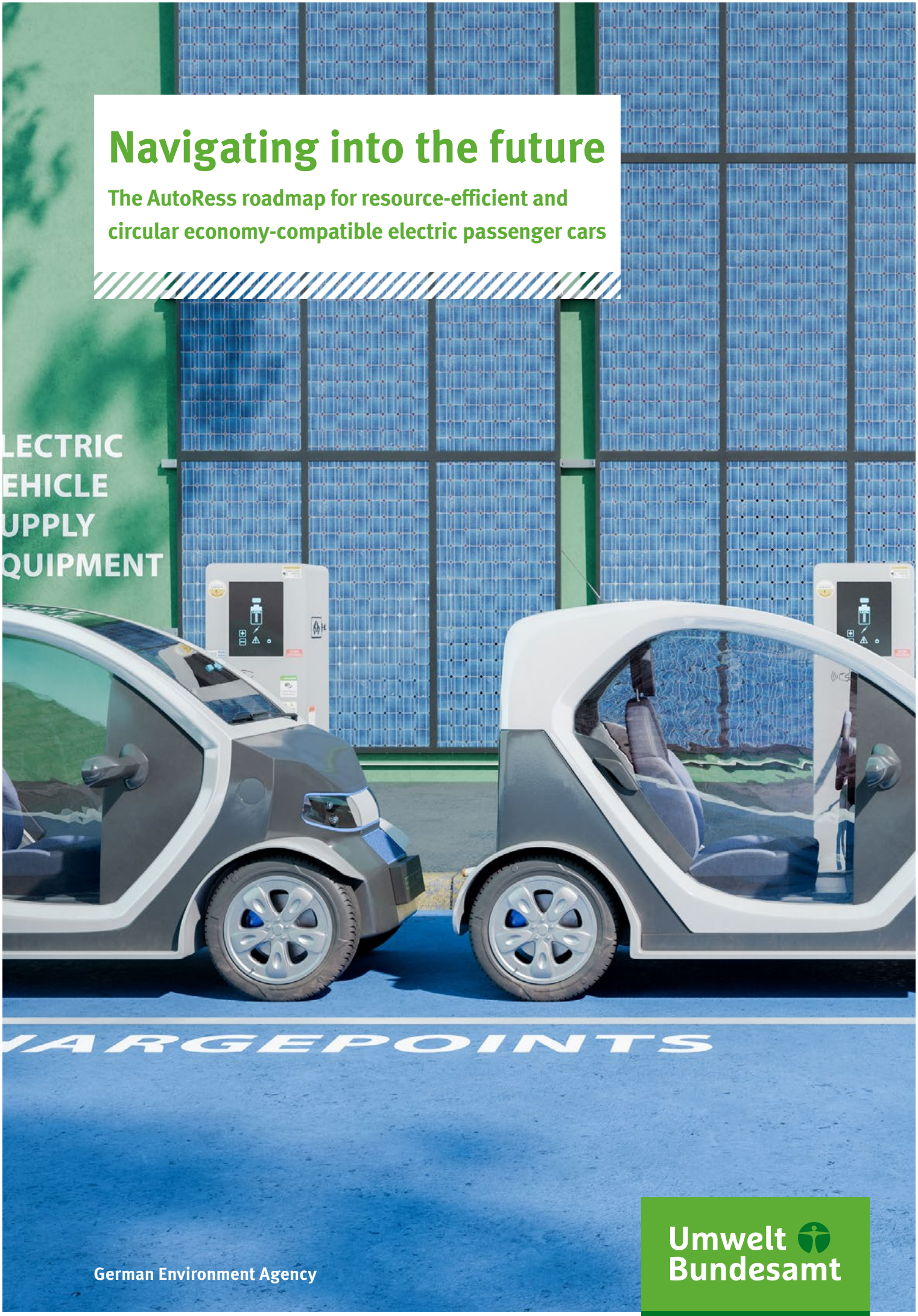
Navigating into the future

The AutoRess roadmap for resource-efficient and circular economy-compatible electric passenger cars



German Environment Agency

Umwelt Bundesamt

Imprint

Publisher:
German Environment Agency
Division I Environmental Planning and Sustainability Strategies
Division III Sustainable Production and Products, Waste Management
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Extended Producer Responsibility – Electrical Equipment, Vehicles and Batteries

Layout:
Gerda Palmetshofer

Publications as pdf:
www.umweltbundesamt.de/en/publications

Credits:
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Date: October 2025

ISSN 2363-832X

Navigating into the future

The AutoRess roadmap for resource-efficient and circular economy-compatible electric passenger cars

Measures to reduce raw material requirements in the transport sector through circular economy in conjunction with an energy transition in passenger car transport

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Mehlhart Consulting

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AutoRess-Roadmap

The roadmap shows which political and other measures can achieve relevant reductions in greenhouse gas emissions and raw material consumption from car traffic.

What levers are available?

- Vehicle size
- Energy consumption/ GHG-emissions
- Longlivety
- Recycling

Labelling energy efficiency

Bonus malus system for vehicle size ++

Taxation of company cars ++

Environmental bonus for motor vehicle insurance ++

Public procurement guidelines +

Service life guarantee for vehicles +++

Service life guarantee for batteries +++

Replacement of components +++

Information on repair of batteries ++

Service life guarantee for spare parts ++

Extended producer responsibility (EPR-system) +++

Specifications for shredder plants +++

Recycled content target for plastics ++

Recycled content target for steel ++

Information on recyclability ++

Disassembly of components +++

Passport circular economy

Recycled content target for glass and plastics ++

Information on hazardous substances ++

LCA fleet targets +++

Product carbon footprint (PCF) +++

Energy density of batteries +++

CO_2 fleet targets +++

Measures that are about to be introduced at EU level.

2025

2045

already implemented › *short-term* ›› *mid-term* ››› *long-term*

Who is the measure aimed at?

Procurement & use
Purchase decision
Motor vehicle insurance

Production
Vehicle manufacturers
Battery manufacturers
Suppliers

Repair
Repair workshops
Remanufacturing companies

Disposal & recycling
End of life vehicle dismantling companies
(Post-)shredder plant operators
Recycling companies

At what level will the measure be implemented?

EU | Germany

How effective is the implementation of the measure?

immeasurable | low (+) | moderate (++) | high (+++)

How can the measure be implemented?

easy | moderate | difficult

1 Passenger cars of the future

*This roadmap is part of the Refoplan project **"AutoRess – Resource-efficient and circular economy-compatible motor vehicles: Instruments and measures to reduce raw material requirements in the transport sector through circular economy in parallel with an energy transition in transport"** (FKZ 3722 57 101 0), which was carried out by the Öko-Institut, ifeu, Mehlhart Consulting and team ewen on behalf of the German Environment Agency.*

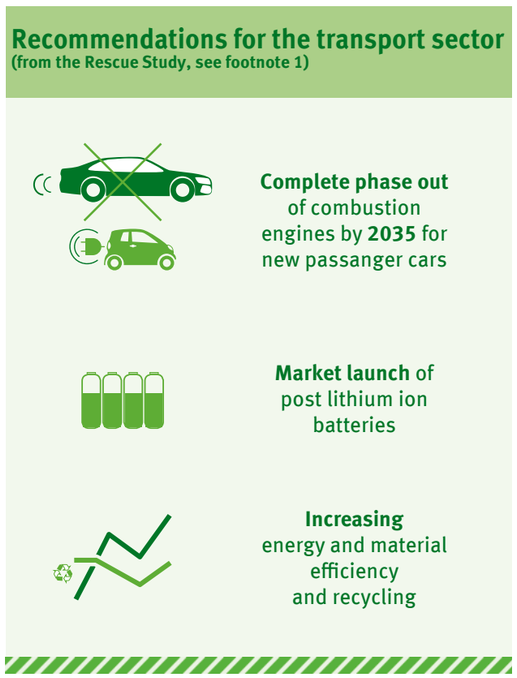
AutoRess analysed options for reducing the impact of passenger car traffic in Germany on the climate and resource consumption. Its main focus was on vehicles, especially electric vehicles, rather than on overarching issues such as traffic avoidance and modal shift, car sharing, etc. Ten fields for action were defined for additional greenhouse gas and material savings and then analysed in detail:

- Drive system conversion
- Vehicle downsizing
- Lightweight construction
- Circulatory design
- Repair and reconditioning of electric vehicle batteries
- Repair and reconditioning of vehicle bodies
- Use of recycled battery raw materials
- Use of recycled metals from vehicle bodies
- Recycling of plastics
- End of life vehicle disposal

The aim of this roadmap is to identify ways in which political and other measures can be used to achieve relevant reductions in greenhouse gas emissions and raw material consumption from passenger car traffic.

Key steps to reduce CO_2 emissions and other environmental impacts from vehicle production and raw material dependencies include downsizing (reducing vehicle size), increasing the service life of both the entire vehicle and individual components (e.g. through reuse, remanufacturing, or other second-life applications), reducing energy consumption, and increasing the recycling of individual materials within the framework of a circular economy.

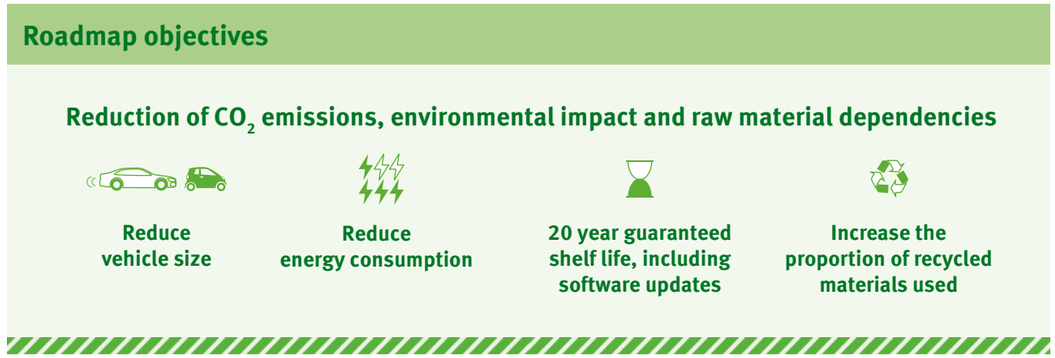
Figure 1



Source: own representation AutoRess, Öko-Institut/ifeu

Detailed description of all measures see Chapter 4 of the AutoRess final report.

Figure 2



Source: own representation AutoRess, Öko-Institut/ifeu

With increasing market penetration of electric drive concepts in the transport sector, demand for critical raw materials is rising significantly. Many of these critical raw materials have considerably environmental and social impacts associated with their primary extraction (e.g. cobalt, nickel, lithium, rare earths, etc.). An average compact electric car requires approximately 1,800 kg of raw materials, most of which must be imported.

In 2018, vehicle manufacturing accounted for 6.2 % of total raw material consumption in Germany, with 82 million tons of raw material equivalents. In addition, the production of various materials and components often requires a high energy input, e.g. the manufacture of cell material for batteries. Similarly, other metals used in large quantities in vehicles, such as copper, aluminum, and steel, have a significant environmental impact in their primary production (in mining, ore processing, smelting and refining).

The *Paris Agreement* and the *Climate Action Plan 2050* also set clear CO_2 reduction targets for the transport sector. These can only be achieved with a significant increase in the electrification of vehicles.

Electri cation, together with the defossilisation of electricity generation, will lead to a reduction in greenhouse gas emissions in the transport sector during the utilisation phase. This increases the relative importance of the consumption of primary raw materials in vehicle production in terms of environmental impact. The circular economy plays an important role in reducing greenhouse gas emissions and raw material consumption.

The 2019 *RESCUE study*[1] had already shown what resource efficient and greenhouse gas neutral transport should look like by 2050. For the two basic strategies of *Substituting Technologies and Products* and *Avoidance through Efficiency, Sufficiency, and Consistency*, the RESCUE study recommended a complete phase out of internal combustion engines in the passenger car sector, market introduction of post-lithium-ion batteries and an increase in energy and material efficiency and recycling.

In 2023, the European Commission published the revised versions of the *Directive 2000/53/EC on end of life vehicles (ELV)* and the *Directive 2005/64/EC on the type approval of motor vehicles*. The proposals aim to promote the use of recycled materials in the automotive industry. The *EU End of Life Vehicles Regulation* is about to be adopted. The roadmap addresses the most important foreseeable aspects. Other important policy regulations in this context include the new *EU Battery Regulation (EU) 2023/1542* which sets requirements for the design as well as for the recovery of specific materials and recycled material usage rates, and the *EU Critical Raw Materials Act 2024/125* which aims to promote the recycling of critical raw materials in the EU in order to reduce dependence on imports and strengthen the circular economy. These regulations form the basis of this AutoRess roadmap. Various vehicle manufacturers have also presented plans on how to strengthen the circular economy in automotive manufacturing.

1 Purr K., Günther J., Lehmann H., Nuss Ph. (2019): *Ways to resource-efficient greenhouse gas neutrality – RESCUE-Study*. UBA-CLIMATE CHANGe 36/2019, Umweltbundesamt, Dessau-Roßlau. https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/rescue_studie_cc_36-2019_wege_in_eine_ressourcenschonende_treibhausgasneutralitaet_auflage2_juni-2021.pdf.

2 Modelling of the AutoRess reference scenario

*As part of AutoRess, **greenhouse gas emissions and raw material requirements** for passenger cars in Germany were modelled across their entire life cycle, from the extraction of raw materials, the production of vehicle parts and pre-liminary products, and the final assembly of vehicles to the utilisation phase and disposal of vehicles, including the recycling of materials.*

A detailed model of passanger car traffic in Germany was created for AutoRess, covering all phases of the vehicle life cycle. Based on this model, greenhouse gas and material savings potentials were calculated for up to five variants for various fields of action (alternative power trains, vehicle downsizing, light weight construction, circular design, repair and recycling of electric vehicle batteries and vehicle bodies, use of recycled battery raw materials and bulk metals, recycling of plastics and end of life vehicle disposal) for up to five variants.

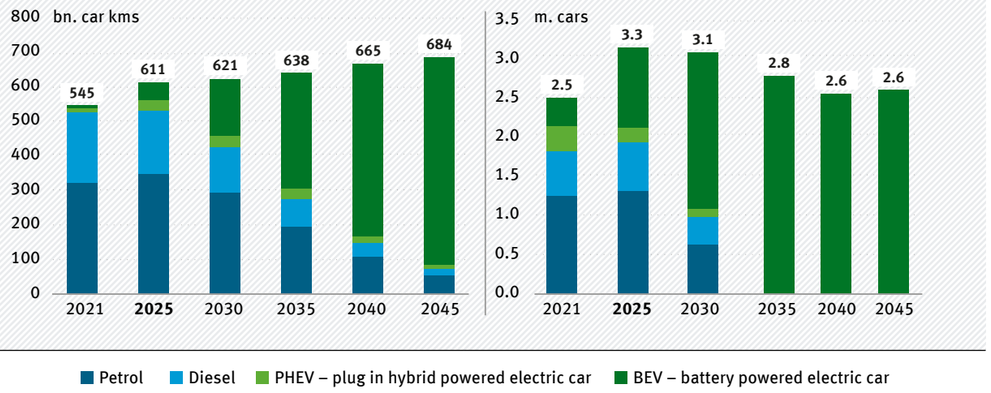
Various variables were included in the reference model:

The future **number of new passanger car registrations** in Germany was taken from the *Projection Report 2024*[2]. According to this, 3.3 to 3.1 million new cars will be registered annually in 2025 and 2030, with the share of battery electric vehicles increasing continuously. After 2030, annual new registrations will fall to 2.8 million vehicles (2035) and 2.6 million vehicles (from 2040). From 2035 onwards, only BEVs will be newly registered (Figure 3, right).

2 Harthan, R. O., Förster, H. et al. (2024): *Technical Annex to the 2024 Greenhouse Gas Projections for Germany (Projection Report 2024)*. Öko-Institut, IREES GmbH, Thünen-Institut, Federal Environment Agency, Dessau-Roßlau. https://www.umweltbundesamt.de/sites/default/files/medien/11850/publikationen/projektionen_technischer_anhang_0.pdf.

Figure 3

Annual mileage (left) and new registrations (right) of cars in Germany by drive type

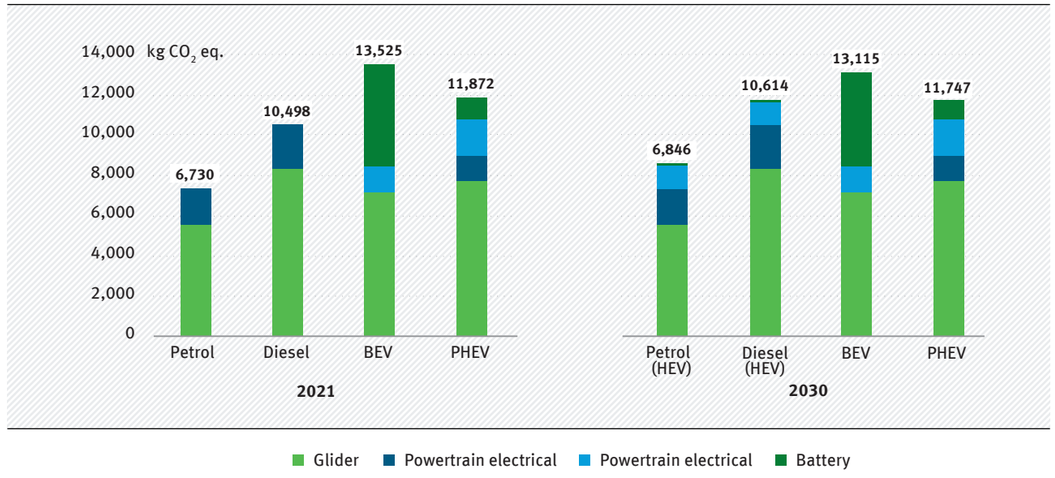


Source: own calculations in AutoRess, ifeu

Detailed description of all measures see Chapter 3.1.2.1 of the final report.

Figure 4

Greenhouse gas emissions from passenger car production in 2021 and 2030



Source: own calculationsin AutoRess,ifeu

Vehicle dimensions, weights, and engine power have risen steadily in recent decades. This growth is expected to continue in the coming years without further measures. In the reference scenario, the *AutoRess model* is based on the average unladen weights of new registrations in 2021, with a further weight increase of 1.2 % per year until 2030.

The **battery capacities** of electric cars are taken from a recent life cycle assessment study[3] and are assumed to average 61 kWh (gross capacity), rising to 88 kWh by 2030. Cell chemistry is shifting from NMC622 batteries in 2021 to NMC811 batteries from 2030 onwards, and a partial switch to lithium iron phosphate (LFP) batteries is also taken into account.

The **specific greenhouse gas emissions** from automotive production were also taken from Biemann et al. 2024. The increasing shift to renewable energies in Europe was taken into account regarding the electricity supply, but not the long-term defossilisation of global material supply.

The average percentage **material compositions** of the vehicle glider and powertrain are based on Biemann et al. 2024 and remain constant in all years.

The **utilisation phase** includes both energy consumption and resulting greenhouse gas emissions during the operation of motor vehicles on the one hand, and emissions and material requirements during the maintenance and repair of motor vehicles on the other. The data for the total mileage of passenger car traffic, the fleet composition by drive type, the average specific energy consumption and the greenhouse gas factors of the energy sources (fuels, electricity) were taken from the *Projection Report 2024*[4], while supplementary factors for upstream emissions from fuels (*well-to-tank*) were taken from the TREMOD model[5]. From 2021 to 2030, passenger car mileage rises by 14 %, with the share of mileage covered by battery electric passenger cars rising to 26 %. Passenger car mileage will continue to rise steadily in the reference scenario after 2030, reaching a level 10 % higher than in 2030 by 2045. Battery electric cars will account for 88 % of passenger car mileage in 2045.

3 Biemann, K.; Helms, H.; Münter, D.; Liebich, A.; Pelzeter, J.; Kämper, C. (2024): *Analysis of the environmental balance of motor vehicles with alternative drive systems or fuels on the way to greenhouse gas-neutral transport.* UBA-TEXTE 13/2024. ifeu – Institut für Energie- und Umweltforschung, Dessau-Roßlau. https://www.umweltbundesamt.de/sites/default/files/medien/11850/publikationen/13_2024_texte_analyse_der_umweltbilanz_von_kraftfahrzeugen_0.pdf.

4 see above, Harthan et al. 2024.

5 Allekotte, M.; Biemann, K.; Colson, M.; Knörr, W.; Heidt, C.; Kräck, J. (2024): *Update of TREMOD/TREMOD-MM and determination of transport emission data according to KSG in 2023*. UBA-TEXTE 126/2024. Federal Environment Agency, Dessau-Roßlau. https://www.umweltbundesamt.de/sites/default/files/medien/11850/publikationen/126_2024_texte_aktualisierung_tremod_.pdf.

3 Greenhouse gas emissions and material requirements of passenger car traffic in Germany in the AutoRess reference scenario without additional measures

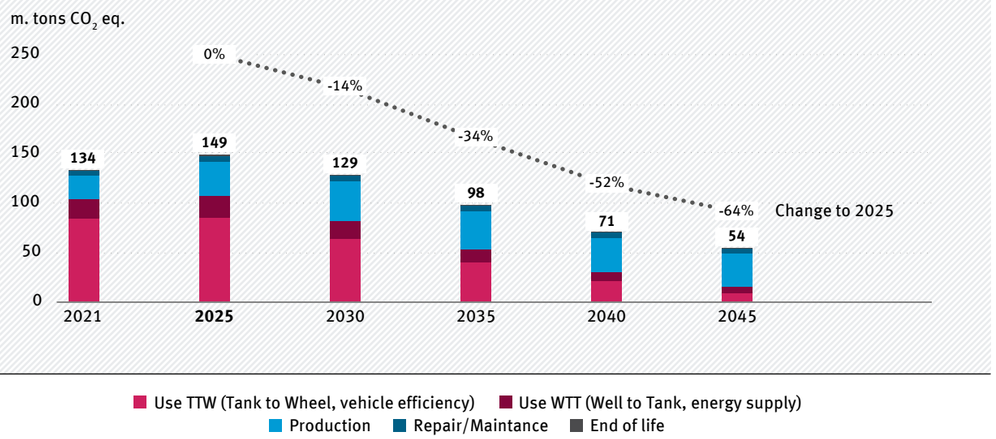
The reference scenario shows the foreseeable future development of greenhouse gas emissions from the production and use of passenger cars in Germany.

In the reference scenario, **greenhouse gas emissions from passenger car traffic in Germany** will fall by 4 % from 134 million tons to 129 million tons by 2030, yet by almost 60 % to 54 million tons by 2045 due to increasing electromobility and the decarbonisation of the electricity supply.

In contrast, emissions from automobile production (Figure 5, light blue bars) will initially rise from 24 million tons of CO_2 eq. to 40 million tons of CO_2 eq. between 2021 and 2030, before falling again to 34 million tons of CO_2 eq. by 2045. The increase in emissions until 2030 is due in equal measure to the higher annual number of new registrations and the rising share of new registrations of electric cars. From 2030 to 2035, the number of new electric car registrations will continue to rise initially, but will decline after 2035 (s. p. 8, Figure 3, right). At the same time, specific emissions from automobile production will decline after 2030 as renewable energies are increasingly used in production processes.

Figure 5

Greenhouse gas emissions from passenger car traffic in Germany in the AutoRess reference scenario

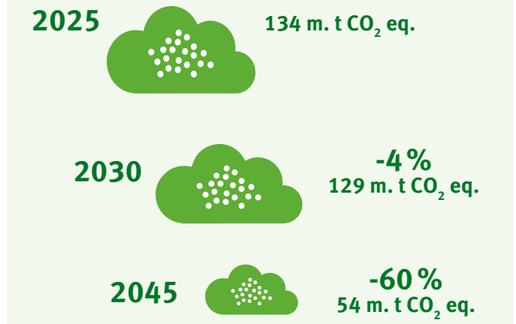


Source: own calculations in AutoRess, ifeu

Detailed description of all measures see Chapter 3.1.2.2 of the final report.

Figure 6

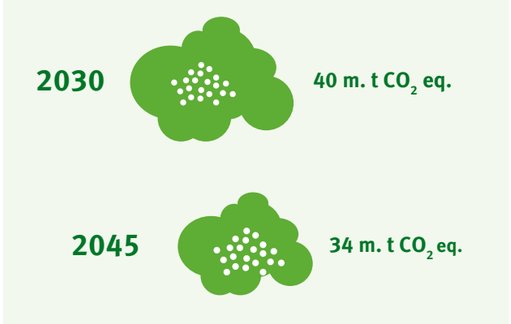
GHG scenarios for passenger car traffic



Source: own representation AutoRess, Öko-Institut/ifeu

Figure 7

GHG scenarios for passenger car production

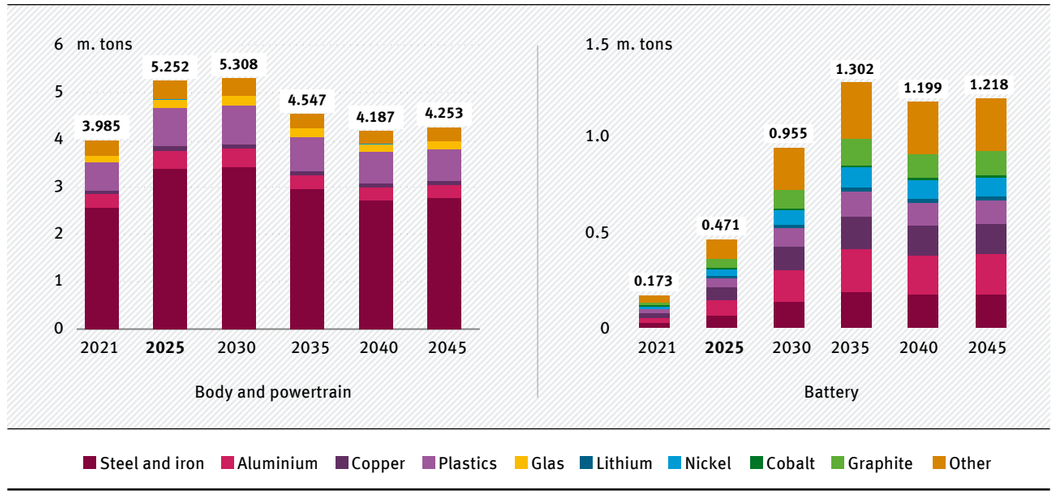


Source: own representation AutoRess, Öko-Institut/ifeu

The **total** annual **material requirements in automotive production** were calculated by material group, differentiated by gliders, powertrains and batteries. The material requirements for gliders and powertrains are mainly determined by the total number of new registrations and the increase in vehicle weight. The shift in new registrations toward electric cars is reflected above all in the sharp increase in material requirements for batteries. The material requirements for gliders and powertrains are dominated by steel and iron, as well as aluminum and plastics. Together, these account for appr. 88 % of the weight. Other weight-relevant material groups are copper and glass. Steel, aluminum, and plastics together also account for 42 % of the material requirements in batteries. Copper, nickel, and graphite also have significant shares of 8-14 % each. In contrast, the share of the cell materials lithium and cobalt are low in the overall material balance, accounting for 1-3 % of the total weight each (Figure 8).

Figure 8

Raw material requirements for passenger car traffic in Germany (new cars) in the AutoRess reference scenario



Source: own calculations in AutoRess, ifeu

4 Vision of a resource-efficient passenger car

The AutoRess project developed the vision of a resource-efficient electric passenger car.

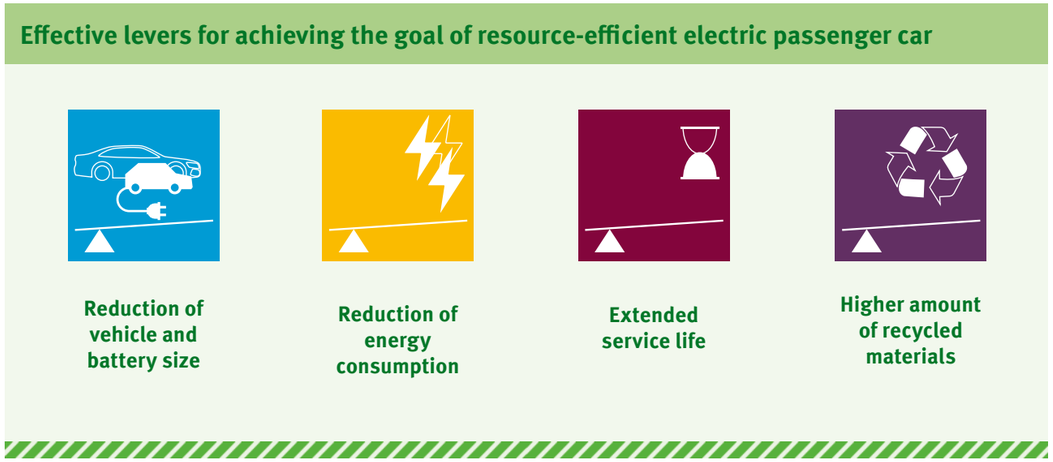
AutoRess' vision of a resource-efficient vehicle is based on purely **battery electric passanger cars.** These are considered resource-efficient and suitable for the circular economy if they meet the following conditions:

- As few primary raw materials as possible are required over the entire life cycle.
- As little energy as possible is consumed over the entire life cycle.
- As few greenhouse gases as possible are emitted over the entire life cycle.
- The vehicle is as durable as possible.
- At the end of its life, the components can be returned to the material cycle as completely as possible and without downcycling.
- The additional environmental and social impacts over the entire life cycle are kept to a minimum.

The modeling carried out in the AutoRess project on resource use and greenhouse gas emissions in the automotive industry in ten selected areas of action identified three levers that have a particularly strong impact on the goals: reduction of vehicle and battery size, reduction of energy consumption, extended service life, and higher amount of recycled materials.

While microcars (class M1) generally weigh more than 1,000 kg due to safety regulations, electric vehicles in classes L7E/L6E, which are subject to very strict weight restrictions (max. 450 kg), are often perceived by users as not being safe enough. It has therefore been proposed to close this gap by introducing a new vehicle class (M0) that is particularly suitable for urban and suburban areas, is subject to weight and size restrictions, and still has basic safety features.

Figure 9

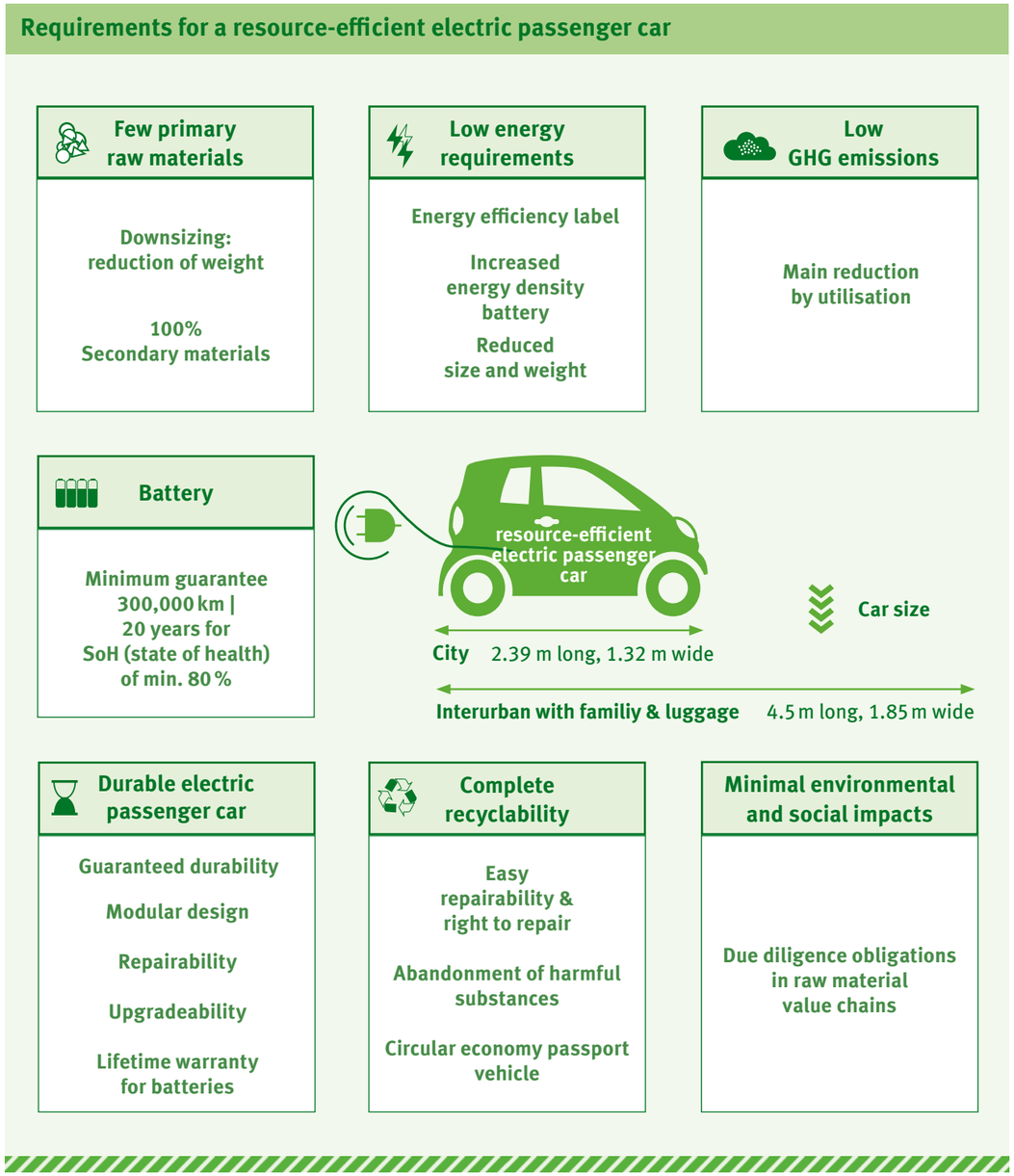


Source: own representation AutoRess, Öko-Institut/ifeu

Detailed description of all measures see Chapter 5 of the final report.

To achieve this, an ideal battery-electric vehicle for urban transport would be less than 2.39 m long and 1.32 m wide, and for interurban transport for a family with luggage, less than 4.5 m long and less than 1.85 m wide. It would consist of 100 % secondary materials, have a service life of 20 years, and also be optimised in terms of repairability. This requires that all vehicle parts (especially those that can break or wear out quickly) are easily accessible and replaceable. This total modularity will also promote the recyclability of the components and materials used in the vehicle by facilitating the dismantling of parts before the body is shredded at the end of its service life. Software and hardware upgrades are guaranteed for the entire service life of the vehicle.

Figure 10



Source: own representation AutoRess, Öko-Institut/ifeu

5 Measures vehicle size

AutoRess derived measures for resource conservation and circular economy in passenger cars. The focus here was on measures for vehicles, not on traffic avoidance and shift, car sharing, etc. Four effective main levers were identified, which are addressed by the measures (see Chapter 4).
In order to realise these levers, regulatory and other measures were researched and developed and then evaluated according to their effectiveness, feasibility and other criteria. The following legal bases were already assumed to be in place: BattV, CRM Act, Euro-7, Combustion Engine Phase Out. The End of Life Vehicles Regulation is about to be passed.
In the AutoRess roadmap (s. p. 4/5), measures that have already been implemented or are about to be implemented, but which are also considered particularly important for AutoRess, are marked with a border.

Bonus malus system based on vehicle size

In a bonus malus system, buyers of smaller cars receive a bonus, while buyers of larger cars pay a malus that also increases with size. One off payments when purchasing a car have a greater impact than annual vehicle taxes. Proposed values for the bonus are less than 2.39 m in length and 1.32 m in width for a battery electric vehicle for city traffic, and less than 4.5 m in length and less than 1.85 m in width for a family with luggage for interurban traffic.

KEY

When will the measure be implemented?

already implemented | short-term | medium term | long term | immediately prior to introduction at EU level

At what level will the measure be implemented?

EU | Germany

Who is the measure aimed at?

Purchase & use
Purchase decision
Motor vehicle insurance

Production
Vehicle manufacturers
Battery manufacturers
Suppliers

Repair
Repair workshops
Remanufacturing companies

Disposal & recycling
End of life vehicle dismantling companies
(Post-)shredder plant operators
Recycling companies

How effective is the implementation of the measure?

immeasurable | low | moderate | high

How can the measure be implemented?

easy | moderate | difficult

Detailed description of all measures see Chapter 5 of the AutoRess final report.

Figure 11

Potential raw material savings (primary raw materials) in passenger car production in Germany through downsizing in 2045 compared to 2025

	Steel	Aluminium	Copper	Plastics	Glas
Downsizing scenario 2045	-27 %	-12 %	+28 %	-22 %	-23 %
Reference scenario 2045	-12 %	+5 %	+54 %	-7 %	-8 %

Source: own calculations in AutoRess, Öko-Institut/ifeu, see AutoRess final report, chapter 3.3

Taxation of company cars

An estimated 20 to 25 % of new registrations in Germany are company cars that are also used privately.[6] The reason for the attractiveness of cars as a salary component is low taxation: for employees, the taxable monetary benefit is significantly cheaper than the cost of a privately purchased car. Companies can deduct the purchase of cars for business purposes as operating expenses without a maximum price limit and regardless of the vehicles' CO_2 emissions. Under this measure, resource-efficient electric cars, e.g. those with small dimensions, are taxed less than other vehicles.

Environmental bonus in motor vehicle insurance

With regard to the CO_2 emissions of a car, many motor insurance companies now offer environmental discounts when insuring an environmentally friendly vehicle. One example from Germany is *R+V Environmental Bonus*[7]: 10 % discount on the insurance premium for electric and hybrid cars and 5 % for cars with low CO_2 emissions (up to 95 g/km). Further environmental discounts of this kind may be introduced in the near future.

Promotion of sustainable vehicles in public procurement guidelines

The *Clean Road Vehicles Procurement Act* (*SaubFahrzeugBeschG*) covers sustainability aspects throughout the entire life cycle of vehicles, including compliance with due diligence obligations in the raw material value chains, the use of secondary materials in production, repairability during use and recyclability. Similar to other *Guidelines for Environmentally Oriented Procurement* issued by the *German Environment Agency*, a guideline with recommendations for vehicles is being developed.

6 Blanck, R.; Zimmer, W. (2021): Klimaschutzinstrumente im Verkehr. Umgestaltung der Kfz Steuer Bonus Malus System. Umweltbundesamt (Hrsg.). Dessau-Roslau. S. 8. https://www.umweltbundesamt.de/sites/default/files/medien/366/dokumente/uba-kurzpapier_bonus-malus-system_kliv.pdf.
7 https://www.ruv.de/kfz-versicherung/autoversicherung/e-auto.

6 Measures energy consumption / greenhouse gas emissions

Product Carbon Footprint (PCF) for vehicles

Vehicle manufacturers will be required to disclose a CO_2 footprint (*Product carbon footprint, PCF)* for new vehicles. A standardized method is not yet available. In the long term, limits on the maximum CO_2 footprint will be introduced.

Fleet targets based on life cycle assessments

Similar to the CO_2 emission standards for passenger cars and light commercial vehicles, which regulate the average CO_2 emissions of the new vehicle fleet, fleet targets based on the results of a life cycle assessment (*LCA*) will be introduced. These fleet targets will be introduced in the long term when the new vehicle fleet has been completely converted to electric vehicles. A coordinated method is not yet available. In the long term, limits on the maximum environmental footprint for electric vehicle fleets will be introduced.

European CO_2 emission standards for passenger cars and light commercial vehicles (Regulation (EU) 2019/631)

This regulation governs the average CO_2 emissions of a car manufacturer's new vehicle fleet. With the *Fit for 55* package, the EU Commission has presented a proposal to tighten the existing target value of the regulation on CO_2 fleet targets: for 2030 to -55 % (previously -37.5 %) compared to 2021 levels and a continuation of the targets until 2035 (-100 %).

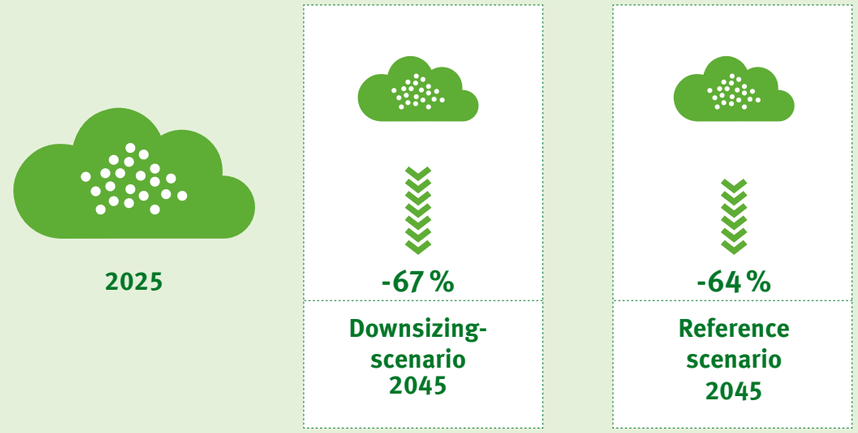
Minimum energy density values for batteries

This measure sets minimum requirements for the energy density of drive batteries. The Battery Ordinance defines energy conversion as a functional unit, which already provides an incentive in this direction – with fixed limits, this could become even more significant. Limits for battery weight per car could be achieved by limiting battery capacity and increasing energy densities.

Detailed description of all measures see Chapter 5 of the AutoRess final report.

Figure 12

Potential reduction in greenhouse gas emissions from passenger car production in Germany through the additional measures examined in 2045 compared to 2025



Source: own calculations in AutoRess, Öko-Institut/ifeu, see AutoRess final report, chapter 3.2

Label energy efficiency

Inclusion of the battery footprint in the *Energy Consumption Labeling Regulation for Passenger Cars* (energy efficiency label). This measure is already provided for in the current *Battery Regulation*.

7 Measures longevity

Minimum service life guarantee for vehicles incl. batteries

Introduction of a statutory lifetime warranty for the entire vehicle based on realistically achievable lifespans; a warranty of 20 years is proposed. Wear parts are excluded from this.

Minimum service life guarantee for batteries

A mandatory minimum warranty for batteries of 300,000 km or 20 years is established and after this period, the *State of Health* (SOH) must still be 80 %. Currently, there are no legal obligations for further incentives for long warranty periods for batteries, except for the general two year product warranty and the requirements for traction batteries for M1 and N1 vehicles in the *Euro-7 Regulation* (Annex II: main service life five years and 100,000 km at 80 % SOH, extended service life of eight years and 160,000 km at 72 % SOH), as well as voluntary manufacturer warranties.

Replacement and removal of parts and components

Vehicle manufacturers will be required to provide detailed instructions on how to replace and remove vehicle parts and components. Vehicles must be designed in such a way that components with potential for reuse can be removed when the vehicles are disposed of. This also applies to drive batteries and electric motors. This measure is part of the proposal for a new *End of Life Vehicles Directive* presented by the EU Commission on July 13, 2023.

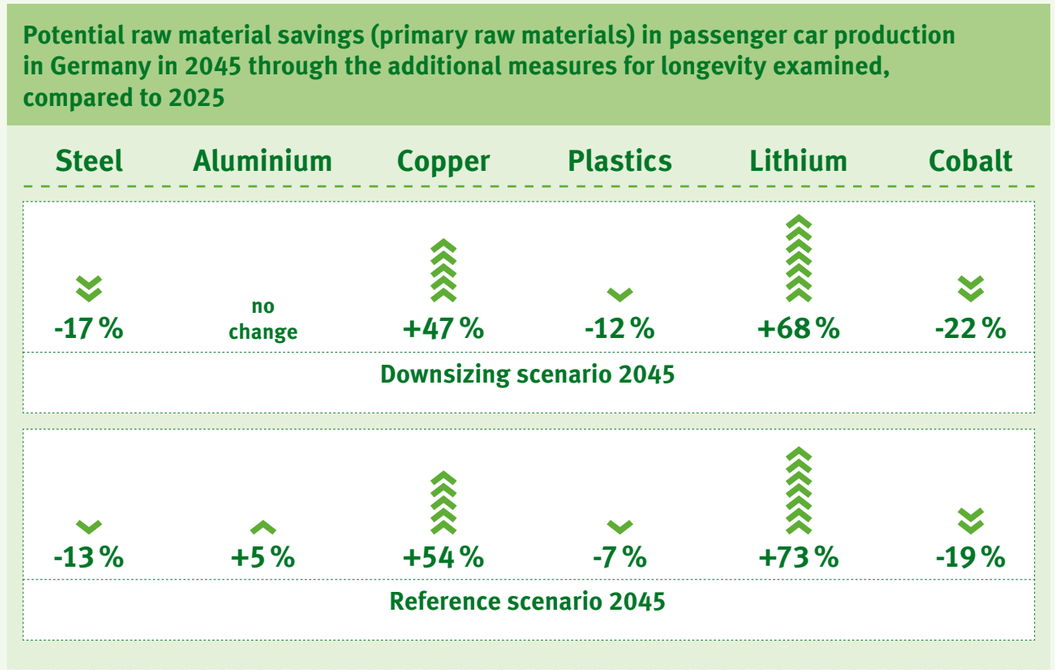
Minimum service life guarantee for spare parts

A mandatory minimum warranty of two years for spare parts is established.

Detailed description of all measures see Chapter 5 of the AutoRess final report.

Figure 13

Potential raw material savings (primary raw materials) in passenger car production in Germany in 2045 through the additional measures for longevity examined, compared to 2025



Source: own calculations in AutoRess, Öko-Institut/ifeu, see AutoRess final report, chapter 3.5

Access to information on the repair and maintenance of EV batteries

Vehicle manufacturers will be required to provide affordable access to software updates and spare parts for 20 years, thereby supporting EV battery reconditioning activities. A right to repair ensures that independent repair shops have access to the information, tools, and parts necessary for the repair and maintenance of EV batteries without legal or technical restrictions.

Software updates for other components

Vehicle manufacturers will be required to provide software updates for 20 years, even for components other than EV batteries.

8 Measures recycling

EPR system to finance the proper treatment of end of life vehicles



In order to ensure adequate financing for the mandatory treatment of end of life vehicles and to offer recycling companies incentives to improve quality, an EPR system will be extended in which vehicle manufacturers will be held responsible for financing the treatment of end of life vehicles in accordance with *Extended Producer Responsibility* (*EPR*).

Requirements for shredder and post shredder plants



Copper in particular is a contaminant in steel recycling that reduces the quality of recycled steel. In order to ensure the high quality of the recovered steel, a maximum value of 0.1 % copper in the steel fraction is set for vehicle shredding plants. The main aim here is to separate copper particles that enter the steel fraction during the shredding process. However, the copper contained in the steel alloy cannot be separated at an economically viable cost.

Mandatory dismantling of valuable components



Article 30 of the EU Commission's proposal for an *End of Life Vehicle Regulation* requires authorized treatment facilities to dismantle a number of valuable parts, components, and materials from shredding in order to reuse them or recycle them in a higher quality manner. In particular, the engine, main wiring harness, glass windows and electronic components must be removed.

Mandatory reporting on the use of materials that affect disassembly and recyclability

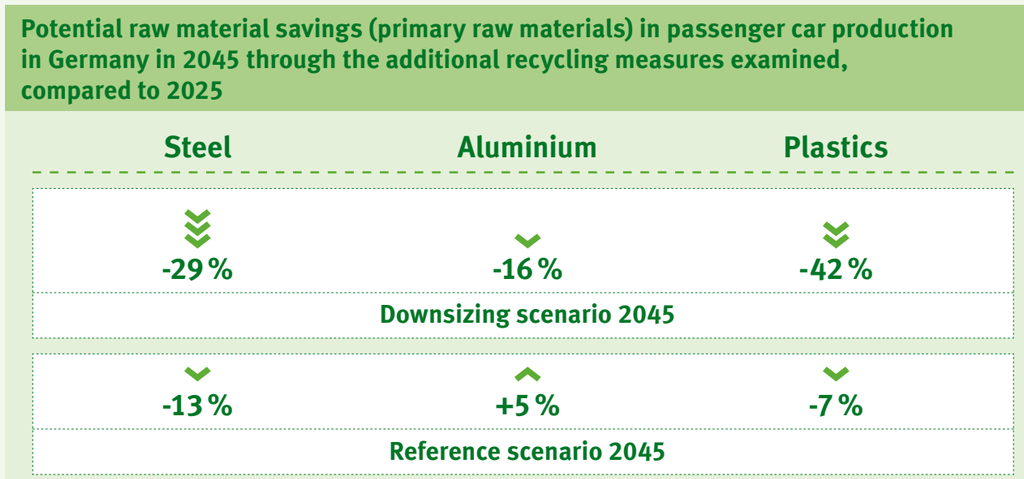


The use of a particular material or technique in the assembly of a component can be beneficial for later reuse or recycling, but in other cases it can hinder it. The focus of this measure is on developing a feedback mechanism that ensures that information on how certain design elements affect end of life is communicated and integrated into the design process.

Detailed description of all measures see Chapter 5 of the AutoRess final report.

Figure 14

Potential raw material savings (primary raw materials) in passenger car production in Germany in 2045 through the additional recycling measures examined, compared to 2025



Source: own calculations in AutoRess, Öko-Institut/ifeu, see AutoRess final report, chapters 3.9 and 3.10

Setting a recycled content target for plastics



Require at least 25 % recycled content in automotive plastics (excluding bio-based materials, Article 6 in the proposal for the *ELV Regulation*) to reduce demand for primary resources. Incentives should prioritize post consumer plastic recyclates from end of life vehicles in order to close the material loop.

Setting a recycled content target for steel



A target for the use of recycled steel in vehicle production is introduced. One challenge here is a sufficiently high quality of steel scrap from vehicle shredding plants. Contaminants such as copper reduce the quality of recycled steel and currently prevent a higher recycling rate in the production of high quality flat steel products. A legal minimum target for the recycled steel content in vehicles would shift the market towards higher quality. According to calculations, a recycled content of 25 % by 2030 and 30 % by 2035 would be achievable with a closed recycling loop.[8]

Setting recycling targets for glass and plastics



In addition to the recycling target of 30 % for plastics set out in the proposal for a new *End of Life Vehicles Regulation*, this measure introduces a recycling target of 25 % for glass. Since plastics and glass account for only a small proportion of vehicle weight, they are often disposed or recovered to a small extent after shredding which reduces the quality of the recovered material.

Information on hazardous substances



Information on any hazardous substances that may be present is necessary for the reuse of components and the recycling of materials. Recycling

8 Sutter, J.; Adjei, F.; Baron, Y.; Kosinska-Terrade, I. (2025): *Boosting the use of recycled steel in the EU automotive industry under the ELV Regulation*. Öko-Institut. Berlin. https://www.transportenvironment.org/uploads/files/2025_04_Report_Recycled_steel_EU_automotive_industry_fi al.pdf.

companies need additional dismantling information that goes beyond the current information of *IMDS* (*International Material Data System*) and *SCIP* (S*ubstances of Concern In Products*), e.g. flame retardants. The proposed measure provides for the introduction of an obligation to document information on the content of substances with a hazard classification along the value chain.



Introduction of a vehicle circular economy passport

In the *Vehicle Recycling Passport* provided for in the *End of Life Vehicles Regulation*, the vehicle manufacturer additionally declares, for the information of consumers, the respective percentage shares of recycled materials installed in the vehicle.

The AutoRess final report as well as all further AutoRess publications are available at the UBA website:
http://umweltbundesamt.de/themen/verkehr/ressourcenschonung-im-verkehr.



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