues and any additives, as well as

[8] Permanent magnet types addressed by CRM Act are: Neodymium-Iron-Boron; Samarium-Cobalt; Aluminium-Nickel-Cobalt; Ferrite. All of described obligations stemming from CRM Act, except for labelling of product containing the magnet specifying its type, do not apply to ferrite permanent magnets.

	information enabling access and removal of such magnets. CRM Act requires operators placing products containing certain amount of such magnets to inform about the share of neodymium, dysprosium, praseodymium, terbium, boron, samarium, nickel and cobalt recovered from post-consumer waste present in the permanent magnets incorporated in the product. The Commission is also empowered to set out recycled content targets for these CRMs via delegated acts after 2030. The new proposal replacing ELV and 3R type-approval directives will foresee an obligation for the manufacturers to draft declarations on the CRM content in vehicles and present it during the type-approval process and will require to remove parts and components containing CRMs prior to vehicles' shredding. It will also empower the Commission to set out recycled content targets for these materials. Despite the fact, that both initiatives concern CRMs present in vehicles, their provisions will be complementary. To avoid legal uncertainty, CRM Act contains clear rules specifying that in case of adoption of EU harmonised legislation on recycling or recycled content of permanent magnets[9], this harmonised legislation will apply instead of provisions of the CRM Act. The new Regulation replacing ELV and 3R type-approval Directives would be an example of such legislation (*lex specialis*). Both analysed initiatives have the same objective, as they aim to improve the recovery and recycling of CRMs and promote inclusion of such recycled materials in new vehicles. Revision of ELV Directive is also specifically listed in the CRM Communication, as it is a key element from the CRM perspective.
2	**Eco-design Directive[10] / Eco-design for Sustainable Products Regulation (ESPR) Proposal[11]**
Legislative or non-legislative?	Legislative, mandatory. Status: Directive in force; Commission proposal for a Regulation, repealing this Directive, was adopted on 30 March 2022.
Brief description	The Eco-design Directive establishes minimum product-related and, where relevant, information requirements, for 'energy-related products', on energy efficiency and other environmental aspects. This is being operationalised via implementing regulations per product category, in accordance with regular working plans. These regulations, for a given product category, prevent the worst-performing products to enter the EU market. Since the first Circular Economy Action Plan (2015) the Commission systematically includes circular economy aspects (in addition to energy efficiency) in product requirements under the Eco-design Directive, including inter alia reparability, durability, upgradability and recyclability when drafting new or revising existing eco-design requirements. The proposal for a Regulation on eco-design for sustainable products will extend the Eco-design framework beyond energy-related products,

[9] Articles 27(9) and 27 () of CRM Act.

[10] Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products (OJ L 285, 31.10.2009, p. 10–35).

[11] Proposal for a Regulation of the European Parliament and of the Council establishing a framework for setting eco-design requirements for sustainable products, amending Regulation (EU) 2019/1020 and repealing Directive 2009/125/EC (COM/2022/142 final).

	excluding food and feedstuff. It will also enable the setting of eco-design requirements for groups of products sharing common characteristics. The ESP Regulation is a framework regulation, it will enable the setting of additional legislative measures which will strengthen products sustainability and facilitate more informed choices for consumers. Eco-design requirements to be set under ESPR will be mandatory. The ESPR will enable the setting of requirements that improve information flows through, inter alia, establishing a Digital Product Passport. The Digital Product Passport would give access along the value chain to relevant product characteristics (e.g. durability and reparability of products, presence of substances of concern, handling at the end of life etc.), with differentiated access to consumers, businesses and compliance authorities were appropriate.
Interaction with the ELV and 3R type-approval revision	The ESPR will enable the setting of appropriate minimum performance and information requirements for a wider range of physical products, including vehicles and its parts. However, the Directives under revision already lay down certain requirements and obligations related to vehicles circularity. The 3R type-approval Directive requires that vehicles should be constructed in such a manner, that they are reusable and/or recyclable to a minimum of 85 % by mass, and reusable and/or recoverable to a minimum of 95 % by mass. The ELV Directive sets out re-use, recycling and recoverability at the corresponding levels. It also encourages vehicle manufacturers to use recycled materials and limit the use of hazardous substances and design vehicles suitable for dismantling and recycling. Also, the design and manufacture of vehicles are subject to overall type-approval legislation, in particular the type-approval Regulation 2018/858/EU of the European Parliament and of the Council[12], which lays down sector specific requirements for vehicles. These requirements are much different from the rules applicable for other products placed on the EU market, as they were established in order to address the specificity of the automotive sector. In addition it needs to be noted, the ESPR is based on the New Legislative Framework: Regulation (EC) No 765/2008 of the European Parliament and of the Council[13] and Decision No 768/2008/EC of the European Parliament and of the Council[14]. However, the sector automotive legislation related to type-approval do not follow the New Legislative Framework. The procedure of obtaining a type-approval is set out specifically for vehicles in its scope, in order to consider all the modalities related to their design and use. As the legal framework for vehicle design and end-of life already exists and it takes into the account the characteristics of the automotive sector, new requirements should be built on it rather than developed based on the ESPR. However, it needs to be underlined, that the level of ambition

[12] 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 (OJ L 151, 14.6.2018, p. 1–218).

[13] Regulation (EC) No 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products and repealing Regulation (EEC) No 339/93 (OJ L 218, 13.8.2008, p. 30–47).

[14] Decision No 768/2008/EC of the European Parliament and of the Council of 9 July 2008 on a common framework for the marketing of products, and repealing Council Decision 93/465/EEC (OJ L 218, 13.8.2008, p. 82–128).

	in transition to circularity and sustainability will be similar in the new legislative proposal replacing the ELV and 3R type-approval Directives as it would be if new provisions were established through delegated acts based on the ESPR. Nonetheless, certain design requirements for vehicles or its parts could be set out under ESPR. It could concern vehicles which are outside the scope of this proposal, as well as other automotive related products, such as tyres. It is intended to propose development of recycled content targets for rubber via a delegated act prepared under the ESPR Framework. The Commission has ensured complementarity and consistency between the future legislation and the ESPR and delegated acts adopted on its basis, for example for the definition of the respective requirements and empowerments (e.g. using the same definition of 'recycled content') and making use of the same methodologies for their implementation (e.g. on measurement of recycled content).
3	**Type-Approval Regulation** (EU) 2018/858[15]
Legislative or non-legislative?	Legislative, mandatory. Status: Regulation in force.
Brief description	The legal framework for the type-approval of motor vehicles aims at facilitating the free movement of automotive products in the internal market by laying down common requirements designed to achieve environmental, energy performance and safety objectives which are specified in several separate legal acts. These legal acts deal with a multitude of detailed technical requirements for different vehicle systems and components and are frequently updated to adapt them to technical progress while at the same time minimising the regulatory burden on industry. The type-approval Regulation sets the central procedural framework for the requirements for the approval and market surveillance of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles. As such it lays down the rules on conformity of vehicle types with the requirements of several pieces of legislation which are listed in the Annexes to the Regulation. Once the compliance with the various requirements of different legislations is checked by the national type-approval authority, the vehicle type can be placed on the market and registered in the internal market. It follows that the placing on the market or registration of the vehicle type cannot be refused for requirements for which the vehicle type has gone through the type-approval procedure.
Interaction with the ELV and 3R type-approval revision	The requirements of the 3R type-approval Directive are currently controlled in the process of vehicle type-approval established by the Type-Approval Regulation. With the inclusion of the 3R type-approval Directive and the ELV Directive in one new regulation, the requirements that will be formulated in the new instrument for type-approval will also need to be verified in accordance with the rules of Type-Approval Regulation. Therefore, the new proposal will cross-refer to provisions of the analysed regulation, not only for the type-approval procedures but

[15] 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, (OJ L 151 14.6.2018, p. 1).

	also in relation as market surveillance.
4	**Euro 7 Regulation Proposal[16]**
Legislative or non-legislative?	Legislative, mandatory. Status: Commission proposal for a Regulation was adopted on 10 November 2022.
Brief description	The general objective of the initiative is to ensure the proper functioning of the single market by setting more adequate, cost-effective and future-proof rules for vehicle emissions as well as to ensure a high level of environmental and health protection in the EU by further reducing air pollutant emissions from road transport. This initiative will contribute to achieving the general objective by pursuing the following three specific objectives. It will reduce complexity of the current Euro emission standards, provide up-to-date limits for all relevant air pollutants and improve control of real-world emissions. The proposal is in support of aims in the Ambient Air Quality Directive[17] by setting limits for pollutants which are currently also covered by rules on the ambient air concentrations of specific air pollutants such as Ammonia, particles or NOx. Key new elements are the alignment of emission rules in a technology neutral way and by combining rules for Light-Duty Vehicles and Heavy-Duty Vehicles. Furthermore, the emission limits will be valid and verified in a wider and clearer defined range of conditions.
Interaction with the ELV and 3R type-approval revision	Both initiatives concern the environmental performance of vehicles and their design. The requirements set out in these acts will be verified in accordance with procedures established in the Type-Approval Regulation. While the Euro 7 proposal aims at reducing vehicle emissions during a longer part of a vehicle's lifetime by extending durability requirements, the revision of the ELV Directive focuses on designing the vehicles in a more circular way, to facilitate the reuse, recycling and recovery of vehicles and their parts and the actual treatment of the vehicle at the end of its life. The new proposal will also contribute to achievement of overall emission objectives of Euro 7 proposal, as it will limit the export of non-roadworthy, often polluting, used vehicles outside the EU. This proposal will also provide more detailed rules on removal and recycling of certain vehicle components, such as emission control systems, necessary to achieve the limit values in Euro 7 proposal, including catalysts, which contain significant amounts of CRMs. The Euro 7 proposal envisages also creation of Environmental Vehicle Passport, a digital tool granting access to information on the environmental performance of a vehicle at the moment of registration, including the level of pollutant emission limits, CO_2 emissions, fuel consumption, energy consumption, electric range and engine power, and battery durability and other related values. The new proposal replacing ELV and 3R type-approval Directives will build on this, extending the scope of information that could be accessed via this passport to data facilitating the disassembly, reuse, recycling and recovery of vehicles

[16] Proposal for a regulation on type-approval of motor vehicles and engines and of systems, components and separate technical units intended for such vehicles, with respect to their emissions and battery durability (Euro 7) (COM(2022) 586).
[17] Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe (OJ L 152, 11.6.2008, p. 1).

	and their parts.
5	**Waste Framework Directive[18] (WFD)**
Legislative or non-legislative?	Legislative, mandatory. Status: Directive in force; Commission proposal for amending directive expected to be adopted in 2023.
Brief description	The WFD establishes horizontally applicable concepts and definitions related to waste generation and waste management, including waste treatment, recycling and recovery. It lays down waste management principles, which should contribute to the reduction of adverse impact of the waste management to human health and the environment, with an emphasis on waste prevention. It follows from the waste hierarchy laid down in the WFD that waste prevention comes on top of the hierarchy followed by preparation for re-use and recycling in second and third place. Other recovery options, e.g. energy recovery shall finally take precedence over disposal. Additionally, it outlines conditions for waste to be considered a by-product and regulates the end-of-waste status. Pursuant to Art. 9 of the WFD, Member States must undertake actions to prevent waste generation, with measures encouraging the re-use of products, promoting and supporting sustainable production and consumption and reduction of hazardous substances in materials and products. The WFD sets targets for the preparation for re-use and the recycling of waste materials from municipal waste, which were increased in the 2018 revision through the setting of targets for the years 2025, 2030 and 2035. The WFD obliges Member States to ensure the functioning of Extended Producer's Responsibility (EPR) schemes, which is a set of measures taken by Member States to ensure that producers of products bear financial responsibility or financial and organisational responsibility for the management of the waste stage of a product's life cycle. The WFD sets up a set of minimum requirements for EPR schemes to that end. In the new Circular Economy Action Plan, adopted in March 2020, the Commission committed to take steps towards: - significant reduction of generation of waste, - better use of secondary raw materials and - environmentally sound waste management. The Commission furthermore committed itself to assess feasibility of harmonising the separate waste collection systems in the Member States. The ongoing revision of the WFD is focused on textiles and food waste. Another revision, of a larger scope, is envisaged for 2025.
Interaction with the ELV and 3R type-approval revision	One of the aims of this proposal is to provide more clarity in the determination when a used vehicle should be considered waste. Therefore, the definition of end-of life vehicle will be revised, addressing the practical difficulties experienced in its application in the Member States, but it will remain in line with the general definition of waste provided for in the WFD. The definition of "recycling" in the proposal for a Regulation will be aligned with the definition in the WFD, in particular it will exclude backfilling operations from its scope. The ELV Directive revision envisages also clearer methodology to

[18] Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives (OJ L 312 22.11.2008, p. 3).

	calculate recycling rates, ensuring that what is accounted as "recycled" only includes materials which are effectively recycled, and not just collected for recycling, and improving the reporting on recycling targets. This change fits into the logic of the WFD, which aims to ensure high-quality recycling. The WFD, through the Commission Implementing Decision (EU) 2019/1004[19] adopted on its basis, provides for more correct and precise measurement of the amounts of recycled waste, by defining terms such as 'calculation point', 'measurement point' or 'preliminary treatment'. This implementing act establishes specific rules for calculation of recycled waste, indicating different calculation points for various waste materials and recycling operations and provided rules concerning reflecting the preliminary treatment operations in the calculation. Further to these rules, data on waste recycling will be more accurate, as currently all waste collected for recycling is reported as recycled while all waste in practice is not currently effectively recycled. Similar changes in the calculation of the amount recycled waste stemming from ELVs will be done under the new legislative proposal. The proposal will also contain provisions laying down EPR rules for ELVs. The ELV Directive was adopted before the WFD. It contains provisions on the responsibility of vehicles manufacturers for the end-of life phase of vehicles. These provisions are however not aligned with the provisions set out in the WFD. This will be adjusted with the revision of the ELV Directive and the provisions on EPR would build on Articles 8 and 8a of the WFD.
6	**Batteries Directive[20] / Batteries Regulation (BR) Proposal[21] and final compromise agreement text[22]**
Legislative or non-legislative?	Legislative, mandatory. Status: Directive in force; Commission proposal for a Regulation, repealing this directive, was adopted on 10 December 2020. A final compromise text was agreed by the co-legislators on 18 January 2023 and should be published in the course of 2023 in the EU Official Journal.
Brief description	The Batteries Directive establishes general requirements for the treatment and recycling of batteries at the end of their life, but does not cover other aspects of the production and use phases of batteries, such as electrochemical performance and durability, GHG emissions, or responsible sourcing. The proposal for a Batteries Regulation aims to ensure that batteries placed in the EU market are sustainable and safe throughout their entire life cycle. The proposal introduces also progressive requirements to minimise the carbon footprint over the life cycle of batteries. It strengthens the functioning of the EU internal market for batteries and promotes the circular economy by closing the materials loop. The new Regulation lays takes over existing restrictions for mercury and cadmium in batteries and defines a procedure for introducing new

[19] Commission Implementing Decision (EU) 2019/1004 of 7 June 2019 laying down rules for the calculation, verification and reporting of data on waste in accordance with Directive 2008/98/EC of the European Parliament and of the Council and repealing Commission Implementing Decision C(2012) 2384 (notified under document C(2019) 4114).

[20] Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC (OJ L 266, 26.9.2006, p. 1–14).

[21] 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 […]).

[22] Interinstitutional file: 2020/0353 (COD).

	substance restrictions in batteries. It also includes provisions on mandatory recycled content targets and requirements on electrochemical performance and durability parameters. It obligates manufacturers to draft carbon footprint declaration for certain battery types and to ensure batteries' removability and replaceability. It requires the economic operators placing certain types of batteries on the market to implement supply chain due diligence policies verified by a notified body and conduct detailed risks assessment. The Regulation lays also down targets on collection, recycling efficiencies and materials recovery.
Interaction with the ELV and 3R type-approval revision	The Batteries Regulation will significantly contribute to putting the automotive industry on a circular path with respect to batteries. This is crucial due to the battery's environmental footprint, in particular for batteries in future EV. However, it needs to be underlined, that the environmental impact of vehicles is not limited to batteries, but covers also the manufacture and end-of life treatment of other elements of vehicles. Therefore, in order to address this need, the ELV needs to be revised so that it complements the Batteries Regulation with a similar objective to increase circularity. The new proposal will be fully complementary with the Batteries Regulation. Both initiatives are prepared in close cooperation, in the view of significant increase in the electrification of passenger cars, buses and, to a lesser extent, vans and lorries that can be observed nowadays and the observed trend of its rapid growth. All the batteries used in vehicles are within the scope of Batteries legislation. Both: the design of batteries and their treatment, when removed, is regulated by the Batteries Regulation. The new proposal replacing ELV Directive will clearly oblige economic operators to ensure that batteries used in vehicles are designed to allow for their removal, as well as oblige the ATFs to remove the battery from the ELVs before shredding, as a part of a depollution treatment of the vehicle. The main overlaps between these two legal acts regard: (a) prohibition using certain substances in automotive batteries, (b) treatment of waste vehicle batteries. The Batteries Regulation provides restrictions related to use of mercury and cadmium in certain types of batteries. In case of cadmium, it foresees an exemption for batteries used in vehicles that benefit from a derogation under Annex II to ELV Directive. Moreover, the Batteries Regulation indicates that all exemptions from restrictions on the use of lead, mercury, cadmium or hexavalent set out in Annex II to the ELV Directive (points 5(a) and 5(b) (lead) and 16 (cadmium)) concerning batteries, should be complied with by battery manufacturers[23]. The preferred policy option envisages, that these exemptions for the use of lead and cadmium will, following a transition period, be taken up by the Batteries Regulation and removed from the new regulation replacing ELV Directive. Consequently, all batteries-related restrictions and exemptions therefrom will be regulated in the Batteries Regulation. The Batteries Regulation sets out comprehensive rules concerning the design, collection, treatment and recycling of batteries. It also reinforces

[23] Article 6(2) of the Batteries Regulation states: "In addition to the restrictions set out in Annex XVII of Regulation (EC) No 1907/2006 and in Annex II of Directive 2000/53/EC, batteries shall not contain substances for which Annex I contains a restriction unless they comply with the conditions of that restriction".

	the principle of extended producer responsibility for the collection, transport and treatment/recycling of all batteries, including those coming from vehicles. Similar changes are contained in the future legislation on ELV, for the rest of the vehicle. This will result in ensuring coherence between these two initiatives.
7	**Waste Shipment Regulation[24] (WSR) / Waste Shipment Regulation Proposal[25]**
Legislative or non-legislative?	Legislative, mandatory. Status: Regulation in force; Commission proposal for a Regulation, repealing the previous one, was adopted on 17 November 2021.
Brief description	The Waste Shipment Regulation applies to shipments of waste: • Between EU countries within the EU borders or transiting via non-EU countries; • Imported into the EU from non-EU countries; • Exported from the EU to non-EU countries; • In transit through the EU, on the way from or to non-EU countries. Shipments of hazardous waste from the EU to non-OECD countries are prohibited, while shipments of hazardous waste between Member States or from the EU to OECD countries are subject to the "prior information and consent procedure". Shipments of "green-listed" non-hazardous wastes within the EU and OECD do not usually require the prior consent of the authorities, but information requirements apply. In applying the regulation all parties involved must ensure that waste is managed in an environmentally sound manner, respecting EU and international rules, throughout the shipment process and when it is recovered or disposed of. The proposal for a new WSR adopted in November 2021 aims to (a) improve the functioning of internal market for waste fit for re-use and recycling, which would result in boosting the market for secondary raw materials, (b) guarantee that waste are shipped outside the EU only when they can be managed in environmentally sound manner and (c) tackle illegal shipments of waste. The proposal simplifies procedures for shipments of waste within the EU through their digitalisation. The proposal would allow the export of waste to non-OECD countries only if they notify to the Commission their willingness to import EU waste and demonstrate ability to deal with it in a sustainable manner. Exports of waste to OECD countries will be closely monitored. Economic operators engaged in such export activities will be obligated to set up third party audit schemes to ensure that the facilities treating their waste manage it in an environmentally sound manner. The proposal strengthens enforcement of the Regulation, lays down more stringent provisions on inspections and penalties and enables OLAF to investigate waste trafficking in the EU.
Interaction with the ELV and 3R type-	The new legislative proposal replacing the ELV Directive will not contain any specific provisions on the shipment of ELVs. All shipments

[24] Regulation (EC) No 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste (OJ L 190, 12.7.2006, p. 1).

[25] Proposal for a Regulation of the European Parliament and of the Council on shipments of waste and amending Regulations (EU) No 1257/2013 and (EU) No 2020/1056 (COM/2021/709 final).

approval revision	of ELVs, within the EU as well as with third countries, will continue to be governed by rules of the WSR. As, prior to their depollution, ELVs are classified as hazardous waste, their export to a third country outside the OECD is banned. The new legislative proposal replacing the ELV Directive also aims to clarify when a used vehicle becomes an ELV, which is crucial for determination if the WSR applies to shipment of such vehicles. This clarification will be done by amending the definition of ELV, taking into consideration the existing waste shipment correspondents' guidelines[26]. The new legislative proposal will also establish restrictions regarding the export of used vehicles not classified as ELVs. Such exports will be authorised only provided that the vehicle has a valid roadworthiness certificate. This change is not directly linked with the WSR, as it will not establish similar procedures as when exporting waste, but is necessary to avoid the export of old polluting and not roadworthy vehicles to third countries.
8	**Regulation on Registration, Evaluation, Authorisation and Restriction of Chemicals[27] (REACH)**
Legislative or non-legislative?	Legislative, mandatory. Status: Regulation in force; Commission proposal for amending regulation expected to be adopted in 2023.
Brief description	REACH is the key Union legal instrument to ensure the safe use of chemical substances, as such, in mixtures or in articles. REACH aims to ensure a high level of protection of human health and the environment from risks resulting from the intrinsic properties of chemicals, as well as the free circulation of substances on the internal market, while enhancing competitiveness and innovation. REACH is organised around four processes, namely the registration, evaluation, authorisation and restriction of chemicals. Manufacturers and importers of substances are generally required to gather information on the properties of their chemical substances and to identify the uses and conditions under which they can be safely used. Substances manufactured or imported in quantities exceeding 1 tonne per year must be submit a registration dossier to ECHA containing information about the substance. The European Chemicals Agency (ECHA) is empowered to assess the completeness and compliance of the registrations during the evaluation process. Restrictions of substances included in Annex XVII to REACH ban or limit the manufacturing, placing on the market or use of the substances concerned (varying from a complete ban to a restricted use under specific conditions), including as part of articles (term 'article' is understood under REACH as products). Restrictions can be adopted in case of an unacceptable risk to human health or the environment (Art.68(1)), following a dedicated procedure involving the agency ECHA (Art. 69-73), or, via a simplified procedure, that does not require the involvement

[26] Cf : https://ec.europa.eu/environment/pdf/waste/shipments/correspondents_guidelines9_en.pdf

[27] Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC (OJ L 396 30.12.2006, p. 1).

	of ECHA for substances presenting specific hazards (carcinogenicity, germ cell mutagenicity or reproductive toxicity on Categories 1A and 1B) and could be used by consumers (Art. 68(2)). The Chemicals Strategy for Sustainability announces the targeted revision of the REACH Regulation, which will be limited to achieving the specific aims set out in the strategy. Considered measures include, among others, extending the generic approach to risk management (currently in REACH Art 68(2), restrictions based on hazardousness) to other categories of substances and strengthening enforcement. The revision will not impact the scope of REACH.
Interaction with the ELV and 3R type-approval revision	The main interplay between these two legal acts regard restrictions on use of certain substances in vehicles and its parts. Although these products fall into the scope of REACH, the current Annex XVII applies to them only to the extent to which vehicles are covered in some specific substance restrictions. Specific restrictions on use of lead, mercury, cadmium or hexavalent chromium, as well as exemptions from them, are laid down in ELV Directive. The preferred option envisages that: (a) any new vehicle-related limitation in uses of certain substances will be addressed under REACH or as appropriate under the Batteries Regulation or be covered under the POPs Regulation, using the existing procedures; (b) existing restrictions under ELV on four substances will be maintained in the new Regulation and reviewed via delegated acts with the support of ECHA. The scope of the assessment of exemptions for the four substances remaining under ELV legislation will be widened so that it would cover not only the cases of 'unavoidable use' of these substances (Article 4(2) of the ELV Directive) but also socio-economic, health and environmental impacts[28]. The possibility of a transfer of the restrictions on the four substances and any exemptions therefrom to REACH can be reassessed in the future once the ongoing REACH review is concluded and sufficient implementation time has elapsed to assess its functioning.
9	**Regulation on persistent organic pollutants (POPs)[29]**
Legislative or non-legislative?	Legislative, mandatory. Status: Regulation in force.
Brief description	The Stockholm Convention[30] is implemented in the EU through the POPs Regulation, which bans or limits the production of persistent organic pollutants and their use in both chemical products and articles.
Interaction with the ELV and 3R type-approval revision	The POPs Regulation applies to vehicles. Restrictions on POPs affect not only the substances and materials used for the production of new vehicles but also the treatment of materials recovered from ELVs, which subsequently may impact the ability of ELV operators to fulfil the targets specified in new proposal. The most important POP-related issue for the treatment of ELVs relates to the presence and disposal of the flame retardant decabromodiphenyl

[28] It will be similar as the assessment used when evaluating applications for authorisation under REACH.

[29] Regulation (EU) 2019/1021 of the European Parliament and of the Council of 20 June 2019 on persistent organic pollutants (OJ L 169, 25.6.2019, p. 45–77).

[30] More information on the Stockholm Convention on Persistent Organic Pollutants http://www.pops.int/TheConvention/Overview/TextoftheConvention/tabid/2232/Default.aspx

	ether (DecaBDE) and other POP-BDE in shredder residue. The disposal and recovery of waste containing such POPs and the placing on the market or recovered materials from ELVs containing POPs is regulated through the POPs Regulation. The recently adopted Regulation that amends the waste annexes of the POPs Regulation[31] further reduces the limit values for substances such as POP-PBDEs and HBCDD in waste and introduces limits on newly listed substances such as PFOA and PFHxS.
10	**Directive on the Restriction of Hazardous Substances in Electrical and Electronic Equipment (RoHS)[32]**
Legislative or non-legislative?	Legislative, mandatory. Status: Directive in force.
Brief description	The RoHS Directive aims to prevent the risks posed to human health and the environment related to the management of electronic and electrical waste. It does this by restricting the use of specific hazardous substances in electronic and electrical equipment (EEE) if they can be substituted by safer alternatives. These restricted substances include certain heavy metals, flame retardants and plasticizers. It thus includes a set of restrictions for a specific sub-set of products. The RoHS Directive also promotes the recyclability of EEE, as EEE and its components that have become waste contain fewer hazardous substances due to the restrictions. The RoHS Directive empowers the Commission to, by means of delegated acts, change or add restrictions with a view to achieving the objectives set out in Article 1, i.e. to contribute "to the protection of human health and the environment, including the environmentally sound recovery and disposal of waste EEE."
Interaction with the ELV and 3R type-approval revision	RoHS Directive, similarly as WEEE Directive, excludes from its scope of application (a) means of transport for persons or goods, except for electric two-wheel vehicles which are not type-approved, and (b) equipment which is specifically designed, and is to be installed, as part of another type of equipment that is excluded or does not fall within the scope of the Directive, which can fulfil its function only if it is part of that equipment, and which can be replaced only by the same specifically designed equipment. Therefore, also in this case, the new legislation on ELV will be complementary to the existing legal act on EEE. It also needs to be noted, that there is a group of EEE used in vehicles, which falls into the scope of RoHS Directive, for example equipment which is not specifically designed for vehicles but could be used in them. This EEE shall be compliant with RoHS Directive requirements. As in certain situations determination of whether a given EEE falls into the scope of ELV or RoHS Directive was in practice problematic, the new legislative proposal on ELV aims to provide a clearer distinction between the scopes of these two legal acts. It should be also noted, that the rationale of restrictions and derogations therefrom is based on different principles in these two regimes. The ELV Directive focuses on the criterion of 'avoidability' of certain uses of the

[31] Regulation (EU) 2022/2400 of the European Parliament and of the Council of 23 November 2022 amending Annexes IV and V to Regulation (EU) 2019/1021 on persistent organic pollutants (OJ L 317, 9.12.2022, p. 24–31).

[32] Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (OJ L 174, 1.7.2011, p. 88–110).

	heavy metals in a given application, whereas the RoHS Directive takes into account the availability of substitutes, the socioeconomic impact of substitution, potential adverse impacts on innovation and, where relevant, life-cycle thinking on the overall impacts of the exemption. This distinction will be kept also in the future legislation.
11	**European Climate Law[33]**
Legislative or non-legislative?	Legislative, mandatory. Status: Regulation in force.
Brief description	The European Climate Law writes into law the goal set out in the European Green Deal for Europe's economy and society to become climate-neutral by 2050. The law also sets the intermediate target of reducing net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels and envisages a process for setting a 2040 climate target.
Interaction with the ELV and 3R type-approval revision	The revision of the ELV Directive contributes to achieving climate neutrality both for the automotive sector and other connected industrial sectors. With the electrification of the vehicle fleet, the production and end-of life stages become relevant for the carbon footprint of a vehicle, compared to the use phase. The new legislation will contribute to decreasing the carbon footprint of vehicles through new measures favouring the use of secondary materials in the production of new vehicles. Secondary materials to be used in the automotive sector generally have a lower carbon intensive footprint than primary materials. This is especially the case for aluminium, steel, copper and CRMs like magnesium and REEs which are energy intensive to produce. The same counts for plastics from fossil fuel based production where recycling avoids incineration at end-of life and related carbon emissions. In addition, the new legislation will lay down new measures to increase the quality of metal scraps from ELVs, so that they can be used for high quality recycling/reprocessing by the steel or aluminium industry. The use of scrap is one of the main drivers for the decarbonisation of these industries.
12	**Regulation on emission standards for new passenger cars and vans[34] and proposal of its amendment[35]**
Legislative or non-legislative?	Legislative, mandatory. Status: Regulation in force; Commission proposal for amending regulation was adopted on 14 July 2021. A compromise text was agreed by the co-legislators on 16 November 2022 and should be published in the course of 2023 in the EU Official Journal.
Brief description	This regulation lays down CO_2 emission performance requirements for

[33] Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law') (OJ L 243, 9.7.2021, p. 1–17).

[34] Regulation (EU) 2019/631 of the European Parliament and of the Council of 17 April 2019 setting CO_2 emission performance standards for new passenger cars and for new light commercial vehicles, and repealing Regulations (EC) No 443/2009 and (EU) No 510/2011 (OJ L 111, 25.4.2019, p. 13–53).

[35] 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 (COM/2021/556 final).

	new passenger cars and light commercial vehicles in order to contribute to the achievement of the reduction targets from the Paris Agreement[36]. It sets CO_2 reduction targets for the EU fleet for new registrations of vehicles categories M_1 and N_1. The Regulation contains also incentives for the update of zero- and low-emission vehicles. The proposal for amending this regulation aims to align its ambition in order to contribute to the achievement of the reduction targets from the European Climate Law and sets more ambitious EU fleet targets for 2030 and lays down a 100% EU fleet-wide reduction target for new passenger cars and new vans to apply from 1 January 2035 onwards.
Interaction with the ELV and 3R type-approval revision	The Regulation on CO_2 emission standards focuses on the emissions generated in the use phase of vehicles categories M_1 and N_1. The new regulation replacing ELV and 3R type-approval Directives will focus on the manufacture and end-of life phase of these vehicles. In the view of the ongoing electrification process of the automotive fleet, in particular for these vehicles categories, the emissions generates during the production and treatment phase. As described above, reduction of CO_2 emissions will be achieved mainly by ensuring high quality recycling, strengthening the possibility to retrieve secondary raw materials from the ELVs and stimulating their use in the manufacture of new cars. Therefore, the new legislative proposal will be complementary to regulation on emission standards.
13	**Regulation setting CO_2 emission performance standards for new heavy-duty vehicles[37] and proposal of its amendment[38]**
Legislative or non-legislative?	Legislative, mandatory. Status: Regulation in force; Commission proposal for amending regulation was adopted on 14 February 2023.
Brief description	This regulation lays down CO_2 emission performance requirements for new heavy-duty vehicles in order to contribute to the achievement of the reduction targets from the Paris Agreement. It sets CO_2 reduction targets for the EU fleet for 2025 and 2030 – respectively 15% and 30% – compared to the reported emissions generated in the period 1 July 2019 – 30 June 2020. The Regulation contains also incentives for the update of zero- and low-emission vehicles. The proposal for an amending regulation sets CO_2 emissions reduction targets for certain types and sub-groups of heavy-duty vehicles and introduces binding CO_2 emissions reduction targets for heavy-duty vehicles for 2035 and 2040 onwards, respectively 65% and 90% – compared to the reported emissions generated in the period 1 July 2019 – 30 June 2020. It also widens the scope of this instrument i.e. to vehicles belonging to M_2, M_3, O_3 and O_4 and provides new rules on the monitoring and reporting.
Interaction with the ELV and 3R type-	The Regulation on CO_2 emission standards focuses on the emissions generated in the use phase of vehicles within its scope. The new

[36] Paris Agreement (OJ L 282, 19.10.2016, p. 4).
[37] Regulation (EU) 2019/1242 of the European Parliament and of the Council of 20 June 2019 setting CO_2 emission performance standards for new heavy-duty vehicles and amending Regulations (EC) No 595/2009 and (EU) 2018/956 of the European Parliament and of the Council and Council Directive 96/53/EC (OJ L 198, 25.7.2019, p. 202–24).
[38] Proposal for a Regulation of the European Parliament and of the Council amending Regulation (EU) 2019/1242 as regards strengthening the CO_2 emission performance standards for new heavy-duty vehicles and integrating reporting obligations, and repealing Regulation (EU) 2018/956 (COM(2023) 88 final).

approval revision	regulation replacing ELV and 3R type-approval Directives will focus on the manufacture and end-of life phase of these vehicles. Certain obligations will apply also to these heavy-duty vehicles: using certain heavy metals in their components will be restricted, manufacturers will have to provide information on their dismantlability and users will be obliged to hand them to the authorised treatment facilities at their end-of life. The carbon footprint of these vehicles will be decreased, as valuable secondary raw materials, having a much less carbon intensive footprint than primary material will be retrieved from the vehicles and made available for the manufacture of new vehicles. The new regulation will also improve the quality of recycling operations, in particular with respect to steel and aluminium scrap, what will also contribute to the decarbonisation of automotive sector.
14	**Directive on Vehicle Registration Documents[39]**
Legislative or non-legislative?	Legislative, mandatory. Status: Directive in force; Commission proposal for a revision of this directive expected to be adopted in 2023.
Brief description	The Directive harmonises the form and content of vehicle registration certificates. Such certificates should be recognized by other Member States for identification of vehicle in international traffic or for its re-registration in another Member State. The Directive obliges the Member States to record electronically data on all vehicles registered on their territory and to ensure, that technical vehicle data is made available for the purpose of periodic roadworthiness testing. The directive specifies also, that in the event that the competent authority of a Member State receives notification that a vehicle has been treated as an ELV, the registration of that vehicle shall be cancelled permanently and information to that effect should be added to the electronic register.
Interaction with the ELV and 3R type-approval revision	One of the objectives of the ELV revision is to address the problem of 'missing vehicles'. This will be done, inter alia, by introducing changes regarding registration, re-registration and de-registration of vehicles. Firstly, the scope of information exchanged among the Member States should also include reasons of vehicles' de-registration. Secondly, Member States should report to the Commission the number of vehicles registered, de-registered, treated as ELVs and shipped outside the EU, and to this end, the Commission Decision 2005/293/EC[40] will be supplemented. The new legislative proposal replacing the ELV Directive aims also to introduce more stringent rules on export of used vehicles allowing for such exports provided that such a vehicle has a valid roadworthiness certificate. In order to ensure proper enforcement, the Vehicle Identification Number (VIN) of such vehicles should be made available to customs authorities Introducing of these changes would be done through the future roadworthiness package[41]. The objective of the latter is to ensure better

[39] Council Directive 1999/37/EC of 29 April 1999 on the registration documents for vehicles (OJ L 138, 1.6.1999, p. 57–65).
[40] 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 (OJ L 94, 13.4.2005, p. 30–33).
[41] Tougher vehicle testing rules to save live (europa.eu), Vehicle safety – revising the EU's roadworthiness package (europa.eu)

	exchange of relevant vehicle roadworthiness data at EU level in order to enforce road safety measures more effectively. Although the objective of revisions are different, close cooperation within the Commission on these proposals would ensure the cohesion of these two initiatives and achievements of theirs objectives.
15	**Roadworthiness Directives**[42]
Legislative or non-legislative?	Legislative, mandatory. Status: Directives in force; Commission proposals for revision of these directives expected to be adopted in 2023.
Brief description	The Roadworthiness Directives aim to increase road safety in the EU and to ensure the environmental performance of vehicles, by means of regular testing of vehicles throughout their operational lifetime. They contribute also to reducing air pollutant emissions by detecting more effectively vehicles that are over-emitting due to technical defects, as the rules require periodic technical inspections and roadside inspections. In the view of digital transformation of EU road transport, the revision of these Directives aims to improve road safety, contribute to more sustainable and smarter mobility and to facilitate and simplify the free movement of people and goods in the Union. The specific objectives include ensuring the functioning of modern electronic safety components, advanced driver assistance systems and automated functions during the vehicles' lifetime, performing meaningful emission tests during vehicle inspections and improving the electronic storage, read-out and exchange of roadworthiness-relevant vehicle identification and status data between EU Member States as well as performance data, building amongst others also on the digitalisation of administrative documents and certificates.
Interaction with the ELV and 3R type-approval revision	One of the objectives of the ELV revision is to increase the collection of ELVs in the EU. This aim is to be achieved, inter alia, by introducing requirements concerning export of used vehicles outside the EU, making exports dependent on the vehicles being roadworthy. Therefore, the assessment of vehicle's roadworthiness will be even more important under the new legal framework. Introducing these requirements will contribute to increasing the safety on the roads also outside the EU, as well as the level of environmental protection.
16	**Clean Vehicles' Directive**[43]
Legislative or non-legislative?	Legislative, mandatory. Status: Directive in force.
Brief description	The directive aims at promoting and stimulating the market for clean and energy-efficient vehicles. It requires Member States to ensure that contracting authorities and contracting entities take into account lifetime energy and environmental impacts, including energy consumption and emissions of CO_2 and of certain pollutants, when procuring certain road transport vehicles categories. The Directive defines 'clean light-duty

[42] Directive 2014/45/EU of the European Parliament and of the Council of 3 April 2014 on periodic roadworthiness tests for motor vehicles and their trailers and repealing Directive 2009/40/EC (OJ L 127, 29.4.2014, p. 51–128) and Directive 2014/47/EU of the European Parliament and of the Council of 3 April 2014 on the technical roadside inspection of the roadworthiness of commercial vehicles circulating in the Union and repealing Directive 2000/30/EC (OJ L 127, 29.4.2014, p. 134–218).

[43] Directive (EU) 2019/1161 of the European Parliament and of the Council of 20 June 2019 amending Directive 2009/33/EC on the promotion of clean and energy-efficient road transport vehicles (OJ L 188, 12.7.2019, p. 116–130).

	vehicles' by referring to emission levels and 'clean heavy-duty vehicles' referring to types of fuels used by this vehicle. The Directive sets separate targets for each Member State, depending on the vehicle category, for the periods 2.08.2021 – 13.12.2025 and 01.01.2026 – 31.12.2030. It applies to vehicles procured through purchase, lease, rent or hire-purchase contracts, public service contracts and service contracts.
Interaction with the ELV and 3R type-approval revision	The Directive aims to ensure, that public authorities procure vehicles that do not emit certain amounts of substances to the air during the usage phase. It does not allow for addressing other important environmental aspects, such as circularity in design – it mentions recyclability aspects only in a recital[44], which focuses further on batteries. This legal instrument cannot be used currently to address issues of vehicles' reusability, recyclability and recoverability. Therefore, in order to ensure that circularity is also taken into account then procuring vehicles, the revision of the Clean Vehicles' Directive, currently planned for 2027, will aim to include minimum green public procurement criteria related to vehicles circularity – their recyclability, reusability and recoverability characteristics in the revised Directive.

[44] Recital 20.

ANNEX 11: 3R TYPE-APPROVAL DIRECTIVE EVALUATION REPORT

EVALUATION of Directive 2005/64/EC on the type-approval of motor vehicles with regard to their reusability, recyclability and recoverability ('3R' Type-approval Directive)

Contents

Glossary

Term or acronym	*Meaning or definition*
3R	Reusability, recyclability and recoverability (also reuse, recycling and recovery)
3R Directive	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
ACEA	European Automobile Manufacturers Association
ATF	Authorised Treatment Facility
CFRP	Carbon-fibre-reinforced plastic
ELV	End-of-life vehicles
ELV Directive	Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of life vehicles
EU	European Union
EU-27	The 27 Member States of the European Union
IDIS	International Dismantling Information System
KBA	German Federal Motor Transport Authority (*Kraftfahrt-Bundesamt*)
REACH	Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)
SMEs	Small and medium enterprises
SWD	Staff Working Document
TEC	Treaty establishing the European Community
TFEU	Treaty on the Functioning of the European Union
UNECE	United Nations Economic Commission for Europe

11.1 Introduction

Directive 2005/64/EC on the type-approval of motor vehicles with regard to their reusability, recyclability and recoverability[45] (hereinafter, the "3R Directive") was adopted in 2005. This Directive is part of the EU type-approval framework, which ensures that motor vehicles meet certain safety, environmental, and technical standards before they can be sold and used in the European Union (EU). The framework is based on several pieces of EU legislation that set out the requirements for type approval. The type-approval process is administered by national type-approval authorities and involves the review of technical and test data and the performance of tests to ensure that the vehicles meet the required standards.

The 3R Directive is the main piece of EU legislation linking the design of new vehicles with their reusability, recyclability and recoverability. The main motivation for its adoption was the need to ensure coherence between the type-approval procedures[46] and the obligations contained under the Directive 2000/53/EC on end-of-life vehicles[47] (hereinafter referred to as the "ELV Directive"). The latter contains rules on the collection, treatment and recovery of end-of-life vehicles and their components, as well as restrictions on hazardous substances in new vehicles.

Neither the 3R Directive, nor the ELV Directive have undergone substantial revision since their respective adoptions in 2005 and 2000. Meanwhile, the way type-approval is carried out in the EU has known plenty of changes. The European regulatory framework has been revised to restore the confidence in the type-approval system and to include controls during market surveillance. Regulation (EU) 2018/858[48] has introduced from September 2020 new related EU type-approval rules (better quality and independence of vehicle type-approval and testing authorities, more controls of technical services, more checks on the roads, new EU wide recalls and penalties).

11.1.1 11.1.1 Purpose of the evaluation

This evaluation is being carried out following the presentation of the European Green Deal[49] in December 2019 as a new growth strategy that will foster the transition to a climate-neutral, resource-efficient and competitive economy. Both the European Green Deal and the new Circular Economy Action Plan[50] contain a commitment to review the legislation on end-of-life vehicles with the aim 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". This is in line with the New Industrial Strategy[51], which promotes continued efforts towards sustainable

[45] Directive 2005/64/EC on the type-approval of motor vehicles with regard to their reusability, recyclability and recoverability.
[46] Council Directive 70/156/EEC on the approximation of the laws of the Member States relating to the type-approval of motor vehicles and their trailers.
[47] Directive 2000/53/EC on end-of life vehicles.
[48] Regulation (EU) 2018/858 on the approval and market surveillance of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles.
[49] COM(2019) 640 final, The European Green Deal.
[50] COM(2020) 98 final, A new Circular Economy Action Plan.
[51] COM(2020) 102 final, A New Industrial Strategy for Europe, COM(2021) 350 final, Updating the 2020 New Industrial Strategy: Building a stronger Single Market for Europe's recovery.

product design to strengthen the competitiveness of Europe's industry. The reason for this being that, increasing circularity in the automotive sector can deliver substantial material savings throughout the value chain and production processes, generate extra value and unlock economic opportunities.

To confirm the need for a review of the end-of-life vehicle legislation, an evaluation of the ELV Directive[52] was carried out and published in March 2021. This evaluation also touched upon some of the 3R elements and illustrated that the 3R Directive provides useful information how to demonstrate reusability, recyclability and recoverability. However, some of its provisions were found to be unclear, leaving room for interpretation that could weaken its objectives. In addition, the evaluation of the ELV Directive pointed out that no monitoring mechanism for the implementation of the 3R rates has been put in place by the Member States or the vehicle manufacturers. Lastly, this evaluation raised that the 3R Directive has not appeared to incentivise the transition to a circular economy in the automotive sector. While the latter was not an explicit objective of the Directive, it potentially affects its relevance in today's context of the new Circular Economy Action Plan.

Although the evaluation of the ELV Directive contains brief conclusions on the functioning of the 3R Directive, no formal evaluation of the latter has so far been carried out. Hence, the purpose of this evaluation of the 3R Directive is to analyse to what extend the Directive has achieved its objectives and has led to environmental improvements. In line with the Better Regulation Guidelines[53], the evaluation examines five evaluation criteria, namely: the effectiveness, efficiency, coherence, EU added value and relevance. In particular, the evaluation investigates the following:

- ✓ **Effectiveness:** the extent to which the actions defined under the Directive have been implemented and whether this has resulted in achieving the 3R objectives;
- ✓ **Efficiency:** assessing whether the obligations arising from the implementation of the 3R Directive have been implemented in a cost-effective way and if there is a potential for further synergies to strengthen delivery while minimising costs and administrative burden, including impact on SMEs;
- ✓ **Coherence:** assessing coherence of the 3R Directive with the EU wide policy objectives on circular economy, as well as possible inconsistencies and overlaps of the 3R Directive with other related EU legislation;
- ✓ **EU added value:** assessing what has been the added value of the 3R Directive compared to what Member States could have achieved acting alone at national or international level;
- ✓ **Relevance:** assessing whether the issues addressed by the 3R Directive still match current needs and contribute to solutions to issues addressed by wider EU policies on circular economy, climate change, plastics, resource efficiency, raw materials, etc.

[52] SWD(2021) 60 final Commission Staff Working Document Evaluation of Directive (EC) 2000/53 on end-of-life vehicles.
[53] https://ec.europa.eu/info/sites/default/files/br_toolbox_-_nov_2021_-_chapter_6.pdf

Since the adoption of the 3R Directive in 2005, the automotive sector has undergone considerable changes. The ongoing transition to greener, decarbonised mobility represents a further transformation of the business model and manufacturing practices of the sector, notably with the increase in rare earth elements used in electric vehicles, which are mainly imported from China. In addition, the current geo-political landscape and the related supply chain disruptions and corresponding shortages of the early 2020s stress the relevance of moving towards more circularity in the automotive industry through improving recycling efficiency on the one hand and increasing the use of recycled materials in the production of new vehicles on the other hand. In that way, a further circular transition would allow for improved mitigation of price volatility and supply risk.

The Commission decided to follow a back-to-back approach in which the evaluation of the 3R Directive and the joint impact assessment for the revision of both the ELV and the 3R Directive are conducted in parallel as a single process. The findings of the 3R evaluation will be used to provide further reflection on where improvements may be needed at the vehicle design and type-approval stage to further facilitate the transition to a circular automotive industry. Potential issues or pitfalls of the back-to-back approach were identified on a continuous basis. An example of this is the formulation of problems identified and preliminary policy options following the evaluation, which were subsequently targeted in the impact assessment of the joint revision of the ELV and the 3R Directive.

11.1.2 11.1.2 Scope of the evaluation

This evaluation covers Directive 2005/64/EC on the type-approval of motor vehicles with regard to their reusability, recyclability and recoverability and Commission Directive 2009/1/EC amending, for the purposes of its adaptation to technical progress, Directive 2005/64/EC (the 3R Directive).

It should be noted that the current 3R Directive only sets requirements for the light-duty segment –i.e., M1 and N1 vehicles (cars and vans). Today, no similar legislation is in place for the heavy-duty segment, or for L-category vehicles (which include motorcycles). This is consistent with the scope of the ELV Directive, from which the 3R Directive derives.

The evaluation covers the period from the adoption of the 3R Directive in 2005 up until the recent past (2022). Geographically, the evaluation focuses on the achievements of the 3R Directive in the European Union. Hence, the evaluation covers the EU-27 Member States and additionally considers the implementation in former Member State, the United Kingdom. Therefore, this report analyses both the issues deriving from the nature of the legislation itself as well as those deriving from its transposition and implementation in Member States, including monitoring and enforcement.

However, the EU automotive sector is not an isolated sector, since many of the manufacturers and their suppliers selling vehicles on the EU market are global players. These players come in direct contact with other requirements in terms of vehicle design and production on other major market, which will be considered throughout the analysis.

This staff working document is supported by a study on the evaluation of the 3R Directive and the impact assessment for the review of the ELV and the 3R Directive and its effectiveness, which was carried out from August 2020 to December 2022[54].

The methodology followed for the evaluation of the 3R Directive included a stakeholder consultation and the performance of ten targeted interviews with type-approval stakeholders, followed by targeted consultation through a survey of additional stakeholders (type-approval authorities, technical services, vehicle manufacturers and component suppliers) and a targeted review of the 3R Directive and its linkages to the ELV Directive[55].

This evaluation of the 3R Directive has several limitations. Firstly, it is difficult to accurately measure the environmental impact of the directive, as this would have required long-term data collection and analysis, both on the design characteristics of new vehicles as they enter the EU market and on their treatment at their end of life. Due to a lack of detailed monitoring requirements in both the 3R and the ELV Directives, such detailed historic data are not available. Second, the impact of the 3R Directive on the automotive industry and the wider economy is difficult to isolate from that of the 3R Directive and from technical progress and general automotive industry trends towards greater sustainability. The costs and benefits of the directive for vehicle manufacturers, consumers, and the environment (and their complex interactions across value chains) were particularly difficult to assess quantitatively.

11.2 What was the expected outcome of the intervention?

To minimise the environmental impact of vehicles as they reach their end-of-life stage, vehicle manufacturers should take incorporate waste minimisation into vehicle design considerations. The 3R Directive therefore establishes the link between the design and production stages of certain road vehicles and their end-of-life treatment by setting type-approval requirements for these vehicles regarding their reusability, recyclability and recoverability. It lays down the administrative and technical provisions for the implementation of the minimum rates for the reuse and recovery of end-of-life vehicles set out in Article 7 of the ELV Directive. Vehicles of categories M1 and N1 can only be placed on the European internal market if the manufacturer is able to demonstrate that vehicles are either re-usable, recyclable, or recoverable at least up to the '3R rates' of reusability, recyclability and recoverability set by the 3R Directive.

11.2.1 11.2.1 Description of the intervention and its objectives

The evaluation of the ELV Directive describes how discussions on waste from ELVs date back to the 1970s. Back then, the main concerns were the illegal disposal of hazardous waste and the difficulties to treat plastic waste derived from ELVs. Increasing quantities

[54]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.

[55]The fourteen-week public stakeholder consultation was carried out between 20 July and 26 October 2021 as well as an extensive targeted stakeholder consultation carried out late 2021 and early 2022, stakeholder workshops and Member State meetings in March 2022, and extensive desk research.

of plastic waste were found in the Light Shredder Residues[56] (LSR) and, due to their limited compacting characteristics, took up a large amount of volume within landfills, while their incineration was challenging as it required pre-treatment operations.[57] In addition, other environmental and health risks, such as contamination of the metal scrap with heavy metals, raised public concerns.

As a response, under the Article 175(1) TEC (current Article 192 TFEU), the ELV Directive was adopted in 2000 to minimise the impact of ELVs on the environment and to improve the environmental performance of all the economic operators involved in the life-cycle of vehicles. To achieve this, the ELV Directive set rules on the collection, treatment and recovery of end-of-life vehicles and their components, as well as restrictions on hazardous substances in new vehicles. These rules include quantified **targets (by weight) for the re-use and recycling (85%) of ELVs** as well **as re-use and recovery (95%) of components** from ELVs.

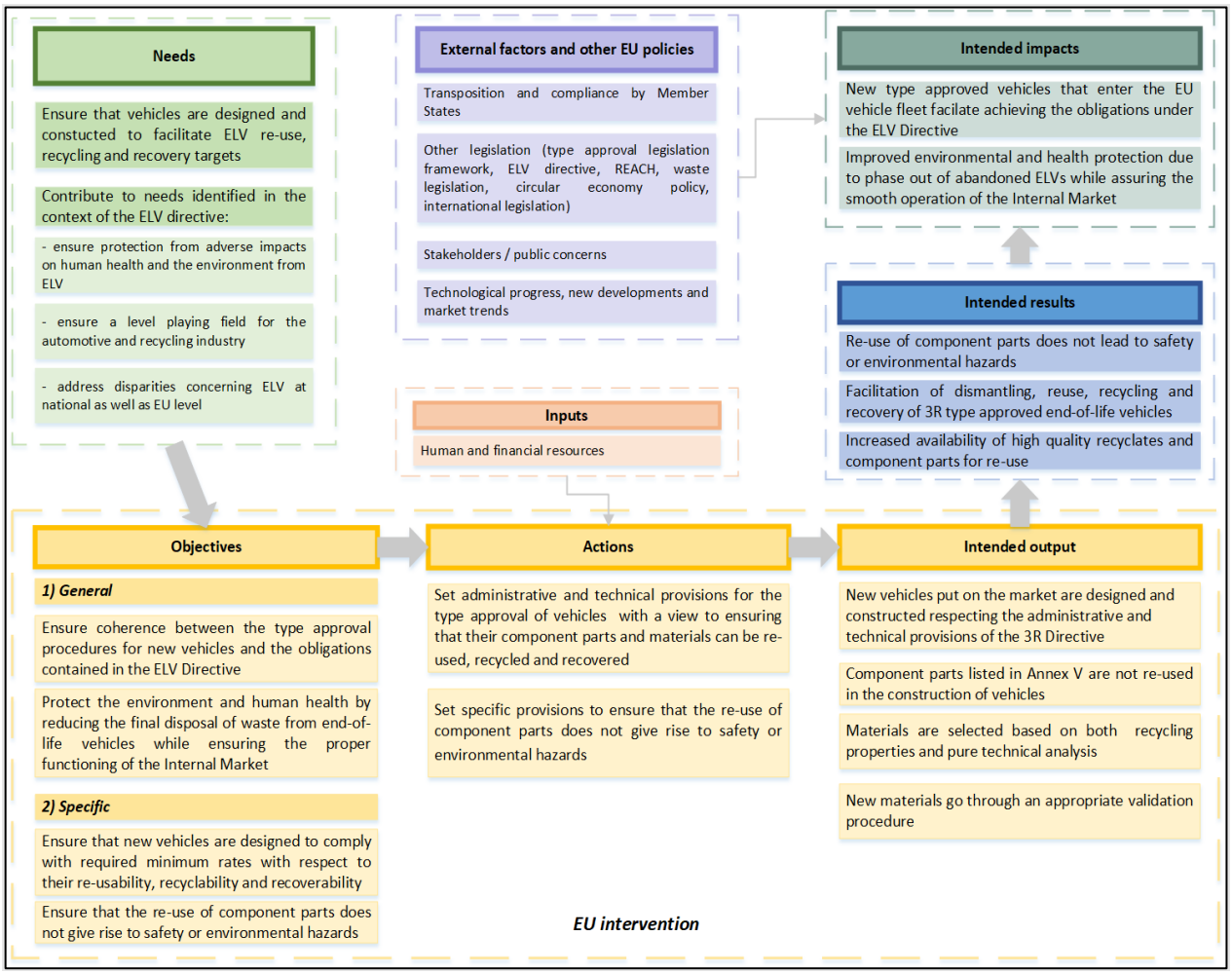
For such targets to be achieved, the ELV Directive requires that vehicles should be designed and manufactured in a way that allows this. The need to incorporate end-of-life measures in the design of new vehicles was first realised in the 1990s.[58] At that time, bilateral agreements were concluded between vehicle manufacturers and Member States – first in France and the Netherlands, later in other Members States – that aimed at setting realistic recycling and recovery targets. Subsequently, the concept of 'design to be recycled' was brought into the design criteria of vehicles meant for the EU market by vehicle manufacturers active in research in recycling processing.

To translate the above into binding legal requirements at EU level, the ELV Directive committed to the preparation of an amendment for the European vehicle type-approval legislation in which new vehicle models are tested and granted type-approval to meet a minimum set of regulatory and technical requirements before being placed on the EU market (Article 7(4) of the ELV Directive).

Figure 11.1 gives an overview of how the overarching needs or problems were translated into general and specific objectives for the 3R Directive. These objectives were in turn translated into specific activities at EU level. That way, the 3R Directive aimed at ensuring the dual objectives of (i) ensuring the coherence between the type-approval procedures for new vehicles and the obligations contained in the ELV Directive and (ii) protecting the environment and human health by reducing the final disposal of waste from ELVs while ensuring the proper functioning of the Internal Market. The intervention logic of how the Directive was expected to work can be summarised along two main actions:

[56]Light Shredder Residue are all the light fractions left over from recycling ELVs. This material contains many different materials: plastics, rubber, glass, sand, textiles, wood, metals, and others.
[57]The treatment of exhaust gas of waste incinerators was less developed at that time.
[58]COM(2004) 162 final. Proposal for a Directive on the type-approval of motor vehicles with regard to their re-usability, recyclability and recoverability and amending Council Directive 70/156/EEC.

Figure 11.1 – Intervention logic of type-approval Directive 2005/64/EC on vehicle reusability, recyclability and recoverability



A. Set administrative and technical provisions for the type-approval of vehicles with a view to ensuring their component parts and materials can be reused, recycled and recovered

The main requirements set in place by the 3R Directive directly translates the targets of the ELV Directive into design requirements for vehicles. In particular, the 3R Directive prescribes that M1 and N1 vehicles (cars and vans) shall be constructed as to be:

- reusable and/or recyclable to a minimum of 85 % by mass, and;
- reusable and/or recoverable to a minimum of 95 % by mass.

To verify this, the 3R Directive includes three main administrative and technical elements. A first element introduced in the 3R Directive is the preliminary assessment of the manufacturer to be carried out by the competent authority before granting any type-approval. Through this assessment, the manufacturers must demonstrate that they manage properly the collection of relevant data received from their suppliers with a view to calculating the recyclability and recoverability rates for any version within a vehicle type to be produced. In this context, the manufacturers should inform the authorities of the strategy they recommend in the field of re-use, recycling and recovery. After the

competent authority has completed all necessary checks of the preliminary assessment, it will issue a certificate of compliance to ascertain that the manufacturer satisfies the obligations under the Directive. This certificate is designated 'Certificate of Compliance with Annex IV to Directive 2005/64/EC'.

Secondly, **compliance with the requirements of the Directive shall be verified in accordance with general rules on vehicle type-approval**. During the type-approval process, the manufacturers shall demonstrate that the vehicle type has been designed and constructed to meet the above rates. The calculation of these shall be carried out on calculation sheets conform to the standards ISO 22628:2002[59] to be submitted to the type-approval authority or designated technical service. Subsequently, the latter issues a validation of the calculation in the light of the above documentation of the certificate of compliance and should conduct physical controls on vehicle prototypes to verify the information submitted by the manufacturer and its suppliers.

Third, in-line with the commonly applied worst-case approach in vehicle type-approval and for the sake of simplification, detailed calculations are restricted to those vehicles within the type that are expected to constitute the greatest challenge in reusability, recyclability and recoverability – i.e., reference vehicle(s).

B. Set specific provision to ensure that the re-use of component parts does not give rise to safety or environmental hazards

To ensure that road safety and the protection of the environment are not impaired by the re-use of component parts, the 3R Directive contains a list of component parts, which are not allowed to be re-used in the construction of new vehicles (Table 11.1). These parts play a key role in the protection of vehicle occupants and in the general safe use of vehicles making that reusing them in another vehicle after being dismantled from end-of-life vehicles would entail many risks.

Table 11.1 - List of component parts deemed to be non-reusable from Annex V of Directive 2005/64/EC

– **List of component parts deemed to non-reusable**
• All airbags (1), including cushions, pyrotechnic actuators, electronic control units and sensors
• Automatic or non-automatic seat belt assemblies, including webbing, buckles, retractors, pyrotechnic actuators
• Seats (only in cases where safety belt anchorages and/or airbags are incorporated in the seat)
• Steering lock assemblies acting on the steering column
• Immobilisers, including transponders and electronic control units
• Emission after-treatment systems (e.g., catalytic converters, particulate filters)
• Exhaust silencers

[59] ISO 22628:2002 on Road vehicles — Recyclability and recoverability — Calculation method.

While separate legislation on safety and environmental vehicle type-approval was already in place[60], there was not yet any harmonised legislation to ensure that reused component parts continue to offer the same level of performance that is required to obtain type-approval. Component parts such as catalytic converters and exhaust silencers, dismantled from end-of-life vehicles, cannot be guaranteed to offer the required level of environmental protection. In addition, it is extremely difficult to check whether dismantled parts from end-of-life vehicles will meet the durability requirements as provided for in the relevant separate legislation on the Euro standards for vehicle emissions.[61] Similarly, separate legislation was already in place providing test procedures to ensure that component parts such as safety belts and airbags operate safely in the case of accidents.[62] The test procedures entailed resistance tests to traction as well as durability tests on retractors, which can only be performed on prototype parts representative of production parts. Such tests performed on reusable component parts would render them unfit for use.

To adapt 3R to technical progress, the Directive underwent a minor amendment in Commission Directive 2009/1/EC.[63] This amendment was appropriate to ensure that competent authorities can verify –for the purpose of reusability, recyclability and recoverability– the existence of contractual arrangements between the vehicle manufacturer concerned and his suppliers and the communication of arrangements.

11.2.2 11.2.2 Point of comparison

The achievements of the 3R Directive will be assessed and compared to a baseline. In this context, the baseline is defined by the date of entry into force of the Directive (2005). Back then, no formal impact assessment of the intervention with an assessment of how the situation would have developed and what could have happened in the absence of the intervention (i.e., counterfactual) was carried out, which limits the possibility to present a comprehensive overview of the original baseline. Nevertheless, the evaluation considers the situation prior to the adoption of the Directive. Considering that the ELV Directive was adopted in 2000, the additional achievements of the 3R Directive over the initial achievements of this closely linked Directive will be assessed to the extent possible.

As indicated above, the ELV Directive committed to the preparation of an amendment to the European vehicle type-approval legislation in which new vehicle models are tested and granted type-approval to meet a minimum set of requirements regarding their reusability, recyclability and recoverability before entering the EU market. Still, the ELV Directive includes some other provisions to improve vehicle design and production in this context.

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[60] In this respect, most of the component parts listed as non-reusable cannot be tested on new vehicle types because the test procedures already required destructive or durability tests to be performed on several samples.

[61] At the time of the proposal of the 3R Directive, Euro 3 was in the process of being revised for the purpose of Euro 4.

[62] Commission Directive 96/37/EC of 17 June 1996 adapting to technical progress Council Directive 74/408/EEC relating to the interior fittings of motor vehicles (strength of seats and of their anchorages) OJ L 186, 25.7.1996, p. 28.

[63] Commission Directive 2009/1/EC of 7 January 2009 amending, for the purposes of its adaptation to technical progress, Directive 2005/64/EC of the European Parliament and of the Council on the type-approval of motor vehicles with regard to their reusability, recyclability and recoverability.

Firstly, the Directive requires Member States to promote the prevention of waste by encouraging the design and production of 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.

Secondly, under the ELV Directive the Member States shall require in each case the relevant economic operators to publish information on the design of vehicles and their components with a view to their recoverability and recyclability.

Although it is highly unlikely that these two provisions – one being an encouragement and the other being an information requirement – would have the same results on the actual reusability, recyclability and recoverability of end-of-life vehicles as the 3R type-approval Directive, the ELV Directive provisions could in principle have led to some improvements in the baseline after 2000. However, the evaluation of the ELV Directive[64] which dived into the specific achievements of the provisions on vehicle design and production, contradicts this assumption. The evaluation found that the provisions in the ELV Directive are insufficiently specific and measurable, while several enforcement problems were also identified for the whole ELV Directive. No information is available which shows that Member States have taken measures in this context. Therefore, we can assume that these provisions had little to no impact on the design and manufacturing of new vehicles making it unlikely that the ELV Directive alone has resulted in new vehicles being easier to dismantle and recycle than they were in 2000.

Some interesting initiatives have been adopted by some car manufacturers, notably to promote the reuse of spare parts, the remanufacturing of components or recycling of materials, as well as the use of recycled materials. These initiatives were taken on a voluntary basis and cannot be traced back to the implementation of the ELV Directive and 3R Directive. This shows that due to business incentives, some improvements in vehicle design for reusability, recyclability and recoverability would most probably still have taken place, even in the absence of the 3R Directive.

Due to a lack of data, this evaluation cannot quantify what share of today's improvements is a direct result of the 3R Directive distinctly from the share due to the ELV Directive or other business incentives.

11.3 How has the situation evolved over the evaluation period?

11.3.1 11.3.1 Current state of play

The 3R Directive indicates that the preliminary assessment of the manufacturer and the issuing of a certificate of compliance in accordance with the 3R prescriptions shall be carried out by a competent body. The competent body may be a technical service or type-approval authority, provided its competence in this field is properly documented.

Since there are no reporting requirements for Member States on the implementation of the Directive, evaluating the 3R implementation comes with challenges. Still, the new type-approval framework Regulation reinforces the type-approval testing of new cars and

[64] See footnote 52.

vans on the EU market and where tests and investigations show non-compliance, the market surveillance authority of the Member State can decide to demand a recall or, in severe cases, full withdrawal from the market.

For the 3R Directive to contribute to circularity of the automotive sector, vehicle types that are granted a 3R type-approval first need to find their way to the European vehicle fleet before eventually being treated at an Authorised Treatment Facility (ATF) as an end-of-life vehicle. Article 10 of the 3R Directive illustrates that the requirements were to be implemented in type-approval in three distinct stages. These stages are summarised in Table 11.2. Only from July 2010 on, five years after the adoption of the Directive, were all new cars and vans entering the EU market required to be type-approved in line with the 3R prescriptions. Considering that the service life of vehicles routinely spans twenty years and beyond, the share of vehicles type-approved under the 3R regime in the vehicles that are currently reaching the end-of-life stage is still expected to be limited (with differences across EU Member States).

Table 11.2 – Implementation roadmap of the 3R Directive in type-approval

Implementation stages of 3R Directive in type-approval		
1	Allowed for new type of vehicles / new vehicles*	12/2006
2	Required for new type of vehicles	12/2008
3	Required for new vehicles	07/2010

*Article 7 on the reuse of component parts also applied from this date.

In addition, observations from other type-approval legislation indicate that most vehicle manufacturers are not early implementers of new type-approval requirements. Taking this into account, Figure 11.2 makes a rough visualisation of the share of 3R type-approved vehicles in the current EU vehicle fleet for cars and vans.[65] In 2020, only about 55% of cars and vans in the EU vehicle fleet were expected to be 3R type- approved. To put these developments in the context of ELVs, Figure 11.3 displays the annual number of new registrations of 3R type-approved vehicles against the annual number of vehicles leaving the EU fleet and the share of ELVs in this last number. In every year of the 8-year period, the new vehicle registrations for cars and vans 3R type- approved outweigh the number of vehicles leaving the fleet which confirms the continuous growth in the EU fleet.

[65] This approximation of the cumulative number of registered vehicles conform to the 3R Directive does not consider new vehicles conform to the Directive before July 2010 and/or early termination of new vehicles conform with the Directive.

Figure 11.2 – Approximation of 3R type-approved vehicles in the EU vehicle fleet for cars and vans between 2011 and 2019, based on: ACEA[66]

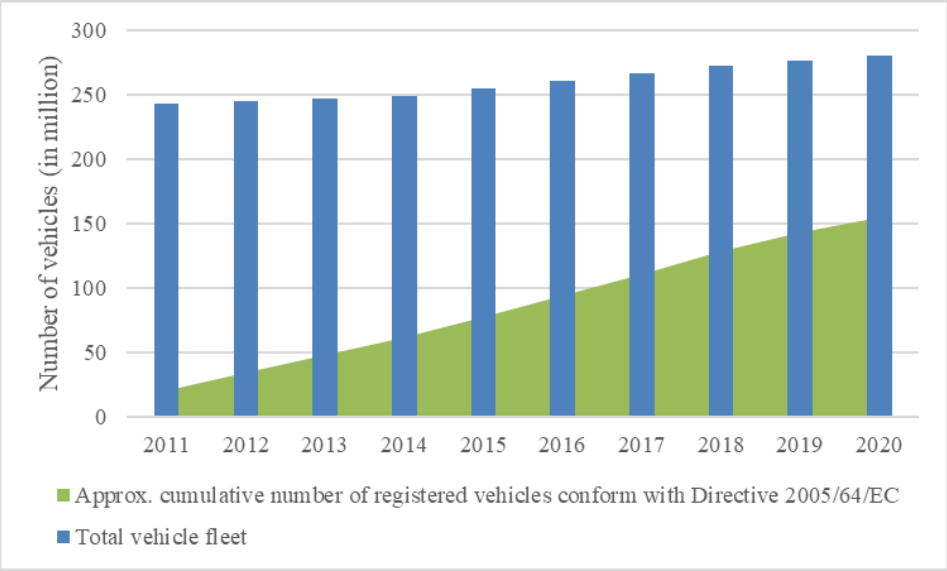
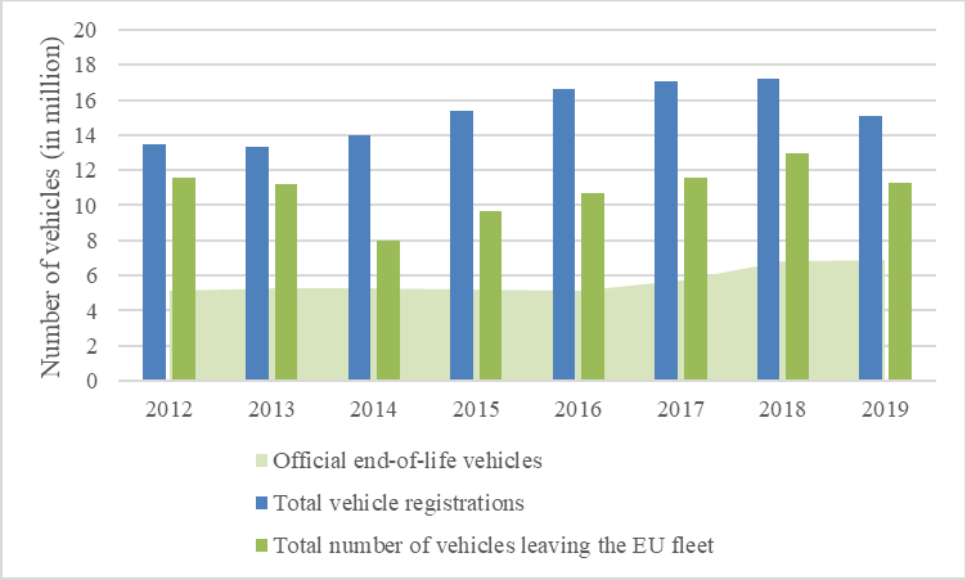


Figure 11.3 – Annual number of vehicle registrations in comparison to the number of vehicles leaving the EU fleet between 2012 and 2019, based on: ACEA[67] and Eurostat[68]



11.3.2 11.3.2 Member State implementation of the 3R Directive

Many national and Commission reports have been published regarding the implementation of the ELV Directive. However, the progress of the implementation of the 3R Directive has not been documented in the same manner throughout Member

[66] ACEA, 2022. Size and distribution of the EU vehicle fleet; ACEA, 2022. Passenger car registrations in Europe 1990-2021, by country; ACEA, 2022. Vehicles in use Europe 2011-2021.
[67] See footnote 66 (ACEA data).
[68] Eurostat, 2021. End-of-life vehicle statistics.

States. All Member States transposed the Directive 2005/64/EC within their national deadlines between 2006 and 2007. Subsequently, Directive 2009/1/EC, amending the 3R Directive, was transposed in all Member States between 2009 and 2010.[69] An overview of the national transposition is presented in Table 11. 3.

Table 11. 3 – Overview of national transposition of 3R Directive and amendment 2009/1/EC[70]

Member State	Transposition 3R Directive 2005/64/EC	Transposition amendment 2009/1/EC
Austria	11.10.2007	27.04.2010
Belgium	03.10.2006	01.10.2009
Bulgaria	27.10.2006	21.05.2010
Croatia	2011	2011
Cyprus	24.02.2006	12.02.2010
Czechia	06.08.2013	06.08.2013
Denmark	03.03.2006	08.03.2010
Estonia	01.06.2006	13.06.2011
Finland	27.07.2006	18.09.2009
France	09.05.2007	06.05.2009
Germany	31.12.2005	15.04.2009
Greece	18.04.2007	17.02.2010
Hungary	26.12.2006	2010
Ireland	25.04.2006	04.05.2010
Italy	18.07.2007	24.10.2009
Latvia	04.07.2006	31.12.2009
Lithuania	16.11.2006	16.01.2010
Luxembourg	07.04.2006	14.01.2010
Malta	25.07.2006	06.11.2009
Netherlands	07.12.2006	29.06.2009
Poland	15.11.2006	2010
Portugal	16.05.2007	12.03.2010
Romania	20.10.2005	26.11.2009
Slovakia	15.12.2006	03.02.2010
Slovenia	11.08.2006	28.08.2009
Spain	23.02.2006	27.03.2009
Sweden	2006	2010
United Kingdom	2007	2009

To date, no infringements have been recorded in relation to the 3R Directive, which could suggest that Member States are effectively implementing the measures regarding the reusability, recyclability and recoverability of motor vehicles. However, this could also be a direct result of the lacking reporting or monitoring obligations upon Member States in the 3R Directive that hamper its enforcement.

[69] The only exception being Croatia, which only became a Member State in 2013 and transposed the Directive 2009/1/EC in 2011.

[70] Based on information from https://eur-lex.europa.eu/legal-content/EN/NIM/?uri=celex:32005L0064 and https://eur-lex.europa.eu/legal-content/EN/NIM/?uri=CELEX:32009L0001.

In general, this absence of reporting and monitoring obligations makes it particularly difficult to obtain extensive data regarding the progress of the Directive's implementation. Moreover, Member States have differing monitoring and market surveillance methods which hampers consistent practice. As an example, the implementation of the 3R Directive in Member State Germany is elaborated further in

Box 11.1.

Box 11.1 – German implementation of the 3R Directive

In Germany, the Federal Motor Transport Authority (KBA) is the designated entity for market surveillance regarding the 3R Directive. Amongst other measures, the KBA oversees awarding manufacturers the 'certificate of compliance with Annex IV' once they have an adequate 3R management strategy in place. Audi – which is part of Volkswagen Group – was the first German brand that fulfilled the requirements of the Directive even before its implementation, with most of its vehicle models being recyclable to a high degree.[71] Later, also other German brands including BMW, Volkswagen and Mercedes started to publish reports concerning their vehicle recycling strategies. In the meantime, Germany set up a list of designated test laboratories to assist the KBA with the attribution of the compliance certificate to vehicle manufacturers.[72]

The German federal state of Sachsen-Anhalt published a handbook on how to monitor the implementation of the ELV Directive, including what is required under the 3R Directive to put vehicles on the EU market.[73]

11.4 Evaluation findings (analytical part)

This section provides the analysis and the results for the five evaluation criteria of effectiveness, efficiency, relevance, coherence, and EU added value. The findings presented are based on the results from desk research, as well as results obtained through stakeholder consultations.

11.4.1 11.4.1 To what extent was the intervention successful and why?

This section provides the analysis and the results for the evaluation criteria of effectiveness, efficiency, and coherence.

11.4.1.1 Effectiveness

Evaluation question 1: To what extent have the objectives of the 3R Directive been met and monitored

Overall conclusion: The 3R Directive has been effective in ensuring that the recyclability, reusability and recoverability rates of vehicles under its scope (as evaluated according to the ISO 22628:2002 standard at the type-approval stage) mirror the

[71] Automobilwoche, 2007. *Audi erfüllt als erster EU-Richtlinie zum Recycling.*
[72] KBA, 2022. Designated test laboratories (EU).
[73] Ministerium für Landwirtschaft und Umwelt (sachsen-anhalt.de) (pp. 10-11).

requirements of the ELV Directive on vehicle recycling, reuse and recovery at end of life.

However, recyclability, recoverability and reusability have an uneven treatment in the 3R Directive, which focuses mostly on recyclability and does not directly address reusability. This is, to a considerable extent, driven by the ISO 22628:2002 standard (Road Vehicles – Recyclability and recoverability – Calculation method). Whereas reuse is implicitly covered by these the recyclability and recoverability rates, it is not specified individually and thus there can be no requirement to report on reusability individually in the calculation. The ISO 22628:2002 standard does define "reusability" separately and specifies criteria for when a component can be considered as "reusable, recyclable or both based on its dismantlability". The logic of the standard results in no obligation for manufacturers to provide separate data about the total weight and composition of components with a greater potential for reuse.

A core part of the 3R type-approval process relates to the specification of components and materials that are considered as recyclable. This is addressed in the ELV "pre-treatment" and "dismantled" fractions that are covered by the ISO 22628:2002 standard calculation. It is also addressed in the ISO 22628:2002 standard calculation section on "metal separation" (i.e., all metals separated from the vehicle through shredding) and on non-metallic residue treatment (specification of recyclable materials). On the other hand, the 3R Directive does not distinguish between treatment technologies, aside from the differentiation into pre-treated, dismantled, metal separation and non-metallic residue treated fractions. If a treatment type falls under the definition of recycling[74], it will be counted towards achieving the reuse and recycling target. Thus, there is no prioritisation of technologies that achieve higher recycling qualities or that reduce the losses of certain materials.

In that sense, we can conclude that the 3R Directive has ensured the required levels of recyclability and recoverability of the vehicles, but the method to qualify the recyclability of the different components of the vehicles has resulted in a simplified process that provides little granularity and does not support the most advanced recycling technologies.

The 3R Directive has also ensured that reused components do not cause any safety or environmental risk by providing a list of components parts that are banned from being reused in new vehicles (such as airbags, seat belts and steering locks), and that the materials used for the construction of a vehicle type comply with the provisions of Article 4(2)(a) of the ELV Directive on the prevention of use of lead, mercury, cadmium and hexavalent chromium in new vehicles.

Overall compliance with the requirements of the 3R Directive has been ensured by the strength of the type-approval framework, which is upheld by the application of the available enforcement mechanisms by EU Member State authorities. There is, however, no systematic monitoring or studies that compare between the targets reported in type-approval declarations of vehicle manufacturers for specific vehicle types and between their actual performance at end-of-life.

[74] Linked to the ELV Directive definition under Article 2(7): "'recycling' means the reprocessing in a production process of the waste materials for the original purpose or for other purposes but excluding energy recovery. Energy recovery means the use of combustible waste as a means to generate energy through direct incineration with or without other waste but with recovery of the heat."

Effect of 3R Directive on achieving the targets ELV Directive

When assessing the interaction between the '3R requirements' of the 3R Directive and those of the ELV Directive, it is important to note the semantic differences between them: whereas the requirements of the 3R Directive are on recyclability, reusability and recoverability (i.e., on circularity potential of vehicles as evaluated at the design and production stages), ELV Directive 3R requirements are on recycling, reuse and recovery rates (i.e., on effective treatment rates at the end-of-life stage). Moreover, the requirements apply to different actors (3R Directive requirements concern Member States and vehicle manufacturers, whereas the ELV Directive requirements concern the Member States) and at various levels (the 3R Directive operates at the vehicle type level, ant the ELV Directive looks at aggregated annual level for the 'average vehicle', i.e., for the flow of end-of-life vehicles, with no recycling rate targets applying specifically to vehicle types or vehicle manufacturers). Therefore, although the nominal values of the 3R rates of both directives are the same (85% for reuse (reusability) and/or recycling (recyclability) and 95% reuse (reusability) and/or recovery (recoverability), the targets have distinct meanings and carry different consequences for authorities and economic operators.

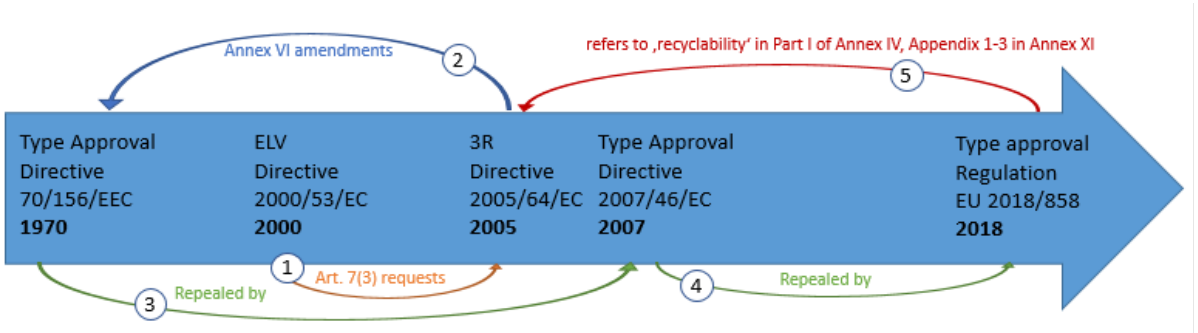
A second point to consider (also more generally when considering the interaction between both Directives, beyond the 3R rates) is that the effect of 3R Directive provisions on ELV Directive targets is mediated by the useful life of vehicle types and the rate at which vehicles reach the end of life: at any given point, the vehicles reaching authorised treatment facilities include vehicles that have been type approved decades ago, vehicles that only very recently entered the market, and everything in between.

A third and last point to consider is that, whereas every Member State in the EU hosts Authorised Treatment Facilities that process end-of-life vehicles, the number of 3R type approvals performed per Member State varies largely. Some Member States have not issued any 3R type approvals since Directive 2005/64/EC came into force (e.g., Latvia, Finland) but do report on type approvals for second stage of N category vehicles. Some Member States perform 3R type approvals regularly (between 6 and 9 annually).

The 3R Directive has remained as part of the EU type-approval framework for motor vehicles through two major overhauls: after two revisions, Directive 70/156/EC on the approximation of the laws of the Member States relating to the type-approval of motor vehicles and their trailers (referred to in the 3R Directive) was repealed by Directive 2007/46/EC, which was in turn repealed by Regulation 2018/858/EU (Figure 11.4).

The changes made in the Regulation on type approval following the amendment prescribed in Annex VI of Directive 2005/64/EC have been maintained throughout the revisions. Therefore, the Regulation on type approval from 2018 further relates to the 3R Directive (step 5 in Figure 11.4). Based on the amendment that 3R Directive, Annex VI stipulates for the general type approval that, if the manufacturer does not meet the requirements of the 3R Directive, no type approval shall be granted.

Figure 11.4 – Timeline of amendments of ELV Directive, 3R Directive and related type-approval legislation. Source: Oeko-Institut.



According to the 3R Directive (recital 2), to facilitate the treatment of vehicles at their end of life, 'manufacturers should be requested to include [reusability, recyclability and recoverability] at the earliest stages of the development of new vehicles'. This is rephrased in recital 15 of the 3R Directive which states that 'the objective of this Directive [is] to minimize the impact of end-of-life vehicles on the environment by requiring that vehicles be designed from the conception phase with a view to facilitating reuse, recycling and recovery'. Both recitals point out the importance of the design phase to ensure the effectiveness of the ELV Directive.

The 3R Directive has therefore acted as the link between the vehicle design and production stages and the end-of-life stage by requiring that the design of a vehicle type meets the requirements that ensure that it will not hinder the achievement of the ELV Directive 3R targets that are relevant at the end-of-life stage of a vehicle. It is by virtue of the slow replacement of old vehicles by new vehicles compliant with 3R Directive, and by the gradual arrival of these vehicles at the end-of-life stage, that the flow of end-of-life vehicles being treated at authorised treatment facilities became increasingly more reusable, recyclable and recoverable. This is visible both in the historic and recent data for the attainment of '3R rates' for ELVs by the different EU Member States (Figures 11.5 and 11.6).

Figure 11.5 – Total recovery and reuse rate of end-of-life vehicles (% of weight of vehicles), 2008-2020. Source: Eurostat, 2021. End-of-life vehicle statistics.

Total recovery and reuse rate of end-of-life vehicles, 2008–2020
(% of weight of vehicles)

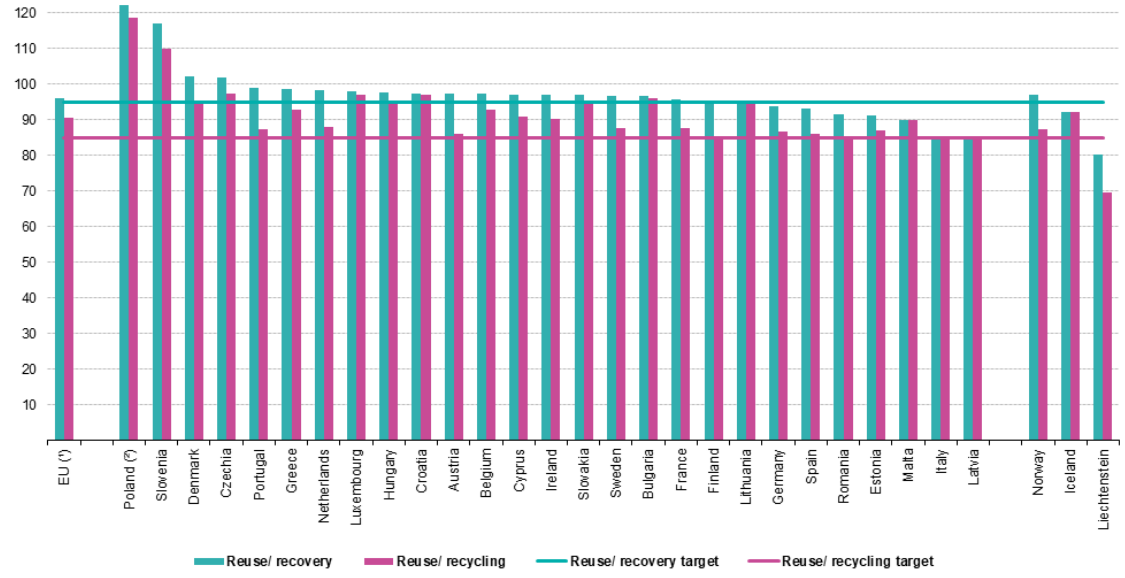
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
EU (¹)	*85.8*	*85.3*	*87.6*	*89.2*	89.9	*90.6*	91.4	92.8	92.7	93.7	92.9	95.0	*96.0*
Belgium	90.2	90.6	91.2	90.6	93.0	93.0	94.2	96.7	96.4	97.3	97.3	97.1	97.3
Bulgaria	86.7	89.2	89.2	92.0	91.3	94.1	95.0	95.1	95.6	98.8	95.8	96.5	96.6
Czechia	86.0	86.3	86.3	86.3	86.3	86.3	86.3	95.7	95.4	95.6	99.3	97.3	101.9
Denmark (²)	82.9	82.3	90.7	92.9	92.6	86.7	86.1	97.6	97.1	99.6	98.2	102.6	102.3
Germany	92.9	86.7	106.2	108.2	106.3	103.8	101.4	95.8	98.0	98.4	95.7	93.6	94.0
Estonia	92.7	87.4	78.4	79.0	85.1	86.4	88.4	87.0	89.8	89.9	91.2	91.9	91.3
Ireland	81.8	82.3	77.4	82.7	87.8	91.6	90.7	91.8	92.8	94.6	95.2	95.2	97.1
Greece	85.7	87.4	86.5	87.7	90.3	91.5	85.5	68.9	108.0	99.5	108.3	77.2	98.8
Spain	85.7	86.0	85.7	87.4	88.2	91.5	93.5	95.0	93.4	94.0	92.6	92.4	93.1
France	81.4	82.1	81.9	84.8	87.0	89.3	91.3	94.3	94.8	94.6	94.2	95.0	95.7
Croatia	:	:	:	:	99.9	100.0	96.2	99.5	99.5	99.7	97.7	96.7	97.5
Italy	87.1	84.6	85.4	85.3	82.3	82.8	85.1	84.7	82.6	83.2	82.6	84.2	84.9
Cyprus	79.8	92.9	86.9	86.6	86.9	86.6	90.2	90.7	93.2	91.9	96.8	95.8	97.2
Latvia	89.0	86.0	86.1	86.0	97.9	92.6	92.4	87.0	94.5	84.1	96.0	89.1	84.6
Lithuania	85.0	86.0	88.5	87.4	90.1	92.4	94.4	95.0	95.4	95.1	95.4	95.1	95.1
Luxembourg	85.0	85.0	88.0	90.9	95.0	95.0	95.0	97.0	96.0	96.2	95.9	97.8	98.0
Hungary	84.4	86.2	86.8	86.2	86.2	91.7	95.6	95.2	95.8	96.9	95.8	95.4	97.7
Malta (²)	:	:	64.2	87.1	96.0	91.9	45.0	77.7	54.4	56.1	81.0	79.2	90.1
Netherlands	85.6	85.2	95.3	96.2	96.1	95.9	96.0	97.0	98.7	98.7	98.4	98.5	98.3
Austria	96.1	96.1	96.5	97.6	94.2	96.7	96.1	96.9	96.9	97.9	97.8	97.8	97.4
Poland	80.1	88.0	89.8	91.5	92.8	90.3	88.0	97.0	96.3	98.6	95.3	122.2	:
Portugal	87.2	86.9	86.8	87.9	87.6	90.5	92.7	92.7	92.1	93.8	94.9	96.7	98.9
Romania	86.5	85.3	85.5	86.8	86.0	87.4	88.5	90.8	92.1	92.6	92.2	92.4	91.6
Slovenia	89.7	87.3	90.6	90.3	103.0	:	91.3	95.6	96.5	109.9	103.7	95.4	117.2
Slovakia	88.8	89.6	90.2	94.6	91.2	93.7	96.0	89.4	97.4	97.5	96.8	97.1	97.1
Finland	81.0	81.0	95.0	95.0	95.0	95.0	97.3	97.3	97.3	97.3	97.3	95.2	95.2
Sweden	91.0	90.0	91.1	90.8	90.6	91.3	91.3	96.8	94.6	97.2	95.3	96.8	96.7
Iceland (²)	98.3	83.0	95.2	82.0	100.0	99.6	97.7	98.5	96.8	97.6	97.6	97.4	92.3
Liechtenstein (*)	*100.0*	92.3	92.3	92.4	92.7	89.0	90.6	90.8	85.6	84.7	85.7	87.1	80.3
Norway	82.7	86.0	94.7	93.3	93.8	94.7	97.5	96.7	97.7	97.2	97.4	96.6	97.2

(:) not available
(¹) Eurostat estimates between 2008 and 2011 as well as in 2013 and 2020.
(²) 2013 data: estimated.
(³) 2012 data: low reliability.
(*) 2008 data: Eurostat estimate.
Source: Eurostat (online data code: env_waselvt)

eurostat

Figure 11.6 – Reuse/recovery and reuse/recycling rate for end-of-life vehicles (% of weight of vehicles), 2008-2020. Source: Eurostat, 2021. End-of-life vehicle statistics.

Reuse/recovery and reuse/recycling rate for end-of-life vehicles, 2020
(% of weight of vehicles)



Note: Countries are ranked in decreasing order by reuse/recovery.
(¹) Eurostat estimates.
(²) 2019 data instead of 2020.
Source: Eurostat (online data code: env_waselvt)

eurostat

Remaining obstacles in vehicle design

Under the ISO 22628:2002 calculation method, all materials considered to be recyclable (even to a low degree) are fully accounted for compliance with the "reuse and recycling" target. Two limitations are observed here in terms of the 3R type-approval process facilitating recycling by fostering the necessary changes in vehicle design.

For the case of materials for which there are no available recycling capacities in the EU at the time of type approval, the application of the ISO 22628:2002 standard leads to a material being considered recyclable when there are technologies which have been successfully tested, at least on a laboratory scale. The logic behind this is that vehicles have a long service life (it is not rare for vehicle to remain in use for more than 20 years, although a minority of vehicles can have much longer or much shorter lives, e.g., if they are wrecked in an accident) in which it can be expected that a technology at laboratory stage would reach maturity in terms of available recycling capacities. However, it is observed that vehicles that have been type-approved may include materials in substantial amounts that end up being poorly recyclable at end of life.

For materials that can be recycled, the ISO 22628:2002 standard prescribes that the full weight of the material is considered for the calculation of the share of the vehicle that is reused and recycled. Material losses during waste operations are not taken into consideration, even though materials are not recycled at 100% efficiency. In addition, there is no differentiation in this case between high-quality recycling (which generates secondary raw materials that can be used in vehicle manufacture or equivalent uses) and downcycling, such as backfilling or construction filling materials.

Achievements of the 3R Directive in preventing safety and environmental hazards from reuse of components

The ELV Directive (in Art. 7(4)) refers to 3R targets as the only provision for which the type-approval shall be used to ensure the compliance. In addition, Art. 7(5) of ELV Directive states that amendment of Directive 70/156/EEC should also take consideration that the reuse of components does not give rise to safety or environmental hazards. Article 7 of the 3R Directive refers to the list of 'Component parts deemed to be non-reusable' specified in its Annex V that cannot count toward recyclability and recoverability rates and that cannot be used in the construction of vehicles covered by type approval legislation. These parts (which include, among others, airbags, electronic control units and sensors, seat belt assemblies, emission after-treatment systems and exhaust silencers) play a key role in the protection of vehicle occupants and in the general safe use of vehicles.

During the stakeholder consultation, upon being asked the question 'One of the objectives of the 3R Directive is to prevent safety and environmental hazards through restrictions on re-use of certain component parts (e.g., airbags, seat belt assemblies). Has this objective been achieved in your view?', of the 34 stakeholders that responded, nine agreed that the objective had been met, five did not agree and the rest did not know. There is no evidence that these safety critical parts are reused in the construction of new vehicles. The type-approval framework (beyond the 3R Directive) effectively prevents

such reuse because the test procedures for such test components require destructive or durability tests to be performed on several samples.

Reporting and monitoring the achievements of the 3R Directive

The lack of monitoring provisions in the 3R Directive has led to an absence of dedicated monitoring of compliance with the 3R Directive. In any case, because the 3R Directive is incorporated in the type-approval framework, type-approval authorities in each EU Member State are responsible for ensuring that the vehicle types comply with the provisions of the 3R Directive before the type approval can be granted and the type can be placed in the market. It is likely that the relative simplicity and lack of ambiguity of the text of the 3R Directive has facilitated a uniform application of its provisions by type-approval authorities in the different Member States.

Hazardous substance and plastic coding provisions are specifically part of the checks to be performed by the competent body (3R Directive, Annex IV). The legal text states that 'the competent body shall ensure that the manufacturer has taken the necessary measures' and that 'the vehicle manufacturer shall be required to demonstrate' that compliance is ensured. There are additional explanations as to what is accepted as a necessary measure, e.g., supply chain management and communication with the manufacturer's staff. It is expected that where the competent body is checking these requirements, they will find the requested information, as the legal text appears clear for this aspect. In both cases, that is point 3.1(f) of Annex IV for the coding and Article 6(2) of the 3R Directive and subsequently article 4.1 and 4.2 of Annex IV for the hazardous substances, there is a reference made to the ELV Directive. These requirements being checked in the preliminary assessment means that they are not checked for each vehicle type to be approved. The 3R Directive, Annex II ('Information Document for EC vehicle type approval') does not contain an information request on hazardous substances or material coding. Therefore, documents and data as to how the manufacturer organizes the information flows on hazardous substances and plastic coding in his value chain is being checked every two years with the update of the preliminary assessment. But, for the types approved, there is no indication whether they contain hazardous substances, e.g., where ELV Directive annex II exemptions cover the use of a prohibited substance in a material and/or component part. On the other hand, the masses obtained in the steps of the ISO 22628:2002 standard calculation, i.e., recyclability and recoverability are indicated for each new type to be approved.

One instrument to ensure circularity of vehicles is the 'strategy for dismantling, reuse of component parts, recycling and recovery of materials'. The manufacturer submits the strategy for dismantling etc. during the preliminary assessment phase (described in Article 6 of the 3R Directive). Although the consultation process confirmed that the strategies of the vehicles manufacturers are checked and 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. It can be assumed that this is because 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 purpose of the dismantling strategy is not fully clear, and whether its current implementation is relevant to the achievement of the goals of the 3R Directive goals may be questionable.

During the evaluation, it was investigated whether type-approval authorities performed any sort of monitoring of the (actual) achievability of the (potential) 3R targets in the type approval phase at end-of-life; i.e., whether the recyclability, reusability and recoverability (potentials) translated into corresponding effective 3R when the vehicles were disposed of. Most are not performing such monitoring, or even studies that look at this aspect, and only one type-approval service provider taking part in the consultation would occasionally visit authorised treatment facilities to see how dismantling is performed and check how this compares with the data provided by the vehicle manufacturer at type approval. This highlights the need to 'close the circle' and bridge information and cooperation gaps between vehicle manufacturers, type-approval authorities and vehicle dismantlers and recyclers.

Evaluation question 2: How effective are the 3R provisions in verifying a vehicle's reusability, recyclability and recoverability?

Overall conclusion: The 3R type-approval process requires manufacturers to compile various data on the vehicle being type-approved as a means of showing its potential reusability, recyclability and recoverability. 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 recycling vs. downcycling). It also does not require taking recycling inefficiencies into account. For this reason, it cannot be considered effective in facilitating recycling of components and material parts to their highest recycling potential.

The scope of the ISO 22628:2002 standard refers to its use for the purpose of calculating the "recyclability rate" and the "recoverability rate". Reuse is covered by these two rates but is not specified individually and thus there is also no requirement to report on reuse individually in the calculation. The standard defines "reusability" separately and specifies criteria for when a component can be considered as "reusable, recyclable or both based on its dismantlability", however, here too, there is no obligation for manufacturers to provide separate data about e.g., the total weight and composition of components with a potential for reuse.

Components removed for reuse or recycling prior to the shredder can be specified in the data provided on the "pre-treated" fraction and on the "dismantled" fraction. For the former, the standard specifies a list of components and materials for which data must be provided. Many of these component parts and materials appear under the ELV Directive Annex I, part 3 and 4 (e.g., depollution and removal requirements), though not all. For the latter, i.e., the 'dismantled fraction', there is no specification, however the calculation format provided in Annex A of the standard requires that data provided is specified in relation to a specific component. In practice, it is understood that each manufacturer will specify different components in this section, "based on the dismantling strategy"[75].

The method of calculation set out through the reference to the ISO 22628:2002 standard refers to specification of components that can be dismantled and reused, but it does not require manufacturers to address reuse separately in their 3R type approval applications. It can be understood that manufacturers rarely refer in their calculation to components that can be reused as it is not possible to make a meaningful assumption of what

[75] This observation is based on documents submitted as examples of type-approval submissions by a Type-approval Authority), and confirmation with other stakeholders (Member State Type-approval Authorities).

components will be dismantled and reused in practice at end of life (because this depends on several factors, notably the state of the parts once the vehicle reaches its end of life, and the future demand for such parts).

However, different type approval documents submitted to the consultants as part of the stakeholder input suggest that the number of components specified can vary greatly. Of two submission examples, one specified a single component (material composition was not specified) and the other close to twenty, of which all were composed of plastic aside from a reference to glass. Based on the component types and composition, the consultants assume that, in the latter case, the components were considered dismantlable for the purpose of recycling. As dismantled components can be relevant for reuse and/or recycling, it is concluded that a vehicle can achieve the 3R rates required at type approval without referring to components that are relevant for reuse. This was explicitly confirmed in a stakeholder interview and, more generally, most stakeholders stated that the verification of reusability of parts and components of ELVs is not facilitated by the 3R Directive.

Most stakeholders who were interviewed or surveyed (e.g., Member State type-approval authorities but also vehicle manufacturers) support this view and specified that reuse is not taken into consideration in the type-approval process. Various stakeholders (including two vehicle manufacturers) explained that reuse is solely based on market demand and that, in principle, every part is reusable – however it is not possible in the design phase to estimate what will be reused when the demand is not yet known.

Evaluation question 3: What are (other) benefits of the 3R Directive for industry, environment and citizens?

Overall conclusion: The other benefits of the 3R Directive are tied to the benefits of the ELV Directive as far as the former plays a supporting role towards the objectives of the latter. In this light, the environmental benefits of the 3R include avoided damages to the environment due to improved handling of ELVs (i.e., increased rates of recovery, recycling and reuse made possible by the changes in vehicle design supported by the 3R Directive). Indirect benefits may include the lower environmental damage associated with resource extraction avoided due to recycling and reuse of materials and components from ELVs and avoided damage to human health due to exposure to hazardous substances whose use is limited by 3R. Other social benefits include the employment and income generation for employees across the EU in the dismantling sector and other economic operators, the majority of which are small and medium enterprises (SMEs).[76] In addition, new employment may have been created at vehicle manufacturers in relation to vehicle design considerations to ensure continued compliance of vehicles to be type approved. As the range of design changes could vary between vehicles it is not possible to estimate the range of this impact.

No evidence was found of a significant impact of the 3R Directive on spare part availability (and, through it, of reduced costs of repairs for consumers).

[76] See Evaluation of Directive (EC) 2000/53 of 18 September 2000 on end-of-life vehicles SWD(2021) 61 final, section 5.1.

A precise quantification of these benefits that is distinct from the previous estimate of the benefits of the ELV Directive is not possible from the (qualitative) evidence basis for the evaluation of the 3R Directive.

11.4.1.2 Efficiency

Evaluation question 4: What are the regulatory costs related to the 3R Directive and are they affordable for industry and consumers? Has the 3R Directive caused unnecessary regulatory burden or complexity?

Overall conclusion: The regulatory costs of the 3R Directive derive from the increased obligation on vehicle manufacturers to report to Member State authorities at the type approval stage, from the changes to vehicle design necessitated by compliance with 3R provisions, and from the administrative support that Member State authorities need to provide to keep the 3R Directive as part of the type approval process.

The administrative costs for vehicle manufacturers and type-approval authorities are modest compared to other aspects of type approval which are more cost intensive such as safety or pollutant emissions (with more physical tests and engineering development requirements) and which have seen a faster path of regulatory development in the period covered by the evaluation.

The compliance costs of the 3R Directive for vehicle manufacturers are expected to be passed to customers in full. Since the 3R Directive has been fully phased in since 2010 (it applies to all newly registered vehicles under its scope), these costs are not expected to increase in the future in absence of further regulatory intervention.

Regulatory costs of the 3R Directive, regulatory burden and complexity

When asked the question 'Since its adoption in 2005, do the economic and environmental benefits achieved by the 3R Directive in your view outweigh the cost of its implementation?', of a total of 31 participating stakeholders, twenty did not provide an answer, however of those that did, the majority (five stakeholders) considered that benefits are high or that costs are low (three stakeholders) or both (one stakeholder). Only two stakeholders stated that benefits are too low and costs too high and one stakeholder that benefits are too low.

The main costs of the 3R Directive for vehicle manufacturers relate to the provision of the necessary supporting information to justify compliance for each type approval of vehicles under scope. Unlike other aspects covered by type approval (vehicle safety, emissions), the demonstration of compliance does not require the performance of physical tests and is instead performed on a documentary basis. Information is provided in the two steps of the 3R type approval, this is i) the preliminary assessment, and ii) the type approval as such. The requirements as to what data must be provided, are listed in Annex I (Requirements), Annex II (Information Document for EC vehicle type approval), and IV (Preliminary Assessment).

The design of 3R provisions is such that the burden on vehicle manufacturers can be partially mitigated when appropriate. For example, the 3R Directive makes use of the concept of a reference vehicle to avoid the need to conduct repeated detailed calculations under the ISO 22628:2002 process. The selection of a reference vehicle takes account of the version within a type that will constitute the greatest challenge regarding reusability,

recyclability and recoverability. The 3R Directive, however, makes clear that all vehicles covered by the type must comply, and that the selection of the reference vehicle should be performed jointly by the manufacturer of the vehicle and the type-approval authority. The exemptions applicable to special purpose vehicles (e.g., motorcaravans, armoured vehicles, ambulances, hearses and others), multi-stage built vehicles belonging to category N1 (provided that the base vehicle complies with the Directive) and vehicles produced in small series have kept the type approval effort proportionate for SMEs. Since the exempted vehicles are still covered by the ELV Directive, this has not measurably hindered the recycling rates at end of life.

In other cases, the information required by the 3R Directive can be reused elsewhere. The preliminary assessment of the manufacturer (according to Article 6(3) of the 3R Directive) requires that the manufacturer prepare a strategy for dismantling, reuse, recycling and recovery[77]. Although the consultation clarified that this strategy and the documents that vehicle manufacturers prepare for the exchange of information using the IDIS platform[78] are not the same, one vehicle manufacturer declared that they provide to IDIS an adapted version of the strategy prepared to comply with Article 6(3) of the 3R Directive. This indicates that the information needed to prepare the 3R strategy is already available in a structured manner within manufacturers.

Compliance with provisions on coding of plastic parts and parts containing hazardous substances are also checked in the preliminary assessment, thus, not per vehicle type, but only whether manufacturers handle data properly and completely over the value chain. This too has a moderating effect on the administrative burden on both vehicle manufacturers and type-approval authorities.

Box 2 – The ELV Directive and the 3R Directive: together or separate?

During the consultation process for the revision of the ELV Directive, stakeholders were asked about the possibility of merging the ELV and the 3R Directives together under one legal text. No stakeholder clearly indicated their preference for a merge of 3R Directive and ELV Directive. The participating Member States that perform 3R type approvals were not in favour of a merge with the ELV Directive. China was provided as an example where one legal instrument is in place, but the European market would be more diverse, according to stakeholders.

An ACEA position paper refers to the positions of the automotive industry in relation to the merge of 3R Directive and ELV Directive: ACEA "call[s] for the current legal framework to be maintained." Rather than focusing on recyclability, they would like to

[77]According to the definition in the 3R Directive, strategy' means 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.

[78]This is an industry-led platform for the exchange of manufacturer-compiled information to promote the environmental treatment of End-of-Life-Vehicles, safely and economically (see: IDIS | The International Dismantling Information System (idis2.com)).

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.[79]

However, the co-existence of two separate legal acts (ELV Directive and 3R type-approval Directive) brings with it the risk that the provisions that are 'mirrored' (e.g., the 3R rates, or the hazardous substance prohibitions) lose coherence if amendments are not made to both pieces of legislation at the same time. The merging of the two existing Directives would ensure this coherence, and it could also simplify the regulatory framework by gathering all requirements into a single act, also contributing to a stronger EU market integration (especially at the end-of-life stage, where there is no equivalent to the harmonisation effect provided by the type-approval framework). Lastly, merging the two Directives would be beneficial to circularity in the automotive sector, helping to bridge the gaps between vehicle design and production and the end-of-life stage.

Evaluation question 5: To what extent has 3R Directive been cost-effective? Are the costs proportionate to the benefits attained?

Overall conclusion: As previously discussed in Evaluation question 4, there is no evidence to suggest that the 3R Directive has resulted in excessive costs for industry, authorities or consumers. At the same time, the evaluation of the effectiveness of the 3R Directive suggests that it has had a positive effect in promoting environmentally friendly design practices in the automotive industry (albeit with limited results in the promotion of reuse). This positive effect was acknowledged by vehicle manufacturers and type-approval authorities alike, although it was not backed up by data.

However, given the difficulty in precisely quantifying the costs and benefits of both the ELV Directive and the 3R Directive, and in performing an allocation of the qualitative benefits between the two pieces of legislation, the cost-effectiveness of the 3R Directive cannot be evaluated in detail. The targeted survey asked 'since its adoption in 2005, do the economic and environmental benefits achieved by the 3R Directive in your view outweigh the cost of its implementation?' About 16% of replies stated that the environmental benefits are high, while 10% stated that the costs were low. This indicates that stakeholders broadly shared the view that the 3R Directive has led to environmental advantages at a reasonable cost.

11.4.1.3 Coherence

Evaluation question 6: To what extent is the EU legislation on circularity in the automotive industry coherent?

Overall conclusion: The 3R Directive was found to be internally coherent and coherent with the ELV Directive. The mirrored '3R requirements' in both directives are seen as a strong element that ensures the coherence between the two texts, despite the differences in meaning of the two sets of requirements (potential rates at type approval vs. effective rates at end-of-life).

[79]ACEA "want 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."

The 3R Directive was also found to remain coherent with the type-approval framework even though it is the last directive remaining that is a main legal text of the overall framework (the others being regulations) and despite some legal references needing an update to improve clarity.

Internal coherence of the 3R Directive and coherence with the ELV Directive

It could be argued that the 3R Directive was set up as a market oversight instrument to support the ELV Directive (i.e., waste legislation). However, from the interviews and workshop participants, specifically the EU Member State representatives' workshop, it became clear that the 3R Directive is more often connected to the general type-approval legislation rather than to the ELV Directive, as usually, both are handled in the Member States in ministries of transport or finance. If expected by the regulator that in the future, the 3R Directive is a means to link the design and production of vehicles with their end-of-life stage, and that the 3R Directive shall contribute to the ELV Directive objectives and effectively ensure that vehicles put on the market are more circular, such intention is to be made more explicit in the 3R legal text and to be communicated to stakeholders.

One of the elements that more strongly ensures the internal coherence of the 3R Directive and the coherence of the 3R Directive with the ELV directive is the mirrored '3R requirements' in both Directives[80]. In absence of improvements in the (potential) reusability, recyclability and recoverability of newly type-approved vehicles, it becomes difficult to meet the (effective) recovery, recycling and reuse targets down the line as the vehicles reach their end-of-life stage, although improvements in recycling and end-of-life treatment are also needed to increase those rates (and thereby the circularity of the vehicles in the scope of both directives).

The scopes of ELV Directive and 3R Directive are similar but not identical. Both include M1 vehicles (passenger cars) and N1 vehicles (light-commercial vehicles). The ELV Directive includes three-wheel motor vehicles but excludes motor tricycles, both defined in the type-approval of two- or three-wheel vehicles and quadricycles[81]. In terms of the exemptions, small series and multi-stage built vehicles are exempt from the 3R Directive but not from the ELV Directive. Special purpose vehicles are exempt from the 3R Directive too; however, they are in scope of ELV Directive (although exempt from Art. 7 provisions on the reuse, recycling and recovery rates, so that they do not enter the calculations for the overall 3R rates at end-of-life). There is no evidence that these minor differences in scope have had a detrimental effect on the achievement of the goals of either directive, especially considering how limited the exemptions are in terms of relative share of ELVs.

The questions of the evaluation refer to the future possible requirements and the future legislation to cover the hazardous substance requirements. For the moment, coherence in

[80] The nominal values of the 3R rates are the same (85% for reuse (reusability) and/or recycling (recyclability) and 95% reuse (reusability) and/or recovery (recoverability), although the targets have distinct meanings and carry different consequences for authorities and economic operators (*cf.* answer to evaluation question 1).

[81] Council Directive 92/61/EEC of 30 June 1992 relating to the type-approval of two or three-wheel motor vehicles (repealed by Directive 2002/24/EC, again repealed by Regulation (EU). No 168/2013 of the European Parliament and of the Council of 15 January 2013 on the approval and market surveillance of two- or three-wheel vehicles and quadricycles).

relation to the substance prohibitions is ensured as far as the legal text of 3R Directive makes a direct reference to ELV Directive Art. 4(2) for the hazardous substances. On the other hand, for the coding of plastic parts, there is no reference to ELV Directive Art. 8(1), but only to Commission Decision 2003/138/EC[82]. Thus, coherence with any changes to ELV Directive Article 8(1), or new part coding standards introduced through other legislation adopted in line with ELV Directive Art. 8 would not be automatically ensured.

The 3R Directive is also seen as coherent with the overall EU type-approval framework, even after the two overhauls that the framework has undergone since the time that the 3R Directive entered into force. Any future modifications to 3R type approvals should at least ensure an update of the legal references (from the old Directive 70/156/EEC to the current Regulation (EU) 2018/858 governing the type approval of and market surveillance of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles). The exemptions of the 3R Directive applicable to certain vehicles (special purpose vehicles, multi-stage built vehicles belonging to category N1 and vehicles produced in small series) are found to be consistent with the normal functioning of the type-approval framework.

Evaluation question 7: To what extent is the 3R Directive externally coherent with other EU legislation and policy developments?

Overall conclusion: In terms of coherence with other EU waste legislation (notably the Waste Framework Directive[83]) and with other EU legislation aimed at promoting sustainability, such as REACH. The 3R Directive is also coherent with the broader objectives of the EU to promote sustainability and reduce waste, but further efforts are needed to increase circularity in the automotive sector and address the remaining challenges, especially those related to the electrification of road vehicles.

Coherence with the Waste Framework Directive and REACH

The various levels of the waste hierarchy are being addressed in a different manner in the 3R Directive. Waste prevention and reuse are not being promoted through the 3R Directive. Also, the 3R Directive does not provide an incentive to improve recyclability with an increasing ambitious level, especially if the 3R targets are being achieved across most of the EU Member States. It is thus likely that the 3R Directive is not effective in ensuring that vehicles placed on the EU market increase in circularity, which would not be fully coherent with the aims of the Waste Framework Directive or with high-level political goals of the European Green Deal. It is estimated that current trends towards greater electrification of the vehicle fleet, or the increased use of new materials for vehicle construction (which, in turn, are motivated by policy initiatives under the European Green Deal) could contribute to make this situation worse.

[82]2003/138/EC: Commission Decision 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.

[83] Waste Framework Directive, Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives (OJ L 312, 22.11.2008, p. 3) as last amended by Directive (EU) 2018/852 of the European Parliament and of the Council of 30 May 2018 (OJ L 150, 14.6.2018, p. 141).

The key for ensuring that the 3R Directive is effectively addressing substance prohibitions is the direct cross-reference to Art. 4(2) in the ELV Directive. It should be possible to add the direct cross-reference to another legislation, e.g., REACH, if deemed necessary in the future. In the case of merging ELV Directive and 3R Directive and should hazardous substance provisions of the ELV Directive be moved to another legislation, (e.g., REACH), it might be relevant that the (dynamic) reference to the legislation where hazardous substance provisions will be regulated in the future is amended to ensure compliance is checked through the 3R approval process. Alternatively, any legislation addressing prohibitions for vehicles in the future would need to address how compliance is to be ensured or how the future 3R type-approval process works in relation to hazardous substance provisions.

Coherence with ISO 22628:2002 and UNECE

Looking at the wording of the targets, the ELV Directive refers to a reusable and/or recyclable and, secondly to a reusable and/or recoverable target. This is a different wording compared to the outcome of calculations according to the ISO 22628:2002 standard which is a "recyclability rate" and "recoverability rate." However, these differences in framing, also in relation to reuse, are not perceived to result in any problems in the implementation, except for reuse not playing a role in the ISO calculations, as indicated by stakeholders.

From the formulation of the targets of the 3R Directive, this can only be a *potential* or hypothetical recyclability and recoverability, since the various masses of materials included in the calculation are 'considered recyclable for the purpose of the calculation'. In the ISO 22628:2002 standard, recyclability is a yes or no decision, while in practice, different recycling efficiencies are achieved for different materials. Hence, the rates calculated through the ISO 22628:2002 standard do not represent the final shares of what is effectively recycled. But, from how the ELV Directive requirement is formulated, and given that no further discrepancy between the wordings of Art. 7 of the ELV Directive, 3R Directive and ISO 22628:2002 could be identified, it is concluded that the standard is coherent with the objectives of the 3R Directive.

However, a minor point was identified, where coherence between ISO standard and EU legislation (ELV Directive & 3R Directive) was not ensured: In relation to the assessment of dismantled component parts to be considered reusable or recyclable, (a) accessibility, fastening and dismantling technology shall be assessed in relation to the dismantlability, (b) safety and environmental hazards shall be assessed in relation to reuse, and (c) material composition and proven recycling technology shall be assessed in relation to recyclability (requested in step 2 in the ISO calculation). Interviewees were asked how the classification of component parts into reusable parts and recyclable parts is done. One vehicle manufacturer answered that "the reusability of vehicle components is usually possible for all components unless they are explicitly excluded by law, or they are wearing parts. Which vehicle components are reused in practice depends on the requirements over the life of a vehicle. This cannot be foreseen by the vehicle manufacturer." This suggests that the assessment of dismantled components to be considered reusable or recyclable according to the three criteria mentioned is of no particular importance for manufacturers in the compilation of the 3R type approval.

The stakeholder consultation also addressed the importance of coherence between the 3R Directive and UNECE Regulation No. 133 (used for international type approvals beyond the EU) in the workshop, explaining that it also made the process more efficient for vehicle manufacturers, i.e., as they did not need to perform the type-approval process multiple times for the same vehicle type in different world regions. The evaluation questions asked whether it is ensured that vehicles placed on the market following a type approval under UNECE Regulation No. 133 also comply with the relevant provisions that are required for vehicles that are type approved based on the 3R Directive, and vice versa.

Minor deviations in the criteria for the selection of the worst-case vehicle were found. Another aspect is, that the definition of recovery in the UNECE Regulation No. 133 differs from that included in the 3R Directive and ELV Directive. The latter refers to a list of recovery processes agreed under the Waste Framework Directive. Hence, the definition in ELV Directive is more detailed than the UNECE Regulation No. 133 definition. However, it was neither mentioned by stakeholders nor were there any other indications that pointed out or concluded that this discrepancy between the definitions was problematic. As the 3R Directive has been the main source for the UNECE regulation, and given that there are only slight differences that are not substantial to the objectives and main provisions, it is assumed that the 3R Directive is coherent with the UNECE Regulation No. 133. A stakeholder reported that his company was applying for type approvals under the UNECE regulation.

11.4.2 11.4.2 How did the EU intervention make a difference and to whom?

Evaluation question 8: What is the added value resulting from having a 3R Directive at EU level?

Overall conclusion: The 3R Directive is deemed to have created EU added value throughout the years it has been in force, with positive impacts in the automotive sector and in the completion of the EU Single Market. The 3R Directive was also successfully turned into an international UNECE Regulation supporting global harmonisation of type approvals.

11.4.2.1 EU added value

The examination of EU added value of the 3R Directive assesses the benefits of developing legislation at EU level, compared to individual action by Member States through the development of their own comparable legislation, or through other combined international efforts, like those of the United Nations Economic Commission for Europe (UNECE). The following analysis is of qualitative nature, having used inputs from stakeholders and previous experience from the type-approval legislation.

When asked ‘In your view, does it make sense to move away from a type-approval Directive on vehicle reusability, recyclability & recoverability to a type-approval regulation on vehicle reusability, recyclability & recoverability?’, 60% of the stakeholders agreed with this thesis. This clear result assumes that the relevant actors acknowledge the added value of regulating 3R on the EU level, by asking for even more

EU intervention. As such, the EU should consider expanding its current 3R Directive into a Regulation, while respecting the principle of subsidiarity in accordance with EU law.

The evaluation of ELV Directive already pointed out the advantages of having these issues regulated at EU level, rather than the Member States' individual national level. Given that the environmental impact of the automotive industry (i.e., pollution, non-recyclable waste, etc.) is affecting all Member States, it was deemed important to prioritise EU legislation supporting the completion of the EU Single Market and to prevent that diverging national regulations emerge.

This is even more so the case for the 3R Directive, considering that the vehicles manufactured in the EU are also sold, transported and disposed of across the Union. Thus, harmonised and coherent regulations concerning the type-approval of vehicles with regard to their reusability, recyclability and recoverability on the EU level are of utter importance for the effective protection of the environment and the functioning of the Single Market.

EU added value of 3R Directive compared to action at national level

During the stakeholder workshop, participants were asked 'How high do you estimate the added value of having EU harmonised rules for vehicles reusability, recyclability and recoverability, compared to what could have been achieved at merely national level?' 50% answered that the added value is significantly higher and 38% stated it is somewhat higher. These results underline that stakeholders recognise the need and the advantages of having coherent regulations on the EU level. This is supported by the increased numbers of manufactured vehicles that are made of recoverable, recyclable and/or reusable materials in Member States that are significant actors in the automotive industry (e.g., France, Germany).

The ELV Directive evaluation had also shown previously that the recorded numbers of ELVs across Member States had also increased after the introduction of the ELV Directive, also confirming that EU level regulations in the domain of sustainability of the automotive sector offer a significant added value compared to individual national actions. As already stated, given the cross-border nature of road transport, vehicle manufacturing and air pollution, EU directives in this sector promote the functioning of a sustainable EU internal market.

The development and governing of reusability, recyclability and recoverability standard for the automotive sector at EU level is key to prevent harm to the functioning of the Internal Market. While local or national initiatives could in theory replace EU action, they would also create considerable obstacles for automotive industry to enter national markets, as numerous standards are expected to arise. This shows that national action poses great risks for the internal market.

EU added value of 3R Directive compared to action at international level

A different approach to action at EU level usually entails action at the international level; i.e., via the UNECE World Forum for Harmonization of Vehicle Regulations. The

UNECE intends to establish "global" harmonisation of certain technical regulations, with mutual recognition of type approvals amongst its agreements' signatories, which include all 27 EU Member States. UNECE regulations are legally binding for its signatories, who must transpose the UNECE provisions to their national legal framework.

In relation to the type-approval of vehicles with regard to their reusability, recyclability and recoverability, the UNECE adopted a very similar regulation to the 3R Directive, namely UNECE Regulation No. 133 (Uniform provisions concerning the approval of motor vehicles with regard to their reusability, recyclability and recoverability), which entered into force in 2014. Therefore, the EU is a driving force behind various measures taken by the UNECE, especially regarding more environmentally friendly and sustainable actions, including established regulations No. 49 and No. 83, which aligned with the EU's Euro VI and Euro 6. The adoption of a global 3R a few years after the 3R Directive was put in place, confirms the EU's role as a source of global standards.

During the stakeholder workshop, participants were asked 'How high do you estimate the added value of having EU harmonised rules for vehicle reusability, recyclability and recoverability, compared to what could have been achieved at merely national level?' From 34 stakeholders that answered, 30 agreed that the harmonised rules have a higher or somewhat higher added value than national legislation (others did not know). In another instance, participants were asked a question regarding equivalence with UNECE legislation: 'For the purpose of obtaining an EU Whole Vehicle Type Approval, a certificate in accordance with UNECE Regulation No. 133 is accepted as alternative to the 3R Directive. How important is it to keep such equivalence with UNECE legislation and why?' The stakeholders that replied to this statement made clear that there is a need to maintain this equivalence with UNECE legislation, mostly because of the global nature of the automotive industry considering the role of export/import of vehicles. They especially mentioned that there are European countries that are signatories to the UNECE without being EU Member States, making harmonised regulations even more important. While the respondents emphasized the importance of continued global harmonisation, many underlined the need for the EU to lead regarding 3R type approval legislation and 'disregard any negative influences from the UNECE', which might slow down progress and effectiveness.

As such, it can be assumed that, in the absence of EU level action, (minimum) standards on type-approval of vehicles regarding their reusability, recyclability and recoverability under the auspices of UNECE would only be promoted by like-minded and similarly developed countries (e.g., EU Member States and third countries) promoting similarly advanced requirements. Nonetheless, the level of stringency adopted would most probably be the lowest common denominator necessary to satisfy UNECE contracting parties that would take more time to adopt and implement the established regulations.

11.4.3 11.4.3 Is the intervention still relevant?

Evaluation question 9: To what extent do the 3R objectives correspond to the current needs?

Overall conclusion: The 3R rates are currently being met by vehicles at type approval without significant problems. At the same time, the corresponding 3R rates at the end-of-life stage are largely being fulfilled by EU Member States, but this could change if the material composition of vehicle changes over time (e.g., through the introduction of new, lightweight materials).

Current relevance of designing vehicles for reusability, recyclability and recoverability

The 3R Directive does not provide an incentive to improve recyclability with an increasing ambitious level, provided the 3R rates are met at type approval (and, albeit indirectly, as long as the 3R targets are being attained across most of the Member States). As for future provisions on circularity, the level of effectiveness will depend on whether the future provisions fine-tune or amend those that are already being covered with lower ambition today, e.g., amendments of the 3R targets or adding new materials to be coded.

As it stands today, the 3R Directive does not sufficiently differentiate between non-recyclable and recyclable materials if technologies are available at the laboratory stage of development and above (i.e., only a low level of development of recycling technologies for the material is required for it to qualify as fully recyclable). In practice, this allows vehicles making use of high volumes of non-recyclable to be placed on the market in some cases, such as carbon-fibre-reinforced plastics (CFRPs) which is increasingly used in vehicles to reduce their weight. For example, BMW placed the first units of the i3 model on the market in 2013, using carbon fibres as a main material for the vehicle body instead of metal to reduce the weight of the vehicle and achieve better efficiency. Based on interviews with waste management operators, capacities for the recycling of this material are still not available for ELV waste management, resulting in a large share of the vehicle weight not being recycled.

Considering that most vehicles sold today do not use CFRPs in significant quantities and yet the 85% reuse and recycling target is not significantly over-achieved, with the trend towards lightweight materials, this could affect the achievability of the 3R targets in the mid-term (as these vehicles are increasingly produced and become progressively more relevant in the ELV waste stream). On the other hand, an increase in use of a non-recyclable material in the vehicle fleet could be sufficient in some cases for recycling capacities to develop over time, having a positive effect on the 3R rates at the end-of-life over time. Should any requirements be introduced in relation to non-recyclables (e.g., obligatory dismantling) it would be beneficial for them to be addressed under 3R Directive to at least ensure that the use and localisation of such materials is communicated to waste operators to ensure the application of appropriate treatment technologies.

Although it has been shown throughout this evaluation that the 3R Directive has been less successful in promoting the reusability of vehicle parts, there is no evidence that the list of parts that are explicitly excluded from reuse has lost relevance.

Evaluation question 10: To what extent can the 3R Directive cover new challenges linked to the transformation of the automotive industry?

Overall conclusion: The transformation of the automotive industry will bring about challenges to the 3R Directive. The increase of vehicles with electrified powertrains on EU roads will pose challenges at their end-of-life (because electric vehicle batteries are difficult to recycle, and there are potential safety risks associated with their disposal, and recycling infrastructure is at present limited) but also at the design and production stages. Compared to their conventional counterparts from about two decades ago, today's electric vehicles contain an increasingly complex mix of materials that includes electronic components and increasing amounts of electronic components that lower the recyclability of new vehicles as currently evaluated under the 3R Directive. In some cases, parts may be software-locked by the vehicle manufacturer for security reasons, which further limits reuse.

On the other hand, many vehicle manufacturers are already making efforts to increase the circularity of products by applying novel design solutions and standardisation of materials or exploring modular solutions to component design that facilitate disassembly and increase vehicle repairability. Other manufacturers are increasingly becoming involved in directly managing the end-of-life phase of their products (with a special focus on electric vehicle batteries and other electric powertrain components, which contain valuable materials). These efforts are currently not rewarded by the 3R Directive, which does not cover circularity aspects beyond the simple calculation of the 3R rates.

During the evaluation of the ELV Directive, more than 50% of the consulted stakeholders noted that the increased use of electrified vehicles will increase waste management costs for ELVs. It is thought that dismantling may temporarily become less profitable as costs for storage, equipment, safety (e.g., against fires from lithium-ion batteries) and transportation may increase. The new Regulation on Batteries is expected to improve circularity in the design of batteries of EVs. The articulation with the ELV Directive and the 3R Directive will be important. In addition to the batteries, ELVs from EVs contain very costly components such as electric motors, which may generate income for the dismantlers. Rare earth elements, which are used for permanent magnets in EVs (average weight of 1-2 kg of permanent magnets per electric vehicle), platinum group metals for catalytic converters (77% use share in automotive catalysts) and precious metals from electric and electronic systems in vehicles are also increasingly found in new vehicles. However, dismantlers are not currently experienced with such components and the markets for them is not yet developed.

The circularity challenges associated to the electrification of vehicles is not limited to the end-of-life stage. Compared to the conventional vehicles that were produced at the start of the evaluation period, todays' vehicles are made up of an increasingly complex mix of materials that includes electronic components and increasing amounts of electronic components that could lower the recyclability of new vehicles as currently evaluated under the 3R Directive, potentially to a point where compliance with 3R rates becomes challenging for new types being brought on the EU market.

Also in the context of the evaluation of the ELV Directive, ATFs referred to the phenomenon of software-locked components or assemblies (e.g., window wiper motors,

inverters, navigation systems, and others) which require a proprietary software key to be installed in a new vehicle after removal. This may be an obstacle for reuse as a component removed without the key will not be reusable and the necessary software key does not have to be provided for free. 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 data security.

On the other hand, some vehicle manufacturers are already making efforts to introduce more circularity into their products and services. For example, Renault tries to integrate more circularity through using "recycled and recoverable materials" such as recycled textiles in the battery-electric Renault ZOE. They also consider how certain vehicle components could be used for other purposes, such as in the case of second life for batteries.[84] Renault also refers to reconditioning of parts (or remanufacturing) to allow their use when repairing other vehicles. With a look to the future, BMW has set an aim to build a recycled electric car by 2040, referring not only to its composition from recycled materials but also to its being emission free. Whereas BMW states that its new cars are currently made with close to 30% recycled materials, the new circular-based approach should increase this to 50% recycled content[85].

11.5 What are the conclusions and lessons learned?

11.5.1 11.5.1 Conclusions

To minimise the environmental impact of vehicles as they reach their end-of-life stage, vehicle manufacturers should take incorporate waste minimisation into vehicle design considerations. The 3R Directive lays down administrative and technical rules to ensure that the parts and materials of vehicles under its scope may be reused, recycled and recovered as much as possible. It makes sure that the reused components do not cause any safety or environmental risks.

The 3R Directive therefore establishes the link between the design and production stages of certain road vehicles and their end-of-life treatment by setting type-approval requirements for these vehicles regarding their reusability, recyclability and recoverability. The 3R Directive applies to new models and models already being produced of vehicles belonging to the M1 (passenger cars), and N1 (light commercial vehicles, i.e., vans) categories. The legislation does not apply to special purpose vehicles (such as armoured cars and ambulances), to vehicles produced in multiple stages or vehicles produced in small series.

According to the 3R Directive, new vehicles may only be sold in the EU if they may be reused and/or recycled to a minimum of 85% by mass or reused and/or recovered to a minimum of 95 % by mass. The reusability, recyclability and recoverability rates (the so-called 3R rates) are calculated using a dedicated international standard (ISO 22628:2002

[84] https://group.renault.com/en/news-on-air/news/circular-economy-moving-up-a-gear/
[85] Circular economy: sustainable into year 2040 | BMW.com

Road Vehicles – Recyclability and recoverability – Calculation method) which provides a simplified methodology for the estimation of the recyclability and recoverability of the vehicle as a whole according to the mass and material composition of its constituent parts. For a material to qualify as recyclable under the ISO 22628:2002 calculation, only a low level of development of existing recycling technology is required. Therefore, the ISO 22628:2002 calculation yields optimistic (potential) recyclability rates, which are difficult to be effectively achieved at the end-of-life stage of the vehicles.

Beyond the 3R rates, the 3R Directive requires manufacturers to have strategies in place to properly manage the reusability, recyclability and recoverability requirements of the legislation. If national authorities consider these strategies satisfactory, the manufacturer receives a certificate of compliance, which is valid for at least two years. This is an additional instrument of the 3R Directive meant to ensure circularity of vehicles. Although the consultation process confirmed that the strategies of the vehicles manufacturers are checked and 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. The usefulness of the dismantling strategy, and whether its current implementation effectively contributes to the goals of the 3R and ELV Directives is unclear.

The 3R Directive limits the reuse of certain component parts, such as airbags, seat belts and steering locks since they could present safety and environmental risks. Hazardous substance and plastic coding provisions are specifically part of the checks to be performed by the competent body.

Interaction between the 3R Directive and the ELV Directive

The 3R Directive was adopted with the aim to ensure coherence between the type-approval procedures on one side and the obligations contained under the ELV Directive on the other side. The latter contains rules on the collection, treatment and recovery of end-of-life vehicles and their components, as well as restrictions on hazardous substances in new vehicles which mirror the requirements of the former. Although the nominal values of the 3R rates of both directives are the same (85% for reuse (reusability) and/or recycling (recyclability) and 95% reuse (reusability) and/or recovery (recoverability) and sometimes used interchangeably, the targets have distinct meanings and carry different consequences for authorities and economic operators. Whereas the requirements of the 3R Directive are on reusability, recyclability and recoverability (i.e., on circularity potential of vehicles as evaluated at the design and production stages), ELV Directive 3R requirements are on recycling, reuse and recovery rates (i.e., on effective treatment rates at the end-of-life stage). Moreover, the requirements apply to different actors (3R Directive requirements apply to vehicle manufacturers, ELV Directive requirements apply to Member States) and at various levels (the 3R Directive operates at the vehicle type level, ant the ELV Directive looks at aggregated annual level for the ‘average vehicle’, i.e., for the flow of end-of-life vehicles, with no recycling rate targets applying specifically to vehicle types or vehicle manufacturers).

Effectiveness

The 3R Directive has been effective in ensuring that the recyclability, reusability and recoverability rates of vehicles under its scope mirror the requirements of the ELV Directive on vehicle recycling, reuse and recovery at end of life. Looking at the historic data on achievement of the 3R rates by EU Member States at end-of-life stage, a positive trend is observed throughout the years of application of both Directives, although it is not possible to isolate the effect of the 3R Directive form these data. The increases in recyclability and recoverability as reported (in aggregate manner) at the end-of-life stage came about in a gradual way. This is to be expected, considering that the effect of 3R Directive provisions on ELV Directive targets is mediated by the useful life of vehicle types and the (variable) rate at which vehicles reach the end of life.

Although the 3R Directive has been effective in relation with the 3R Rates at the type approval stage, during the evaluation it became clear that the recyclability, recoverability and reusability have an uneven treatment in the 3R Directive, which focuses mostly on recyclability and does not directly address reusability. This is to a considerable extent driven by the ISO 22628:2002 standard, which does not specify reusability rates individually. On the other hand, the ISO 22628:2002 standard (and, as a result, the 3R Directive) does not distinguish between treatment technologies with a sufficient degree of granularity; if a treatment type falls under the definition of recycling (which covers technologies at the early stage of development, and therefore with low recycling efficiencies) it will be fully counted towards achieving the reuse and recycling target.

Thus, the 3R Directive provides no prioritisation of technologies that achieve higher recycling qualities or that reduce the losses of certain materials. This could give rise to problems at the end-of-life stage for materials for which there are no available recycling capacities in the EU at the time of type approval, although this is mitigated by the fact that vehicles usually have a long service life in which it can be expected that recycling technology and the availability of recycling capacities improves.

The lack of monitoring provisions in the 3R Directive has led to an absence of dedicated monitoring of compliance with the 3R Directive , although this shortcoming was mitigated by the incorporation of 3R Directive is incorporated into the type-approval framework, whereby type-approval authorities in each EU Member State are responsible for ensuring that the vehicle types comply with the provisions of the 3R Directive before the type approval can be granted and the type can be placed in the market, including the provisions on hazardous substances and coding of plastic parts.

Efficiency

The administrative costs for vehicle manufacturers and type-approval authorities are modest compared to other aspects of type approval, such as safety or pollutant emissions. The lack of regulatory development of the 3R Directive would indicate that these costs have remained stable throughout the evaluation period.

The main costs of the 3R Directive for vehicle manufacturers relate to the provision of the necessary supporting information to justify compliance for each type approval of

vehicles under scope. In some instances, the compliance costs are mitigated by the design of the 3R Directive (e.g., by using a reference vehicle to limit the number of vehicles for which the 3R rates need to be calculated, or through the exemptions applicable to certain vehicles, or by checking the compliance with provisions on coding of plastic parts and parts containing hazardous substances at the manufacturer level instead of at the vehicle type level).

The compliance costs of the 3R Directive for vehicle manufacturers are expected to be passed to customers in full, with no evidence emerging during the evaluation to suggest that the 3R Directive has resulted in excessive costs for industry, authorities or consumers. At the same time, the evaluation of the effectiveness of the 3R Directive suggests that it has had a positive effect in promoting environmentally friendly design practices in the automotive industry (albeit with limited results in the promotion of reuse). Given the difficulty in precisely quantifying the costs and benefits of both the ELV Directive and the 3R Directive, an in performing an allocation of the qualitative benefits between the two pieces of legislation, the cost-effectiveness of the 3R Directive could not be evaluated in detail, although during the stakeholder consultation shared the view that the 3R Directive had led to environmental advantages at a reasonable cost.

Coherence

The 3R Directive was found to be internally coherent and coherent with the ELV Directive. The mirrored '3R requirements' in both directives are seen as a strong element that ensures the coherence between the two texts. The scopes of the ELV Directive and the 3R Directive are similar but not identical. There is no evidence that these minor differences in scope have had a detrimental effect on the achievement of the goals of either directive, especially considering how limited the exemptions are in terms of relative share of ELVs. The 3R Directive was also found to remain coherent with the type-approval framework even though it is the last directive remaining that is a main legal text of the overall framework (the others being regulations) and despite some legal references needing an update to bring them in line with Regulation (EU) 2018/858.

The evaluation of the 3R Directive did not reveal any major coherence issues with other EU waste legislation (notably the Waste Framework Directive) and with other EU legislation aimed at promoting sustainability, such as REACH. In relation to the Waste Framework Directive, it was found that the various levels of the waste hierarchy are being addressed in a different manner in the 3R Directive, with waste prevention and reuse not being promoted through the 3R Directive. The lesser emphasis on reuse is attributed to the logic of the ISO 22628:2002, which was otherwise found to work coherently within the 3R type approval process. Also, the 3R Directive does not provide an incentive to improve recyclability beyond the current 3R targets, and thereby to increase their circularity. This situation would not be fully coherent with the aims of the Waste Framework Directive or with high-level policy goals of the European Green Deal.

Finally, the 3R Directive and UNECE Regulation No. 133 (used for international 3R type approvals of beyond the EU), were found to be fully coherent, as a consequence of the

latter being based on the former. It was found that changes in 3R legislation in the EU would necessitate changes at the UNECE level to preserve coherence and ensure a high level of harmonisation that is highly valued by the automotive industry.

EU added value

The 3R Directive is deemed to have created EU added value throughout the years it has been in force, with positive impacts in the automotive sector and in the completion of the EU Single Market. These impacts were, however, only possible to be evaluated in a qualitative manner, and without being disentangled from the positive impacts brought about by the ELV Directive. Considering that the vehicles manufactured in the EU are also sold, transported and disposed of across the internal borders of the Union and beyond, the EU added value of the 3R Directive (and, by extension, of the type-approval framework) is particularly clear, and this was recognised by stakeholders. A clear further indication of the EU added value of the 3R Directive is the fact that it was successfully turned (with only very minor adaptations) into an international UNECE Regulation supporting global harmonisation of type approvals, further cementing the EU's regulatory leadership in this domain.

Relevance

The relevance of the 3R Directive will be tested by the ongoing transformation of the automotive industry. This is especially true of the increase of vehicles with electrified powertrains on EU roads will pose challenges at their end-of-life. Compared to their conventional counterparts from about two decades ago, today's electric vehicles contain an increasingly complex mix of materials that includes electronic components and increasing amounts of electronic components that lower the recyclability of new vehicles as currently evaluated under the 3R Directive. The use of materials such as CFRPs may see a further increase, driven by the pursuit of lower vehicle weight and greater energy efficiency. In some cases, parts may be software-locked by the vehicle manufacturer for security reasons, which further limits reuse. Should these trends continue, a decreasing level of recyclability could make type approval increasingly difficult to achieve.

Challenges associated to electrification and broader industry trends affecting the design of new vehicles will become apparent also at the end-of-life stage. For example, electric vehicle batteries are singularly difficult to recycle, and there are potential safety risks associated with their removal from end-of-life vehicles disposal, and recycling infrastructure is at present limited. Whereas this may not pose an immediate problem (electric vehicles do not yet dominate new registrations, and they are still a small share of overall ELVs), the importance of these issues will grow as more electrified vehicles reach the end-of-life stage.

There are also positive signs that point towards increased sustainability and circular thinking, even in absence of regulatory intervention: many vehicle manufacturers are already making efforts to increase the circularity of products by applying novel design solutions and standardisation of materials or exploring modular solutions to component

design that facilitate disassembly and increase vehicle repairability. Other manufacturers are increasingly becoming involved in directly managing the end-of-life phase of their products and closing material loops. Electric vehicle batteries and other electric powertrain components such as permanent magnets from electric motors could be a source of valuable critical raw materials upon recycling.

11.5.2 11.5.2 Lessons learnt

The evaluation of the 3R Directive confirmed that it has been, and remains, a useful piece of legislation whose role cannot be understood without putting it in context with the objectives of the ELV Directive and the functioning of the EU type approval framework, whereby EU Member State authorities national authorities certify that a vehicle type meets all EU safety, environmental and conformity of production requirements before authorising it to be placed on the EU market, and ensure that the relevant requirements continue to be met thereafter through market surveillance activities.

By acting at the design and production stages of the life of vehicles as products, the 3R Directive has supported a broad achievement of the goals of the ELV Directive (especially increasing the recycling and recovery of vehicles at the end-of-life stage, and limiting the use of certain hazardous substances in new vehicles).

The fact that the effect of reusability, recyclability and recoverability measures applied at the design stage of vehicles can only be translated into effective gains in reuse, recycling and recovery once the vehicles reach their end of life in significant numbers (usually with decades-long delays) complicates the evaluation of the 3R Directive, especially in terms of effectiveness. It appears, however, that the design costs to make new vehicle types compliant with 3R rates have remained reasonable throughout the evaluation period, and a tangible increase in the 3R rates at the end-of-life stage is apparent across Member States if one adopts a long-term perspective.

Although it can be concluded from the evidence supporting the evaluation that the 3R Directive has been an effective piece of legislation with clear EU added value, and that it has worked in a coherent manner with related pieces of EU legislation (including the type-approval framework itself, and the UNECE regulation that was developed from it), there were several shortcomings in its implementation. First, it was clear from the evaluation that the focus of the 3R rates calculation method supported by the ISO 22628:2002 standard was on recyclability and recoverability, with a lesser emphasis on reusability. Second, the lack of granularity of the ISO 22628:2002 to qualify the recyclability of materials may have resulted in a lack of support for more efficient recycling technologies. And third, the lack of inclusion of additional circularity aspects (notably, recycled content provisions) and of mechanisms to monitor and reward over-compliance with 3R rates may have resulted in lower overall circularity improvements that could have benefited both the automotive and the recycling industries. The exclusion of heavy-duty vehicles and L-category from the scope of the 3R Directive is consistent with the scope of the ELV Directive, from which the 3R Directive derives. If the scope of

ELV is expanded to these vehicles in the future, a consistent expansion of the scope should apply to 3R type-approval legislation.

On the other hand, industry-led initiatives (e.g., the establishment of dismantling information databases, or the voluntary circularity commitments made by several 'front-runner' vehicle manufacturers) indicate that the EU automotive industry is ready to respond proactively to environmental challenges despite an uncertain context of rapid transformations, including a dramatic shift toward electrified powertrains in new passenger cars. Any review of the 3R Directive will need to account for this, and adapt the existing framework to ensure it supports further improvements in circularity and increased collaboration between vehicle manufacturers, recyclers and EU and Member State authorities.

11.6 Evaluation matrix

Table 11.4 – Evaluation matrix: Effectiveness

Evaluation criterion 1: Effectiveness				
Question	*Sub-question*	*Judgement criteria*	*Indicator*	*Data sources*
EQ1 : To what extent have the objectives of the 3R Directive been met and monitored?	1.1. To what extent has the 3R Directive facilitated meeting the reusability, recyclability and recoverability targets of the ELV Directive?	Gap between the achieved targets on reuse, recycling and recovering of end-of-life vehicles and the targets in the ELV Directive	Achieved targets on reuse, recycling and recovering of end-of-life vehicles, including for different materials	Literature review: evaluation of the ELV Directive, JRC study[86], impact assessment study Öko[87]
		Degree to which the 3R Directive has contributed to achieving ELV targets	Estimated contribution of 3R Directive to achieving targets on reuse, recycling and recovering of end-of-life vehicles	Literature review: impact assessment study Öko Stakeholder input from e.g. MS and EU officials, (re)manufacturers, recyclers, NGOs, academics
	1.2. Which obstacles in vehicle design to meeting these targets still remain?	List of obstacles in designing vehicles taking into account reusability, recyclability and recoverability	Obstacles in designing vehicles taking into account reusability, recyclability and recoverability	Literature review: impact assessment study Öko Stakeholder input from e.g. MS and EU officials, (re)manufacturers, recyclers, NGOs, academics
	1.3. To what extent has the 3R Directive prevented safety and environmental hazards through restrictions on re-use of certain component parts?	Degree to which the safety and environmental hazards arising from reuse of components have been resolved by 3R	Reported safety and environmental hazards from reuse of components both before 3R Directive and since the 3R Directive	Literature review: impact assessment study Öko Stakeholder input from e.g. MS and EU officials, (re)manufacturers, recyclers, NGOs, academics
	1.4. To what extent are these achievements monitored? Is there insufficient data to ensure full effectiveness?	Extent to which reported/monitored information is available and complete	List of reported/monitored information on achievements 3R Directive	Literature review: impact assessment study Öko Stakeholder input from e.g. MS and EU officials, (re)manufacturers, recyclers, NGOs, academics

[86] 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), JRC12900.
[87] 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.

EQ2: How effective are the 3R provisions in verifying a vehicle's reusability, recyclability and recoverability?	/	Degree to which the type-approval provision are able to verify a vehicle's actual reusability, recyclability and recoverability	Verified vehicle reusability, recyclability and recoverability versus actual reusability, recyclability and recoverability	Literature review: impact assessment study Öko Stakeholder input from e.g. MS and EU officials, (re)manufacturers, recyclers, NGOs, academics
EQ3: What are other benefits of the 3R Directive for industry, environment and citizens?	/	Degree to which economic, environmental and social indicators improved following the introduction of the 3R Directive	Innovation in vehicle design taking into account reusability, recyclability and recoverability Health and environmental indicators Vehicle prices Indicators of competitiveness and Single Market	Literature review: impact assessment study Öko Stakeholder input from e.g. MS and EU officials, (re)manufacturers, recyclers, NGOs, academics

Table 11.5– Evaluation matrix: Efficiency

Evaluation criterion 2: Efficiency				
Question	*Sub-question*	*Judgement criteria*	*Indicator*	*Data sources*
EQ4: What are the regulatory costs related to the 3R Directive and are they affordable for industry and consumers? Has the 3R Directive caused unnecessary regulatory burden or complexity?	4.1. What are the regulatory costs related to the 3R directive and are they affordable for industry and consumers?	Implementation costs high/low in comparison to price vehicles and other costs for industry	Implementation costs for industry	Literature review: impact assessment study Öko Stakeholder input from e.g. MS and EU officials, (re)manufacturers, recyclers, NGOs, academics Desk research
	4.2. Is there any evidence that the implementation of the 3R Directive has caused unnecessary regulatory burden or complexity?	Extent to which administrative cost and burden can be considered unnecessary	Administrative costs linked to 3R Directive, reported administrative burden or complexity	Literature review: impact assessment study Öko Stakeholder input from e.g. MS and EU officials, (re)manufacturers, recyclers, NGOs, academics Desk research
EQ5: To what extent has 3R Directive been cost-effective? Are the costs proportionate to the benefits attained?	/	Degree to which benefits of the 3R Directive are proportionate or outweigh the related costs	Implementation cost 3R Directive Benefits 3R Directive	Literature review: impact assessment study Öko Stakeholder input from e.g. MS and EU officials, (re)manufacturers, recyclers, NGOs, academics Desk research

Table 11.6 – Evaluation matrix: Coherence

Evaluation criterion 3: Coherence				
Question	*Sub-question*	*Judgement criteria*	*Indicator*	*Data sources*
EQ6: To what extent is the EU legislation on circularity in the automotive industry coherent?	6.1. To what extent is the 3R Directive internally coherent?	Number and relevance on inconsistencies in the 3R Directive	List of inconsistency issues in the 3R Directive	Literature review: impact assessment study Öko Stakeholder input from e.g. MS and EU officials, (re)manufacturers, recyclers, NGOs, academics Desk research
	6.2. To what extent are the 3R Directive and the ELV Directive coherent?	Number and relevance on inconsistencies between the 3R Directive and the ELV Directive	List of inconsistency issues between the 3R Directive and the ELV Directive	Literature review: evaluations of the ELV Directive and other type-approval legislation Stakeholder input from e.g. MS and EU officials, (re)manufacturers, recyclers, NGOs, academics
EQ7: To what extent is the 3R Directive externally coherent with other EU legislation and policy developments?	7.1. Are the 3R requirements and the related type-approval process coherent with the overall type-approval framework, with safety type approval and emissions type approval? To what extent is the scope of the 3R Directive coherent?	Number and relevance on inconsistencies between the 3R Directive and the type-approval framework Share of vehicles and vehicle waste covered by the 3R Directive	List of inconsistency issues between the 3R Directive and the type-approval framework List of vehicle categories covered in type-approval legislation Different vehicle categories in number and in kg waste	Literature review: impact assessment study Öko Stakeholder input from e.g. MS and EU officials, (re)manufacturers, recyclers, NGOs, academics Desk research

	7.2. Are the 3R provisions coherent with the EU waste legislation?	Number and relevance of inconsistencies	List of inconsistency issues	Literature review: impact assessment study Öko Stakeholder input from e.g. MS and EU officials, (re)manufacturers, recyclers, NGOs, academics Desk research
	7.3. Is the 3R Directive coherent with REACH?	Number and relevance of inconsistencies	List of inconsistency issues	Literature review: impact assessment study Öko Stakeholder input from e.g. MS and EU officials, (re)manufacturers, recyclers, NGOs, academics Desk research
	7.4. Is the 3R Directive coherent with ISO 22628: 2002 and international regulations such as UNECE Regulation No. 133?	Number and relevance of inconsistencies	List of inconsistency issues	Literature review: impact assessment study Öko Stakeholder input from e.g. MS and EU officials, (re)manufacturers, recyclers, NGOs, academics Desk research
	7.5. Is the 3R Directive coherent with other EU legislation?	Number and relevance of inconsistencies	List of inconsistency issues	Literature review: impact assessment study Öko Stakeholder input from e.g. MS and EU officials, (re)manufacturers, recyclers, NGOs, academics Desk research

Table 11.7 – Evaluation matrix: EU added value

Evaluation criterion 4: EU added value				
Question	*Sub-question*	*Judgement criteria*	*Indicator*	*Data sources*
EQ8: What is the added value resulting from having a 3R Directive at EU level?	8.1. What is the added value of 3R Directive compared to what could have been achieved at merely national level?	Weighing (dis)advantages of having rules on vehicle design and production taking into account their reusability, recyclability and recoverability at Member State level	(Dis)advantages of having rules on 3R vehicle design and production at Member State level	Literature review: evaluations of the ELV Directive and other type-approval legislation Stakeholder input from e.g. MS and EU officials, (re)manufacturers, recyclers, NGOs, academics
		Weighing (in)consistency between the needs and challenges of the 3R Directive the needs of the internal market	The needs and challenges of the 3R Directive and the needs of the internal market	Literature review: evaluations of the ELV Directive and other type-approval legislation Stakeholder input from e.g. MS and EU officials, (re)manufacturers, recyclers, NGOs, academics
	8.2 What is the added value of 3R Directive compared to what could have been achieved at international level?	Weighing (dis)advantages of having rules on vehicle design and production taking into account their reusability, recyclability and recoverability at international level	(Dis)advantages of having rules on 3R vehicle design and production at international level	Literature review: evaluations of the ELV Directive and other type-approval legislation Stakeholder input from e.g. MS and EU officials, (re)manufacturers, recyclers, NGOs, academics
	8.3 Do the needs addressed by 3R Directive continue to require harmonisation action at EU level?	Degree to which withdrawing the existing EU intervention would lead to negative consequences	Negative consequences of withdrawing the 3R Directive	Literature review: evaluations of the ELV Directive and other type-approval legislation Stakeholder input from e.g. MS and EU officials, (re)manufacturers, recyclers, NGOs, academics

Table 11.8 – Evaluation matrix: Relevance

Evaluation criterion 5: Relevance				
Question	*Sub-question*	*Judgement criteria*	*Indicator*	*Data sources*
EQ9: To what extent do the 3R objectives correspond to the current needs?	9.1 To what extent does designing vehicles taking into account reusability, recyclability and recoverability correspond to the current needs and EU ambitions?	Gap between ambitions in targets for vehicle reusability, recyclability and recoverability (do not) and the current needs and EU ambition	List of current needs for circular automotive industry and vehicle design for circularity; List of ambitions of wider EU initiatives (e.g. CEAP, EU Green Deal and Industrial policy)	Literature review: evaluations of the ELV Directive and other evaluations (Waste Shipment Regulation, REACH, ROHS) Stakeholder input from e.g. MS and EU officials, (re)manufacturers, recyclers, NGOs, academics
	9.2 Is the current list of non-reusable component parts still fit to prevent from today's safety or environmental hazards?	Degree to which the list of components covers all safety and environmental hazards from reuse of component parts of relevance today	Reported concerns regarding reuse of certain (new) components	Literature review: evaluations of other type-approval legislation Stakeholder input from e.g. MS and EU officials, (re)manufacturers, recyclers, NGOs, academics
EQ10: To what extent can the 3R Directive cover new challenges linked to the transformation of the automotive industry?	10.1 To what extent can the 3R Directive cover technological developments in the automotive industry (e.g. the growing share of electric vehicles)?	Degree to which the objectives of the 3R Directive can continue to be met taking into account technological development.	List of technological developments in the automotive vehicles, especially for vehicles in the scope, affecting today's reusability, recyclability and recoverability practices (incl. growing share electric and hybrid vehicles, increased use of lightweight	Literature review: evaluations of the ELV Directive and other type-approval legislation Stakeholder input from e.g. MS and EU officials, (re)manufacturers, recyclers, NGOs, academics

			materials in vehicles like plastics, carbon-fibres, fibre-reinforced (plastics) materials; electronic components, which contain strategic and/or critical raw materials (CRMs))	

11.7 Overview of benefits and costs

Table 11.1. Overview of benefits and costs identified in the evaluation

		Citizens/Consumers		Businesses[88]		Administrations[89]		Environmental costs	
		Quantitative	Comment	Quantitative	Comment	Quantitative	Comment	Quantitative	Comment
[Cost or Benefit description]:									
Administrative costs	recurrent		Compliance costs of businesses are expected to be passed on to consumers. Because the cost of a type approval is spread over all the vehicles in the type, this has a small impact on final vehicle prices.	Costs for OEMs that submit an application for type approval: Fees for applying for type approval varies depending on certificate type (0-600€)[90]	Based on input of a single OEM, processing an application or type approval takes between 0.5-2 FTE and they prepare around 30 applications per annum. Assuming that an OEM processes 30 3RTAs per annum suggests that the burden of compliance is between 15-60 FTE per OEM. It is noted that as 3RTA is internationally compliant, not all submissions will take place in the	Costs for type approval authorities from checking and approving applications for 3R Type approval: estimated at "< 0.25 years FTE per 3R Type approval and at 1.5-2.5 years FTE in total per annum per MS.	One authority estimated the costs for the process at "< 0.25 years FTE per each 3R type approval. From inputs of MS who perform 3R Type approvals it is concluded that 6-9 3R Type approvals are performed per annum. Though the data is not exhaustive, it can be assumed that only between 5-10 MS perform 3R type approvals.		

[88] This includes impacts for OEMs on the one side and for Type approval service providers who provide support in the preparation of documentation for type approval (the latter can be considered similar to certification bodies). One type approval service provider gave information as part of an interview with a Member State (MS) type approval authority. Others did not participate. Input was furthermore provided to consultation efforts in the form of answers to survey questions: OEMs were interviewed, 1 OEM provided answers to the survey confidentially and an association also provided general input in writing, however not answering the survey questions.

[89] Data is based on input form 5 MS Type approval Authorities that participated in stakeholder consultation activities based on a survey of questions. One MS was interviewed, three provided the filled-out survey, 1 provided short input per email, relating to the survey but only to a few of the aspects addressed therein.

[90] Based on a survey of MS Type approval authorities, it is not clear whether these fees apply only to 3R Type approvals or have a different scope – one MS specified only one fee while another gave different fees but said not to have done and 3R ones: Some MS have not performed any TAs 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.

					EU and not all models will be marketed in the EU, i.e., the sum cannot be allocated in total to the Directive.				
Implementation costs	recurrent			Costs for Type approval service providers: Costs of increasing knowhow of vehicle composition and related likelihood of complying with the 3R Targets: Partial costs: Organisation and participation in visits at ATFs to observe the dismantling process.	One Type approval service provider stated that they perform visits at ATFs to see how the dismantling is performed in practice, feeding into their knowledge, however this was necessarily of the vehicle models they type approved and it could be understood that a visit is not performed every year.				
Adjustment costs								Costs related to resource efficiency: in cases where large amounts of "non-recyclable materials" such as reinforced plastics are contained in the vehicle and assumed to be recyclable due to a TRL≥4, such materials	

								will probably be shredded and mixed with other fractions, possibly contaminatio n other fractions and increasing recycling costs.	
Benefi ts	one-off	Benefit of type approval for consumers: as the 3R Type approval applies throughout the EU and as it is linked to the internationa l UN ECE Regulation 133 which is very similar, consumers have the benefit of being to purchase or sell second hand vehicles between borders without the need to recertify the type approval of the vehicle[91]							
Benefi ts	recur rent			Benefits for OEMs: as the 3R Type approval applies throughout the EU and					

[91] This applies to the base vehicle which is affected by the 3R Type approval. In the case of second stage type approvals this may differ as the vehicle may change at different stages of its lifetime, however this is understood to be out of scope of this review.

				is also compliant internationally, OEMs have the benefit of harmonisation as they only need to perform a single type approval for new models they intend to place on the market, which then applies in all countries where that model is marketed. Benefits for Type approval service providers: these establishments are hired by the OEMs to certify and thus support the preparation of type approval applications. Data was not made available on the revenue for such services; however, it would be expected to incur for every type approval performed by the company. [benefits not quantifiable]					
Indirect	**recurrent**					Benefits for MS: where	Basis for assumption		

benefits						type approved vehicles are placed on the market of an MS in which it was not type approved, that MS has benefit of cars being placed on the market that are considered to comply with ELV requirement, without having had any administrative costs to ensure the compliance. [benefits not quanti-fiable]	: The 3R Type approval is harmonised not just for the EU but also internationally.		

ANNEX 12: OVERVIEW OF PROJECTS AND RESEARCH

Since 2000, under the Horizon 2020 and LIFE, the EU has funded around 100 of different projects which have contributed to higher scale of knowledge, expertise in advancement of relevant ELV treatment operations, material recovery, reduced use of rare earth materials and manufacturing/recycling costs. The subsections below provide the overview of the key ongoing and completed projects and research in the field.

12.1 Under Horizon 2020 programme:

1. Circular Process for Eco-Designed Bulky Products and Internal Car Parts (2017-2021)

ECOBULK[92] aims at demonstrating and implementing a new Circular Economy model for bulky composite products in automotive, furniture and building component industrial sectors, with high potential of cross-sectoral replicability and transferability to other industrial sectors, to promote greater re-use, upgrade, refurbishment and recycling of these products. ECOBULK is a large-scale demonstration project that develops different pilot activities and demonstrations at different levels. The initial planning for manufacturing, demonstration and validation of the newly designed circular products have already started in ECOBULK by generating a master plan for the demonstration activities. This preliminary demo plans total 7 EU-countries, 11 demonstrators and in 21 individual demonstrations all over the Europe during years 2019-2021 within the three product sectors automotive, furniture (indoor/outdoor) and building and construction.

2. Removing hazardous substances to increase recycling rates of WEEE, ELV and CDW plastics (2019-2022)

The EU-funded NONTOX project[93] targets two waste streams: end-of-life vehicles (ELV) and construction and demolition waste (CDW). It will develop technologies to remove hazardous substances from these two waste streams. The project investigates the thermochemical conversion of non-target plastics and side streams to increase system efficiency by increasing the range of final products and applications. The project aims to develop an economically competitive recycling process that can produce safe and high-quality secondary plastic materials from contaminated plastic waste.

3. New industrial sorting systems based on laser spectroscopy (LIBS), magnetic induction, and machine vision for recycling of non-ferrous metals (2014)

SMEs and research organisations in the EU-funded SHREDDERSORT project[94] have developed and demonstrated a new industrial sorting system to separate non-ferrous shredder scrap into cast aluminium (Al), wrought Al, and non-Al categories. Compared to the unsorted material, the sorted categories are better suited for recycling into secondary metals, have a higher market value, and will reduce the use of raw materials.

[92] https://cordis.europa.eu/project/id/730456
[93] https://cordis.europa.eu/project/id/820895
[94] https://cordis.europa.eu/article/id/128556-new-industrial-sorting-systems-based-on-laser-spectroscopy-libs-magnetic-induction-and-machin

4. Controlled Closed Loop Recycling for Life-Cycle Optimised Industrial Production (2005-2007)

The Conclore project[95] aimed to develop a viable, low-emission system for manufacturing 100 %-recyclable single-component car interior products. Materials can be recovered at the end of the vehicle's useful life and be recycled into another product — in any sector. By focusing on modifications to the production of automotive parts, the concept involved reintegration of recycled polymer material with quality equal to that of virgin material.

5. Automotive Residue Valorization (2016)

The AUTOREVAL project[96] aimed at the total elimination of landfill disposal, as regards car-fluff, with the related environmental impact and transportation costs. In the context of this project a new kind of innovative industrial plant was to be developed, which should be able to process and convert ASR (Automotive Shredder Residue or car fluff) and ELT (End of Life Tyres) rubber, into fuel products, reducing the environmental impact and making more efficient the entire automotive sector. In this way, materials transformed into fuels will be used as energy source by the players of the sector, contributing in this way to the development of a circular economy that embraces the whole vehicles life.

6. Advanced Reluctance Motors for Electric Vehicle Applications (2016)

To enable a large scale adoption of EVs, a new generation of electric drive systems is needed to reduce dependency on rare earth materials, while improving energy efficiency, power density and reducing manufacturing/recycling costs. The ARMEVA[97] project developed a new rare-earth-free generation of advanced reluctance motors.

7. Robust recycling technology that separates different plastic types from a mix of plastic waste to produce a plastic material directly marketable to manufacturers (2017-2018)

The technology developed within the TRIBOSORT project [98] allows to 1) recycle all ultimate scrap residues from ELV and WEEE, 2) separate its valuable plastic components with a purity of 95% minimum, 3) provide an industrial scale solution with a production capacity of 1.5t/h 4) produce a final recycled plastic material directly marketable to manufacturers, 5) provide a Recycle certificate along with our final products.

8. X-ray sensor for the recognition of polymer type, additive and fillers in black and coloured plastics for recycling and analysis (2019-2020)

The black plastics, which represent 30-50% of plastic scraps in Waste Electric and Electronic Equipment (WEEE) and End-of-Life Vehicles (ELV), end up as residue and are disposed in landfills, buried or exported outside EU, because the existing plastic sorting technologies are not able to sort black plastics based on the type of polymer and to identify the presence of additives such as Brominated Flame Retardants (BFR) and pollutants which are forbidden by

[95] https://cordis.europa.eu/article/id/86900-simpler-structures-for-improved-auto-recycling
[96] https://cordis.europa.eu/project/id/717514
[97] https://cordis.europa.eu/project/id/605195
[98] https://cordis.europa.eu/project/id/790321

EU directives on recycling. The SELEX project[99] exploits for the first time a combination of X-ray solutions allowing: 1) to discriminate polymers used in the plastic matrix both for coloured and black plastics; 2) to provide quantitative information about presence of fillers, additives and pollutants present in the polymer matrix, including BFR.

9. Supporting the Electric Vehicle REVOLUTION through maximising EV Range and End-of-Life Vehicle Recovery through optimisation of recycled plastics and advanced light materials (2021-2023)

The REVOLUTION project[100] aims at overcoming the challenges hindering the use of recycled materials, but more broadly, restricting the widespread adoption of circular economy principles in the automotive industry. REVOLUTION will use machine learning and artificial intelligence to optimise the input of recycled materials and injection moulding process to deliver high-quality parts.

10. Advanced Light materials for sustainable Electrical Vehicles by Integration of eco-design and circular economy Strategies

The LEVIS[101] project developed multi-material structural parts using thermoplastic-based carbon fibre reinforced plastics/metal hybrid materials integrated with a structural health monitoring system. The aim was to achieve a significant weight reduction while keeping the mechanical in-service performance of the targeted parts. As such, new sustainable materials and suitable manufacturing and assembly procedures as well as advanced simulation methodologies/workflows and innovative sensing/monitoring technologies were developed.

11. Leading the TRansion of the European Automotive SUpply chain towards a circulaR futurE (2021-2024)

The fact that the car industry has little involvement in CRM recovery from end-of-life vehicles (ELVs) led to the development of the idea of the TREASURE project[102]. The TREASURE project will develop a scenario analysis and simulation tool to assess the positive and negative implications of circular economy practices and principles in car manufacturing to facilitate the adoption of CRM recovery and circular economy in this sector.

12. Advanced and sustainable recycling processes and value chains for plastic-based multi-materials (2018-2022)

The MultiCycle project aimed[103] to introduce an advanced and sustainable recycling process as well as the value chains for plastic-based multi-materials. This process will be demonstrated in fibre reinforced thermoplastic composites for the automotive sector from which plastics constitute around 16% of End-of-Life Vehicles weight, i.e. ca. 1 million tons/year in EU.

[99] X-ray sensor for the recognition of polymer type, additive and fillers in black and coloured plastics for recycling and analysis | SELEX Project | Fact Sheet | H2020 | CORDIS | European Commission (europa.eu)
[100] https://cordis.europa.eu/project/id/101006631
[101] https://cordis.europa.eu/project/id/101006888
[102] https://cordis.europa.eu/project/id/101003587
[103] https://cordis.europa.eu/project/id/820695

13. Optimising quality of information in Raw Materials data collection across Europe (2017-2019)

The ORAMA project[104] focuses on optimising data collection for primary and secondary raw materials in Member States. For End-of-Life Vehicles the focus is on developing 'INSPIRE-alike' protocols. ORAMA will demonstrate how to create more robust Material Systems Analysis studies and reliable Sankey diagrams for stocks and flows of specific raw materials.

12.2 Under LIFE programme:

1. A novel and efficient sorting process for post-shredder ELVs to meet and overcome ELV directive targets (2014-2017)

The LIFE CARWASTE project[105] aims to contribute to the effective life-cycle management of cars through an innovative process to exploit currently landfilled waste material produced at end-of-life. More specifically, it plans to develop and demonstrate an innovative technology and process to facilitate the re-use of 'fluff' materials in cement and steel plants.

2. Aim to realise 95% ELV-recycling in the Netherlands by means of post shredder technology (2011-2015)

The PST project's[106] main objective was to reach an ELV recycling rate of 95% by the end of 2014 and thus allow the Netherlands to comply with the ELV Directive. It planned to do this by demonstrating and optimising a PST plant using the VW-SiCon process in the Dutch province of Gelderland. The PST project beneficiary ARN Recycling reported an End-of-Life Vehicles (ELV) recycling rate of 83.7% for material recycling and a total of 96.1% for recycling and energy recovery for 2012; and 86.1% and 96.0%, respectively, for 2014.

3. Industrial Platform Demonstrator to achieve 95% recycling of the "end-of-life vehicle" (2011-2015)

The objective of the LIFE project ICARRE 95[107] was to demonstrate how to recycle 95% of End-of-Life Vehicles (ELVs) at a regional scale (up to 30 000 ELVs per year) and to create a model that can be applied and exported to other sites and countries in France and Europe. To reach its objective, the project concentrated its efforts on plastics, foams, glass, textiles and catalytic converters. The project aimed to outline an effective process for dismantling recovered car and to develop a cradle-to-cradle process for recycling the targeted components.

4. High performance devulcanized masterbatches for End-of-Life Tire reuse in high-volume technical compounding applications (2020-2024)

The LIFE GREEN VULCAN project[108] aims at increasing the reuse rate of rubber waste with an innovative and environmentally-friendly devulcanisation technology. The project

[104] https://cordis.europa.eu/project/id/776517
[105] https://webgate.ec.europa.eu/life/publicWebsite/project/details/3968
[106] https://webgate.ec.europa.eu/life/publicWebsite/project/details/3397
[107] https://webgate.ec.europa.eu/life/publicWebsite/project/details/3343
[108] https://webgate.ec.europa.eu/life/publicWebsite/project/details/5357

contributes to the implementation of the End-of-Life Vehicles Directive by enabling increased recycling rates.

5. ELV DEPOLLUTION BAY -equipped island for the management of materials and components for end of life vehicles (2017-2019)

The main objective of the LIFE De-BAY[109] project was to lower the environmental impact of ELVs by developing more efficient recovery systems and techniques for small and medium-sized dismantlers. This technology would be validated and demonstrated within fully-equipped and integrated depollution islands at two pilot dismantling sites. The aim was to enable the recovery of larger amounts of vehicle materials and components (e.g. plastics, glass and filters) and up to 99% of all ELV fluids by weight, in a much faster and more efficient way than is possible using current tools and systems. The main environmental benefits demonstrated by the project were the increased/improved recovery of spent fuels and other fluids from ELVs, and the reduction of hazardous materials and not-recoverable wastes sent to landfills. On a yearly basis, for example: +50 000 l/year more petrol recovered, +12 000 l/year engine oil, +5 000 l/year brake fluids, and +1 700 kg/year air conditioning refrigerants.

6. Recycling of textile fibres from end-of-life tyres for production of new asphalts and plastic compounds (2015-2018)

The project REFIBRE-LIFE[110] aimed to overcome the two main existing barriers limiting ELT fibre recycling. Its overall objective was that 100% of the ELT fibre material is transformed into a useful secondary raw material within a 'circular economy' approach. The project's objectives were, among others, to construct and validate an innovative industrial pilot plant to treat, clean and process ELT fibres, making them recyclable and re-usable and produce new materials (plastic compounds and asphalts) that have been modified with the fibre.

7. Boosting circular economy of plastics from end-of-life vehicles through recycling into high added-value applications(2018-2022)

The LIFE CIRC-ELV project[111] aims to boost plastic recycling rates in the automotive sector by recycling polypropylene in end-of-life cars and reusing it in new products. Substituting virgin plastics with the recycled kind would contribute to the EU circular economy package. It would also support the Waste Framework Directive and ELV Directive by closing the manufacturing loop for plastics used in car manufacturing and tackle the depletion of fossil resources from which they are currently derived.

8. Low energy chemo-thermal recycling of carbon fibre composites, a central step to a circular economy for CFRP products (2022-2025)

The current manufacturing methods for CFRP parts produce large quantities of scrap. This material is made up of in-production scrap, end-of-life components (e.g. automotive parts,

[109] https://webgate.ec.europa.eu/life/publicWebsite/project/details/4685
[110] https://webgate.ec.europa.eu/life/publicWebsite/project/details/4241
[111] https://webgate.ec.europa.eu/life/publicWebsite/project/details/4918

aircraft wings, wind turbine blades, sporting and consumer goods) and full-scale test articles. The LIFE CFCycle project[112] aims to implement and evaluate a low-energy approach for recycling carbon fibre reinforced polymers (rCF). This will be achieved by a low-temperature and low-pressure chemical recycling process known as chemolysis. The objective is to recycle at least 2 000 tonnes CFRP scrap per year from automotive parts, aircraft wings and wind turbo blade to establish a supply chain for CFRP scrap and to demonstrate the suitability of the recycled material in at least three applications. The project contributes to the implementation of the End-of-Life Vehicle (ELV) Directive, which requires that 85% of each vehicle manufactured after January 2015 must be re-used or recovered.

12.3 Under other programs:

1. Selective recovery of non-ferrous metal automotive shredder by combined electromagnetic tensor spectroscopy and laser-induced plasma spectroscopy (2014-2016)

The SHREDDERSORT project[113] aims at developing a new dry sorting technology for non-ferrous automotive shredder. First, shredder will be separated into different metals, based on their conductivity. To this end, a new electromagnetic sensing technique combined with a vision system will be used.

2. Future Availability of Secondary Raw Materials (2022-2026)

The FutuRaM project[114] will address, among others, the waste stream of End-of-Life Vehicles. It seeks to (1) develop knowledge on the availability and recoverability of secondary raw materials (SRMs) within the European Union (EU), with a special focus on critical raw materials (CRMs), to enable fact-based decision making for their exploitation in the EU and third countries, and (2) disseminate this information via a systematic and transparent Secondary Raw Materials Knowledge Base (SRM-KB).

[112] https://webgate.ec.europa.eu/life/publicWebsite/project/details/5682
[113] https://cordis.europa.eu/project/id/603676
[114] https://cordis.europa.eu/project/id/101058522

ANNEX 13: SME TEST FOR THE PREFERRED OPTION

As indicated in Annex 4 of this impact assessment, the preferred option would impact large companies involved in the manufacturing of vehicles as well as the steel and plastics industries. As it would also impact SMEs, this Annex provides an analysis (based on the methodology for "SME test" laid out in the Commission Better Regulation Guidelines[115]), on:

1. the types of SMEs affected by the measures contained in the preferred option;
2. how they have been consulted in the development of this impact assessment;
3. what the expected impacts on these SMEs are;
4. how possible negative impacts on these SMEs have been minimised.

13.1 Step (1) − Identification of affected businesses[116]

The categories of SMEs affected by the proposed measures have been identified based on their activities (dismantling; shredding/recycling; repair and garage shops; export of used vehicles).

- **Dismantlers**: there are approximately 12 000 "authorised treatment facilities" (ATFs) in the EU, which are on the frontline for the dismantling of ELVs. Most of them are SMEs. Some others are integrated in larger companies which also carry out shredding activities. A number of them also have contractual links with vehicle manufacturers, while others are completely independent. 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 (to be reused) 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 (and without an authorisation to do so).

- **Shredding/recycling companies**: there are a few hundred[117] companies in the EU active in the sorting, shredding and processing of ELVs and waste fractions resulting from ELVs. Some of them are linked to large waste management companies while others are SMEs. They buy depolluted ELVs from ATFs, shred them, sort the resulting waste, sell the resulting sorted and shredded materials to industries using secondary materials as

[115] See tool #23 in https://commission.europa.eu/law/law-making-process/planning-and-proposing-law/better-regulation/better-regulation-guidelines-and-toolbox/better-regulation-toolbox_en

[116] See as well as Annex 4.

[117] 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.

feedstock in their production processes, and send residual waste to landfills or for 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 others 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 shredding companies have however been investing in plastics recycling and in improved technologies for metal recovery and have called for the establishment of recycled content obligations for these materials in new vehicles to support their activities.

- **Repair shops and garages:** The sector of the maintenance and repair of motor vehicles in the EU is composed of around 450 000 companies which are mostly micro SMEs with fewer than 10 employees[118]. They would be mainly affected 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 for 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 burden for them compared to the baseline scenario, especially if the measures imply obligations.

- **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 for which the purchase/sale of used vehicles in just one part of their regular business activities. There are also companies which exercise exclusively these activities, buying used cars from garages, insurance companies or individual owners, and organising their export to non-EU countries.

13.2 Step (2) consultation of SME stakeholders

The review process for the ELV Directive started in 2018 and included extensive consultation of the stakeholders affected by this legislation, especially SMEs. The first consultations took place in the context of the evaluation of the ELV Directive[119]. They were followed by consultations carried out as part of the present impact assessment (Open Public Consultation on the Impact Assessment for joint review of the ELV Directive and 3R type-approval Directive[120], specific consultation for 3R type-approval aspects, additional targeted consultations and bilateral discussions with different groups of stakeholders). The review of the ELV Directive was also covered by an opinion from the "Fit for future platform[121]" which reflected views from stakeholders. Particular attention was paid to reach out to SMEs during

[118] Annual detailed enterprise statistics for trade (NACE Rev. 2 G) [SBS_NA_DT_R2__custom_4698656]
[119] End-of-life vehicles: evaluation of the ELV Directive published (europa.eu)
[120] https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12633-End-of-life-vehicles-revision-of-EU-rules_en
[121] https://cor.europa.eu/en/our-work/Pages/Fit-for-Future-opinion-on-End-of-life-vehicles-and-3R-type-approval.aspx

these consultations, either through their umbrella federations at EU or national levels, or directly.

The analysis of the OPC for the impact assessment carried out from July to October 2021 illustrates how SMEs took part in the consultation process. Among the 208 stakeholders which contributed to this consultation, 62.5% were SMEs or organisations representing the interests of SMEs (130 responses), covering a wide geographical scope.

Among others, these stakeholders included for example the European association for national associations of automotive recyclers in Europe (EGARA[122]); the Association of ATFs in Catalonia (AETRAC[123]); the French Private Companies Association for Waste Management (FNADE[124]); the French federation of companies working on services linked to automotive sector, including repair (Mobilians[125]); the French Federation of Craft Businesses in the automotive sector and in mobility services (FNA[126]); Gremi de Recuperació de Catalunya[127]; a Finnish ATF (Suomen Autopurkamoliitto r.y)[128]; a Czech metal waste processor (DEMONTA Trade SE[129]); the German association of recycling companies (Bundesvereinigung Deutscher Stahlrecycling- und Entsorgungsunternehmen e.V.[130]).

Organisation size

		Answers	Ratio
Micro (1 to 9 employees)		65	31.25 %
Small (10 to 49 employees)		34	16.35 %
Medium (50 to 249 employees)		31	14.90 %
Large (250 or more)		59	28.37 %
No Answer		19	9.13 %

In terms of sectoral representation, vehicle manufacturers, importers, suppliers (50), together with waste management operators (dismantlers, ATFs – 47, recyclers, shredder operators – 45) represented the major groups of stakeholders.

[122] https://egaranet.org/
[123] https://aetrac.org/
[124] https://www.fnade.org/fr
[125] https://www.mobilians.fr/
[126] https://fna.fr/
[127] https://www.gremirecuperacio.org/sobre-nosotros/
[128] https://www.autopurkamoliitto.fi/
[129] https://www.demontagroup.cz/
[130] https://www.bdsv.org/der-verband/

If you represent the private sector (Company or business organisation), please specify your area of interest / activity You can select more than one box:([ID14])

		Answers	Ratio
Vehicle producer/ manufacturer/ suppliers/ importer([ID17])		50	24.04 %
Car dealer([ID18])		6	2.88 %
Repair shop([ID19])		10	4.81 %
Insurance company([ID20])		6	2.88 %
Dismantling sector, Authorised Treatment Facility([ID21])		47	22.60 %
Recycling sector incl. shredder and PST operators([ID22])		45	21.63 %
Import / export of used vehicles([ID23])		2	0.96 %
Other([ID24])		94	45.19 %

13.2.1 13.2.1 SMEs views relating to measures to increase the re-use of vehicle parts:

The OPC included a specific question, addressed to the professional audience, on which measures would contribute to increase the reuse of vehicles parts, from **189 responses totally received, 130 came from SMEs mostly representing the ELV dismantling sector. 84 of them supported the view that the introduction of an obligation for repair shops to offer used spare parts (together with new spare parts) to their customers would contribute to increase the reuse of vehicle parts.** 75 of them were of the opinion that car manufacturers should be obliged to enable ATFs to unlock parts with digital keys so that these parts could be reused after dismantling. Additionally, 66 of the respondents representing the SMEs agreed that the manufacturers should be obliged to provide the dismantling centres information about the parts. 54 of the participants in this category supported the measure to remove certain parts of ELVs before shredding with the aim to support reuse.

26. In your view which of the following measures would contribute to increase the reuse of vehicle parts? More than one answer can be indicated.

		Answers	Ratio
Implementation of a separate reuse target by weight of the reused part compared to the weight of the vehicle.		13	10.00 %
Implementation of separate reuse targets for specific vehicle components such as tyres, combustion engines, gears, bumpers etc.		34	26.15 %
Obligation for repair shops to offer customers used spare parts as an alternative to new ones (see the example of France above).		84	64.62 %
Obligation for ATFs to remove certain parts of ELVs before shredding to help increase reuse (if yes, see next question).		54	41.54 %
Obligation for car manufacturers to enable (e.g. the ATFs) unlocking parts so that they can be reused and dismantled.		75	57.69 %
Obligation for car manufacturers to provide the dismantling centres (ATFs) information about which parts can be used as identical parts in other models of the manufacturer or even other brands.		66	50.77 %
Establishing rules that the origin of a spare part must be demonstrated and can be tracked.		55	42.31 %
No change of the current situation.		3	2.31 %
Other		25	19.23 %
I do not know / no opinion		20	15.38 %
No Answer		5	3.85 %

If you represent the private sector (Company or business organisation), please specify your area of interest / activity You can select more than one box:

		Answers	Ratio
Vehicle producer/ manufacturer/ suppliers/ importer		29	22.31 %
Car dealer		3	2.31 %
Repair shop		6	4.62 %
Insurance company		3	2.31 %
Dismantling sector, Authorised Treatment Facility		39	30.00 %
Recycling sector incl. shredder and PST operators		26	20.00 %
Import / export of used vehicles		0	0.00 %
Other		55	42.31 %

13.2.2 13.2.2 Recycled content target for plastics

Out of 130 responses from SMEs, 71 strongly agreed or agreed with setting a recycled content target for plastics. 30 of these SMEs belonged to dismantling sector or ATFs, while 15 represented the recycling sector. Only 11 of SMEs in these sectors opposed to setting a mandatory target on use of recycled plastic in new vehicles. Taking the total number of SMEs, 36 (or 27.8 %) of them did not agree, while 28 (or 21.5%) remained neutral.

31. Do you agree with including in the ELV Directive a recycled plastics content target for new vehicles? ([ID282])

		Answers	Ratio
Strongly agree([ID301])		47	36.15 %
Agree([ID305])		24	18.46 %
Neutral([ID307])		23	17.69 %
Disagree([ID339])		8	6.15 %
Strongly disagree([ID340])		3	2.31 %
I do not know / no opinion([ID341])		19	14.62 %
No Answer		6	4.62 %

If you represent the private sector (Company or business organisation), please specify your area of interest / activity You can select more than one box:([ID14])

		Answers	Ratio
Vehicle producer/ manufacturer/ suppliers/ importer([ID17])		29	22.31 %
Car dealer([ID18])		3	2.31 %
Repair shop([ID19])		6	4.62 %
Insurance company([ID20])		3	2.31 %
Dismantling sector, Authorised Treatment Facility([ID21])		39	30.00 %
Recycling sector incl. shredder and PST operators([ID22])		26	20.00 %
Import / export of used vehicles([ID23])		0	0.00 %
Other([ID24])		55	42.31 %

When asked to indicate **other materials for which recycled content targets should be considered,** most of the SMEs representing dismantling, ATFs, vehicle producers, manufacturers, suppliers and recycling sector chose **glass, platinum group metals, REEs, aluminium alloys, other CRMs and steel alloys and magnesium as the most potential candidates.**

35. Please indicate other materials for which recycled content targets should be considered and explain shortly why (multiple materials can be indicated).([ID366])

		Answers	Ratio
Glass([ID370])		45	34.62 %
Platinum group metals (PGMs)([ID374])		45	34.62 %
Rare earth elements (REEs)([ID373])		41	31.54 %
Aluminium alloys([ID372])		38	29.23 %
Other Critical Raw Materials([ID378])		34	26.15 %
Steel alloys([ID371])		32	24.62 %
Magnesium([ID376])		32	24.62 %
Copper alloys([ID379])		31	23.85 %
Niobium([ID377])		30	23.08 %
I do not know / no opinion([ID381])		30	23.08 %
Gallium([ID375])		29	22.31 %
Other([ID382])		26	20.00 %
None([ID380])		19	14.62 %
No Answer		9	6.92 %

From the SMEs cluster, the distribution of the responses to this question is provided below:

If you represent the private sector (Company or business organisation), please specify your area of interest / activity You can select more than one box:([ID14])

		Answers	Ratio
Vehicle producer/ manufacturer/ suppliers/ importer([ID17])		5	7.81 %
Car dealer([ID18])		2	3.13 %
Repair shop([ID19])		5	7.81 %
Insurance company([ID20])		0	0.00 %
Dismantling sector, Authorised Treatment Facility([ID21])		26	40.63 %
Recycling sector incl. shredder and PST operators([ID22])		16	25.00 %
Import / export of used vehicles([ID23])		0	0.00 %
Other([ID24])		25	39.06 %

13.2.3 13.2.3 Material specific recycling targets

When inquired about establishing a material-specific targets, on the overall, the SMEs were supportive, 83 of them agreed as it would increase the separate recycling, while 70 also noted

the increase of the quality of recycling. Although 70 participants admitted that the establishment of the material specific targets would increase costs, 45 also acknowledged that setting such targets would increase the revenues from the sale of recycled materials.

6. In your opinion, the establishment of material-specific recycling targets in EU law would (more than one answer can be indicated):

	Answers	Ratio
Increase the separate recycling of materials addressed by such targets	83	63.85 %
Increase the quality of recycling of materials addressed by such targets	70	53.85 %
Increase recycling costs	70	53.85 %
Increase revenues from sale of recycled materials	45	34.62 %
Other	16	12.31 %
I do not know / no opinion	12	9.23 %
No Answer	2	1.54 %

In this context, 28 ELV management operators also agreed that such regulatory approach on recycling targets would have a positive impact on innovation development. SMEs specified that the major impacts are expected in increasing i) innovative eco-design of products; ii) high-quality recycling; and iii) innovative recycling opportunities and processes.

28. Would material-specific recycling targets have an impact on innovation?

	Answers	Ratio
Yes	32	59.26 %
No	9	16.67 %
I don not know / no opinion	12	22.22 %
No Answer	1	1.85 %

13.2.4 13.2.4 Export related requirements for the used vehicles

70 % of all the participants of the OPC represented SMEs and were in favour of new EU-wide export related measures for used vehicles. Assessing the individual responses received, 64 of SME stakeholders agreed with idea to introduce a requirement to provide a valid roadworthiness certificate as a mandatory condition to authorise the export of a used vehicle to a non-EU country. This response was followed by the support to better enforce the existing ban on export of ELVs (57), while 49 suggested to focus on illegal export of ELVs by improving the traceability of vehicles and introducing mandatory criteria to distinguish waste vehicles from used vehicles.

10. Which of the following options is in your view the most adequate to overcome the problem of 'illegal exports' of ELVs to non-EU countries, as well as the problem posed by the export of used vehicles which are not considered as waste? (more than one reply is possible)

		Answers	Ratio
Enact new conditions for the export of used vehicles, so that export is only possible upon presentation of a valid roadworthiness certificate		64	49.23 %
Enact new conditions for the export of used vehicles (as presented in the suggestions above) and better enforce the ban on export of ELVs		57	43.85 %
Not enact any new conditions for the export of used vehicles, but rather focus on illegal export of ELVs, through enhanced enforcement efforts, better traceability and making the criteria for distinguishing them from used vehicles binding under EU law		49	37.69 %
Enact new conditions for the export of used vehicles, so that export is only possible for vehicles which comply with certain environmental criteria (for example, air pollutants or greenhouse gas emission limits)		41	31.54 %
I do not know / no opinion.		14	10.77 %

Taking the overall scope of respondents, the main responses were received from dismantling ATF, recycling sector and vehicle producers, manufacturers, suppliers and importers. 8 car dealers and representatives specialising in import/export of used vehicles responded to this question; 3 of them identified themselves as SMEs.

13.3 Step (3) assessment of the impact on SMEs

13.3.1 13.3.1 EPR related measures

Stakeholders were asked to provide their opinion whether it is necessary to compensate the authorised treatment facilities (ATFs) for their dismantling efforts that, under the current conditions, are not economically viable, in order to ensure a high quality of recycling.

Overall, more than 64% of stakeholders representing SMEs agreed that it is necessary to compensate the costs incurred by the ATFs. The dismantling and recycling sector alone was represented by 65 SMEs. 40 of them were in favour, while 9 of them indicated as I don't know/ no opinion. **Out of 18 individual respondents who identified themselves as vehicle producers, suppliers or importers, 8 individuals disagreed with such an approach.**

From the SMEs cluster, the distribution of the responses to this question is provided below:

41. Please indicate whether you agree with the following statement: To ensure that a high quality of recycling is achieved, it is necessary to compensate the authorised treatment facilities (ATFs) for their dismantling efforts that, under the current conditions, are not economically viable.

		Answers	Ratio
Yes		70	64.22 %
No		11	10.09 %
I do not know/no opinion		25	22.94 %
No Answer		3	2.75 %

If you represent the private sector (Company or business organisation), please specify your area of interest / activity You can select more than one box:

		Answers	Ratio
Other		55	50.46 %
Dismantling sector, Authorised Treatment Facility		39	35.78 %
Recycling sector incl. shredder and PST operators		26	23.85 %
Vehicle producer/ manufacturer/ suppliers/ importer		8	7.34 %
Repair shop		6	5.50 %
Car dealer		3	2.75 %
Insurance company		3	2.75 %
Import / export of used vehicles		0	0.00 %

13.3.2 13.3.2 Impacts on companies involved in the dismantling and recycling sector:

The economic viability of SMEs in the **dismantling sector** is already fragile. Under the baseline scenario, they will face considerable challenges within a 10- to 15-year horizon, due to the consequences of the shift to electric vehicles. The dismantling of EVs will indeed require an evolution of their business model, notably investments for new technologies and infrastructure.

For SMEs in the dismantling sector, the measures in the preferred option consisting in increasing the number of parts and components to be removed prior to the shredding phase will generate important extra costs. These costs would be partly offset by additional revenues, notably linked to the sales of used spare parts, which will be considerably encouraged through measures designed to improve the market for such parts. In the same vein, valuable components removed prior to shredding (parts containing plastics, aluminium, CRMs) and sent for high quality recycling will command higher prices than when these components are sent to shredders. Taking advantage of the digitalisation process will be critical in empowering the smaller and often family-run companies to reach out to new market players by connecting to online platforms and distant

marketplaces at both local and international levels. In addition, the 'pull-effect' from the mandatory target on recycled content for plastics are expected to boost the competitiveness of dismantlers, as they would become the primary supply spots of the high-demand high-quality secondary materials. The measures designed to address the problems of "missing vehicles" will also have a considerable effect for the dismantling sector, as this will result in an important extra volume of ELVs of up to 3.2 million units delivered to ATFs in 2035, and thereby a considerable increase in their turnover. For the extra costs linked to the proposed measures which cannot be offset through market conditions, the measures proposed on EPR will be key to ensure that vehicle manufacturers provide the necessary financial support to dismantlers so that they maintain their competitiveness and face down unfair competition from the informal sector.

Based on the elements presented above, it clear that an important number of factors will influence the competitiveness of SMEs in the dismantling sector. The proposed measures, especially to increase the collection of ELVs, will lead to an important additional economic activity and increased turnover. According to the modelling from the main impact assessment, it would also lead to the creation of about 8,000 jobs in 2035 compared to the baseline related to implementation of the recycled content, quality of recycling and collection related measures. The expected increase in the demand for spare parts, improvements in their distribution and the fluctuations of prices of secondary materials (i.e., spare parts for re-use and materials destined for recycling) will be essential elements to determine the profitability of ATFs. While it remains challenging to provide an accurate projection of the costs and revenues for SMEs from the measures contained in the preferred option, it is estimated that they would be able to increase their competitiveness, with a higher turnover and additional employees, and an overall increased net revenue of 2 million EUR in 2035.

For SMEs involved in the **sorting, shredding and recycling** of ELV waste, the most impactful measures are those:

(i) on better collection of ELVs, which would mean that additional ELVs would be supplied to shredding and recycling plants;

(ii) on recycled content, which should ensure an increased market share for recycled plastics [and steel] through ensuring a steady supply from these recyclates to industries processing them into new products, and boost their competitiveness;

(iii) designed to increase the quality of recyclates and improve the treatment of waste, especially the requirements for selective treatment of a list of parts and components (as described in Measure 13b) and new requirements on the ban on the landfilling for automobile shredders residues and on mixing of ELV scrap with WEEE and other scraps during shredding and post-shredding technologies. These measures would require investments, notably for the companies which are currently not operating modern shredding and post shredding technologies.

Overall, the proposed measures would have a substantial impact on SMEs active in this sector, with a large increase in turnover and also new investment needs. And in that case again, the measures proposed on EPR are meant to ensure that extra costs which cannot

be offset under normal market conditions should be borne by vehicle manufacturers to support the recycling sector. As for SMEs in the dismantling sector, the overall economic impact on shredding and recycling companies will be highly dependent on the prices of recyclates, which cannot be predicted with certainty. Taking these uncertainties into consideration and based on the model used for this impact assessment, the overall economic impact for the shredding sector has been assessed as representing a net cost of 190 million € in 2035 compared to the baseline, while it would be of 265 million € net revenues for the recycling sector. As indicated above, the extra costs for the shredding sector would be compensated by contributions from the vehicle manufacturers through EPR schemes, so that the competitiveness of the shredding sector would not be affected. The social impact would translate in the creation of 6 000 jobs for the whole sorting, shredding and recycling sector.

Overall, the proposed measures should support the competitiveness of **SMEs in the dismantling and recycling sector** through new market opportunities. It is however likely that a number of SMEs might not be able or willing to adapt their business models or invest in the technologies necessary to meet the new requirements. In addition, the measures proposed on the design/production of vehicles, as well as those on EPR, could also encourage vehicle manufacturers to play a greater role in management of ELV waste. This could take the form of contractual arrangements with existing actors in the waste management, or of a more direct intervention through direct investments in this field. As a result, it is likely that the proposed measures could lead to a concentration of actors in the dismantling and recycling sectors and a reduction in the number of SMEs in this field. It should be underlined that this trend for concentration is expected to happen under the baseline scenario, as some vehicle manufacturers intend to exercise a higher control over the recovery of materials contained in electric vehicles, due to their value and relevance for their industry. The proposed measures under the preferred option could exacerbate this trend but it is expected that a concentration of the sector would take place in any event under the baseline scenario.

Impact on companies in the maintenance and repair of vehicles: For the SMEs in this sector, the most impactful measure assessed as part of this report is the measure requiring them to offer used spare parts together with new spare parts to their customers (as is currently the case in France). Adopting this measure would be up to EU Member States. This would represent an additional burden compared to the baseline. This will be the case especially for the companies which are not currently used to proposing used spare parts to their customers, as they would have to carry out an additional task. In practice, this new measure would translate in spending a certain amount of time to search for used spare parts. There are many online platforms offering used spare parts for sale, thus facilitating search for the appropriate one.

Impact on companies involved in the export of used vehicles: 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 impacted. 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. The overall net economic impacts for this sector have been assessed to reach a loss of 510 million EUR costs by 2035 compared to the baseline scenario.

13.4 Step (4) minimising negative impacts on SMEs

The negative impacts of the preferred option have been minimised through (i) a careful design and adaptation of the measures to ensure that their cost remains proportional to the expected benefits and are not excessive for SMEs and (ii) the introduction of mechanisms of compensation by vehicle manufacturers for possible extra costs linked to the proposed measures, which could be not offset under normal conditions by SMEs (through the establishment of "extended producer responsibility" schemes).

- **Companies in the dismantling/recycling sector:** The measures impacting companies in the dismantling and recycling sector have been devised in a way to reflect the different situations in the Member States, their degree of technological development, the need to remain technology-neutral and avoid excessive costs. This is in particular the case for the obligations to ensure an improved treatment of ELV and their related scrap: one of the most important measures in that regard is the obligation for dismantlers and shredding companies to operate a selective treatment of a list of parts and components contained in ELV. The definition of the items contained in this list has taken into consideration the associated costs and benefits linked to their selective dismantling. As a result, the preferred option did not retain the suggestions made during the consultation process to include a number of components (as reflected in Measure 14c, which does not form part of the preferred option), in view of the high costs linked to their dismantling compared to the environmental and economic benefits. The preferred measure in that regard is Measure 14b, which includes a shorter list. In addition, the obligation for selective treatment is less stringent than the suggestion made during the consultation process that the items contained in the list should all be removed manually by dismantlers before the shredding stage. This remains an option, but the selective treatment can also be operated by shredding companies if they provide evidence that the quality of the scrap resulting from shredding will be of similar quality than for components removed priori to shredding. This was an important demand by the shredding operators.

  The costs linked to the new requirements for the SMEs in the dismantling and recycling sector are also mitigated through (i) measures designed to stimulate the market for recyclates and re-use of spare parts and (ii) financial contribution by vehicle manufacturers to offset compliance costs which cannot be absorbed under normal market conditions (through EPR schemes).

  The measures designed to improve the market for recyclates are in the first place the requirements on the mandatory use of recycled plastics (and potentially steel), which will

ensure that a steady supply of recycled plastic and steel from ELV scrap is channelled towards the production of new vehicles. These measures correspond to a longstanding request by the dismantling and recycling industry and have proven to be very effective in boosting the recycling of plastics when they were first implemented at the EU level for bottles made of Polyethylene terephthalate (PET). The measures designed to boost the market for the re-use and remanufacturing of spare parts described in Measure 14b will one the other hand provide a larger access for ATFs to the market of spare parts and help them better compete with informal actors.

The measure foreseeing the establishment of EPR schemes will in addition ensure that the dismantlers and recyclers can benefit from financial support channelled by the vehicle manufacturers to offset compliance costs. In this case, this means that SMEs in the dismantling and recycling sector will not have to face along the extra-costs of measures designed to improve the collection and treatment of ELV waste but would be able to rely on the financial contribution of large companies (vehicle manufacturers). While calling for the establishment of such schemes, the dismantling and recycling sector has also emphasised that EPR schemes should not be used by the vehicle manufacturers to impose their practices and business models towards them. They have insisted in particular on the need that they should be adequately represented in the governing bodies of Producer Responsibility Organisations and that there is an oversight by public authorities on the functioning of the EPR schemes. These concerns have been taken into account in the preferred option, which includes explicitly these points.

- **companies in the maintenance and repair of vehicles:** In view of the relatively limited input received by SMEs in this sector in the consultation, the very small size of many of companies and the concern that a mandatory obligation could place an unnecessary burden on them, the preferred option did not retain the measure making it mandatory at EU level for these companies to offer used spare parts together with new spare parts to their customers. Rather, it provides that Member States should put in place a set of measures to promote the market and acceptance for used spare parts. This could include an obligation on garages to provide offers for used spare parts (as described above), but this would remain at the discretion of the Member States and not be an EU wide obligation.

- **Companies involved in the export of used vehicles:** the measure on the export of used vehicle has been devised in a way which does not constitute a blanket ban. During the consultation process, suggestions were made to ban the export from the EU to third countries of all used vehicles which would be over a certain age or not complying with Euro emissions. This would have led to a prohibition of export for a wide range of vehicles, even those which are still roadworthy, without the possibility for exporters to overcome it. This suggestion has not been retained in the preferred package, which foresees rather than the export is conditioned upon the presentation of a valid roadworthiness certificate. Exporters could then be able to continue exporting used vehicles for which the certificate has expired, on the condition that they ensure that the vehicle continues to be roadworthy and obtain the required certificate before export.

While this would represent a cost, it is deemed proportionate to the aim of the measure, which is to avoid the export of non-roadworthy vehicles outside the EU, and consistent with the obligations applying to vehicles on the EU road which cannot be driven without such certificate.

13.4.1 13.4.1 EU-wide measures to mitigate impacts for SMEs

The impact assessment has taken into account that the attainment of higher quality treatment of ELV, the uptake of recycled materials in new vehicles, a wider re-use of materials and the design of more circular vehicles can only succeed if the European companies are ready to engage in new circular business models and are equipped to do so. This requires new technologies, investments and reforms that unlock the full potential of such investments. This is the case for SMEs in automotive and recycling sectors, which need to be modernised, extend their capacity in meeting upgraded treatment requirements, customers' needs and keep up with the digitalisation of the processes.

The EU has put in place in the last years an unprecedented level of public financial support for investments which are specifically geared towards the green transition. This represents considerable opportunities for all actors in the waste sector, which are mostly SMEs, and the industries processing waste to accelerate the transition to the circular economy. It includes funding available under the Multiannual Financial Framework for the period 2021-2027, especially the **European Structural and Investment Funds**[131]. In addition, the **Recovery and Resilience Facility (RRF)**[132]**, including REPowerEU**[133]**,** which is the key instrument at the heart of the €807 billion **NextGenerationEU**[134], supports reforms and investments (with more than €11 billion until 2026) in 21 Member States for innovative and advanced solutions for separate collection, sorting, reuse and recycling, as well as fostering the development and adoption of circular economy innovations.

Circular economy is also embedded in the matrix of the **Horizon Europe**[135] programme on research, notably its partnership on circularity[136]. It is one of the pillars of the **Programme for the environment and climate action (LIFE) 2021–2027**[137]**,** the only EU funding instrument entirely dedicated to environmental and climate objectives, with an allocation of €5 billion for the period 2021-2027. Thanks to these programmes, the EU supports more than 200 000 businesses every year. EU Funding is available for all types of companies of any size and sector including entrepreneurs, start-ups, micro companies, small and medium-sized enterprises. More information on projects under these programmes which are particularly targeting the design and recycling of ELVs is provided in Annex 9 of this report.

[131] https://ec.europa.eu/regional_policy/index.cfm/en/funding/accessing-funds/
[132] https://ec.europa.eu/info/business-economy-euro/recovery-coronavirus/recovery-and-resilience-facility_en
[133] https://commission.europa.eu/publications/guidance-recovery-and-resilience-plans-context-repowereu_en
[134] https://ec.europa.eu/info/strategy/recovery-plan-europe_en
[135] https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe_en
[136] https://ec.europa.eu/commission/presscorner/detail/en/ip_21_1122
[137] Regulation (EU) 2021/783 of the European Parliament and of the Council of 29 April 2021 establishing a Programme for the Environment and Climate Action (LIFE), and repealing Regulation (EU) No 1293/2013 (OJ L 172, 17.5.2021, p. 53–78).

The European Investment Bank is also a key player in supporting the transition to a circular economy and has recently stepped up its engagement in this field[138]. **The European Investment Fund[139]** provides specific support to European SMEs in the form of business loans, microfinance, guarantees and venture capital. **The InvestEU programme** also supports circular economy approaches, including in SMEs, by mobilising public and private investment through an EU budget guarantee[140].

Finally, there are a number of different platforms established to coordinate and streamline the support for the SMEs at the EU level. For instance, the Enterprise Europe Network (EEN)[141] helps businesses innovate and grow on an international scale. It is the world's largest support network for SMEs with international ambitions. It brings together experts from member organisations that are renowned for their excellence in business support, including chambers of commerce and industry, regional development organisations, universities and research institutes and innovation agencies. Such cooperation mechanism supports the SMEs in dealing with different challenges in running their businesses across different sectors.

[138] See "The EIB Circular Economy Guide Supporting the circular transition", published in 2020 and available at: https://www.eib.org/attachments/thematic/circular_economy_guide_en.pdf
[139] https://www.eif.org/
[140] https://investeu.europa.eu/what-investeu-programme/investeu-fund_en
[141] https://een.ec.europa.eu/about-enterprise-europe-network

ANNEX 14: IMPACTS OF THE PROPOSED MEASURES FOR THE AUTOMOTIVE INDUSTRY IN THE INTERNATIONAL CONTEXT

14.1 Main findings

The European automotive industry has been continuously growing since 1980. Thanks to the technological progress resulting in the emerge of more fuel-efficient and electric vehicles[142], this growth has further enhanced. **Today Europe is the second biggest vehicle manufacturer in the world[143],** whereas 12.1 million **vehicles produced in the EU accounts for 15.3%** of the total motor vehicle production worldwide. Passenger cars represent 82 % of all the vehicles produced in the EU[144]. Although compared to 2020, manufacturing of passenger cars dropped by 7.7 % in 2021, **the EU maintained its global competitiveness by delivering 9.9 million cars[145].**

Based on ACEA statistics, every year the European automobile industry exports 5 747 063 motor vehicles[146], with a positive trade balance of 2 182 321 units. In 2021, over 3 million passenger cars were imported to the EU[147]. According to JRC estimates in the study on the recycled content for plastics[148], the import of new vehicles manufactured in non-EU countries presents 30% of the total number of vehicles traded in the EU, while the export of the EU manufactured vehicles to third countries is 46%. The number of manufactured vehicles would increase by 1.3 times in the EU, which can be translated into 19.3 million vehicles in 2030 and accordingly 19.5 million – in 2035 (vs. 14.9 and 15.0 million of the EU sales)[149].

142 https://www.mckinsey.com/~/media/mckinsey/industries/automotive%20and%20assembly/our%20insights/a%20long%20term%20vision%20for%20the%20european%20automotive%20industry/race-2050-a-vision-for-the-european-automotive-industry.pdf

143 https://www.acea.auto/figure/world-motor-vehicle-production/

144 https://www.acea.auto/figure/eu-motor-vehicle-production-by-type/

145 https://www.acea.auto/figure/eu-passenger-car-production/

146 https://www.acea.auto/figure/eu-motor-vehicle-trade-by-vehicle-type-in-units/

147 In 2021, the EU imported 458,769 passenger cars from Turkey, followed by China (435,080) and Japan (401,276). More information available at: https://www.acea.auto/figure/eu-motor-vehicle-imports-main-countries-of-origin-in-units/

148 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.

149 *Ibid.*

Table 14.1 Overview of the main countries of origin of passenger car imports in the EU (in units), ACEA, 2021.

	2016	2017	2018	2019	2020	2021
World	3,659,905	3,865,048	3,963,023	3,973,903	3,057,873	3,097,550
Turkey	569,756	718,163	714,895	701,111	494,081	458,769
China	60,954	99,854	133,280	133,465	169,803	435,080
Japan	489,473	552,017	581,385	674,336	484,358	401,276
United Kingdom	1,170,174	901,298	841,402	700,371	507,383	393,410
South Korea	294,623	411,952	435,814	441,870	318,493	377,404
United States	253,205	239,786	256,411	349,089	387,720	308,506
Morocco	179,959	222,965	266,276	280,731	240,488	270,977
Mexico	133,601	228,668	262,147	218,077	170,600	178,267
South Africa	148,521	140,966	172,407	213,198	124,892	93,483
Switzerland	60,965	64,113	65,877	58,514	48,052	53,966

To enter the EU market, manufacturers must adhere to a variety of legal requirements:

i) all imported vehicles to the EU must be type-approved. This process involves demonstrating that the vehicles meet the essential safety and environmental requirements of the EU. Certificate of compliance, granted during the type-approval process, shall include the appropriate documentation and describe the strategy recommended by the manufacturer to ensure dismantling, reuse of component parts, recycling and recovery of materials[150];

ii) vehicles must be designed in way that meets the EU safety standards established in Vehicle General Safety Regulation[151], such as the electronic stability control, lane departure warning, advanced emergency braking systems;

iii) Vehicles shall be labelled[152] and to include the information on the fuel efficiency and emissions. This information helps consumers in taking decisions before purchasing cars and encourage the manufacturers to reduce the fuel consumption in new cars.

[150] Article 6(5) of the current 3R type-approval Directive.
[151] https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32019R2144
[152] https://climate.ec.europa.eu/eu-action/transport-emissions/road-transport-reducing-co2-emissions-vehicles/car-labelling_en

All manufacturers placing their vehicles on the EU market shall comply with the EU specific rules on the fuel efficiency and Euro emissions standards. The expected impacts of the new legislation are comparable to those analysed under the impact assessment of the Euro7 proposal[153] which introduces the emission compliance requirements for all motor vehicles put on the EU market, i.e., manufactured and imported to the EU. Based on the compiled evidence, the assessment reveals, most of EU trade partners for the vehicle production, namely the United States, United Kingdom, China, Japan, South Korea, and Switzerland, are developing more stringent standards or are already following the Euro standards. It is in particular relevant for countries, participating in the EU single market as a part of EFTA agreement. It was also revealed that the manufacturers are able to adjust the vehicles' emission control systems to the markets that do not require compliance with the Euro emission standards, e.g. China or the United States.

Similar reasoning can be applied for assessing the impacts across the global producers regarding the proposed design-related requirements for vehicles that would be placed on the EU market. In this context, it is important to take into account that it is a common practice upon which the vehicle manufacturers worldwide adapt to specific market requirements by designing and producing vehicles that meet the requirements to those markets. Manufacturers align to the markets by offering a range of models fitted to the preferences of the customers. This may include different engine types, trim levels, and other aspects.

Overall, manufacturers adapt to EU requirements by using a variety of strategies and technologies to design vehicles that are compliant with the regulations and that meet the preferences and needs of customers in that market. Manufacturers also often adapt to specific requirements by localizing their production in that market. According to the European Automobile Manufacturers' Association (ACEA), currently 301 automobile factories operate across Europe, producing passenger cars, light commercial vehicles, heavy-duty vehicles, buses, engines and batteries, with 194 of these plants being situated within the EU itself[154].

14.1.1 14.1.1 Decarbonisation efforts by vehicle manufacturers

Although there are no global or the EU wide recycled content requirements for vehicles, many manufacturers have already taken efforts to include higher shares of secondary materials and thus to decarbonise their production lines. Substitution of primary materials with the recycled content reduce the carbon footprint and also brings significant cost savings to the producers. These are examples of car manufacturers already integrating recycled content: an average of just under 30 % of BMW Group vehicles are currently made from recycled and reused materials. It is intended to gradually expand this figure to 50 %[155]. BMW Group has set itself the target of increasing the proportion of secondary materials in the thermoplastics used in new vehicles from currently around 20 % to an average of 40 % by 2030[156]. PEUGEOT 508 has an average of 31% recycled and natural materials in the vehicle; Stellantis[157] plans to boost recycled material content in vehicles by 35%[158]. Toyota aims to

[153] Proposal for a Regulation on type-approval of motor vehicles with respect to their emissions and battery durability (Euro 7) COM(2022) 586 final

[154] https://www.acea.auto/figure/interactive-map-automobile-assembly-and-production-plants-in-europe/

[155] https://www.bmw.com/en/magazine/sustainability/circularity-at-bmw.html

[156] https://www.press.bmwgroup.com/global/article/detail/T0403390EN/revolution-in-the-car-industry:-parts-made-from-recycled-fishing-nets?language=en

[157] Stellantis N.V. is a multinational automotive manufacturing corporation formed in 2021 on the basis of a 50–50 cross-border merger between the Italian-American conglomerate Fiat Chrysler Automobiles and the French PSA Group.

increase the use of recycled plastics by more than three times compared to current levels by 2030 – and fully switch to leather-free interiors by that time[159]. In 2021, Ford used post-consumer nylon in a battery box and 50% of post-consumer PP, ocean plastics and nanocellulose PU foam in various applications. Ford Motor expects that by 2035, half of its plastics will come from recycled or renewable materials, and that the company will be completely carbon-neutral by 2050[160]. Volvo, the Swedish manufacturer, set the ambition by 2025 to reach 25 % of its used plastics to be bio-based or from recycled materials, and 25% of steel with 40% aluminium coming from recycled sources[161]. To have a common industry-supported definition and approach for measuring recycled content of automotive products, a group of vehicle manufacturers, such as Ford Motor Company, General Motors, Honda Development & Manufacturing of America, LLC (HDMA), Stellantis, Toyota Motor North America, and their suppliers has recently adopted guidance[162].

These facts shows that the automobile industry is already taking initiatives in finding solutions that would lead to a more efficient and cost-saving production process of vehicles, by foreseeing optimal use of secondary materials, particularly steel. As these actions are voluntary, they are not currently supported or incentivised by law. Introduction of mandatory recycled content targets would send a clear signal to the automotive sector and credibility to the market players in terms of providing a balanced supply and demand of the secondary materials in a long term.

In addition to voluntary actions at the company level, different countries, where the vehicle manufacturers are established, implement national policies in order to accelerate decarbonisation of the steel industry. These include the following examples:

- China which is responsible for producing well over half of the world's steel in 2020 has announced it will be putting a price on steel emissions, possibly as soon as 2023[163]. They further announced as part of the 14th Five-Year-Plan (2021-2025) that it will be prioritising the creation of a circular economy[164], seeking to increase the use of scrap steel to 320 million tonnes by 2025, an increase of around 30% relative to estimates for 2020. This follows India – the world's second largest steel producer in 2020 – releasing their own Steel Scrap Recycling Policy[165], aiming to promote a circular economy in the steel sector by facilitating steel recycling across the product life cycle.

- The EU is in the process of developing a carbon border adjustment mechanism[166] for steel, while the United States[167] has announced that it is considering the same. These

[158] https://www.reuters.com/business/autos-transportation/stellantis-set-boost-recycled-material-content-vehicles-2022-10-11/

[159] https://www.toyota-europe.com/sustainability/circularity#:~:text=Recycling%20of%20Plastics,free%20interiors%20by%20that%20time.

[160] https://corporate.ford.com/articles/sustainability/recycling-plastic-water-bottles.html

[161] https://www.volvocars.com/intl/v/sustainability/circular-economy

[162] https://waste-management-world.com/artikel/automotive-industry-develops-new-guidance-for-measuring-recycled-content-of-automotive-products/

[163] https://www.asiafinancial.com/china-carbon-market-expansion-delayed-caijing

[164] http://english.www.gov.cn/policies/policywatch/202107/08/content_WS60e639b0c6d0df57f98dc92b.html

[165] https://pib.gov.in/newsite/PrintRelease.aspx?relid=194359

[166] https://ec.europa.eu/commission/presscorner/detail/en/qanda_21_3661

[167] https://ustr.gov/sites/default/files/files/reports/2021/2021 Trade Agenda/Online PDF 2021 Trade Policy Agenda and 2020 Annual Report.pdf

policies would apply tariffs on imported emissions-intensive goods from jurisdictions with weak or absent emissions policy in an effort to limit carbon leakage and incentivise stronger emissions measures overseas.

- France[168] and Japan[169] recently released roadmaps for decarbonising the iron and steel sector, setting out specific targets and laying out concrete steps for their steel sectors, with the national plan calling for emission reductions of 31% by 2030.
- Germany, which is the biggest vehicle manufacturer of the EU, announced earmarking 7 billion EUR[170] for green hydrogen. It also includes EUR 55 million for steel production run by hydrogen.

These already now ongoing practices are expected to affect the driving forces of the market for secondary metals, and accordingly to balance the supply-demand of low-carbon steel. It is an important factor for the automotive industry which is the major "client" for steel sector operating at the local, regional and global scale.

14.1.2 14.1.2 Automotive global supply chain

The automotive industry is functioning on global supply chain for several reasons:

(a) Access to production materials. Manufacturing of vehicles requires a range of different materials (ferrous, non-ferrous metals, plastics, etc.). By having a global supply chain, producers can access these materials from different parts of the world. By outsourcing certain parts of the production process to countries, vehicle producers reduce the overall cost of production and increase profits.
(b) Competitiveness advantage. A well-functioning global supply chain provides the vehicle manufacturers with advantage to be able to quicker respond to changing market demands and trends.
(c) Expertise. Certain automotive components or processes may be better managed by suppliers who hold the specialized expertise. For this reason, a global supply chain gives the vehicle manufacturers the access to a wider pool of suppliers and their specialized knowledge.

Taking in to account the above aspects, the global supply chain plays a central role for the smooth functioning of the automotive industry. In this context, the implementation of the foreseen design requirements builds on this model. The future Regulation aims to respect these principles and does not disrupt but rather to improve the business working model.

Introduction of recycled content targets for plastics would allow the manufacturers exporting vehicles to the EU to maintain their competitiveness within the global supply chain. It would not restrict the vehicle manufacturing companies – established both at the EU and in third countries – to source their recycled plastics or steel from outside the EU if they can verify that that this content used in their production is indeed recycled materials based on the specification criteria (e.g. minimum % share of closed-loop). Being within a global supply

[168] https://www.conseil-national-industrie.gouv.fr/files_cni/files/csf/mines-metallurgie/plan_siderurgie_france.pdf
[169] https://www.meti.go.jp/english/press/2021/1027_002.html
[170] https://www.iea.org/policies/11561-package-for-the-future-hydrogen-strategy

chain, manufacturers are in a position find the best quality materials for their production needs. The global supply chain allows manufacturers to source materials from the most cost-effective and efficient sources, regardless of geographical location. As a result, with a possibility to source recycled content from outside the EU, manufacturers enjoy broader access to a pool of suppliers specialising in the concrete areas.

Therefore, introduction of the new design-related requirements for vehicles takes into account the fact that the global nature of the supply chain is an important aspect of the automotive industry. Along these lines, it is therefore, important to set the same legal requirements for both the EU manufacturers of vehicles and importers for the following reasons:

- Legal clarity. Common requirements simplify the process of importing and selling vehicles in the EU, reducing costs and administrative burdens for companies operating in the market.
- Fair competition. By setting up the same requirements for both the EU manufacturers and importers, a level playing field is ensured.
- Market stability. Consistent and uniform legal requirements ensure stability and predictability in the EU automotive market. This attracts investment, foster growth in the industry.
- Consumer protection. Same level of requirements ensures that all vehicles made available on the EU market meet the same requirements.

Today, many countries where the automobile industry is established, regulate end-of-life treatment. In South Korea, end of life treatment of vehicles has been managed by the Act on Resource Circulation of Electrical & Electronics and ELVs since 2008, which is similar to the EU WEEE and ELV Directives[171]. It regulates the restricted use and prohibition of toxic substances (e.g., cadmium, hexavalent chromium, lead, and mercury) in vehicles and promotes their recycling by establishing a resource-circulation system of ELVs. It set a mandatory target recycling rate of 95% including 10% energy recovery as a maximum in the beginning of 2015. In Japan, legislation on ELV recycling was implemented in 2005 based on the shared EPR concept. Automobile manufacturers including importers take responsibility for the collection and recycling of ELVs[172]. The Circular Economy Promotion Law[173] in China was designed to reduce waste and promote sustainability. The provisions and targets for recycling and waste reduction, as well as regulations for the management of waste, apply to the automotive industry and the vehicles it produces[174]. Overall, these regulations set recycling requirements mainly focussing on the recovery of metals, plastic, and other materials from end-of-life vehicles for re-use.

Since the late 2000s, China has adopted the circular economy as a national priority and defined vehicle remanufacturing as a strategic sector. Remanufacturing uses approximately

[171] Jang, Y.-C.; Choi, K.; Jeong, J.-h.; Kim, H.; Kim, J.-G. Recycling and Material-Flow Analysis of End-of-Life Vehicles towards Resource Circulation in South Korea. Sustainability 2022, 14, 1270. https:// doi.org/10.3390/su14031270.

[172] https://mdpi-res.com/d_attachment/sustainability/sustainability-14-01270/article_deploy/sustainability-14-01270.pdf?version=1643006861

[173] https://leap.unep.org/countries/cn/national-legislation/circular-economy-promotion-law-peoples-republic-china

[174] The dismantlement or reutilization of waste motor vehicles shall be conducted in accordance with the relevant laws and administrative regulations (Article 38) https://ppp.worldbank.org/public-private-partnership/sites/ppp.worldbank.org/files/documents/China_CircularEconomyLawEnglish.pdf

60% less energy and 70% fewer materials than making new products. Vehicle remanufacturing in particular has a huge market potential in China, with its existing stock of 365 million vehicles, and an automotive repair and maintenance market worth 157 billion USD annually[175]. There are also other exemplary business cases towards support for the market of used and remanufactured spare parts. Renault Group established an ambitious policy designed to boost the remanufacturing of vehicles parts and components, thereby reducing the use of virgin materials. This approach has led to generate revenues of nearly 120 million EUR in 2019 alone from remanufacturing activities. By 2025, Renault expects to generate 200 million EUR through its recently planned recycling business[176]. Volvo currently remanufactures 36 different component groups, including engines, gearboxes, turbo compressors and clutches. In 2021, Volvocars International saved over 4,000 tonnes of CO_2 by remanufacturing over 37,000 parts[177].

Similar to the situation in recycled content, manufacturers already integrate different elements of circularity into the manufacturing policies. A number of companies publish this information on their websites in a form of strategies, annual sustainability reports[178] or general overviews[179]. Among other information, these documents include the overview on the innovations, investment into R&D, long term climate neutrality objectives, social and corporate responsibility in sourcing materials, measures taken to increase resource efficiency[180] and decrease cost of production. Therefore, new requirement for the manufacturers to prepare and implement circularity strategies for vehicles would complement the current practices by defining common criteria for content and presentation.

14.1.3 14.1.3 Factors for the development of the European automotive industry

Europe is the birthplace of the automobile and has a long history of developing breakthrough innovations[181]. Representing 27 percent 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. Moreover, Europe has the right talent and human capital to continue successful automotive innovations and has a number of globally leading universities along the ACES trends: 13 out of 17 universities globally leading in the area of electrification are based in Europe; also 4 out of 17 in autonomous driving and 8 out of 19 in connectivity.

[175] https://ellenmacarthurfoundation.org/circular-examples/advancing-vehicle-remanufacturing-in-china-the-role-of-policy
[176] More information available at: https://ellenmacarthurfoundation.org/circular-examples/groupe-renault,https://www.reuters.com/markets/europe/renault-expects-11-billion-revenue-new-recycling-business-2021-11-30
[177] https://www.volvocars.com/intl/v/sustainability/circular-economy
[178] E.g. Nissan: https://www.nissan-global.com/EN/SUSTAINABILITY/LIBRARY/SR/2022/, Hyundai: https://www.hyundai.com/eu/about-hyundai/sustainability/sustainability.html; Stellantis: https://www.stellantis.com/content/dam/stellantis-corporate/sustainability/csr-disclosure/fca/fca_2020_sustainability_report.pdf; Ford: https://www.ford.co.uk/experience-ford/sustainability
[179] Examples: BMW https://www.bmwgroup.com/en/sustainability.html; Kia: https://www.kia.com/eu/about-kia/sustainability/
[180] E.g. Toyota Europe https://www.toyota-europe.com/sustainability/circularity
[181] More information available at: https://www.mckinsey.com/~/media/mckinsey/industries/automotive%20and%20assembly/our%20insights/a%20long%20term%20vision%20for%20the%20european%20automotive%20industry/race-2050-a-vision-for-the-european-automotive-industry.pdf

The EU contributes to this development by providing a number of different funding opportunities for both public and private sector, through Horizon 2020, LIFE programmes. More information on the projects is provided in Annex 11 of the IA.

14.2 Conclusion

From the legal point of view, future requirements would apply equally both to European producers and to importers and would be consistent with the EU's international obligations on the trade relationships and the WTO, considering that the requirements are non-discriminatory and justified for reasons linked to environmental protection. The new legislation will in due course be notified under the TBT Agreement.

Moreover, the EU manufacturers would not be put in the more advantageous position, as the majority of the manufacturers, representing the most popular brands of the imported vehicles to the EU, already integrate business practices to optimise the functioning of their production lines and the increase the efficiency in material use. These aspects are comparable to the measures proposed under the preferred option of this impact assessment.

Therefore, the design related requirements to be foreseen under the future legislation would be complementary to the current set of the EU rules and would apply in a proportionate and non-discriminatory manner for both importers and those manufacturers established in the EU. Such regulatory approach would therefore not affect the international competitiveness of the EU or third parties.

ANNEX 15: CONTRIBUTION OF THE REVISION OF THE ELV AND 3R TYPE-APPROVAL DIRECTIVES TO THE CIRCULARITY OF CRITICAL RAW MATERIALS (CRM)

The Commission proposal for a Critical Raw Materials Act adopted in March 2023 contains a series of measures linked inter-alia to the development of Critical Raw Materials (CRMs) value chains in the EU, and to the diversification of supply and partnership to reduce supply risks. It contains measures designed to increase the circularity of products containing CRMs and the recycling capacity for these products in the EU. Considering that new vehicles contain substantial quantities of CRMs (see sections 15.1 and 15.4.1 below), and that at the same time end-of-life vehicles represent an important source of secondary raw materials, the joint revision of the ELV and Type Approval Directives represents a key opportunity to improve the recovery of CRMs used by the automotive industry, hence already contributing to the objectives of the CRM Act. Furthermore, the extension of the scope of the EU legislation on ELV and 3R type-approval to new vehicles such as lorries, buses and two-wheelers broadens the EU capability to recover higher quantities of CRMs from vehicles, which represents an additional boosting contribution to the CRM Act circularity objectives.

This annex summarises key information and data related to proposed measures for circularity of CRMs in the preferred package, including: 15.1) Relevant information (EU import reliance, market share, main and expected future use) on CRMs in vehicles and relevant components containing these CRMs; 15.2) expected 2035 and 2040 impacts of these measures for the circularity of the relevant CRMs 15.3) suggestions for follow-up review clauses on CRM circularity measures, and 15.4) additional contribution of the potential ELV and Type-Approval directives extension of scope to a higher circularity of CRM. The data presented in this Annex have been compiled by the Commission Joint Research Centre, and is a part of a study to be published later in 2023[182].

15.1 Relevant information on CRMs in vehicles and relevant components

There are **more than 60 materials** used in ICEVs (internal combustion engine vehicles) and EVs (electric vehicles), although only a dozen of materials represents up to 95% of the total weight of the vehicles. From a CRMs perspective, most of the value of an ELV is not in the most abundant materials and CRM content differs significantly between ICEVs and EVs[183]. ICEVs mainly contain cerium (Ce), lanthanum (La), palladium (Pd), platinum (Pt) and rhodium (Rh) in the catalytic converter, whereas EVs contain **many CRMs in the electric power train**: namely neodymium (Nd), praseodymium (Pr) and dysprosium (Dy) in the **REPMs (rare-earth permanent magnets)** of the e-motor, lithium (Li), cobalt (Co), manganese (Mn), and nickel (Ni) in the battery (batteries types and materials are covered by

[182] Nacef Tazi, Martina Orefice, Charles Marmy, Yifaat Baron, Maria Ljunggren, Patrick Wäger, Fabrice 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

[183] Amund N. Løvik, Charles Marmy, Maria Ljunggren, Duncan Kushnir, Jaco Huisman, Silvia Bobba, Thibaut Maury, Theodor Ciuta, Elisa Garbossa, Fabrice Mathieux, Patrick Wäger, Material composition trends in vehicles: critical raw materials and other relevant metals. Preparing a dataset on secondary raw materials for the Raw Materials Information System, EUR 30916 EN, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-45213-3, doi:10.2760/351825, JRC126564.

the adopted Battery Regulation). A trend valid for both ICEVs and EVs is the higher and **higher amount of electrics and electronics**[184], which corresponds to a higher content of silver (Ag), gold (Au), Dy, Nd and Pd. The possible future deployment of fuel cells vehicles might also require large amounts of Pd and Pt for the appropriate catalyst.

Larger requests of copper[185] (Cu) and other base metals such as aluminium (Al) are occurring due to the transition from ICEVs towards EVs. Moreover, **metals alloys often contain CRMs**: 4xxx and 5xxx Al-alloys contain respectively silicon metal (Si) and magnesium (Mg), beside to other metals as Cu and Mn while steel laminations (also named electrosteel or Si-steel) contain up to 3.5 wt.% of Si, and high-strength steel is relevant for the content of niobium (Nb). Similarly, Mg alloys are made-up also of Al and Mn and, in general, the automotive sector corresponds to 50% of the Mg demand in Europe[186]. In Table 15.1Table 15.1 a summary on import reliance, current use in the automotive sector and market share for the automotive or all the EU sectors and future demand of some critical and precious metals are reported. Through the parameters in Table 15.1 Table 15.1, an analysis of the relevancy of CRMs in ELV is provided together with failures in the EU strategic autonomy and in circularity of the same materials, which might be mitigated by one or more measures. The parameters were already defined in the methodology for establishing the EU list of CRMs[187] and the data, in particular, were extracted from the Raw Material Information System - RMIS dataset[188] . A circularity failure is observed when the circularity of a CRM contained in key components is not maximized, e.g. because of technical limitations or because of market reasons (e.g. limited demand of secondary raw materials). In the criticality assessment, the parameter on the market share provides insight on the importance of a material for the EU economy, in particular in terms of end-use applications. It is significantly important to know the current and expected market share of the automotive industry for given CRMs to suggest a product or specific waste policy measures.

[184] Bobba, S., Carrara, S., Huisman, J., Mathieux, F., & Pavel, C. (2020). Critical Raw Materials for Strategic Technologies and Sectors in the EU - a Foresight Study, doi:10.2873/58081
[185] On 2023 CRM list
[186] European Commission, study on the EU's list of Critical Raw Materials (2020), Factsheets on Critical Raw Materials.
[187] European Commission, Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, Pennington, D., Tzimas, E., Baranzelli, C., et al., *Methodology for establishing the EU list of critical raw materials : guidelines*, Publications Office, 2017, https://data.europa.eu/doi/10.2873/769526
[188] https://rmis.jrc.ec.europa.eu/

Table 15.1 Summary of key features of relevant CRMs contained in vehicles

List of materials	EU import reliance	Current use in the automotive sector	Market share of the automotive industry (CRM, 2020)	Expected future use in the automotive sector	Why the EU should act to mitigate current circularity failure** ?
Rare earth elements (REEs) - Nd, Pr and Dy	100%	Permanent magnets (PMs) for electric (drive and not drive) motors	No specific data for the automotive sector. 100*% end use for PMs in different sectors (automotive, wind energy…)	Nd demand expected to increase by 11 fold by 2032; PM e-drive motors share in the EU fleet expected to be 77% in 2040;	Environmental concerns of REEs mining, processing and smelting; no EU recycling of REE, but they are lost in ferrous fractions or into landfill; building up know-how in REEs recycling will also thrive know-how of REEs processing value chain at EU level
Silicon metal	63%	Mainly in steel laminations of the e-drive motors. It is also used in Al-alloys.	No specific data for the automotive sector. 38*% use in (steel laminations and electronics, both for different sectors.	Exponential increase of steel lamination in e-drive motors due to EU fleet electrification.	Currently lost in the recycling of Si-steel as common steel
Ga	31%	Mainly in integrated circuits, sensors	No specific data for the automotive sector. 70*% use for manufacturing integrated circuits, sensors and LEDs for different sectors.	Increase of Ga due to more electronic components and to electrification of EU fleet	Lack of information of Ga use in vehicles; current practices lead to no EU recycling from ELVs.
Pd	93% of primary Pd	Mainly in autocatalysts, but also in electronics and printed circuits boards and semiconductors.	87% in autocatalysts and 4%* in electronics (general)	Increase of Pd due to more electronic components and to electrification of EU fleet	Current sorting and recycling practices lead to losses of this material; underuse of urban mine potential to generate Secondary Raw Materials (SRM)
Precious metals (Au and Ag)	Unknown for Au, 40% of primary Ag	Au mainly used in electronics as contact material, also for wires for integrated circuits or transistors. Ag used in electronics car applications and solders.	8% use of Ag in the automotive sector. 11%* use of Au in electronic applications.	Increase the use of Ag in vehicles due to the need of higher electrical properties, durability and oxide resistance	Not CRMs but current sorting and recycling practices prevent the full recovery of precious metals from controllers units; underuse of ELV potential to generate SRM;

*Source: JRC elaboration, based on RMIS dataset. https://rmis.jrc.ec.europa.eu/ *EU end-use sector, not specifically related to automotive sector* **It is considered that a CRM or a CRM based component is characterised by a circularity failures if circularity principles are hindered, due either to technical challenges of market failures (no demand of recycled materials).

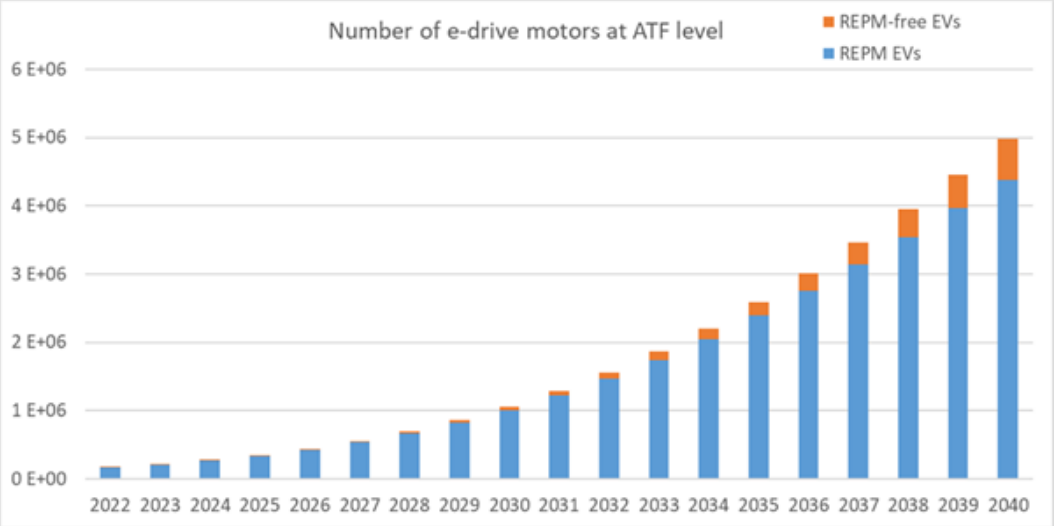
While platinum group metals (**PGM)** in catalytic converters are already recovered due to their high market values, **Pd from car electronics and controllers** are not targeted in the current sorting and recycling processes. **Precious metals (Au and Ag)** in the same vehicle controllers can also be targeted together with Pd, as their recovery potentials from ELV are not maximised.

REEs from ELVs are not recycled at all. REEs are present in several components of both ICEVs and EVs: for instance, glass windows and catalytic converters do have La and Ce (albeit not recovered); electronics, actuators and small motors do have REPMs even if they belong to specific ICEVs segments as found from indirect evidence of shredded ICEVs. However, undoubtedly, the largest consumption of **REPMs** is **in the e-drive train motors**. **Si-steel in steel laminations** can also be targeted together with REEs in e-drive motors. It has been reported that the current and expected 2035-2040 EU passenger car fleet would rely mainly on REPM e-drive motors, containing the highest concentration of REEs (Nd, Dy and Pr) in vehicles. A second type of e-motors does not have REPMs but a Cu induction coil (labelled in the JRC report as REPM-free e-motors). This later expected market share would be less than 23% in the forecasted period of 2035-2040. REEs have a very high future supply risk and are crucial to e-motor as well as other EU strategic sectors. At the same time, their expected increased use in the coming years make them a priority target to be legislated. As electric motors are developing in all sectors, there is also currently an untapped potential related to re-use opportunities of electric motors coming from end-of-life vehicles. Finally, it is supposed that vehicles also have significant amounts of **gallium Ga, in integrated circuits, sensors and microchips**, but little to no data are available for these two materials.

REEs in REPMs and **Si-steel in steel laminations**, both in **e-drive motor**, are used here as examples to illustrate current **circularity failures**. The baseline scenario for e-motors is, once reaching an Authorised Treatment Facility (ATF) that they are not disassembled from the car hulk prior to shredding, and therefore leading to REPM and Si-steel loss, while copper contaminates some ferrous and non-ferrous metals fractions.

Figure 15.1 reports the forecasted amounts (in number per year) of e-motors collected at ATF level.

Figure 15.1: Forecasted (number of) e-motors from EVs (passenger cars) expected to enter ATF in the EU



Source: JRC 2023[189]. It is assumed here an average of one e-drive motor per EV.

REPM e-motors contain circa 1.2 kg of REPMs, up to 5 kg of Cu and up to 23 kg of Si-steel. REPM-free e-motors do not contain REEs but still contain similar amount of Si-steel and up to 10 kg of Cu. As the know-how of REEs recycling and the lack of recycling infrastructures in Europe currently prevent from recovering REEs from REPM, the potential quantities above would be diluted (downcycled) in the ferrous and non-ferrous fractions or send to landfill if no relevant measures would mitigate such circularity failures.

15.2 Expected 2035 and 2040 impacts of the measures for the circularity of the relevant CRMs and other materials contained in the preferred option[190]

The measures aiming at improving circularity of CRMs and other relevant materials are reminded in this section and are assessed against three dimensions:

- Impact on material flows and on production of Secondary Raw Materials (SRM)
- Environmental based assessment
- Socio-economic assessment.

Impacts on innovation as well as administrative burdens are also captured in this analysis of impacts. While the full assessment is available in the JRC report[191], initial selected expected impacts are reported below.

15.2.1 15.2.1 Measure 1: Mandatory removal of e-drive motor by authorised treatment facilities:

Linked to the option PO3A, M13a in Annex 7.2.3

The scope of this measure only targets EVs (PHEV+HEV+BEV).

The assessed measure on e-drive motors is thus targeting circa. 2.5 million ELV reaching EU ATFs in 2035, and circa. 5 million ELV at ATF level in 2040. Of those motors, it is also forecasted that 2.3 million and 4.3 millions permanent magnets e-motors from ELV would be separately collected from ATFs in 2035 and 2040. The SRM production estimated is presented in Table 15.9Table 15.9.

[189] Nacef Tazi, Martina Orefice, Charles Marmy, Yifaat Baron, Maria Ljunggren, Patrick Wäger, Fabrice 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.
[190] Steel, copper, aluminium
[191] Nacef Tazi, Martina Orefice, Charles Marmy, Yifaat Baron, Maria Ljunggren, Patrick Wäger, Fabrice 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

Table 15.9: 2035 and 2040 SRM production from measure 1. Units in kt.

Material (kt)	2035	2040
REPM materials (REEs, Fe, Co, ...)	0.35	1.4
Si-steel*	7.1	31.2
Copper	8.1	19.1
Aluminium	23.8	52.7

*Source: JRC, 2023. *it is considered here the recovery of silicon steel as a separate flow. However, further assessment is ongoing to assess this recovery's feasibility*.

For SRM from REPM recycling, the potential corresponding flows available for recycling due to this measure are up to 2 kt in 2035 and 4.2 kt in 2040. Since the assumed 2035 and 2040 recycling rate for magnets would be respectively 18% and 35%, the output flows (e.g. REEs, Fe, Co) produced would be up to 0.35 kt in 2035 and up to 1.4 kt in 2040. Such flows would in principle cover, in closed loop perspective, 3% to 12% of the expected e-drive motors 2035-2040 EU demand scenarios (for passenger cars), with contributions to the reduction of supply disruptions and to the EU strategic autonomy.

This measure would also increase reuse flows. The potential of reuse of permanent magnet is relevant for e-drive motors as well as other markets and can also contribute to remanufacturing strategies, implying the creation of further incentives for reuse and the development of second-hand products and markets. In this sense, the content of Dy, which increase the resistance to demagnetization, will be a significant parameter in the REPM composition.

The assessment of environmental impacts of changing the End of Life (EoL) handling of e-drive motors is based on a review of life cycle assessments (LCA) on e-drive motors and NdFeB magnets. Based on a first analysis, this measure would lead to a reduction of climate change impacts thanks to separate removal and recycling of the e-drive motor, instead of shredding it with the car hulk. The potential incorporation of secondary REOs to replace primary REOs into new products would significantly lower the environmental impacts and hazardous (connected to generation of radioactive waste) from primary mining. The reduction of resource scarcity is also significant.

From socio-economic dimension, this measure would lead to a further job creation at ATF level and would lead to an increased turn over at ATF and recyclers level thanks to the expected surplus of SRM flows from e-drive motors removal.

The cost of removal of e-motors, revenues at ATF level as well as those returned that incur from their recycling or reuse were assessed. Initial results estimate a 10 minutes removal time of e-motor for recycling purposes at ATF level, and 20 minutes non-destructive removal time for reuse purposes. The assessment was based on a labour cost of 35€ per hour, 8 working hours a day and 200 days of work per annum representing a single job. 19€ and 129€ of additional logistic costs for the ATF per e-motor in case of removal (for recycling) and disassembly (for reuse) were therefore calculated. Such costs cover logistics not related to the removal actions, like costs of storage of removed motors or their inclusion in a sales platform in the case of reuse and may have

some overlap with the costs estimated for removal. Revenues for recyclers were based on the same sources as the ones used in the ELV impact assessment main support study[192].

Thus, the partial socio-economic impacts would be:

- Overall, costs for ATF operators can be allocated to two main entries (see Table 15.10Table 15.10): i.e., removal activities and its accompanying logistic costs. It is assumed that the costs for removal operations would be up to 15 M€ in 2035 and up to 29 M€ in 2040. The ATF logistic costs (transport, storage…) would be up to 50 M€ in 2035 and up to 96 M€ in 2040. The difference of costs between the assessed years is also linked to the significant increase of EVs reaching EoL over the years. Collected e-motor flows from ATF would in principle be diverted to reuse or recycling purposes. Overall, the main challenge towards the feasibility of this measure relies on the development of magnet recycling infrastructure as well as market opportunities for e-motor materials (including REPM but also electric steel). Furthermore, the development of markets for reused e-motor would lead to higher environmental savings compared to recycling routes, the latter may create economical pressure to favour reuse of e-motors rather than recycling where the motors are still intact (meaning that recycling and its benefits could still take place at a later point in time).
- Revenues are distributed over ATFs (see Table 15.10Table 15.10) and recyclers (see Table 15.11Table 15.11). Thanks to this measure, it is estimated an overall ATF additional revenue up to 98 M€ in 2035 and 214 M€ in 2040, respectively. The additional revenues at recyclers' level are expected to be respectively circa. 68 M€ in 2035 and up to 181 M€ in 2040. Here also, the higher increase of revenues is also due to the higher share of EVs reaching EoL over the assessed years. Recyclers' revenues consider here the recycling of REPM materials, assuming the establishment of future recycling facilities. In a conservative scenario, where no magnet recycling is considered, revenues will decrease to 56 M€ for recyclers in 2035 and 130 M€ for recyclers in 2040. Revenues are considered as conservative as the separate treatment of e-motor might generate additional revenues thanks to the production of other metals flows such as secondary Si-steel or secondary copper.
- Looking only at the costs expected for ATFs and the end-of-life HEV, PHEV and BEV being collected for treatment, it is estimated that the cost of the measure per vehicle for the ATF would be around 25€ over the assessed years. The benefits for the ATF are currently lower than expected costs and so would not cover the burden of implementation. Though the expected revenues to recyclers would help set off gradually the burden in 2035 and completely in 2040, the cost calculations are initial and some form of compensation (through the EPR) or allocation of revenues (through an increase in the cost recyclers are willing to pay ATFs) would be needed for ATFs to retain economic feasibility. This assessment only considers the EVs fleet since they contain e-motors. In case of all ELV flow considered, it is estimated that the cost of the measure per vehicle (all drive trains considered) for the ATF would be around 7€ in 2035 and 12€ in 2040.

[192] 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

Table 15.10: ATF economic assessment

	2035	2040
ATF dismantling costs	15 M€	29 M€
ATF logistic costs	50 M€	96 M€
cost per vehicle reaching ATF [only EVs reaching ATFs]	25 €	25 €
cost per vehicle reaching ATF [all vehicles reaching ATFs]	7 €	12 €
ATF revenues	98 M€	214 M€

Table 15.11: Recyclers economic assessment

	2035	2040
Recyclers revenues w/ magnets	68 M€	181 M€
Recyclers revenues w/o magnets*	56 M€	130 M€

**Considering revenues from recycling electrosteel as steel in general.*

- Jobs to be created at ATF level would be up to 270 in 2035 and 520 in 2040, should the e-motor measure be applied. Removal of e-motors can also be performed in (semi-) automated process, leading to a decrease of destructive removal time to less than 1 minute. The use of (semi-) automated processes might decrease the forecasted jobs to be created at ATF level, but will require an investment in equipment. Impacts are not expected to change in cases where the e-motor would be disassembled for reuse purposes, instead of recycling routes, as at present equipment only shortens the time needed for destructive removal. Employment at recyclers' level is not assessed because of lack of data. The latter is dependent on the future development of EU recycling facilities to recover Nd and magnet materials.

Overall conclusions stemming from this partial socio-economic impact assessment describe the benefits and some main challenges towards higher efficiency of this measure to fulfil its objective of improving REE circularity. As compared to the baseline, this measure leads to a higher job creation and additional revenues for both ATFs and recyclers. The reuse of e-motors could generate even further revenues for ATFs and may motivate ATFs to perform non-destructive reuse should the demand for second hand motors develop. Additional costs are generated due to the separate sorting and recovery of e-motors. The level of benefits and thus also of their ration to costs is highly dependent on whether robust REE recycling processes and market will develop by 2040. Clearly, this measure contribute to setting-up such an infrastructure and market in the EU. Overall, more benefits than burdens are stemming from this measure, when compared to the baseline option when e-motors are shredded with the car hulk. EPR might support the additional burden at ATF level in order to ease the implementation of this measure in the early times where the total revenues related to this measure do no suffice for the practice to be economically feasible. Another opportunistic benefit related to the removal of e-drive motors from passenger cars would be linked to the optimisation of costs related also to the collection and removal of batteries from ELVs. As the Battery Regulation would require 100% collection of EVs batteries, treatment and removal costs might be allocated to batteries and near-by components such as e-drive motors or inverters, leading to a decreased ATF burdens related to the removal of e-drive motors.

This measure would also have a positive impact on innovation and R&D devolvement in EU. The available e-drive motors flows would thrive research, innovation and the development of new recycling technologies to increase the recovery of SRM from these flows. It is unlikely that such measure would hinder advances in performance and new technology approaches.

15.2.2 15.2.2 Measure 2: Design provisions for e-drive motors:

Linked to the option PO1B, M7 design requirements in A7.2.1

This measure would be applied for new types put on the EU market and would enhance the eco-design of e-drive motors in future vehicles. The core of the measure is defining design constraints on the OEM to provide clear and succinct instruction on the disassembly operations. Such instructions should include a list of interfering components and parts to be taken out to reach the e-drive motor, the different tools required as well as the number of fastening techniques to unlock and extract the e-drive motor. This measure also ensures that the design of the vehicle and joining, fastening or sealing techniques do not prevent disassembly operations. While this measure would not markedly influence the potential SRM production from e-drive motors recycling, nor their environmental impacts, the estimated reporting and design costs might be slightly impacted.

The assessed measure would require OEM investments in the reporting of instructions and reports to be provided to ATF to ease the disassembly of the e-drive motor. Besides, in order to ensure eco-design provisions and possibly optimise disassembly operations at ATF level to extract the e-drive motor, R&D costs would be generated at OEM level to enable technologies and processes. Such costs are aligned with the five strategic R&D areas identified by the European Council for Automotive R&D[193]. However, it is expected that these R&D costs allocated to the ease of disassembly design of the e-drive motors would be distributed over the next decade and are also aligned with most of the OEMs perspective towards the development of sustainable vehicles and improved mobility, see for example the BMW I vision circular[194], or Renault Re-factory[195]. This measure is not foreseen to hinder innovation and the development of new technologies.

From ATF perspective, the measure aims to facilitate disassembly operations of the e-drive motor when present in the ELV. It is then expected a decrease in removal and disassembly times as well as the optimisation of ATF costs.

15.2.3 15.2.3 Measure 3: Mandatory removal of selected embedded electronic components (EEC) group by authorised treatment facilities:

Linked to the option PO3B – M13b, A7.2.3

The JRC analysis[196] is building mostly on methodologies and results from the recent project EVA II[197], conducted by Empa for the (Swiss) federal office of the environment (FOEN). This measure would apply to selected electronic components embedded in vehicles. The key characteristic of

[193] https://www.eucar.be/strategic-pill%E2%80%8Bars/
[194] https://www.press.bmwgroup.com/global/article/detail/T0341253EN/the-bmw-i-vision-circular?language=en
[195] https://www.renaultgroup.com/en/news-on-air/news/station-flins-re-factorys-incubator-opens-its-doors/
[196] Nacef Tazi, Martina Orefice, Charles Marmy, Yifaat Baron, Maria Ljunggren, Patrick Wäger, Fabrice 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
[197] Marmy, C., Capelli, M., Boni, H., Bartolome, N., & Marseiler, U. (2023). *Projekt EVA II - Synthese –Schlussbericht*

those components is that they require electricity to function, either from an external source through a cable, or with the help of an internal battery. These components were shortlisted by the JRC from four main categories: Controllers, Headlights, Actuators and Cables. Such components contain base and strategic metals (steel, Al and Cu), plastics but also precious metals and CRM such as Palladium (Pd) and Gallium (Ga). Pd content is expected to increase due to more electronic components and due to the electrification of the EU fleet.

Those metals are mostly lost at the end-of-life if the components are not removed from ELVs prior to their recycling, because car recycling processes are currently optimized to recover basis metals such as Fe, Al or Cu. In order to improve the performance of the recovery of CRM and precious metals from vehicles, the measure requires the removal of selected electronic components embedded in vehicles in order to recycle them separately in e-waste recycling facilities, which are optimized for precious metals recovery. Electronic components recycling infrastructure is already well established in Europe. Initial JRC analysis shortlisted the following components to be dismantled prior to shredding:

- Inverter (for EVs);
- Control module/valve box of automatic transmission;
- Infotainment control unit (sound, navigation and multimedia).

The JRC analysis reports the analysis of impacts of embedded electronic components; see Table 21 of the JRC report for potential secondary raw material produced from each assessed category, see table 22 of the JRC report on the environmental impacts of the recycling of each assessed category, see figure 9 of the JRC report on the cost distribution over waste management operators, assessed per category of EEC). Afterwards, the shortlisting rational is introduced and the potential additional benefits at EU level of the three components are presented in Table 15..

As also stated in the additional opportunistic benefits linked to the removal and collection of EVs batteries (covered by the Battery Regulation), near-by components would be more accessible after such removal, leading to a decreased allocated ATF costs related to their treatment and removal. The inverter (for EVs) is positively affected by this synergy and its related removal costs would decrease thanks to the removal of EVs battery.

Table 15.5: Potential additional benefits of the shortlisted components, calculated at EU level

	2035	2040
Secondary Cu, in t	3,397	3,628
Secondary precious metals (Au and Ag), in t	15.1	16.1
Secondary Pd, in t	0.6	0.7
Estimated separate recycling costs of the three components, per car, in € (based on EVA II project)	5.9	5.9
Estimated net additional environmental benefits of the three components, per fleet, in t CO_{2eq}	68,956	73,651

15.2.4 15.2.4 Measure 4: Request of information from OEMs on specific CRMs contained in vehicles, and their labelling:

Linked to the option PO1A – M3 – A7.2.1

The measure on declaration of CRMs has already been applied previously in the context of eco-design regulations, in particular on requirements for servers and data storage products[198]: this regulation requests (in Annex II, section 3.3) manufacturers to declare compulsory information on CRMs content (mainly Cobalt and Neodymium) at component level. This measure was introduced to address the lack of information on present CRMs in the targeted products and to provide relevant information for recyclers to decide to disassemble such components materials and invest in recovery infrastructure, and for policy makers to take further measures in the future building on solid knowledge.

Considering the previous experience on servers and data storage products, a similar measure can be applied to REEs at REPM level of e-drive motors and Ga in size fixed controller category in order to address the same lack of information. The assessment of the impacts of this measure presented in this section is largely based on the assessment presented in the Impact Assessment of the Eco-design regulation proposal for enterprise servers.

It was stated in the SWD on servers and data storage products that[199], once separated, Nd scrap can be further processed to recover the CRM. Due to the different types and sizes of e-drive motor technologies available in the EU market, a mandatory information requirement at this component level could inform on the presence, location and the exact amount of the targeted CRMs that the e-drive motor contains, and this would encourage the separation at early stages of disassembly in the authorised treatment facilities. Similar mandatory information requirement could be applied to Ga content at controllers' level larger than 10 cm^2 and sensors. A previous JRC study had mentioned

[198] https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1553786820621&uri=CELEX%3A32019R0424
[199] https://ec.europa.eu/transparency/documents-register/api/files/SWD(2019)106_0/de00000000060780?rendition=false

the lack of information on the use of this CRM in vehicles, in particular Ga[200]. Additionally to the initial assessment on information on weight and location of REEs in e-drive motors, further requested information on number of permanent magnets, their coating and whether gluing was used in their assembly within the rotor could significantly increase the dismantler and recycler knowledge to adapt the necessary operations to efficiency extract the permanent magnets from the e-drive motor.

The available standards on material efficiency, including those developed under CEN/CLC/JTC 10[201] (e.g EN 45558 - General method to declare the use of CRMs in energy-related products) could also be used to ease the enforcement of this requirement at e-drive motor level.

Labelling parts or products with specific material content (to ease its depollution or sorting) would in principle incentivise the dismantling and separate collection of the e-drive motor at authorised treatment facilities.

As for expected economic impacts, no costs for transposition into national legislation is foreseen since the form of the envisaged legislation is an EU regulation (linked to 3R type-approval). The estimated compliance costs for OEMs would be mainly concentrated in reporting and documentation delivery from supplier to OEMs. Since the automotive industry is already equipped with material and component communication channels (e.g. IMDS, IDIS), costs of compliance are estimated to be limited. From EoL value chain perspective, additional costs could be related to the search of relevant information in documentation but in principle these would largely be compensated by additional revenues from the sales of CRMs. The estimated overall additional costs for ATFs and recyclers are then supposed to be low to medium. This measure adapted to the e-drive motors would increase ATFs and recyclers knowledge on this component and it is likely to increase recycling, reuse, and remanufacturing actions as well as relevant investment in recovery infrastructure.

It is estimated that limited additional direct socio-economic and environmental benefits would be generated from the implementation of this measure 4 (linked to M3). However, it is expected that the quality of treatment and of output flows of secondary raw materials (hence of value) that will be generated by measures 1 (linked to M13a) and 2 (linked to M7) on e-drive motors and the measure 3 (linked to M13b) on selected EEC components is likely to be enhanced thanks to this measure on CRM information request. It is also unlikely that this requirement would impact negatively job creation. This measure is not intended to hinder innovation and the development of new technologies.

15.3 Suggestions for follow-up review clauses on CRM measures for vehicles

The measures presented in this report could in the future be complemented by others, to be potentially mentioned in review clauses. Follow-up (potentially more ambitious) measures might tackle further circularity failures by addressing other CRMs and components (e.g. Ga or Ti) when more data are available, or by introducing new targets (e.g. recycled content or recycling

[200] Amund N. Løvik, Charles Marmy, Maria Ljunggren, Duncan Kushnir, Jaco Huisman, Silvia Bobba, Thibaut Maury, Theodor Ciuta, Elisa Garbossa, Fabrice Mathieux, Patrick Wäger, Material composition trends in vehicles: critical raw materials and other relevant metals. Preparing a dataset on secondary raw materials for the Raw Materials Information System, EUR 30916 EN, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-45213-3, doi:10.2760/351825, JRC126564.

[201] https://standards.cencenelec.eu/dyn/www/f?p=205:7:0::::FSP_ORG_ID:2240017&cs=18A65BEA4289B745403E9407952618CE3

efficiency for REEs or Mg) when initial recycling infrastructures will be operational in the EU. These pre-requisites would be necessary to trigger CRM recycling and thrive investments as well as innovation in the automotive sector.

15.4 Additional contribution of the potential extension of scope to circularity of CRMs

As mentioned in the main SWD document, the ELV and Type-Approval directives apply to passenger and light commercial vehicles; M1 and N1, respectively. It was stated that 85% of the EU vehicles fleet falls within the current scope of the ELV/Type-Approval directives. The remaining is therefore not covered and represents circa. 52 million vehicles that include trucks (lorries), busses, two- and three- wheelers, estimated in the core document to account 4.13 million tons of materials. In the context of ensuring higher circularity of vehicles and ensuring alignment with the circularity objectives of the CRM Act, the present section provides additional information, from a CRM perspective, to support the possibility of including additional vehicles within the scope of the ELV/Type-Approval; namely lorries, buses and motorcycles (two- or three wheelers).

15.4.1 15.4.1 Evidence on CRM content in lorries, buses and motorcycles:

Newest environmental standards and constraints for heavy-duty vehicles (EU 2019/1242) and EURO 6/7 standards will require the integration of additional technology devices in vehicles to ensure alignment with 2025 and 2030 targets[202]. These controllers included in vehicles would lead to the increase of specific CRMs in vehicles. For instance, controllers would be included for exhaust gas control, leading to more Cu or Pd/Pt in vehicles. The electrification or hybridization of the power train to reduce CO_2 emissions would also increase contents of Cu, Si-steel, REPM and others CRMs in these vehicles. While an average passenger BEV is equipped with one e-drive motor of 45 kg and an average peak of 100 kW, an electric truck drivetrain could afford multiple e-drive motors and reach for instance a peak power of 490 kW[203]. This would lead to the significant increase of numbers and mass of e-drive motors in the truck drivetrain. Volvo FH electric drivetrain is for example equipped with 2 to 3 electric motors, the Tesla Semi is also propelled using three e-drive motors, similar to those used in Tesla model 3. The introduction of electric lorries, buses and motorcycles will also increase CRM content in batteries, especially lithium, nickel and cobalt[204]. It is also estimated that PGM average content in lorries will raise by 30%, with palladium covering the major share of PGM used in automotive applications (compared to platinum and rhodium[205]). Pd content in a class 7/8 heavy duty truck catalyst can be up to 60g[206,207]. Assuming same Pd content for buses, and considering EoL vehicles from these two categories, the untapped potential of Pd in EoL vehicles from these two vehicle categories is presented below in Table 15.6.

Table 15.6: Untapped recovery potential of Pd from lorries and buses catalysts, calculated at EU level

[202] Colpier, L, Chazalette, B, Gaudeau, O, Cor, O, Etude recyclage poids lourds, rapport final-mise à jour, Ademe, 2021
[203] https://www.volvotrucks.com/en-en/trucks/trucks/volvo-fh/volvo-fh-electric.html
[204] IEA (2021), *The Role of Critical Minerals in Clean Energy Transitions*, IEA, Paris https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions.
[205] Johnson Matthey, PGM market report, May 2022.
[206] Based on an LNG Heavy Duty Truck, World Platinum Investment Council-WPIC. Platinium quarterly presentation. Q4 2019, March 2020.
[207] Compared to an average of 3.9g to 5.6 g per passenger car autocatalyst. WPIC, April 2021

	2035	2040	2035	2040
Vehicle category	Number of vehicles reaching EoL		Pd content (ton)	
Lorries	289,992	310,292	17.4	18.6
Buses	32,972	35,057	2	2.1

Source: EoL data from IA main study, Pd content from World Platinum Investment Council (March, 2020)

Pd is widely used in catalytic converters and to a lesser extent in vehicle electronics. The automotive industry (all vehicle categories) is the largest consumer of Pd, covering more than 80% of supply annually.

In order to ensure higher performances, OEMs are also relying on REPM motors for heavy vehicles, leading to the use of Rare Earth elements and Si-steel laminates in the engine. Based on IDTechEx benchmark on electric motors used in vehicles, most of e-lorries (all types of truck), e-buses and electric two-wheelers are propelled with permanent magnet motors, relying heavily on laminated Si-steel and also rare earth materials, see Table 15.7.

Table 15.7: Motor types in vehicles (e-lorries, e-buses and electric two-wheelers) and main CRMs used

Vehicle	Motor type	Main CRMs used
Electric two-wheelers (EU brands)	Permanent magnet synchronous motor - PMSM, with a typical weight of 19 kg	Laminated Si-steel and REE in magnets
Electric two-wheelers (non EU brands)	Brushless DC motor - BLDC, with a typical weight from 4 kg to 15 kg	Laminated Si-steel and REE in magnets
Electric lorries	More than 93% are based on PMSM and permanent magnet assisted reluctance motor - PMAR motors	Laminated Si-steel and REE in magnets
Electric buses	More than 99% of full and plug-in hybrid buses are PMSM	Laminated Si-steel and REE in magnets

Source: IDTechEx, 2021

Consequently, more CRMs are expected to be used in electric motors for hybrid and electric trucks, buses and motorcycles. This includes REE materials (Neodymium and Dysprosium) but also Si-steel, Terbium, Niobium and also Cobalt. The fleet electrification would also generate an increase of electric and electronic devices (e.g. inverter), leading to the increase of copper, precious metals (gold and silver) and PGM, as stated in the JRC report.

Besides, electric infrastructure would lead to higher CRMs demand, with a slightly higher demand for truck infrastructure, compared to passenger vehicles ones. Infrastructure includes charging

station, post and connexions to the grid, as modelled by Raghavan et al.[208]. Other scenarios illustrated by the latter reference also describe higher metal demands for hydrogen fuel cell electric cars and trucks implying significant demand for PGMs.

Thus, these vehicles categories contain relevant CRMs in their drivetrain, electric and electronic devices, with an even higher content for trucks and buses due to the increase of their overall weight and the multiplication of e-drive motors used to reach higher performances. These vehicles also contain significant shares of steel and aluminium in their bill of materials.

15.4.2 15.4.2 Challenges on CRM recovery from the extended scope, including export and miss-management:

As stated in the main document (see section 2.4 Problem area 4), these vehicles do not currently abide by specific legal requirements on their design or end-of-life phases, leading in principle to the loss of important share of secondary raw materials, including CRMs. Main circularity failures are related to:

- Design phase: circularity or design for recycling are not necessarily integrated as a requirement in the design of these vehicles. In addition, lack of information of CRM content and location in these vehicles could prevent EU dismantlers and recyclers to properly recover these materials from collected vehicles.
- Collection phase: the main challenge is related to the absence of structured and professional end of life value chain to properly collect and manage end of life vehicles such as truck, buses[209]. Main EU authorised treatment facilities (ATFs) are generally designed to collect and treat M1 and N1 vehicle categories. They do not treat two- and three- wheelers neither. This failure compromises circularity and guaranteed environmentally sound management of waste stemming from these vehicles. This failure is also worsened by the export trends of end of life trucks and buses from EU to third part countries, leading to the loss of significant amount of materials from Europe (estimated to be up to 4.13 million in 2019). Current ATF facilities are certainly not prepared to appropriately treat these vehicles and recover CRMs. Collection of e-motorbikes is currently not established and will benefit from the collections targets for Light Means of Transport (LMT) proposed by the battery regulation.
- Recovery phase: the absence of reuse and/or recycling incentives of these vehicles prevent the proper reuse and recycling of parts and materials, including CRMs. These vehicles are also likely to be mainly exported outside Europe at their end of life.

15.4.3 15.4.3 Expected impacts of initial CRM measures for passenger cars in case of the proposed extension to new vehicles (lorries/buses/2-wheelers):

A wider scope covering new vehicles such as lorries, buses and motorcycles will mathematically increase the fleet size targeted by the ELV/3RTA directives, and mathematically increase number and mass of CRM-rich components potentially targeted. This could in principle lead to the development or creation of new business models in EU internal markets, but also reduce environmental hazards stemming from these EoL vehicles.

[208] Raghavan, S. S., Nordelöf, A., Ljunggren, M., & Arvidsson, R. (2023). Metal requirements for road-based electromobility transitions in Sweden. *Resources, Conservation and Recycling*, *190*, 106777

[209] Colpier, L, Chazalette, B, Gaudeau, O, Cor, O, Etude recyclage poids lourds, rapport final-mise à jour, Ademe, 2021

From a CRM perspective, the extension of vehicle scope to lorries, buses and motorcycles would enhance the transition to a circular economy and improve the performances of measures (see above) already assessed for passenger vehicles, which are:

- **Measure 1**: mandatory removal of e-drive motors by authorised treatment facilities, linked to the option **PO3A, M13a:**

This measure can be strongly impacted by the scope extension , as the number of e-drive motors covered would significantly increase, leading in principle to a linear increase of impacts assessed for passenger vehicles e-drive motors.

As the majority of motor types of the new scope are based on several permanent magnet motors with REPM, it is expected an increase of secondary raw materials (REPM materials, Si-steel, copper and aluminium) production from this measure. The increase of e-drive motor's flow size could also in principle increase reuse flows. Both recycling and reuse flows are expected to contribute to the reduction of supply disruptions and to the EU strategic autonomy.

From a socio-economic perspective, a scope extension would increase the number of motors targeted, leading to similar impacts assessed for passenger vehicles, but with a higher extent.

Assuming:

- that the extension of scope would increase the number of vehicles collected by 15%,
- that trucks and lorries contain significant number of REPM motors,

It can be then assumed that at least 17.5% (=15%/85%) of additional REPM motors and additional mass of CRMs would be collected and treated (*JRC rough estimates*).

Additionally, a positive synergy is foreseen with batteries removal obligations described in the Battery Regulation. This would lead to a cost optimisation at ATF level of batteries near-by components, hence reducing e-drive motors removal costs.

- **Measure 2**: design provisions for e-drive motors, linked to the option **PO1B, M7:**

The new scope to be covered by eco-design requirement would increase dismantlers and recyclers capacity to effectively manage e-drive motors from the extended scope. A better design that facilitates disassembly operations of e-drive motors will decrease removal and disassembly times as well as the optimisation of ATF costs, leading to even further optimised impacts of the measure 1 (PO3A, M13a).

- **Measure 3**: mandatory removal of selected small parts by authorised treatment facilities, linked to the option **PO3B, M13b:**

Similarly to measure 1, and based on the expected electrification of the new scope, an increased flow of copper, PGM and precious metals are expected to be recovered, especially from lorries and buses. Thus, a very positive contribution is also foreseen in case of scope extension. The inverter removal from EVs would also in principle benefit from removal obligations of batteries described in the Battery Regulation, hence reducing its removal costs at ATF level from the extended scope.

- **Measure 4**: request of information from OEMs on specific CRMs contained in targeted vehicles, and their labelling, linked to the option **PO1A, M3:**

As most of motor types included in the scope extension are REPM materials, providing information on location, content and characteristics of REEs in e-drive motors would significantly increase dismantlers and recyclers information and support their decision on rare earth permanent magnet proper end of life management.

An increase of scope's size would have the same expected impacts as assessed for passenger vehicles, both for REE in e-drive motors and Ga in controllers.

15.4.4 15.4.4 Additional Expected impacts of the proposed extension the current legislation to new vehicles (lorries/buses/2-wheelers) to the recovery of CRM and the implementation of the CRM Act objectives:

Additional measures assessed in the main document could also support further recovery of CRM in case of scope extension to lorries, buses and motorcycles. Main additional benefits are linked to:

- Requirements for manufacturers to provide additional information to dismantlers/recyclers on recycling/dismantling (**M28**):

Similarly to the analysis of impacts of measure 4 for passenger cars (linked to M3), this measure is strongly linked to the improved circular design of vehicles under the scope of the ELV/3RTA directives. It is expected an improved dismantler and recycler knowledge on CRM based parts, their location, CRM content characteristics and the relevant information to properly dismantle and recycle CRM from wastes stemming from these vehicles. This measure is also in strong synergy with M30a, should these vehicles need to be properly treated in authorised treatment facilities.

- Mandatory treatment of End of Life vehicles in authorised treatment facilities (**M30a**):

The implementation of EURO 6 rules should in principle decrease the export of lorries and buses to third part countries, leading to the increase of wastes stemming from these vehicles in the EU. This would develop new business models related to the end of life management of these vehicles to properly collect and treat them. It is unsure if the current authorised treatment facilities would be able to collect and treat large sized vehicles such as lorries and trucks, as they are more designed for the treatment of M1 and N1 vehicles. It is expected in short terms a higher additional investments at ATF level to ensure their capacity to receive and treat lorries and buses. If new types of ATF are to be created, they will have to fully consider the novel CRM components of these types of vehicles. However, the expected impacts of this scope extension will lead to higher material recovery from wastes stemming from these vehicles as well as the increase of CRM flows available for recycling. It is also expected an additional jobs created at waste management operators level and also an increase of their revenues related to the management of materials stemming from this new scope. Similarly to measure 1 for passenger cars (linked to M13a), a positive cost-revenue ratio is foreseen in the medium-long terms, as new business model related to this scope extension should emerge.

The CRM Act is clearly supporting actions on CRM recovery to be included in the revision of the ELV/3RTA directives, based on its current scope (limited to M1 and N1 vehicles). In overall

terms, a scope extension to lorries, buses and motorcycle would lead to a higher circularity of CRMs contained in these vehicles. It would also ensure the implementation of CRM Act objectives related to the design and recycling of CRM from all vehicle categories. These vehicles, if properly treated in authorised treatment facilities including through mandatory separate dismantling and recovery of selected CRM-rich parts prior to shredding and supported by an increased knowledge of CRM content would in principle contribute to reach the CRM Act 15% recycling targets aimed. It should also in principle support reuse flows and the creation of secondary markets for (CRM) parts in the EU.

The scope extension of the ELV/3RTA directive would then be inclusive and encourage the setting-up of up-to-date treatment and recovery facilities for these vehicles and contribute to the development of CRM value chains in Europe.