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PART 1/4

COMMISSION STAFF WORKING DOCUMENT

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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Glossary

Term or acronym	Meaning or definition
3R type-approval (3RTA) Directive	Directive 2005/64/EC on the type-approval of motor vehicles with regard to their reusability, recyclability and recoverability
ASR	Automotive Shredder Residues
ATF	Authorised Treatment Facilities
BAT	Best available techniques
Batteries Regulation	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 […]).
BCR	Benefit – Cost Ratio (a value > 1 indicates a positive return on investment)
BEV	Battery Electric Vehicle
CEAP	Circular Economy Action Plan
CoD	Certificate of Destruction
CPA	Circular Plastics Alliance
CRM	Critical Raw Material
EAF - DRI	Electric Arc Furnace – Direct Reduced Iron
EC	European Commission
ECHA	The European Chemicals Agency
EEE	Electrical and electronic equipment
EGD	European Green Deal
ELV	End-of-life vehicle
ELV Directive	Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of life vehicles
EoL	End-of-life
EPR	Extended Producer Responsibility
ESPR	Proposal for a Regulation of the European Parliament and of the Council Ecodesign for Sustainable Products
ETS	Emissions Trading System (https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets_en)
EU	European Union
EV	Electric Vehicle
GHG	Green House Gas
HDV	Heavy Duty Vehicle (e.g., a bus (M2,M3), lorry (N2,N3) or trailer (O)) as defined in Regulation 2018/858
ICE	Internal Combustion Engine
IMDS	International Material Data System
ISG	Inter-service Steering Group
L3e-L7e-category/ 'motorcycles'	Two-wheel motorcycles (L3e), two-wheel motorcycles with sidecars (L4e), powered tricycles (L5e), light quadricycles (L6e) and heavy quadricycles (L7e), excluding L1e and L2e categories as defined in Regulation 2013/168
Li-ion batteries	Lithium-ion batteries
PHEV	Plug-in Hybrid Electric Vehicle
PRO	Producer Responsibility Organisation
PST	Post-Shredder Technologies
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)
REE	Rare Earth Element
RoHS	Directive 2011/65/EC on the restriction of the use of certain substances of concern in electrical and electronic equipment
SDG	Sustainable Development Goals
SME	Small and Medium-sized Enterprise
SUV	Sport Utility Vehicle
SVHC	Substance of Very High Concern
WEEE	Waste Electrical and Electronic Equipment
WEEE Directive	Directive 2012/19/EU on waste electrical and electronic equipment (WEEE)
WFD	Waste Framework Directive, Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste

1 INTRODUCTION

1.1 Political context

The European Green Deal (EGD) is Europe's growth strategy to ensure by 2050 a climate neutral, clean and circular economy, optimising resource management and minimising pollution. The Circular Economy Action Plan (CEAP)[1] and the New Industrial Strategy for Europe[2] lay out the roadmap for the European industry to meet the EGD objectives. The Circular Economy Action Plan contains a commitment to review the legislation on end-of-life vehicles (ELVs) 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". The EU Action Plan: "Towards Zero Pollution for Air, Water and Soil"[3] also stressed the need for the Commission to propose new measures to address the EU's external environmental footprint linked to the export of ELVs and used vehicles. The European Council[4] and the Parliament[5] have both recognised the importance of this initiative.

In this light, **the purpose of this impact assessment is to provide the evidence needed for the joint review of the Directive 2000/53/EC on end-of-life vehicles ("ELV Directive")[6] and of Directive 2005/64/EC on the type-approval of motor vehicles with regard to their reusability, recyclability and recoverability ("3R type-approval" Directive)[7]. The review of these Directives aims to boost the transition of the automotive sector to a circular economy, thereby reducing the environmental footprint linked to the production and end-of-life treatment of vehicles and strengthening the sustainability of the automotive and recycling industry in Europe.**

The invasion of Ukraine by Russia in 2022 reiterated the importance for the EU industry to reduce the vulnerability of its supply chains, especially for critical raw materials (CRMs) essential for the EU's strategic autonomy and for the transition to a carbon-neutral economy. The EU heads of state or government have made the transition to a circular economy a priority in that respect, contributing to securing EU supply of critical raw materials[8]. This is also a key point in the Green Deal Industrial Plan for the Net-Zero Age[9].

The automotive sector is a pillar of the EU economy and its transition to more circular models will have a considerable spill over effect on key related industries, especially the extraction and processing sectors. The automotive industry is embedded in complex and global supply chains and has recently faced production shutdowns, semiconductor shortages and problems sourcing skilled labour. This initiative comes at a time of supply chain challenges and intense competition which have put pressure on automotive manufacturers to reduce costs and improve efficiency. The shift towards electric vehicles, as the EU and other major automotive markets in the world seek to drastically reduce the carbon intensity of road transport, requires

[1] https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en
[2] https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/industry-and-green-deal_en
[3] https://eur-lex.europa.eu/resource.html?uri=cellar:a1c34a56-b314-11eb-8aca-01aa75ed71a1.0001.02/DOC_1&format=PDF
[4] https://data.consilium.europa.eu/doc/document/ST-13852-2020-INIT/en/pdf
[5] https://www.europarl.europa.eu/doceo/document/TA-9-2021-0040_EN.html
[6] Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of life vehicles
[7] 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.
[8] See the Versailles Declaration adopted in March 2022: https://www.consilium.europa.eu/media/54773/20220311-versailles-declaration-en.pdf and the Conclusion adopted by the European Council on 9 February 2023
[9] https://commission.europa.eu/system/files/2023-02/COM_2023_62_2_EN_ACT_A%20Green%20Deal%20Industrial%20Plan%20for%20the%20Net-Zero%20Age.pdf

a major transformation of the industry and heavy investments in new technologies such as battery production to stay competitive. In addition, the automotive sector is one of the largest users of CRMs in the EU industry and the electrification of the fleet will lead to a considerable increase in the demand for these materials. Increasing the recovery of CRMs used in the automotive sector is therefore an essential element of this review, and an important contribution to the overall EU strategy to improve the security of supply of such materials, as reflected in the Commission proposal for a CRM Act[10].

The transition of the automotive sector to circularity is also key to reaching by 2050 the climate neutrality targets included in the European Green Deal, complementing the various initiatives under the "Fit for 55" package[11]. The initiative is also consistent with other recently launched initiatives designed to improve the eco-design of products and ensure sustainable management of waste, especially the proposal for a new Regulation on batteries[12], the proposal for a Regulation laying down harmonised conditions for the marketing of construction products[13], the proposal for a Regulation on Ecodesign for Sustainable Products (ESPR)[14] and the proposal for a new Waste Shipment Regulation[15]. Finally, this initiative complements other recent legislative developments designed to transform the automotive industry, such as the proposed revised CO_2 standards for cars and vans[16], the proposed Euro 7 standard on emissions from new motor vehicles[17] and the ongoing revision of the three Directives of the "Roadworthiness Package"[18]. A more detailed description of the interaction between this initiative and other EU policies and legislation can be found in Annex 10. This initiative supports the implementation of the Sustainable development Goals (SDGs), in particular SDG 9 "Industry, innovation and infrastructure", SDG 12 "Responsible consumption and production", SDG13 "Climate action".

[10] COM(2023) 160 final

[11] More information on the package is available at: https://ec.europa.eu/commission/presscorner/detail/en/IP_21_3541

[12] 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 […]). The proposal for a new Regulation on batteries addresses automotive batteries and contains a comprehensive new legal regime covering their whole life cycle, designed to address their environmental footprint. The revision of the ELV and 3R TA Directives will not contain provisions regulating the design, production and end-of-life of batteries. It will address vehicles as a whole as well as their parts and components, in a way which complements the proposal for a Batteries regulation and would ensure that the overall environmental footprint of vehicles is addressed.

[13] COM(2022)144

[14] Proposal for a Regulation of the European Parliament and of the Council establishing a framework for setting Ecodesign requirements for sustainable products and repealing Directive 2009/125/EC, COM(2022)142 final, 2022/0095 (COD). Requirements on the circular design and production of motor vehicles should build on the exiting legal framework applying to vehicles, which are set out and enforced through the "type-approval" process. This is therefore a separate legal framework than the one set out under the upcoming ESPR instrument. Consistency between the two legal instruments should nevertheless be ensured to ensure a high level of ambition for the transition of this sector to a circular economy. The ESPR also does not deal with the end-of-life phase of the vehicle, vehicle component or material used in the vehicle, which are subject to the ELV Directive.

[15] 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, 2021/0367(COD). On this point, the revision would in particular aim to ensure, in line with the proposal on waste shipments, that ELVs (which if untreated are hazardous waste) cannot be exported outside the OECD countries.

[16] Proposal for a Regulation of the European Parliament and of the Council amending Regulation (EU) 2019/631 (COM(2021) 556 final)

[17] Proposal for a Regulation of the European Parliament and of the Council 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)

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

1.2 Legal context

The ELV Directive was adopted in 2000 and established for the first time a harmonised EU framework designed to ensure the environmentally sound treatment of vehicles reaching the end of their life and considered as waste[19]. To this end, the ELV Directive sets out measures which need to be implemented by the Member States and relate to:

1. The prevention of waste, especially measures to limit the presence of hazardous substances in vehicles and to encourage Member States to take account and facilitate the recycling and reuse of vehicles and their parts, in the design and production stage of new vehicles;
2. The collection of ELVs, notably through obligations for Member States to ensure that authorised treatment facilities (ATFs) are available within their territory, that ELVs are transferred to ATFs and that this transfer occurs without any costs for the last holder;
3. The environmentally sound treatment of ELVs, through requirements on depollution;
4. The setting of annual targets for the reuse and recycling (85%) as well as reuse and recovery (95%) of ELVs, based on the overall weight of vehicles;
5. The provision of information by producers on components and materials used in vehicles, to facilitate their identification for reuse and recovery.

This Directive contains 13 Articles and 2 Annexes. Except for the Annex II on hazardous substance restrictions, it has not been subject to any substantial amendments since its adoption in 2000. At the occasion of the revision of the Waste Framework Directive in 2018, the co-legislators agreed[20] that the *Commission "shall review [the ELV] Directive, by 31 December 2020, and to this end, shall submit a report to the European Parliament and the Council, accompanied, if appropriate, by a legislative proposal"*. It indicates that the ELV Directive revision should focus on the feasibility of setting recycling targets for specific materials and the problem of 'unknown whereabouts' of end-of-life vehicles.

The 3R type-approval Directive[21]**, adopted in 2005, aims to improve the design of new vehicles with regard to their reusability, recyclability and recoverability.** The need for this Directive was foreseen when the ELV Directive was adopted in 2000, in order to link the provisions of the ELV Directive (like the prohibition of certain hazardous substances, treatment of ELVs and the reuse, recycling and recovery targets) to 'design' provisions in the type-approval process. In particular, the Directive states that vehicles should be constructed so as to be 85% recyclable/reusable and 95% reusable/recoverable. The 3R type-approval Directive is part of the type-approval framework[22], whereby new vehicle types are tested and granted type-approval before being placed on the EU market, provided they meet a set of technical requirements. It places obligations on national type-approval authorities to verify information provided by car manufacturers on reusability, recyclability and recoverability of new vehicle types.

[19] The definition of 'waste' in the ELV Directive is in line with the general definition of waste used in EU legislation, whereby waste means "any substance or object which the holder discards or intends or is required to discard". Old collection cars which are kept on the premises of individuals are not considered as ELVs as there is no intention to discard them from the side of their owner.

[20] See Article 10a of Directive 2018/849/EU, OJ 150, 30.5.2018, p. 93

[21] Directive 2005/64/EC on the type-approval of motor vehicles regarding their reusability, recyclability and recoverability ("3R type-approval Directive")

[22] 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

2 PROBLEM DEFINITION

This impact assessment addresses the following four problems:

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

These four problems were identified in the evaluations of the ELV Directive[23] and of the 3R type-approval Directive[24] as preventing the transition of the overall automotive supply chain to a circular economy.

These problems relate to all stages of the life cycle of the automotive sector beyond use (design, production, waste management). They have different features and affect different economic operators (vehicle manufacturers, dismantlers, recyclers, authorities). This impact assessment therefore provides in the first place an analysis of their specific drivers and of specific options designed to address each of the objectives corresponding to these problems separately. This allows for a thorough presentation of each problem and of the different possible options to address them, as well as of their respective impacts.

It is however also essential that these problems are addressed in a consistent and mutually supportive manner to improve circularity across the whole automotive supply chain. There are clear links and synergies between the problems, objectives and measures linked to design, production, waste collection and recycling. For example, improving the design and production of new vehicles is key to ensuring higher quantity and quality of recycling of ELV, and improving quality of recyclates from ELVs is also essential to allow them to be taken up as recycled materials in new vehicles. For that reason, after an analysis of options specific to each problem, this impact assessment provides, in section 8.1, a preferred package of options covering them all, which represents the most effective and efficient solution to meet the general objective of this initiative (improving circularity for the whole automotive supply chain). A more detailed presentation of these problems and their drivers are provided in Annex 6.

2.1 Problem area 1: Lack of integration of circularity in vehicle design and production

2.1.1 What is the problem?

The EU automotive sector is among the world's biggest, providing 13.8 million direct and indirect jobs, representing 6.1% of total EU employment. In 2021, 12 million motor vehicles (cars, vans, lorries, buses) were manufactured in the EU and 11.5 million were placed on the

[23] https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/1912-End-of-life-vehicles-evaluating-the-EU-rules_en

[24] See Annex 11 of this report

EU market[25]. The production of vehicles is one of the most resource intensive industries and represents a significant impact in terms of use of raw materials. Europe's automotive sector is responsible for 19% of the demand of the EU's steel industry (over 7 million tons/year[26]), 10% of the overall consumption of plastics (6 million tons/year[27]), a significant share of the demand for aluminium (42% for all transport equipment, around 2 million tons/year[28]), copper (6% for automotive parts[29]), rubber (65% of the production of general rubber goods[30]) and glass (1.5 million tons of flat glass produced in the EU[31]). The electrification of the automotive sector, combined with the increasing integration of electronics in vehicles, will lead to more copper and CRMs, including rare earth elements[32] in vehicles, as well as more advanced and lightweight materials like high grade steels and rapidly growing demand for aluminium alloys. The market demand has also resulted in a steady rise in sales of Sport Utility Vehicles (SUVs). SUVs represented around 40% of annual car sales of vehicles in Europe in 2020, compared to 10% in 2010. SUVs are heavier than conventional cars and their production requires greater amounts of primary materials, which considerably increases their environmental footprint. This has compounded the trend for heavier vehicles.

The result is that the production of vehicles represents a considerable environmental footprint, primarily due to the GHG emissions linked to the energy required for the extraction and processing of primary materials such as coal and iron ore (for steel), bauxite (for aluminium), copper or oil (for plastics). The extraction and processing of metals represent about 10% of global greenhouse gas emissions globally. **The automotive industry is undergoing profound changes towards climate-neutrality through the electrification of the vehicle fleet.** As a result, the "production phase" in the vehicle lifecycle will have a higher environmental footprint than its "use phase", notably due to the importance of raw materials for the manufacturing of EVs. In terms of shares of the production carbon footprint, aluminium will be contributing 35-50%[33], steel 15-25%, plastics 4-7%, compared to 10-20% for the battery raw materials[34].

The dependence on primary materials is also making the supply chain for the automotive industry more vulnerable, compounding the challenges observed recently with disruptions for semi-conductors or magnesium and the hike in energy prices that followed the start of the war in Ukraine.

The automotive sector is only recently starting to embrace the decarbonisation of their production process to enable a full transition to a circular economy. Due to quality requirements, the automotive industry relies heavily on the supply of primary raw materials

[25] https://www.acea.auto/figure/key-figures-eu-auto-industry/
[26] More information available at: https://www.eurofer.eu/publications/economic-market-outlook/economic-and-steel-market-outlook-2022-2023-third-quarter/
[27] Based on JRC study report on recycled content of plastics in the vehicles.
[28] CRM_2020_Factsheets_critical_Final.pdf (europa.eu)
[29] CRM_2020_Factsheets_non-critical_Final.pdf (europa.eu)
[30] More information available at: https://www.etrma.org/rubber-goods/
[31] More information available at: https://glassforeurope.com/the-sector/key-data/
[32] Rare earth elements (REEs) are mainly used for permanent magnets in EVs (average weight of 1-2 kg of permanent magnets per EV); platinum group metals (PGMs) are used for catalytic converters (77% share in automotive catalysts) and printed circuit boards; gallium is used for lighting equipment and integrated circuits; magnesium (50% share in automotive sector) and niobium (23% share in automotive steel) are used for metal alloys; and natural rubber for production of tyres. Electric and electronic systems in vehicles also contain additional precious metals, PGMs, gallium, tantalum, and REE.
[33] R.G. Billy, D.B. Muller, Aluminium use in passenger cars poses systemic challenges for recycling and GHG emissions, Resources, Conservation & Recycling 190 (2023), https://doi.org/10.1016/j.resconrec.2022.106827
[34] Conzade, Julian, et al., 2021. Why the future automotive future is electric. McKinsey Center for Future Mobility. https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/why-the-automotive-future-is-electric

and uses very little recycled materials. This is the case especially for plastics, steel[35] and aluminium[36]. Notwithstanding the recent advances made by EU automotive industry frontrunners, the current level of integration of circular models in the design, production and end-of-life stages of the vehicle lifecycle remains insufficient to attain the objectives of the Circular Economy Action Plan to "*promote more circular business models by linking design issues to end-of-life treatment, consider rules on mandatory recycled content for certain materials, and improve recycling efficiency*".

2.1.2 What are the problem drivers?

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

Market failure

Prices of primary materials do not factor in environmental externalities of extraction and processing and are generally lower than secondary materials due to economies of scale. The lack of market demand for secondary materials has in turn not encouraged the recycling sector to invest and increase supply and quality of recyclates suitable for the automotive sector.

Regulatory failures

Regulatory requirements designed to ensure that the automotive sector reaches climate-neutrality have focused on the use phase of vehicles (rather than on the circularity in the production and end-of-life stages). This has encouraged the incorporation of lightweight and composite materials in new vehicles, which are particularly challenging and costly to recycle. The growing use of new techniques to assemble parts (typically gluing elements instead of using screws) in vehicles has further hampered easy dismantling and high-quality recycling of ELVs.

The provisions in the ELV Directive[37] on the design of cars to facilitate dismantling, re-use, remanufacturing and recycling, as well as the use of recycled content, are too generic. The provisions in the 3R type-approval Directive lack specificity, for example for the verification that (i) the reusability, recyclability and recoverability targets are met and for (ii) incentivising a more sustainable vehicle design and production. The verification of how vehicle manufacturers meet their obligations on recyclability and recoverability is largely built on the ISO 22628 standard from 2002[38] that does not take into account the degree of development in recycling technologies and allows for a wide interpretation as to what materials can be considered as "recyclable". In addition, there is no reporting obligation for Member States and the Commission on the implementation of the 3R type-approval Directive and no regular monitoring has been carried out at this point. Moreover, **there are no legal incentives for manufacturers to increase the amount of recycled content in new vehicles or to use materials and parts which can be easily repaired, dismantled, re-used,**

[35] For steel, with significant ongoing decarbonisation investments in electric arc furnaces (EAF), ELV steel scraps typically contain too much copper hindering scrap utilisation rates. Combined with increasing demand of flat products with even lower copper tolerances by the automotive industry, this is a hindrance to higher recycled content rates leading to use of primary units to dilute and to significant loss of economic value (see also Material Economics (2020), Preserving value in EU industrial materials - A value perspective on the use of steel, plastics, and aluminium, EIT – Climate KIC).

[36] Increasing secondary raw materials is hindered by the switch from cast to wrought alloys. In the case of aluminium, the transition to EVs requires lower alloying levels for wrought aluminium alloys than currently available in (ELV) aluminium scraps, posing a real and significant risk of mixed aluminium scrap surpluses especially for high EV deployment scenarios, whereby high energy intensity materials cannot be recycled to their full potential.

[37] Article 4(1)(b) and (c) of the ELV Directive.

[38] https://www.iso.org/standard/35061.html

remanufactured or recycled[39]. Lack of clarity in definitions for secondary raw materials makes it difficult to distinguish between primary and secondary raw materials and between post-consumer scrap and pre-consumer scrap.

2.2 Problem area 2: Lack of quality and quantity in reuse and recycling

2.2.1 What is the problem?

Vehicles reaching their end of life currently are not managed in optimal conditions. About 6.1 million ELVs are collected every year in the EU, representing 6.9 million tons of waste[40], with 66% (4 million tons) of ferrous metals, 11% (0.7 million tons) of non-ferrous metals, 2% (0.1 million tons) of glass and 14% (1 million tons[41]) of mixed plastics[42]. **While substantial progress has been made since 2000 to reach the 85% recycling/re-use target set out in ELV Directive, a large share of materials, in particular Automotive Shredder Residues (ASR) is sent to landfills or incinerated.** The share of plastics in the composition of vehicles has considerably increased, and today ranges from 14 to 18% of the total weight of new passenger cars. **Only 19% of plastics or 0.2 million tons per year from ELVs is currently going to recycling and 0.1 million tons are effectively recycled, while around 0.8 million tons of plastic waste per year either ends up in landfills (40%) or is sent to waste-to-energy facilities (41%).**

The increased use of certain materials in new vehicles since the introduction of the ELV Directive poses challenges, in particular the integration of carbon-fibre- and, most of all, glass-fibre-reinforced plastics as lightweight materials that cannot currently be recycled easily. The widespread use of electronics in new vehicles creates additional difficulties. They contain important concentrations of **CRMs, including REEs, which are currently not recycled at the end-of-life[43].** Finally, while the recycling rates of metals like steel (88%) or aluminium (95%) from ELVs are high, the **quality of the scrap is often too low,** notably due to contamination with other materials during the shredding process. For steel this is typically due to high levels of copper content in ELV scrap and for aluminium due to insufficient sorting of alloys respectively containing zinc, copper, silicon and magnesium alloying elements accumulating in cast aluminium. This prevents higher scrap utilisation rates in the production of new high-grade products and the scrap is downcycled for other purposes.

The share of parts and components from ELVs which are re-used or remanufactured remains low. The suboptimal management of waste from ELVs represents a loss of resources for the industry in the EU, either because waste is not recycled back into the economy (especially for plastics or glass) or because the quality of the scrap is often too low (especially for steel and aluminium) for direct use by the industry in the EU.

2.2.2 What are the problem drivers?

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

Market failures

[39] Such incentives are being established at the EU level for batteries and packaging, based on the provisions of the Waste Framework Directive (Article 8a) on the "modulation of fees" foreseen for "extended producer responsibility schemes", in line with the polluter pays principle set out in Article 191(2) of the Treaty on the Functioning of the European Union (TFEU).
[40] In 2019, the average weight of an ELV was estimated at 1137 kg (based on reports by Member States).
[41] Collected at the authorized treatment facilities (ATFs).
[42] These figures exclude tyres, battery casings and the plastic sheathing of wiring harnesses.
[43] This is also the case of other CRM (e.g., niobium or magnesium) that are integrated as alloying elements in basic metals (steel or copper) and are currently not targeted in the recycling processes.

It is currently not profitable to recycle from ELVs materials such as plastics and glass or precious metals from electronic components. Economies of scale and incentives to promote better quality of scrap are lacking. Authorised Treatment Facilities (ATFs) are mostly SMEs which make their business in the commercialisation of the most valuable spare parts removed from ELVs and the sale of depolluted ELVs to shredders. The market for other spare parts[44] remains limited, as the cost for their dismantling is high and many ATFs are not equipped to reach out to a wider range of customers for instance on digital marketplaces. After ATFs, ELVs are transferred to shredders where, in most Member States, there is no sophisticated technology in place to sort, separate and recover various materials contained in ELVs into clean fractions, notably high-quality steel and aluminium scraps and plastics suitable for mechanical recycling. Investments in "post shredding technologies" (PST) are capital intensive and they remain underdeveloped across the EU.

Regulatory failure

The definition of "recycling" in the ELV Directive includes "backfilling"[45] and is broader than other definitions applied to other waste streams, pursuant to the Waste Framework Directive. As a result, in some Member States, considerable amounts of wastes from ELVs, especially inert materials, glass particles, mixed plastics, rubbers, fibres and textiles are backfilled and accounted as recycled. The **methodology to calculate that the recycling/re-use targets are met is not sufficient to provide clear evidence** that only waste which enters recycling is counted towards the achievement of the targets[46]. **The ELV and 3R type-approval Directives do not sufficiently incentivise vehicle manufacturers to provide dismantling information on components and materials that would facilitate ATFs, garages and repair shops to identify, locate and dismantle valuable spare parts and components.** As an example, the lack of sufficient information on CRMs contained in vehicles do not ease their early-stage disassembly and sorting in the authorised treatment facilities. The provisions on this point in Article 8 of the ELV Directive, and their implementation by the vehicle manufacturers, are often seen by the dismantling sector as too limited, notably as the information might not be free of charge and not user-friendly. There is **no incentive either in the current legal framework for economic operators to increase the re-use and remanufacturing rates of parts from used vehicles or ELVs**.

Regarding financial responsibility, **the ELV Directive does not specify that car manufacturers should contribute financially to the costs linked to the dismantling, re-use, remanufacturing and recycling of materials and components from ELVs.** This contrasts with other sectors, such as batteries, electric and electronic equipment and packaging, where "extended producer responsibility" (EPR) schemes explicitly include the financing by producers of the waste management phase of their products. In March 2022, the Commission carried out inspections at the premises of automotive companies and associations of such companies, based on concerns that several of them may have violated antitrust rules

[44] Such as bumpers, dashboards and windshields.

[45] The Waste Framework Directive defines backfilling as "any recovery operation where suitable non- hazardous waste is used for purposes of reclamation in excavated areas or for engineering purposes in landscaping. Waste used for backfilling must substitute non-waste materials, be suitable for the aforementioned purposes, and be limited to the amount strictly necessary to achieve those purposes".

[46] This is firstly due to shortcomings in the reporting foreseen in 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. In addition, this methodology has not been adapted to reflect the improvements introduced at the EU level for other waste streams, as laid down in Article 11a of the Waste Framework Directive for municipal waste, and in Article 6a of Directive 94/62/EC on packaging and packaging waste.

and colluded to agree not to provide any financial support to the dismantling and recycling sector. The investigations on this case are ongoing[47].

2.3 Problem area 3: 'Missing vehicles' cause environmental impacts

2.3.1 What is the problem?

While around 6.1 million ELVs are reported to be treated according to the ELV Directive every year, **it is estimated that around 32% of de-registered vehicles, i.e., approximately 3.4 million units per year, are of unknown whereabouts (so-called "missing vehicles") and 1 million units (10%) are exported as used vehicles**. Despite numerous studies on this problem[48], it remains challenging to estimate the proportion of these vehicles gone missing due to administrative failures, illegal dismantling in the EU or illegal export outside the EU. In any case, the treatment of ELVs and the recovery of materials from these ELVs is not in accordance with the requirements and causes environmental damages, such as oil spillage, unsound treatment of refrigerants or improper removal of hazardous substances and of components for higher quality of recycling. This represents unfair competition and economic losses for authorised treatment facilities, which have to abide by EU rules. It further means a loss of secondary resources which are important for reducing industry's environmental footprint through the use of recyclates instead of primary resources. Illegal dismantling and export of ELVs are also feeding criminal networks.

The export of used vehicles also raises important environmental and public health challenges. While the export of ELVs from the EU to non-OECD countries are considered as hazardous waste and thus banned, this is not the case for used vehicles that have not (clearly) reached the waste stage. Although these vehicles are not formally waste, they are exported to third countries are often close to end of service stage, meaning that they cannot be used for the primary purpose they were conceived, in a fully safe manner. The EU is the biggest exporter of used vehicles worldwide. In 2020, the number of used vehicles exported from the EU to third countries amounted to **870,000 vehicles at a value of € 3.85 billion.** The most important destinations are Africa, Eastern Europe, Central Asia and the Middle East. Used vehicles exported from the EU contribute to affordable access to mobility in third countries, where they are used longer than in the EU. However, as documented in a recent study[49] on the quality of used vehicles carried out by the Dutch Ministry of Infrastructure and Water Management, a significant part (more than 60%) of used vehicles exported to African countries do not meet Euro 4/IV emissions standard, are older than 15 years and do not have a valid roadworthiness certificate. The roadworthiness status proves that the vehicle is in a technically and environmentally sound condition to use it[50]. Therefore, it is an essential factor determining the appropriateness and full functionality of a vehicle to be safely exploited during its service phase. According to the Correspondents Guidelines No 9 "Shipments of Waste Vehicles"[51], failure to pass a periodic roadworthiness test for more than 2 years may be considered as one of the indicators to suspect that the vehicle is not functional anymore, it is technically irreparable, and thus should be considered as an end-of-

[47] See: https://ec.europa.eu/commission/presscorner/detail/en/ip_22_1765

[48] Umweltbundesamt,(2022), Illegal treatment of end of-life vehicles - Assessment of the environmental, micro- and macroeconomic effects, texte 130/20 22

[49] https://www.ilent.nl/documenten/rapporten/2020/10/26/rapport--used-vehicles-exported-to-africa

[50] As it is explained in Recital 3 of Directive 2014/45/EU, the roadworthiness testing is a part of a wider regime designed to ensure that vehicles are kept in a safe and environmentally acceptable condition during their use; Recital 6: Vehicles with malfunctioning technical systems have an impact on road safety and may contribute to road crashes involving injuries or fatalities. Moreover, as it is further explained in Recital 22, Roadworthiness tests cover all items relevant to the specific design, construction and equipment of the tested vehicle. Compatibility between parts and components, such as between wheels and wheel hubs, should be treated as a critical safety item and should be checked during roadworthiness testing.

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

life vehicle. There are also indications that a considerable portion of exported vehicles undergo illegal alterations, like the removal of air bags and exhaust filters. They present a serious risk of polluting the environment and for road safety. According to WHO, road accidents cause the death of 1.25 million people and injure 20-50 million people annually. Despite having only 54% of the global vehicle fleet, low and middle-income countries account for 90% of these fatalities. The African continent, which is the main destination of used vehicles exported from the EU, has the highest road traffic fatality rates, with 246,000 deaths annually, and this figure is expected to rise to 514,000 in 2030, representing an increase of 112%. In order to address these problems, and as documented by the UN Environmental Programme[52], a growing number of countries and regional organisations[53] committed to restrict the import of used vehicles, based on their age, compliance with air pollutant emission limits (Euro standards) or roadworthiness criteria.

2.3.2 What are the problem drivers?

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

Market failures

There are **economic incentives for insurance companies, dealers and private owners of ELVs to sell them on online market places or directly to non-authorised treatment facilities or export them in contravention of EU rules: they will obtain higher prices than if they have to deliver them to authorised treatment facilities, which have to abide by the requirements of the ELV Directive** for the treatment of these vehicles and are subject to social security, employment and other fiscal charges (unlike the informal sector).

The steady demand in developing countries is an important driver for the export of used vehicles outside the EU, associated with the high prices that exporters of such vehicles can obtain compared to what they could gain with selling them in the EU. There are also factors that can make it difficult to sell certain types of used vehicles in the EU, such as emission taxes and restrictions on access to urban centres. This can make it more attractive for exporters to sell these vehicles in developing countries where such restrictions might not exist. Overall, the demand for used vehicles in developing countries is a significant factor in the global trade in used vehicles and is likely to remain so in the future. The global fleet of LDVs is set to at least double by 2050. Some 90% of this growth will take place in non-OECD countries which import a large number of used vehicles.

Regulatory failures

The ELV Directive and the EU legislation on registration documents and roadworthiness do not contain sufficient provisions to track a vehicle until it reaches the end-of-life. Especially, the obligation to record and report ELVs, upon issuance of a certificate of destruction (COD), is not clearly attributed to stakeholders and public authorities. **The difficulty in exchanging information on the registration and de-registration of vehicles** contained in the vehicle registers of the different Member States **is a key obstacle to the problem of unknown whereabouts.**

The absence of clear and legally binding criteria on the distinction between used vehicles and ELVs also makes enforcement of the requirements of the ELV Directive very

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

[53] The Economic Community of West African States (ECOWAS[8]) adopted on 5 September 2020 a Directive limiting the import of used vehicles to a minimum Euro 4/IV emission standard. The age limit for importing vehicles into the region is five years for light-duty vehicles, two-wheel motor vehicles, tricycles and quadricycles and 10 years for heavy-duty vehicles.

challenging. Specific guidelines[54] were developed to assist enforcement and customs officials in implementing the rules on the export of ELVs, and especially to distinguish between ELVs and used cars. These guidelines are however non-binding and are combined with a lack of enforcement capacity. The illegal sector widely exploits this grey area, notably to export illegally ELVs, which are waste and shall be subject to treatment under the EU waste legislation, however they are presented as used vehicles, for which no trade restrictions apply. Even economic actors in the formal sector[55] regularly auction total loss vehicles without checking their final destinations.

Moreover, the absence of a requirement to **export from the EU only roadworthy vehicles** allows exports of used vehicles even for those not authorised to be driven on EU roads due to lack of compliance with safety or environmental rules. The enforcement of the mandatory roadworthiness status of a vehicle is an essential part of the EU regime designed to ensure that vehicles are kept in a safe and environmentally acceptable condition during their use. Directive 2014/45/EU[56] contains a long list of minimum elements which have to be tested, in order for a vehicle to obtain a roadworthiness certificate. Every vehicle that is at least 4 years old circulating on EU roads has to have a valid roadworthiness certificate. As per Article 5 of Directive 2014/45/EU, cars and vans must be tested at least every two years after the age of 4, while heavy-duty vehicles, including their trailers must undergo inspections every year. In accordance with the EU legislation, each Member State shall recognise the roadworthiness certificate issued by tother Member State. While these requirements are a condition for a vehicle to be used on EU roads, they are currently not relevant when used vehicles are exported from the EU to third countries. In addition, there are also no requirements that exporters of used vehicles and competent authorities of EU Member States check that used vehicles comply with the conditions set out by importing countries for the import of such vehicles.

There are no specific provisions in the ELV Directive requiring the Member States to carry out **inspections or take enforcement actions** to ensure that its provisions are properly implemented, or to establish penalties against breaches of the requirements set out in the Directive.

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

2.4.1 What is the problem?

The ELV and 3R type-approval Directives apply to passenger vehicles (M1), as well as to light commercial vehicles (N1)[57]. **Around 85 % of 323 million vehicles registered in the EU fall within the scope of ELV Directive[58]. 15% of registered vehicles are therefore not covered, representing around 52 million vehicles (motorcycles (L3e-L7e), lorries and buses)[59].** By mass, this represents 33% of registered vehicles, or 191 million tons. The average sum of materials from motorcycles), busses and lorries that became waste in 2019 can be estimated to amount to more than 4.13 million tons[60]. L1 and L2 including e-bikes and

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

[55] for example, insurance companies which own a large share of accidented vehicles

[56] 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

[57] Motor vehicles used for the carriage of goods and with a maximum mass not exceeding 3,5 tonnes (vans).

[58] 76 % passenger cars (M1 type) and 9 % lorries (N1 type).

[59] It should be noted that this impact assessment does not address the situation of e-bikes, ships, planes, trains, agricultural and non-road mobile machinery, and vehicles used for military purposes and space. These vehicles are non-road vehicles, with the exception of non-type approved (electric) bicycles. These are subject to specific regulations.

[60] 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

mopeds, although included in the LMT definition under the Battery Regulation, are not considered for the scope extension here[61]. The reason is that they are smaller than motorcycles, are not included in the vehicle registrations in certain member states and are typically collected via bicycle and scooter dealers compared to large motorcycles.

There is no comprehensive information on the treatment of end-of-life motorcycles, lorries and buses. The information gathered for this impact assessment shows that there is an important market for used spare parts dismantled from end-of-life motorcycles and lorries, and that the treatment of the vehicles outside the scope of the current legislation also has specific features:

- End-of-Life motorcycles are often treated by small operators in the EU;
- End-of-life lorries have a longer lifetime than M1-N1 vehicles, are exported in large number (up to 75%) outside the EU when reaching a certain age and, when dismantled in the EU, are usually treated in facilities which are either specialised in their treatment, or also treat end-of-life passenger cars;
- A non-negligible share of used busses (around 33%) are exported outside the EU, and their dismantling raises specific challenges dues to a lower share of metals and higher share of textile and glass compared to other vehicles.

The vehicles excluded from the ELV and 3R type-approval Directives are currently not subject to any specific requirement when it comes to eco-design and their waste phase. The consequences of this exclusion are the following:

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

The data collected for this impact assessment shows that **at least seven Member States have adopted various types of legal provisions governing the end-of-life stage of lorries, buses or motorbikes.** Many of them have especially established a requirement that these vehicles should be delivered to an ATF at end-of-life and require that their dismantling complies with specific obligations, especially on depollution. This poses the risk of fragmenting the EU market, as economic actors willing to escape national rules could decide to get their vehicles dismantled in another EU Member State with lower or no requirements.

Overall, the integration of circularity in the business model of producers of vehicles outside the scope of the ELV and 3R type-approval Directives largely relies on voluntary actions.

2.4.2 Problem drivers

Regulatory failures

The main driver for the problem outlined above is the exclusion of powered two- and three wheelers, lorries and buses from the scope of the ELV and 3R type-approval Directives. More than twenty years after adoption of the ELV Directive, this has led to a situation where there is no transparency on the degree of circularity of the sectors concerned and that they are not

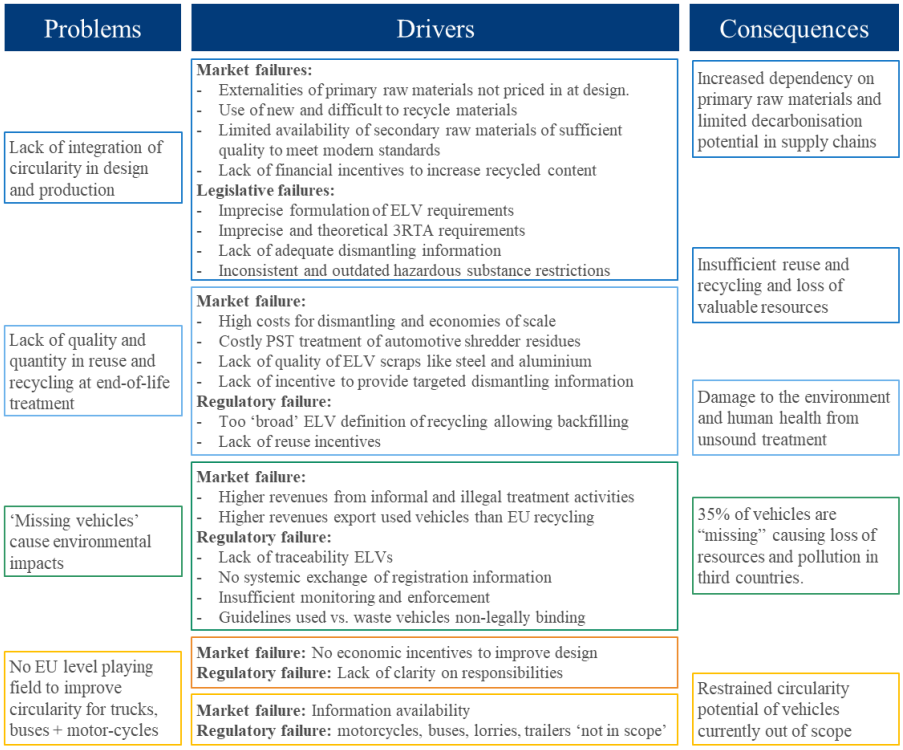
[61] See page 17 in Huisman, J., Bobba, S., "Available for Collection" study on alternative collection targets for waste portable and light means of transport batteries, EUR 30746 EN, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-39442-6, doi:10.2760/163961, JRC125615.

incentivised to go beyond a "business as usual" scenario. The fact that a few Member States have started to set out national regulations covering the end-of-life stage of vehicles not in the scope of the EU legislation is a sign that the current limited scope is considered as sub-optimal.

2.5 Overview of problems and drivers

Figure 1 below presents an overview of the main problems this initiative aims to address, their drivers and consequences, in line with what is presented in Sections 2.1 to 2.4.

Figure 1 - Problems, drivers and consequences



2.6 Who is affected and how?

The stakeholders which are primarily affected by the problems described in this section are those involved in the whole supply chain for the design, production and waste management of vehicles. This includes vehicle manufacturers, importers, suppliers of spare parts for the automotive industry, dismantlers (which are mostly SMEs), shredding/recycling companies, industries relying on scraps as feedstock for their production (notably in the steel, aluminium, copper and plastics sectors), exporters of used vehicles, insurance companies (who own and sell a large share of ELVs), workers, consumers, non-EU stakeholders like third-country producers exporting vehicles to the EU and importers of used vehicles from the EU, competent authorities in charge of the implementation of the ELV and type-approval legislation. More information on how these stakeholders are affected by the initiative can be found in Annex 3.

3 WHY SHOULD THE EU ACT?

3.1 Legal basis

The legislative proposal is based on Article 114 of the Treaty on the Functioning of the European Union (TFEU), which is to be used for measures that aim to establish or ensure the functioning of the internal market. This is essential as the proposal is designed to set out requirements which govern the placing on the EU market of motor vehicles.

The proposal tackles a number of key problems related to the single market. These include: i) an uneven playing field for vehicles placed on the market; ii) barriers to the functioning of recycling markets and improvement in economies of scale; iii) uneven implementation of the ELV Directive, since applicable rules are subject to interpretation; iv) lack of attention to quality and value retention in reuse and recycling; v) the persistent problem of 'missing vehicles' and lack of clarity to distinguish ELVs from used vehicles in the case of export and (vi) the need for a stable and fully harmonised regulatory framework, in particular related to uneven implementation of the polluter pays principle across Member States.

Harmonised rules are necessary to ensure that all goods placed on the EU market comply with similar conditions. Article 114 TFEU is the legal basis of the overall regulatory framework on type-approval of motor vehicles, including the 3R type-approval Directive, whereas the ELV Directive has an environmental legal basis (Article 192 TFEU). At the time of adoption of the ELV Directive, the choice of an environmental legal basis was justified as the Directive did not place any direct obligations on any economic operators, in particular no obligations linked to the placing on the market of vehicles, and as it essentially set out measures to be adopted by the Member States, targeting the end-of-life stage of a vehicle.

The policy options will lead to further harmonisation of: product requirements for vehicles placed on the Union market, in particular related to i) harmonised requirements for the inclusion of recycled content for plastics, steel and CRMs; ii) harmonised and improved materials declarations on the presence and locations of hazardous substances, the levels of recycled content for a range of materials including CRMS, and iii) improved requirement on information exchanges facilitating reuse and recycling. The proposal will also set requirements for ensuring a well-functioning market for secondary raw materials while preventing and reducing the environmental impacts from the production and recycling of vehicles.

The new legislation will modernise the existing requirements relating to the placing on the market of vehicles on the EU market, which currently are included in the 3R type-approval Directive, and those requirements will be merged with the rules applicable to the end-of-life stage of the vehicle. The new legislation will furthermore include a number of new provisions aimed at closing the material loop in products. With this in mind, it is appropriate that the new legislation is based on Article 114 TFEU, thus allowing for both ensuring a smooth functioning of the internal market and a high level of environmental protection.

The choice of Article 114 of the 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, aiming at covering in one single instrument sustainability/circularity requirements applying to the whole lifecycle of products, such as the proposal for a Batteries Regulation[62], the proposal for a Regulation on Eco-design for Sustainable Products[63] and the proposal for a Regulation on Packaging and Packaging Waste[64].

3.2 Nature of the legal instrument

The evaluation of the ELV Directive and 3R type-approval Directive identified the generic nature of their provisions as one of their main shortcomings. Many of these provisions were

[62] 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 […]).

[63] Proposal for a Regulation of the European Parliament and of the Council establishing a framework for setting ecodesign requirements for sustainable products and repealing Directive 2009/125/EC.

[64] Proposal for a Regulation of the European Parliament and of the Council on packaging and packaging waste, amending Regulation (EU) 2019/1020 and Directive (EU) 2019/904, and repealing Directive 94/62/EC.

found to be too general, not setting sufficiently clear requirements and not measurable. This led to diverging interpretation among the Member States (for example on the calculation of recycling targets), to a lack of progress (for example on design for recycling) or could not be properly monitored (for example the provisions in the 3R type-approval on the verification by Member States that vehicle producers adequately demonstrate that new vehicle types comply with the requirements on re-usability, recyclability and recoverability). This is hampering the functioning of the EU single market and not resulting in a better protection of the environment.

In addition, the co-existence of two separate legal acts (ELV Directive and 3R type-approval Directive) brings with it the risk that their respective provisions are not synchronised. The provisions of both Directives are intrinsically linked, as the 3R type-approval Directive needs to mirror the provisions of the ELV Directive. The merger of the two existing Directives into a single Regulation represents the most efficient solution to ensure this synchronisation. It will provide the necessary legal certainty, simplify the current regulatory landscape by gathering all requirements into a single act and contribute to a stronger EU market integration. A Regulation will ensure that the obligations are implemented at the same time and in the same manner in all 27 EU Member States in a harmonised way. Compared to a Directive, the choice of Regulation also reduces the administrative costs linked to the transposition process into national legislation and allows new EU requirements to apply earlier. The choice of a Regulation is consistent with the rest of the type-approval regulatory framework, where Directives have been turned into Regulations as part of the measures adopted at the EU level in the aftermath of the "Dieselgate" emissions scandal.

3.3 Subsidiarity: necessity and added value of EU action

To ensure a harmonised and well-functioning internal market across all EU Member States and enable a smooth transition of the automotive sector to the circular economy, in line with the ambition of the European Green Deal, it is essential to put in place a common set of rules at the EU level, with clear requirements and obligations addressed to both Member States and economic operators. Otherwise, the risk is to fragment the EU market and make progress on circular economy dependent on voluntary actions by economic actors or individual Member States. EU action is necessary to meet all the objectives of this initiative.

The EU automotive sector benefits greatly from the internal market. As indicated above, type-approval rules streamline the conditions linked to the placing on the EU market as adopted at EU level. Without active EU level regulatory intervention, only small-scale and local incentives to design and produce vehicles in a way which limits the use of primary materials and increase the use of secondary materials are expected, as there are no legally binding provisions on the design for circularity of such vehicles today.

Harmonisation of requirements would facilitate the development of modern and environmentally sound infrastructure for the treatment for all vehicles in the EU, support innovation and address the implementation problems related to the different interpretations of existing legislation. It would also allow setting a clear reporting and monitoring mechanism, resulting in transparency and data comparability across the sector.

The difficulties related to the "missing vehicles" are common to all Member States. The cross-border dimension of the problem is one of its main features and requires an EU response. There were different attempts by some Member States to address the problem, which have not proven effective. The difficulty in exchanging information on the registration of vehicles between vehicle registers of the different Member States requires a harmonised solution. The same goes for the export of used vehicles from the EU, which can only be governed at the EU level in view of the EU common rules on customs and external trade.

Finally, the treatment of vehicles not covered by the ELV Directive has been regulated differently by the Member States. The study supporting the evaluation of the EU rules on end-of-life vehicles[65] revealed that only few Member States have established a consistent legal framework for the treatment of these vehicles at the end-of-life, whereas in others it is not clear how they are treated and what consequences to the environment are caused when the treatment is carried under sub-optimal conditions. Maintaining nationally fragmented regulatory frameworks in the EU would leave more than 45 million vehicles currently on EU roads at higher risk of encountering illegal dismantling activities, environmentally unsound treatment causing an uneven playing field between economic operators and significant potential loss of valuable secondary raw materials from the ELVs.

The objectives of the revision of the EU rules on end-of-life vehicles cannot be sufficiently achieved by the Member States acting individually but can rather, by reason of the scale and effects of the measures, be better achieved at Union level.

4 OBJECTIVES: WHAT IS TO BE ACHIEVED?

4.1 General objectives

The overall objective of this initiative is to improve the functioning of the EU internal market by reducing the negative environmental impacts linked to the design, production, service life and end-of-life treatment of vehicles and contributing to the sustainability of the automotive and recycling sectors.

4.2 Specific objectives

In order to address the problems described in section 2, the initiative seeks to address the following five specific objectives:

1. '**Design circular'**: Improve circularity at the design phase of vehicles, to facilitate and increase the removal, reuse, remanufacturing and recycling of materials, parts and components contained in vehicles, so that vehicle producers use more materials and technologies which do not hamper the removal of re-usable parts and components, use more materials which are easy to recycle and dismantlers are provided with information allowing them to increase and improve the removal, re-use and recycling of parts, components and materials from ELVs.
2. **'Use recycled content**: Significantly increase the use of recycled materials (especially plastics, steel, aluminium and CRMs) in the production of vehicles, thereby incentivising recycling, reducing strategic dependencies of raw materials for the automotive industry and supporting the decarbonisation of the EU industry.
3. **'Treat better'**: Significantly increase the quantity and quality of materials (especially plastics, steel, aluminium and CRMs) re-used, remanufactured and recycled from ELVs, thereby reducing the environmental footprint linked to the management of the waste generated by the automotive industry, supporting the creation of a dynamic market for secondary materials in the EU and facilitating the incorporation of more reusable parts into used vehicles extending their lifespan at moderate costs for end-users.
4. **'Collect more'**: Significantly increase the collection of ELVs in the EU and ensure roadworthiness of used vehicles exported from the EU, so that the number of "missing vehicles" and the EU external pollution footprint and road safety risks associated with the export of non-roadworthy used vehicles outside the EU are reduced.

[65] SWD(2021)60

5. **‘Cover more vehicles’**: Increase circularity in the design, production and end-of-life treatment of vehicles (lorries, buses, trailers[66] and L3e-L7e category vehicles[67]) which are currently outside the scope of the ELV and 3R type-approval legislation and ensure that they are treated properly.

5 WHAT ARE THE AVAILABLE POLICY OPTIONS?

5.1 What is the baseline from which options are assessed?

The automotive sector is currently undergoing a massive transformation in its design and production patterns, triggered by the shift to (heavier) electric vehicles, increasing use of advanced and lightweight materials and the growing number of electronic components in vehicles. The main share of the environmental footprint of the automotive sector will shift from the use phase to the materials production and end-of-life phase. Electrification will increase the mass in vehicles in general and of non-ferrous metals in particular. The trend to put on the market larger and heavier vehicles (like SUVs) is expected to continue, which translates into an increasing use of primary materials and its associated carbon footprint, which can offset the environmental gains linked to the phasing out of combustion engine. For aluminium for instance, current ELVs contain around 100 kg of predominantly cast alloys, whereas average new vehicles contain 180 kg and BEVs more than 320 kg of aluminium per vehicle, predominantly wrought alloys[68]. For global production, a four-fold increase in aluminium demand is expected[69] towards 2050. The limitations inherent to both the ELV and the 3R type-approval Directives (generic provisions, limited monitoring and enforcement) would remain, and prevent real changes towards making the design and production of all vehicles placed on the EU market more circular.

Novel components, advanced materials and more complex (and lighter) vehicle designs will further increase the reliance of the sector on CRMs. Electric drivetrains will significantly increase the share of electric drive motors in the EU fleet, either being induction motors or permanent magnet motors[70] containing rare earth elements such as neodymium and dysprosium for their construction[71]. Dysprosium demand will double by 2030 to six times higher by 2050; praseodymium will increase by 50% in 2030 and double by 2050[72]; for neodymium an eleven-fold increase by 2032 is expected[73]. Increasing numbers of electronic components shifts the presence of platinum-group metals from catalysts to multiple parts distributed over the vehicles. The use share of magnesium, another CRM used for lightweight parts and in aluminium alloys, is expected to increase significantly, with an annual growth of 9.5% from 2020 to 2025[74].

[66] Also referred to as Heavy Duty Vehicles (HDV), categories as defined in Regulation 2018/858

[67] L-category vehicles include light 2-wheel powered vehicles (category L1), three-wheel mopeds (L2), two-wheel motorcycles (L3), two-wheel motorcycles with sidecars (L4), powered tricycles (L5), light quadricycles (L6) and heavy quadricycles (L7) as defined in Regulation 2013/168. The scope considered here excludes L1 and L2.

[68] DuckerFrontier, Aluminium content in European Passenger Cars, prepared for European Aluminium, public summary 10.10.2019.

[69] R.G. Billy, D.B. Muller, Aluminium use in passenger cars poses systemic challenges for recycling and GHG emissions, Resources Conservation and Recycling 190 (September):106827, March 2023, DOI: 10.1016/j.resconrec.2022.106827.

[70] A detailed list of electric traction motor types is available in (JRC, 2023). N. Tazi, M. Orefice, C. Marmy, Y. Baron, M Ljunggren, P Wäger, F. Mathieux, Initial analysis of selected measures to improve the circularity of Critical Raw Materials and other materials in passenger cars, EUR 31468 EN, Publications Office of the European Union, Luxembourg, 2023, ISBN 978-92-68-01625-1, doi: 10.2760/207541, JRC132821

[71] EU Science hub, JRC Raw Materials Information System, https://rmis.jrc.ec.europa.eu/apps/veh/#/v/materials

[72] “European Commission, Critical materials for strategic technologies and sectors in the EU - a foresight study, 2020”.

[73] https://www.idtechex.com/en/research-article/rare-earths-in-evs-problems-solutions-and-what-is-actually-happening/25071

[74] Source: JRC 2023 ongoing CRM project: https://www.intlmag.org/page/3d-demonstrator-2020

The uptake of recycled materials like plastics, steel and aluminium would be largely left to voluntary initiatives by individual economic actors. Plastics materials in vehicles is expected to represent around 200 kg on average per light-duty vehicle (13% of the total weight of an average EV). Currently, the level of (post-consumer) recycled plastics in cars is limited to 2.5% and little progress on this is expected without regulatory intervention in the next years, so that the automotive sector would remain a major user of virgin plastics across the EU industries[75].

The problems linked to the waste stage of the life cycle of vehicles will remain. Under a baseline scenario, **around 10 million passenger cars and vans would become ELVs in 2035**, containing 7.6 million tons of steel (and cast iron), 1.3 million tons of aluminium, 175 thousand tons of copper and brass, 250 thousand tons of glass and 1.6 million tons of plastics. The dismantling and recycling sector would continue to focus on materials and parts which are profitable, and, in the absence of incentives or regulatory requirements, the quantity of recyclates from materials which are difficult to remove or recycle (especially plastics, glass, CRMs, textiles, composite materials) will not increase. Without incentives, the quality of recyclates would not improve either, hampering their uptake in new production and ultimately preventing the design and production of vehicles to become more circular. Electric vehicles are expected to represent up to 35 % of ELVs by 2035[76]. The costs per vehicle for dismantling batteries and e-drive motors are high and require sizeable investments in new skills and equipment (e.g., handling and storage of batteries). Most CRMs in EVs risk therefore to continue to be lost during the recycling processes or downcycled due to lack of economies of scale and lack of recycling and further refining capacity. This is likely to be the case for rare earths magnet materials diluted in the ferrous ELV stream or for other CRMs like magnesium or silicon to be found in mixed unsorted ELV steel and aluminium fractions.

A lack of new policy intervention would result in considerable losses of resources, including of CRMs, with significant impacts on the environment and the EU economy and a missed opportunity to put the automotive sector on a path to circularity, at a moment where the shift to electrification is driving profound changes in its business and production models.

Finally, a side effect to the shift to EVs might be the development of the market for second-hand vehicles, which are more affordable than new EVs. This could in turn boost the demand for used spare parts and provide incentives for the whole automotive supply chain to increase re-use and remanufacturing.

The **problem of missing vehicles** was identified in 2010 and has not been successfully addressed since then, despite a series of soft law initiatives and individual measures taken by some Member States. **Without policy intervention addressing the drivers of this problem, it is anticipated that the problems with illegal and informal activities and loss of resources will continue at similar levels**. Despite efforts by some Member States, it is expected that the number of missing vehicles will amount to approximately 3.2 million in 2035. By 2035, it is estimated that over one million of old, used, non-roadworthy vehicles would be exported annually from the EU to third countries, mostly in Africa, non-EU central Europe and central Asia, exposing populations in destination countries to air pollution and road safety problems. It could be that the implementation of new import requirements by

[75] The automotive sector is the third consumer of virgin plastics in the EU, representing ca. 10% of the consumption, after packaging (34%) and building and construction (24%), see Maury, T., Tazi, N., Torres De Matos, C., Nessi, S., Antonopoulos, I., Pierri, E., Baldassarre, B., Garbarino, E., Gaudillat, P. and Mathieux, F., Towards recycled plastic content targets in new passenger cars, EUR 31047 EN, Publications Office of the European Union, Luxembourg, 2022, ISBN 978-92-76-51784-9 (online), doi:10.2838/834615 (online), JRC129008.

[76] Estimates are based on data Aeris Europe 2021 and ACEA 2021.

receiving countries leads to a reduction in the volume of exported used vehicles from the EU; in the absence of international harmonised standards on this point and in view of limited enforcement capacities in importing countries to control shipments of used vehicles, this reduction is expected to be of a small magnitude.

Finally, keeping a large amount of road **vehicles outside the scope of the ELV and 3R type-approval legislation** would mean that the design, production and end-of-life treatment of these vehicles would continue to operate on a 'business as usual' scenario with limited integration of circularity considerations, no guarantee that the vehicles are managed in a sustainable manner when they reach the end of their life, and losses of resources not re-used or recycled. In 2030, the number of end-of life motorcycles would amount to approximately 1.6 million units, the number of end-of-life lorries to approximately 265,000 units and the number of end-of-life buses to approximately 30,000 units[77]. This represents 5 million tons of materials by 2030. These vehicles (especially lorries and buses) will use a growing quantity of CRMs, in order to comply with the latest CO_2 emission performance[78] and air emission standards (requiring for example technologies for exhaust gas control, leading to more copper, platinum and palladium), but also due to the electrification or hybridisation of some models (requiring lithium batteries and the use of permanent magnets containing rare earth elements in e-drive motors) and the shift of other models to hydrogen-powered technologies (with the associated use of fuel cells for which platinum plays an essential role as a catalyst element)[79]. Voluntary actions by some economic operators might slightly increase the contribution of these sectors to the circular economy, but there would be no leverage at the EU level to use this potential to its full extent. It is likely that Member States would increasingly adopt different measures applying to these vehicles[80], posing a risk of fragmentation in the internal market.

The export of used lorries and buses to third countries could decrease as a result of the implementation of the Euro VI standard[81] which necessitates that heavy-duty vehicles put on the EU market after 2013 are equipped with advanced aftertreatment technologies which require the use of high-quality fuels and reagents, especially for diesel-powered vehicles (i.e. diesel exhaust fluid or AdBlue) which may not be widely available in a number of importing countries. If it materialises, this decrease would lead to a corresponding increase in the number of vehicles becoming waste in the EU, but would still not guarantee that the exported used vehicles are roadworthy upon export. It should be noted that the impact of the implementation of Euro VI norms in the EU on the level of export of used vehicles is likely to be much higher for lorries than for M1-N1 vehicles: the practical totality used lorries exported from the EU are diesel vehicles which, when equipped to comply with Euro VI norms, may not function properly in countries which do not have the same the fuel standards and cannot supply these lorries with the required technologies and urea. The impact is less clear on the export of used M1-N1 vehicles as they can continue to be driven with lower fuel quality (albeit being much more pollutant than compliant vehicles).

Overall, the problems described in section 2 will increase in severity in the future. Without simultaneous regulatory intervention in all above areas at the same time, the automotive sector will increasingly depend on supply of primary raw materials,

[77] Source: study supporting the impact assessment report

[78] Regulation (EU) 2019/1242 of the European Parliament and of the Council of 20 June 2019 setting CO2 emission performance standards for new heavy-duty vehicles

[79] See Annex 15 for more information on this point

[80] 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.

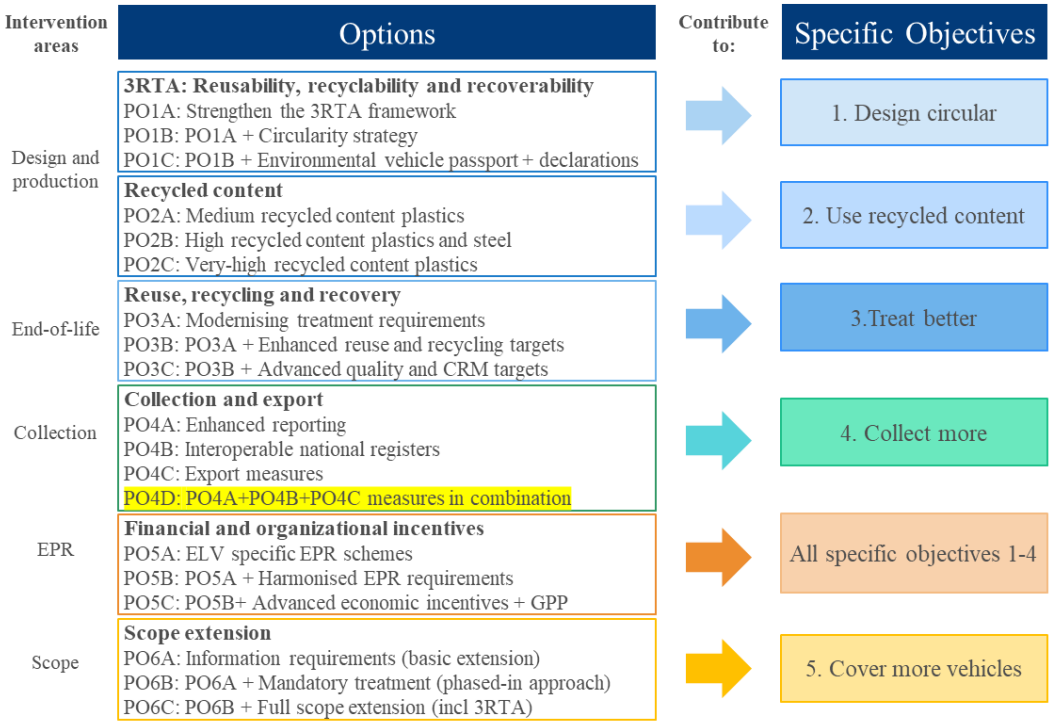
[81] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02009R0595-20200901

including CRMs, with a significant environmental footprint at extraction and processing stages.

5.2 Description of the policy options

As displayed in Figure 2, this impact assessment presents and analyses policy options designed to attain each of the five specific objectives described in Section 4.2. For each of these specific objectives, the impact assessment analyses three policy options (A, B and C), which are specifically addressing the objective in question, except for Policy options 5A to 5C which contain supporting measures for the attainment of different objectives and therefore serve to attain several of them[82].

Figure 2 - Policy options and specific objectives



1. Policy options 1A, 1B and 1C are designed to meet specific objective 1 - **'Design circular'**;
2. Policy options 2A, 2B and 2C are designed to meet specific objective 2 - **'Use recycled content'** and include requirements for car manufacturers to incorporate minimum amounts of recycled materials in new vehicles;
3. Policy options 3A, 3B and 3C are designed to meet specific objective 3 - **'Treat better'** and aim to improve the management of waste from ELVs and to support the market for re-used and remanufactured parts;
4. Policy options 4A, 4B and 4C are designed to meet specific objective 4 - **'Collect more'** and aim at higher collection rates of ELVs;
5. Policy options 5A, 5B and 5C provide appropriate **financial and organisational incentives** to support the implementation of the other policy options;
6. Policy options 6A, 6B and 6C are designed to meet specific objective 5 **'Cover more vehicles'** and improve circularity for the vehicles currently outside the scope of the ELV and 3R type-approval legislation.

[82] In Annex 4.2.2 the structuring of the options is further explained, including a two-step approach where the effect of policy options 5 to the other options is computed first, before determination of total joint impacts. This approach to prevent 'circular calculations' thus complies with the BRG tool #16, Figure 1b.

The options are based on a comprehensive list of 52 potential policy measures listed in Table 1, which are extracted from the evaluations of the existing legislation, and input from Member States and stakeholders as described in more detail in Annex 2. They also take account of the suggestions provided in the Fit for Future Platform (F4F) opinion, which can be found in Annex 5[83]. A detailed description of each measure presented below can be found in Annex 7.2 for selected measures and Annex 7.3 for discarded measures, as well as references to the underlying information in the supporting study. Table 1 includes discarded measures (marked with an X) for which the reasoning is provided in Section 5.3, planned entry-into-force dates in the second last columns and whether measures are included in the final preferred option as well be substantiated later in Section 8.1 to avoid repetition of the same table.

Table 1 Overview of all measures considered

Policy Options	#	**Measures** (all implementing dates are specified as +x yrs from entry-into-force)	**EIF ***	**Pref. ***
PO1 – *Design Circular*	1A	M1 - Ensure that new 3RTA rules provide for a proper implementation of circularity requirements for new vehicle types	+1	Y
		M2 - Empowerment for the Commission to develop a refined methodology to determine compliance with 3R-requirements	+3	Y
		M3 - Provision of basic dismantling information to ELV treatment operators	+3	Y
		M4a - Declaration on substances of concern verified by 3R type-approval authorities	+3	N
		M5a - Restrictions of substances under the revised ELV Directive *(analysed separately in Annex 9)*	+1	N
	1B	*Includes measures M1,M2,M3 of PO1A.*		
		M4b - Mandatory declaration on recycled content of plastics, steel, aluminium	+5	Y
		M5b - Restrictions of substances under REACH and other existing legislation *(analysed separately in Annex 9)*	+8	N
		M6 - Obligation for vehicle manufacturers to develop circularity strategies	+3	Y
		M7 - Design requirements for new vehicles to facilitate the removal of components	+6	Y
	1C	*Includes measures M1-M3, M6,M7 of PO1A and PO1B.*		
		M4c - Mandatory declaration on recycled content for materials, other than plastics, including CRMs, steel, aluminium	+5	Y
		M5c - Hybrid approach: maintenance of current restrictions under ELV with new restrictions under REACH (*analysed separately in Annex 9)*	+8	Y
		M8 - Establishment of a digital Circularity Vehicle Passport	+7	Y
Discarded PO1		M34 - Voluntary pledges campaign to increase circularity		X
		M35 - Preparation of non-binding guidelines to improve circularity		X
		M36 - Obligatory due diligence requirements for materials used in vehicles		X
PO2- *Use Recycled Content*	2A	M9a - Mandatory recycled content targets for plastic used in vehicles - 6% recycled plastics content by 2031, 10% by 2035 at fleet-level, of which 25% of recycled material from closed loop production, calculation and verification rules at +2 yrs	+6	N
		M10a – Empower the Commission to set a mandatory recycled content target for steel, including calculation and verification rules at +3 yrs, based on a dedicated feasibility study, application to newly type approved vehicles at +7 yrs	+7	Y
	2B	M9b - Recycled plastics content: 25% in 2031 for newly type-approved vehicles only, of which 25% from closed loop production, calculation and verification rules	+6	Y
		M10b - Steel recycled content: 20% in newly type-approved vehicles, calculation and verification rules	+7	N
	2C	M9c - Recycled plastics content: 30% in 2031 for newly type-approved vehicle only, of which 25% from closed loop production, calculation and verification rules	+6	N
		M10c - Steel recycled content: 30% in newly type-approved vehicles, of which 15% from closed loop, calculation and verification rules	+7	N
		M11- Empower the Commission to set a mandatory recycled content targets for other materials (aluminium alloys, CRM), feasibility study +3 yrs, target levels, calculation and verification rules +5 yrs, application to newly type approved vehicles >7 yrs	>7	Y

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

Discarded PO2		M37 - Higher than 30% of recycled content target for plastic of in 2031		X
		M38 - Recycled content targets for copper		X
		M39 - Recycled content targets for glass		X
		M40 - Recycled content targets for rubber/ tyres		X
PO3- *Treat Better*	3A	M12- Aligning the definition of recycling (at EIF) and aligning the calculation methodology for recycling rates (+3 yrs) with other waste legislation	+3	Y
		M13a - Mandatory removal of certain parts/components prior to shredding to encourage their recycling or re-use, 'list A'	+3	Y
		M14a - New definition of 'remanufacturing' (at EIF) and new monitoring requirements (+3 yrs) for (preparing for) re-use/ remanufacturing	+3	Y
		M16a - Ban on the landfilling of automotive waste residues from shredding operations	+3	Y
	3B	*Includes all measures of PO3A (cumulative)*		
		M13b - Mandatory removal of longer list of components, including those that contain a high concentration of valuable metals or CRMs, 'list B'	+3	Y
		M14b – Market support for the use of spare parts	+3	Y
		M15b – Recycling targets for plastics – 30% at 5 yrs EIF. Calc rules +2 yrs EIF	+5	Y
		M16b – Ban on mixed shredding of ELVs with WEEE and packaging waste	+3	Y
	3C	*Includes all measures of PO3A and PO3B (cumulative)*		
		M13c – Mandatory removal of additional components, 'list C'	+5	N
		M15c – Glass – 70% recycling as container glass quality or equivalent.	+5	N
		M16c – Setting requirements on Post Shredder Technologies (PST) to improve the quantity and quality of metal scrap recovered from ELVs	+5	N
Discarded PO3		M41 – setting specific recycling targets for metals		X
		M42 – setting specific recycling targets for non-metal materials		X
PO4 – *Collect More*	4A	M17a – Reporting by Member States on "missing vehicles", vehicle registrations, the import and export of used vehicles, incentives to encourage delivery to an ATF and penalties	+3	N
		M18 - Obligations for dismantlers /recyclers to check and report on ELVs/ CoDs	+3	Y
		M19a - Setting minimum requirements for sector inspections and enforcement action (including non-binding Correspondents Guidelines No9)	+1	Y
	4B	M17b - Setting fines for the ELV sector if an ELV is sold to illegal dismantlers and for dealers (and electronic platforms) dealing with dismantled (used) spare parts from non-authorised facilities.	+3	Y
		M19b - Clearer definition of ELVs to ensure that there is a better distinction between used vehicles and ELVs (binding CG9)	EIF	Y
		M20 - Improving the information contained in national vehicle registries and making them interoperable	+5	Y
	4C	M19c - Provide or making available information on vehicle identification and roadworthiness to customs authorities (VIN)	+4	Y
		M21 - Export requirements for used vehicles linked to roadworthiness	+7	Y
	4D	Includes measures M17b,M18,M19a-c,M20,M21of PO4A, PO4B and PO4C (cumulative)	+3	Y
Discarded PO4		M43 - Establish a mandatory collection target of ELVs based on the reporting obligations on the national vehicle market		X
		M44 - Voluntary campaigns on export of ELVs incl. waste shipment correspondents' guidelines No9 on distinction ELVs and second-hand vehicles		X
		M45 – Establishing a central EU vehicle registration database		X
		M46 - Exchange of Member States on the implementation of incentives supporting effectiveness of the Certificate of Destruction (CoD)		X
		M47 - Support / software interfaces to international notification system		X
		M47a – Setting threshold for age and emission for the export of all used vehicles from the EU to third countries		X
PO5 – *EPR*	5A	M22 - Requirement for the Member States to establish collective or individual EPR schemes, incl. monitoring compliance costs and minimum financial obligations	+3	Y
		M23 - Reporting obligations for producers	+3	Y
	5B	*Includes measures M22, M23 of PO5A (cumulative)*		
		M24 - Harmonised modulation of EPR fees	+5	Y
		M25 - Transfer of the EPR fees/ guarantees (cross-border EPR)	+3	Y
	5C	*Includes measures M22-M25 of PO5A and PO5B (cumulative)*		
		M26 – Setting up national deposit refund schemes	+5	N
		M27 - Harmonised GPP criteria (voluntary)	+5	N

Discarded PO5		M48 - Establishment of an EU wide EPR scheme M49 - European-wide deposit refund scheme supervised by a single European body M50 - Collection of vehicles at holder's premises and abandoned vehicles free of charge for the last holder		X X X
PO6 – *Cover more vehicles*	6A	M28 - Provision of information to dismantlers and recyclers	+5	Y
	6B	*Includes measure M28 of PO6A (cumulative)* M30a - Mandatory treatment of end-of-life L3e-L7e-category vehicles, lorries (N2,N3) and buses (M2,M3) and trailers (O) at ATFs + CoD M30b - Export requirements for used vehicles linked to roadworthiness for lorries (N2,N3) and buses (M2,M3) and trailers (O) M31b - Minimum EPR requirements for end-of-life L3e-L7e category, lorries (N2,N3) and buses (M2,M3) and trailers (O) M32 - Review clause on the regulatory extension of 3RTA scope to new vehicles	 +5 +5 +5 +8	 Y Y Y Y
	6C	*Includes measures M28,M30a-b,M31b of PO6A and PO6B (cumulative)* M31c - Full application of EPR and advanced economic incentives M33 - Full scope application of the new 3RTA and end-of-life treatment requirements to additional vehicle categories	 >7 >7	 N N
Discarded PO6		M51 - Extension of new requirements to special purpose, multistage vehicles and vehicles produced in small series M52 - A full regulatory 3RTA scope extension to all vehicle categories		X X

** Entry-into-force of the Regulation; Pref. is preferred option, see Section 8.1*
*** Included in the preferred option, Y = YES, N = NO, See Section 8.1, X = Discarded, See Section 5.3*

5.2.1 Policy Options 1A, 1B and 1C (related to specific objective 1 'design circular')

PO1A, **PO1B** and **PO1C** are designed to meet the specific objective 1 **'Design Circular'**, with an increasing level of ambition. These options are cumulative (i.e., PO1B = PO1A + additional measures; PO1C = PO1B + additional measures).

"PO1A - Better compliance verification" includes first the adaptation of 3R type-approval process to the new Framework Regulation on type approval and market surveillance[84], including the possibility to perform conformity of production and market surveillance tests. It includes the possibility to recall vehicles, withdraw type-approval certificates and sanction manufacturers in case of non-compliance (M1). It includes an empowerment for the Commission, within 3 years, to review the calculation methodology on how vehicles manufacturers should demonstrate compliance with their obligations on recyclability and re-usability of new vehicles. This could be done through supporting a change to the current ISO standard on this point, or through the development of standards at EU level, and would be preceded by an impact assessment. (M2). **PO1A also requires manufacturers to provide treatment operators and consumers, through existing platforms, with detailed and user-friendly repair, reuse and safe dismantling instructions (M3) and the location of the parts/components in their vehicles containing CRMs[85]**. See Annex 7.2.1 for more details.

"PO1B – Circularity strategy" contains the measures in PO1A, with additional **requirements for vehicle manufacturers to develop a specific circularity strategy for each new vehicle which is type-approved ("type-specific strategy").** The strategy would foster cooperation between vehicle manufacturers and actors in the dismantling and recycling sectors. The objective of this "type-specific strategy" would be for vehicle manufacturers to demonstrate how they will follow-up on their obligations to ensure that the requirements on re-usability, recyclability and recoverability for this vehicle are met, with a particular focus on

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

[85] with a specific focus on declaration of indicative weights, locations, fastening and coating techniques as well of labelling of CRMs such as Neodymium and Dysprosium in e-drive motors

materials such as CRMs, for which no recycling technology is currently available at commercial scale or that need to be removed prior to shredding. The findings from the strategy should be used to inform the recycling/dismantling sector, as well as by the vehicle manufacturer to improve the circular design of future vehicles. This strategy should contain a nontechnical summary which should be publicly available. To provide transparency and allow for monitoring of the progress made by the sector toward circularity, the Commission will establish regular reports on circularity in the automotive sector, drawing notably from these strategies (M6). In addition to these measures, **PO1B** includes provisions on **design for dismantling and recycling**, especially a requirement that batteries, electric drive motors from EVs and other CRM-containing parts/components are designed in such a way that professional dismantlers can remove them safely without excessive costs (M7). This also includes an empowerment for the Commission to develop standards or specific requirements on the design for dismantling and recycling of selected parts or components from vehicles, especially those made of plastics or containing CRMs, to be adopted within 6 years after the adoption of the new legislation. Additionally, **vehicle manufacturers are requested to provide evidence of the share of recycled content (plastics and steel, but also aluminium and copper) used in each vehicle type as relevant and necessary for the attainment of the objectives of the future legislation**[86] (M4b). Finally, **PO1B** clarifies that all new restrictions of substances in vehicles, due to reasons related primarily to their chemical safety, will be carried out under REACH[87] or, for the specific case of substances in batteries used in vehicles, under the new Batteries Regulation[88]. It addresses the call to ensure a legal coherence, as highlighted in F4F opinion[89]. Under this policy option the existing restrictions on lead, mercury, hexavalent chromium and cadmium in vehicles, as well as their specific exceptions in Annex II, remain with enhanced provisions[90] under the new ELV Regulation with a planned reassessment, at 8 years, of their potential full take-up by REACH (M5). See Annex 7.2.1 for more details.

PO1C: Circularity Vehicle Passport for circular vehicles: PO1C builds on **PO1B** and includes in addition the requirement that each vehicle needs to be accompanied by a digital **Circularity Vehicle Passport** (M8), containing information provided by the manufacturer on the composition of vehicles and its components, relevant for repair, maintenance, dismantling, re-use, remanufacturing and recycling as a single entry for consumers and treatment operators. This development responds to the suggestion of the F4F opinion and is fully consistent with the corresponding provisions that are included in the proposal for Battery Regulation (battery passport) [91], the ESPR proposal (product passport[92]) and the proposal for the Euro 7 standard (Environmental Vehicle Passport[93]). As part of the digital information, recycled content levels for all should be declared allowing for verification of manufacturer's claims (M4c) to monitor actual decarbonisation results as explained in 5.2.2 and Annex 7.2.2

[86] Including the shares of post-consumer, pre-consumer and closed loop percentages derived from ELV treatment on a mass-balance basis.
[87] Or, for substances identified as Persistent Organic Pollutants, these would be covered under the Regulation on Persistent Organic Pollutants.
[88] Based on the results of provisional 1st reading agreement 9 December 2022: https://www.europarl.europa.eu/news/en/press-room/20221205IPR60614/batteries-deal-on-new-eu-rules-for-design-production-and-waste-treatment
[89] For more information see Suggestion 6 at https://cor.europa.eu/en/our-work/Pages/Fit-for-Future-opinion-on-End-of-life-vehicles-and-3R-type-approval.aspx;
[90] Allowing an in depth assessment of alternatives and of their socio-economic impacts, similar to that carried out under REACH.
[91] 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 […]).
[92] COM(2022) 142 final
[93] COM(2022) 586 final

in more detail. The Commission would be tasked to develop the technical features of this passport within 7 years from entry into force of the new legislation, ensuring further consistency with other similar initiatives under development in the ESPR framework and the Euro7 regulation. See Annex 7.2.1 for more details.

5.2.2 Policy Options 2A, 2B and 2C (related to specific objective 2 'use recycled content')

PO2A, **PO2B** and **PO2C** target the specific objective 2 **'use recycled content'**, with an increasing level of ambition. These options are alternative and not cumulative.

In view of the low recycling and recycled rates of plastics from ELVs, these options would have a focus on recycled content for plastics, but also address recycled content for metals (steel, aluminium, CRMs). Only recyclates from post-consumer waste[94] would be eligible to be accounted for the targets presented below. Increasing pre-consumer (or post-industrial) recycled content does not contribute as much to decarbonisation and scrap quality improvement as post-consumer recycled content. Due to lower costs and higher quality of pre-consumer content, the likelihood it is recycled is much higher than for post-consumer and basically part of the baseline as manufacturers are increasingly incorporating more. The proposed targets would only apply to new M1 and N1 vehicle types[95] entering the EU market and excluding L3e-L7e category vehicles, lorries, buses and trailers not covered by the current ELV Directive. A specific methodology for the calculation and verification of recycled content for plastics would also be established, similar to what is implemented or in development in other legislative proposals[96]. This is especially relevant to distinguish the differences in average carbon footprint of post- versus pre-consumer waste and to establish a harmonised and consistent mass-balance approach for fair accounting of recycled content volumes. In the case of plastics, this is required to address future developments in chemical recycling[97]. This does not jeopardise setting a target level as it incentivises mechanical treatment first. With chemical recycling maturing, there is possibly upwards potential in the future when chemical recycling is more mature to deal more polluted and mechanically difficult to recycle plastics as specified in the JRC study. See Annex 7.2.1 for more details.

PO2A includes a requirement for **recycled content targets for plastics**[98] **in new vehicles of** at least **6%** of the overall plastics contained in the **vehicle fleet by 2031, and 10% by 2035** (M9a)[99], of which **25%** of recyclates originates from **closed loop** recycling from ELVs. **PO2A** includes an empowerment allowing the Commission **to lay down a future target for recycled content for steel for newly type approved vehicles 3 years after entry into force** of the Regulation, based on a dedicated feasibility study particularly focusing on the determining an appropriate target level. The study will investigate i) the current and forecasted availability of steel recycled from post-consumer sources of steel waste; ii) the current share of post-consumer waste in various steel semi-products and intermediates used in vehicles; iii) the potential uptake of post-consumer recycled steel by manufacturers in vehicles to be type-approved in the future; and iv) the relative demand of the automotive

[94] CPA. (2021). *Guidance on Waste Definitions* (Issue September). https://ec.europa.eu/docsroom/documents/46954/attachments/8/translations/en/renditions/native

[95] Type approval means the procedure whereby a Member State certifies that a type of vehicle, system, component or separate technical unit satisfies the relevant administrative provisions and technical requirements; (art.3, Directive 2007/46/EC).

[96] See the proposals for a Regulation on packaging and packaging waste, the Single Use Plastics Directive, the proposed Ecodesign for Sustainable Products Regulation and the Battery Regulation.

[97] See Section 4.2.3 of the JRC supporting study: Maury, T., Tazi, N., Torres De Matos, C., Nessi, S., Antonopoulos, I., Pierri, E., Baldassarre, B., Garbarino, E., Gaudillat, P. and Mathieux, F., Towards recycled plastic content targets in new passenger cars, EUR 31047 EN, Publications Office of the European Union, Luxembourg, 2022, ISBN 978-92-76-51784-9 (online), doi:10.2838/834615 (online), JRC129008.

[98] Thermoplastics (e.g., polyolefins, styrenics, polyamides) as well as polyurethane foams.

[99] This corresponds with scenario JRC3a in in the respective study (JRC129008).

sector in comparison to the demand for post-consumer steel waste of other sectors. The necessary calculation and verification rules should be laid down at the same time. **Actual targets would start to apply 7 years** after entry into force of the Regulation (M10a). Under **PO2A**, no other mandatory recycled content targets for other materials would be set, but a mandatory declaration regarding the share of recycled materials embedded in new vehicle types at type-approval stage (see M4b for the declaration to this point).

PO2B includes mandatory recycled content targets for plastics in newly type-approved vehicles of 25%, of which 25% from closed loop (M9b). This would represent an annual growth of 30% until 2031 compared to the average baseline in 2022[100]. The target for plastic would apply from 6 years after into force of the Regulation. **PO2B** would set **a mandatory recycled content target for steel at 20% for newly type approved vehicles** in the Regulation with the target to be achieved 7 years after entry into force. A review clause is foreseen in case supply and demand of steel is rapidly increasing or decreasing as material choices may be subject to change (M10b).

PO2C includes mandatory recycled content targets for plastics in newly type-approved vehicles of **30% of recycled content** of which 25% from closed loop[101](M9c). **PO2C** would further include a **recycled content target for steel of 30% for newly type approved vehicles, including a 15% closed loop percentage** (M10c). In addition, the Commission would be (i) tasked to **assess the desirability, feasibility and impacts of setting out recycled content targets in new vehicles for other materials, especially aluminium alloys, copper and CRMs such as rare earth elements or magnesium** (M11), and (ii), based on a feasibility study, empowered to set out recycled content targets for the materials in question. The study shall investigate both technical limitations in supply and demand similar to the feasibility study for steel and focus additionally at the wider economic viability, technical and scientific progress, including changes in the availability of recycling technologies concerning the type of materials recycled; their material specific recycling rates and investigate the risk of disproportionate negative impacts on the affordability of vehicles containing these other materials derived from post-consumer recycled content. This feasibility study is planned 3 years after entry into force.

5.2.3 Policy Options 3A, 3B and 3C (related to specific objective 3 'treat better")

PO3A, **PO3B** and **PO3C** target the specific objective 3 **'Treat better'**, with increasing levels of ambition. These options are cumulative.

PO3A modernises the current provisions of the ELV Directive to improve clarity and enhance the quality of the treatment of waste. The first element is aligning the ELV Directive with the more recent and **stricter definition of recycling used in other sectoral waste legislation** (M12) which explicitly excludes backfilling[102]. A clearer methodology for the calculation of recycling rates would also be established, similar to what is implemented or in development in EU law and ensuring that what is accounted as "recycled" only includes materials which are effectively recycled and not just collected for recycling. As a supporting element, a ban on the landfilling of the residues from shredding operations ("automotive shredder residue" or ASR) would be included (M16a)[103] to ensure increased metal and plastics recovery and use of remaining non-inert materials for energy recovery. The option would also clarify the obligation (currently unclear in the ELV Directive) that some parts and

[100] This corresponds with the scenario JRC4b in the Annex of the study (JRC129008).
[101] This corresponds with the scenario JRC4c in the Annex of the study (JRC129008).
[102] Backfilling is a recovery operation where suitable waste is used for reclamation purposes in excavated areas or for engineering purposes in landscaping and where the waste is a substitute for non-waste materials
[103] Currently, 4 Member States already ban the disposal in landfills of fractions from post-shredder treatment.

components[104] are to be removed prior to the shredding phase, as to facilitate high quality recycling or re-use (M13a). Finally, to support reuse and remanufacturing of spare parts, a definition of remanufacturing (including conditions for warranty) would be introduced in the new legislation, as well as clearer instructions for reporting **on the level of re-use and remanufacturing** from ELVs (M14a). All these measures follow the suggestions provided in the F4F opinion focussing on retrieving higher volume and quality of secondary materials from the automotive sector[105]. See Annex 7.2.3 for more details.

PO3B: This Policy Option contains the measures in **PO3A** and, in addition, **new enhanced measures** to promote the re-use and recycling of relevant metals, plastics and certain CRMs. The list of parts/components to be **removed prior to shredding** (mentioned in **P03A) would be extended with parts and components with high concentrations of valuable materials or CRMs** (M13b)[106]. A derogation to this removal requirement would apply if evidence can be provided by the dismantlers that the materials/parts/components will be separated with the same efficiency as manual dismantling/ semi-automated disassembly by post shredding technologies (PST). For monitoring purposes, Member States are to report on established and used capacities of PST plants. The option also foresees that incentives should be put in place to support the market for re-used and remanufactured parts, building on legislation and best practices in some Member States[107](M14b). To improve warranty conditions of used spare parts, information on their origin should be made mandatory as a condition for their sales (i.e., through the provision of the VIN number of the ELV the parts come from).

To boost plastic recycling and ensure a sufficient supply of recyclates to meet the demand for recycled plastics in vehicles (see PO2), a **specific plastic recycling target[108]** of 30% by 2031 would be established (M15b). To ensure improved quality of steel and aluminium scraps from ELVs, a ban on the mixing of ELV scraps with WEEE scraps (such as white goods and refrigerators) and packaging waste (such as aluminium cans) would be established for shredders (M16b), reducing (copper) impurities and improving traceability notably for the closed loop share of automotive plastics recycling[109]. See Annex 7.2.3 for more details.

PO3C contains the measures in **PO3B** and, in addition, specifically targets **higher quality of recycling for specific materials.** Additional components **and novel lightweight materials** would be added to the list of parts/components to be removed prior to shredding (M13c)[110]. For glass, a material specific recycling target of 70% would be set, accompanied with quality criteria to ensure that only recyclates to container glass or equivalent quality are accounted towards the recycling target (M15c). The Commission would be required within 5 years to develop specific and additional requirements to improve the efficiency of post-shredder treatment (PST) operations by setting minimum quality standards (M16c). This may be

[104] The current ELV Directive lists in Annex I (4) batteries, large metal components (such as engines and gear boxes), large plastic components (bumpers, dashboard, fluid containers), catalysts, glass (including windshields, rear and side windows).
[105] For more information see Suggestion 7 at https://cor.europa.eu/en/our-work/Pages/Fit-for-Future-opinion-on-End-of-life-vehicles-and-3R-type-approval.aspx
[106] The additional parts would include e.g., main wiring harness (copper), electric and electronic components (such as printed circuit boards with a surface area > 10 cm2, photovoltaic panels with a surface area > 0.2 m^2, controllers, engine motors), mono-material aluminium components with a weight > 10 kg, requiring the separate collection and treatment of cast and wrought aluminium, e.g., bumpers, wheels, heat exchangers, NdFeB permanent magnets, electric steel and copper from EV drive train in case not destined for (preparation for) reuse/remanufacturing.
[107] See for example the measure established in France that requires garage and repair shops to provide offers for used spare parts together with new spare parts to their customers (see Article L224-67 of the "Code de la Consommation", available at https://www.legifrance.gouv.fr/codes/article_lc/LEGIARTI000032226565/2018-01-19).
[108]Applying to ELV thermoplastics and polyurethanes.
[109] The WEEE Directive Art 5 requires separate collection for such products and Art 8/ Annex VII specifies selective treatment requirements.
[110] This would include difficult to recycle lightweight materials such as glass and carbon fibre reinforced plastics, as well as smaller copper and EEE parts, small motors, inverters, etc.

needed in case novel sorting technologies for aluminium, magnesium or CRMs are insufficient. See Annex 7.2.3 for more details.

5.2.4 Policy Options 4A, 4B, 4C and 4D (related to specific objective 4 'collect more')

PO4A, **PO4B** and **PO4C** target the specific objective 4 **'Collect more'**, with different policy strategies and scope. **PO4D** is a cumulative combination of both the collection and export measures under **PO4A**, **PO4B** and **PO4C**. See Annex 7.2.4 for more details.

PO4A focuses on **enhanced reporting and enforcement of existing rules.** Member States are required to keep better track of their national vehicle fleets and ELVs by **mandatory annual reporting on the number vehicles registered, de-registered, treated as ELVs and shipped outside the Member State of registration** (M17a)[111]. To facilitate better traceability, a new obligation would be established for **dismantlers to issue a certificate of destruction (CoD) for each ELV treated and report it digitally** to the competent authorities of their Member State, and for **shredders to only accept ELVs with a corresponding CoD** and then to notify final destruction to the same competent authorities (M18). This is in line with the suggestions from the F4F platform which stressed that the delivery and registration of CoD need to be improved[112]. Member States are encouraged to exchange best practices on the use of incentives to achieve higher ELV collection numbers[113]. To strengthen enforcement, there is a definition of **minimum requirements for sector inspections** and enforcement actions (M19a). Finally, reporting on sanctions applied by the Member States with respect to violations of the rules set out in the future legislation is added to the national reporting requirements (M17a).

PO4B provides new measures designed **to improve exchange of information between Member States on missing vehicles and to foster harmonised enforcement. With regard to the exchange of information between Member States**, PO4B consists in provisions to ensure that **Member States (i) provide additional information in their national vehicles registers** on elements which are necessary to track de-registered vehicles and ELVs[114] and (ii) **provide access through digital means to their national registers to all other Member State competent authorities** to improve traceability (M20)[115]. This would allow for better control of the vehicle status and strengthen the ability of enforcement authorities to carry out more stringent checks on compliance, as stressed in the F4F opinion[116]. These provisions could be added either in Directive 1999/37/EC on the registration documents for vehicles or in the new legislation on 3R type-approval and ELV. For the **export of vehicles, the definition of ELVs will be clarified by introducing mandatory criteria which will make it easier to distinguish waste vehicles from used vehicles** (M19b) and hence avoid that ELVs are exported as used vehicles. It corresponds with the suggestion of the F4F opinion, acknowledging the illegal export of vehicles outside of the EU being one of the major issues with regard to the implementation of the ELV Directive[117]. Finally, **Member States would be**

[111] Complementing Commission Decision 2005/293/EC.
[112] RegHub consultation on the implementation of the end-of-life vehicle Directive, 2022: https://cor.europa.eu/en/our-work/Pages/Fit-for-Future-opinion-on-End-of-life-vehicles-and-3R-type-approval.aspx
[113] Notably through deposit return schemes whereby financial support is provided to the last owner of a vehicle upon its delivery to an ATF. Such schemes are in place in a number of EU Member States already.
[114] This should include information on the motives for which vehicles are permanently removed from the register (treatment as an ELV in an ATF, export, theft, etc.), as well as a requirement for the owner of a vehicle which is "temporarily de-registered" to report changes on the ownership of the vehicle in question to the registration authority.
[115] For example through the use of the European Vehicle and Driving Licence Information System (Eucaris).
[116] For more information see Suggestion 3, https://cor.europa.eu/en/our-work/Pages/Fit-for-Future-opinion-on-End-of-life-vehicles-and-3R-type-approval.aspx
[117] For more information see Suggestion 2, https://cor.europa.eu/en/our-work/Pages/Fit-for-Future-opinion-on-End-of-life-vehicles-and-3R-type-approval.aspx

required to establish appropriate sanctions for breaches of the legislation, in case of selling ELVs to illegal dismantlers, illegal export, illegal sales of used spare parts (M17b).

PO4C: Under this option, new provisions would be established with regard to the export of used vehicles outside the EU. First, exporters would be required to make available to customs the **vehicle identification number (VIN)**and the information on the validity of the roadworthiness status of used vehicles (M19c). Secondly, only those used vehicles which are verified to be roadworthy **would be authorised to be exported to non-EU countries**. In addition, the future legislation would foresee development of a complementary control mechanism to check how the EU vehicles comply with the rules on imports of used vehicles imposed by third countries[118] regarding the environment and road safety. (M21).

PO4D: Under this option, **all** measures (M17 to M21, see Table 1) from PO4A, PO4B and PO4C are combined to most effectively achieve the objective **'Collect more'**. The combination thus includes incentives and / or penalties to make use of CoDs, improvement of registration and deregistration procedures, better statistics / monitoring on vehicle stock and import / export and the fight against illegal export of ELVs and environment, health and safety problems in the receiving countries.

5.2.5 Policy Options 5A, 5B and 5C (related to specific objectives 1 to 4)

PO5A, PO5B and PO5C aim at establishing economic incentives and organisational arrangements contributing to meeting the first four specific objectives of the initiative to ensure proper implementation. They are cumulative.

PO5A requires **Member States to establish specific Extended Producer Responsibility (EPR) schemes for vehicles[119], aligned with the minimum requirements applicable to other sectoral waste streams, as specified in the Waste Framework Directive**[120]. This means that Member States would require vehicles manufacturers to bear financial and organisational responsibility for the management of the waste stage of the vehicle life cycle, including sorting and treatment operations, in addition to cost coverage which is already part of the requirements of the current ELV Directive. The F4F opinion particularly recommended to focus on proper implementation of polluter pays principle through addressing the mandatory treatment operations that are not economically viable[121]. Member States would have to establish such schemes, or extend the scope of existing ones, to ensure that vehicle manufacturers provide for advanced measures to guarantee that legal requirements for collection and treatment of ELVs are achieved (M22). When it comes to collection of ELVs, this would include **digitalisation of reporting of ELVs collected and treated in ATFs and shredders**, and **dedicated awareness-raising campaigns** designed to improving the collection of ELVs. When it comes to treatment, **vehicle manufacturers will be made responsible for the costs** related to the difference between revenues generated by the sale of parts/components/materials resulting from the dismantling/recycling processes and the costs linked to their **mandatory dismantling and recycling** and other treatment requirements that are net cost negative (M23). Producer responsibility may be organised collectively or individually, while setting uniform conditions for the modulation of the financial contributions to avoid distortion of the internal market and to limit administrative burden, where necessary. See Annex 7.2.5 for more details.

[118] For example on limitations of imports linked to the age or compliance with emission standards of used vehicles

[119] There are already provisions on cost coverage of delivery/take-back of an ELV by producers (Article 5(4) ELVD). Although not a fully-fledged EPR scheme, the basics of cost coverage already exist and are explicitly referred to in the WFD (article 8a(4)). This means that PO5 would not necessarily entail starting up completely new EPR schemes

[120] See Articles 8 and 8a of the Waste Framework Directive (Directive (EU) 2018/851).

[121] For more information see Suggestion 7 at https://cor.europa.eu/en/our-work/Pages/Fit-for-Future-opinion-on-End-of-life-vehicles-and-3R-type-approval.aspx;

PO5B: Policy option 5B complements the obligation for Member States to establish EPR schemes for ELV with harmonised requirements designed to ensure a uniform and fair implementation across the EU single market. To avoid that Member States apply diverging methodologies relating to the responsibilities of the vehicle manufacturers, **harmonised criteria for the modulation of fees to be paid by vehicle manufacturers would be set, based on circularity features,** such as the weight of a vehicle, the dismantling time for key parts/components like batteries, the expected level of recyclability/re-usability, the share of materials preventing high-quality recycling process and the level of recycled content (for metal, plastics and CRM) (M24). These elements comply with the recommendations of the F4F recalling that including recyclability and durability criteria in vehicle design can facilitate dismantling and lift implementation burden from ATFs[122]. Taking into account the large volume of used cars shipped within the EU and the need for fair cost allocation between economic actors in different Member States, **specific requirements are put in place to make sure that vehicle manufacturers contribute to the costs of dismantling and recycling of vehicles which become ELVs in a Member State different from the Member State where it was first registered ("cross-border EPR")** (M25). See Annex 7.2.5 for more details.

PO5C includes **advanced economic incentives** to increase the collection of ELVs and promote the market for vehicles manufactured in a circular manner. It gives the discretion for the Member States to establish **"deposit return schemes"** based on the common EU wide criteria, whereby a lump sum of money is given to the last owner of an ELV upon its delivery to an ATFs (M26). This measure reflects the suggestion of F4F platform[123]. The second component of this option is the possibility to establish harmonised **Green Public Procurement (GPP) criteria for the purchase of all vehicles,** based on circularity criteria described for PO5B, and consistent with the Clean Vehicles Directive[124](M27). See Annex 7.2.5 for more details.

5.2.6 Policy Options 6A, 6B and 6C (related to specific objective 5 'cover more vehicles')

PO6A, PO6B and PO6C target the specific objective 6 **'Cover more vehicles'** with an increasing level of ambition. These options are cumulative.

PO6A includes a **limited extension of the scope** of the new legislation to additional categories of vehicles including L3e-L7e-category vehicles, buses (M2,M3), lorries (N2,N3) and trailers (O)[125]. The manufacturers of these vehicles would be required to **provide information to dismantlers and recyclers**, through existing or new platforms, **to facilitate depollution, dismantling and recycling** of these vehicles (M28). This shall include at the minimum information on the location of substances of concern, of CRMs as well as instructions on dismantling. These requirements **would not be applicable to special purpose vehicles, multistage and vehicles produced in small series**. See Annex 7.2.6 for more details.

PO6B consists of a **broader extension of the scope of the new legislation.** In addition to the requirements set out in PO6A, it includes a **mandatory requirement that end-of-life L3e-L7e category vehicles (which includes motorcycles), lorries, buses and trailers are treated in an ATF**, with their dismantling accompanied by a CoD similar to PO4A (M30a). To complement this measure and ensure traceability of used vehicles, used **lorries and buses**

[122] Ibid.

[123] For more information see Suggestion 5 at https://cor.europa.eu/en/our-work/Pages/Fit-for-Future-opinion-on-End-of-life-vehicles-and-3R-type-approval.aspx; RegHub consultation on the implementation of the end-of-life vehicle Directive, 2022;

[124] 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). A review of this Directive is foreseen by the end of 2027.

[125] Vehicles of categories L3-L7, M2, M3, N2, N3 and O.

should be subject to similar requirements as for passenger cars **with regard to export related requirements based on roadworthiness** (M30b). **Manufacturers of lorries and buses should also be requested to assume the responsibility for the collection and reporting obligations set for these vehicles (basic EPR scheme)** (M31). Finally, a review clause for a phased-in future scope extension is included when more information is available (M32). See Annex 7.2.6 for more details.

PO6C: Policy sub-Option 6C includes a full scope extension, with all requirements for M1 and N1 vehicles equally applying to the additional vehicles categories as well in the medium term. This implies full application of the modernised 3R type approval procedure and requirements on reusability, recyclability and recoverability as specified in PO1A-C, the recycled content requirements of PO2A-C, the advanced waste treatment requirements of PO3A-C (M33) and finally, the **establishment of EPR schemes**, including compliance cost offsetting and the other minimum EPR requirements as under PO5A-C, for L3e-L7e category vehicles, lorries, buses and trailers (M34). See Annex 7.2.6 for more details.

5.3 Measures discarded at an early stage

These measures were screened to identify those that should be retained for further analysis. Annex 7.3 provides a detailed list of individual discarded measures and the rationale behind their screening out from further consideration. A short summary of discarded measures per intervention area and the reasons for discarding are presented here:

Design circular (specific objective 1): A range of voluntary measures, non-binding guidelines and pledges by manufacturers to increase circularity are discarded due to low effectiveness and higher results expected from the circularity strategy measure under PO1B. Setting obligatory **due diligence** requirements for materials used in vehicles is discarded as being covered under the Corporate Sustainability Due Diligence Directive (CSDD)[126]. Setting overall carbon footprint requirements for the entire vehicle is not included, but this problem is addressed through direct measures in Policy Option 2. See Annex 7.3.1 for more details.

Use recycled content (specific objective 2): Setting levels of plastics recycled content above 30% in 2031 is discarded as they are not attainable without serious supply – demand misbalances and disproportionate costs. Setting at this point in time recycled content targets for glass, rubber, CRMs and other metals (such as copper and aluminium) is also discarded, in view of other measures under PO3. However, the possibility to set such targets at a later stage is foreseen in case market failures would not be sufficiently addressed (M11). See Annex 7.3.2 for more details.

Treat better (specific objective 3): Setting material-specific recycling rates for steel, aluminium or copper was discarded since the recycling rates are already high (steel, aluminium) and the main concerns are related more to scrap qualities. Here, other measures such as mandatory removal of parts and improving sorting and waste treatment are more effective and indirectly improve copper recycling rates. The same counts for other materials like glass, plastics and specific components such as electronics. Setting recycling targets for CRM was also discarded at this stage, but recycling should be considerably enhanced through other measures, especially relating to the design of new vehicles (obligation to declare location and dismantling information for CRM), improved waste treatment (obligation to remove parts and components containing CRM to ensure their recovery) and EPR schemes (fee modulation taking into consideration amount of CRM and recycled CRM in new vehicles). See Annex 7.3.3 for more details.

[126] Proposal for a Directive of the European Parliament and of the Council on Corporate Sustainability Due Diligence and amending Directive (EU) 2019/1937 (COM/2022/71 final)

Collect more (specific objective 4): A range of voluntary measures are discarded due to low expectations on their effectiveness, important feasibility challenges, subsidiarity reasons or legal obstacles, including the setting of an EU-wide Deposit Refund Scheme (DRS), which would require strict rules for registration and deregistration and be sensitive to fraud. Setting collection targets at Member State level is discarded as other measures are expected to be more directly effective. As an alternative to the requirement for the exporters to non-EU countries to provide the information on the roadworthiness status of the used vehicles, another measure was considered, according to which a maximum age of the vehicle or a minimum EU emission standard would be established for the export of all used vehicles from the EU to third countries. However, such regulatory approach was not followed, as it could have a disproportionate effect of banning all the export of used vehicles, in manner which would not allow to take into account the specific import requirements for the used vehicles, when these are officially applied by the import countries. Instead, it was decided to base the export of used vehicles on the requirement to have a valid 'roadworthiness' status in accordance with Directive 2014/45/EU. The assessment showed that this approach is the most effective as it allows to prove whether these vehicles comply with the EU stringent environmental and safety standards. Moreover, such approach would ensure that the vehicles which are exported with the aim to continue their service in third countries, are not of lower quality than those which are authorised to be on the EU public roads See Annex 7.3.4 for more details.

Provide appropriate financial and organisational incentives (specific objectives 1-4): Mandatory collection of vehicles at holder's premises and collection of abandoned vehicles free of charge are discarded as cost-ineffective and not stimulating vehicle owners to hand in vehicles at designated facilities. The option that vehicle manufacturers could set up EU-wide EPR schemes (rather than at national level) was discarded due to (i) subsidiarity constraints, as the organisation of the waste management systems, the relations between waste operators, the vehicle registers and the management of EPR schemes are currently operated at national level (ii) concerns that it would not be politically acceptable by Member States and (iii) lack of EU staff and funds available to set up the required EU instance to manage such a scheme. For more information see the description of this discarded measure M48 in Annex 7.3.5. However, vehicle manufacturers would still have the option to set up individual schemes within the national schemes put in place by Member States (M22). In addition, the Member States would need to make sure that the "cross-border" dimension of the problem (i.e. large number of vehicles dismantled in a Member State different from the one where they were put on the market for the first time) is properly addressed (M25). This would make it easier for vehicle manufacturers to develop an EU-wide approach for their extended responsibility, even when this is based on national EPR schemes. See Annex 7.3.5 for more details.

Cover more vehicles (specific objective 5): Extension of the vehicle category scope to special purpose vehicles, multistage vehicles and vehicles produced in small series is discarded as, on the basis of available information the measure appears disproportionate. See Annex 7.3.6 for more details.

6 WHAT ARE THE IMPACTS OF THE POLICY OPTIONS?

6.1 Methodological considerations

The quantification of the impacts of the policy options relies on studies and quantitative models complemented with qualitative assessments for those cases where data is scarce. The information sources include in particular a study by Oeko-Institut[127] which includes a custom-

[127] 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

made impact assessment model for the purpose of this revision, a dedicated report by the JRC on recycled plastic in vehicles[128] and a JRC study on CRMs in vehicles[129]. Data on the number and types of vehicles placed on the market are the same as in the Euro 7 impact assessment, complemented by an assessment of the number of vehicles becoming waste, collected and exported annually[130]. The model computes a variety of policy options individually and the effect of combinations of them for the preferred options proportional to the mass flows involved. Detailed information can be found in Annex 4. To improve robustness of the analysis, the estimated impacts and their underlying assumptions were presented in stakeholder workshops and verified by independent experts, the JRC and concerned stakeholders. In the following sections, the individual tables summarise the main environmental and economic impacts for each of the policy options. The impacts presented are for the year 2035[131].

For the environmental impacts, avoided greenhouse gas emissions and the amount of materials recovered (at higher quality compared to the baseline) are chosen as the main categories to summarise results. Some of the measures target an improvement in the quality of materials recycled from vehicles and not just an increase in quantity. These different recycling qualities have a financial significance which is captured in the calculation of revenues from recycled material as well environmental benefits which are quantified as far as possible. Data for other years, broken down per vehicle, are available in Annex 8.

For economic impacts and how stakeholders are affected, cost and revenue redistributions between operators are taken into account. The main 'reallocation' elements are the future value of plastic recyclates from the plastics recycled content, the value of cleaner steel scraps and the revenues derived from dismantled materials at ATFs. The reduced value of dismantled 'hulks' is accounted for by reduced payments of shredders to ATFs. Another significant effect relates to the value of vehicles not exported anymore. The impact assessment takes account the effect on prices of vehicles, as additional costs on vehicle manufacturers and other economic operators are ultimately passed on (partially or in full) to consumers.

In the tables below, when referring to monetary impacts, the minus (-) symbol is used when referring to a cost (a negative monetary impact) and a plus (+) in case of a revenue (a positive monetary impact). All values are presented as net present values. Economic data presented reflects how costs and revenues are expected to be allocated to various stakeholder, including underlying assumptions and sensitivities.

6.2 Environmental impacts

6.2.1 Design circular: Improve reusability, recyclability and recoverability, 3R type-approval

The strength of the 3R type-approval approach is that a vehicle type cannot be placed on the EU market unless it complies with all type approval requirements. The actual benefits of measures to improve recyclability, reusability and recoverability of vehicles are of a mid- or

[128] 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

[129] N. Tazi, M. Orefice, C. Marmy, Y. Baron, M Ljunggren, P Wäger, F. Mathieux, Initial analysis of selected measures to improve the circularity of Critical Raw Materials and other materials in passenger cars, EUR 31468 EN, Publications Office of the European Union, Luxembourg, 2023, ISBN 978-92-68-01625-1, doi: 10.2760/207541, JRC132821.

[130] Commission Staff Working Document accompanying the Regulation of the European Parliament and of the Council on type-approval of motor vehicles and of engines and of systems, component and separate technical units intended for such vehicles, with respect to their emission and battery durability (Euro 7)

[131] More information on the projections used in the SWD are explained in Annex 4.

long-term prevention nature when vehicles become waste many years later. It is therefore difficult to quantify the exact environmental benefits and values in the future. Nonetheless, the value of the measures can be compared qualitatively against the current baseline, since past vehicle design choices frequently hinder current recycling possibilities.

The general reusability and recyclability of vehicles placed on the market following the **PO1A - improved 3R type-approval compliance verification** requirements are expected to improve the level of reuse and recycling by about 5% in the long term. **PO1B - Circularity Strategy** (incl. PO1A measures) will have more immediate effect. The design for dismantling requirements and increased cooperation with recyclers will enhance recycling of increasing shares of lightweight, difficult-to-recycle materials in the medium-term. **PO1C – Circularity Vehicle Passport** (incl. PO1A and PO1B measures) ensures that necessary reuse and dismantling information to address existing information gaps to match supply and demand is delivered using digital technology. Reuse and recycling rates will increase further in the long term due to repairability requirements on the use of digital keys and interchangeable components. The additional **mandatory declaration on the use of recycled content** for all materials provides better substantiation of related claims to the consumer, supporting greener vehicle purchase decisions and providing an incentive for further decarbonisation achievements in the supply chains. For substance restrictions, the 'transfer to REACH' and the 'hybrid approach' will have effectively similar impacts given either ELV, under REACH or in a hybrid approach a comprehensive approach to restrict these substances is introduced. More detailed information can be found in Annex 8.1.1.

6.2.2 Use recycled content: increase recycling and decarbonise production for selected materials

PO2A – plastic recycled content targets[132] of 10% in 2035 based on the **fleet level** create a final demand for recyclates in the automotive industry of 240 ktons in 2035[133]. **PO2B – targets** of 25%[134] starting in 2031 **for newly type-approved** vehicles correspond to an additional demand of recyclates of 713 ktons for 2035. This should boost the recycling of plastics from ELVs, as this means that 53% of ELV plastics recyclates would have to be reintroduced in the automotive sector. **PO2C – targets** of 30% in 2035 correspond to a demand of recyclates of 872 ktons in 2035[135]. The target would represent an effective recycling rate of available ELV plastics of 64% which poses a supply – demand imbalance risk. The GHG savings linked to **PO2B** would be 314 ktons of $CO_{2\text{-eq}}$, and 376 ktons of $CO_{2\text{-eq}}$ for **PO2C**.

For steel, a recycled content target under **PO2B** and **PO2C** provide an additional push to integrate higher quality scrap into new vehicles, assuming such scrap becomes available, with roughly 585 ktons of GHG savings in comparison to the baseline for 2035 and 900 ktons towards 2040 for **PO2B**. Compared to **PO2A, PO2B** and **PO2C** would reduce the demand for natural gas, coal and iron ore and increase the demand for electricity by 2035 as displayed in Table 2. The summary of the main environmental impacts for the PO1 and PO2 affecting the design and production stages are visualised in Table 1. For more information see Annex 8.1.2.

Table 2 Environmental impacts of Recycled Content targets for plastics and steel, 2035

Environmental impacts	PO2	PO2A	PO2B	PO2C

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

[133] Corresponds with the scenario JRC3a of the JRC study (JRC129008).

[134] Corresponds with the scenario JRC4b in the Annex of the study (JRC129008).

[135] Corresponds with the scenario JRC4c in the Annex of the study (JRC129008).

(in 2035, annual compared to baseline)				
Vehicles placed on market (units)		15,025,000		
Recycled content plastics (JRC study)	**PO2 plastics**	10% in 'fleet' in 2035	25% of newly TA from 2030	30% of newly TA from 2030
Design and production	**Baseline**	(values in addition to baseline)		
Recycled content plastics (kton)	123	+240	+713	+873
CO2 savings (kton CO2-eq., plastics RC)	46	+90	+314	+376
Reduced decease incidence PM	2	+4	+13	+16
Energy savings (GWh)	1,161	+2,264	+7,283	+8,740
BOE (million Barrel of Oil equivalent saved)	1	+1.4	+4.5	+5.4
Contribution to the CPA targets	1%	3%	8%	9%
Recycled content steel	**PO2 steel**	**PO2A**	**PO2B**	**PO2C**
Recycled content steel (kton)	1,515	0	+505	+1,212
CO2 savings (kton CO2-eq., steel RC)	1,754	0	+585	+1,404
Reduction in Electricity use (GWh)	-776	0	-259	-621
Natural gas savings (million m3)	45	0	+15	+36
Hydrogen savings (ton H2)	9,185	0	+3,062	+7,348
Coal savings (kton)	500	0	+167	+400
Iron ore savings (kton)	1,808	0	+603	+1,446

6.2.3 Treat better: Improve treatment quality and quantity

All three options under **PO3** bring significant environmental benefits from higher quantities and qualities of recycling. For **PO3A**, the effect of better implementation of the current Annex I of the ELV Directive has a significant positive effect of about 1 million tons of materials recovered at higher quality, corresponding with 1.5 million tons of CO_2 savings compared to the baseline. In order of magnitude of GHG savings, improved aluminium and steel recycling contributes the most, followed by the environmental benefits of improved plastics recycling[136]. **PO3B** (incl. PO3A) and **PO3C** (incl. PO3B measures) bring even higher benefits. The increased separation of (cast) aluminium components provides significant gains for **PO3B** of around 3.7 million tons of $CO_{2\text{-eq}}$ saved, primarily due to reuse and corresponding aluminium production avoided. Initial assessment for the e-drive motors mandatory removal prior to shredding shows that circa 1 million ELV in 2030 and 5 million ELVs in 2040 will be affected by this provision[137], respectively, compared to baseline scenario. Copper recovery from e-drive motors would increase by 97% and would decrease contamination of secondary base metals, hence increasing quality. The mandatory removal and separate recycling of e-drive motors would also thrive the permanent magnet recycling value chain and generate new flows of CRMs for further recycling. It is estimated circa 4.2 kton of permanent magnets, including 1.5 kton of REEs, to be available in 2040 for high quality recycling from future EU ELVs. For **PO3C**, the advanced quality targets provide savings equivalent to 2.9 million tons of $CO_{2\text{-eq}}$.

The update of the recycling, reuse and remanufacturing definitions proposed in the revision would exclude some recycling processes that yield very-low quality recyclates. A more consistent definition of recycling in particular provides an incentive for the improved recycling of plastics and glass contributing to 600 kton and 200 kton of annual GHG savings respectively. The results are excluding the effect of increased collection from PO4 but already

[136] Recycling quality improvements of PO3 are not overlapping with the allocation of plastics recycling benefits of PO2 to avoid double counting.

[137] N. Tazi, M. Orefice, C. Marmy, Y. Baron, M Ljunggren, P Wäger, F. Mathieux, Initial analysis of selected measures to improve the circularity of Critical Raw Materials and other materials in passenger cars, EUR 31468 EN, Publications Office of the European Union, Luxembourg, 2023, ISBN 978-92-68-01625-1, doi: 10.2760/207541, JRC132821.

includes the PO5 effect of EPR measures in the last column of Table 3. See Annex 8.1.3 for a detailed assessment per material and other years.

Table 3 Environmental impacts of improved treatment quantity and quality, 2035

Environmental impacts (in 2035, annual compared to baseline)	**PO3**	**PO3A**	**PO3B**	**PO3C**	**Amplification** (+ EPR)
ELVs treated EU (units, legal & illegal)	**Baseline**	9,621,000			+2,107,000
Recycling stage (kton of material)		(values in addition to baseline)			
Steel (reused and recycled pre-shredder)	719	+812	+1,188	+1,457	+273
Aluminium (reused and recycled pre-shredder)	133	+99	+365	+204	+84
Copper (reused and recycled pre-shredder)	11	+27	+79	+54	+18
Glass (recycled pre-shredder, high quality)	22	+4	+131	+131	+30
Plastics (reused and recycled pre-shredder)	84	0	+125	+138	+29
CRMs (permanent magnet materials)		+0.35	+0.35	+0.35	0
Improved **quality** (kton of material)	161	+381	+1,217	+1,313	+280
Recycling stage - GHG savings (kton CO_2-eq)	**Baseline**	(values in addition to baseline)			
Steel	6,662	+597	+641	+672	+147
Aluminium	14,270	+693	+1,994	+1,309	+459
Copper	318	+69	+143	+76	+33
Glass	13	+4	+126	+126	+29
Plastics recycling (allocated to PO3)	929	0	+758	+661	+174
EEE (invertor only)	139	+15	+26	+36	+6
GHG savings (kton CO_2-eq.)		+1,378	+3,688	+2,880	+848

6.2.4 Collect more: Improve collection quality and quantity

Under policy options **PO4A** to **PO4C**, improved collection of ELVs increases the number vehicles treated at ATFs and reduces extra-EU exports, leading to more higher quality recycling the EU. The cumulative **PO4D**, which combines all measures from **PO4A** to **PO4C**, is the most effective as it generates synergies from this combination, which are higher than a simple addition. The resulting summary of environmental impacts shows significant additional material recovery and corresponding GHG savings. **PO4B**, with improved enforcement and harmonised national registers, significantly reduces the number of vehicles of unknown whereabouts and improves the quality of treatment at ATFs, resulting in 1.5 million tons of CO_2-eq from recycling plus 0.1 million tons CO2-eq. from better recovery of air conditioning refrigerants. **PO4C**, which focusses on export regulatory measures, is expected to save up to 3.2 million tons of CO2-eq from recycling plus 0.2 million tons CO2-eq. from better recovery of air conditioning refrigerants. The CO2 savings take account of the fact that the CO2 emissions generated by the dismantling of old vehicles as waste in the EU and the production of new cars to replace them are offset by the reduction of CO2 emissions achieved when taking into consideration the emissions generated, during their use phase, by newly produced vehicles, compared to much older ones. The highest impacts are achieved with **PO4D**, a combination of all measures, with savings of 5.6 million tons of CO2-eq. In addition to GHG savings, eliminating the export of non-roadworthy used vehicles from the EU to third countries will decrease the external environmental and heath related costs associated with air pollution[138] as well as with the informal dismantling of vehicles (linked for example to improper treatment of waste oil, tyres, refrigerants from air-conditioning systems and lead-acid batteries, which is a significant source of lead pollution in developing

[138] For the assessment of magnitude of possible external costs associated with the export of used non-roadworthy vehicles from the EU to third countries, see the Handbook on the External Costs of Transport: European Commission, Directorate-General for Mobility and Transport, Essen, H., Fiorello, D., El Beyrouty, K., et al., Handbook on the external costs of transport: version 2019 – 1.1, Publications Office, 2020, https://data.europa.eu/doi/10.2832/51388

countries[139]) in the receiving countries. The measure is likely to lead to changes in the overall vehicle fleet imported in receiving countries: the replacement of old used vehicles with more modern ones would lead reduced air pollution and increase road safety. In addition, as the lifetime of modern vehicles is longer than the lifetime of old ones, there would less vehicles becoming waste in the recipient countries[140]. This would therefore reduce the pollution caused by the unsound treatment of ELVs in the countries concerned[141].This will reduce the EU external pollution footprint and support the development of policies and actions supporting a more sustainable, safer and efficient transport system in these countries. More information is available in Annex 7.2.4 under M21.

Table 4 Environmental impacts of improved collection, 2035

Environmental impacts (in 2035, annual compared to baseline)	**PO4**	**PO4A**	**PO4B**	**PO4C**	**PO4D**	**Amplification** (+EPR)
Collection stage (units)	**Baseline**	(values in addition to baseline)				
ELVs treated in the EU (legal & illegal)	9,620,640	+115,624	+501,037	+1,079,156	+1,721,511	+321,177
to ATFs and CoD (reported)	7,630,563	+218,401	+796,520	+1,374,639	+2,916,291	+385,413
treated in the EU (non-reported)	1,990,077	-102,777	-295,483	-295,483	-1,194,780	-359,719
Export of used vehicles and ELVs	3,226,456	-115,624	-501,037	-1,079,156	-1,721,511	-385,413
Used vehicles + ELV export reduction	0.0%	3.6%	16%	33%	53%	+12%
Materials recovered (ktons)	8,568	+103	+446	+961	+1,533	+284
Steel/ cast iron	7,084	+85	+369	+795	+1,268	+43
Aluminium	1,074	+13	+56	+121	+192	+6
Copper/Brass	142	+2	+7	+16	+25	+11
Average Plastic	268	+3	+14	+30	+48	+1
Platinum	30	+0	+2	+3	+5	+0.3
GHG savings **recycling** (kton CO_2-eq.)	27,850	+353	+1,513	+3,222	+5,218	+1,132
GHG savings refrigerants (kton CO_2-eq)	969	+30	+113	+207	+408	+56

6.2.5 Provide appropriate financial and organisational incentives to improve collection and waste treatment

The assessment of the EPR and economic incentives related measures, described in **PO5A**, **PO5B** (incl. PO5A) and **PO5C** (incl. PO5B), is based on their amplifying effect on the measures for recycling (under **PO3A** - **PO3C**) and on collection (under **PO4A** to **PO4C**), and previously displayed in the Tables 3 and 4. The amplifying effect of EPR on the compliance level for collection and recycling is calculated and shows an additional 12% reduction in export of non-roadworthy used vehicles and ELVs, or 385,000 fewer vehicles exported, plus an extra 320,000 units brought to ATFs in the EU at end of life. The combined effect is an additional 284 kton of materials and 1.1 million tons of CO_2-eq, which includes 56 kton of equivalent CO_2 savings from improved refrigerant recovery. More details are available in Annex 8.1.4 and 8.1.5.

[139] https://apps.who.int/iris/rest/bitstreams/1091390/retrieve

[140] If the vehicle is imported at an age of 5 years, it will possibly last another 25 years in the country of destination before becoming an ELV. An imported vehicle with an age of 18 years might last another 12 years in the receiving country before becoming waste. Thus, the waste generated for the same service is twice as much when old vehicles are imported.

[141] For more information on these aspects, see section 6.12 in 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

6.2.6 Cover more vehicles: Extend the vehicle category scope

The main indicator used to assess the environmental and economic impacts of **PO6A**, **PO6B** (incl. PO6A) and **PO6C** (incl. PO6A and PO6B measures) is the number of additional vehicles which would be treated in ATFs in the EU compared to the baseline, as well as the corresponding materials which would be recovered. For the environmental impact assessment, the GHG savings linked to such recovery is then calculated for L3e-L7e category vehicles, buses (M2, M3) and lorries (N2,N3), but not for trailers due to lack of information. For **PO6C**, the export reduction effect of a full EPR system (M31c) can be determined as well, however, the full scope extension to 3RTA, recycled content targets cannot be quantified (M33). On that basis, the assessment shows that the environmental benefits of **PO6A** are modest, as it would result in a limited number of additional lorries, buses and L3e-L7e category vehicles dismantled in ATFs compared to the baseline, and of the corresponding materials recycled or re-used. **PO6B** would provide higher environmental benefits, including 510 ktons (PO6B) and 660 ktons (PO6C) of material reused or recycled at higher quality. This corresponds with 1,1 million respectively 1.4 million tonnes of CO_{2eq} as GHG savings. This is the result from:

(i) the obligation to treat all lorries, buses and L3e-L7e category vehicles in ATFs, which would reduce increase the number of vehicles treated by ATFs by 39% and reduce those treated by the informal sector in the EU under less environmentally efficient conditions (M30a). This measure would particularly affect L3e-L7e category vehicles;
(ii) the new requirements on the export of used lorries and busses, which could lead to a drop in export in non-roadworthy vehicles of up to 19% and subsequent treatment of these vehicles in ATFs in the EU (M30b);
(iii) the basic requirements for manufacturers of lorries, buses and L3e-L7e category vehicles to facilitate collection and reporting on end-of-life vehicles (M31).

The environmental benefits of **PO6C** are expected to be larger than for **PO6B**, as **PO6C** would entail a much broader range of measures affecting the design, type-approval and treatment of lorries, buses and L3e-L7e category vehicles. However, there is insufficient information on parameters (for example on the feasibility to set up recyclability target under the type-approval framework, as well as an overall recycling target for the whole vehicle at end-of-life stage; on current rate and possible increase in the use of recycled materials; on the feasibility to require that a list of "difficult-to-recycle materials" are removed prior to shredding) which are key to calculate the environmental benefits of the measures under **PO6C**. It is therefore not possible to quantify the additional impacts of M33.

Table 5 Environmental impacts of the scope extension, 2035

Environmental impacts (2035, compared to baseline)	**PO6**	**PO6A**	**PO6B**	**PO6C***
Scope extension (values in million units)	**Baseline**	(values in addition to baseline)		
ELVs (L3e-L7e-category vehicles)	1,624,242			
ELVs (buses, M2,M3)	32,972			
ELVs (lorries and trailers, N2,N3,O)	289,992			
ELVs to ATFs (L3e-L7ecategory vehicles)	0	Not assessed	+487,273	+633,454
ELVs to ATFs (M2,M3)	21,762		+2,119	+2,754
ELVs to ATFs (N2,N3,O)	75,398		+35,408	+46,030
ELVs non-reported to ATFs (L3e-L7e)	0	Not assessed	30%	39%
ELV+ used export reduction (M2,M3)	11,211		19%	25%
ELV+ used export reduction (N2,N3,O)	214,594		17%	21%
Materials recovered (ktons of materials)		(values in addition to baseline)		
Additional reuse (L3e-L7e, ktons)	301	Not assessed		
Additional reuse (M2, M3, ktons)	104		+31	+40
Additional reuse (N2, N3,O, ktons)	553		+166	+216

Additional recycling (L3e-L7e, ktons)	191	Not assessed	+57	+75
Additional recycling (M2, M3, ktons)	127		+38	+49
Additional recycling (N2, N3,O, ktons)	720		+216	+281
Total materials recovered (ktons)	1,995		+508	+661
GHG savings (ktons of CO2eq.)	(values in addition to baseline)			
GHG savings (L3e-L7e, ktons CO2eq.)	2,639	Not assessed	+126	+164
GHG savings (M2, M3, ktons CO2eq.)	1,235		+152	+178
GHG savings (N2, N3,O, ktons CO2eq.)	2,055		+841	+1,094
Total GHG savings (ktons of CO2eq.)	5,929		+1,120	+1,436

**Excluding impacts for the full scope extension of M33. Only impacts of measure M31c (EPR and collection) are assessed.*

6.3 Economic impacts

6.3.1 Design circular: Improve reusability, recyclability and recoverability

The estimated operational costs for modernising the 3R type-approval framework of **PO1A**, excluding administrative costs, are rather limited and assessed qualitatively. The revisions to the 3R-type-approval calculation will make the process somewhat more complex for OEMs and type-approval authorities. Possible sanctions for non-compliance are not included in these estimates. The expected increase in the rate of reuse of certain components means suppliers of new replacement part see a loss of business, while ATFs and remanufacturers will see an increase. Vehicle owners shall benefit from increased supply of spare parts from improved digital marketplaces and less digital keys hampering repair. With a large number of different parts and values, these revenues are not quantified. The costs of improving recyclability of difficult-to-recycle materials and R&D related to the circularity strategies in **PO1B** (incl. PO1A) are not assessed in detail, but the envisaged cooperation between recyclers and manufacturers is an important improvement, frequently mentioned by a range of stakeholders. Costs for developing the digital Circularity Vehicle Passport are determined at 2 million EUR annually and thus relatively limited under **PO1C** (incl. PO1A and PO1B measures). It overlaps with existing and new digital platforms that manufacturers are further expanding. Thus, development costs are already assumed for the baseline. For substances, the 'restriction under REACH and other existing legislation' and the 'hybrid approach' will have overall similar impacts, with a slightly higher impact in terms of administrative burden given the need for automotive operators to familiarise with REACH and its restriction procedures. They hybrid approach is assessed to be that resulting in the highest ease of implementation. More information can be found in Annex 8.1.1. Administrative costs are presented in Section 6.4 and Annex 8.3.

6.3.2 Use recycled content: increasing recycling and decarbonising production for selected materials

The costs and revenues for the plastics and steel recycled content targets are summarised in Table 6[142]. It is assumed the quality of produced recyclates comply with the technical specifications of manufacturers. This requires investments in recycling technology. The total sum of costs and revenues range approximately from 15 to 49 EUR/vehicle in 2035, depending on the sub-options as well as on expected new price setting of recyclates. Costs are relatively high in the short term as manufacturers and suppliers will adapt production, carry out the necessary R&D, testing and validation of the new blends and securing supply from recyclers. For the targets of **PO2B**[143] and **PO2C**[144], in 2035, the measures would cost 740

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

[143] Corresponds with scenario 4b in the JRC study.

[144] Corresponds with scenario 4c in the JRC study.

respectively 1,170 million EUR but generate a net profit for recyclers of 600 respectively 70 million EUR at the same time thus providing an important incentive for secondary markets for raw materials.

Table 6 Economic impacts of recycled content targets for plastics and steel, 2035

Economic impacts (in 2035, annual compared to baseline, excl. admin costs)	**PO1**	**PO1A**	**PO1B**	**PO1C**
Vehicles placed on market (units)	**Baseline**	15,025,000		
Design stage		(values in addition to baseline)		
Operational costs 3RTA (qualitative)		(-)	(--)	(--)
Hazardous substance declaration (qualitative)		(o)	(o)	(o)
Production: Recycled content plastics (JRC study)	**PO2** Plastics	**PO2A** (PoM 6-10%)	**PO2B** (TA 2030 25%)	**PO2C** (TA 2030 30%)
Recycled content plastics (kton)	95	+240	+713	+873
Manufacturer and supplier costs	0	-205	-392	-739
Recycler investments	-4	-20	-69	-83
Plastics (processing costs)	-53	-101	-284	-349
Plastics (revenues recyclers)	112	+216	+602	+739
Production Recycled content steel	**PO2** Steel	**PO2A**	**PO2B** (20% in 2035)	**PO2C** (30% in 2035)
Recycled content quality steel (kton)	1,515		+505	+1,212
Shredder and sampling costs (HQ steel, M EUR)			-4	-10
Steel industry (cost HQ scrap, M EUR)			-33	-80
Manufacturers (premium RC steel, M EUR)			-33	-80
Shredders (revenues HQ scrap, M EUR)			+33	+80
Steel industry (reduced processing costs, M EUR)			+33	+80
Total costs plastics + steel (all stakeholders)	-58	-326	-816	-1,340
Total revenues plastics + steel (all stakeholders)	112	+216	+668	+899

For the recycled content target for steel, the necessary shredder costs for improving ELV steel scrap sampling to ensure quality requirements are estimated at 4 million EUR for **PO2B** and 10 million EUR for **PO2C**. Further costs for improving quality of treatment, including a ban on mixed treatment and the removal obligations of components are allocated to **PO3**. On the costs side, the cost potential is estimated at 66 million EUR, assumed to be split between the steel industry and automotive manufacturers. These (avoided) costs do present an increasing purchasing price for steel producers, which could be covered by lower ETS[145] costs, estimated conservatively at 132 EUR resp. 156 EUR/ton CO_{2eq} according to the low scenario of the DG MOVE handbook[146]. The corresponding GHG reduction is presented in Section 6.2.2. See Annex 8.1.2 for more details and assumptions.

6.3.3 Treat better: Improve treatment quality and quantity

The results of the impact assessment for PO3 are displayed below. The majority of the costs are for the dismantlers and linked to the requirements on removal of parts prior to shredding in **PO3A** and **PO3B** (around 350 million EUR), partially compensated by additional revenues from removed materials. Similarly, the recycling definition improvement and ban on the landfilling of the residues from shredding operations of **PO3A** come with a cost. The costs for removal of CRM relevant components under **PO3A** are estimated at 65 million EUR by the

[145] https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets_en

[146] European Commission, Directorate-General for Mobility and Transport, Essen, H., Fiorello, D., El Beyrouty, K., et al., Handbook on the external costs of transport: version 2019 – 1.1, Publications Office, 2020

JRC and further discussed in Annex 15.2[147]. The cost-effectiveness of dismantling smaller components under **PO3C** (including PO3A and PO3B measures) is much lower compared to **PO3A** and **PO3B**. The ban on mixed treatment of ELV with other scrap types (**PO3B**) at the same time reduces shredder capacity flexibility leading to extra costs, at the same time, it improves quality of recycling and noticeably the value of ELV steel and aluminium fractions in return. Since this is difficult to quantify and very shredder and Member State specific, the net result is assumed to be cost neutral. It should be noted that the modelling approach focused on manual dismantling[148] **does not allow to quantitatively assess the less costly mechanical recycling** scenario, for the **PO3B** and **PO3C** in those countries that have sufficient PST capacity. The **PO3C** costs are to be regarded 'worst-case'.

There is a substantial shift in costs and revenues between stakeholders for all three policy options. The value of removed materials minus dismantling costs will not be a direct net profit to the ATFs, as shredder companies will pay less for dismantled hulks where significant material value is already removed and subsequent lower treatment costs due to for instance the prior removal of glass. In Section 8.2 and in Annex 8.2.3, these 'propagations' of reduced costs and revenues are made explicit per stakeholder, material, component and for other years.

Table 7 Economic impacts of improved treatment quantity and quality, 2035

Economic impacts (in 2035, annual compared to baseline)	**PO3A**	**PO3B**	**PO3C**	**Amplification** (+EPR)
Treatment (in million EUR, - =cost, + =revenue)			(values in addition to baseline)	
ATFs				
ATF dismantling costs	-173	-412	-401	-80
ATF additional revenues	+34	+100	+70	+21
Shredders/PST operators (excl. RC)				
Shredder costs	-347	-998	-686	-230
Shredder additional revenues	+309	+902	+634	+187
Recycling/ End-processing				
Recyclers costs	-140	-82	-132	-1
Recyclers additional revenues	+68	+152	+146	19
Total costs (all stakeholders)	-660	-1,492	-1,219	-310
Total revenues (all stakeholders)	+412	+1,153	+851	+227

ATFs and shredders are commonly SME's, recyclers are regarded large enterprises including plastic recyclers, steel mills and non-ferrous smelters that produce secondary raw materials as 'commodities'

6.3.4 Collect more: Improve collection quality and quantity

Under policy options **PO4A** to **PO4C** and the cumulative **PO4D**, ATFs will benefit from more ELVs diverted to them from illegal operators in the EU and from the limitations regarding the export of used unroadworthy vehicles. Detailed trade and economic information is available in Annex 8.1.4. Car dealers, in particular those specialised in exports outside the EU, would incur lost profits (up to 414 million EUR for **PO4D),** as the prices for exporting used vehicles are higher than for selling old used vehicles or ELVs in the EU. ATFs would incur net profits of respectively 24, 82, 125 and 308 million EUR, for **PO4A** to **PO4D**. Shredders and recyclers will also have additional turnover and profits from more ELVs treated, however as the profit per ton of depolluted and dismantled vehicle is limited, the net effect is low. With a substantial shift in costs and revenues between stakeholders, again the

[147] N. Tazi, M. Orefice, C. Marmy, Y. Baron, M Ljunggren, P Wäger, F. Mathieux, Initial analysis of selected measures to improve the circularity of Critical Raw Materials and other materials in passenger cars, EUR 31468 EN, Publications Office of the European Union, Luxembourg, 2023, ISBN 978-92-68-01625-1, doi: 10.2760/207541, JRC132821.

[148] 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

'propagations' of reduced costs and revenues are made explicit for each stakeholder, material, component and other years in Annex 8.2.4 and summarised per vehicle in Section 8.2.

Table 8 Economic impacts of improved collection, 2035

Economic impacts (in 2035, annual compared to baseline)	**PO4A**	**PO4B**	**PO4C**	**PO4D**	**Amplification** (+EPR)
Collection (in million EUR, - =cost, + =revenue)			(values in addition to baseline)		
Consumers	0	0	-134	-142	-17
Car dealers (export requirements)	-27	-123	-282	-414	-241
ATF profits	+24	+82	+125	+308	+203
Shredder profits	+2	+7	+15	+24	+14
Total costs	-27	-123	-416	-556	-257
Total additional revenues	+26	+89	+140	+332	+217

6.3.5 Provide appropriate financial and organisational incentives to improve collection and waste treatment

The economic and governance elements of ELV-specific EPR schemes under **PO5A-C** will support better cooperation between manufacturers and recyclers to jointly improve both design and treatment of vehicles. The impact of the EPR and economic incentives related measures is presented as an **amplifying** effect on the measures to meet the specific objectives 1, 3 and 4. The **PO5B** (incl. PO5B measures) results are already visualised in previous Tables 2 to 4 and 6 to 8 and clearly show the additional benefits of improved governance and financial incentives. Dependent on the choice of new collection and recycling requirements and their additional costs, EPR schemes and producers (and subsequently consumers) will be required to compensate ATFs and shredders for the additional costs incurred to improve recycling quality and compliance. Compared to the baseline, the estimated **additional** compliance cost offset per ELV ranges between 3 and 33 EUR per ELV in 2035, dependent on the combination of policy options and member state specific price-setting elements that can affect the economic performances of the ATFs, shredders and recyclers. For more details see Annex 8.2.5.

6.3.6 Cover more vehicles: Extend the vehicle category scope

The information provisions of **PO6A** would generate moderate costs for manufacturers which would have to provide a set of information to dismantlers and recyclers on the composition of their vehicles and their dismantling. The related administrative costs are specified in Section 7.1. Lorry manufacturers are already used to doing this, so the costs would take form a limited administrative burden, which could be a bit higher for manufacturers of buses and L categories vehicles. This information should on the other hand facilitate and speed up the activities by dismantlers, so reduce their overall costs, although this is difficult to quantify.

PO6B (incl. PO6A measures) main economic impacts would be linked to the measures on the export of lorries and buses, with decrease in revenues for (specialised) exporters, but more vehicles to be treated by ATFs in the EU, generating additional turnover for this sector. The requirements to treat lorries, buses and L3e-L7e category vehicles in ATFs would represent extra economic activities for the dismantling sector operating under advanced environmental standards. The costs would take the form of investments to upgrade facilities which currently do not meet the standards to be authorised as a treatment facility. Overall, this impact will more important for operators treating end-of-life L3e-L7e category vehicles, for which the informal sector is more prevalent than for the other types of vehicles. For manufacturers, **PO6B** would generate limited costs under the form of administrative burden linked to their basic obligations as producers in terms of collection and reporting (Section 7.1).

PO6C (incl. PO6A and PO6B measures) would generate important costs for the whole supply chain, in view of the wide changes that it would require for each actor along the supply chains (manufacturers having to ensure at type-approval stage that their vehicles are 85% recyclable and to incorporate recycled plastics; dismantlers having to modernise their practices to ensure removal of parts and materials for re-use and recycling; recyclers having to improve treatment of waste from lorries, buses and L3e-L7e category vehicles (M33)). They cannot fully be quantified however, and only a partial calculation corresponding to measures on EPR and collection is presented below. **PO6C** would also generate revenues from higher volume and quality of used spare parts and materials sent for recycling. This part of the quantification (M31c) is displayed in Table 9.

Table 9 Economic impacts of the scope extension, 2035

Economic impacts (2035, compared to baseline)	**PO6A**	**PO6B**	**PO6C***
Scope extension (million units)			
Lost revenues exporters (M EUR)	(values in addition to baseline)		
Costs (lost revenue L3e-L7e; M EUR)	not assessed		
Costs (lost revenue M2,M3; M EUR)		-2.5	-4.4
Costs (lost revenue N2,N3,O; M EUR)		-48	-84
ATFs (M EUR)	(values in addition to baseline)		
Costs	not assessed	-39	-53
Revenues		+42	+55
Recyclers (M EUR)	(values in addition to baseline)		
Revenues	not assessed	+39	+50
Net value scope extension		-9	-36

**Excluding impacts for the full scope extension of M33. Only impacts of measure M31c (EPR and collection) are assessed.*

6.4 Administrative burden

Administrative burden per policy option is included in Section 7.1 in the comparison of options in Tables 10-14. A detailed overview of the administrative burden for all years is provided in Annex 3 per stakeholder affected as well as per measure and split in recurrent and one-off costs and summarised in Annex 8.3 per individual policy option and operator. For **PO1C**, the 3R calculation and required declaration generally follows existing procedures, with some one-off transition costs totalling 2.57 million EUR. The total recurring administrative burden for the information provision of **PO1C** is assed at 5.68 million EUR; including the adaptations for the Circularity Vehicle Passport. For plastics recycled content, the certification costs are estimated to be limited to 0.24 million EUR in 2035 for **PO2B** and thus marginal compared to processing costs. A similar value is expected for the steel recycled content target, following the same approach. The highest costs of roughly 32 million EUR are related to for **PO3B and PO3C** where ATFs are required to improve reporting over depollution and mandatory removal (roughly 3 EUR/ELV). The recurring costs related to **PO4** for collection including EPR in setting up PROs in **PO5** range between 35 and 54 million EUR (4 to 6 EUR/ ELV) with an additional one-off cost of 1.35 million EUR. In total, including some administrative costs for the scope extension of **PO6**, the **total recurring administrative costs range between 72 and 106 million EUR** (5 and 7 EUR per new vehicle sold) **plus 1.4 to 4.0 million of one-off costs**.

6.5 Social impacts

6.5.1 Job creation

An overview of the social impacts is provided in in Section 7.1 in the comparison of options in Tables 9-13. The main impact category is the creation of total jobs, with significant impacts related to the recycled content options with respectively 600, 1,200 and 1,800 jobs for the options **PO2A-PO2C** for both manufacturers and shredder/PST operators. Second in

contribution are the additional jobs related to mandatory removal of components, ranging for 930 jobs for **PO3A** to over 6,500 jobs for **PO3C** (including PO3A and PO3B measures) due to long dismantling times of smaller components in case a manual definition of 'removal' would be selected. For the collection options **PO4A** with 330 jobs, **PO4B** with 1,200 jobs, **PO4C** with 2,000 jobs and the cumulative **PO4D** with 4,400 jobs are expected for SMEs. The scope extension implies 700 extra jobs for **PO6B** (incl. PO6A) versus 830 for **PO6C** (incl. PO6A and PO6B measures). Other social and health effects relate to the export restrictions. Limiting the export of non-roadworthy vehicles may have a significant effect on local air pollution and increased road safety in developing countries. See Annex 8.4.1 for more details including job creation per policy option and economic operator.

6.5.2 Impacts on SMEs

The measures proposed in this impact assessment are likely to have substantial impacts on a number of SMEs, which are dominating the waste management sector, creating both opportunities and challenges. The economic viability of SMEs in the **dismantling sector** is already fragile and they will anyway have to face, under the baseline scenario, important challenges linked to the dismantling of EVs (notably for the training of staff and investments and adaptations so as to properly dismantle and store batteries and other EV components). For SMEs in the dismantling sector, measures 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, as well as of valuable components (plastics, aluminium, CRMs) for high quality recycling. 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 targets on recycled content for plastics and (in the future) for steel are expected to boost the competitiveness of dismantlers, as they would become the primary supply spots of the wanted high-quality secondary materials. The measures designed to address the problems of "missing vehicles" will also have an important effect for the dismantling sector, as this will result in an important extra volume of ELVs delivered to ATFs, and thereby an 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 compete with illegal actors.

For SMEs involved in the **sorting, shredding and recycling** of ELV waste, the most impactful measures are those (i) on recycled content, which should ensure an increased market share for recycled plastics and steel and boost their competitiveness, as well as (ii) those designed to increase the quality of recyclates and improve the treatment of waste, especially the removal of parts prior to shredding and the requirements on 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. In that case again, the measures proposed on EPR are due to ensure that extra-costs which cannot be offset under normal market conditions should be borne by vehicle manufacturers to support the recycling sector.

Overall, the proposed measures should support the competitiveness of SMEs in the dismantling and recycling sector through new market opportunities. It is likely though 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, leading them to focus on activities such as repairs or sales of second-hand cars, rather than on the treatment of ELVs. In addition, the

measures proposed on the design/production of vehicles, as well as those on EPR, could also encourage vehicle manufacturers to take 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.

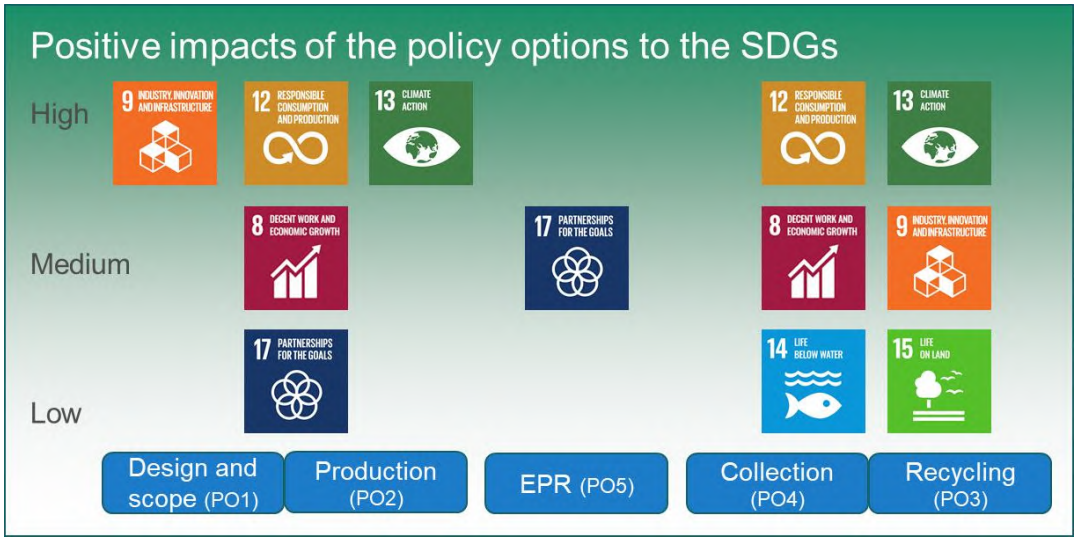
SMEs exporting used vehicles to third countries would be directly affected by the measures on export foreseen under this initiative. They would incur costs linked to the obligation for them to carry out roadworthiness tests for vehicles which are currently exported after the certificate has expired. 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 roadworthiness requirement estimated at 51 million EUR (**PO6B**) respectively 88 million EUR (**PO6C**). They would then have to sell these vehicles as ELVs to ATFs in the EU, at a lower price than what they could have obtained for exporting them.

Operators from the informal sector repairing and treating L3e-L7e category vehicles would also be affected as they would have to upgrade their standards and facilities to become officially authorised to treat these vehicles at end-of-life. This would require investments and possibly represent a loss of activities for those which are not able or willing to become an authorised treatment facility. More information on the impacts of proposed measures on SMEs can be found in Annex 13.

6.5.3 Contribution to SDGs

Figure 3 visualises the contribution of the policy options to the SDGs. On the left-hand 'design and production' side of the diagram, policy options **PO1** and **PO2** contribute mostly to sustainable innovations (SDG9), responsible consumption and production with a lower environmental footprint (SDG12) and climate action (SDG13). The collection and recycling options **PO3** and **PO4** contribute to the same SDGs and to less pollution water and air pollution (SDG14 and SDG15) to a lesser extent. **PO5** improves partnerships for the goals (SDG17). See Annex 3.3 for more details.

Figure 3 Contribution of the Regulation to the SDGs



7. HOW DO THE OPTIONS COMPARE?

7.1 Summary of impacts and costs/ benefits

Table 10 provides a qualitative overview of the main environmental benefits[149] and administrative costs for the 3RTA policy options for **PO1**. As indicated in Section 6, the environmental impacts of the options do materialise many years later at end-of-life and are thus not quantified but evaluated qualitatively. A growing incorporation of circularity requirements in the design and production of new vehicles is regarded important to achieve the long-term circularity objectives in the automotive sector, at relatively limited administrative costs as presented below, even for the most comprehensive **PO1C** (incl. PO1A and PO1B measures). The qualitative evaluation on the reduction of substances of concern is available in Annex 7.1, here the hybrid approach of **PO1C** offers the best cost – benefit balance.

Table 10 Comparison and summary of impacts, PO1 - Design Circular, 2035.

PO1	**Costs and benefits** (in 2035, compared to baseline, excl. admin)	PO1A	PO1B	PO1C
Environmental benefits (qualitative)		(values in addition to baseline)		
1	3RTA - Circularity at design	(+)	(++)	(+++)
1	Reduction substances of concern	(0)	(0/+)	(+)
Admin burden (3RTA in Million EUR)		(values in addition to baseline)		
1	Manufacturers, authorities (recurrent)	-0.8	-3.8	-5.6
1	Manufacturers, EC (one-off)			-2.6
Job creation (in FTE)		(values in addition to baseline)		
1	Manufacturers 3RTA	+5	+5	+5

Since materials production is particularly energy intensive, the related environmental benefits of using recycled content, improving collection and recycling are expressed in GHG savings as the primary environmental impact category for comparison for **PO2-PO6**[150]. Table 11 provides an overview of the main environmental benefits and related costs to the recycled content targets for plastics and steel for **PO2**. For plastics recycled content, the additional costs for **PO2C** in comparison with **PO2B** are high against marginal environmental benefits. The steel recycled content target of **PO2B** provides significant GHG savings against limited additional costs.

Table 11 Comparison and summary of impacts, PO2 - Recycled content, 2035.

PO2	**Costs and benefits** (in 2035, compared to baseline, excl. admin)	PO2A	PO2B	PO2C
Environmental benefits (in kton of materials)		(values in addition to baseline)		
2	Materials recycled (steel RC)	0	+505	+1,212
2	Materials recycled (plastics RC)	+240	+713	+873
GHG savings (kton of CO2-eq)		(values in addition to baseline)		
2	GHG savings production (steel RC)	0	+585	+1,404
2	GHG savings production (plastics RC)	+90	+314	+376

[149] Except for the recycled content related GHG savings of PO2 and its financial relevancy for the future functioning of ETS / CBAM, the other GHG savings cannot be attributed unambiguously to individual economic operators and thus not be directly capitalised using available financial instruments. Therefore 'monetised GHG savings' is used in below tables except in the case of PO2 where 'avoided CO2 taxation under ETS' is used to illustrate its attribution potential. This approach is in line with quantifying non-market benefits as described in Tool 14 of the Better Regulation Guidance and Tool 23 related to monetising environmental impacts for the purpose of Cost Benefit Analysis and the BCR as determined in Section 7.1

[150] European Commission, Directorate-General for Mobility and Transport, Essen, H., Fiorello, D., El Beyrouty, K., et al., Handbook on the external costs of transport: version 2019 – 1.1, Publications Office, 2020, https://data.europa.eu/doi/10.2832/51388

Costs (M EUR, excl. admin)		(values in addition to baseline)		
2	Costs production (steel RC)	0	-71	-170
2	Costs production (plastics RC)	-326	-745	-1,171
Revenues (M EUR, excl. admin)		(values in addition to baseline)		
2	Revenues production (steel RC)	0	+67	+160
2	Revenues production (plastics RC)	+216	+602	+739
Monetised GHG savings (M EUR)		(values in addition to baseline)		
2	Avoided CO_2 taxation ETS (steel RC)	0	+133	+318
2	Avoided CO_2 taxation ETS (plastics RC)	+20	+71	+85
Admin burden (3RTA in Million EUR)		(values in addition to baseline)		
2	Manufacturers, TA authorities (recurrent)	-0.24	-0.24	-0.33
Job creation (in FTE)		(values in addition to baseline)		
2	Manufacturers	+1,642	+3,264	+6,529
2	SMEs: ATFs+shredders	+598	+1,196	+1,794

For **PO3**, Table 12 shows the additional amounts recycled at higher quality are comparable for **PO3B** (incl. PO3A) and **PO3C** (incl. PO3A and PO3B measures), but the GHG savings are higher for **PO3B** due to improved aluminium separation as the main factor. The costs for the recycling option **PO3A** are much lower compared to the environmentally more effective options **PO3B** (see Annex 8.3 for details). Removal obligation prior to shredding of e-drive motor is estimated to contribute around 100 and 500 jobs in 2030 and 2040, generating specific additional costs at professional dismantler's level but also generating higher revenues at the value chain level by 2040[151].

Table 12 Comparison and summary of impacts, PO3 - Treat Better, 2035.

PO3	**Costs and benefits** (in 2035, compared to baseline, excl. admin)	**PO3A**	**PO3B**	**PO3C**
Environmental benefits (in kton of materials)		(values in addition to baseline)		
3	Materials at higher quality (recycling)	+942	+1,888	+1,984
GHG savings (ktons of CO2-eq)		(values in addition to baseline)		
3	GHG savings recycling (N1,M1)	+1,378	+3,688	+2,880
Costs (M EUR, excl. admin)		(values in addition to baseline)		
3	Costs recycling (N1,M1)	-660	-1,492	-1,219
Revenues (M EUR, excl. admin)		(values in addition to baseline)		
3	Revenues higher quality (recycling)	+412	+1,153	+851
Monetised GHG savings (M EUR)		(values in addition to baseline)		
3	Monetised GHG savings at higher quality (recycling)	+312	+836	+653
Admin burden (3RTA in Million EUR)		(values in addition to baseline)		
3,5	SMEs, authorities, PROs (recurrent)	-31.7	-31.7	-31.8
Job creation (in FTE)		(values in addition to baseline)		
3	SMEs: ATFs+shredders	+934	+6,224	+6,504

For collection **PO4,** Table 13 shows the additional amounts collected and recycled and the GHG savings for the four different Policy Options, where **PO4D** is including cumulatively all measures under **PO4A** to **PO4C**. **PO4D** has the highest GHG savings with higher costs and revenues as well. This result is without the amplifying effect of the implementation of EPR, which adds another significant +2 million tons of GHG savings, +400 million EUR in revenues, +470 million EUR of monetised monetised GHG savings and -750 million EUR additional costs as presented in section 6.2.4. Detailed results are presented in Annex 8.4 and 8.5 for other years, per individual policy option and per stakeholder.

[151] N. Tazi, M. Orefice, C. Marmy, Y. Baron, M Ljunggren, P Wäger, F. Mathieux, Initial analysis of selected measures to improve the circularity of Critical Raw Materials and other materials in passenger cars, EUR 31468 EN, Publications Office of the European Union, Luxembourg, 2023, ISBN 978-92-68-01625-1, doi: 10.2760/207541, JRC132821.

Table 13 Comparison and summary of impacts, PO4 – Collect More, 2035.

PO4*	Costs and benefits (in 2035, compared to baseline, excl. admin)	PO4A	PO4B	PO4C	PO4D
Environmental benefits (in kton of materials)		(values in addition to baseline)			
4	Materials recovered (collection + export)	+103	+446	+961	+1,533
4	Vehicles collected and treated more	+116,000	+500,000	+1,100,000	+1,700,000
GHG savings (ktons of CO2-eq)		(values in addition to baseline)			
4	GHG savings collection + export	+353	+1,513	+3,222	+5,218
Costs (M EUR, excl. admin)		(values in addition to baseline)			
4	Costs collection + export	-27	-123	-416	-556
Revenues (M EUR, excl. admin)		(values in addition to baseline)			
4	Revenues collected + export	+26	+89	+140	+332
Monetised GHG savings (M EUR)		(values in addition to baseline)			
4	Monetised GHG savings collected extra (incl. export)	+80	+343	+731	+1,183
Admin burden (3RTA in Million EUR)		(values in addition to baseline)			
4,5*	SMEs, authorities, manufacturers (recurrent)	-35	-54	-54	-54
4,5*	Authorities (one-off)	-1.35	-1.35	-1.35	-1.35
Job creation (in FTE)		(values in addition to baseline)			
4	SMEs: ATFs and shredders	+328	+1,195	+2,062	+4,374
5*	Manufacturers, PROs	+512	+512	+512	+512

** Some administrative burden and job creation include the impacts of EPR elements from PO5.*

Table 14 shows the results for **PO6**. For **PO6C** (incl. PO6A and PO6B measures), the costs and revenues can only be partly quantified due to lack of sufficient data on the impact of measures on design, production and recycled content. The data mentioned below are only indicative and not covering all costs and revenues. **PO6B** (incl. PO6A) has relatively high environmental benefits due to increased reported collection and treatment of new vehicles at ATFs (see Annex 8.6 for more details), with limited costs/revenue losses for (i) exporters, linked to the requirements to provide the information on the roadworthiness status for the export of lorries and busses, and for (ii) waste treatment operators, linked to the upgrade of facilities dealing with the treatment of end-of-life L3e-L7e category vehicles.

Table 14 Comparison and summary of impacts, PO6 - Cover more vehicles, 2035.

PO6	Costs and benefits (2035, compared to baseline, excl. admin)	PO6A	PO6B	PO6C*
Environmental benefits (in kton of materials)		(values in addition to baseline)		
6	Materials arriving at EoL (scope extension)	n.a	+508	+661
GHG savings (ktons of CO2-eq)		(values in addition to baseline)		
6	GHG savings scope extension (L+HDV)	n.a	+1,120	+1,436
Costs (M EUR, excl. admin)		(values in addition to baseline)		
6	Costs scope extension (M2,M3,N2,N3)	n.a	-90	-141
Revenues (M EUR, excl. admin)		(values in addition to baseline)		
6	Revenues scope extension	n.a	+81	+105
Monetised GHG savings (M EUR)		(values in addition to baseline)		
6	Monetised GHG savings (scope extension)	n.a	+254	+326
Admin burden (3RTA in Million EUR)		(values in addition to baseline)		
6	Manufacturers, authorities, vehicle owners (recurrent)	-4.6	-13.6	-13.7
6	Manufacturers (one-off)	-0.082	-0.082	-0.082
Job creation (in FTE)		(values in addition to baseline)		
6	Manufacturers (qualitative)	n.a	701	829

** Only impacts of measure M31c (EPR and collection) are assessed.*

7.2 Cost benefit analysis, cost efficiency, effectiveness, coherence and proportionality

Cost benefit analysis

Based on the quantitative information available for most policy options (see section 7.1), a presentation and comparison of the benefit - cost ratios (BCR) of the different options is presented in Table 15. A BCR ratio above 1 identifies those options where the benefits outweigh the costs. The higher the ratio, the higher the 'return on investment'.

For these ratios, all quantifiable costs and revenues for the policy options, including recurring administrative burden, are taken into consideration. The benefits include revenues linked to additional material recovery as well as the environmental benefits in the forms of GHG savings which could be monetised. The costs include all treatment costs (including investment costs) and lost revenue potential in the case of export reduction. Due to their different nature or insufficient data, other external environmental costs or revenues, like health benefits, reduced air pollution (in developing countries due to higher quality exported vehicles), or the externalities related to reduced energy consumption, fossil fuel and raw material dependencies are not monetised. Therefore, the values of Table 15 are to be regarded as conservative estimates for the full societal benefits.

All detailed costs and benefit breakdown are presented in Tables 8.28 – 8.32 of Annex 8.5.2. This also includes a description of the key assumptions and allocations in the case of policy options 2 and 3 that are closely related. Here, specific allocations are applied to enable a fairer and more comparable benchmark for the steel and plastics recycled content targets, based on **direct** costs and benefits for the combined effect of the recycling efforts for these materials (PO3) that simultaneously enable the uptake of recycled content (PO2). See Annex 8.5.2 for the details and specific assumptions applied.

Table 15 Benefit – costs ratios (BCR) per policy option, 2035

Benefit / Cost ratios (2035, compared to baseline, including recurrent administrative costs)	**Policy options**			**Preferred** (individually)	**Preferred** (combined + EPR)
EUR per ton of CO2 reduction	(values in addition to baseline)				
PO1 3RTA	**PO1A**	**PO1B**	**PO1C**		
B/C ratio 3RTA	Not assessed quantitatively				
PO2 + PO3 Steel recycled content	**PO2A**	**PO2B**	**PO2C**		
B/C ratio design + production, steel RC *1	N.A.	1.69	2.38	N.A.	N.A.
PO2 + PO3 Plastics recycled content	**PO2A**	**PO2B**	**PO2C**		
B/C ratio design + production, plastics RC *2	0.96	1.21	0.94	1.21	1.21
PO3 Recycling	**PO3A**	**PO3B**	**PO3C**		
B/C ratio recycling *3	0.99	1.22	1.03	1.22	1.24
PO4 Collection	**PO4A**	**PO4B**	**PO4C**	**PO4D**	
B/C ratio collection (incl. export)	3.97	3.51	2.09	2.73	2.67
PO6 Scope extension	**PO6A**	**PO6B**	**PO6C**		
B/C ratio scope extension	Not assessed	3.72	Not fully assessed	3.72	3.72
Benefit / costs ratio				**1.57**	**1.58**

**1 This includes the costs for removal of steel parts at ATFs originally allocated to PO3, *2 This includes the avoided emissions from plastics incineration originally allocated to PO3 for the plastics recycled under PO2, *3 This excludes the costs and avoided emissions allocated to PO2 (see Annex 8.5.2 for details and assumptions)*

For **PO2B** and **PO2C** for the steel recycled content, the potential BCR lies significantly above 1 indicating important monetised CO_2 savings compared to the related costs for dismantling, sampling and sorting. It must be noted however that there is significant uncertainty on a number of important factors which are critical to set out directly in the future

legislation an adequate level for a recycled content target for steel in new vehicles (see below for more elements on this).

For plastics, the BCR is lower, with relatively speaking higher investments to realise the monetised CO_2 credits in this case. Only **PO2B** has an acceptable BCR of 1.21. In the case of **PO2A**, the BCR slightly below 1 is due to relatively high investment costs for a smaller volume of plastics. For **PO2C**, a more constrained supply-demand balance and higher quality constraints to meet the closed loop share results in higher estimated costs of recyclates compared to the more optimal balance for **PO2B**. It should be noted that besides the economic revenues of material and energy savings, there are non-monetised environmental benefits like the external costs of fossil-fuel savings of 1.4, 4.5 and 5.4 billion Barrels of Oil equivalent for respectively **PO2A, PO2B** and **PO2C**, reduced plastic waste volume and health benefits as specified in Section 6.2.3.

For the recycling policy options, **PO3B** (incl. PO3A measures) shows the most attractive benefit/ costs ratio where the material revenues from improved separation (1.15 billion EUR) plus monetised CO_2 savings (0.84 billion EUR plus 0.2 billion from avoided incineration) together outweigh the significant costs (1.50 billion EUR and 0.05 billion EUR removal costs) to achieve the improved treatment quality.

All collection options have a high BCR ranging from above 7 for **PO4A** to above 2 for **PO4C** and the cumulative option **PO4D.** Here, it should be noted that in absolute terms, the GHG savings are increasingly significant with **PO4D** having more than a tenfold value of +5.2 million tons of CO_{2eq} compared to +0.4 and +1.5 million tons for respectively **PO4A** and **PO4B**. **PO4D** is thus by far the **most effective** option with a net monetised result of +1,1 million EUR. Moreover, the higher collection volume further amplifies the recycling results of PO3 in particular and improve the availability of materials for the recycled content targets of PO2 (see Section 8.2).

PO6B (including PO6A measures) has a comparable BCR to the PO4 options of 3.7, reflecting the relatively high environmental benefits and increased revenues vs limited costs, linked to the additional treatment of lorries, buses and L3e-L7e category vehicles.

Cost – efficiency: cost per ton of CO2 avoided

To further compare the costs of the reduced GHG savings as a key decarbonisation objective of the proposal, Table 16 shows the costs per ton of CO_{2eq} avoided for the different options. It shows that the cumulative **PO4D** collection measures and particularly the roadworthiness requirement upon export in combination with all other measures has the lowest cost of only 43 EUR per ton of CO_2 reduction due to more recycling in the EU. This is followed by the **PO2B** recycled steel. Here the assessment is based on the combination of impacts including the costs for the **PO3B** (including PO3A measures) recycling improvement options, consistent with the same allocations as for the benefit - cost ratios highlighted under Table 15 above. The results for steel are thus indicative as the costs of creating higher purity scrap allocated to **PO3B** are related to both the removal of steel parts (allocated to PO2) as well as copper parts from the steel fraction (allocated to PO3 as a separate target material). For the steel recycled content, the costs of **PO2B** and **PO2C** are respectively 88 EUR and 29 EUR per ton.

Similarly for plastics, again based on the same allocations as for the benefit - cost ratios highlighted under Table 15 above, **PO2B** for plastics has a cost of 109 EUR per ton of CO_2 avoided and is more efficient compared **PO2A** with relatively high investment costs for a relatively low amount of plastics, resulting in over 200 EUR per ton of CO_{2eq}. For the higher volumes of **PO2C**, high prices of recyclates lead to a cost of 270 EUR per ton of CO_{2eq}.

Table 16 Cost per ton of GHG reduction for the various policy options, 2035

Costs per ton of CO_{2eq} avoided (2035, compared to baseline, including recurrent administrative costs)	**Policy options**			**Preferred** (individually)	**Preferred** (combined + EPR)
EUR per ton of CO2 reduction	(values in addition to baseline)				
PO1 3RTA	**PO1A**	**PO1B**	**PO1C**		
Production (3RTA)	Not assessed quantitatively				
PO2 Steel recycled content	**PO2A**	**PO2B**	**PO2C**		
Production + **recycling** (steel RC) *1	N.A.	€ 88	€ 29	N.A.	N.A.
PO2 Plastics recycled content	**PO2A**	**PO2B**	**PO2C**		
Production + **recycling** (plastics RC) *2	€ 257	€ 109	€ 270	€ 109	€ 109
PO3 Recycling	**PO3A**	**PO3B**	**PO3C**		
Recycling (excl. costs plastics/steel) *3	€ 231	€ 108	€ 203	€ 108	€ 103
PO4 Collection	**PO4A**	**PO4B**	**PO4C**	**PO4D**	
EUR/ton CO2, collection + export	< 0	€ 23	€ 86	€ 43	€ 50
PO6 Scope extension	**PO6A**	**PO6B**	**PO6C**		
EUR/ton CO2, scope extension (L+HDV)	n.a.	€ 8	n.a	€ 8	€ 8
				€ 69	**€ 72**

**1 This includes the costs for removal of steel parts at ATFs originally allocated to PO3, *2 This includes the avoided emissions from plastics incineration originally allocated to PO3 for the plastics recycled under PO2, *3 This excludes the costs and avoided emissions allocated to PO2 (see Annex 8.5.2 for more details)*

Efficiency, effectiveness, coherence and proportionality

Below Table 17 provides a summary of the comparison of the options based on the two key criteria that are quantified regarding 'effectiveness', for which the absolute GHG savings are used as the primary parameter and 'efficiency', from the previous Table. For PO1 and PO6 a more qualitive comparison is performed, as well as for the criteria of 'coherence' and 'proportionality' are provided. A more detailed description and the reference to all the individual instances in the supporting study are provided in Annex 8.5.2

Table 17 Comparison of options compared to the general objectives, effectiveness, efficiency, coherence and proportionality

PO1. Design Circular	**PO1A**	**PO1B**	**PO1C**
Effectiveness	(++)	(++)	(+++)
Efficiency	(++)	(++)	(+++)
Coherence	(+)	(++)	(+++)
Proportionality	(++)	(+++)	(+++)
PO2. Steel Recycled Content	**PO2A**	**PO2B**	**PO2C**
Effectiveness	(o)	(+)	(++)
- incl. GHG savings (kton CO_{2eq})	0	+585	+1,404
Efficiency	(o)	(++)	(++)
- Benefit Cost Ratio (BCR)	N.A.	1.7*	2.4*
Coherence	(o)	(+++)	(++)
Proportionality	(o)	n.a.	n.a.
PO2. Plastics Recycled Content	**PO2A**	**PO2B**	**PO2C**
Effectiveness	(+)	(++)	(++)
- incl. GHG savings (kton CO_{2eq})	+426*	+1,313*	+1,599*
Efficiency	(-)	(+)	(-)
- Benefit Cost Ratio (BCR)	0.96*	1.2*	0.94*
Coherence	(+)	(+++)	(++)
Proportionality	(o)	(+)	(--)
PO3. Treat Better	**PO3A**	**PO3B**	**PO3C**
Effectiveness	(++)	(+++)	(++)
- incl. GHG savings (kton CO_{2eq})	+1,042*	+2,689*	+1,656*

(+++)	(+++) highly positive
(++)	(++) moderately positive
(+)	(+) slightly positive
(o)	(o) neutral/ baseline
(-)	(-) slightly negative

Efficiency	(-)	(+)	(o)	
- Benefit Cost Ratio (BCR)	0.91*	1.2*	0.99*	
Coherence	(++)	(+++)	(+)	
Proportionality	(+)	(+++)	(-)	
PO4. Collect More	**PO4A**	**PO4B**	**PO4C**	**PO4D**
Effectiveness	(+)	(++)	(+++)	(+++)
- incl. GHG savings (kton CO_{2eq})	+353	+1,513	+3,222	+5,218
Efficiency	(+++)	(+++)	(++)	(++)
- Benefit Cost Ratio (BCR)	4.0	3.5	2.1	2.7
Coherence	(+)	(+)	(++)	(++)
Proportionality	(++)	(++)	(+)	(++)
PO5. EPR	**PO5A**	**PO5B**	**PO5C**	
Effectiveness	(++)	(+++)	(+)	
Efficiency	(+)	(++)	(+)	
Coherence	(++)	(+++)	(++)	
Proportionality	(+)	(+++)	(++)	
PO6. Cover more vehicles	**PO6A**	**PO6B**	**PO6C**	
Effectiveness	(-)	(++)	(++)	
- incl. GHG savings (kton CO_{2eq})	n.a.	+1,120	n.a.	
Efficiency	(+)	(+++)	(-)	
- Benefit Cost Ratio (BCR)	n.a.	3.7	n.a.	
Coherence	(+)	(++)	(+++)	
Proportionality	(+)	(++)	(--)	

(--)	(--) moderately negative
(---)	(---) highly negative
n.a.	not assessed

** Based under the same PO2/PO3 assumptions as applied to Table 15 and 16*

The analysis reveals a range of consistent performances for almost all criteria for **PO1C**.

PO2C for recycled content of plastics has a lower score for proportionality, due to constraint availability of plastic recyclates. Both **PO2A** and **PO2C** for plastics have a benefit – cost ratio below 1, even when the monetised GHG savings of avoided incineration are added to the revenue side. The plastics recycling volume of **PO2B** appears to offer the best balance in costs and revenues.

For steel recycled content, **PO2A** is less efficient than **PO2B** and **PO2C**, however there are significant uncertainties in setting an appropriate target level, which make it difficult to derive a reliable assessment of the proportionality of the targets.

PO3A and **PO3C** (incl. PO3A and PO3B measures) have a benefit – cost ratio below 1 as well. The proportionality of **PO3C** is scoring low as the additional removal costs of materials and components are very costly compared to **PO3B** (incl. PO3A).

PO4C with the roadworthiness requirements upon export has a very significant impact on GHGs savings and therefore a higher effectiveness than PO4A and PO4B. It will also affect directly specialised car dealers exporting (low quality) used vehicles. The export requirements are proportionate: they do not set up a blanket ban on the export of used cars (even those above a certain age) but only require that used vehicles are roadworthy in compliance with Directive 2014/45/EU as a condition for export. Car dealers wishing to export a used vehicle whose roadworthiness certificate has expired can do a periodic technical inspection (PTI) to obtain a new certificate. This requirement is also consistent with the legislation applying in the EU as a vehicle which is not considered roadworthy cannot legally be driven on the EU roads. The cumulative **PO4D,** which combines measures from **PO4A, PO4B** and **PO4C**, has the maximum effectiveness as it provides for complementary measures applying both to (i) missing vehicles in the EU and (ii) ELVs and used cars exported outside the EU to ensure a higher collection in the EU.

PO5B (incl. PO5A measures) offers advantages of increasing harmonisation in the implementation of EPR requirements across the EU, whereas leaving room to member states for the market specific implementations. The measures under **PO5C** (incl. PO5A and PO5B measures) would be difficult to apply uniformly across the EU and may be unacceptable from a subsidiarity point of view (criterium not displayed in Table 17). Therefore, **PO5B** for EPR is the most effective, coherent and proportional choice.

PO6B (incl. PO6A measures) provides relevant environmental benefits. They are higher than PO6A which provides only limited benefits (even though they cannot be quantified). As indicated above, the impacts of **PO6C** cannot be completely quantified) but will certain generate important costs and would not be proportionate. In that respect, **PO6B** is a coherent and proportionate approach to increase circularity a harmonised manner in sectors which are currently not subject to any specific EU legal requirements.

8 PREFERRED POLICY PACKAGE

Based on above comparison of options, the preferred policy package is a combination of the following options: **PO1C** (incl. PO1A and PO1B measures) for the design stage; A mix of choices for policy option 2: **PO2A**, M10a for recycled content for steel, **PO2B**, M9b for plastics and the empowerment for the Commission to establish targets for materials other than plastics and steel from **PO2C**, M11; **PO3B** (incl. PO3A measures) for waste management; the cumulative approach for **PO4D** for collection; **PO5B** (incl. PO5A measures) for economic incentives and EPR and **PO6B** (incl. PO6A measures) enabling a phased-in approach for the scope extension. These choices are explained below.

These options are included in this preferred policy package as they are the most effective and efficient in addressing each of the specific problems identified in section 2, first on their own merits. Second, the options are also mutually supportive and **together** form a carefully balanced package as explained at the end of section 8.1.

8.1 Preferred options

Design circular: PO1C, including all **PO1A** and **PO1B** measures (M1-3,M4c,M5c,M6-M8), is the preferred option. It anchors the circularity requirements as an important element of the type-approval of new vehicle types. It contains a mix of short term obligations (requirement for vehicle manufacturers to make available detailed and user-friendly dismantling and recycling information, including the use and location of CRMs in vehicles and on the share of recycled content used in new vehicles; follow-up on manufacturers' obligation to ensure recyclability and re-usability of type-approved vehicles through circularity strategies) and actions on a medium term (revision of the methodology to calculate recyclability and re-usability of new vehicles at type-approval stage and the development of an Circularity Vehicle Passport). This provides an ambitious, cost-effective and proportionate package to improve the circularity in the design of vehicles. For the substances in vehicles, the preferred option is to cover all new restrictions of substances in vehicles under REACH[152], the Union's core chemicals legislation, while existing restrictions on four substances in vehicles (and their associated exemptions) would remain regulated under the ELV/3RTA legislation.

Feedback from affected stakeholders: Many stakeholders from the automotive manufacturing sector stressed that they have embarked into the transition to circularity and that only minimal amendments were needed to the applicable legislation. They also specifically requested to consider other design-related compliance demands related to safety and climate neutrality requirements to avoid conflicting requirements. They often oppose the

[152] Or, for substances identified under the Stockholm convention as Persistent Organic Pollutants, addressed under the POPs Regulation [Regulation (EU) 2019/1021]

merger between the ELV Directive and the 3R TA Directive. A few of them however are in favour of addressing better design for recycling provisions in the new legislation, to ensure a level playing field and better transparency. The dismantling and recycling sectors (mostly SMEs) are calling for more ambitious legislation on the design for dismantling/recycling and on the sharing of information from vehicle manufacturers to help dismantling. Environmental NGOs, waste management authorities and public authorities are almost unanimously in support of a life-cycle approach covering all stages of the lifecycle and consequently to address the design for circularity measures.[153]

Use recycled content: The preferred option includes a mix of the following measures: M9b for plastics, M10a for steel and M11 for other materials.

The ambition level of **PO2B,** M9b is the preferred option for **plastics** with recycled content targets of 25% applicable to newly type approved vehicles by 2031, of which 25% closed-loop. It provides a significant increase to the recycling of plastics from ELVs and lower the carbon footprint linked to the use of plastics in new vehicles. The **PO2B** level provides the best-cost-benefit balance, avoids excessive costs and risks of supply shortage, and offers most certainty for manufacturing planning.

For steel recycled content, all options can provide significant GHG savings and an important 'pull effect' to better utilise ELV steel scraps in the future, but to a different degree and in different stages. They complement the 'push effect' for increased quality of steel scrap defined under **PO3B** and enhance cooperation between manufacturers, steel industry and recyclers. The ambition level of **PO2A** (M10a) takes best into account the need to further address the uncertainty related to the ability of the automotive producers to increase the incorporation of steel scrap, in particular post-consumer scrap, in new electric vehicles[154]. The advantages of **PO2B** would be that creating a pull to increase scrap utilisation in steel production can achieve faster decarbonisation of production compared to other, more long-term technology conversions and it reduces the need for natural gas, coal and iron-ore in steel production more short-term, provided high quality scraps are made available. **However, the uncertainty in setting an appropriate target level directly in the future legislation is too high.** This is due to uncertainties about (i) the future share of long products (more likely to be able to include recycled steel) in EVs; (ii) current uptake levels of post-consumer scrap in flat production; (iii) the share of pre-consumer versus post-consumer in current scrap utilisation rates and finally about (iv) the impact of such target on the availability and prices of scrap for other steel-demanding sectors. In that regard, the establishment of a steel recycled content target under **PO2B**, M10b, presents the risk to define the target level too low with the consequence that it would not form an actual incentive to higher post-consumer scrap uptake levels. **PO2C,** M10c with the higher target and closed loop percentage may reduce flexibility in the sourcing of post-consumer scrap and is therefore not selected. **PO2A**, M10a is **the preferred option** in the case of steel.

Other recycled content targets for materials like aluminium and other CRMs like magnesium and REE permanent magnet materials cannot yet be substantiated as automotive designs are changing fast and recycling markets are very dynamic with significant progress in sorting technologies. Aluminium is a complex material with a range of alloy types involved and complex logistics to achieve sufficient economies of scale from treatment from sorted alloy families. It is further challenging to establish specific recycled content targets for each type. There are many economic factors to consider, e.g. demand and market value, recycling

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

[154] Notably linked to the future share of steel long products in electric vehicles, which are the best candidates for such incorporation

feasibility and profitability of each type, when determining targets for individual alloys. For these materials, the combination of the mandatory recycled content declaration under **PO1C** and the treatment requirements of **PO3B** are regarded adequate for the short term, but an empowerment for the Commission to come forward with recycled content targets for additional materials (such as CRMs, and aluminium) is foreseen within 5 years after the entry into force of the new legislation, if this proves necessary in the future (**PO2C**, M11).

Feedback from affected stakeholders: Strong support was expressed for recycled content targets from the recycling and dismantling sectors, which are mostly composed of SMEs, and by civil society organisations. The automotive sector was more split on the opportunity to set such targets for plastics, mentioning possible lack of supply of recyclates meeting the specifications of their sector, as well as advocating that any possible future target should include pre-consumer waste and allow for chemical recycling. The plastics industry also insisted that chemical recycling was needed to increase recycled plastics in vehicles. The steel industry did not express support for recycled steel target, with EUROFER indicating that higher ELV scrap target will compete with (hydrogen based) EAF-DRI in the future as part of long-term investments in 'green steel'. The automotive sector is divided: individual vehicle manufacturers have been developing a proactive approach in increasing the use of recycled content, as a key element in their decarbonisation policy. Several car manufacturers acknowledge difficulties in sourcing steels with recycled contents above 25%. The recycling sector sees a steel recycled content target as essential to help securing their supply of high-quality steel scrap and compensate for their investments to improve it. ACEA explicitly stated the need for sufficient lead time to adjust supply chains to new recycled content requirements.

Treat better: PO3B (including measures (M12, M13a-b,M14a-b,M15b,M16a-b) related to **PO3A** as highlighted in Table 1) **is the preferred option**, as it most effectively addresses the complexity of improving recycling quantity and quality for a wide variety of different materials present in ELVs. The GHG savings are higher and the costs are lower for **PO3B** in comparison to **PO3C**. The stricter definition of "recycling" and restrictions on landfilling will ensure that residues from shredding are effectively recycled or recovered, rather than backfilled or landfilled. This option also contains specific and cost-effective measures for each of the materials and different types. The removal obligations prior to shredding of **PO3B** allow for substantial progress to recover and recycle batteries and electric drive motors from EVs and other parts/components containing plastics, precious metals and CRMs, which are associated with the electrification of the fleet and the wide use of electronics in new vehicles (M13a, M13b). To remain technology-neutral, a derogation from this obligation would apply when recyclers provide verifiable evidence that separation leads to recyclates of at least similar high quality as via manual dismantling. The **PO3B** ban on mixed treatment and mandatory removal and separate recycling of e-drive motors would thrive the permanent magnet recycling value chain and generate new flows of CRMs for further recycling. It is estimated that respectively circa 2.4 kton and 4.2 kton of permanent magnet flows would be made available in 2035 and 2040 for high quality recycling from future EU ELVs. The separate sorting and recycling of e-drive motors will have a positive impact on innovation and R&D in the EU. The available e-drive motors thanks to this option would thrive research, innovation and the development of new recycling technologies to increase the recovery of SRM, especially CRMs. It would further decrease copper contamination in steel and aluminium scraps from ELVs.

Feedback from affected stakeholders: The most common responses supported measures to improve the separate recycling of materials from ELVs, to increase their quality. The dismantling and recycling sectors pointed out that these measures would increase their costs.

EuRIC and BVSE[155] expressed strong concerns in case removal obligations would be strictly interpreted as a manual dismantling approach, which could lead to excessive costs and hamper innovation in (semi)-automated pre-treatment and PST.

Collect more: PO4D, which encompasses all measures (M17b, M18, M19a-c, M20, M21) of **PO4A**, **PO4B**, and **PO4C** as outlined in Table 1, represents the preferred option. Table 4 confirms that this combination is the most effective means of achieving the objective of increased ELV collection. Additionally, Table 15 demonstrates that this combination provides a high cost-benefit ratio at the same time. The traceability of used vehicles and ELVs would be improved through (i) a clearer allocation of responsibility for the issuing and reporting of the certificate of destruction (CoD) among economic operators and competent authorities and (ii) the integration of additional information in national vehicle registration systems and their interoperability between Member States. To address the illegal export of ELVs and reduce export of non-roadworthy vehicles, binding criteria for the distinction between used vehicles and ELVs would be established as well as (M19b) a requirement that the export of used vehicles is only authorised if it can be verified that the vehicle concerned is roadworthy. (M21). New provisions on enforcement would also help addressing illegal treatment and export of ELVs. The impact of these measures should be significant in terms of bringing additional ELVs for treatment to legal ATFs in the EU and reducing the EU external environmental footprint linked to the export of vehicles which are not roadworthy.

Feedback from affected stakeholders: There was strong support from stakeholders to adopt ambitious measures to address the persistent problems of "missing vehicles", including through stricter conditions on the export of non-roadworthy used vehicles.

Financial and organisational incentives: PO5B (including all measures (M22-M25) related to **PO5A** as highlighted in Table 1) is the preferred option, providing substantial incentives for a better functioning of the recycling market via the establishment of an obligation for producers to increase collection of ELVs and cover costs of dismantling efforts that cannot be offset by the trade in used parts or recyclates. This will also help reducing illegal practices[156]. To ensure harmonisation on how fees are calculated across the EU and further create design incentives leading to lower future recycling costs, this option sets out criteria on how EPR fees are to be modulated, such as the weight of the vehicle, the time to dismantle components such as the battery and amount of recycled content. In addition, it sets out a mechanism to ensure that fees by vehicle manufacturers are paid to recyclers, in the case where the vehicle is treated as an ELV in an EU Member State different than the one where it was placed on the market ("cross-border" EPR mechanism). This takes account of the important volume of intra-EU movements of used vehicles. It is particularly relevant for waste operators located in Member States which have a large share of old used vehicles in their fleet, as these vehicles often become waste and are treated in these Member States, while many of these vehicles were placed on the EU market as new vehicles in another Member State.

Feedback from affected stakeholders: Many vehicle manufacturers pointed out that the dismantling sector is profitable under normal market conditions and does not need extra financial compensation. Some of them stressed that they should be entitled to exercise their producer responsibility duties through individual schemes, and not be obliged to join Producer Responsibility Organisations. Stakeholders from the dismantling, shredding and recycling sector pleaded for more financial responsibility from the automotive industry to cover extra costs linked to increased collection and improved waste management, but also

[155] EuRIC-European Recycling Industries' Confederation, BVSE - Bundesverband Sekundärrohstoffe und Entsorgung
[156] Umweltbundesamt,(2022), Illegal treatment of end of-life vehicles - Assessment of the environmental, micro- and macroeconomic effects, texte 130/20 22

underlined that EPR obligations should not reduce their independence and called for clear safeguards in future schemes in this regard.

Cover more vehicles: PO6B (including the information provision measures M28 from **PO6A** plus M30a-b,M31b,M32) as highlighted in Table 1) is selected as the preferred option for the scope extension to L3e-L7e category vehicles, lorries, buses and trailers. It sets out basic requirements for environmental protection and minimum recycling quality via (i) the provision of information by manufacturers on composition of these vehicles, (ii) the obligation that lorries, buses and L3e-L7e category vehicles reaching end-of-life shall only be treated in authorised treatment facilities (ATFs), (iii) new rules on the export of lorries and busses and (iv) the establishment of manufacturer's responsibility for the collection and reporting for these vehicles (basic EPR scheme). These requirements are reaching less far than those applying to M1-N1 vehicles, providing more moderate environmental benefits, at a limited cost. They represent a "phased-in" approach, i.e., a starting point to put these vehicles on a path to more circular business models, initiating a change in practices and allowing to gain additional information which could pave the way for more ambitious measures in the medium to long-term.

Feedback from affected stakeholders: Almost all stakeholder categories participating in the open public consultation were in favour of extending the Directive to additional vehicles, including all environmental NGOs, absolute majority of public authorities and waste management operators who were mainly represented by SMEs. For automotive producers and suppliers, more companies were in favour rather than against, but most of them indicated that a full extension of the scope to new vehicles would not be desirable in the short term, in view of the differences between these vehicles and the vehicles currently in the scope of the ELV and 3RTA Directives.

Interlinkages and synergies between the options in the preferred policy package

The preferred policy package offers the best choice of combination of options, as it addresses in a synergetic way all the objectives of this review and apply to all relevant stakeholders in an equitable manner[157]. The options retained in the preferred package are closely interlinked and mutually supportive, as illustrated by the following examples

- The measures under the preferred option **PO1C** on design and type-approval (for example requirements for vehicle manufacturers to develop circularity strategies and provide better information to dismantlers and recyclers) will greatly support implementing the preferred measures under **PO3B** on waste treatment (for example removal and selective treatment by the dismantlers of components and parts, to allow for higher quality recycling and higher rate of re-use of spare parts).
- The measures under **PO3B** are needed to allow for a higher uptake of recycled materials, such as plastics, steel and CRMs in new vehicles, and thereby implement the preferred measures under PO2. At the same time, the measures on recycled content in PO2 are essential for the success of measures under PO3: they will boost the market for secondary materials, ensuring that a steady supply of high quality recyclates from ELVs will find its way for incorporation into new vehicles, thereby supporting the economic viability of measures under PO3.
- The increase in collection of ELVs generated by the preferred measure under **PO4D** increases the overall effectiveness of the package**.** It provides much higher amounts of

[157] The guidance provided in Tool 16 of the BRG (figure 1b in page 118), ie assessing measures for each objective first separately and selecting the best ones which should feature in the preferred package and then compute the synergies, is followed. This is applied with a computational order in the impact assessment as explained in Annex 4.2.2

materials to be treated from ELVs collected more and directly amplifies the recycling impacts (PO3) and availability of recycled content (PO2).

- The economic and governance incentives provided under **PO5B** are in turn essential to ensure that the costs for the new measures under PO3B and PO4C are equitably shared between dismantlers, shredder, recyclers and vehicle manufacturers, so that they can be implemented in cost-effective manner and have a maximised impact.

The choice of the preferred package of options PO1 to PO5 is therefore based both on the individual performance for each option in meeting its corresponding specific objective, but also on its impact in facilitating and maximising the implementation of other objectives. Other combinations of options, in particular those for PO4 and PO5 providing significant synergies for the recycling potential of PO3 and the recycled content of PO2, would provide a lower performance in this regard.

The option on the extension of scope (PO6) has less direct links with the other options, as it applies to different segments of the automotive sector. The preferred option (**PO6B**) consists in the best performing one for putting these segments on a path to more circular business models, taking fully into account the principle of proportionality: the measures proposed would represent limited new obligations in the short to medium term, avoiding the imposition of excessive costs or burdens.

8.2 Combined impacts of the preferred policy package

The combined impacts of the preferred policy package are presented in Table 18. They are calculated for the year 2035 and compared to the baseline scenario. Data for 2030 and 2040 are provided in Annex 8.5. Compared to the impacts presented per policy option in Section 6, there are significant synergies when applied in combination as explained in Section 8.1.

The overall environmental benefits are assessed as an **annual reduction of 12.3 million tons of CO_2-eq in 2035** (10.8 million tons in 2030 to 14.0 million tonnes in 2040), key for the decarbonisation of the automotive industry. These CO2 savings represent **2.8 billion EUR when monetised.** This is linked notably to a **better valorisation of 5.4 million tons of materials** (plastics, steel, aluminium, copper, CRMs) which would be either recycled at higher quality or re-used, as well as to the fact that **up to 3.8 million additional ELVs would be collected and treated** extra in the EU. **350 tons of rare earths** in permanent magnet materials would be separately collected for reuse and recycling in 2035 (1,500 tons in 2040), which would **contribute greatly to the EU efforts for strategic autonomy for CRMs.**

The total annual revenues for the preferred option is 5.2 billion EUR in 2035, including 2.8 billion EUR of monetised GHG savings, **against a cost of 3.3 billion EUR, leading to a 1.8 billion net revenue. The cost of the preferred option is determined at 66 EUR for all new vehicle put on the market in 2035**. The estimated **additional jobs are determined at 22,100**, of which **14,200 are created in SMEs.**

The overall costs for public authorities are estimated to reach 24 million EUR (less than 2 EUR/vehicle), mostly linked to the supervision of EPR schemes, enforcement activities (in particular inspection campaigns and control on export of ELVs and used vehicles[158]) and adaptation of national vehicles registration systems. The various measures on digitalisation of procedures[159] will increase efficiency for enforcement authorities and economic operators, and alleviate their burden.

[158] Costs related to enforcement measures M17,M19 and M21 are specified in Annex 3.2 in Table 3.5 in detail.

[159] Digital reporting on certificate of destruction; exchange of information from national vehicle registries via digital means; interoperability with single windows system to allow customs to act on export-related measures

Table 18 Total environmental benefits and costs and per vehicle for the preferred option in 2035

	Environmental impacts (2035, compared to baseline)	**Preferred option**	**Economic impacts** (2035, vs. baseline, incl. admin burden)	**Preferred option**
PO	**All life-cycle stages** (in kton of materials)		**Design + production** (M EUR, - = cost, + =revenue)	
2	Steel recycled content	+0	Manufacturers (incl. admin burden)	-430
2	Plastics recycled content	+713	Admin burden authorities	-23
3	Materials at higher quality (recycling)	+2,322	**Collection + recycling** (M EUR, - = cost, +=revenue)	
4	Materials recovered (collection + export)	+1,876	Consumers, vehicle owners (incl. admin burden)	-153
6	Materials recovered (scope extension)	+508	Car dealers (export requirements)	-574
	Total materials recycled at HQ (kton)	**+5,420**	ATFs	-40
ELVs collected, treated +reported (M units)		**8.2**	Shredders/PST operators	-110
4,5,6	Extra ELVs to ATFs and CoD reported	+3.8	Recyclers (incl. plastics, steel RC)	+375
4,5,6	Non-reported treatment	-1.7	Admin burden treatment	-42
4,5,6	Export of ELVs/used vehicles	-2.1	**Collection+recycling** (M EUR, - =cost, + =revenue)	
GHG savings (ktons of CO2-eq)			Total costs (all)	-€ 3,417
1,2	GHG savings production (steel RC)	+0	Total revenues (all)	€ 2,420
2	GHG savings production (plastics RC)	+314	**Total** (M EUR, excl CO2 credits)	-€ 997
3	GHG savings recycling (N1,M1)	+4,536	**Total** (M EUR, incl CO2 credits)	€ 1,797
4	GHG savings collection + export (N1,M1)	+6,350	**Total** (EUR/ vehicle, excl. CO2 credits)*	**-€ 66.34**
6	GHG savings scope extension (L+HDV)	+1,120	**Total** (EUR/ vehicle, incl. CO2 credits)*	**€ 119.58**
	GHG savings (ktons of CO2-eq)	**+12,320**	Average cost GHG savings (EUR/ton)	**-€ 80.91**

** Represents all costs and benefits allocated to all new vehicles, including the scope extension and recurring administrative burden; The net costs per new N1,M1 vehicle, e.g. excluding the scope extension, is 65.01 EUR, see Annex 8.5.4 for all vehicle numbers and disaggregated numbers per vehicle category*

The costs and revenues for the different stakeholders affected by the preferred option, calculated per vehicle and for all stages of the process (type-approval, design, production, collection, waste treatment, export), are estimated as follows:

- **For vehicle manufacturers**, the net costs linked to production and design, primarily related to plastic recycled content, would represent roughly 26 EUR per vehicle (N1,M1, 392 million EUR adjustment costs, 38 million EUR administrative burden for the manufacturer and 23 million EUR administrative burden for authorities). In addition, the costs linked to collection and treatment (150 million EUR not covered by revenues, including administrative burden for treatment of 42 million EUR) which could potentially be covered by the manufacturers under the EPR schemes would amount to 12 EUR per new vehicle[160]. The total costs (580 million EUR) for manufacturers (production + EPR fees) of 39 EUR per new vehicle are expected to be ultimately covered by the consumer when buying a new vehicle. These are short to medium-term costs for the EU automotive industry. The preferred option would also reduce its energy and strategic raw material dependencies and provide for important savings. While these revenues cannot all be quantified, they are expected to be significant and spill over to the whole automotive supply chain (see section 8.3 for more elements on this point);
- **For the waste treatment sector**, the costs (530 million EUR) for **ATFs** of 44 EUR per vehicle, mainly from dismantling efforts, slightly outweigh anticipated revenue increases (490 million EUR) of 40 EUR per vehicle. Similarly, for **shredders**, the 101 EUR of extra cost per vehicle (1,230 million EUR in total) mainly from new investments in better sorting technologies compares against a 92 EUR of revenue potential (1,120 million EUR). In these two cases, the differential between costs and revenues is expected to be covered by fees from manufacturers under EPR schemes. It is important to stress that the

[160] The sensitivity analysis shows for the EU as a whole, the EPR fee may range between 3 EUR and 33 EUR per vehicle placed on the market. See Annex 8.2.5 for more details.

situation will considerably differ between Member States and economic operators, depending on the current treatment technologies used (esp. availability of PST) and labour costs. For **recyclers**, due to increased materials availability (incl. CRMs removed) and improved prior separation in previous stages, the revenue potential of 49 EUR per vehicle (440 million EUR) clearly outweighs a 29 EUR per vehicle cost increase (770 million EUR). The combined administrative burden for treatment operators is 3.50 EUR per new vehicle. The preferred option would also reinforce and boost the recycling sector, encouraging its modernisation and expansion. The preferred option would favour innovation in new processes and technologies, for sorting and high-quality recycling, building on current research[161].

- **For specialised car and heavy-duty vehicle exporters**, the revenue loss is expected to reach around 47 EUR per new vehicle sold (570 million EUR);
- For **consumers**, in addition to a likely increase in prices of new vehicles of around 39 EUR per vehicle (aforementioned 580 million EUR), they might also expect a decrease in prices when selling second-hand cars due to reduced export there of 12 EUR per vehicle (150 million EUR), but should also be able to benefit from cheaper prices for used spare parts due to all measures designed to support their recovery and sales;
- The **administrative costs for public authorities** (23 million EUR) dealing with type approval, vehicle registration, customs control and ECHA) are 1.40 EUR per vehicle.
- The total **one-off administrative costs** are 2.45 million EUR for manufacturers and 1.55 million EUR for authorities.

Annex 8.5.4 specifies the costs and revenues breakdown per vehicle and stakeholder. It further quantifies the uncertainty in the costs per vehicle, for various scenarios as well as the breakdown for the current vehicle category scope.

8.3 Expected impacts on the competitiveness of the automotive industry

Reducing the negative environmental impacts linked to the design, production, service life and end-of-life treatment of vehicles will contribute to the sustainability of the vehicle production and recycling sectors, but it is also important to discuss the distinct impacts of the initiative on the competitiveness of the automotive industry as a whole. This is especially so in the current context of the transition to climate neutrality, which puts pressures on the automotive industry, requiring significant investments, innovation and new technologies, reorganisation of supply chains and reducing strategic dependencies of raw materials.

Despite the moderate cost increases for the automotive industry[162] resulting from the application of the proposed measures, increased circularity of the automotive sector can grow its competitiveness in several ways.

First and foremost, by increasing the use of recycled materials and reducing waste, vehicle manufacturers can reduce the energy embedded in their products. As evidenced by the substantial GHG savings foreseen for all policy options assessed, increasing levels of ambition in circularity will help manufacturers decarbonise in a cost-efficient way. Some of the measures in the preferred policy package –notably, those related to extended producer responsibility schemes under option PO3– would result in a net transfer of funds from vehicle manufacturers to dismantlers and shredders, for instance to cover necessary recycling technology investments in the short term. However, these funds will ultimately benefit the

[161] Since 2000, under the Horizon 2020 and LIFE, the EU has funded around 100 different projects which have contributed to higher scale of knowledge, expertise in advancement of relevant ELV treatment operations, material recovery. See Annex 12.
[162] See, in particular, the costs per vehicle for the preferred package in section 8.2. The average cost of 65 EUR are modest in relation to the purchase price of a vehicle or the additional cost of an EV as compared to a baseline conventional vehicle and constitute a 0.2% increase in case an average sales price of EUR 38,000 is assumed.

markets for secondary raw materials serving the automotive industry with higher quality recycled materials with a lower environmental footprint.

Secondly, the proposed measures under policy options PO1 and PO2 can help manufacturers reduce their dependence on virgin raw materials, which can be subject to price fluctuations and supply chain disruptions. By using recycled materials and implementing circular processes, vehicle manufacturers will create more resilient supply chains and reduce their exposure to price volatility. This is especially true for CRMs and to increase their recovery from end-of-life vehicles, this initiative sets out that the Commission will develop specific requirements on the design for dismantling, removability and recycling of CRM relevant parts and components from vehicles.

Third, circular practices can create new revenue streams for companies by turning waste into a valuable resource. For example, vehicle manufacturers can sell recycled materials to other industries, or offer recycling services to customers. Some manufacturers are already pursuing innovative business models where they lease EV batteries and take them back from their customers at the end-of-life stage to recycle them to extract valuable materials such as lithium and cobalt.

Fourth, as an indirect benefit, circular practices can enhance a company's brand image and reputation by demonstrating its commitment to sustainability and environmental responsibility. This can, in turn, attract investors which are interested in investing in sustainable products and thereby allowing the manufacturers to benefit of a green investment premium. Furthermore, it can also attract environmentally conscious consumers willing to pay a premium for sustainable products and increase brand loyalty. Several EU manufacturers may be considered front-runners in different aspects of circular production and design. An increased focus on circularity will also help vehicle manufacturers meet the regulatory requirements in non-EU markets and increase the appeal of their products and services.

8.4 REFIT (simplification and improved efficiency)

The preferred option provides for improved efficiency and harmonisation and takes into account majority of suggestions provided in the Fit for Future Platform (F4F) opinion[163]. In terms of the overall regulatory burden, the costs and benefits of the preferred package are considered to be balanced and proportionate to achieve the objectives of the revision. There are higher costs in the short term for applying new requirements related to the vehicle design and improving the quality of ELV treatment which would be offset over time and result in significant GHG savings in the production phase, and higher economic viability of ELV treatment operators[164], while also supporting the competitiveness of the operators across automotive value chain.

Specification of common requirements for vehicle type-approval procedures (e.g. clarification of the type-approval procedure, information requirements) will streamline internal market procedures for manufacturers (PO1-2). Further simplification would result in new restrictions on chemical substances being centralized under REACH, the primary EU chemical legislation (PO1), including the restrictions relevant to the extended vehicle categories (PO6). As regards the treatment of ELVs, the alignment of recycling definition with the Waste Framework Directive will simplify the legal interpretation and will increase comparability of the reporting data by MS (PO3). Setting ELV criteria for EPR schemes will limit diverging approaches in Member States (PO5). This will allow to simplify procedures, and thus would improve transparency. Alignment of requirements for the extended vehicle categories will provide legal clarity for the economic operators of the automotive sector (PO6).

[163] For more information about the selected suggestions from the F4F opinion see Annexes 1 and 5.

[164] Impacts on the affected groups of stakeholders is provided in Annex 3.

8.5 Application of the 'one in, one out' approach

The estimates of administrative costs for the purposes of the Commission's 'one-in-one-out' policy are presented in Table 19 below and in Annex 3. The administrative costs for public authorities and inspection-related activities have been excluded.

Table 19 Costs related to the 'one in, one out' approach

Costs in million EUR	Citizens/ consumers		Businesses	
	One-off	Recurrent	One-off	Recurrent
Administrative costs (for offsetting)	0	2.331	2.452	79.720

Overall, the recurrent costs related to the 'one-in, one-out' approach per vehicle are assessed at 81.8 million EUR or EUR 5.45 per new vehicle for the preferred option package. The preferred option makes a maximum use of the digitalisation potential to ensure efficient enforcement of new requirements, without which the impacts would have been an additional 32.2 million EUR or 40% higher costs. In comparison, streamlining of reporting obligation with existing requirements prevents another 8.8 million EUR or 11% higher costs. The development of digitally accessible documentation through existing platforms and then via the Circularity Vehicle Passport will ensure an efficient access by economic operators, in particular SMEs (e.g. ATFs, garages and repair shops), to information needed to boost circular use of automotive materials. Digitalisation will also play a significant role in increasing the collection of ELV and addressing the problem of "missing vehicles". This will be done through digitalisation of reporting of ELVs by ATFs to competent authorities and by ensuring that Member States authorities exchange digitally the vehicle registration information required to better track used vehicles and ELVs across the EU. ATFs would benefit due to more streamlined issuing and tracking of CoDs[165]. Interconnection with the EU Single Window Environment for Customs would enable customs authorities to enforce new conditions on the export of used vehicles.

8.6 International Aspects

In 2021, the European automobile industry exported 5 million passenger cars, while over 3 million passenger cars were imported to the EU[166]. The sales of new vehicles manufactured outside the EU represent 30% of the overall sales in the EU, while 46% of the vehicles manufactured in the EU are exported[167]. Measures under the preferred option on **design and production** equally apply to domestic and imported products. Exporters to the EU would have to comply with the requirements under type-approval and with the plastics and steel recycled content targets[168]. This would complement other requirements which are mandatory for the placing of a vehicle on the EU market. An assessment of the economic

[165] There is significant synergy between this revision and the general digitalisation of the national vehicle registration system under DG MOVE's revision of the roadworthiness package and Directive 2014/46/EU on vehicle registration documents. The reduced administrative burden from digitalisation of vehicle registration documents is potentially worth up to 1 EUR per vehicle or 9.8 million EUR of recurrent savings in total when fully implemented. This potential 'one-out' saving is fully allocated to DG MOVE's impact assessment and, despite the synergies, not to this proposal.

[166] In 2021, the EU imported 458,769 passenger cars from Türkiye, followed by China (435,080), the United Kingdom (393,410), Japan (401,276), South Korea (377,404), the United States of America (308,506). More information available at: https://www.acea.auto/figure/eu-motor-vehicle-trade-by-vehicle-type-in-units/, https://www.acea.auto/figure/eu-passenger-car-imports-main-countries-of-origin-in-units/

[167] 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.

[168] The recycled plastics and steel could be sourced from within or outside the EU.

impact demonstrates that the proposed new design related requirements[169] would not significantly affect production cost per vehicle. The obligation for vehicle manufacturers and importers to provide information on substances of concern, dismantling of parts/components and of recycled content will be based on digital platforms already in existence or in development by the entire automotive supply chain, regardless of producing inside or outside Europe. The costs linked to financial contributions for **EPR schemes under PO5B** would apply equally to manufacturers of vehicles in the EU and those importing vehicles in the EU, similar as what is foreseen for example for batteries under the future Regulation on batteries.

The improved recycling obligations of **PO3B** may lead to reduced amounts of waste fractions shipped from the EU. This is consistent with the CEAP objective that the EU should take more responsibility for the waste generated in Europe, while respecting the EU's international legal obligations. The proposal is fully consistent with the Basel Convention. For fractions that will be exported for treatment abroad, the approach is in line with the Waste Shipment Regulation that they should be treated in "broadly equivalent conditions' as in the EU. The export limitation for used vehicles which are not roadworthy, combined with all collection enhancing measures and improved traceability via interoperable registers under **PO4D,** ensures vehicles that are not technically fit to be on the EU roads would not be exported and not create safety and environmental (pollution) problems in third countries. The expected export reduction for used passenger vehicles could reach up to 65%. This is a maximum level, based on available studies[170,171] indicating that a large share of used vehicles currently exported are of low quality and value and do not comply with the roadworthiness requirements in accordance with Directive 2014/45/EU. **These export requirements complement actions and policies which have been launched recently by many receiving countries** to improve air quality and road safety, via restrictions on the import of used vehicles based on roadworthiness conditions, age limits or compliance with Euro emission standards[172]. The export measures are justified by the need to address the EU environmental footprint linked are consistent with the EU environmental policy, as reflected notably in the EU Action Plan: "Towards Zero Pollution for Air, Water and Soil"[173]. Additionally, these measures are also consistent with the CEAP and the EU waste policy as they contribute to the implementation of 'waste hierarchy', in particular by preventing non-roadworthy vehicles, which are at the end of their useful life, from being disposed in the receiving countries where often substandard treatment of ELVs causes environmental damages, such as oil spillage, unsound treatment of refrigerants or improper removal of hazardous substances and of components for higher quality of recycling[174]. Addressing the problem of unsustainable trade in used vehicles which generate environmental pollution and road safety is not solely the responsibility of importing countries. As indicated in section 5.1, the control on the import of used vehicles represents substantial challenges for importing countries. In addition, the

[169] i.e. recycled content target, requirement to adopt vehicle-type circularity strategy

[170] Umweltbundesamt,(2022), Illegal treatment of end of-life vehicles - Assessment of the environmental, micro- and macroeconomic effects, texte 130/20 22.

[171] Netherlands Human Environment and Transport Inspectorate, Ministry of Infrastructure and Water Management (2020): Used vehicles exported to Africa: A study on the quality of used export vehicles.

[172] For example, specific age limitations for the import of used vehicles have been adopted in 2020 under the umbrella of the Economic Community of West African States (ECOWAS). The age limit for importing vehicles into the ECOWAS region is 5 years for light duty vehicles, two-wheel motor vehicles, tricycles and quadricycles and 10 years for heavy-duty vehicles. A period of 10 years is granted to countries that have not yet adopted these age limits to gradually comply. See Directive C/Dir.2/09/20 relating to the harmonization of the limits of gas and exhaust particle emission for light and heavy vehicles, two wheel vehicles, tricycles and quadricycles within the ECOWAS region.

[173] https://eur-lex.europa.eu/resource.html?uri=cellar:a1c34a56-b314-11eb-8aca-01aa75ed71a1.0001.02/DOC_1&format=PDF

[174] This is for example associated with the pollution risks linked, among others, with the informal recycling of lead-acid batteries.

technical control processes are not yet robust enough to identify unsafe or high pollutant vehicles in some countries relying on the import of used vehicles[175]. **The export-related measures contained in the preferred option and the import measures taken by importing countries are therefore mutually supportive. Export measures enhance the efficiency of measures taken by importing countries and are key to ensure that the overall global trade in used vehicles becomes more sustainable.** This is in line with the recognition by the UN Environmental Assembly of the global environmental challenges linked to trade of used vehicles. On this basis, the UN Environment Programme, working together with other international organisations[176], is spearheading international cooperation to ensure that exporting and importing countries address jointly these problems. **The export related measures are also consistent with the current efforts of the European Commission to support the African Union and its members states in harmonising road transport regulations and policies.** Under the current Multiannual Financial Perspectives, the Commission provides more than EUR 50 million to the African Union for projects in that regard, such as the African Transport Policy Programme[177], providing assistance with setting vehicle's standards and safety ratings for new and used vehicles, the Tripartite Transport and Transit Facilitation Programme[178], enforcing vehicle load management and vehicle standard regulations, and the UN Road Safety Fund (UNRSF[179]) which, among other things, promotes the use of roadworthy vehicles with an emphasis on periodic technical inspection.

The new export requirements should not lead to major disruptions in the supply of used vehicles to the recipient countries. The collected evidence suggests that countries which have already implemented comprehensive import restrictions for several years, which notably require inspections of used vehicles prior to export by private companies[180], have not seen major changes in the volume of used vehicles that they imported. While in some cases there was a decrease for a short transitional term, imports resumed to previous levels after a few years. These regulatory changes have been contributing to higher quality of second-hand vehicles and the renewal of the fleet with safer and cleaner vehicles[181]. The export-related measures will contribute to ensure that the future demand for vehicles in developing countries is increasingly met by cleaner vehicles: while the export of vehicles from the EU which are not roadworthy will result in a decrease in the export of the most polluting and dangerous ones, the export of roadworthy used vehicles will continue to be allowed. These vehicles are expected to be less polluting in the future in light of the new emission standards applying in the EU. Used vehicles of a higher quality will also last longer which means that there will be a reduced need to replace them and increase imports. The possibility that the supply of used vehicles shifts from the EU to other exporting countries cannot be ruled out, but would

[175] See for example reports from International Motor Vehicle Inspection Committee (CITA) for Togo: https://citainsp.org/wp-content/uploads/2018/07/TogoReportFinalEN.Final_.pdf and for Cameroon: https://citainsp.org/wp-content/uploads/2020/07/Report_AVIS_Cameroun_final.pdf

[176] Especially the United Nations Economic Commissions for Europe (ECE), the International Motor Vehicle Inspection Committee (CITA) and the Fédération Internationale de l'Automobile (FIA), which have established the "Project of Safer and Cleaner Used Vehicles for Africa". See https://unece.org/sites/default/files/2023-05/Safer%20and%20Cleaner%20Used%20Vehicles%20for%20Africa%20%28Final%29.pdf

[177] https://www.ssatp.org/topics/urban-mobility

[178] https://tttfp.org/

[179] https://roadsafetyfund.un.org/

[180] Kenya and Mauritius have for example established and implemented a sophisticated regime governing the import of used vehicles for many years (since 2008 for Kenya and 2017 for Mauritius), which require notably that import is only authorised upon the presentation of a test operated by accredited specialised companies in the exporting country and verifying the roadworthiness of the vehicles concerned. The volume of imported used vehicles has not decreased but the imported vehicles are newer and cleaner. Such comprehensive regimes are not yet in place in most other importing countries, which have only more recently started to set out rules on the import and placing on the market of used vehicles.

[181] For more information see Annex 7.2.4.

require significant changes in the market and its possible negative environmental consequences would be mitigated through the ongoing international cooperation initiatives led by UNEP on this issue.

9 HOW WILL ACTUAL IMPACTS BE MONITORED?

Effective monitoring relies on harmonised reporting on all measures included in the preferred option package. Reporting over the design and production differs from reporting on the ELV requirements in type of information to be reported, timing and type of stakeholders. For the design and production stages, the main responsibilities are with manufacturers to provide reliable information on their compliance with the recyclability/re-usability targets, on the circularity strategy and chemical content (including substances of concern information, and recycled content). Verification is mainly up to type-approval and market surveillance competent authorities of Member States to check requirements at the level of economic operators. Communication of dismantling information to treatment operators and general circularity data to vehicles owners will be increasingly digitalised and made available via existing IT platforms. The reporting over collection, treatment and EPR predominantly follows existing reporting sequences from treatment operators to PROs, to competent authorities and to the Commission, including Eurostat. Table 19 provides a list of indicators to monitor implementation of the new Regulation. Based on these elements, the Commission will carry out a review of the new legislation within 8 years after its entry into force.

Table 20 Monitoring indicators

Objectives	Monitoring indicators	Monitoring details
Design and production stages		
Design circular (PO1)	3R percentages declared at 3R type-approvals per vehicle type	M1 in Annex 7.2.1
	The number of verified substances of concern declarations	M4a in Annex 7.2.1
	The number of verified recycled content declarations	M4b in Annex 7.2.1
	Verification of circularity strategy information	M6 in Annex 7.2.1
Use recycled content (PO2)	Percentage of recycled content for steel per new vehicle type	M9, M10 in Annex 7.2.2
Collection and recycling stages		
Treat better (PO3)	Reuse + recycling and reuse + recovery rates (ESTAT)	M12 in Annex 7.2.3
	Amount of removed parts and components prior shredding	M13 a-c in Annex 7.2.3
	Number of inspections at treatment operators	M17b in Annex 7.2.4
	Monitoring overviews warnings and fines at treatment operators	M17b in Annex 7.2.4
Collect more (PO4)	Number of vehicles and weight collected and recycled (ESTAT)	Existing at Eurostat
	Number of vehicles and weight placed on the marked (ESTAT)	Idem
	Number of vehicles and weight in the national fleets (NEW)	M20 in Annex 7.2.4
	Number of used vehicles exported from the EU	M21
	Number of inspections of exports of ELV or used vehicles	M19a
Financial Incentives (PO5)	Number of ELV specific PROs and the number of ATFs and PST plants and their treatment capacity	M23 in Annex 7.2.5
All life-cycle stages		
Cover more vehicles (PO6)	Number of reports on the fleet development and number of vehicles treated at ATFS with CoDs issued	M30a,b, M31b in Annex 7.2.6

ESTAT = existing data field in Eurostat ELV statistics[182]; NEW = recommended addition to ESTAT ELV statistics

[182] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=End-of-life_vehicle_statistics#Number_of_end-of-life_vehicles